1990

SERVICE MANUAL

REAR WHEEL DRIVE RAM TRUCK

CHRYSLER MOTORS

CHRYSLER MOTORS

1990

SERVICE MANUAL

DODGE TRUCKS

CHRYSLER MOTORS

To order the special service tools used and illustrated, please refer to the instructions on inside back cover.

Chrysler Motors reserves the right to change testing procedures, specifications, diagnosis, or repair methods at any time without prior notice or incurring obligation.

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FOREWORD

The information contained in this service manual has been prepared for the professional automotive technician involved in daily repair operations. Information in this manual is divided into groups. Each group covers a general vehicle system (brakes, steering, body, etc.). Each group is further divided to address individual components or systems within the group.

The Component and System Index will assist you in locating the correct group for the component or system you require.

These groups contain general information, diagnosis, testing, adjustment, removal and installation, assembly and disassembly procedures for the components.

The diagnosis charts are designed to help you locate and correct problems with a systematic approach. The tab locator at the right side of this page will help you to quickly locate the first page of each group. The first page of each group contains an alphabetical index to assist in the location of the component or system.

The information, descriptions, testing procedures, and specifications were in effect at the time this manual was released for printing.

Information describing the operation and use of standard and optional equipment is included in the Owner's Manual located in the glove box.

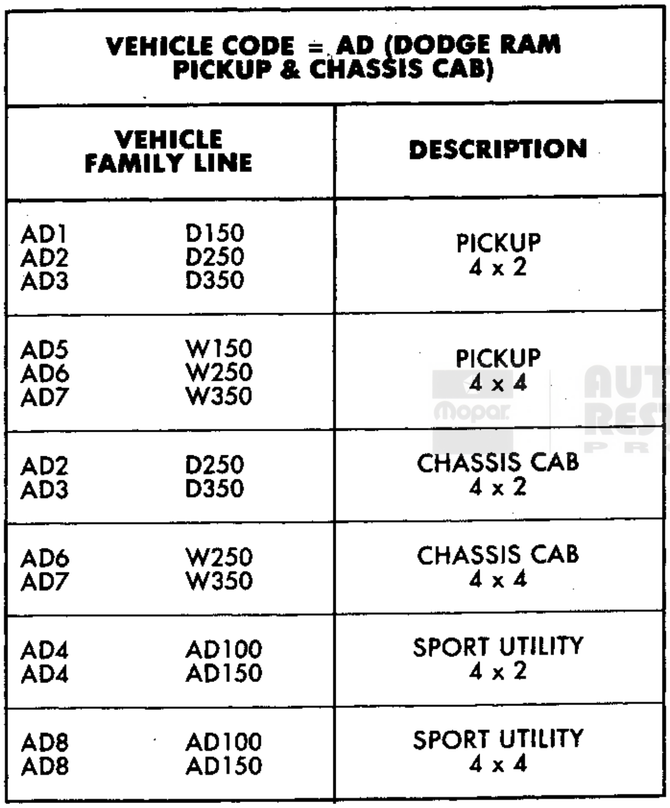
GROUP	TITLE
—	Introduction
0	Lubrication and Maintenance
1	Accessories
2	Front Suspension
3	Rear Axle
5	Brakes
6	Clutch
7	Cooling System
8	Electrical
9	Engine
11	Exhaust System/Intake Manifold
13	Frame
14	Fuel System
16	Propeller Shaft—Universal Joints
17	Springs—Shock Absorbers
19	Steering
21	Transmission
22	Wheels and Tires
23	Body
24	Heating and Air Conditioning
25	Emissions Control Systems

INTRODUCTION

VEHICLE AND COMPONENT IDENTIFICATION

VEHICLE CODE

The Dodge Ram Pickup, Chassis Cab and Sport Utility Vehicle Code Chart is described below (Fig. 1):



VEHICLE CODE = AD (DODGE RAM PICKUP & CHASSIS CAB)		
VEHICLE FAMILY LINE		DESCRIPTION
AD1 AD2 AD3	D150 D250 D350	PICKUP 4 x 2
AD5 AD6 AD7	W150 W250 W350	PICKUP 4 x 4
AD2 AD3	D250 D350	CHASSIS CAB 4 x 2
AD6 AD7	W250 W350	CHASSIS CAB 4 x 4
AD4 AD4	AD100 AD150	SPORT UTILITY 4 x 2
AD8 AD8	AD100 AD150	SPORT UTILITY 4 x 4

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Fig. 1 Vehicle Code Chart

VEHICLE IDENTIFICATION NUMBER (V.I.N.)

The Vehicle Identification Number (V.I.N.) is located on the upper left corner of the instrument panel, near the windshield. All VIN's consist of 17 characters in a combination of letters and numbers that provide specific information about the vehicle (Fig. 2).

The V.I.N. is also located on the Equipment Identification Plate, the Vehicle Safety Certification Label and on the frame rail.

EQUIPMENT IDENTIFICATION PLATE

The equipment identification plate, contains information regarding the vehicle: model, wheel base, V.I.N. (Vehicle Identification Number), T.O.N. (Order Number), and all production or special equipment on the vehicle when it was shipped from the factory (Fig. 3). Always refer to this plate when ordering parts.

The Equipment Identification Plate is located on the under hood panel in the right front corner.

VEHICLE SAFETY CERTIFICATION LABEL

A vehicle safety certification label (Fig. 4) is attached to the rear facing of the driver's door. This label reflects the date of manufacture (month and year), Gross Vehicle Weight Rating (GVWR), Gross Axle Weight Rating (GAWR) front, Gross Axle Weight Rating (GAWR) rear and the Vehicle Identification Number (VIN). The Month, Day and Hour of manufacture is also included on this label.

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

BODY CODE PLATE

This plate is riveted to the inner panel under the cowl on the passenger side.

There are seven (7) lines of information on this plate. Information reads from left to right, starting with line 1 at the bottom of the plate to line 7 at the top (Fig. 5).

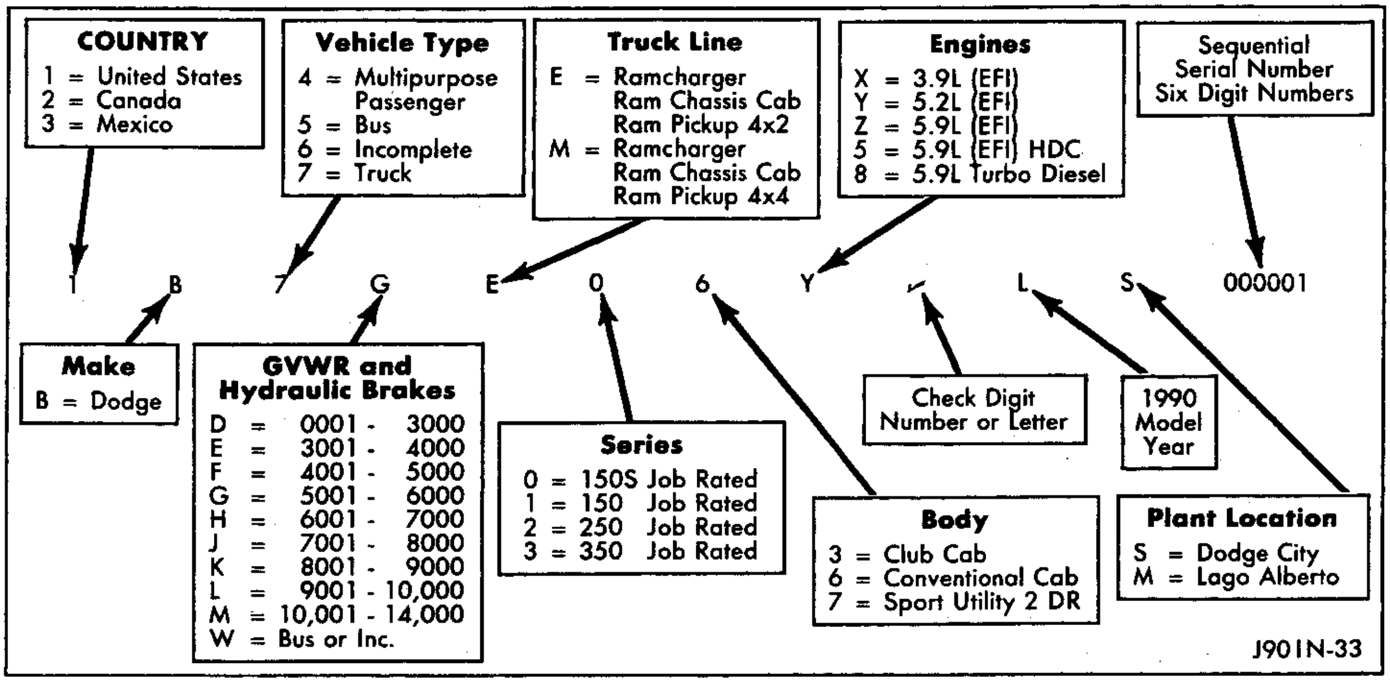
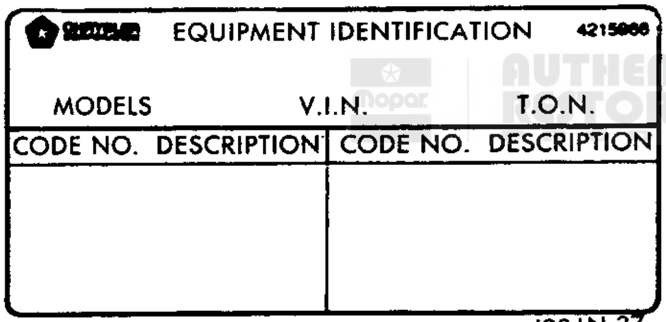


Fig. 2 Vehicle Identification Number (VIN)


EQUIPMENT IDENTIFICATION 4215066

MODELS V.I.N. T.O.N.

CODE NO.	DESCRIPTION	CODE NO.	DESCRIPTION

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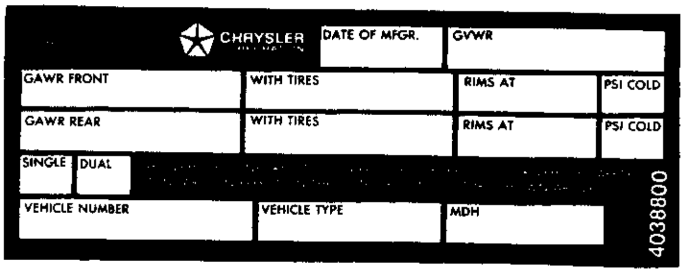
Fig. 3 Equipment Identification Label


CHRYSLER

DATE OF MFGR.

GVWR

GAWR FRONT

WITH TIRES

RIMS AT

PSI COLD

GAWR REAR

WITH TIRES

RIMS AT

PSI COLD

SINGLE

DUAL

VEHICLE NUMBER

VEHICLE TYPE

MDH

4038800

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Fig. 4 Vehicle Safety Certification Label

Refer to the body code plate chart (lines 1 thru 3) for detailed information (Fig. 6).

Lines 4 thru 7, of the body code plate, are sequenced on the plate as follows:

- 3 digit sales codes
- 3 digit numeric codes
- 6 digit SEC codes

When there is an SEC code to be punched on the body code plate and there is not enough room left on

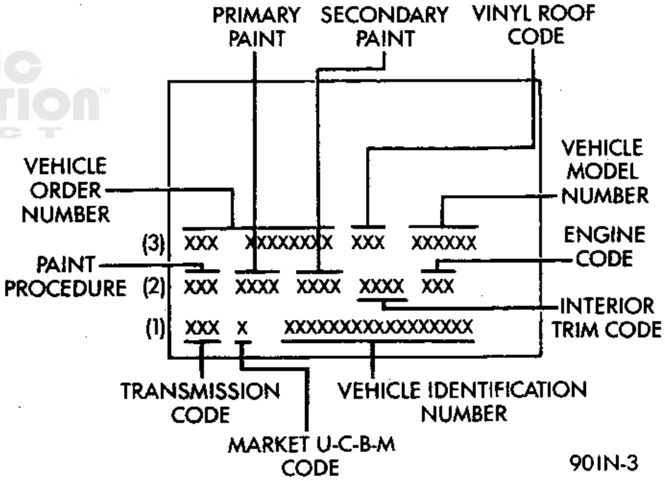

Fig. 5 Body Code Plate

a line to punch the full 6 digits, the balance of that line will be left blank and the SEC code will be punched on the next line.

The last nine positions of line #7 will contain a two digit species, when applicable, and a six digit gateline sequence number (the last six numbers of the VIN).

The last code shown on either plate will be followed by END. When two plates are required, the last code space on the first plate will show CTD (for continued).

When a second plate is required, the first four spaces of each line will not be used due to overlap of the plates.

Line	Digit	Information
Line #1	Digit 1-3	Transmission Sales Code
	Digit 4	Open Space
	Digit 5	Market Code - U-C-B-M
	Digit 6	Open Space
	Digit 7-23	Vehicle Identification No.
Line #2	Digit 1-3	Paint Procedure
	Digit 4	Open Space
	Digit 5-8	Primary Paint
	Digit 9	Open Space
	Digit 10-13	Secondary Paint
	Digit 14	Open Space
	Digit 15-18	Trim Code
	Digit 19	Open Space
	Digit 20-22	Engine Sales Code
	Digit 23	Open Space
Line #3	Digit 1-12	Vehicle Order Number
	Digit 13	Open Space
	Digit 14-16	Vinyl Roof Code (Door Combo Code - Pillette)
	Digit 17	Open Space
	Digit 18-23	Model

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Fig. 6 Body Code Plate Information

ENGINE SERIAL NUMBER (PARTS REPLACEMENT INFORMATION)

On the 238 C.I.D. (3.9 Liter) 6 cylinder engine, the engine serial number is on a pad located on the right side of the block.

On the 318 C.I.D. (5.2 Liter) and the 360 C.I.D. (5.9 Liter) 8 cylinder engines, the engine serial number is located on the left front corner of the block, below the cylinder head (Fig. 7).

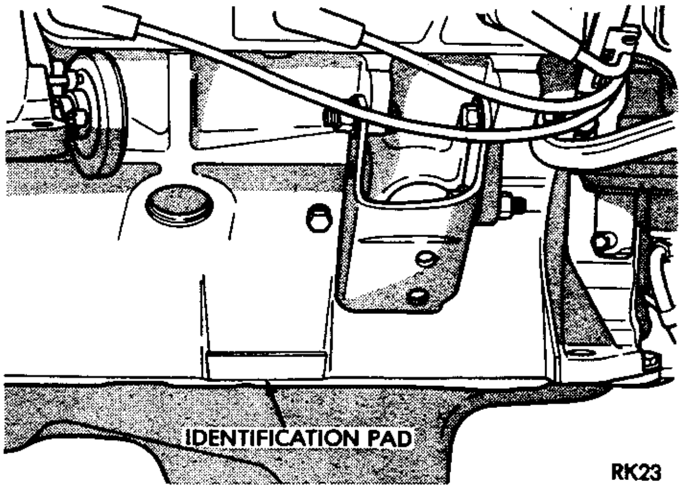

Fig. 7 Engine Serial Number 5.2L and 5.9L

TRANSMISSION IDENTIFICATION

Specific light and medium duty vehicles referred to in this manual can be identified by part number, model and built date supplied on the Transmission Identification Tag.

Operation requirements are, in some instances, different for each vehicle and engine combination and some internal parts will also be different. Therefore, when replacing parts, refer to the number stamped on left side of the transmission oil pan flange.

MANUAL TRANSMISSION: An aluminum Identification Tag is secured to the power take-off cover. Do not discard this tag if the transmission power take-off cover is removed. On other transmission models, a blue metal identification tag is permanently attached to the left top of transmission case near the case cover.

AUTOMATIC TRANSMISSION: A surface pad has been provided on the right of the transmission case to supply identification.

See Group 21, Transmissions for additional information.

POWER TEAM AVAILABILITY

RAM PICKUP

VEHICLE LINE	WHEELBASE	GVWR	ENGINE & SALES CODE					TRANSMISSION				
			3.9L EFI EHB	5.2L EFI ELG	5.9L EFI EMG	5.9L EFI EMJ	5.9L DIESEL ETA	5-SP MAN. O.D.	4-SP MAN. O.D.	4-SP MAN.	3-SP AUTO	4-SP AUTO O.D.
D150 4 x 2	2921 mm (115 in) 3327 mm (131 in)	2495 kg (5500 lbs)	S					S		O	O	
				O					S	O	O	O
					O					S		O
	3327 mm (131 in)	2722 kg (6000 lbs)	S					S		O	O	
				O					S	O	O	O
					O					S		O
	3378 mm (133 in) 3785 mm (149 in)	2722 kg (6000 lbs)		S						S		O
					O					S		O
D250 4 x 2	3327 mm (131 in)	3357 kg (7400 lbs)	S							S @		O
				O						S @	O	O
					O					S		O
	3785 mm (149 in)	3357 kg (7400 lbs)		S						S		O
					O					S		O
	3327 mm (131 in) 3785 mm (149 in)	3860 kg (8510 lbs)			S					S		O
							O	S			O	
D350 4 x 2	3327 mm (131 in)	3946 kg (8700 lbs)			S					S		O
							O	S			O	
		4581 kg (10,100 lbs)				S				S		O
							O	S			O	
W150 4 x 4	2921 mm (115 in) 3327 mm (131 in)	2858 kg (6300 lbs) 2903 kg (6400 lbs)	S @							S		O
				O						S @		O
					O					S		O
	3785 mm (149 in)	2903 kg (6400 lbs)		S						S @		O
					O					S		O
W250 4 x 4	3327 mm (131 in) 3785 mm (149 in)	3402 kg (7500 lbs)		S						S @		O
					O					S		O
	3327 mm (131 in) 3785 mm (149 in)	3860 kg (8510 lbs)			S					S		O
							O	S			O	
W350 4 x 4	3327 mm (131 in)	3946 kg (8700 lbs)			S					S		O
							O	S			O	
		4581 kg (10,100 lbs)				S				S	O	
							O	S			O	

S = STANDARD O = OPTIONAL @ = Not available in California J901N-39

POWER TEAM AVAILABILITY (CONT.)

RAM CHASSIS CAB

VEHICLE LINE	WHEELBASE	GVWR	ENGINE & SALES CODE					TRANSMISSION				
			3.9L EFI EHB	5.2L EFI ELG	5.9L EFI EMG	5.9L EFI EMJ	5.9L DIESEL ETA	5-SP MAN. O.D.	4-SP MAN. O.D.	4-SP MAN.	3-SP AUTO	4-SP AUTO O.D.
D250 4 x 2	3327 mm (131 in)	3357 kg (7400 lbs)			S							S
		3860 kg (8510 lbs)			S ⓐ					S		O
						S ⓑ				S		O
							O	S			O	
D350 4 x 2	3327 mm (131 in)	3946 kg (8700 lbs)			S ⓐ					S		O
						S ⓑ				S		O
	3429 mm (135 in) 4039 mm (159 in)	4581 kg (10,100 lbs)				S				S		O
		4763 kg (10,500 lbs)					O	S			O	
W250 4 x 4	3327 mm (131 in)	3860 kg (8510 lbs)			S ⓐ					S		O
						S ⓑ				S	O	
							O	S			O	
W350 4 x 4	3327 mm (131 in)	3946 kg (8700 lbs)			S ⓐ					S		O
						S ⓑ				S	O	
							O	S			O	
	3429 mm (135 in)	4581 kg (10,100 lbs)				S				S	O	
		4989 kg (11,000 lbs)					O	S			O	

RAMCHARGER SPORT UTILITY

D100 4 x 2	2692 mm (106 in)	2540 kg (5600 lbs)		S								S
D150 4 x 2	2692 mm (106 in)	2540 kg (5600 lbs)			S							S
W100 4 x 4	2692 mm (106 in)	2722 kg (6000 lbs)		S						S		O
W150 4 x 4	2692 mm (106 in)	2722 kg (6000 lbs)			S					S		O
		2903 kg (6400 lbs)		S						S ⓐ		O
					S					S		O

S = STANDARD
O = OPTIONAL

ⓐ = Not available in California.
ⓑ = California Only.

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TRUCK MODEL LINE-UP AND WEIGHTS

RAM PICKUP

MODEL/ FAMILY	BODY(3) STYLE	GVWR		PAYLOAD ALLOWANCE (1)		CURB WEIGHT (2)	
D150 AD1 4 x 2	61	2495 kg	5500 lbs	853 kg	1880 lb	1642 kg	3620 lbs
	62	2495 kg 2722 kg	5500 lbs 6000 lbs	804 kg 1021 kg	1772 lbs 2252 lbs	1691 kg 1700 kg	3728 lbs 3748 lbs
	31	2722 kg	6000 lbs	852 kg	1878 lbs	1870 kg	4122 lbs
	32	2722 kg	6000 lbs	787 kg	1736 lbs	1934 kg	4264 lbs
D250 AD2 4 x 2	62	3357 kg 3860 kg	7400 lbs 8510 lbs	1527 kg 1952 kg	3366 lbs 4304 lbs	1830 kg 1908 kg	4034 lbs 4206 lbs
	32	3357 kg 3860 kg	7400 lbs 8510 lbs	1369 kg 1846 kg	3019 lbs 4070 lbs	1987 kg 2014 kg	4381 lbs 4440 lbs
D350 AD3 4 x 2	62(4)	3946 kg 4581 kg	8700 lbs 10,100 lbs	2001 kg 2485 kg	4411 lbs 5478 lbs	1945 kg 2097 kg	4289 lbs 4622 lbs
W150 AD5 4 x 4	61	2858 kg	6300 lbs	978 kg	2156 lbs	1880 kg	4144 lbs
	62	2903 kg	6400 lbs	966 kg	2131 lbs	1936 kg	4269 lbs
	32	2903 kg	6400 lbs	789 kg	1740 lbs	2114 kg	4660 lbs
W250 AD6 4 x 4	62	3402 kg 3860 kg	7500 lbs 8510 lbs	1364 kg 1769 kg	3007 lbs 3899 lbs	2038 kg 2092 kg	4493 lbs 4611 lbs
	32	3402 kg 3860 kg	7500 lbs 8510 lbs	1259 kg 1664 kg	2775 lbs 3668 lbs	2143 kg 2196 kg	4725 lbs 4842 lbs
W350 AD7 4 x 4	62	3946 kg	8700 lbs	1749 kg	3855 lbs	2198 kg	4845 lbs

(1) Payload includes maximum weight of driver, passengers, cargo and optional equipment not included in payload or GVW package – Payload allowance for Chassis Cabs is not supplied due to large variations of body equipment installed.

(2) Includes base engine

(3)

Body Style	Cab	Bed Length
61	Std.	1981 mm (6.5 ft)
62	Std.	2438 mm (8.0 ft)
31	Club	1981 mm (6.5 ft)
32	Club	2438 mm (8.0 ft)
63	Std.	N.A.
64	Std.	N.A.
71	Sport Utility	N.A.

(4) Dual Rear Wheels

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TRUCK MODEL LINE-UP AND WEIGHTS (CONT.)

RAM CHASSIS CAB

MODEL/ FAMILY	BODY(3) STYLE	GVWR		PAYLOAD ALLOWANCE (1)	CURB WEIGHT (2)	
D250 AD2 4 x 2	62	3357 kg 3860 kg	7400 lbs 8510 lbs	(1)	1721 kg 1740 kg	3794 lbs 3835 lbs
D350 AD3 4 x 2	62	3946 kg	8700 lbs	(1)	1794 kg	3954 lbs
	63(4) (4)	4581 kg 4763 kg	10,100 lbs 10,500 lbs	(1)	1963 kg 1972 kg	4327 lbs 4347 lbs
	64(4) (4)	4581 kg 4763 kg	10,100 lbs 10,500 lbs	(1)	2032 kg 2043 kg	4479 lbs 4505 lbs
W250 AD6 4 x 4	62	3860 kg	8510 lbs	(1)	1886 kg	4158 lbs
W350 AD7 4 x 4	62	3946 kg	8700 lbs	(1)	2038 kg	4494 lbs
	63(4) (4)	4581 kg 4990 kg	10,100 lbs 11,000 lbs	(1)	2136 kg 2145 kg	4709 lbs 4729 lbs

RAMCHARGER – SPORT UTILITY

MODEL/ FAMILY	BODY(3) STYLE	GVWR		PAYLOAD ALLOWANCE(1)		CURB WEIGHT(2)	
D100 AD4 4 x 2	71	2540 kg	5600 lbs	603 kg	1330 lbs	1937 kg	4270 lbs
D150 AD4 4 x 2	71	2540 kg	5600 lbs	606 kg	1336 lbs	1934 kg	4264 lbs
W100 AD8 4 x 4	71	2722 kg	6000 lbs	618 kg	1363 lbs	2103 kg	4637 lbs
W150 AD8 4 x 4	71	2722 kg 2903 kg	6000 lbs 6400 lbs	621 kg 796 kg	1369 lbs 1755 lbs	2102 kg 2107 kg	4631 lbs 4645 lbs

(1) Payload includes maximum weight of driver, passengers, cargo and optional equipment not included in payload or GVW package – Payload allowance for Chassis Cabs is not supplied due to large variations of body equipment installed.

(2) Includes base engine

(3)

Body Style	Cab	Bed Length
61	Std.	1981 mm (6.5 ft)
62	Std.	2438 mm (8.0 ft)
31	Club	1981 mm (6.5 ft)
32	Club	2438 mm (8.0 ft)
63	Std.	N.A.
64	Std.	N.A.
71	Sport Utility	N.A.

(4) Dual Rear Wheels

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STANDARD TRUCK BODY DIMENSIONS

VEHICLE FAMILY	WHEELBASE AVAILABLE	CAB TO AXLE	BODY TYPE	STANDARD BODIES AVAILABLE				
					LOAD SPACE DIMENSIONS (2)			
				NOMINAL LENGTH	LENGTH	MAX. WIDTH	HEIGHT	VOLUME
AD-1 AD-5	2921 mm (115 in)	—	Sweptline	1981 mm (6.5 ft)	1981 mm (78 in)	1778 mm (70 in)	485 mm 19.1 in)	1.71 m^3 (60.35 ft^3)
AD-1 AD-2 AD-3 AD-5 AD-6 AD-7	3327 mm (131 in)	—	Sweptline	2438 mm (8 ft)	2489 mm (98 in)	1778 mm (70 in)	485 mm (19.1 in)	2.15 m^3 (75.8 ft^3)
AD-2 AD-3 AD-7	3327 mm (131 in)	1422 mm (56 in)	Chassis Cab	2438 mm (8 ft)	—	—	—	—
AD-3 AD-7	3249 mm (135 in)	1524 mm (60 in)	Chassis Cab	2896 mm (9.5 ft)	—	—	—	—
AD-3	4039 mm (159 in)	2134 mm (84 in)	Chassis Cab	3810 mm (12.5 ft)	—	—	—	—
AD-4	2692 mm (106 in)	—	Sport Utility 4 x 2	—	1778 mm (70 in) ①	1588 mm (62.5 in)	1062 mm (41.8 in)	2.99 m^3 (105.8 ft^3)
AD-8	2692 mm (106 in)	—	Sport Utility 4 x 4	—	1778 mm (70 in) ①	1588 mm (62.5 in)	1062 mm (41.8 in)	2.99 m^3 (105.8 ft^3)
AD-1	3378 mm (133 in)	—	Sweptline	1981 mm (6.5 ft)	1984 mm (78.1 in)	1778 mm (70 in)	485 mm (19.1 in)	1.71 m^3 (60.4 ft^3)
AD-1 AD-2 AD-5 AD-6	3785 mm (149 in)	—	Sweptline Club Cab	2438 mm (8 ft)	2489 mm (98 in)	1778 mm (70 in)	485 mm (19.1 in)	2.15 M^3 (75.8 ft^3)

① Driver seat to tailgate.
② Based on S.A.E. procedure J1100.

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TORQUE REFERENCES

Individual Torque Charts appear at the end of many Groups. Refer to the Standard Torque Specifications and Bolt Identification Chart in this Group for torques not listed in the individual torque charts (Fig. 1).

BOLT TORQUE

BOLT SIZE	GRADE 5		GRADE 8	
	N·m	ft-lbs (in-lbs)	N·m	ft-lbs (in-lbs)
1/4-20	11	(95)	14	(125)
1/4-28	11	(95)	17	(150)
5/16-18	23	(200)	31	(270)
5/16-24	27	20	34	25
3/8-16	41	30	54	40
3/8-24	48	35	61	45
7/16-14	68	50	88	65
7/16-20	75	55	95	70
1/2-13	102	75	136	100
1/2-20	115	85	149	110
9/16-12	142	105	183	135
9/16-18	156	115	203	150
5/8-11	203	150	264	195
5/8-18	217	160	285	210
3/4-16	237	175	305	225

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Fig. 1 Grade 5 and 8 Standard Torque Specifications

Note that the torque specifications given in the chart are based on the use of clean and dry threads. Reduce the torque by 10% when the threads are lubricated with engine oil and by 20% if new plated bolts are used.

Various sizes of internal and external hex-lobular (Torx) head fasteners are used as attaching hardware on numerous components and assemblies. Due to the ever-changing usage and application of automotive fasteners, Torx-head fasteners may not be identified as such throughout this manual.

METRIC THREAD AND GRADE IDENTIFICATION

Metric and SAE thread notations differ slightly. The difference is illustrated in Fig. 2.

Common metric fastener strength property classes are 9.8 and 12.9 with the class identification embossed on the head of each bolt (Fig. 3). Some metric nuts will be marked with single digit strength identification numbers on the nut face.

SAE strength classes range from grade 2 to 8 with line identification embossed on each bolt head. Markings corresponding to two lines less than the actual grade (Fig. 4). FOR EXAMPLE—Grade 7 bolt will exhibit 5 embossed lines on the bolt head.

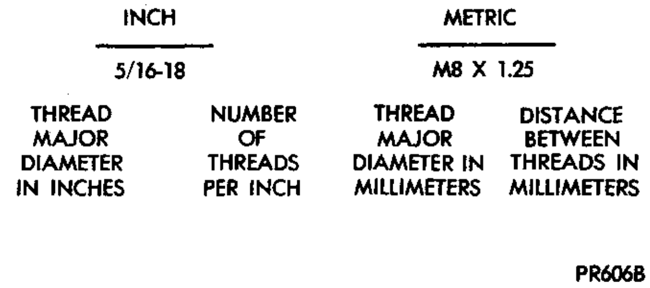

Fig. 2 Thread Notation (Metric and SAE)

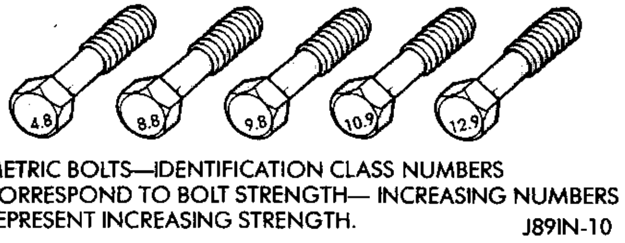

Fig. 3 Metric Bolt Identification

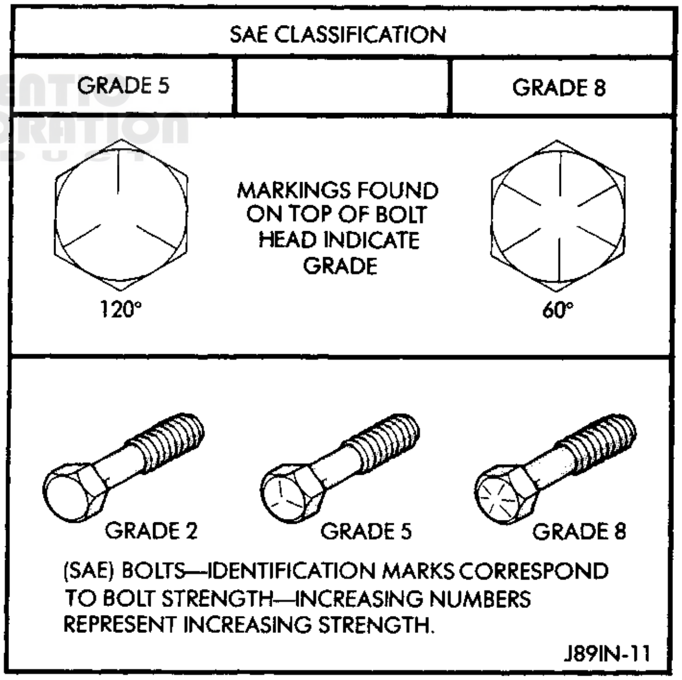

Fig. 4 SAE Bolt Identification

INTERNATIONAL SYMBOLS

Some of the International Symbols shown below are used to identify controls and displays in this vehicle. These symbols are applicable to those controls which are displayed on the instrument panel or in the immediate vicinity of the driver (Fig. 5).

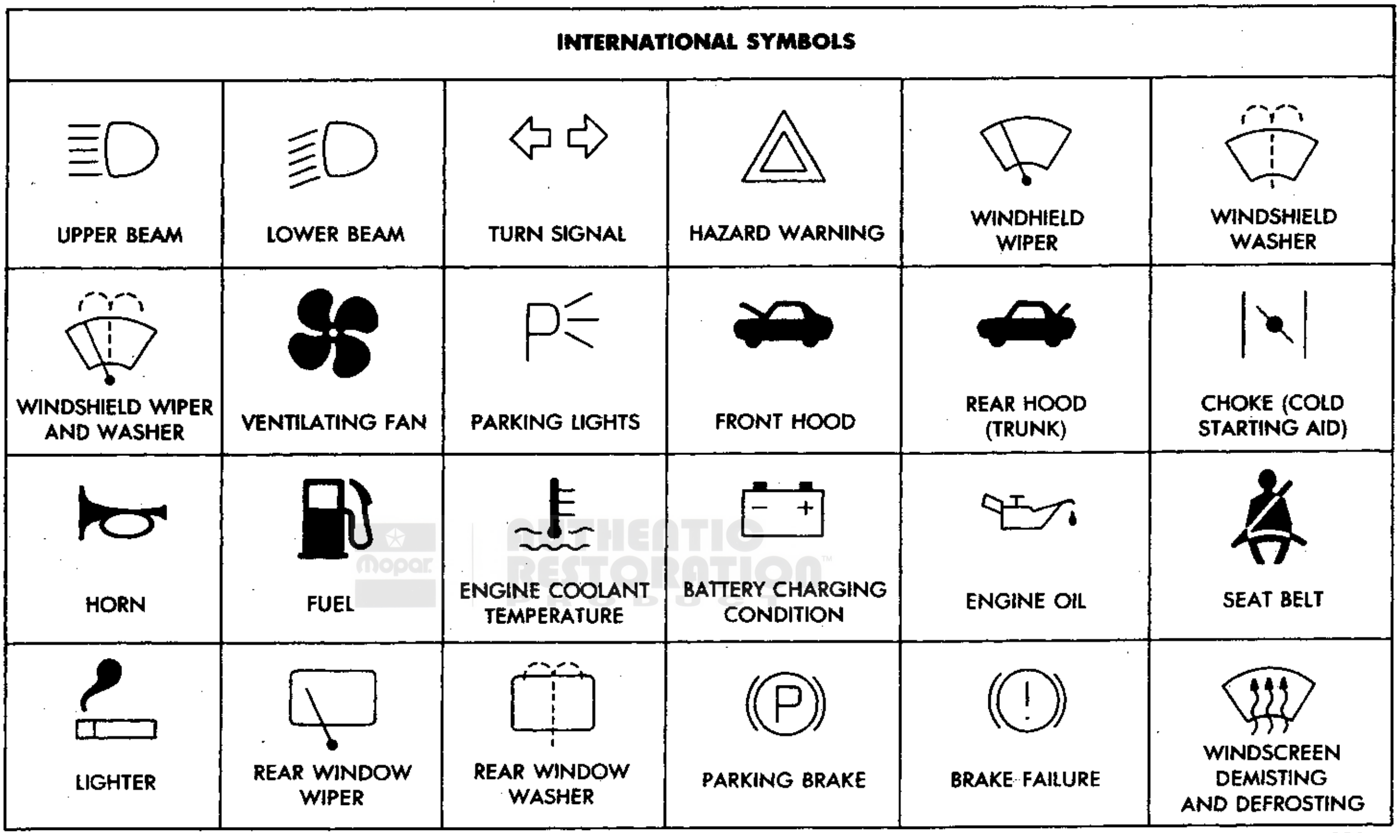

Fig. 5 International Symbols

METRIC SYSTEM

Artwork, specifications, and tightening references in this Service Manual are identified in the metric system and in the SAE system.

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

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

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

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Fig. 6 Metric Prefixes

The metric system is based on quantities of one, ten, one hundred, one thousand, and one million (Fig. 6).

The following Tables will assist you in conversion procedures.

CONVERSION TABLES

in-lbs to N•m

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

N•m to in-lbs

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

ft-lbs to N•m

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

N•m to ft-lbs

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

in. to mm

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

mm to in.

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

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CONVERSION TABLES (CONT.)

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

COMMON METRIC EQUIVALENTS

1 Inch = 25 Millimeters
1 Foot = 0.3 Meter
1 Yard = 0.9 Meter
1 Mile = 1.6 Kilometers

1 Cubic Inch = 16 Cubic Centimeters
1 Cubic Foot = 0.03 Cubic Meter
1 Cubic Yard = 0.8 Cubic Meter

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LUBRICATION AND MAINTENANCE

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GENERAL INFORMATION

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INTRODUCTION

Maintenance and lubrication service recommendations have been compiled to provide maximum protection for the owner's investment against all reasonable types of driving conditions.

Since these conditions vary with the individual operator's driving habits, the area in which the vehicle is operated and the type of service to which the vehicle is subjected, it is necessary to prescribe lubrication and maintenance service on a time schedule as well as a mileage interval basis.

Vehicles with a Gross Vehicle Weight Rating (GVWR) of 3 855 kg (8,500 lbs.) or less must meet light duty emission standards (see LIGHT DUTY CYCLE Maintenance charts). Vehicles with a Gross Vehicle Weight Rating of (GVWR) 3 856 kg (8,501 lbs.) or more must conform to the heavy duty emission standards (see HEAVY DUTY CYCLE Maintenance charts).

The GVWR for each vehicle appears on the Safety Certification label, affixed to the lock pillar on the drivers door (Fig. 1).

Additional information can be found in the Owner's Manual provided with the vehicle.

SEVERE SERVICE

Vehicles operating under one or more of the following conditions will require more frequent service (see the Lubrication and Maintenance Schedules—Heavy Duty Cycle).

(a) In extremely dusty areas.

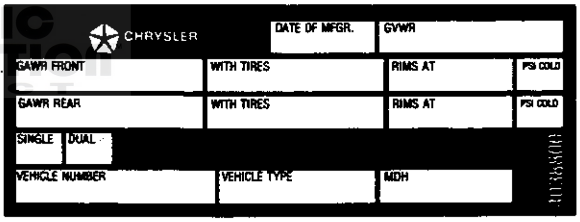

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Fig. 1 Safety Certification Label

(b) 50% or more of the vehicle operation in heavy city traffic in high temperatures (32°C or 90°F or higher).

(c) Prolonged idling.

(d) Extremely short run operation.

(e) Commercial type operation.

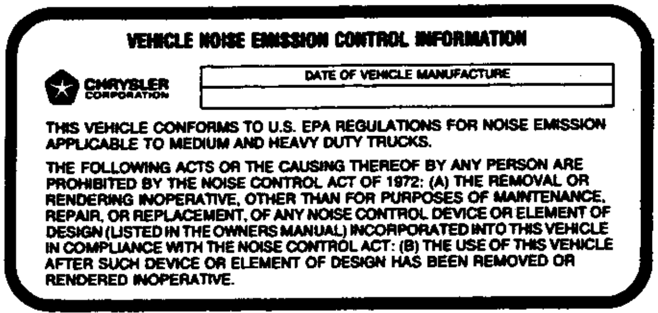
(f) Operated in water.

After extended operation in mud, sand, water, or similar dirty conditions, have your brake drums, brake linings, and axle joints inspected and cleaned as soon as possible. This will prevent any abrasive wear or unpredictable braking action.

It is the owner's responsibility to determine driving conditions (normal or severe service operation), to have the vehicle serviced according to the Maintenance Schedule and to pay for the necessary parts and labor.

NOISE CONTROL SYSTEMS

All vehicles built over 4 535 kg (10,000 lbs.) Gross Vehicle Weight Rating (GVWR) and manufactured for sale and use in the United States are required to comply with the Federal Government's Exterior Noise Regulations. These vehicles can be identified by the Noise Emissions Control Label located in the operator's compartment (Fig. 2).



VEHICLE NOISE EMISSION CONTROL INFORMATION

CHRYSLER CORPORATION

DATE OF VEHICLE MANUFACTURE

THIS VEHICLE CONFORMS TO U.S. EPA REGULATIONS FOR NOISE EMISSION APPLICABLE TO MEDIUM AND HEAVY DUTY TRUCKS.

THE FOLLOWING ACTS OR THE CAUSING THEREOF BY ANY PERSON ARE PROHIBITED BY THE NOISE CONTROL ACT OF 1972: (A) THE REMOVAL OR RENDERING INOPERATIVE, OTHER THAN FOR PURPOSES OF MAINTENANCE, REPAIR, OR REPLACEMENT, OF ANY NOISE CONTROL DEVICE OR ELEMENT OF DESIGN (LISTED IN THE OWNERS MANUAL) INCORPORATED INTO THIS VEHICLE IN COMPLIANCE WITH THE NOISE CONTROL ACT: (B) THE USE OF THIS VEHICLE AFTER SUCH DEVICE OR ELEMENT OF DESIGN HAS BEEN REMOVED OR RENDERED INOPERATIVE.

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Fig. 2 Vehicle Emission Control Information Label

REQUIRED MAINTENANCE FOR NOISE CONTROL SYSTEMS

The following maintenance services must be performed every 6 months or 9 600 km (6,000 miles) whichever occurs first to assure proper operation of the noise control systems. Inspection and service should be performed anytime a malfunction is observed or suspected. In addition, proper maintenance of the entire vehicle will help the effectiveness of the noise control systems.

EXHAUST SYSTEM

Inspect the entire exhaust system for leaks and damaged parts. Devices such as hangers, clamps and U-bolts should be tight and in good condition. Damaged components, burned or blown out mufflers, burned or rusted out exhaust pipes should be replaced according to the procedures and specifications outlined in Group 11, Exhaust system and Intake Manifold.

AIR CLEANER ASSEMBLY

Inspect air cleaner housing for proper assembly and fit. Make certain that the air cleaner is properly positioned and indexed on the throttle body and the cover is tight. Check all hoses leading to the cleaner for tightness. The gasket between the air cleaner housing and throttle body must be intact and in good condition. The air filter element must also be clean and serviced according to the instructions outlined in the Scheduled Maintenance Section of this manual.

TAMPERING WITH NOISE CONTROL SYSTEM PROHIBITED

Federal law prohibits the following acts or the causing thereof:

(1) The removal or rendering inoperative by any person other than for purposes of maintenance repair, or replacement of any device or element of design incorporated into any new vehicle for the purpose of noise control prior to its sale or delivery to the ultimate purchaser or while it is in use.

(2) The use of the vehicle after such device or element of design has been removed or rendered inoperative by any person.

PARTS REQUIRING NO LUBRICATION

There are many parts that should not be lubricated; some because they are permanently lubricated, some because lubricants will be detrimental to their operating characteristics, and some because lubricants will cause component failures. In particular, rubber bushings should not be lubricated since this not only will cause them to fail, but will destroy their necessary frictional characteristics. Parts that should not be lubricated are as follows (Fig. 3):

Air Pumps
Alternator Bearings
Clutch Release Bearing
Drive Belts
Drive Shaft Center Bearing
Fan Belt Idler Pulley
Idler Arm Assembly
Rubber Bushings
Rear Spring Shackle Bolts
Rear Wheel Bearings on D-100 and D-200 Vans
Starter Bearings
Suspension Strut Bearing
Throttle Control Cable
Throttle Linkage
Water Pump Bearings

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Fig. 3 Parts Not Requiring Lubrication

FUEL USAGE

All engines require the use of unleaded fuel to reduce exhaust emissions, and to protect the catalytic converters. Use fuel having an octane rating of at least 87, (R + M)/2.

UNLEADED GASOLINES ONLY must be used in vehicles equipped with catalyst emission control systems. All vehicles, so equipped, have labels located on the instrument panel and adjacent to the fuel filler cap or door that state, UNLEADED FUEL ONLY. These vehicles also have fuel filler tubes specially designed to accept the smaller diameter unleaded gasoline dispensing nozzles only.

The exhaust emission system of your vehicle is designed to meet all emission regulations while, at the same time, provide excellent fuel economy.

CLASSIFICATION OF LUBRICANTS

Oils, lubricants, and greases are classified and graded according to standards recommended by the Society of Automotive Engineers (SAE), American Petroleum Institute (API) and National Lubricating Grease Institute (NLGI).

ENGINE OIL

The SAE grade number indicates the viscosity of engine oils, for example, SAE 30, which is a single grade oil. Engine oils are also identified by a dual number, for example, SAE 10W-30, which indicates a multigrade oil.

GEAR LUBRICANTS

The SAE grade number also indicates the viscosity of Multipurpose Gear Lubricants.

The API classification system defines gear lubricants in terms of usage such as API GL-4 or API GL-5 etc.

LUBRICANTS/GREASES

Semisolid lubricants, bear the NLGI designation and are further classified as grades 0, 1, 2, 3 etc.

PARTS AND LUBRICATION RECOMMENDATIONS

Your Chrysler Motors vehicle has been engineered to perform for you for years to come. You will occasionally require service and maintenance for your vehicle and **Chrysler Motors recommends the use of "MOPAR" brand parts and accessories.**

Each MOPAR part has been specifically designed to maintain top efficiency and quality by the same team of engineers who designed your vehicle. Only MOPAR can make this claim.

Remember, whenever your vehicle requires a new part, always request the brand name MOPAR, it's worth the effort!

LIGHT DUTY CYCLE—GASOLINE ENGINES

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

X = Scheduled maintenance for all vehicles.
O = Scheduled maintenance for all vehicles (except California). Recommended for proper vehicle performance for vehicles built for sale in California.

Where both time and mileage are shown, follow the interval which occurs first. **Miles (Thousand)**	7½	15	22½	30	37½	45	52½	60	67½	75	82½	90	97½	105	112½	120
Kilometers (Thousand)	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192
Coolant Condition, Coolant Hoses/Clamps (12 months)	X	X	X	X	X	X	O	O	O	O	O	O	O	O	O	O
Exhaust System—Check	X	X	X	X	X	X	O	O	O	O	O	O	O	O	O	O
Oil—Change (12 Months)	X	X	X	X	X	X	O	O	O	O	O	O	O	O	O	O
Oil Filter—Change (2nd Oil Change) *		X		X		X		O		O		O		O		O
Drive Belt Tension—Inspect & Adjust		O[1]		X		O[1]		O		O		O		O		O
Drive Belt (V-Type)—Replace								O								
Spark Plug—Replace				X				O				O				O
Air Filter—Replace				X				O				O				O
Fuel Filter—Replace as necessary																
Coolant—Flush/Replace (36 months) & 24 months/48 000 km (30,000 miles) thereafter							O									
EGR Valve & Tube—Replace (clean passengers at 60 months)								O[2]								O[2]
PCV Breather—Clean								O								O
PCV Valve—Replace (60 months)								O[2]								O[2]
Vacuum Emission Components—Replace (60 months)								O								O
Ignition Timing—Adjust to Specs as necessary								O								O
Ignition Cables, Distributor Cap & Rotor—Replace								O								O
Manifold Heat Control Valve—Lubricate								O								O
Battery—Replace								O								
Oxygen Sensor—Replace											O[2]					

* If accumulated mileage is less than 12 000 km (7,500 miles) for 12 months, replace the filter at each oil change.

[1] For California vehicles, this maintenance is recommended by Chrysler Motors to the owner, but is not required to maintain the warranty on the air pump drive belt. This maintenance is not allowed on California Durability Vehicles.

[2] Requires Emission Maintenance Reminder Light. If so equipped, these parts are to be replaced at the indicated mileage, or when the emissions maintenance reminder light remains on continuously with the key in the "on" position, whichever occurs first.

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HEAVY DUTY CYCLE — GASOLINE ENGINES

Inspection and service should be performed anytime a malfunction is observed or suspected.

Where both time and mileage are shown, follow the interval which occurs first. Miles (Thousand)	6	12	18	24	30	36	42	48	54	60	66	72	78	82½	84	90	96	102	108
Kilometers (Thousand)	9.6	19	29	38	48	58	67	77	85	96	106	116	125	132	135	145	154	164	174
Coolant Condition, Coolant Hoses/Clamps (12 months)	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Exhaust System — Check	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Oil — Change (12 Months)	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Oil Filter — Change (2nd Oil Change)*		X		X		X		X		X		X			X		X		X
Drive Belt Tension — Inspect & Adjust			X[1]			X			X[1]			X				X[1]			X
Drive Belt (V-Type) — Replace									X										
Air Filter/Air Pump Air Filter — Replace				X				X				X				X			
Crankcase Inlet Air Filter — Clean				X				X				X					X		
Spark Plug — Replace					X					X						X			
Fuel Filter — Replace as necessary																			
Coolant — Flush/Replace (36 months) & 24 months/48 000 km (30,000 miles) thereafter									X										
EGR Valve & Tube — Replace										X[2]									
EGR Tube — Clean Passengers										X[2]									
PCV Valve — Replace										X[2]									
Vacuum Emission Components — Replace										X									
Ignition Timing — Adjust to Specs, as necessary										X									
Ignition Cables, Distributor Cap & Rotor — Replace										X									
Manifold Heat Control Valve — Lubricate										X									
Battery — Replace										X									
Oxygen Sensor — Replace														X[2]					

* If accumulated mileage is less than 9 600 km (6,000 miles) for 12 months, replace the filter at each oil change.

[1] For California vehicles, this maintenance is recommended by Chrysler Motors to the owner but, is not required to maintain the warranty on the air pump drive belt.

[2] Requires Emission Maintenance Reminder Light. If so equipped, these parts are to be replaced at the indicated mileage, or when the emissions maintenance reminded light remains on continuously with the key in the "on" position, whichever occurs first.

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For light duty cycle vehicles GVW rating of 3 855 Kg (8,500 lbs.) and below.

Component	Truck Models	Fittings	Service Interval	Lubricant
Center Link	AD1 AD2 AD4	2	36 000 km (22,500 miles) or 2 years	Multi-purpose grease - NGLI grade 2 EP (Multi-Mileage Lubricant)
Drag Link Ball Joints	AW1 AW2 AW8	2	12 000 km (7,500 miles) or 6 months	Multi-purpose grease - NGLI grade 2 EP (Multi-Mileage Lubricant)
Gearshift Mechanism Overdrive 4	AD1	1	36 000 km (22,500 miles) or 2 years	Multi-purpose grease - NGLI grade 2 EP (Multi-Purpose Lubricant)
Parking Brake Ratio Lever Pivot	AD1 AD2 AD4 AW1 AW8	—	36 000 km (22,500 miles) or 2 years	Multi-purpose grease - NGLI grade 2 EP (Multi-Purpose Lubricant)
Propeller Shaft U-joint	AW1 AW2 AW8	3 (1 Piece rear P/shaft)	12 000 km (7,500 miles) or 6 months	Multi-purpose grease - NGLI grade 2 EP (Multi-Purpose Lubricant)
Propeller Shaft Slip Spline	AD1 AD2 (2 piece P/shaft)	1	36 000 km (22,500 miles) or 2 years. For severe service, every 4 800 km (3,000 miles) or 3 months. Daily, if vehicle is operated in water	Multi-purpose grease - NGLI grade 2 EP (Multi-Purpose Lubricant)
Suspension Ball Joints	AD1 AD2	4	36 000 km (22,500 miles) or 2 years — every engine oil change for off-highway operation	Multi-purpose grease - NGLI grade 2 EP (Multi-Mileage Lubricant)
Tie Rod Ball Joints	AD1 AD2 AD4	4	36 000 km (22,500 miles) or 2 years	Multi-purpose grease - NGLI grade 2 EP (Multi-Mileage Lubricant)
	AW1 AW2 AW8	2	12 000 km (7,500 miles) or 6 months. Daily, if vehicle is operated in water	
NP-241 Transfer Case Shift Lever Pivot	AW1 AW2 AW8	—	As Required	Multi-purpose grease - NGLI grade 2 EP (Multi-Purpose Lubricant)
Wheel Stop	AD1 AD2 AD4	—	36 000 km (22,500 miles) or as required	Wax Type Lubricant
Constant Velocity Joint (Front P/shaft)	AW1 AW2 AW8	1	12 000 km (7,500 miles)	Multi-purpose grease - NGLI grade 2 EP (Multi-Purpose Lubricant)

For heavy duty cycle vehicles GVW rating of 3 856 Kg (8,501 lbs.) and above.

Component	Truck Models	Fittings	Service Interval	Lubricant
Center Link	AD2-3	2	39 000 km (24,000 miles) or 2 years	Multi-purpose grease - NGLI grade 2 EP (Multi-Mileage Lubricant)
Drag Link Ball Joints	AW3	2	9 600 km (6,000 miles) or 6 months	Multi-purpose grease - NGLI grade 2 EP (Multi-Mileage Lubricant)
Constant Velocity Joint (Front P/shaft)	AW3	1	9 600 km (6,000 miles)	Multi-purpose grease - NGLI grade 2 EP (Multi-Purpose Lubricant)
P/shaft U-Joints	AW3	3	9 600 km (6,000 miles) or 6 months. For severe service, every 1 600 km (1,000 miles). Daily, if vehicle is operated in water.	Multi-purpose grease - NGLI grade 2 EP (Multi-Purpose Lubricant)
P/shaft Slip Spline	AW3 (135" WB)	1	39 000 km (24,000 miles) or 2 years. For severe service every 4 800 km (3,000 miles) or 3 months. Daily, if vehicle is operated in water.	Multi-purpose grease - NGLI grade 2 EP (Multi-Purpose Lubricant)
Suspension Ball Joints	AD2-3	4	39 000 km (24,000 miles)	Multi-purpose grease - NGLI grade 2 EP (Multi-Mileage Lubricant)
Tie Rod Ball Joints	AD2-3 AW2-3	4 2	39 000 km (24,000 miles) or 2 years 9 600 km (6,000 miles) or 6 months	Multi-purpose grease - NGLI grade 2 EP (Multi-Mileage Lubricant)
NP-205 Transfer Case Shift Linkage	AW2-3	—	As required	Light Engine Oil
NP-241 Transfer Case Shift Lever Pivot	AW2	—	As required	Multi-purpose grease - NGLI grade 2 EP (Multi-Purpose Lubricant)

FLUID CAPACITIES

COOLING SYSTEM	**QUARTS**	**LITERS**	**POWER STEERING**	**PINTS**	**LITERS**
3.9L ENGINE	15.1	14.3	ALL	2.7	1.28
5.2L ENGINE (Except AW150)	17.0	16.1	**REAR AXLE**	**PINTS**	**LITERS**
5.2L ENGINE (AW150)	16.5	15.6	CHRYSLER 8¼ Inch (210 mm)	4.4	2.08
5.9L ENGINE (Except AW150)	15.5	14.7	CHRYSLER 9¼ Inch (235 mm)	4.5	2.13
5.9L ENGINE (AW150)	15.0	14.2	DANA 60	6.0	2.84
ENGINE CRANKCASE	**QUARTS**	**LITERS**	DANA 70	7.0	3.31
3.9L ENGINE	4.0	3.8	**FRONT AXLE**	**PINTS**	**LITERS**
5.2L & 5.9L (no Filter change)	4.0	3.8	Spicer 44 FBJ	5.6	2.65
5.2L & 5.9L (with Filter change)	5.0	4.7	Spicer 60 F	6.5	3.07
FUEL TANK	**GALLON**	**LITERS**	**TRANSMISSION-AUTOMATIC**	**QUARTS**	**LITERS**
STANDARD 3.9L & 5.2L ENGINES	22.0	83.0	A 727 (5.9L ENGINE)	8.4	7.9
OPTIONAL 3.9L & 5.2L ENGINES	30.0	113.0	A 998 (3.9L ENGINE)	8.6	8.1
STANDARD 5.9L ENGINE	30.0	113.0	A 999 (5.2L ENGINE)	8.6	8.1
AD100 & AW100	34.0	128.0	**TRANSMISSION-MANUAL**	**QUARTS**	**LITERS**
TRANSFER CASE	**PINTS**	**LITERS**	NP-435 (4 Speed)	3.5	3.3
NP-205	4.5	2.13	NP-2500 (5 Speed)	2.0	1.9
NP-241	6.0	2.84			

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ASSIST (JUMP) STARTING

WARNING: DO NOT ATTEMPT TO PUSH OR TOW A VEHICLE TO GET IT STARTED. UNBURNED FUEL COULD ENTER THE CONVERTER AND, ONCE THE ENGINE HAS STARTED, IGNITE AND CAUSE THE CONVERTER TO OVERHEAT AND RUPTURE.

BOOSTER BATTERY

WARNING: TO PREVENT PERSONAL INJURY OR DAMAGE TO CLOTHING, DO NOT ALLOW BATTERY FLUID TO CONTACT EYES, SKIN OR FABRICS. DO NOT LEAN OVER A BATTERY WHEN CONNECTING JUMPER CABLES OR ALLOW CABLE CLAMPS TO TOUCH EACH OTHER. KEEP OPEN FLAMES OR SPARKS AWAY FROM BATTERY VENT HOLES. ALWAYS WEAR EYE PROTECTION WHEN WORKING WITH BATTERIES.

If it becomes necessary to use a booster battery, with jumper cables, to start a vehicle's engine because its battery is discharged, the following procedure should be followed:

(1) Set parking brake and place automatic transmission in PARK (NEUTRAL for manual transmission).

(2) Turn off lights, heater and other electrical loads.

(3) Observe charge indicator. If indicator is light or yellow replace battery. DO NOT attempt jump starting when indicator is light or yellow. If charge indicator has a green dot in the center, failure to start is not due to a discharged battery and the cranking system should be checked. If charge indicator appears dark in the center, proceed as follows:

(4) Attach one end of one jumper cable to positive terminal of booster battery and the other end of same cable to positive terminal of discharged battery (Fig. 4).

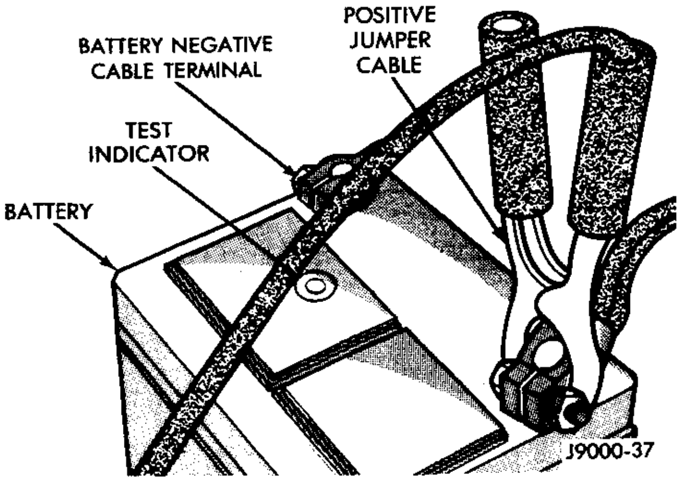


Fig. 4 Connecting Positive Jumper Cable

WARNING: DO NOT PERMIT VEHICLES TO TOUCH EACH OTHER AS THIS COULD ESTABLISH A GROUND CONNECTION AND COUNTERACT BENEFITS OF THIS PROCEDURE.

(5) Connect ONE end of other jumper cable to Negative (−) Post of booster battery. Connect OTHER end of the jumper cable to a good engine ground free from dirt or grease of vehicle with discharged battery. Make sure a good connection is made.

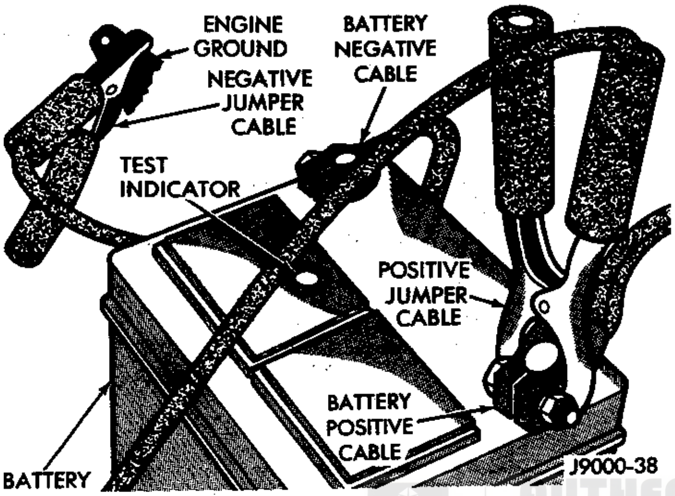


Fig. 5 Both Jumper Cables Connected

WARNING: DO NOT CONNECT TO NEGATIVE POST OF DISCHARGED BATTERY (Fig. 5).

(6) Take care that clamps from one cable to not inadvertently touch clamps on other cable. DO NOT lean over battery when making connections. The negative connection must provide good electrical conductivity and current carrying capacity.

WARNING: DURING COLD WEATHER WHEN TEMPERATURES ARE BELOW FREEZING POINT, ELECTROLYTE IN A DISCHARGED BATTERY MAY FREEZE. DO NOT ATTEMPT JUMP STARTING BECAUSE BATTERY COULD RUPTURE OR EXPLODE. BATTERY TEMPERATURE MUST BE BROUGHT UP ABOVE THE FREEZING POINT BEFORE ATTEMPTING JUMP STARTING.

(7) After engine is started or if engine fails to start, cables must be disconnected in following order:

(a) Negative cable at engine ground.

(b) Negative cable at negative post on booster battery.

(c) Cable between positive post of both batteries.

WARNING: ANY PROCEDURE OTHER THAN ABOVE COULD RESULT IN:

(1) PERSONAL INJURY CAUSED BY ELECTROLYTE SQUIRTING OUT BATTERY VENT.

(2) PERSONAL INJURY OR PROPERTY DAMAGE DUE TO BATTERY EXPLOSION.

(3) DAMAGE TO CHARGING SYSTEM OF BOOSTER VEHICLE OR OF IMMOBILIZED VEHICLE.

PORTABLE STARTING UNIT

There are many types of these units available. Follow instructions of their manufacturer for necessary precautions and operations.

CAUTION: It is very important that their operating voltage does not exceed 15 volts because damage to battery, starter motor, alternator or electrical system may occur.

HOISTING RECOMMENDATIONS

See the Owner's Manual for Emergency Jacking procedures.

TWIN POST

Lift points for twin post hoisting are shown in Fig. 6. Suitable hoist adaptors are available from hoist manufacturers.

FLOOR JACK

A regular floor jack may be used to raise the vehicle at the locations described (with the exceptions and precautions). In addition, a front jacking point is locating at the center of the front crossmember (inboard) (Fig. 6).

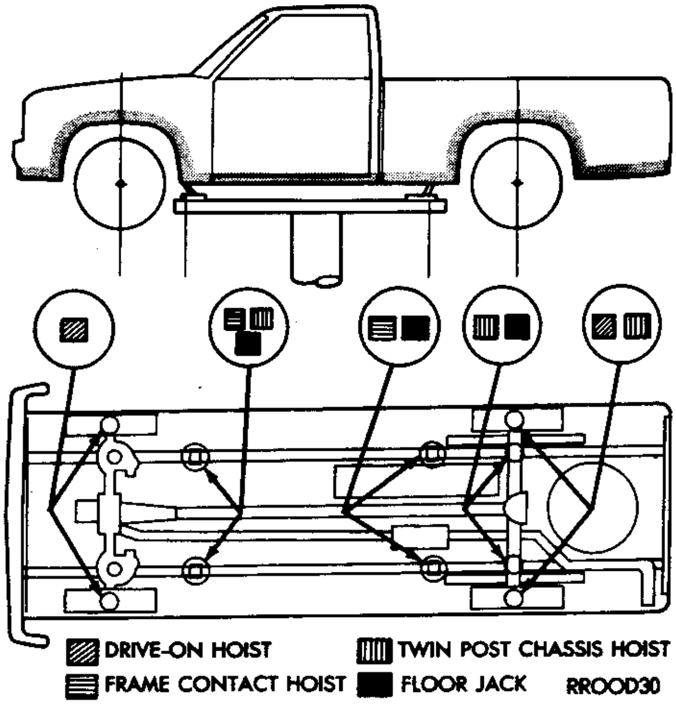


Fig. 6 Hoisting and Jacking Points

CAUTION: Do not attempt to lift a vehicle with a floor jack positioned under the axle housings, body side sills, steering linkage components, propeller shafts, engine/transmission oil pans, fuel tank, or front suspension arms. Use the frame rail lift locations only.

SINGLE POST HOIST/OUTBOARD TWIN POST

Frame contact lift points for single post hoist are shown in Fig. 6.

WARNING: WHEN SERVICE PROCEDURES REQUIRE REMOVING REAR AXLE, FUEL TANK, AND SPARE TIRE, PLACE ADDITIONAL WEIGHT ON REAR END OF VEHICLE, ANCHOR VEHICLE TO HOIST OR PLACE JACK STANDS UNDER VEHICLE FOR SUPPORT TO PREVENT TIPPING WHEN CENTER OF GRAVITY CHANGES.

HOISTING (4WD MODELS)

A conventional hydraulic hoist may be used after inspecting and adjusting lifting arms, pads or ramps to provide clearance between transfer case or skid plate during lifting procedure (Fig. 7).

If a twin post hoist is used a 4 x 4 x 12 inch wood spacer may be required under the front axle tube (opposite differential housing) to maintain a level lifting position.

CAUTION: Any blocking or spacer material used for increasing lift height must be secured in a safe manner that will not unbalance the vehicle or damage components such as hydraulic lines, exhaust system or steering linkage.

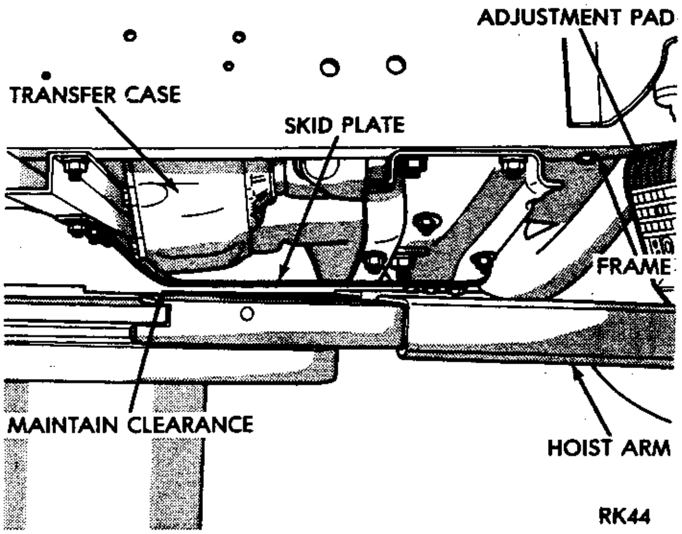


Fig. 7 Hoisting (Single Post Hoist Typical)

TOWING RECOMMENDATIONS

TOWING EQUIPMENT

When towing a Chrysler Motors vehicle a SAE approved sling-type towing device may be used (Fig. 8). A crossbeam and spacer blocks may be required for proper attachment (Fig. 9). In most sling-type towing applications, J-hooks are recommended for attaching the sling crossbar to the underside of the vehicle. When J-hooks cannot be used, T-hooks are required (Fig. 10). If T-hooks are being used, be sure the elongated hole in the chassis is reinforced and the T-hook shank is in-line with the hole (Fig. 11).

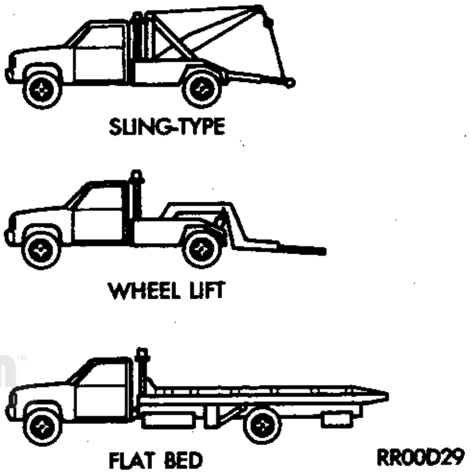


Fig. 8 Recommended Towing Devices

Many of Chrysler Motor vehicles are equipped with air dams, spoilers, or ground effects skirting which make sling-type towing impractical. In these cases the use of a wheel-lift or flat-bed towing device (Fig. 8) is recommended. When using a wheel-lift towing device, be sure the unlifted end has a minimum ground clearance of 5 inches; if not, use a towing dolly. If a flat-bed towing device is used, the approach ramp angle should not exceed 15°.

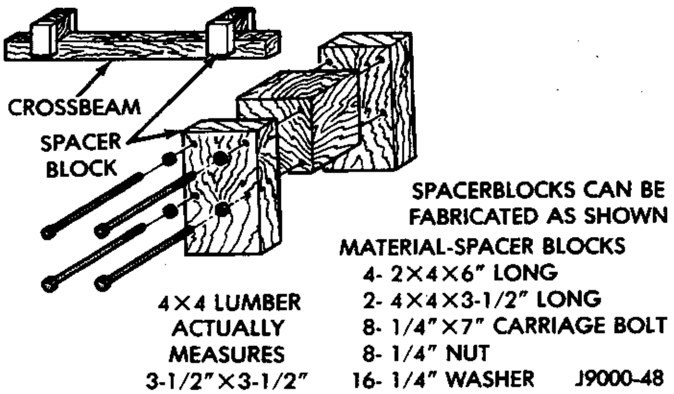


Fig. 9 Crossbeam and Spacer Block Construction

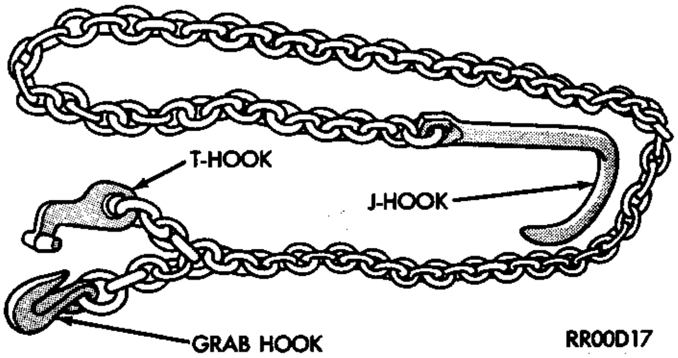


Fig. 10 Towing Chains and Hooks

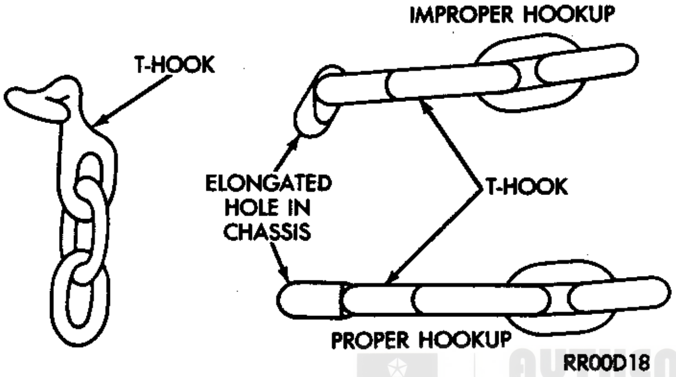


Fig. 11 T—Hook Usage

LIFTING-GROUND CLEARANCE

Towed vehicle should be raised until lifted wheels are a minimum of four inches from the ground. Be sure there is adequate ground clearance at the opposite end of the vehicle, especially when towing over rough terrain or when crossing sharp rises such as curbs. If necessary, ground clearance can be increased by removing the wheels (secure brake drums when using rear pickup method) from the lifted end of the disabled vehicle and carrying the lifted end closer to the ground. An eight inch ground clearance must be maintained between brake drums or rotors and the ground.

REAR TOWING PICKUP

2WD vehicles may be towed on the front wheels for extended distances at a speed not to exceed 50 km/h (30 mph). It is recommended that the rear pickup method be used when possible (Figs. 12 and 13).

4WD vehicles may be towed (transfer case in neutral) on the front wheels for distances not to exceed 25 km (15 miles). For extended distances, the front propeller shaft should be disconnected.

The steering wheel must be clamped in the straight-ahead position with a steering wheel clamping device designed for towing service use.

CAUTION: Do not use steering column lock to secure front wheel position for towing.

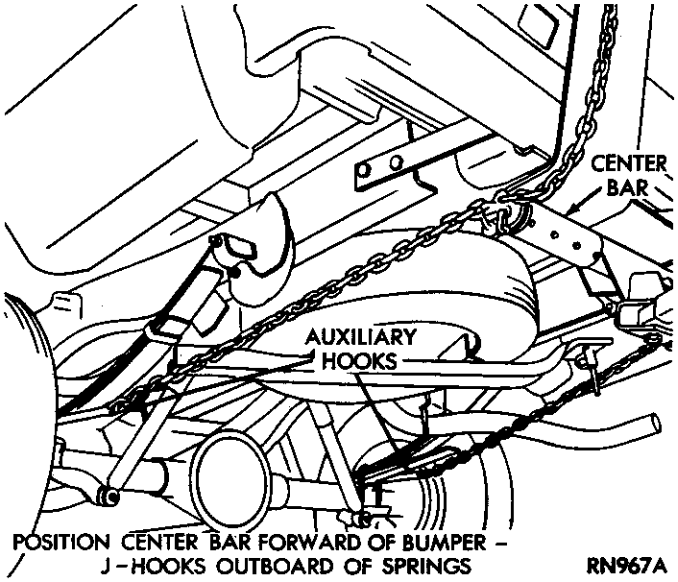


Fig. 12 Rear Pickup—AD and AW Vehicles

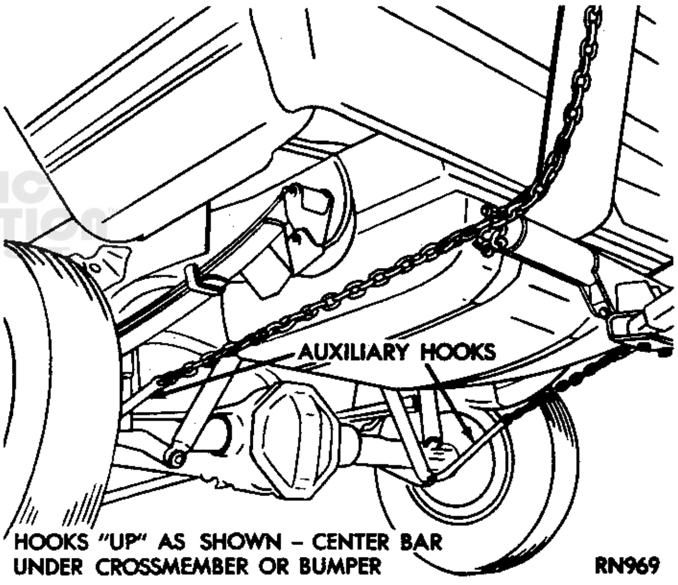


Fig. 13 Rear Towing Pickup—Sport Utility

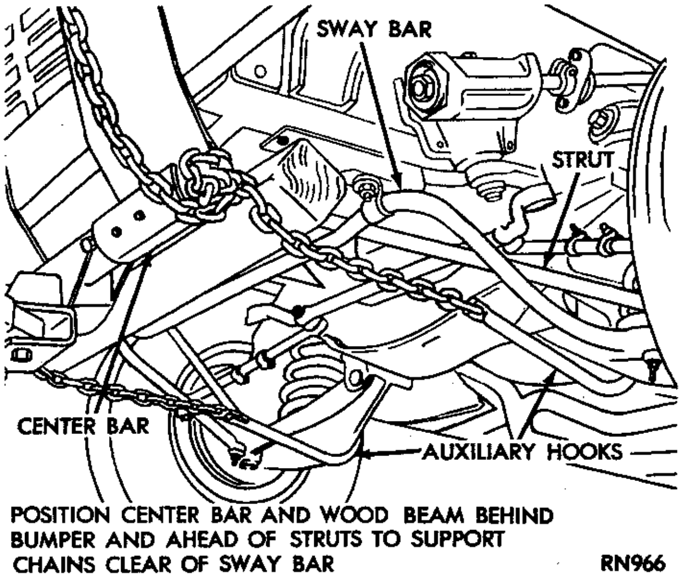
FRONT TOWING PICKUP (FIGS. 14 AND 15)

Care must be taken when lifting the vehicle from the front so that the lower spoiler will not be damaged.

MANUAL TRANSMISSION vehicles may be towed on the rear wheels at speeds up to 50 km/h (30 mph) for a distance of 25 km (15 miles), provided the transmission is in neutral and the driveline has not been damaged. The parking brake must be released.

AUTOMATIC TRANSMISSION vehicles may be towed on the front wheels at speeds not to exceed 40 km/h (25 mph) for a distance of 25 km (15 miles).

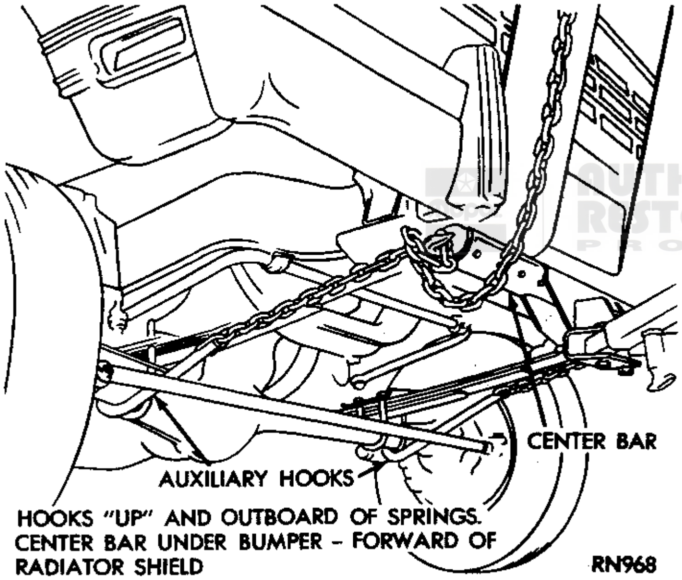
CAUTION: If these limits cannot be met, the front wheels must be placed on a tow dolly.



POSITION CENTER BAR AND WOOD BEAM BEHIND BUMPER AND AHEAD OF STRUTS TO SUPPORT CHAINS CLEAR OF SWAY BAR

RN966

Fig. 14 Front Towing Pickup—2WD Vehicles



HOOKS "UP" AND OUTBOARD OF SPRINGS. CENTER BAR UNDER BUMPER - FORWARD OF RADIATOR SHIELD

RN968

Fig. 15 Front Towing Pickup—4WD Vehicles

FLAT TOWING (4 WHEELS ON GROUND)

AUTOMATIC TRANSMISSION: Towing behind another vehicle is NOT recommended.

MANUAL TRANSMISSION: Towing behind another vehicle is allowed provided the transmission is in NEUTRAL and the parking brake is released.

IGNITION KEY AVAILABLE

Vehicles may be towed with all four wheels on the ground. Place the transmission in neutral. DO NOT tow more than 24 km (15 miles) or exceed 56 km/h (35 mph). If the transmission is not operative, or the vehicle is to be towed more than 24 km (15 miles), the driveshaft must be disconnected or the vehicle towed with the rear wheels off the ground.

IGNITION KEY NOT AVAILABLE

If the vehicle is locked and keys are not available, place rear wheels on a dolly. Lift and tow from the front. As an alternative (providing the parking brake is released), all vehicles covered in this section may be towed with the rear drive shaft disconnected.

SAFETY PRECAUTIONS

The following precautions should be taken when towing the vehicle.

(1) Remove exhaust tips and any other optional equipment except bumper guards, that interfere with the towing sling. Padding (heavy cloth or carpeting) should be placed between the tow sling and any painted surfaces.

(2) When placing the tow hooks on the rear axle, position hooks so as not to damage brake lines.

(3) Do not allow any of the towing equipment to bear on the fuel tank.

(4) Vehicle is not to be towed by hooking on the front or rear shock absorbers or coil springs.

(5) Do not lift or tow the vehicle by attaching to or wrapping around the bumper.

(6) A safety chain system completely independent of the primary lifting and towing attachment must be used.

(7) Any loose or protruding parts of damaged vehicle, such as hoods, doors, fenders, trim etc., should be secured prior to moving the vehicle.

(8) Operator should refrain from going under a vehicle while it is lifted by the towing equipment, unless the vehicle is adequately supported by safety stands.

(9) Never allow passengers to ride in a towed vehicle.

(10) State and local rules and regulations must be followed when towing a vehicle.

(11) Special consideration must be given to vehicles with optional campers, special bodies, front tire mounts, trailer hitches, etc.

(12) Heavily loaded light truck vehicles have the frame rails designed to flex under heavy loading. If the vehicle is lifted and towed from the rear, the frame rail flex may be increased enough to allow box to cab contact and could cause damage to box and/or cab. A towing dolly or flatbed carrier is desirable for heavily loaded vehicles.

VEHICLE STORAGE

Vehicles that may be stored for varying intervals require protection against deterioration. Vehicles should be driven a minimum of 40 highway km (25 highway miles) per month after the engine has reached normal operating temperature. This will prevent the accumulation of condensation and formation of rust on internal engine components such as cylinder bores.

Maintain the fuel level in the main tank between 3/4 full and full. This prevents the possibility of carburetor gum formation which will cause starting problems and poor mileage.

Normal maintenance services should be carried out at the time or mileage intervals specified.

If the vehicle cannot be driven each month, prepare the vehicle according to the appropriate procedure to prevent damage to the engine and chassis.

STORAGE FOR LESS THAN 1 MONTH

Vehicles inoperative for one month require the following maintenance:

(1) Add one quart of special rust preventive oil, MOPAR Engine Oil Supplement or equivalent, for each five gallons of gasoline in the fuel tank.

(2) Run the engine at the 1000 rpm for five minutes.

STORAGE FOR 1 TO 3 MONTHS

Vehicles inoperative for one to three months require the following maintenance in addition to those described above.

(1) Drain fuel tank and operate engine until carburetor runs dry.

(2) Remove spark plugs and pour 2 ounces of special rust preventive oil into each cylinder. Crank the engine. Replace plugs and tighten to 41 N•m (30 ft. lbs.) torque.

(3) Remove valve covers and coat rocker arms, rocker arm shaft, valve springs, push rods and valve stems with special rust preventive oil.

(4) Check cooling system for leaks and proper antifreeze protection.

STORAGE FOR MORE THAN 3 MONTHS

Vehicles inoperative for more than 3 months require the following maintenance in addition to those described above.

(1) Place the vehicle on blocks or jackstands to remove weight from tires. Inflate tires to recommended pressure.

(2) Check the transmission, rear axle and steering system for proper lubricant level.

(4) Disconnect battery cables. Clean and coat cable terminals with grease. Remove battery and place on a trickle charge.

ENGINE

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ENGINE OIL

DURING BREAK-IN

The crankcase oil installed in the engine at the factory is a high quality, energy conserving type lubricant. Oil changes should be consistent with anticipated climatic conditions under which vehicle operation will occur. The recommended SAE viscosity grades are shown in Fig. 1. Only oils with the proper API quality classification should be used when adding or changing the crankcase engine oil.

CAUTION: Nondetergent or straight mineral oils must never be used.

Frequently a new engine will consume some oil during its first few thousand miles of operation. This should be considered as a normal part of break-in and not interpreted as an indication of difficulty.

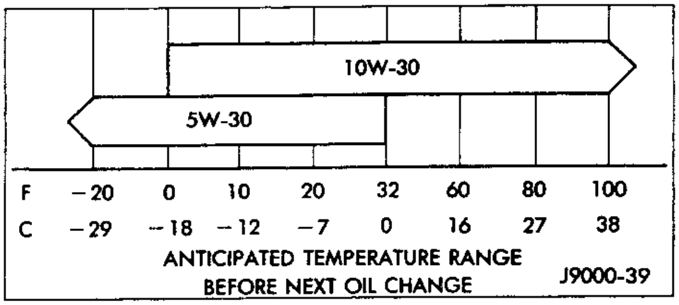


Fig. 1 Recommended Viscosity Grades

SELECTING ENGINE OIL

OIL QUALITY

For maximum engine protection under all driving conditions, use only engine oils that conform to API Service Catagories “SG” or “SG/CD”. To assure use of properly formulated engine oils, it is recommended that MOPAR Oils, or equivalent be used (see Chrysler Material Standard MS-6395).

VISCOSITY

Multi-viscosity oils protect the engine over a wide range of operating temperatures and driving conditions. Therefore these oils can be used all year round. Select oil viscosity according to the lowest air temperature expected before the next oil change (Fig. 1). Low viscosity oils make engine starting easier in cold weather. Oils of the SAE 5W-30 grade number are preferred when minimum temperatures consistently fall below -12°C (10°F).

ENERGY CONSERVING

There are many engine oils currently available that could increase the fuel economy of your vehicle. They are marketed as ENERGY CONSERVING, or ENERGY CONSERVING II. Those oils identified as ENERGY CONSERVING II provide greater fuel economy benefits than those identified as ENERGY CONSERVING. In addition to selecting the proper API quality category and viscosity grade, use of ENERGY CONSERVING type engine oils are preferred.

ENGINE OIL IDENTIFICATION SYMBOL

A symbol has been developed to aid the vehicle owner in the proper selection of engine oil. This symbol is located on the oil container and is composed of three distinct areas for identifying various aspects of the oil (Fig. 2).

(1) The top portion will indicate the quality of the oil, such as “SG” or “SG/CD”.

(2) The center portion will show the SAE viscosity grade of the oil, such as SAE 5W-30 or 10W-30.

(3) The lower portion will show only ENERGY CONSERVING or ENERGY CONSERVING II, if it is applicable to that oil. Energy conserving when shown, indicates, that oil, offers fuel economy benefits in gasoline engines.

ENGINE OIL LEVEL INDICATOR

The engine oil level indicator dipstick is located on the right front of the engine, left of the alternator.

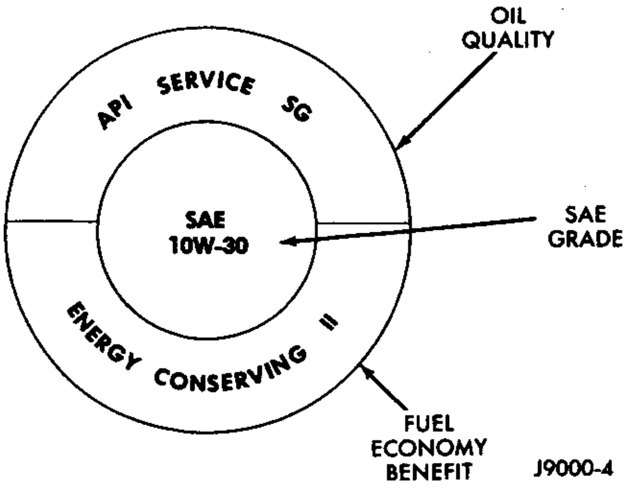


Fig. 2 Oil Container Symbol

CHECKING ENGINE OIL LEVEL

To assure proper lubricant of your vehicle's engine, the engine oil must be maintained at the correct level. Check the oil level at regular intervals, such as every fuel stop. Add oil only when the level on the dipstick is at or below the ADD OIL mark.

CAUTION: Do not overfill crankcase. This will cause oil aeration and loss of oil pressure.

MATERIALS ADDED TO ENGINE OILS

It is not necessary to add any material to crankcase oils for most types of vehicle operation. In some instances, such as infrequent operation or short trips only and during break-in after a major engine overhaul and/or new piston installation, addition of special materials containing anti-rust and anti-scuff additives are beneficial. MOPAR Engine Oil Supplement, or equivalent, is a suitable product for this purpose.

ENGINE OIL FILTER SELECTION

All engines are equipped with full-flow, throwaway oil filters. It is possible, particularly in cold weather, that the vehicle may develop high oil pressure for a short duration.

The quality of replacement filters varies considerably. Be sure that any replacement filter used is a high quality filter, and is capable of withstanding a pressure of 1765 kPa (256 psi—manufacturer's specifications) to avoid filter and engine damage.

ENGINE OIL AND FILTER CHANGES

ENGINE OIL

Engine oil should be changed at the following intervals:

(1) Light Duty Cycle—Every 12 months or 12 000 km (7,500 miles), whichever occurs first.

(2) Heavy Duty Cycle—Every 12 months or 9 600 km (6,000 miles), whichever occurs first.

(3) Severe Service Cycle—Every 3 months or 4 800 km (3,000 miles), whichever occurs first, if the vehicle is driven under any of the following conditions:

(a) Frequent driving in dusty conditions

(b) Frequent trailer pulling

(c) Extensive idling

(d) Frequent short trip driving (less than 8 km or 5 miles) at temperatures below 10°F (-12°C).

(e) More than 50%operation at sustained high speeds over 112 km/h (70 mph) during hot weather (above 90°F or 32°C).

CAUTION: Do not overfill crankcase. This will cause oil aeration and loss of oil pressure.

ENGINE OIL FILTER

NORMAL DRIVING—The oil filter should be replaced with a new filter at every second engine oil change. Each 12 months, if the mileage is less than 12 000 km (7,500 miles) Light Duty Cycle or 9 600 km (6,000 miles) Heavy Duty Cycle, replace the oil filter at each oil change.

SEVERE SERVICE—For severe operating conditions as outlined above, the oil filter should be replaced at every second oil change.

DISPOSING OF USED ENGINE OIL

WARNING: TEST RESULTS SUBMITTED TO EPA HAVE SHOWN THAT LABORATORY ANIMALS DEVELOP SKIN CANCER AFTER PROLONGED CONTACT WITH USED ENGINE OIL. ACCORDINGLY, THE POTENTIAL EXISTS FOR HUMANS TO DEVELOP A NUMBER OF SKIN DISORDERS, INCLUDING CANCER, FROM SUCH EXPOSURE TO USED ENGINE OIL. CARE SHOULD BE TAKEN WHEN CHANGING ENGINE OIL, TO MINIMIZE THE AMOUNT AND LENGTH OF EXPOSURE TIME TO USED ENGINE OIL ON YOUR SKIN. PROTECTIVE CLOTHING AND GLOVES, THAT CANNOT BE PENETRATED BY OIL, SHOULD BE WORN. THE SKIN SHOULD BE THOROUGHLY WASHED WITH SOAP AND WATER, OR USE WATERLESS HAND CLEANER, TO REMOVE ANY USED ENGINE OIL. DO NOT USE GASOLINE, THINNER, OR SOLVENTS.

Care should be taken in disposing of the used engine oil from your vehicle. Used oil, indiscriminately discarded, can present a problem to the environment. Contact your dealer or service station, to determine where used oil can be safely discarded.

COOLING SYSTEM

WARNING: TAKE CARE TO AVOID THE RADIATOR COOLING FAN WHENEVER THE VEHICLE HOOD IS RAISED. IF YOU MUST WORK NEAR THE FAN, DISCONNECT THE FAN MOTOR LEAD.

INSPECTION

WARNING: WHEN REMOVING THE RADIATOR CAP, CARE SHOULD BE TAKEN TO PREVENT SCALDING FROM HOT PRESSURIZED COOLANT.

Coolant protection checks should be made every 12 months (prior to the onset of freezing weather, where applicable). If coolant is dirty or rusty in appearance, the system should be drained,flushed and refilled with fresh coolant.

Check radiator cap for proper vacuum sealing and operation. Use caution when removing the radiator cap to avoid contact with hot coolant or steam. Place a cloth over the cap, turn to the first stop, (do not press down), pause to allow pressure to release through the overflow tube,then press down and turn counterclockwise to remove cap. Check face of radiator and air conditioning condenser for any accumulation of bugs, leaves, etc. Check tubing at coolant reserve tank and radiator. Inspect entire system for leaks.

Your cooling system has a 50/50 solution of antifreeze and water from the factory. This is the recommended solution for most operating temperatures and provides good corrosion protection.

Failure to follow anti-freeze concentration and replacement recommendations or failure to use antifreeze formulated to prevent corrosion of all cooling system metals, may result in radiator plugging. The result is engine overheating or cooling system leaks, such as at core hole plugs, resulting in loss of coolant.

RADIATOR CAP

The radiator cap must be fully tightened in order to provide a good seal with the radiator filler neck. This prevents loss of coolant and ensures that coolant will return to the radiator from the coolant reserve tank. The vent valve and its seat can become contaminated with coolant sediment etc. The valve and seat should be carefully cleaned if:

(1) The system will not go under pressure.

(2) The coolant reserve bottle gains coolant abnormally.

(3) The top radiator hose collapses on cool-down.

DRAIN, FLUSH AND FILL

Drain, flush, and fill the cooling system at the mileage or time intervals specified in the Maintenance Schedule in this Group. If the solution is dirty or rusty or contains a considerable amount of sediment, clean and flush with a reliable cooling system cleaner. Care should be taken in disposing of the used engine coolant from your vehicle. Used coolant, indiscriminately discarded, can present a problem to the environment. Contact your dealer, service station or governmental agency to find out where used coolant can be properly discarded in your area.

Refer to Group 7, Cooling System for the proper drain, flush and fill procedures.

HOSES AND FITTINGS

Inspect the hose fittings for looseness and corrosion. Inspect the hoses for brittleness and cracks.

Thoroughly inspect the hose ends that are slipped onto nipples.

Engine performance may be adversely affected by air leaks into such unlikely places as the heater and air conditioner control vacuum hoses, coolant hoses or the power brake booster vacuum hose.

ENGINE AIR CLEANER

The engine air cleaner should be replaced every 48 000 km (30,000 miles) under normal driving conditions. When the vehicle is frequently operated in dusty conditions the air cleaner should be replaced and the wrapper cleaned as required.

Remove cleaner assembly, remove paper element (Fig. 3). Clean filter element by blowing dirt out gently with compressed air (Fig. 4). Direct air from inside out, and keep nozzle two inches away from element to avoid damage. If the filter element is saturated with oil for more than 1/2 its circumference replace the filter element and wrapper assembly. Check the rest of the crankcase ventilating system for proper operation.

Do not immerse paper element in liquid.

On vehicles equipped with a heated air system, do not immerse temperature sensor (located in air cleaner housing) in cleaning solution.

Wash the cleaner cover and body with cleaning solvent and wipe dry.

Replace paper element (and wrapper, if equipped). Replace cleaner assembly on engine.

THROTTLE CONTROL LINKAGE

All transmission linkage pivot pin areas except ball joint type, should be cleaned of dust and dirt (Fig. 5). Lubricate every second oil change with Multipurpose Grease NLGI Grade 2 E.P. **Do not lubricate throttle body linkage, throttle linkage ball joints, throttle control cables, or transmission kickdown cables.**

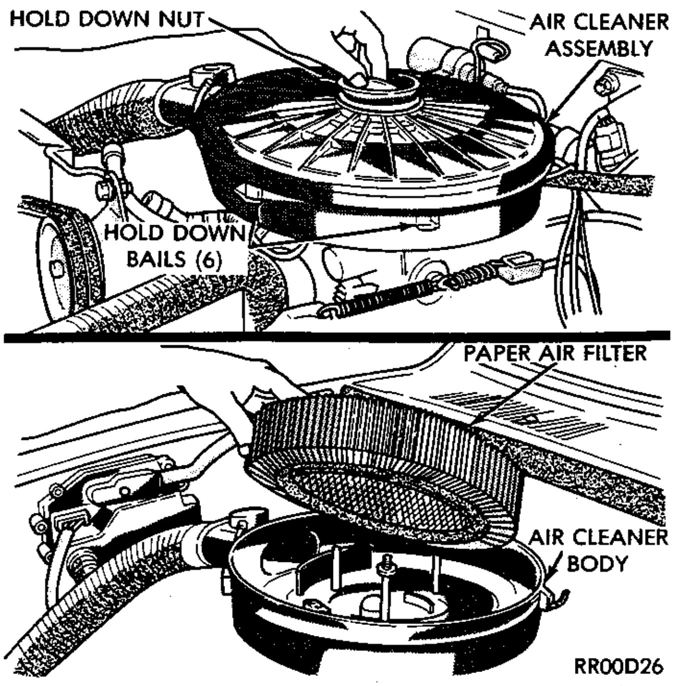


Fig. 3 Engine Air Cleaner Assembly (Typical)

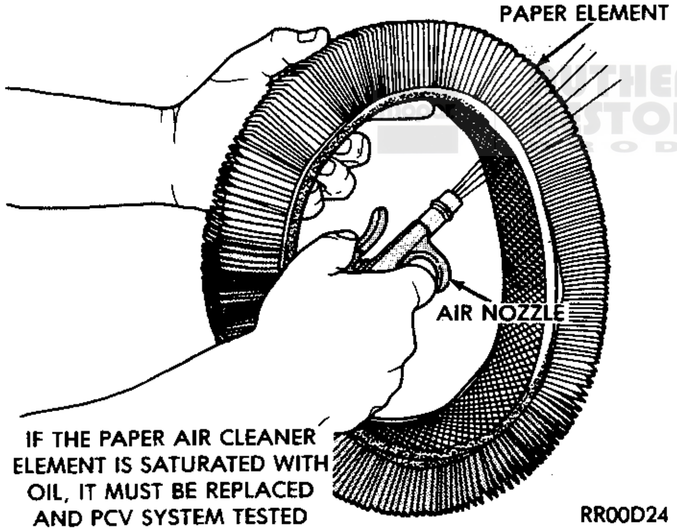


Fig. 4 Cleaning Filter Element (Typical)

MANIFOLD HEAT CONTROL VALVE

On the LEFT HAND manifold, test the manifold heat control valve for free operation. With the engine idling, accelerate momentarily. The counterweight should move CLOCKWISE. If no movement is observed, shaft is binding or the thermostat spring is weak or broken. Be sure manifold is COOL before applying MOPAR Manifold Heat Control Valve Solvent, or equivalent, to each end of the shaft at the bearings (Fig. 6). Allow the solvent to soak a few minutes to dissolve deposits. Then, work the valve back and forth until it turns freely. If the spring is weak or broken, replace the spring.

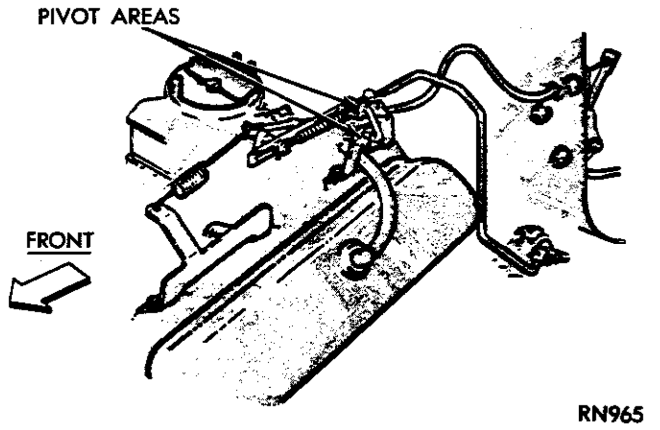


Fig. 5 Accelerator Linkage Pivot Areas

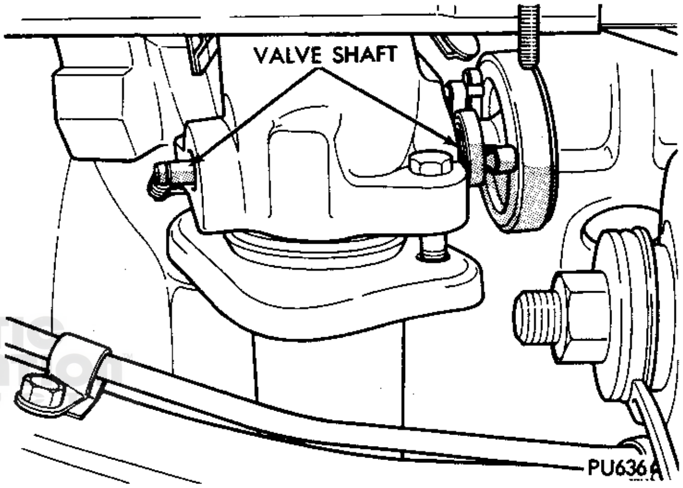


Fig. 6 Manifold Heat Control Valve

AIR INJECTION SYSTEM

All valves and switches in the Air Injection System and the air pump should be checked for proper operation and replaced, if necessary. Inspect the check valve tubing for corrosion and replace, if excessive corrosion is evident.

CRANKCASE VENTILATION SYSTEM

All models with gasoline operated engines are equipped with a closed crankcase ventilation system designed to eliminate emission of residual fumes and vapors from the crankcase by directing these fumes back through the engine combustion chambers.

VENTILATION SYSTEM OPERATION

The ventilation system operates by manifold vacuum. Air is drawn from the air cleaner, through the crankcase inlet air cleaner. Then the air is circulated through the engine and drawn out through the PCV valve, and into a passage in the throttle body, becoming part of the calibrated air/fuel mixture (Fig. 7). This mixture is drawn into the combustion chamber and burned.

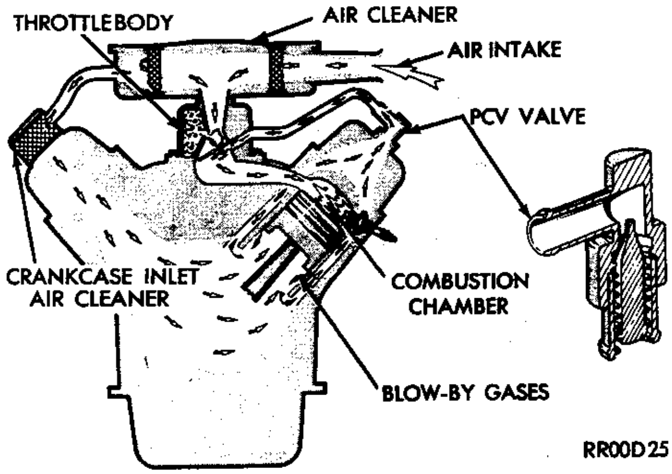


Fig. 7 Crankcase Ventilation System Operation (Typical)

FREQUENCY OF SERVICE

The crankcase ventilation system must be kept clean to maintain good engine performance and durability.

Periodic service is required to remove combustion products from the valve, hoses and intake manifold passages. The components should be inspected and serviced as indicated at the mileage or time interval specified in the appropriate Lubrication and Maintenance Chart. If a vehicle is used extensively for short trips with frequent idling, the crankcase ventilation system may require servicing more frequently.

INSPECTION AND SERVICE PROCEDURE

(1) With engine idling:

(a) Remove PCV valve. If the valve is not plugged, a hissing noise will be heard as air passes through the valve, and a strong vacuum should be felt when a finger is placed over the valve inlet (Fig. 8).

(b) Install the PCV valve. Remove the crankcase inlet tube from the air cleaner assembly and loosely hold a piece of paper over the open end of the tube. After allowing about a minute for the crankcase pressure to reduce, the paper should be sucked against the opening with a noticeable amount of force.

(2) With engine stopped; remove PCV valve and shake. A clicking noise should be heard to indicate that the valve mechanism is free.

(3) If the crankcase ventilation system meets the tests in (1) and (2) above, no further service is required. If not, the PCV valve should be replaced and the system checked again. Install a new Mopar PCV Valve, or equivalent. **Do not attempt to clean the old PCV valve!**

(4) If test (1b) fails when a new PCV valve has been installed, it will be necessary to replace the PCV hose and clean the PCV hose intake port.

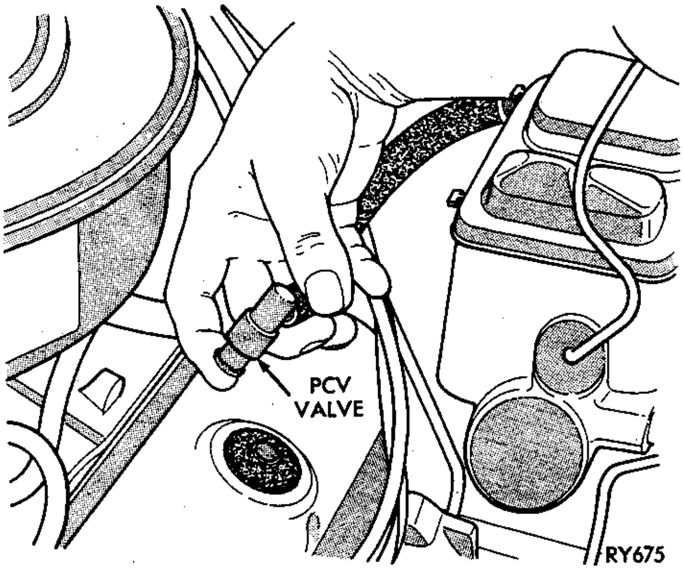


Fig. 8 Check Vacuum at PCV Valve

(5) Clean the crankcase inlet air filter.

(6) Clean or replace the engine air cleaner.

CRANKCASE INLET AIR FILTER

Clean and lubricate the crankcase inlet air cleaner at the mileage or time interval shown in the Lubrication and Maintenance Schedule.

(1) Disconnect the hoses from the crankcase inlet air filter (Fig. 9).

(2) Remove the crankcase inlet air filter and wash it thoroughly in kerosene or similar solvent.

(3) Lubricate or wet the filter, by inverting the crankcase inlet air filter and filling with SAE 30 engine oil. Position the air filter to allow excess oil to drain thoroughly through the vent nipple located on the top of the air filter.

More frequent service may be required for vehicles used in short run, stop and go or extended engine idle service.

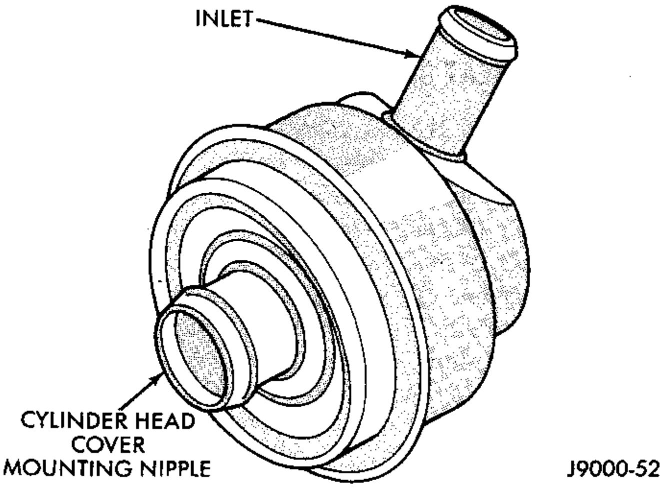


Fig. 9 Crankcase Inlet Air Filter

FUEL SYSTEM

Inspect the fuel system cap, lines, hoses and connections at the mileage or time intervals specified in the Lubrication and Maintenance Schedule.

Use gasoline having a minimum octane rating of 87 (R + M)/2.

Should your vehicle develop spark knock (ping), purchase your gasoline from a different source. Vehicles may respond differently to gasolines having the same octane rating. Occasional trace knock at low engine speeds is not harmful. Continued knock at high speeds, however, can damage your engine and should be reported to your dealer immediately. Engine damage, as the result of continued operation of a vehicle with spark knock, may not be covered by the new vehicle warranty.

In addition to choosing the proper octane rating, use of gasolines containing high level of detergent additives is also recommended. The use of these high detergent gasolines will reduced fuel injector and intake system deposit build-up and maintain the excellent driveability of your vehicle. If in doubt, premium unleaded gasolines generally contain more detergent additives than the lower octane regular unleaded gasolines.

Unleaded gasolines only, must be used in vehicles equipped with catalyst emission control systems. All vehicles so equipped have labels located on the instrument panel and adjacent to the fuel filler cap or door that state UNLEADED FUEL ONLY. These vehicles also have fuel filler tubes specially designed to accept the smaller diameter unleaded gasoline dispensing nozzles only.

The exhaust emission system of your vehicle is designed to meet all emission regulations while, at the same time, providing excellent fuel economy. Catalyst systems require that only unleaded gasoline be used. Use of leaded fuel will not only destroy the effectiveness of the catalytic converter used to reduce exhaust emissions, but will also make part of the fuel control system inoperative and lead to high fuel consumption. **Damage resulting from the use of leaded gasoline may not be covered by the new vehicle warranty.**

GASOLINES CONTAINING ALCOHOL

Some gasolines sold at service stations contain alcohol, although they may not be so identified. Use of fuels containing alcohol is not recommended, unless the nature of the blend can be determined as being satisfactory.

GASOHOL—A mixture of 10% ethanol (grain alcohol) and 90% unleaded gasoline may be used in your vehicle. If driveability problems are experienced as a result of using GASOHOL, it is recommended that the vehicle be operated on unleaded gasoline, only.

METHANOL—DO NOT use gasoline containing methanol (wood alcohol). Use of this type of alcohol can result in vehicle performance deterioration and damage to critical parts in the fuel pump, injector and other fuel system components. Fuel system damage and vehicle performance problems, resulting from the use of gasoline containing methanol alcohol, may not be covered by the new vehicle warranty.

GASOLINES CONTAINING MTBE

Gasoline and MTBE blends are a mixture of unleaded gasoline and up to 15% MTBE (Methyl Tertiary Butyl Ether). Gasoline blended with MTBE may be used in your vehicle.

MATERIALS ADDED TO FUEL

Indiscriminate use of fuel system cleaning agents should be avoided. Many of these materials intended for gum and varnish removal may contain highly active solvents or similar ingredients that can be harmful to gasket and diaphragm materials used in fuel system component parts.

FUEL FILTER

A plugged fuel filter can be caused by contaminants in the fuel. This can limit the speed at which a vehicle can be driven and cause hard starting. If these conditions occur, the filter should be replaced.

VACUUM OPERATED COMPONENTS

Inspect all vacuum operated and emission related components to ensure they are not cracked or broken. Replace component(s), as necessary.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

The EGR valve and EGR tube (if so equipped) at the mileage or time interval specified in the Lubrication and Maintenance Schedules. For additional information refer to Group 25, Emission Control System.

IGNITION WIRES, DISTRIBUTOR CAP AND ROTOR

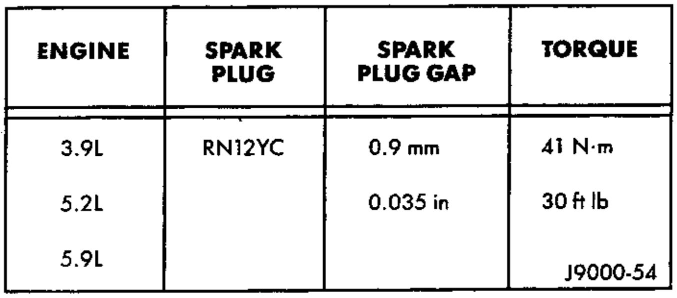
Replace the ignition wires, distributor cap and rotor at the mileage interval indicated on the Lubrication and Maintenance Schedule. Check the distributor for excessive wear and proper component clearances. Replace, if necessary.

OXYGEN (O_2) SENSOR

Replace the oxygen sensor at the mileage and time interval specified in the Lubrication and Maintenance Schedule. Refer to Group 25, Emission Control System for additional information.

SPARK PLUGS

Replace the spark plugs (Fig. 10) at the mileage or time interval specified in the Lubrication and Maintenance Schedule. Refer to Group 8D, and the Owner's Manual provided with the vehicle for additional information.



ENGINE	SPARK PLUG	SPARK PLUG GAP	TORQUE
3.9L	RN12YC	0.9 mm	41 N·m
5.2L		0.035 in	30 ft lb
5.9L			

Fig. 10 Spark Plug Replacement

IGNITION TIMING

Check and adjust the ignition timing (and cam timing on the 2.5L Engine) according to specifications shown on the Engine Emission Control Information Label, located in the engine compartment.

BATTERY

All vehicles are equipped with maintenance-free batteries (Fig. 11). A maintenance-free batterie has no removable battery cell caps. **Water never needs to be added to a maintenance-free battery.** Small vent holes in the cover allow the gases that are produced to escape. A special chemical composition inside the battery reduces production of gas to an extremely small amount at normal charging voltages.

The battery contains a **Visual Test Indicator**. When an adequate charge level exists the indicator is GREEN. When charging is required the indicator is RED or BLACK. When replacement is required the indicator is YELLOW.

VACUUM OPERATED EMISSION CONTROL COMPONENTS

Replace these components at the time or mileage intervals indicated in the Lubrication and Maintenance Schedules. Refer to Group 25, Emission Control System for more information.

RUBBER AND PLASTIC COMPONENT INSPECTION

Variables such as type of vehicle service, geographic area of vehicle operation, and length of exposure time to heat and contaminants are factors affecting the life of rubber and plastic components. To provide best vehicle performance and avoid adverse effect on component life, it is recommended that the following components be inspected when performing other under hood services. **Components should be replaced immediately if there is any evidence of degradation that could result in failure.**

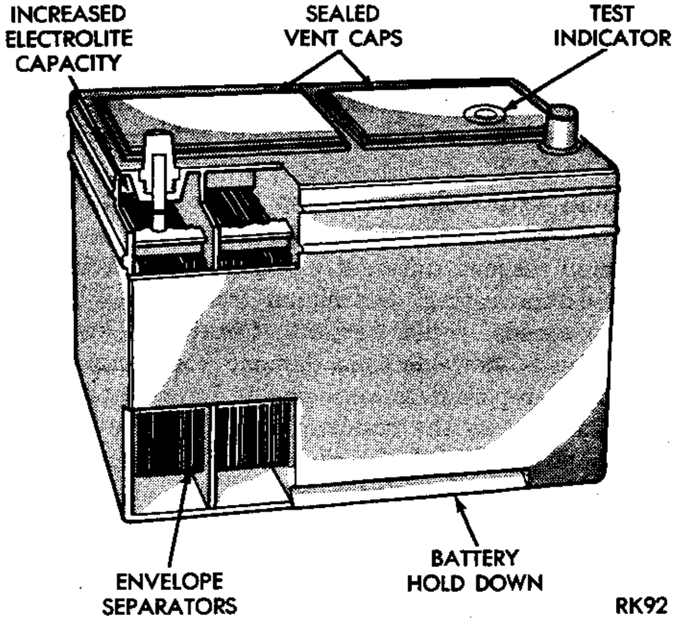


Fig. 11 Maintenance Free Battery

HOSES (EXCEPT EMISSION HOSES)

Refer to Group 25, Emissions Control Systems for inspection of emission hoses.

Inspect surface of hoses and nylon tubing for evidence of heat and mechanical damage. Hard and brittle rubber, cracking, checking, tears, cuts, abrasion and excessive swelling indicate deterioration of the rubber. Hose and nylon tubing located close to the exhaust manifold or any source of intense heat should receive special attention. Be certain that nylon tubing in these areas is not melted or collapsed.

Inspect hose routing to ensure hose does not come in contact with any heat source or moving component which will cause heat damage or mechanical wear.

Inspect all hose connections such as clamps and couplings to make sure they are secure and no leaks are present. **In many instances, fluids such as oil, power steering fluid and brake fluid are used during assembly of hoses to couplings. Therefore, oil wetness at the hose-coupling area is not necessarily an indication of leakage.** Actual dripping of hot fluid when systems are under pressure (during vehicle operation), should be noted and clamps tightened before hose is replaced based on leakage.

DRIVE BELTS

At the mileage indicated in the Lubrication and Maintenance Chart, all belts should be checked for their condition and proper tension. Improper belt tension can cause belt slippage and failure.

Belts should be inspected for evidence of cuts, cracks, or glazing. Replace the belts if there is an indication of damage which could result in belt failure. If adjustment is required, the belts must be adjusted according to the specifications and procedures described in Group 7, Cooling System. Special tools are required to properly measure tension and to restore belt tension to factory specifications.

ENGINE MOUNTS

Inspect the connecting fasteners between the block and the engine mount bracket and those holding the mount to the frame for correct torque (see Group 9, Engines). The rubber in the mount should be inspected for excessive softening and/or swelling caused by oil and/or gasoline contamination. Slight surface deterioration and wear at the ends will not adversely affect performance. If, however, excessive engine movement, rubber softening or swelling, or noise caused by metal-to-metal contact is observed, the engine mount assembly should be replaced.

CAUTION: Avoid continuous contamination with oil or gasoline. Such contamination will result in reduced engine mount life.

IGNITION WIRES

The ignition wires should be kept clean and properly connected. Terminals should be fully seated and the nipple assemblies should not be removed from the distributor or coil towers.

EXHAUST SYSTEM

The exhaust system must be properly aligned to prevent stress, leakage, and body contact. If the system contacts any panel, it may amplify objectionable noises originating from the engine or the body.

Inspect the exhaust system at the mileage or time intervals specified in the Maintenance Schedule in this Group for the following conditions. Correct as required.

(1) Exhaust system leaks, damage, misalignment.
(2) Grounding against body sheet metal or frame.
(3) Catalytic converter "bulging" or heat damage.

When inspecting an exhaust system, critically inspect for cracked or loose joints, stripped screws/bolt threads, corrosion damage, and worn or broken hangers. Replace all components that are badly corroded or damaged. Do not attempt repair.

CAUTION: The catalytic converter(s) will become contaminated if leaded gas is used, or if the engine or emission controls are not maintained as scheduled. If this occurs, the catalyst (the alumina-coated beads in the converter) or the entire converter must be replaced.

AIR CONDITIONING COMPRESSOR

The lubricant level in the air conditioning compressor should be checked if there are signs that oil was lost (oily shaft seal area, oil covered fittings, etc.). Loss of oil usually accompanies loss of refrigerant charge. The presence of gas bubbles (white foam) as viewed through the filter drier sight glass, while the system is in operation, indicates some loss of refrigerant charge has occurred.

For compressor oil level check or recharging system, see Group 24, Heating and Air conditioning.

DRIVETRAIN

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CLUTCH AND BRAKE LINKAGE

If the clutch and brake pedal assembly should start to squeak or grunt, the pivot bushings should be lubricated (Fig. 1). Use a multipurpose (NLGI Grade 2) grease, MOPAR Multi-Purpose Lubricant, or equivalent.

CLUTCH MASTER CYLINDER

The clutch master cylinder fluid level should be periodically inspected when other under hood service is performed. The fluid level in the reservoir should be up to the bottom of the lid retaining collar (Fig. 1). If the fluid level should become low, locate and correct any possible leaks and fill the reservoir with clean, moisture free brake fluid conforming to DOT 3, (MUSS 116) standard only. MOPAR Brake Fluid or equivalent will provide the best clutch performance.

CAUTION: Do not allow any petroleum base fluids to contaminate the clutch hydraulic system, seal damage will result.

MANUAL TRANSMISSIONS NP2500 OVERDRIVE 5-SPEED/NP435 OVERDRIVE 4-SPEED

SHIFTER MECHANISM BOOT

Inspect both automatic and manual shifter boots for stone or heat damage. Replace, if necessary.

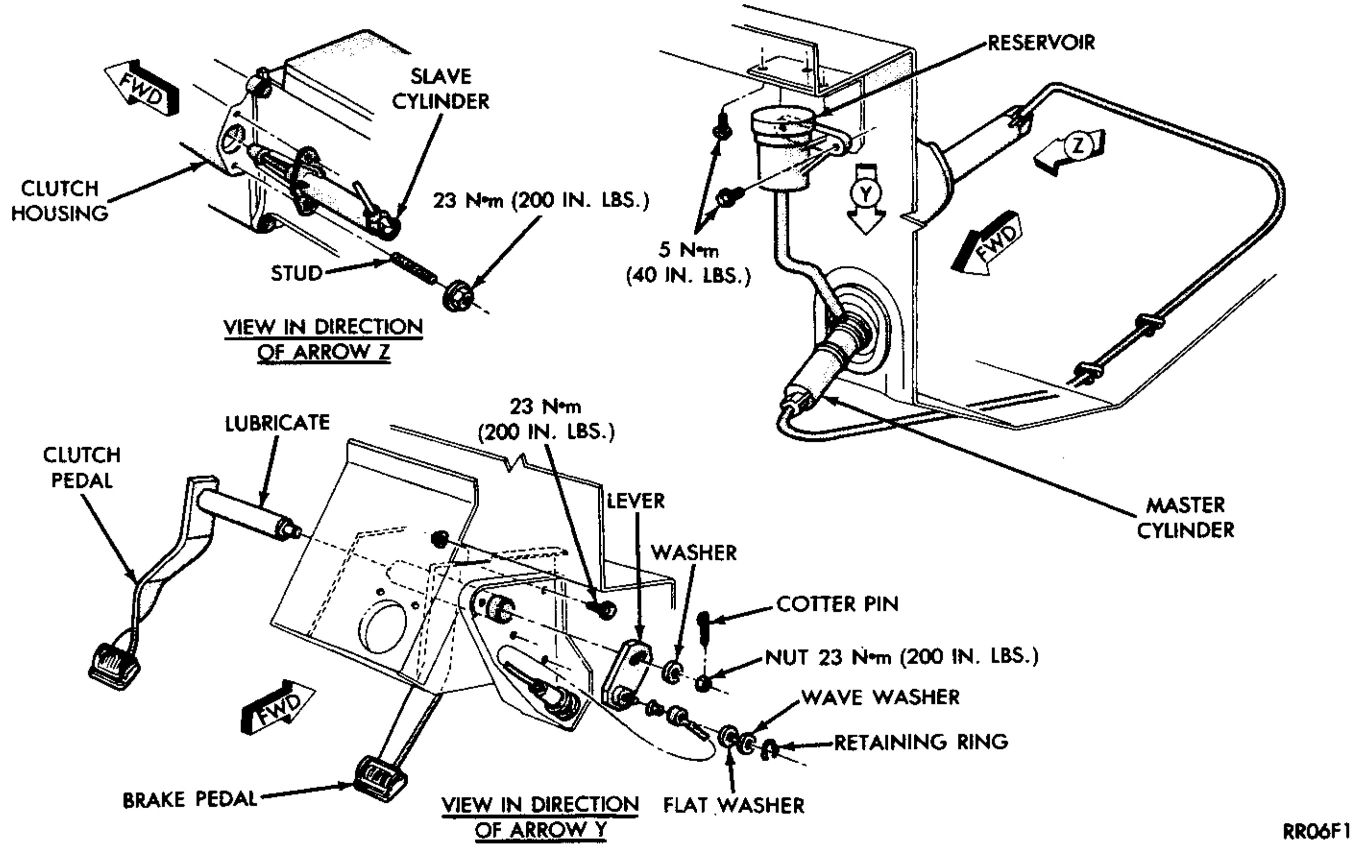

Fig. 1 Clutch and Brake Pedal Assembly

CHECK FLUID LEVEL

The NP2500 overdrive 5-speed and NP435 overdrive 4-speed should be inspected for leakage and proper oil level whenever general maintenance is performed under the vehicle. To check oil level, remove the filler plug (Figs. 2 and 3). If low, fill to the bottom of the filler hole with SAE 10W-30 engine oil (API Classification SG or SG/CD). **Dextron II ATF may be used if high shift effort is experienced during warm-up in cold weather. Drain the 10W-30 oil from the transmission and fill with two quarts of Dextron II ATF fluid.**

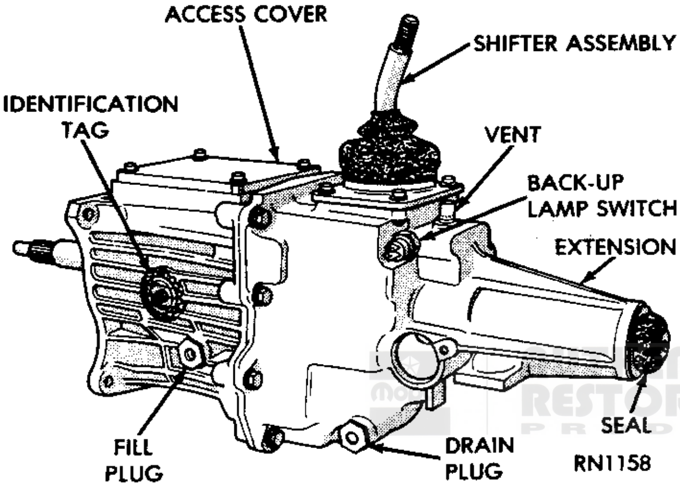

Fig. 2 NP2500 Manual Transmission

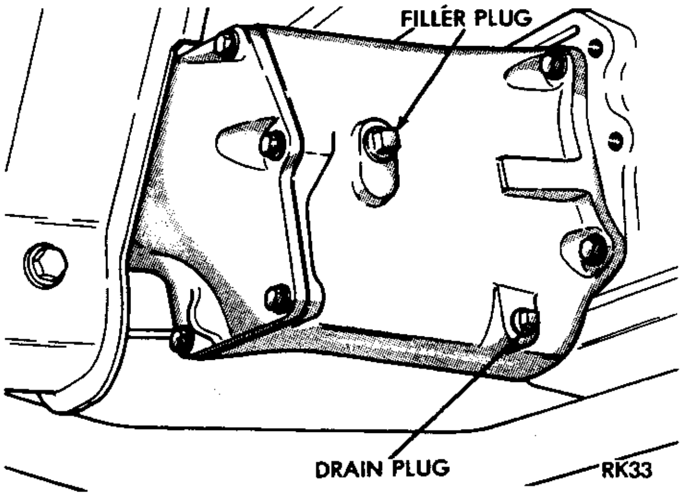

Fig. 3 NP435 Manual Transmission

SPECIAL ADDITIVES

Chrysler Motors does not recommend the addition of any special additives to the transmission other than special dyes to aid in detecting fluid leaks.

The use of transmission sealers should be avoided since they may adversely affect the seals.

DRAIN AND FILL

The NP2500 overdrive 5-speed and NP435 overdrive 4-speed manual transmission should be drained and filled at the following intervals (Fig. 4).

Normal Service	Light Duty Cycle 60 000 km	 37,500 miles
	Heavy Duty Cycle 58 000 km	 36,000 miles
Severe Service	29 000 km	18,000 miles

J9000-43

Fig. 4 Manual Transmission—Drain and Fill Intervals

GEARSHIFT LINKAGE (MANUAL TRANSMISSION)

The gearshift control mechanism should be lubricated every 36 000 km (22,500 miles) or every two years whichever occurs first, or more frequently if high shift effort or noise (mechanism rattling) is apparent.

The four-speed gearshift control mechanism is equipped with a grease fitting located on the left side (Fig. 5), accessible from the underside of the vehicle. Using a high pressure grease gun, apply Multipurpose Grease, NLGI, Grade 2 E.P. into the control mechanism until the grease is visible on the operating levers. **Vehicle must be in reverse gear position, with the engine OFF, when lubricating this mechanism.**

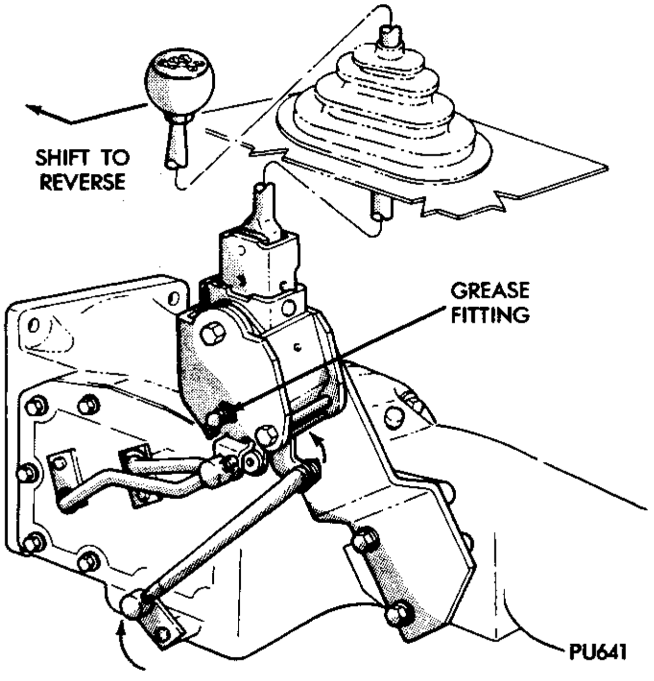

Fig. 5 Four-Speed Shift Mechanism

AUTOMATIC TRANSMISSION

CHECK FLUID LEVEL

The fluid level in the automatic transmission should be checked when performing other underhood services. Operation with an improper fluid level will greatly reduce the life of the transmission and fluid.

When the fluid level is checked, especially on vehicles operated under conditions of severe service, the condition of the fluid should be observed. If severe darkening of the fluid, accompanied by a strong odor is noted, the fluid and filter should be changed and the bands adjusted. A physical change in the fluid, such as this, may be the result of overheating.

To check the automatic transmission fluid level, the following procedure must be used:

(1) Vehicle must be on level ground.

(2) Engine should be running at idle speed.

(3) Apply parking brake.

(4) Place gear selector momentarily in each gear position, ending with the lever in N (neutral).

(5) Remove dipstick, wipe clean and determine if fluid is hot or warm. Hot fluid is approximately 82°C (180°F) which is the normal operating temperature after the vehicle has been driven at least 24 km (15 miles). The fluid cannot comfortably be held between the finger tips. Warm is when fluid is between 29°-52°C (85°-125°F).

(6) Wipe dipstick clean, insert until cap seals. Remove the dipstick and note the reading.

(a) If the fluid is hot, the reading should be in the crosshatched area marked OK.

(b) If the fluid is warm, the fluid level should be between the two dimples.

(7) If the fluid level checks low, add sufficient fluid to bring the level to within the marks indicated for the appropriate temperature. It is important proper lubricant is used in the transmission. MOPAR ATF PLUS (Automatic Transmission Fluid Type 7176) should be used. Dextron II automatic transmission fluid should be used only if the recommended fluid is not available.

(8) To prevent dirt and water from entering the transmission after checking or fluid replacement, make certain that the dipstick cap is seated properly.

CAUTION: Do not overfill the transmission.

SPECIAL ADDITIVES

Chrysler Motors does not recommend the addition of any special additives to the transmission other than special dyes to aid in detecting fluid leaks.

The use of transmission sealers should be avoided since they may adversely affect the seals.

DRAIN, FILTER CHANGE, BAND ADJUSTMENT AND FILL

Change the automatic transmission fluid and filter and adjust the bands at the following intervals (Fig. 6).

NORMAL USAGE	WAGON	NO SERVICE REQUIRED
	VAN	60 000 km (37,500 miles) LIGHT DUTY CYCLE
		38 000 km (24,000 miles) HEAVY DUTY CYCLE
SEVERE USAGE	VAN/ WAGON	19 200 km (12,000 miles)

J9000-55

Fig. 6 Automatic Transmission—Service Intervals

If the transmission is disassembled for any reason, the fluid and filter should be changed and the bands adjusted (see Group 21, Transmission for service procedures).

Trucks do not have a torque converter drain plug. No attempt should be made to drain the converter.

Refer to Group 21, Transmission for the proper Drain and Refill procedures.

TRANSFER CASE

FLUID LEVEL CHECK

With vehicle in level position remove filler plug (Fig. 7 or 8), and check fluid level. If level is below bottom of filler plug hole, add sufficient lubricant to restore level to bottom of filler hole.

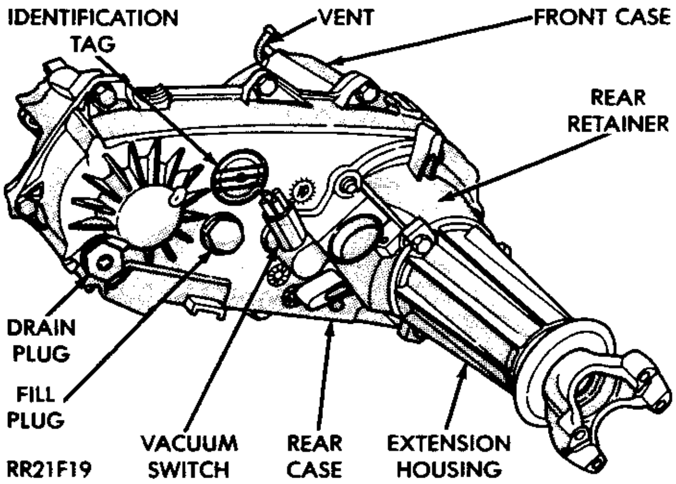

Fig. 7 NP241 Transfer Case Drain and Fill Locations

DRAIN AND FILL

The transfer case should be drained and filled at 58 000 km (36,000 miles) Heavy Duty Cycle or 60 000 km (37,500 miles) Light Duty Cycle. Refer to Group 21, Transmission for the proper procedures.

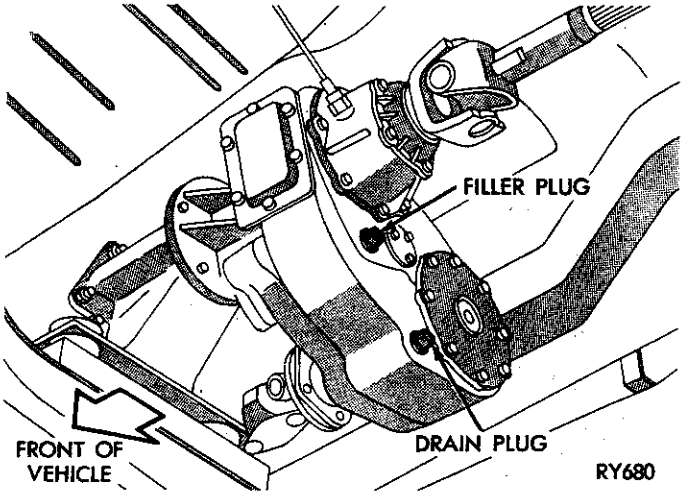

Fig. 8 NP205 Transfer Case Drain and Fill Locations

LUBRICANT SELECTION—NP-241 TRANSFER CASE

Mopar ATF Plus type 7176, or DEXRON II AFT or equivalent are recommended.

LUBRICANT SELECTION—NP-205 TRANSFER CASE

Engine oils SG or SG/CD may be used in this transfer case. Use SAE 30 grade motor oil.

GEAR SHIFT MECHANISM (TRANSFER CASE)—NP-241 AND NP-205

The shift mechanism should be cleaned and lubricated as required to maintain ease of operation.

When mechanism is cleaned, lubricate pivot and sliding contact areas and shift linkage pivot ends with light engine oil (Figs. 9 and 10).

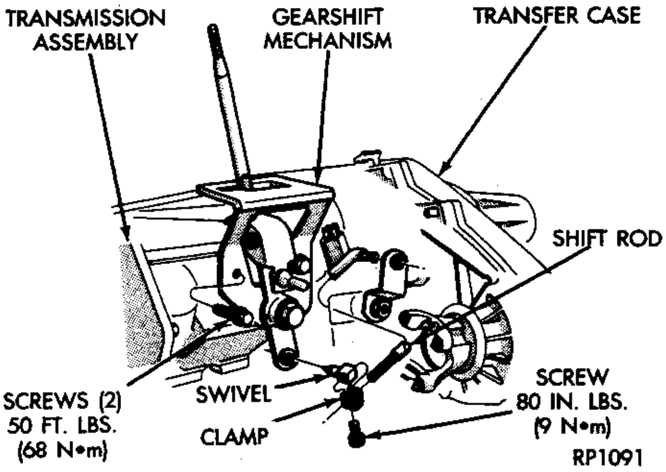

Fig. 9 Gearshift Mechanism Lubrication (NP241 Transfer Case)

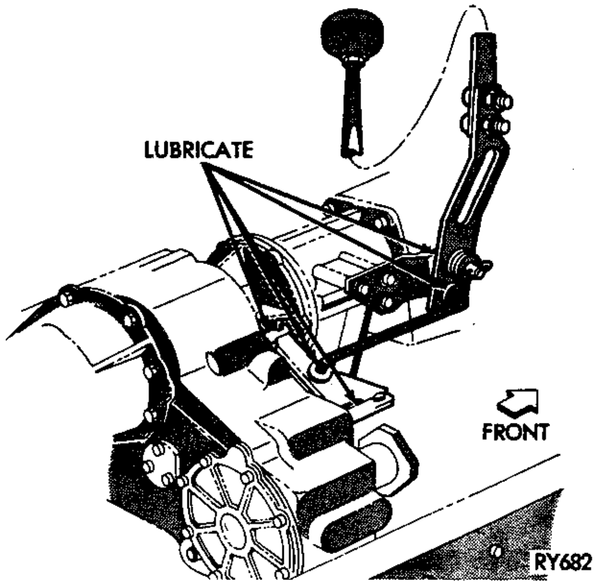

Fig. 10 Gearshift Mechanism Lubrication (NP205 Transfer Case)

AXLES

CONVENTIONAL DIFFERENTIAL (FRONT AND REAR)

All truck rear axles contain SAE 80W-90 multipurpose type gear lubricant when delivered from the factory.

FREQUENCY OF OIL CHANGE

Chrysler Motors does not recommend regularly scheduled oil changes for axles in vehicles whose operation is classified as normal truck service, unless the lubricant has become contaminated with water or to provide the correct viscosity grade for the anticipated temperature range as follows (Fig. 11):

The presence of water in the gear lubricant will result in corrosion and possible failure of differential

Anticipated Temp. Range	Recommended SAE Grade
Above 32°C (90°F)	SAE 140 SAE 80W-140 SAE 85W-140
−23°C to 32°C (−10°F to 90°F)	SAE 90 SAE 80W-90 SAE 80W-140 SAE 85W-140
Below −23°C (−10°F)	SAE 75W SAE 75W-90 SAE 80W SAE 80W-140

J9000-56

Fig. 11 Viscosity Grades for Anticipated Temperature Range components. Operation of the vehicle in water, as may be encountered in some off-highway, types of service will require draining and filling the axle to avoid damage.

FLUID LEVEL CHECK

For normal service, periodic fluid level checks are not required. When the vehicle is serviced for other reasons, however, the exterior surfaces of the axle assembly should be inspected for evidence of gear oil leakage. Perform a fluid level check to confirm suspected leakage. With the vehicle supported on an axle or wheel type hoist or on the ground, maintain fluid level at the bottom of the filler plug opening. Confirmed leakage should be repaired as soon as possible.

LUBRICANT SELECTION

Chrysler Motors recommends that Multipurpose Gear Lubricant, as defined by the American Petroleum Institute GL-5, should be used in all rear axles with conventional differentials. MOPAR Hypoid Lubricant, or equivalent, is recommended.

FILL PLUGS—TYPE AND LOCATION

Front axles (Fig. 12) will have a metal screw in type fill plug. Rear axles will have either the screw in fill plug or a rubber PRESS IN type plug (Fig. 13).

Maintain fluid level to bottom of fill plug opening. Spicer 60 axles may have a rubber press-in type fill plug. When installing rubber fill plug ensure inner lip of fill plug is fully seated in cover.

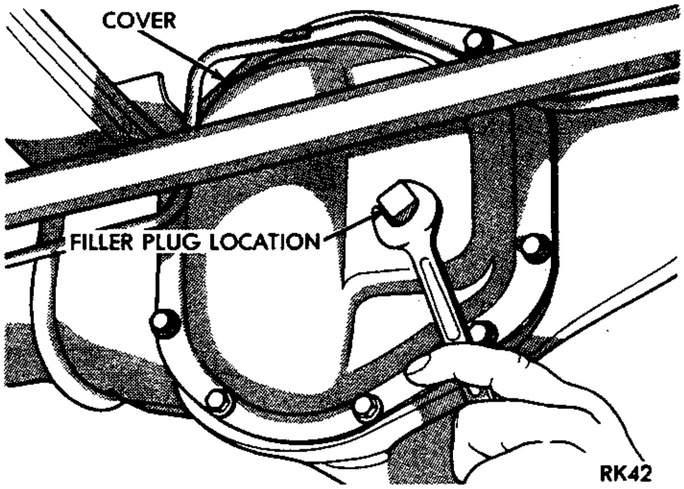

Fig. 12 Removing Filler Plug (Front Driving Axle)

REAR AXLE (LIMITED SLIP DIFFERENTIAL)

For rear axles equipped with Auburn Gear Anti-Spin or Spicer Power-Loc or Trac-Loc Limited Slip Differentials, follow the same inspection procedure and lubricant recommendations as outlined for axles with conventional differentials.

These limited slip differentials require the use of a friction control additive (Friction Modifier). The addition of this special friction modifier additive is necessary to aid in preventing the occurance of axle CHATTER in these units.

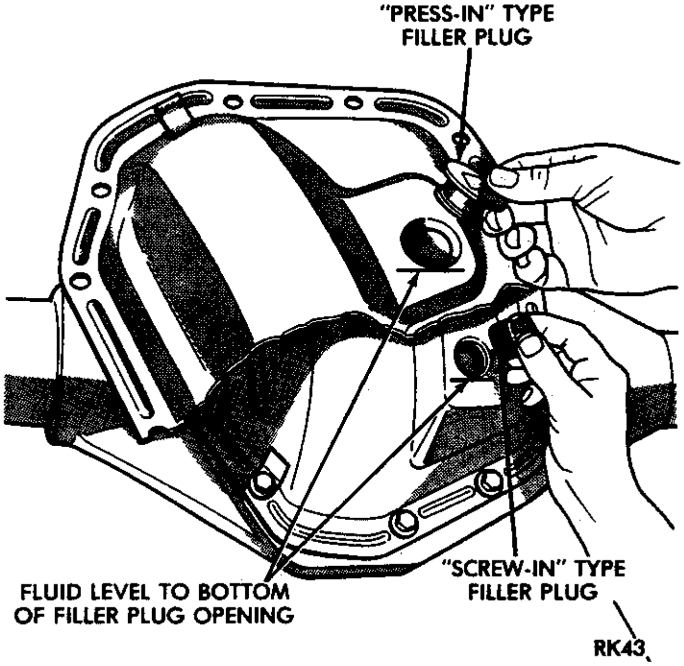

Fig. 13 Rear Axle Fill Plugs (Typical)

FRONT AXLE UNIVERSAL DRIVE JOINT AND PIVOT BEARINGS

MODEL AW350 (WITH SPICER 60F AXLE ONLY)

Every 9 600 km (6,000 miles) Heavy Duty Cycle or 12 000 km (7,500 miles) Light Duty Cycle lubricate the pivot bearings with a Multipurpose grease E.P. No. 2.

Do not use high pressure to fill front axle universal drive joints.

MODELS AW100, AW250, AW150 (WITH SPICER 44-8FD AXLE)

The front axle universal joint and pivot bearings are permanently lubricated and do not require servicing.

PROPELLER SHAFT UNIVERSAL JOINTS

PROPELLER SHAFT UNIVERSAL JOINTS—CROSS TYPE (NOT EQUIPPED WITH GREASE FITTINGS)

Lubrication of cross type universal joints that do not have grease fittings is not required. The seals should be inspected for external leaks or damage whenever the vehicle is serviced for other reasons (Fig. 14). If external leaks or damage is evident, the universal joint should be replaced.

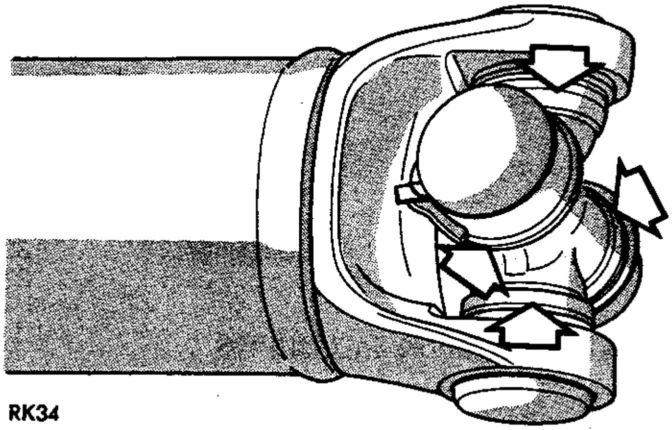

Fig. 14 Universal Joint Seal Inspection

PROPELLER SHAFT UNIVERSAL JOINTS—SLIP SPLINES (EQUIPPED WITH GREASE FITTINGS) CONSTANT VELOCITY JOINT (FIGS. 15 AND 16)

Under normal driving conditions (highway type operation) lubricate every 12 000 km (7,500 miles) with MOPAR Multipurpose Lubricant, or equivalent. If vehicle is operated in water, the universal joints should be lubricated daily.

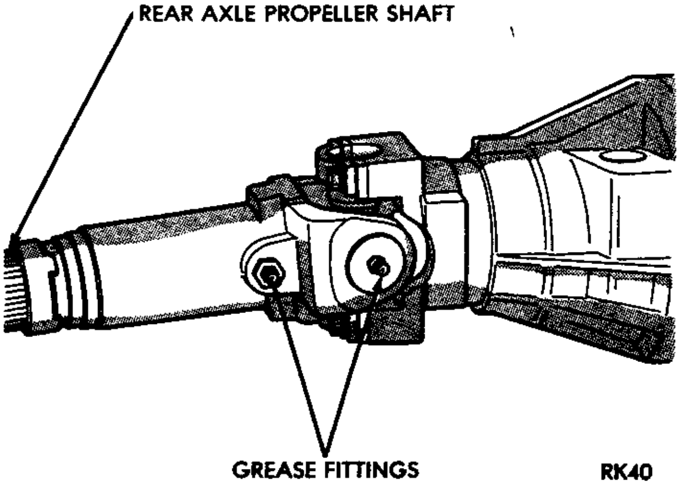

Fig. 15 Universal Joint and Slip Spline with Grease Fittings (Typical)

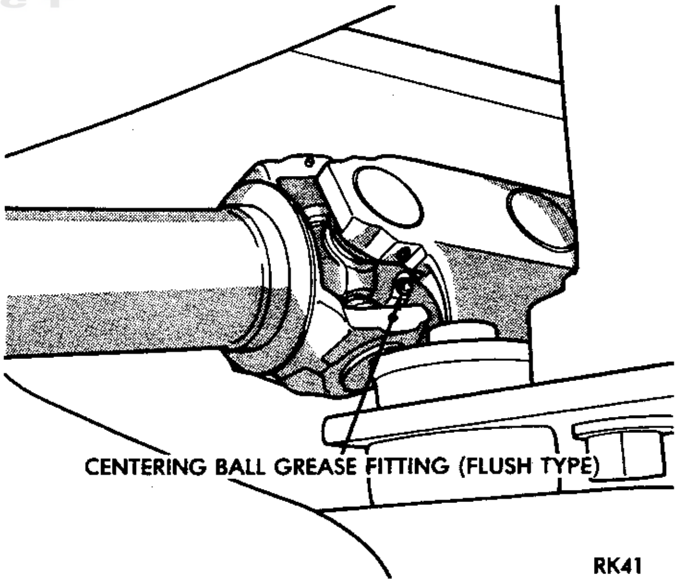

Fig. 16 Constant Velocity Universal Joint Lubrication Points

CHASSIS AND BODY

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STEERING LINKAGE

INSPECTION

Whenever the vehicle is hoisted, all steering linkage joints should be thoroughly inspected for evidence of damage (Fig. 1). Damaged seals should be replaced to prevent leakage or contamination of the grease.

LUBRICATION

Steering linkage joints should be lubricated every 36 000 km (22,500 miles) or every two years whichever occurs first. When lubricating joints use only the special long life chassis grease such as MOPAR Multi-mileage Lubricant, or equivalent.

FRONT SUSPENSION BALL JOINTS

INSPECTION

The front suspension ball joints should be inspected when ever a vehicle is serviced for other reasons (Fig. 1). Damaged seals should be replaced to prevent leakage or contamination of the grease.

LUBRICATION

Ball joints are semi-permanently lubricated at the factory with a special grease. They should be greased every 39 000 km (24,000 miles) for Light Duty Cycle operation and 36 000 km (22,500 miles) for Heavy Duty Cycle operation or every two years whichever occurs first. When lubricating ball joints, use only a special long life chassis grease intended for this purpose such as MOPAR Multi-mileage Lubricant or equivalent.

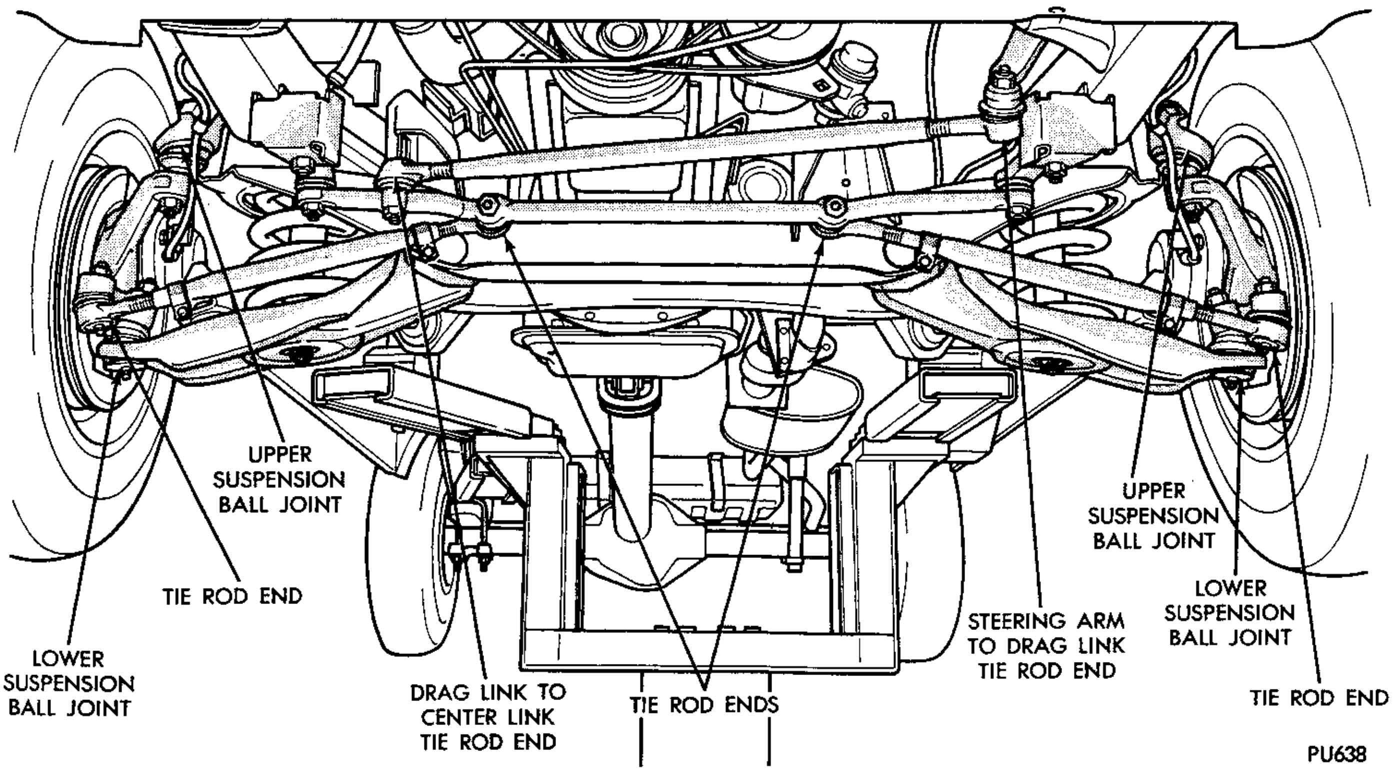

Fig. 1 Steering Linkage Lubrication

Front Suspension ball joints on vehicles used for off-highway operation should be greased at every engine oil change.

PROCEDURE

Before lubrication, clean the accumulated dirt and grease from the outside surface of the seal to permit complete inspection and wipe off the outside surface of the grease fittings to remove accumulate dirt from grease inlet area to avoid grease contamination.

Then fill and flush the joints with lubricant. Stop filling when grease begins to flow freely from the bleed areas at the base of the seal, or if the seal begins to balloon.

After lubrication, wipe off any excess grease from exterior surfaces of ball joints and adjacent component surfaces.

MANUAL STEERING GEAR

The manual steering gear is permanently lubricated at the factory and periodic lubrication is not required.

POWER STEERING

WARNING: FLUID LEVEL SHOULD BE CHECKED WITH THE ENGINE OFF TO PREVENT PERSONAL INJURY FROM MOVING PARTS.

The power steering fluid level should be checked at the power steering pump reservoir whenever the vehicle is serviced for other reasons. Before removing the reservoir cap, wipe the outside of the cap and reservoir with a cloth to remove dirt that can fall into the reservoir. Fluid level should be maintained to the proper level indicated on cap dipstick (Fig. 2).

Only fluids specially formulated for minimum effect on rubber hoses should be used (MOPAR Power Steering Fluid or equivalent).

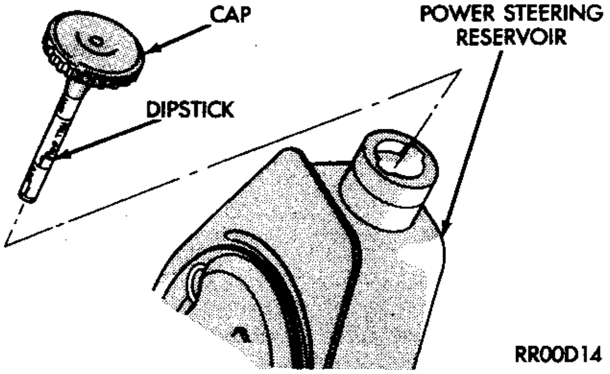

Fig. 2 Power Steering Pump (Typical)

WHEEL BEARINGS

INSPECTION/LUBRICATION INTERVALS

FRONT WHEEL BEARINGS

Inspect the lubricant whenever the rotors are removed or service is performed on the brake system, but at least at the following intervals.

Spicer 44-8FD and 60F Axle— Every 19 000 km (12,000 miles) Heavy Duty Cycle or 24 000 km (15,000 miles) Light Duty Cycle.

All Except Spicer 44-8FD and 60F Axle— Every 39 000 km (24,000 miles) Heavy Duty Cycle or 36 000 km (22,500 miles) Light Duty Cycle.

Wheel bearings in vehicles equipped with Spicer 44-8FD or 60F axles used for off-highway operation should be inspected every 1 600 km (1,000 miles). Bearings should be cleaned and packed every day when vehicle is operated in deep mud or water.

The bearings should be cleaned or packed as required and whenever the disc brake pads are replaced (Figs. 3 and 4).

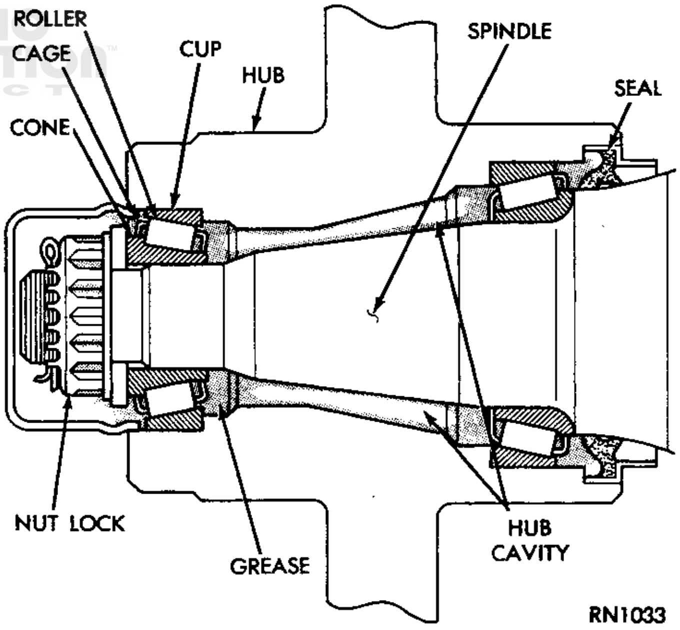

Fig. 3 Front Wheel Bearings 2WD Vehicles

REAR WHEEL BEARINGS

8-3/8 and 9-1/4 Inch Chrysler Axles— These bearings are normally considered to be permanently lubricated. Cleaning and packing is required only when axle shafts are removed or in cases of extreme water or dust contamination.

Dana 60— Clean and pack as required and whenever brake linings are replaced or brake drums resurfaced.

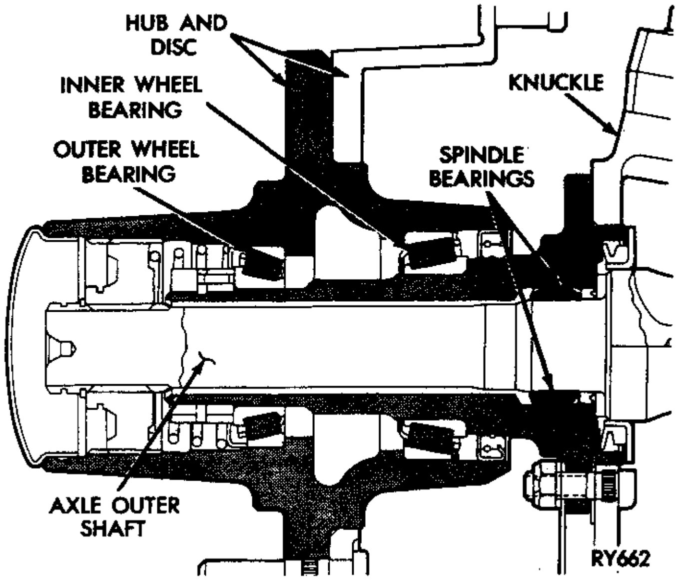

Fig. 4 Front Wheel and Spindle Bearings 4WD Vehicles

INSPECTION AND LUBRICATION PROCEDURE

The condition of the grease in the hub and bearing area on trucks equipped with either drum or disc brakes should be inspected at the intervals specified above. The presence of water, rust, or dirt may indicate the necessity of seal replacement. If it is found that the grease has become contaminated, is low or if the vehicle has been operated under severe or dusty conditions, all of the lubricant should be thoroughly cleaned from the bearings, wheel hubs, dust cap, and/ or covers. After cleaning, carefully check for evidence of spalling of cups, rollers and inner race of cone. Bearings should be replaced if any defects exist. Apply grease to the hub, annulus area, and dust cap using High Temperature Multipurpose Grease (E. P. MOPAR Front Wheel Bearing Grease), or equivalent. **To avoid mixing different types of grease which may be incompatible, never add grease, lubricate completely.**

UPPER AND LOWER CONTROL ARM BUSHINGS

An off center condition of inner metal to outer metal is a sign of early failure of upper and lower control arm bushings. Total failure is evident by excessive movement within bushing and a noise caused by metal-to-metal contact. Small cracks in outer, nonconfined rubber does not constitute failure.

Lower control arm bushings may be visually inspected by lifting the vehicle on a hoist and inspecting from underneath. Upper control arm bushing may be inspected by removing the front wheels. If failure exists, replace bushing (see Group 2, Front Suspension for the proper procedure).

BRAKES

The vehicle is equipped with disc brakes on the front and drum brakes on the rear wheels. Maintenance and service on the brakes is covered under Group 5, Brakes.

MASTER CYLINDER

The fluid in the master cylinders should be checked when performing other underhood services (Fig. 5). If necessary, add fluid to bring level to the bottom of the split rings. With disc-brakes, fluid level can be expected to fall as the brake pads wear. However, low fluid level may be caused by a leak, and a checkup may be needed. Only brake fluid conforming to DOT 3 should be used (DOT 3 is Federal, Department of Transportation specification). MOPAR Brake Fluid is a fluid of this quality and is recommended to provide best brake performance.

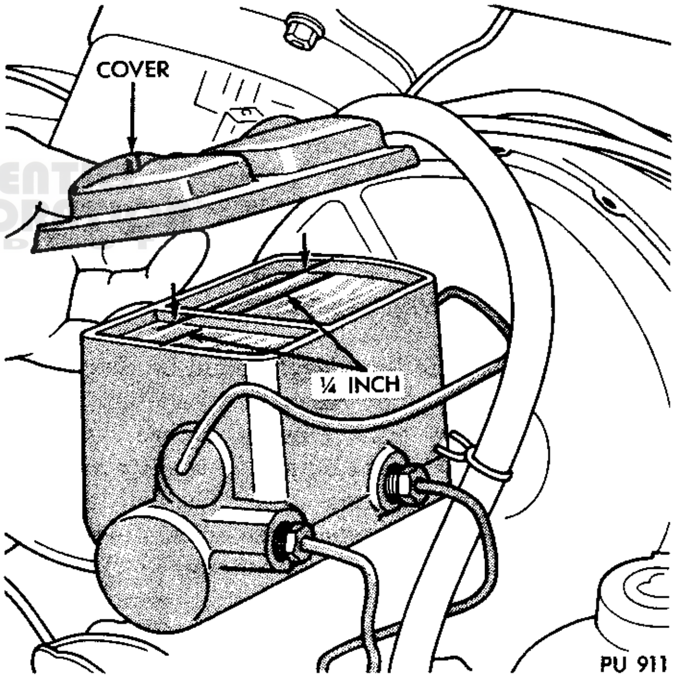

Fig. 5 Check Master Cylinder Fluid Level (Typical)

CAUTION: Use of a brake fluid that may have a lower initial boiling point then speified by MVSS 116, DOT 3, may result in sudden brake failure during hard, prolonged braking.

Use only brake fluid that has been stored in a tightly closed container, to avoid contamination with foreign matter or moisture.

CAUTION: Do not allow petroleum base fluids to contaminate the brake fluid. Seal damage will result!

PARKING BRAKE

Pivot and sliding contact areas should be lubricated as required to maintain ease of operation (Fig. 6). Apply a film of smooth white body hardware lubricant to sliding mechanism, such as MOPAR Spray White Lube or equivalent. Use engine oil to lubricate the control lever pivot areas.

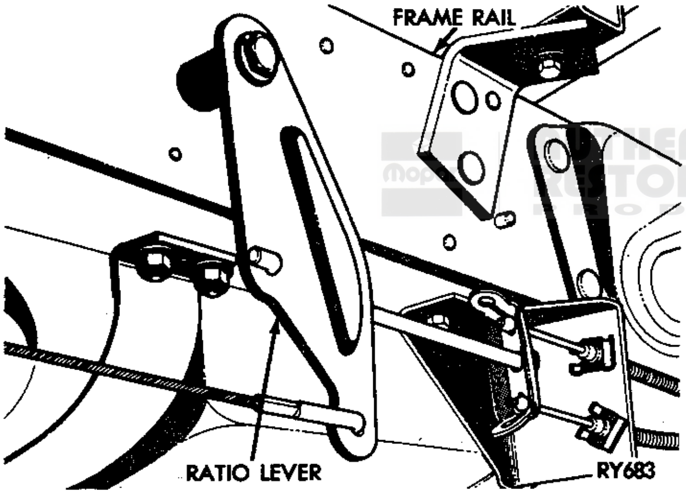

Fig. 6 Parking Brake Ratio Lever Lubrication

BRAKE HOSES

Inspection of brake hose and tubing should be included in all brake service operations and at each lubrication period. The hoses should be checked for:

(1) Correct length, severe surface cracking, pulling, scuffing or worn spots. Should the fabric casing of the hose be exposed by cracks or abrasions in the rubber hose cover, the hose should be replaced.

(2) Faulty installation can cause twisting, wheel/tire or chassis interference.

HEADLIGHTS

To assure correct adjustment of headlight aiming, it is recommended that the headlights be checked and, if necessary, properly aimed every six months.

Changes in front and rear suspension, such as front suspension height and/or deflection of rear springs due to heavy load, will change the headlight beam pattern and may cause unsafe night driving conditions.

If a vehicle is to be loaded abnormally, the headlight aiming should be checked and adjusted to serve the new conditions. Refer to Group 8L, Exterior Lamps, for adjusting procedures.

SPEEDOMETER CABLE

Lubrication of speedometer cable is not required. For service of noisy or erratic operation of cable see Group 8E, Instrument Panel and Gauges.

BODY MECHANISMS LUBRICATION

Body and other operating mechanisms and linkages should be inspected, cleaned and lubricated as required to maintain ease of operation and to provide protection against rust and wear.

Prior to the application of any lubricant, the parts concerned should be wiped clean to remove dust and grit. After lubrication, excess oil or grease should be removed.

Particular attention should also be given to hood latching components to ensure proper function. When performing other underhood services, the hood latch, release mechanism, and safety catch should be cleaned and lubricated.

The external lock cylinders should be lubricated twice a year, preferably in the fall and spring. Apply a small amount of a high quality lubricant such as Mopar Lock Cylinder Lubricant, or equivalent directly into the lock cylinder. Avoid excess lubricant. Insert the key into the lock cylinder and rotate from the unlocked to the locked position. Without adding more lubricant, repeat this procedure three or four times. Wipe all the lubricant off the key with a clean cloth to avoid subsequent soiling of clothing. If a lubricant is used that cannot be dispensed directly into the lock cylinder, apply a small amount of the lubricant to the lock cylinder key. Insert the key into the lock cylinder, then proceed as described above, in order to distribute the lubricant within the lock cylinder.

The following mechanisms should be inspected, cleaned and all pivot and sliding contact areas of these components lubricated as required with the proper lubricant (Fig. 7).

COMPONENT	SERVICE INTERVAL	LUBRICANT
Door Hinges	As Required	Engine Oil
Door Latches	As Required	Multi-Purpose Grease (Water Resistant) (1)
Hood Latch Release Mechanism & Safety Catch	When Performing Other Underhood Services	Multi-Purpose Grease NLGI Grade 2 EP (2)
Hood Hinges	As Required	Engine Oil
Seat Regulator & Track Adjuster	As Required	Multi-Purpose Grease NLGI Grade 2 EP (2)
Tailgate Hinge (Quick Release Pins)	As Required	Multi-Purpose Grease NLGI Grade 2 EP (2)
Tailgate Check Arms	As Required	Engine Oil
Tailgate Latches	As Required	Smooth White Body Hardware Lubricant (3)
Tailgate Release Handle (Pivot & Slide Contact Surfaces)	As Required	Multi-Purpose Grease NLGI Grade 2 EP (2)
Window System Components (Regulators, Tracks, Links, Channel Areas — Except Glass Run Weatherstrips and Felt Lubricator, if Equipped)	As Required	Smooth White Body Hardware Lubricant (3)
Lock Cylinders	Twice/Year	Lock Cylinder Lubricant (4)
Window Regulator Felt Tube Lubricator, if so Equipped	As Required	Engine Oil
Parking Brake Mechanism	As Required	Multi-Purpose Grease (1)

1. Mopar Wheel Bearing Grease (High Temperature)
2. Mopar Multi-Mileage Lubricant
3. Mopar Spray White Lube
4. Mopar Lock Cylinder Lubricant

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Fig. 7 Lubrication Chart—Body Mechanisms

ACCESSORIES

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SNOW PLOW

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GENERAL INFORMATION

A snow plow is optionally available for Ram Truck and Ramcharger vehicles. The primary mechanical components are illustrated in Figure 1.

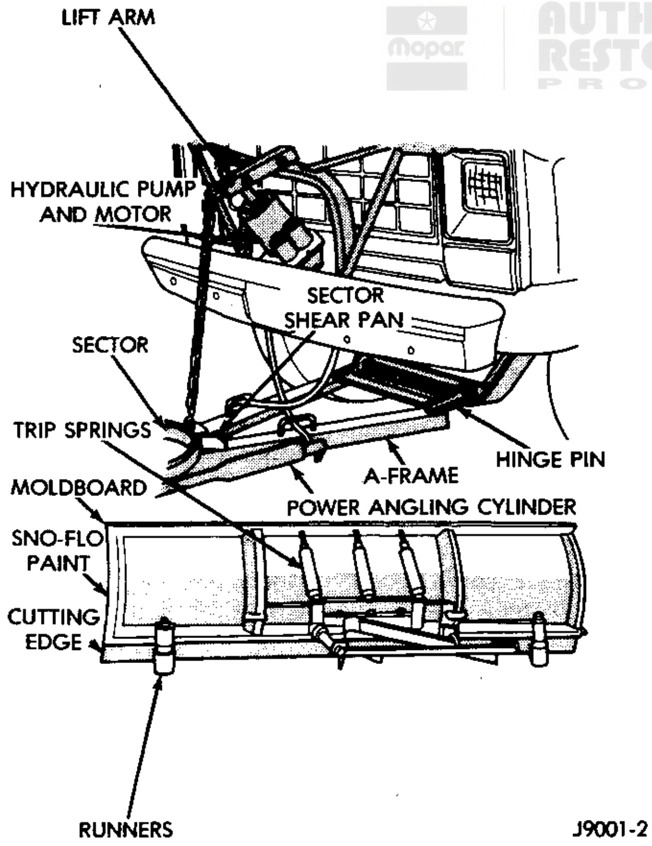

Fig. 1 Snow Plow Components

COMPONENT DESCRIPTION

The primary snow plow components (Fig. 1) are described within the following list:

- **moldboard (blade)** — constructed from high tensile steel — strong but lightweight;
- **trip springs** — allow the moldboard (blade) to trip (tilt) forward and slide over immovable obstructions without losing the snow load — this function protects both the snow plow and the vehicle;
- **sector** — constructed from high strength steel — used for positioning the moldboard (blade) straight ahead or angling it to the right or left;
- **sector shear pin** — this self-locking pin locks the moldboard (blade) in either a straight ahead or an angled plowing position — if the blade impacts obstructions with strong force, the pin will shear to protect the snow plow and the vehicle from damage — the is pin not used with power angle plowing;
- **power angling cylinders** — these cylinders enable the operator to hydraulically position the moldboard (blade) either straight ahead or to the right or left while plowing;
- **hinge pins** — these pins enable the operator to attach or detach the snow plow from the vehicle in minutes without tools;
- **cutting edge** — the replaceable steel grader blade edge extends the life of the blade;
- **runners** — the adjustable and replaceable runners retain the cutting edge at the proper height;
- **Sno-Flo paint** — this specifically developed high-
- visibility, yellow paint provides fast, smooth snow-rolling action;
- **hydraulic pump and motor (Electro-Touch™)** — this unit provides the power for hydraulically raising, lowering and angling the snow plow;
- **A-frame** — provides the means for attaching the snow plow to the vehicle; and
- **lift arm** — raises and lowers the snow plow.

SYSTEM DESCRIPTION AND OPERATION

HYDRAULIC CYLINDER AND MOTOR

The snow plow hydraulic cylinder and motor (power) unit is an electrically powered, electrically controlled hydraulic mechanism that is specifically designed to raise, lower and angle the blade.

The power unit is comprised of a high torque, 12-volt motor that is directly coupled to a gear-type hydraulic pump. A driver-actuated, solenoid-controlled switch located in the engine compartment connects battery voltage to the motor. The pump is supplied with hydraulic fluid from an integral reservoir, which completely surrounds the hydraulic cylinder that raises and lowers the blade.

The remotely located (instrument panel) toggle switches provide a means to electrically operate the electro-hydraulic solenoid valves. The solenoid (electro-mechanical) hydraulic valves (designated "A", "B", and "C"), along with the mechanical hydraulic check valves, pilot check valve and crossover relief valve, control the pressurized hydraulic fluid for snow plow blade positioning.

SOLENOID (ELECTRO-MECHANICAL) VALVES

Three solenoid (electro-mechanical) hydraulic valves are used for snow plow hydraulic fluid control. Each solenoid valve is comprised of two components:

- cartridge — comprised of a valve and a solenoid armature that enables the hydraulic valve to be operated and controlled electrically; and
- coil — the electrical component that retracts the cartridge solenoid armature (and the hydraulic valve) via electromagnetic action.

The cartridge threads into and out of the power unit similar to the way a spark plug is installed and removed from an engine.

With power applied, the solenoid armature (connected to the hydraulic valve) retracts and pulls the spool or poppet valve into the OPEN position.

When the current flow ceases (power off), the compressed coil spring forces the armature (and the hydraulic valve) back to its normal, de-energized CLOSED position.

SOLENOID VALVE "A"

The solenoid valve "A" cartridge contains a poppet valve that is normally de-energized in the CLOSED position. When closed, the valve retains pressurized hydraulic fluid in the lift cylinder. When it is energized (valve opened), it allows the hydraulic fluid to flow from the lift cylinder back to the reservoir, which enables the plow blade to lower via gravity.

Solenoid valve "A" is designed to remain energized (valve open) during snow plow operation to provide a "floating" blade position, which ensures that the plow blade is guided up-down by the surface deviations.

SOLENOID VALVE "B"

The solenoid valve "B" cartridge contains a spool valve that is normally in the de-energized CLOSED position to allow the pressurized hydraulic fluid to flow to solenoid valve "C". In the energized OPEN position, the pressurized hydraulic fluid is diverted to the lift cylinder, which causes the plow blade to be raised.

SOLENOID VALVE "C"

The solenoid valve "C" cartridge contains a spool valve that is normally in the de-energized CLOSED position to allow the pressurized hydraulic fluid to flow to the right-side power angling cylinder, which angles the plow blade to the left. At the same time, it allows the hydraulic fluid that is being forced from the retracting left-side power angling cylinder to flow through the "C" cartridge valve and return to the pump reservoir.

Energizing the solenoid valve will route pressurized hydraulic fluid to the left-side angling cylinder, which angles the plow blade to the right. Also, during this action, the hydraulic fluid is forced from the retracting right-side power angling cylinder, it flows through the "C" cartridge valve and it returns to the pump reservoir.

MECHANICAL HYDRAULIC VALVES

The mechanical hydraulic valves all have the same function: they control the direction of the hydraulic fluid flow.

CHECK VALVES

Hydraulic "check" (one-way) valves allow fluid to flow freely in one direction while preventing fluid from flowing in the opposite direction.

A pump "check" valve is used in all applications to prevent hydraulic fluid from leaking back through the pump to the reservoir.

Two additional "check" valves are necessary because solenoid valves "B" and "C" (as do all spool valves) have some leakage.

One "check" valve is located between solenoid valve "B" and the lift cylinder. It prevents fluid in the lift cylinder from leaking back through solenoid valve "B", which could cause the weight of the plow to angle the plow blade to the left by forcing fluid through solenoid valve "C" into the right-side power angling cylinder.

The other "check" valve is located between solenoid valve "B" and solenoid valve "C". It prevents the hydraulic fluid in either power angling cylinder from being forced through solenoid valve "B" and back to the lift cylinder.

PILOT CHECK VALVE

A pilot "check" valve is more sophisticated than a standard "check" valve because it has a piston in addition to a ball "seat" and spring. A pilot "check" valve is located between solenoid valve "C" and the reservoir. It has two functions:

- it prevents the hydraulic fluid in either angling cylinder from leaking back to the reservoir; and
- it allows the hydraulic fluid from the retracting angling cylinder (during an angling cycle) to return to the reservoir.

The valve action is accomplished by pressurized hydraulic fluid moving the piston, which forces the "check" ball off its "seat".

CROSSOVER RELIEF VALVE

The crossover relief valve has the function of protecting against potential damage that can be caused by an abnormally high opposite force (from impact) being applied against the end of the blade (e.g., when the blade end contacts a curb or other immovable structure). This type of action will cause very high hydraulic pressure to accumulate in one of the angling cylinders.

When the hydraulic pressure increases sufficiently to open the crossover relief valve, the valve allows the highly pressurized hydraulic fluid to flow directly to the opposite power angling cylinder. This function aids in cushioning the impact and results in only changing the angle position of the plow blade.

SYSTEM OPERATION

Refer to Figures 2 through 5 for voltage application and hydraulic fluid flow for each snow plow function. Each figure illustrates the components that are actuated and associated for the applicable function.

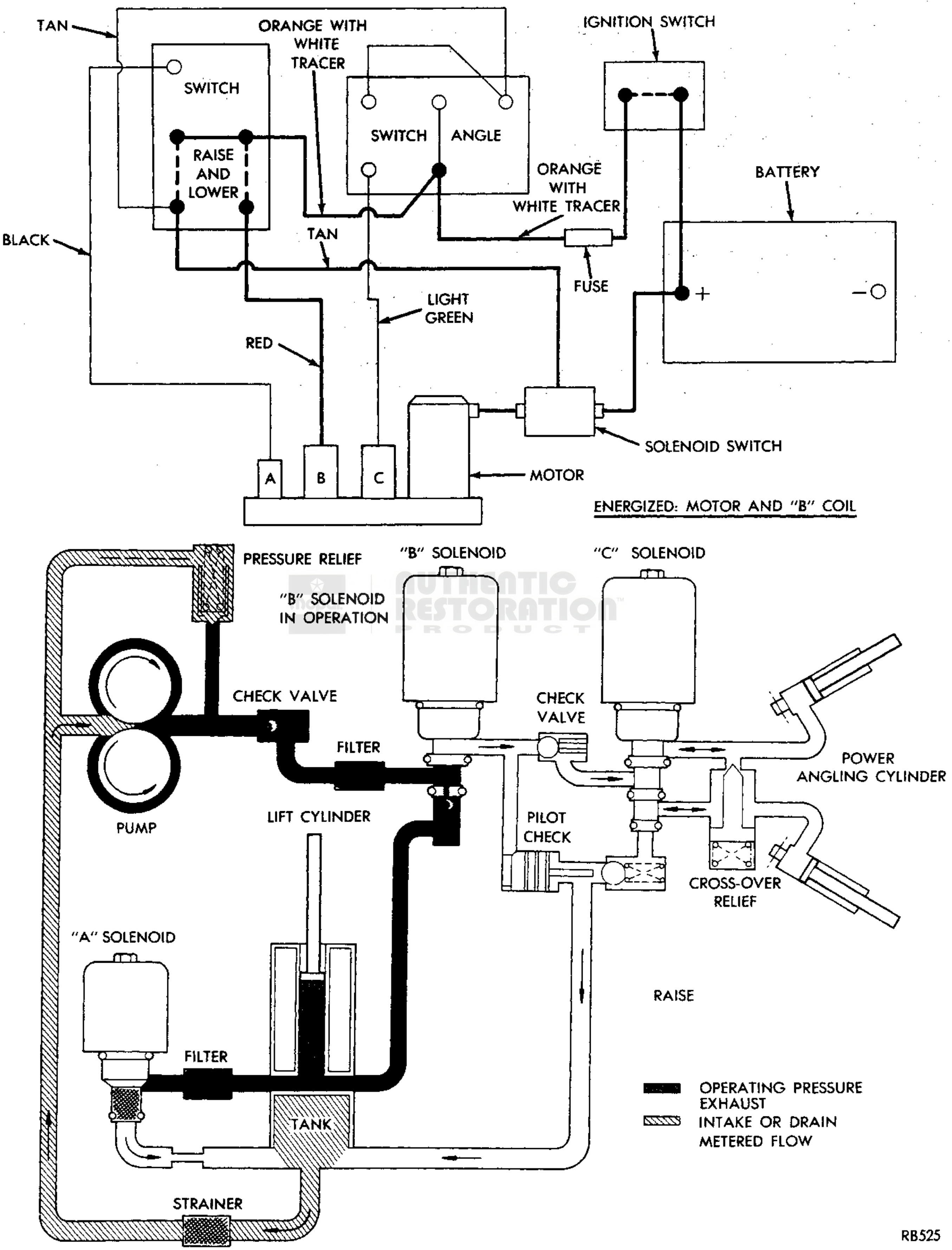

Fig. 2 Raise Blade—Voltage Application & Hydraulic Fluid Flow

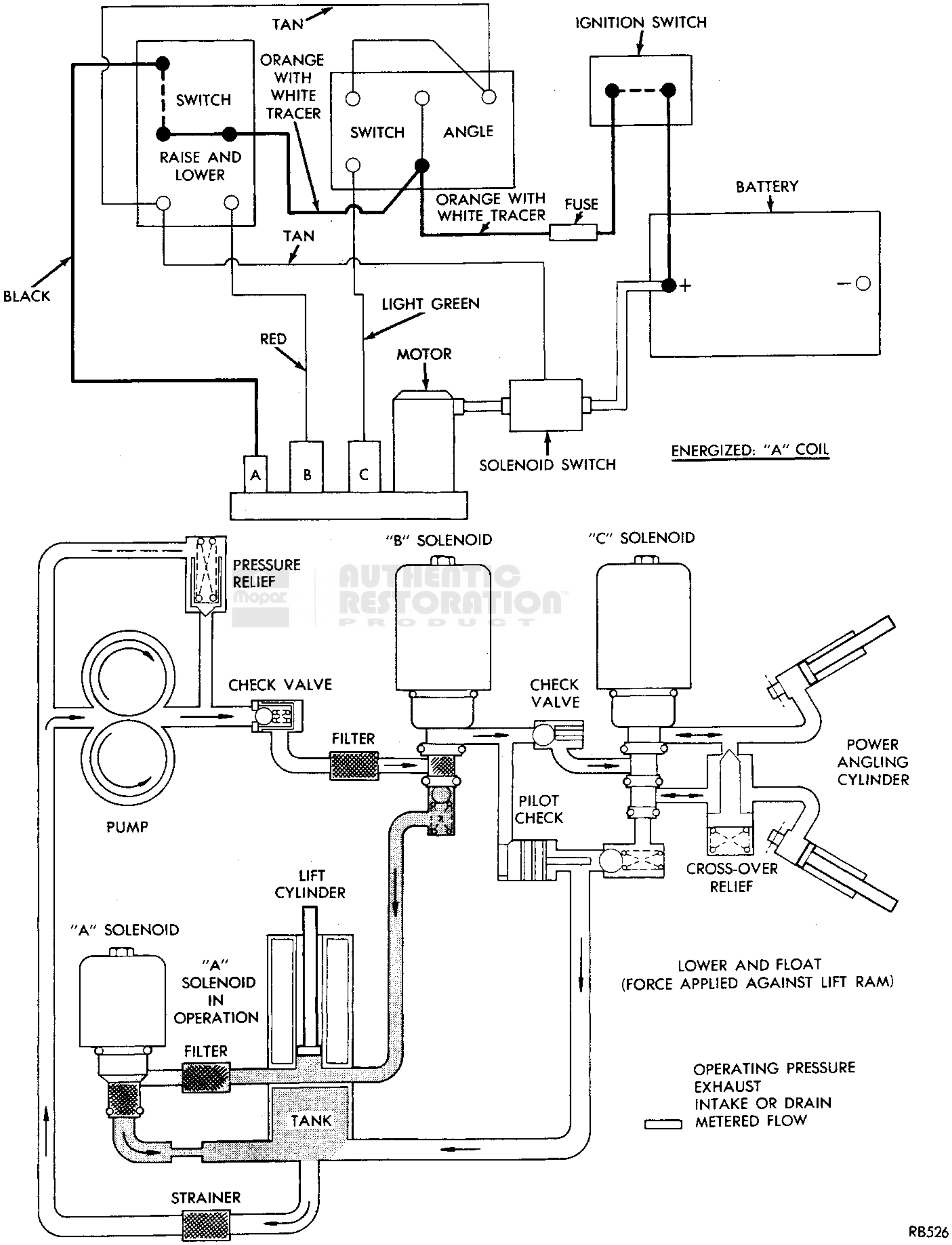

Fig. 3 Lower & Float Blade—Voltage Application & Hydraulic Fluid Flow

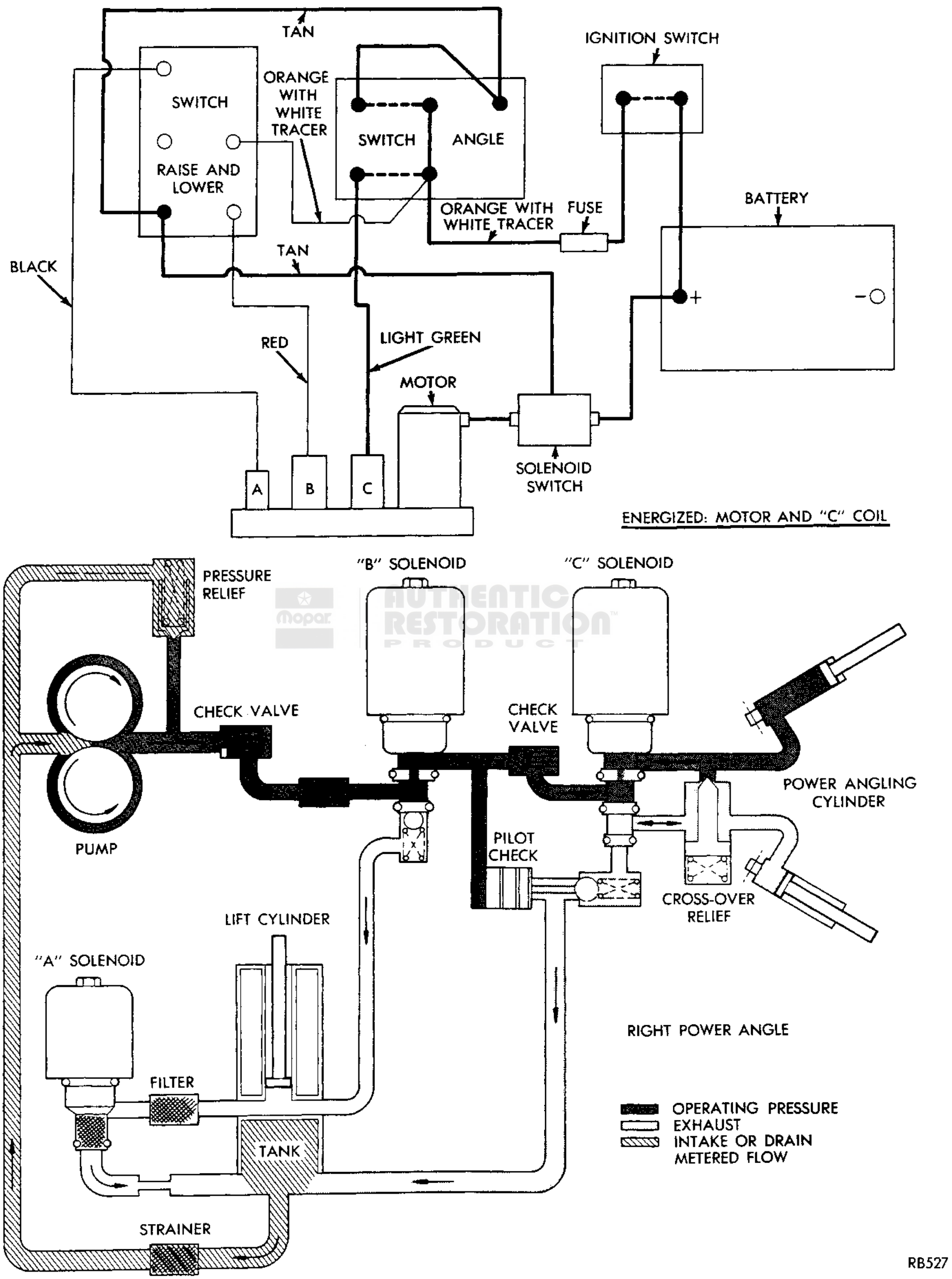

Fig. 4 Angle Blade Right—Voltage Application & Hydraulic Fluid Flow

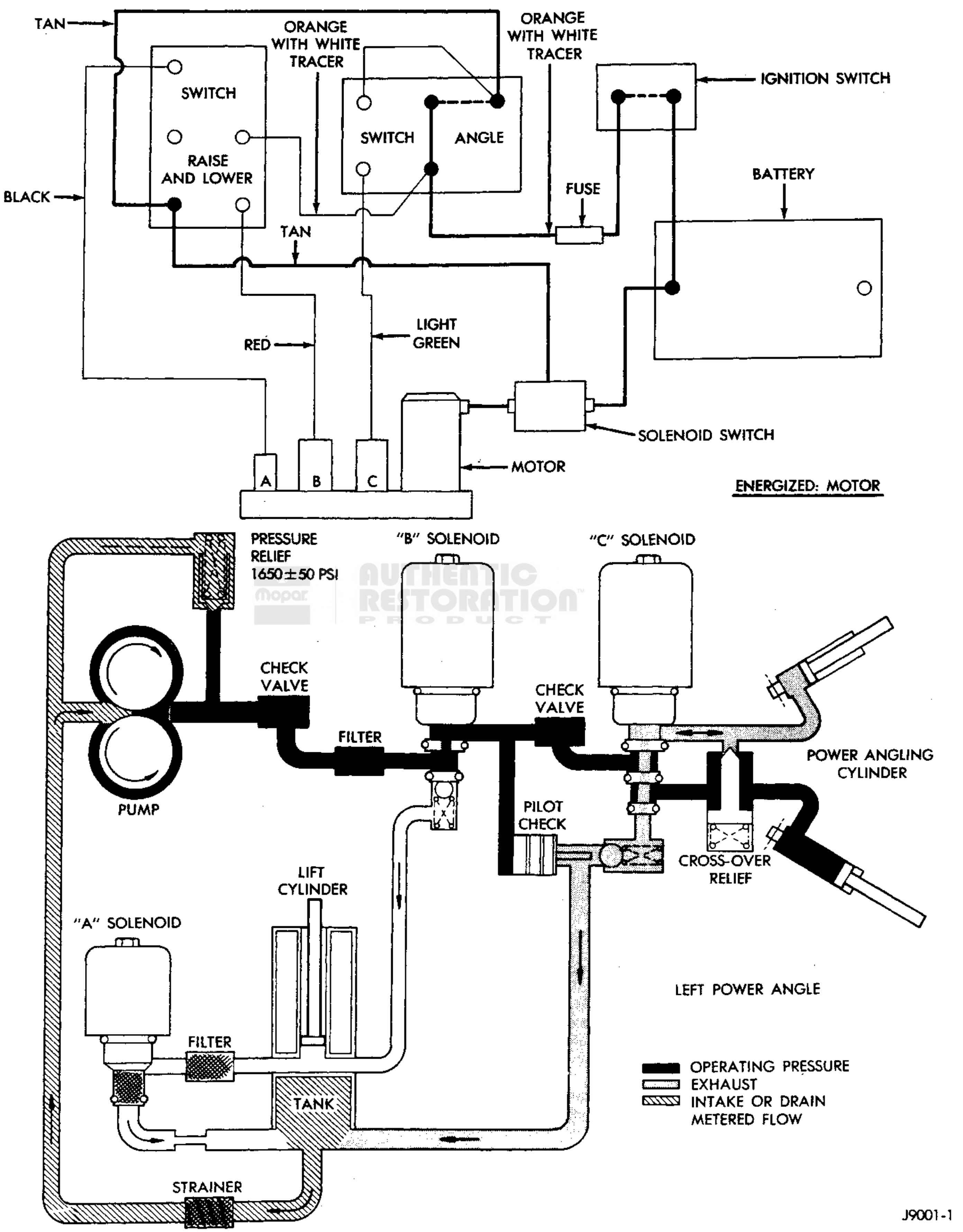

Fig. 5 Angle Blade Left—Voltage Application & Hydraulic Fluid Flow

SNOW PLOW DIAGNOSIS

Condition	Possible Cause	Correction
PLOW BLADE WILL NOT LIFT OR LIFTS SLOWLY	(a) Low hydraulic fluid level.	(a) Add fluid to proper level.
	(b) Discharged battery.	(b) Recharge battery.
	(c) Leaking or open "A" cartridge.	(c) Clean or replace "A" cartridge.
	(d) No voltage at "B" coil.	(d) Locate malfunction and repair.
	(e) Inoperative "B" coil.	(e) Replace "B" coil.
	(f) Malfunctioning motor.	(f) Repair or replace motor.
	(g) Malfunctioning pump.	(g) Replace pump.
PLOW BLADE WILL NOT ANGLE RIGHT—MOTOR IS OPERATIONAL	(a) Improper coupler engagement.	(a) Engage coupler properly.
	(b) Mechanical bind or interference.	(b) Eliminate mechanical bind or interference.
	(c) Malfunctioning coupler.	(c) Repair or replace coupler.
	(d) No voltage at "C" coil.	(d) Locate malfunction and repair.
	(e) Inoperative "C" coil.	(e) Replace "C" coil.
	(f) Inoperative "C" cartridge.	(f) Clean or replace "C" cartridge.
PLOW BLADE WILL NOT ANGLE LEFT—MOTOR IS OPERATIONAL	(a) Improper coupler engagement.	(a) Engage coupler properly.
	(b) Mechanical bind or interference.	(b) Eliminate mechanical bind or interference.
	(c) Malfunctioning coupler.	(c) Repair or replace coupler.
	(d) Leaking or open crossover relief valve.	(d) Clean or replace crossover relief valve.
PLOW BLADE WILL NOT ANGLE—MOTOR IS OPERATIONAL	(a) Improper coupler engagement.	(a) Engage coupler properly.
	(b) Mechanical bind or interference.	(b) Eliminate mechanical bind or interference.
	(c) Leaking or open crossover relief valve.	(c) Clean or replace crossover relief valve.
PLOW WILL NOT REMAIN IN ANGLED POSITION	(a) Air in cylinders and hoses.	(a) Purge cylinders and hoses.
	(b) Leaking "C" cartridge O-ring seals.	(b) Replace O-ring seals.
	(c) Leaking or open pilot check valve.	(c) Clean or replace pilot check valve.
	(d) Leaking crossover relief valve.	(d) Clean or replace crossover relief valve.
	(e) Crossover relief valve opening pressure too low.	(e) Replace crossover relief valve.
MOTOR DOES NOT OPERATE	(a) Discharged or defective battery.	(a) Recharge or replace battery.
	(b) Loose or corroded electrical connections.	(b) Clean and tighten electrical connections.
	(c) Inoperative solenoid switch.	(c) Replace solenoid switch.
	(d) Malfunctioning control switch.	(d) Replace control switch.
	(e) Malfunctioning motor.	(e) Repair or replace motor.
PLOW BLADE WILL NOT LOWER	(a) No voltage at "A" coil.	(a) Locate malfunction and repair.
	(b) "A" cartridge jammed in closed position.	(b) Clean or replace "A" cartridge.
	(c) Inoperative "A" coil.	(c) Replace "A" coil.
PLOW BLADE CREEPS DOWNWARD	(a) Leaking "A" cartridge.	(a) Clean or replace "A" cartridge.
	(b) Leaking "A" cartridge O-ring seal.	(b) Replace O-ring seal.
	(c) Leaking B-Check Valve.	(c) Clean or replace Pump Check Valve.
	(d) Leaking Ram Packing Cup.	(d) Replace Ram Packing Cup.
	(e) Leaking O-ring seal at bottom of cylinder.	(e) Replace O-ring seal.
PLOW BLADE WILL NOT CLEAN SURFACE	(a) Runner height incorrect.	(a) Adjust runners.
	(b) Cutting edge unevenly worn.	(b) Replace.
BLADE WILL NOT FOLLOW SURFACE DEVIATIONS	(a) Not in "Lower Float Position".	(a) Position switch at "Lower Float".
	(b) Insufficient slack in lift chain.	(b) Adjust lift chain.
SNOW STICKS TO FACE OF BLADE	(a) Sno-Flo paint worn off.	(a) Refinish.

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SNOW PLOW WIRING DIAGRAMS

Refer to Figures 6, 7 and 8 for wiring diagrams for the snow plow power unit, the controls and the auxiliary lighting.

For electric motor and solenoid specifications, refer to Snow Plow Specifications chart at end of this group.

SERVICE PROCEDURES

DIAGNOSIS

When malfunctions are encountered, refer to the Snow Plow Diagnosis chart and the Voltage Application & Hydraulic Fluid Flow illustrations before disassembling the unit.

SOLENOID VALVE COIL FUNCTIONAL TEST

Test the solenoid valve coils to determine if they are functioning properly, according to the following procedure.

(1) Hold a steel screwdriver blade approximately 1/8 inch above the retaining nut on the coil to be tested.

(2) Have a helper position the control switch that energizes the applicable coil (e.g., place the RAISE/LOWER switch in the LOWER and FLOAT positions to energize solenoid valve "A" coil).

CAUTION: Do not connect an ohmmeter to a solenoid coil when voltage is applied to the coil. This can cause internal damage to the ohmmeter.

(3) If the coil has voltage applied and current is flowing through the coil, the electromagnetic action will pull (attract) the screwdriver down to the retaining nut. Absence of electromagnetic attraction indicates a malfunction. An ohmmeter or continuity tester should then be used to determine whether the coil has continuity.

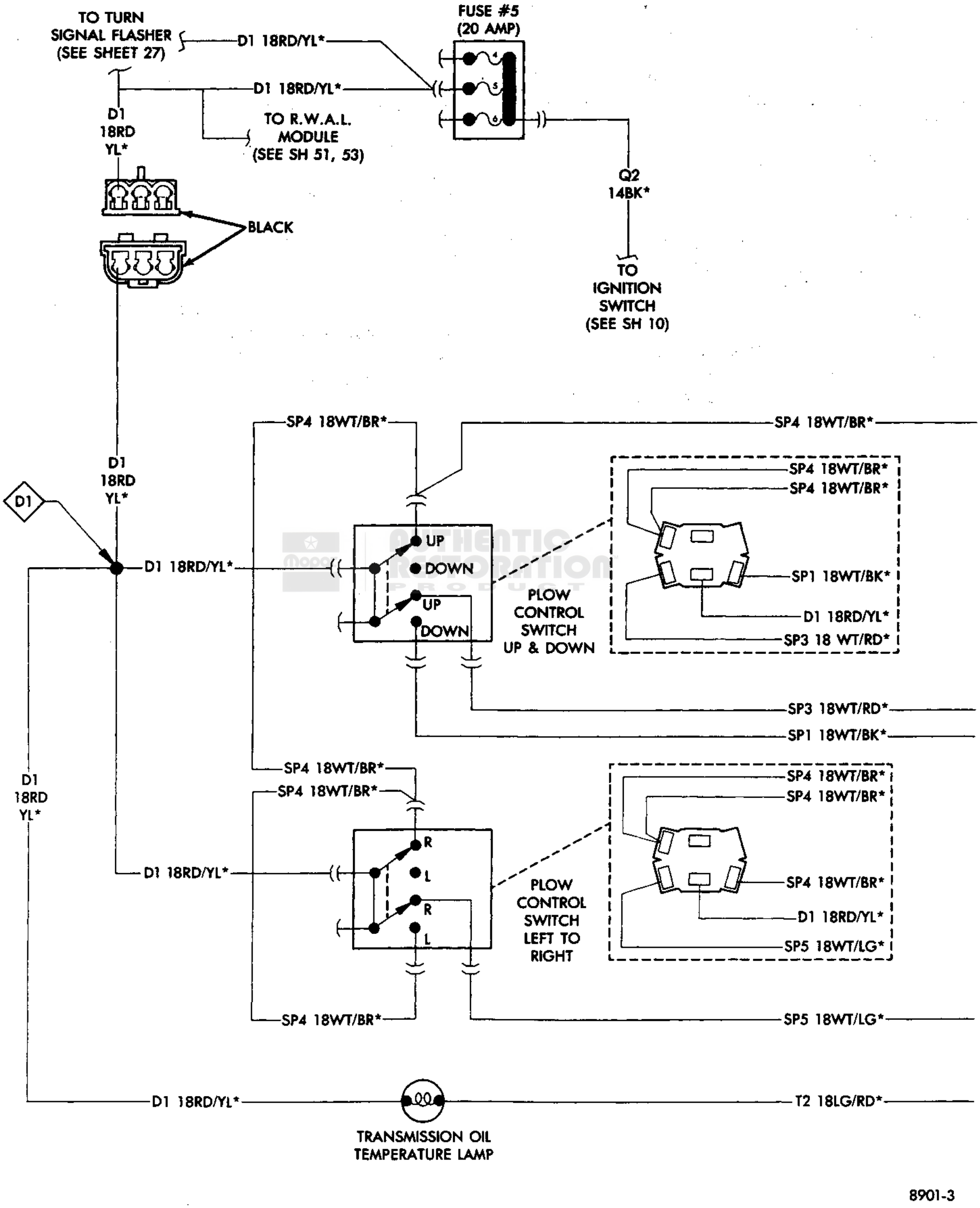

Fig. 6 Snow Plow Control Wiring Diagram

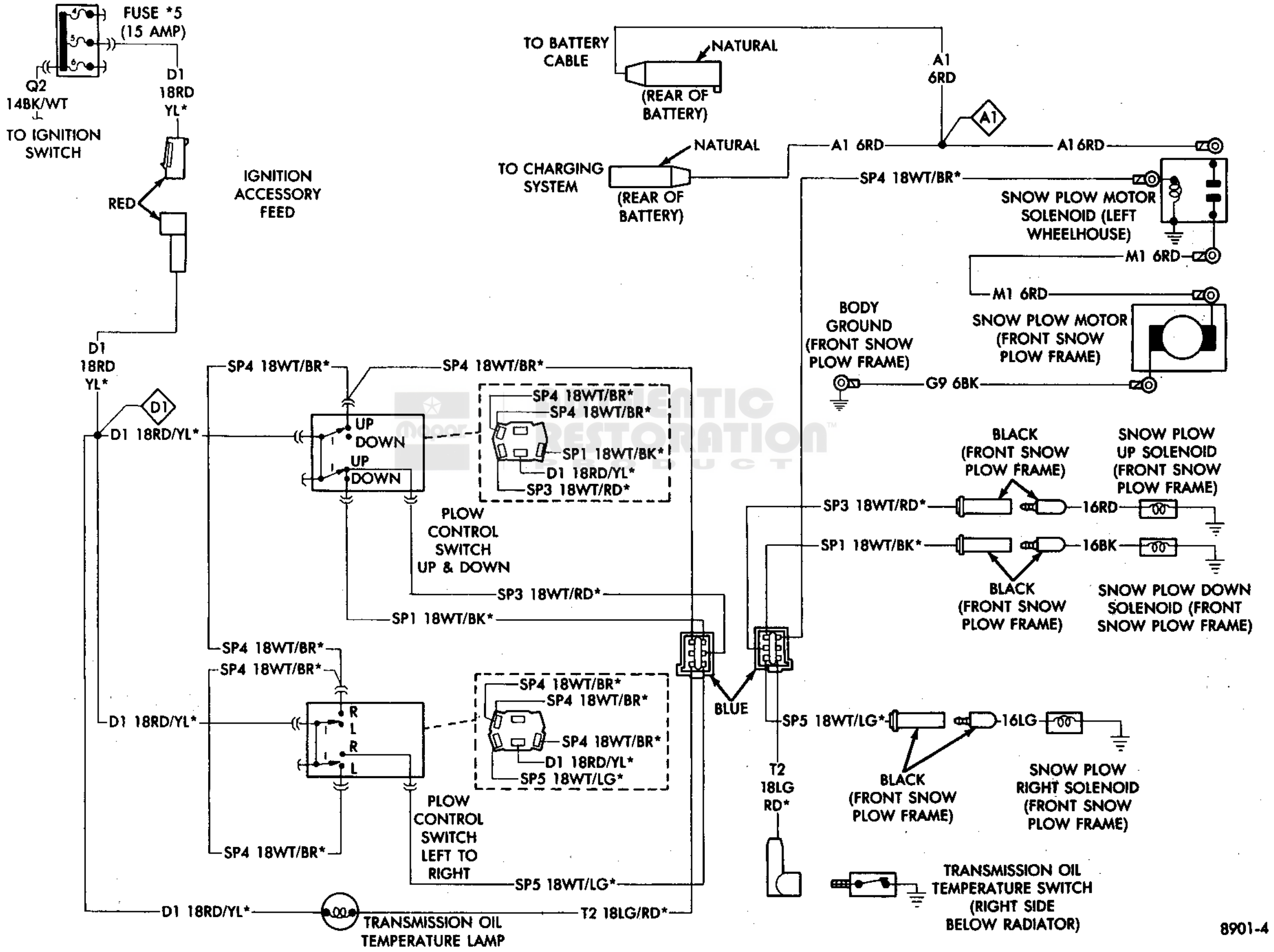

Fig. 7 Snow Plow Control Wiring Diagram (Cont'd)

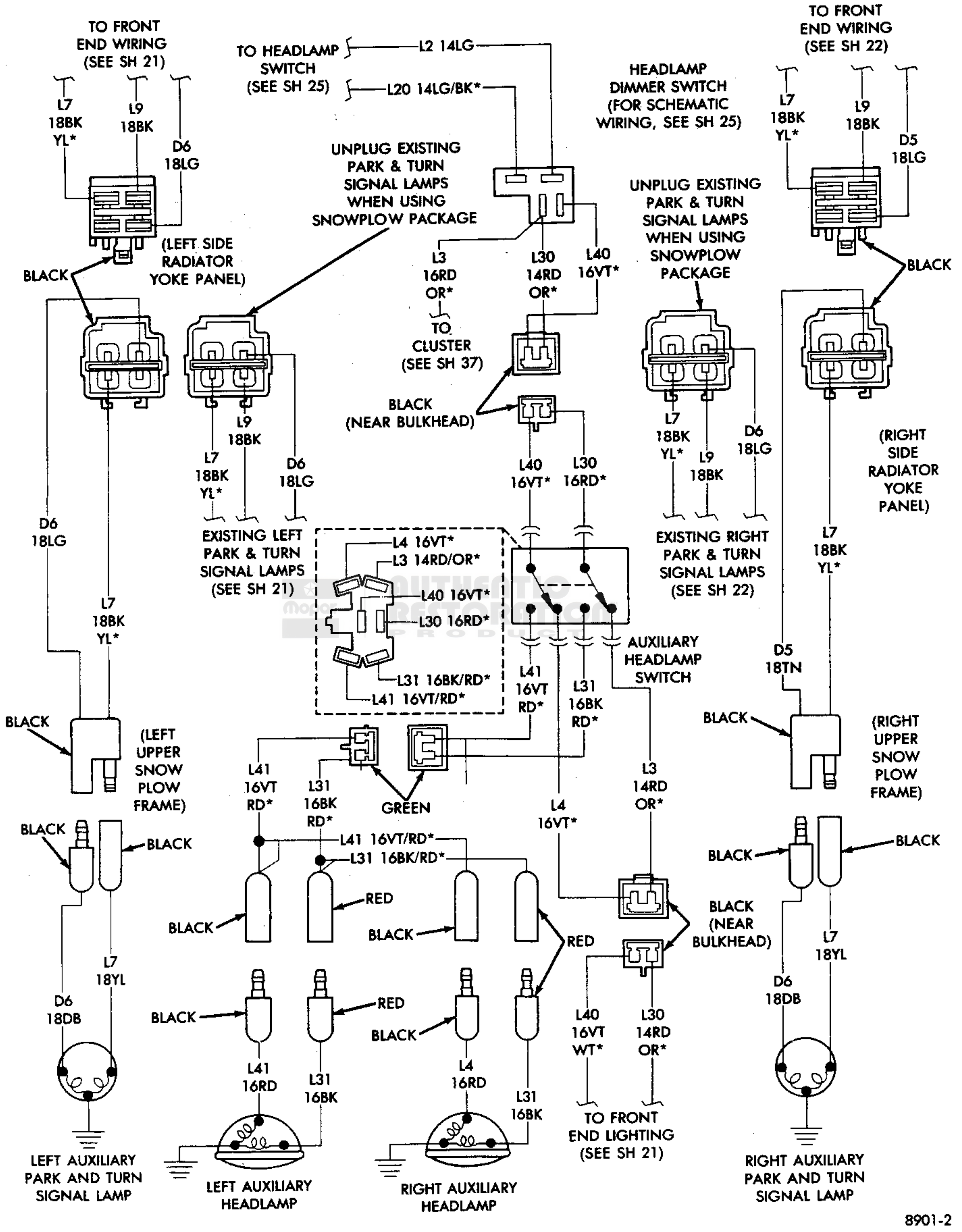

Fig. 8 Snow Plow Auxiliary Lighting Wiring Diagram

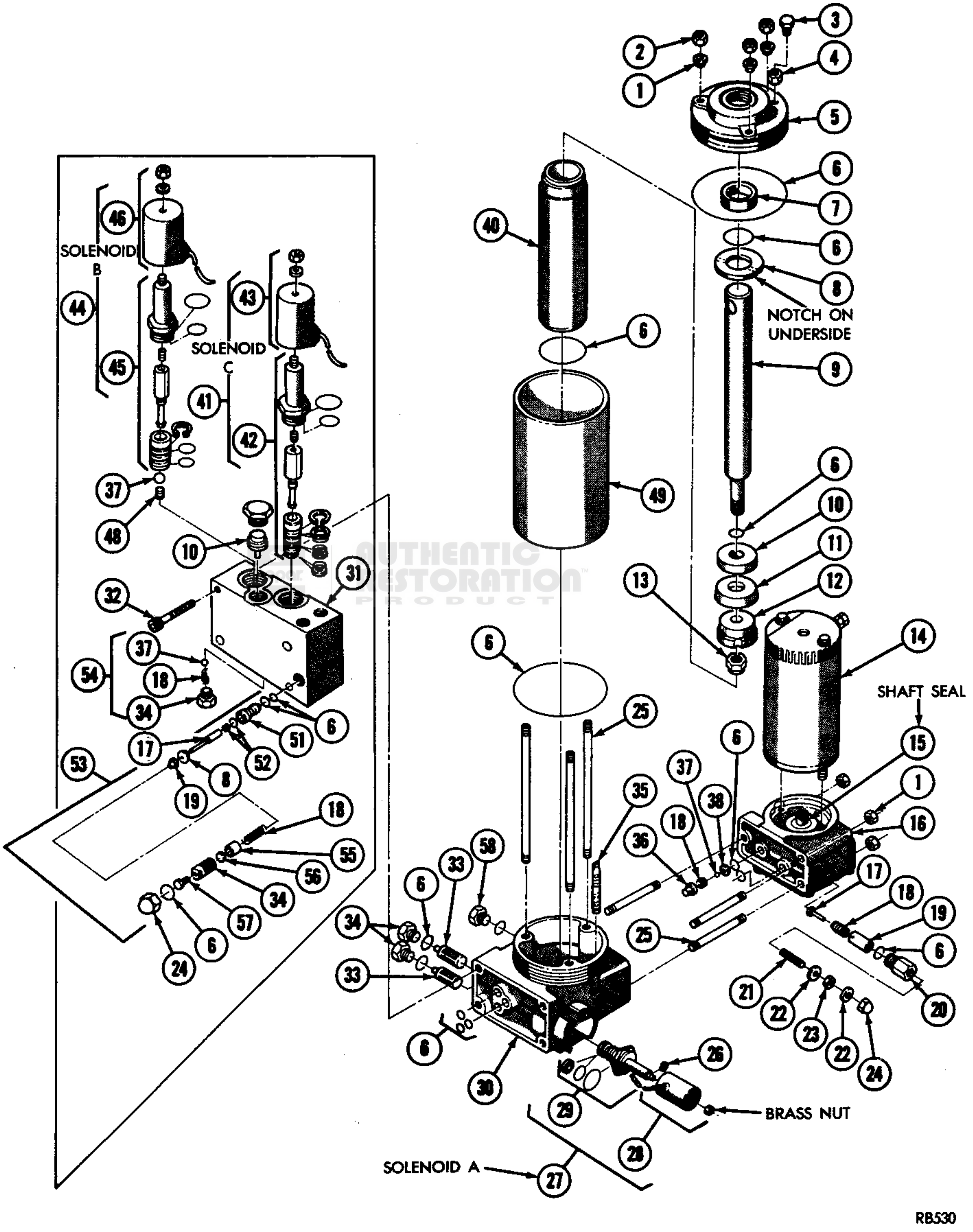

Fig. 9 Power Unit—Exploded View

1. Plastic Washer
2. Locknut
3. Pressure Relief Valve
4. Filler Plug
5. Cover and Seal
6. O-Ring Seal
7. Sleeve
8. Washer
9. Ram
10. Piston
11. Packing Cup
12. Piston Follower
13. Locknut
14. Motor
15. Shaft Seal
16. Pump Housing
17. Poppet
18. Spring
19. Guide
20. Retainer
21. Setscrew
22. Aluminum Washer
23. Jamnut
24. Acorn Nut
25. Stud
26. Brass Washer
27. 2-Way Solenoid
28. 2-Way Coil
29. 2-Way Valve
30. Base and Strainer
31. Valve Block
32. Socket Head Cap Screw
33. Filter
34. Plug
35. Strainer
36. Check Valve Retainer
37. Ball
38. Insert Valve
39. Cylinder Tank
40. Cylinder
41. 4-Way Solenoid
42. 4-Way Valve
43. 4-Way Coil
44. 3-Way Solenoid
45. 3-Way Valve
46. 3-Way Coil
47. Cap Plug
48. Check Spring
49. Cylinder Tank
50. Valve Block
51. Cage
52. O-Ring Seal/Glide Ring
53. Crossover Valve
54. Pilot Check Valve
55. Spacer
56. Disc
57. Adjustment Screw
59. Drain Plug

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LEGEND FOR FIG. 9

POWER UNIT DISASSEMBLY/INSPECTION

(1) Remove the drain plug (Fig. 9). Drain the unit.

(2) Extend the ram and piston rod completely to drain the remaining oil from the cylinder.

(3) Remove the cover locknuts (Fig. 9) and remove the cover.

(4) Inspect the casting for damage and cracks, and the seal for cuts (Fig. 9).

(5) Remove the ram and the piston. Inspect the nylon sleeve, the piston, and the piston follower for excessive wear (Fig. 10).

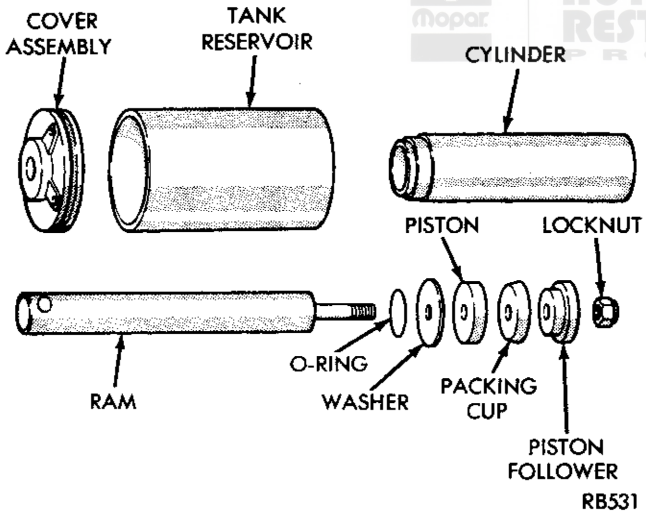

Fig. 10 Lift Cylinder Components

(6) Inspect the cylinder for pitting and scoring in the bore (Fig. 10).

(7) Inspect the ram for nicks, scratches, and rust/corrosion (Fig. 10).

(8) Inspect the piston packing cup for wear and sealing lip cut (Fig. 10).

(9) Clean and inspect the base strainer.

(10) Replace all the O-ring seals during assembly.

(11) Loosen the motor attaching bolts. Do not remove the bolts from the motor. Retain or secure the motor end plate in-place during removal, then temporarily install two 1/4-20 nuts on the motor attaching bolts to retain the motor intact.

Both Prestolite and American Bosch motors are used in snow plow power unit. A Prestolite motor can be identified by a domed top cover and the trade name stamped on the body. American Bosch motors have a flat top cover and no identifying name or marks.

(12) Remove the pump drive shaft seal (if damaged) with a pointed tool.

(13) Verify that the seal kit replacement components are correct for the unit.

(14) Dip the replacement seal in oil and install it over the pump shaft with the seal lip facing down.

(15) Position the seal in the pump housing slightly below the boss face.

(16) Remove solenoid valve "A" coil from the base and test it for electrical continuity. The normal coil DC resistance is 9.0 ohms ±10%.

(17) Remove solenoid valve "A" cartridge (two-way valve) with a 1 1/8-inch diameter deep socket wrench and inspect for external damage.

(18) Remove the filters and clean the screens with cleaning solvent and compressed air. Discard the O-ring seals and the nylon retaining rings.

(19) Remove the pump housing (Fig. 9), and then remove the insert valve, the ball, the spring, and the retainer from the pump housing (Fig. 11). Inspect all the components for damage and contamination. Discard the O-ring seals.

(20) Remove the socket-head screws and remove the valve block from the pump housing (Fig. 9). Discard the O-ring seals.

(21) Remove solenoid valve "B" (three-way valve) with special tool J-25399 (Fig. 9).

(22) Remove the ball and the spring from the valve block (Fig. 9). Clean the solenoid valve and inspect it for external damage.

(23) Disassemble the three-way valve (Fig. 9). Discard the O-ring seal.

(24) Remove and clean solenoid valve "C" (four-way valve) with special tool J-25399 (Fig. 9). Inspect the solenoid valve for external damage.

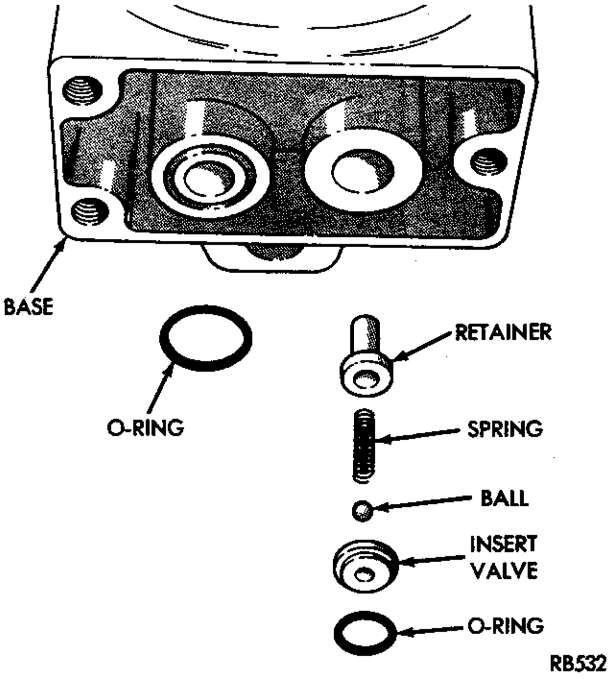

Fig. 11 Insert Valve—Exploded View

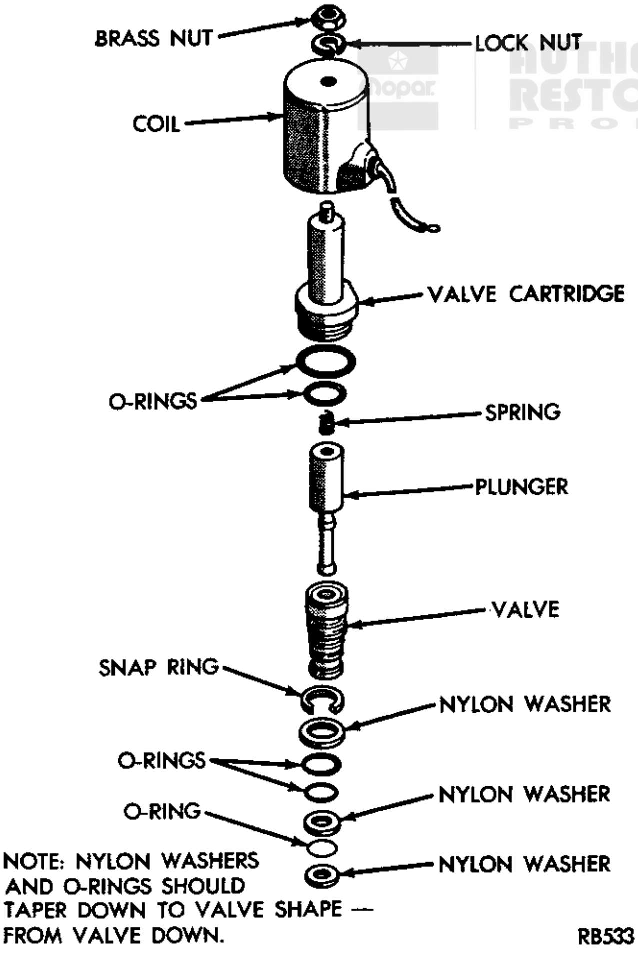

Fig. 12 Solenoid Valve "C"/Four-Way Valve—Exploded View

(25) Disassemble the four-way valve (Fig. 12). Discard the O-ring seals (Fig. 12).

(26) Test solenoid valve "B" and "C" coils for electrical continuity. The normal coil DC resistance is 3.7 ohms.

(27) Remove the pilot "check" valve plug, the spring and the ball from the bottom of the valve block.

(28) Inspect the spring for damage and the ball seat for nicks.

(29) Remove the acorn nut for access to the crossover valve components (Fig. 9).

(30) Remove the crossover valve components (Fig. 13). Inspect for external damage. Discard the O-ring seals.

(31) With all the components removed from the block, clean the block with compressed air to remove all foreign material.

POWER UNIT ASSEMBLY

Before assembly, ensure that all components are thoroughly clean and free of all foreign material. Use replacement gaskets and seals during assembly. Petroleum jelly (or an equivalent lubricant) may be used as an aid in positioning and installing the rubber O-ring seals.

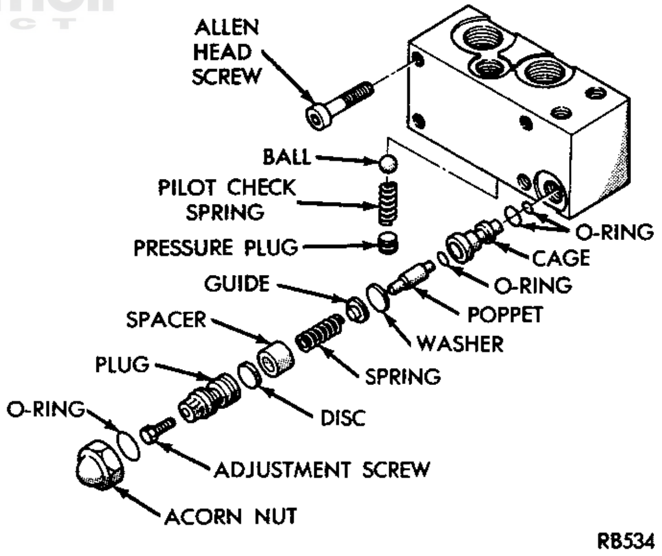

Fig. 13 Crossover Relief Valve—Disassembled

(1) Install the crossover valve components in the valve block with replacement O-ring seals (Fig. 13)

(2) Install the ball, spring and pressure plug with a replacement O-ring seal in the bottom of the valve block (Fig. 13)

(3) Assemble solenoid valve "C" (four-way valve) with replacement O-ring seals and nylon retainer rings (Fig. 12).

(4) Install solenoid valve "C" (four-way valve) with Tool J-25399 (Fig. 9).

(5) Assemble solenoid valve "B" (three-way valve) with replacement O-ring seals.

(6) Install the ball, spring and solenoid valve "B" with Tool J-25399 (Fig. 9).

(7) Install the valve block and the replacement O-ring seals on the pump base.

(8) Install the retainer, the spring, the ball, the insert valve and the pump housing with replacement O-ring seals (Fig. 11). Tighten the pump housing-to-base nuts with 11.3 N•m (100 in-lbs) torque.

(9) Install the filters and the plugs with replacement O-ring seals (Fig. 9).

(10) Install solenoid valve "A" cartridge (two-way valve) in the pump base with replacement O-ring seals (Fig. 9).

(11) Install solenoid valve "A" coil (Fig. 9).

(12) Install the motor on the pump housing (Fig. 9). Engage the gear shaft tang with the notch in the motor output shaft. Tighten the motor-to-housing cap screws with 5 N•m (45 in-lbs) torque.

(13) Install the ram and piston with replacement O-ring seals (Fig. 9).

(14) Position the cover on the reservoir and secure it with locknuts (Fig. 9). Tighten the locknuts with 11.3 N•m (100 in-lbs) torque.

POWER ANGLING CYLINDER SERVICE

If angling cylinder fluid leakage occurs (a slight wetting is normal), the cause could be a loose gland nut (Fig. 14). Tighten the gland nut.

CAUTION: Over-tightening the gland nut can "lock" the cylinder. Leakage will not cease immediately because fluid has accumulated between the packing and the gland nut. If the leakage persists after continued usage, replace the rod packing (Fig. 14).

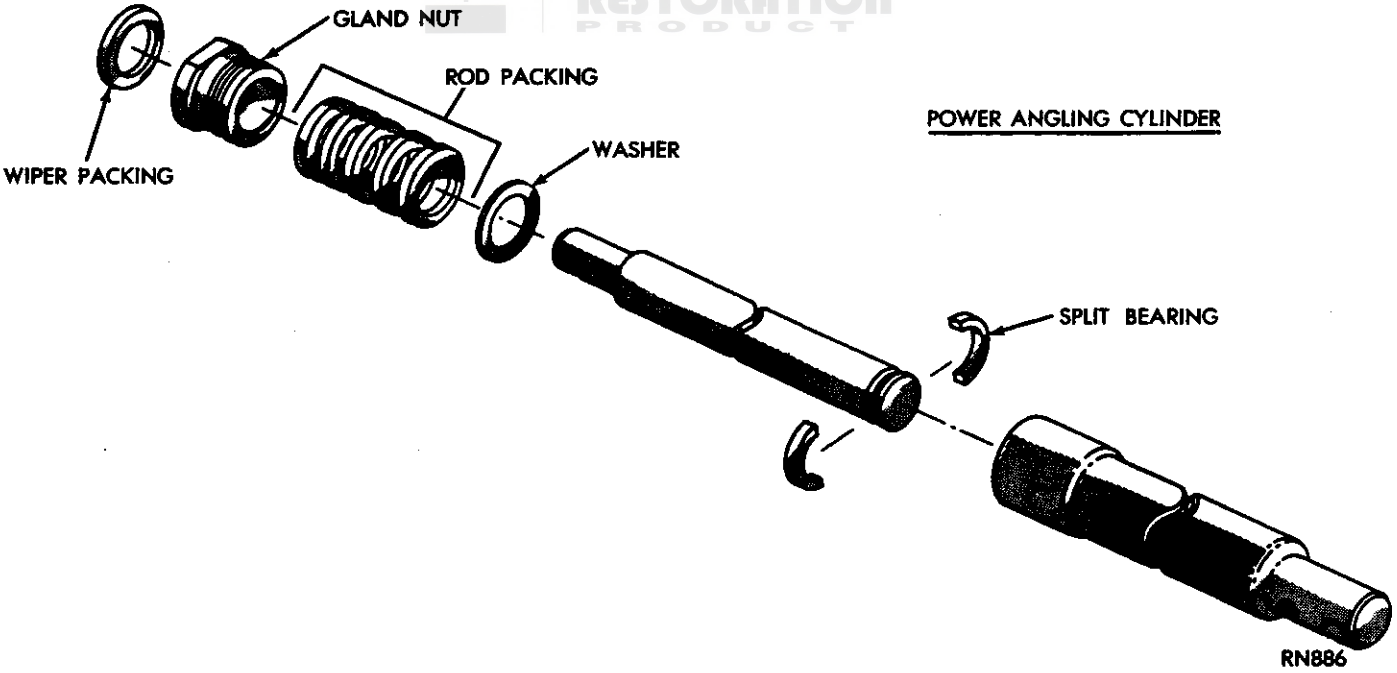

Fig. 14 Angling Cylinder—Exploded View

SPECIFICATIONS

SNOW PLOW SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

MOTOR SPECIFICATIONS

American Bosch M0551046A

No load (motor not attached to pump) operation:
CAUTION: Do not operate motor continuously for more than 30 seconds.
Applied Voltage — 12 Volts DC
Max. Current — 24 Amperes
Speed (Min.) — 5900 rpm
With load (pump operating):
CAUTION: Do not operate motor continuously for more than 5 seconds.
Applied Voltage — 12 Volts DC
Max. Current — 230 Amperes

Prestolite MGL4105

No load (motor not attached to pump) operation:
CAUTION: Do not operate motor continuously for more than 30 seconds.
Applied Voltage — 10 Volts DC
Max. Current — 45 Amperes
Speed (Min.) — 10,000 rpm
Under Load (pump operating):
CAUTION: Do not operate motor continuously for more than 5 seconds.
Applied Voltage — 12 Volts DC
Max. Current — 230 Amperes

HYDRAULIC SPECIFICATIONS

PUMP

Pressure Output (pump relief valve opening pressure 1650 ± 50 psi

CROSSOVER RELIEF VALVE

Opening Pressure 3800 ± 400 psi

SOLENOID VALVES A, B, AND C SPECIFICATIONS

A Coil

Applied Voltage — 12 Volts DC
Current — 0.83 Amperes
Nominal resistance (one ohmmeter probe to coil wire, other to metal coil cover)—9.0 ± 10% ohms.

B and C Coils

Applied Voltage — 12 Volts DC
Current — 1.24 Amperes
Nominal resistance (one ohmmeter probe to coil wire, other to metal coil cover)—3.5 ± 10% ohms.

SOLENOID SWITCH

Applied Voltage — 12 Volts DC
Max. Current — 5 Amperes
Nominal resistance (one ohmmeter probe to coil wire, other to metal foot)—2.65-4.5 ohms.

HYDRAULIC FLUID CAPACITY

NOTE: 1 Quart = 32 Fluid Ounces

A Reservoir and Pump	28 oz.
Hoses & 1-1/2 x 10 Cylinders	16 oz.
Total	1 qt., 12 oz. (44 oz.)
B Reservoir and Pump	28 oz.
Hoses & 1-1/2 x 12 Cylinders	19 oz.
Total	1 qt., 15 oz. (47 oz.)
C Reservoir and Pump	1 qt., 4.5 oz. (36.5 oz.)
Hoses & 2 x 12 Cylinders	28 oz.
Total	2 qt., 5 oz. (64.5 oz.)

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TORQUE SPECIFICATIONS

COMPONENT	SET-TO-TORQUE	RECHECK TORQUE
Reservoir Cover Nuts 5/16-24	11.3 N•m (100 in-lbs)	11-14 N•m (100-125 in-lbs)
Pump Nuts 5/16-24	11.3 N•m (100 in-lbs)	11-14 N•m (100-125 in-lbs)
Endplate or Valve Block Capscrews 5/16-18	11 N•m (95 in-lbs)	11-12 N•m (95-105 in-lbs)
Motor-to-Pump Housing Capscrews 1/4-20	5 N•m (45 in-lbs)	5-6 N•m (45-55 in-lbs)

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FRONT SUSPENSION

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GENERAL INFORMATION

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DESCRIPTION—2WD VEHICLES

All two-wheel drive (2WD) Ram Truck and Ramcharger vehicles are equipped with a coil-spring operated (independent) front suspension system at each side of the vehicle (Fig. 1). The coil springs are located between the frame side rail bracket and the lower suspension arm. The lower suspension arms are attached to a stationary crossmember. A 0.3 inch (7.6 mm) ozone-resistant, rubber noise isolation pad is located between the upper end of the coil spring and the frame bracket. This pad dampens noise that would otherwise be transmitted via the metal-to-metal contact of the spring and the frame bracket. A shock absorber is located inside each spring coil and it is attached to the frame side rail bracket and to the lower suspension arm.

Both suspension arms have replaceable bushings at the inboard ends and replaceable ball studs at the outboard ends. The lower suspension arms are equipped with tension-type ball studs. The upper suspension arms also control the caster and camber angles via adjustable eccentric (cam) bolts located at the inboard ends.

The suspension arm ball studs and the tie-rod end ball studs are semi-permanently lubricated during manufacture.

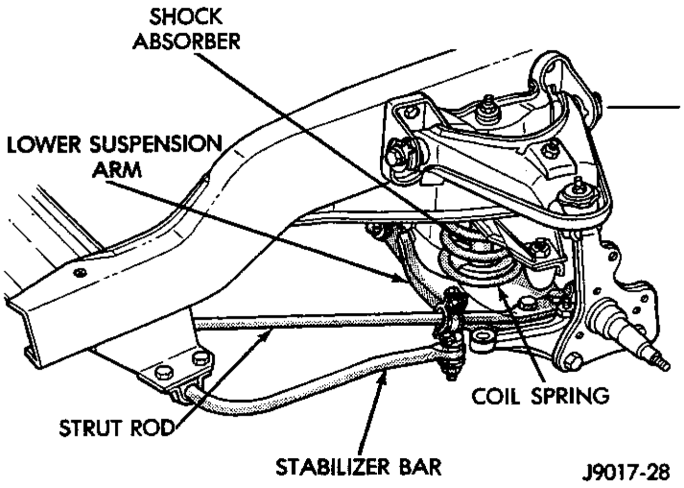

Fig. 1 Front Suspension—2WD Vehicles

Refer to Group 17—Springs And Shock Absorbers for service information involving the coil springs, the shock absorbers and the stabilizer bar. Refer to Group 19—Steering for service information involving the steering linkage.

DESCRIPTION—4WD VEHICLES

All four-wheel drive (4WD) Ram Truck and Ramcharger vehicles are equipped with a leaf-spring operated front suspension system (Fig. 2). The leaf springs are the fixed-rate type and are attached to the frame side rail brackets and to the front axle.

The front leaf springs are attached to the axle shaft tubes at the spring pads by U-bolts and nuts (Fig. 2).

The housing for Model 44 and Model 60 front axles consists of an iron center casting (differential housing) with axle shaft tubes extending from either side. The axle shaft tubes are pressed into and welded to the differential housing to form a one-piece axle housing. Both axles have a hypoid gear differential and the centerline of the drive pinion gear shaft is located below the centerline of the ring gear. The removable, stamped steel cover located at the front of the differential housing provides a means for inspection and for differential service without removing the complete front axle from the vehicle.

A small, stamped metal axle gear ratio identification tag is attached to the housing cover via one of the cover bolts. This tag also identifies the number of ring gear and drive pinion gear teeth.

Refer to Group 17—Springs And Shock Absorbers for service information involving the leaf springs and the shock absorbers.

SERVICE INFORMATION

The lower ball studs (2WD vehicles) should be replaced if more than 0.020 inch “end play” exists.

The tie-rod end ball stud seals are serviced separately and should be inspected for damage at the same time the engine oil is changed. Refer to Group 19—Steering for additional service information.

All front suspension components that contain rubber (e.g., bushings) should be tightened while the suspension is at the normal height above the surface (refer to the Specifications chart) and with the full weight of the vehicle supported by the wheels/tires.

Rubber bushings should never be lubricated.

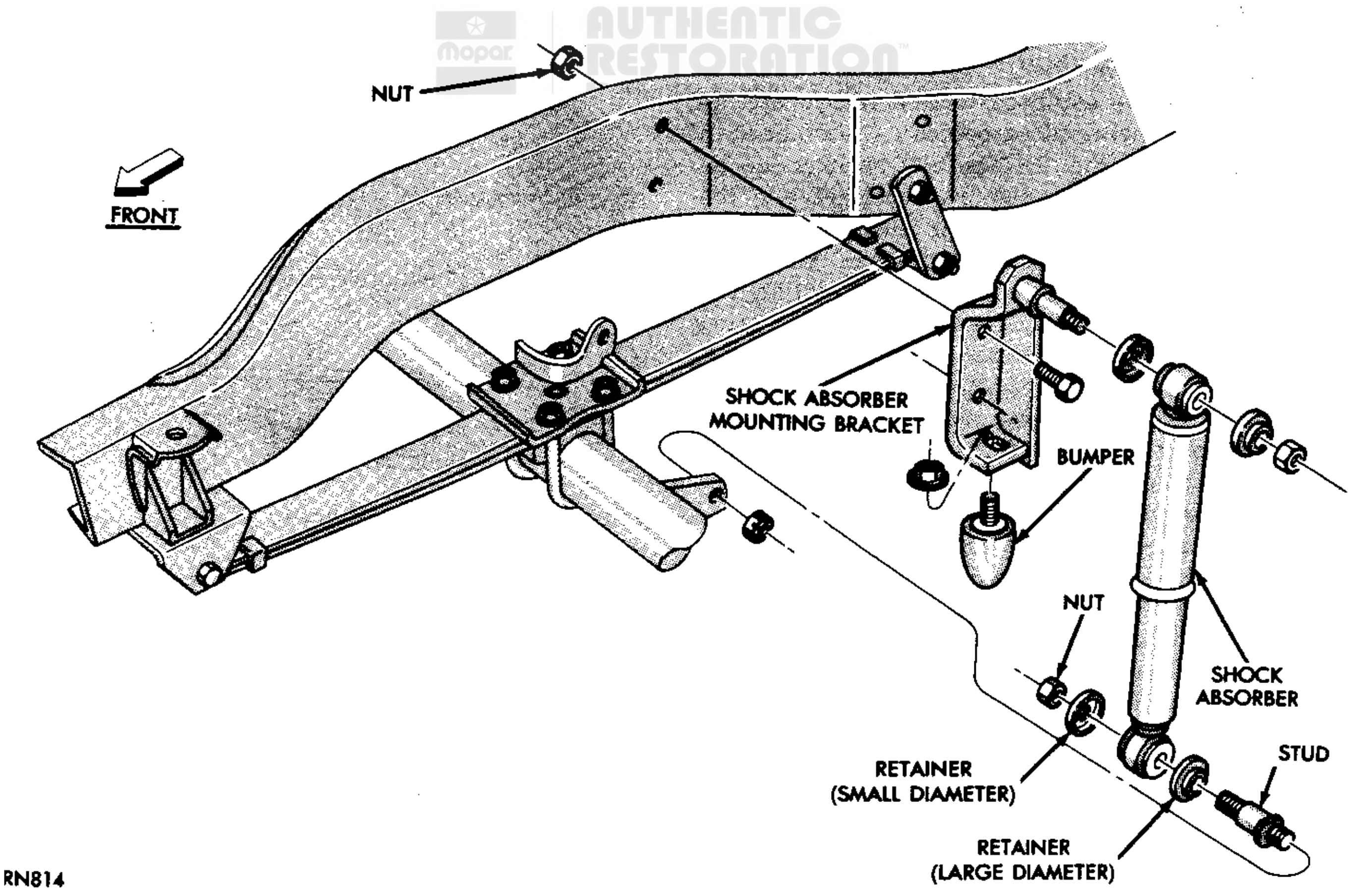

Fig. 2 Front Suspension—4WD Vehicles (Typical)

FRONT WHEEL ALIGNMENT

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GENERAL ALIGNMENT INFORMATION

Front wheel alignment involves the correct adjustment or positioning of all the interrelated suspension angles and linear distances that affect the rotation and the steering of the vehicle front wheels. The importance of front wheel alignment and wheel/tire balancing is essential to maintain ease of steering, good directional stability and to prevent abnormal tire tread wear.

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

The method of measuring the front wheel alignment will vary depending on the type of alignment equipment being used. The instructions provided by the manufacturer of the equipment should always be followed, with the exception that the alignment specifications contained in this manual (or a subsequent service bulletin) should always have precedence.

There are six suspension system and steering linkage measurements that are used to determine if the front wheel alignment is correct (Fig. 1):
- vehicle height,
- caster angle,
- camber angle,
- wheel "toe" position,
- steering axis inclination, and
- wheel "toe-out" on turns (turning radius).

All the angles and linear distances are mechanically adjustable except the vehicle height, the steering axis inclination and the wheel "toe-out" position on turns (turning radius). Although not adjustable, the measurements are valuable in determining if there are bent or damaged components involved, particularly when the camber and the caster angles cannot be adjusted to be within the recommended specifications.

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

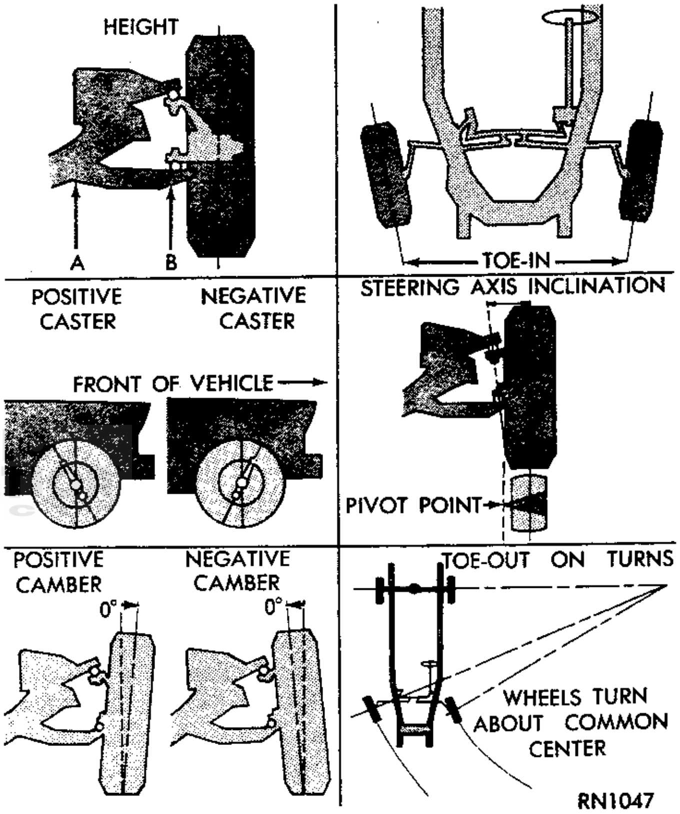


Fig. 1 Wheel Alignment Measurements

The measurements and adjustments should be made in the following sequence:
- vehicle height differential (not adjustable),
- caster angle,
- camber angle (adjustable for 2WD vehicles only),
- wheel "toe" position,
- steering axis inclination (not adjustable), and
- wheel "toe-out" on turns (not adjustable).

The **height differential** between the left side and the right side of the vehicle should be zero. The vehicle should be on a level surface, or on an alignment rack, with a full tank of fuel and no luggage or passenger load. The tires must all have the same recommended pressure.

The **caster** angle is the number of degrees of forward or rearward tilt of the steering knuckle (wheel spindle support arm) from the vertical (i.e., from 0 degrees). Forward tilt from the vertical is negative caster. Rearward tilt from the vertical is positive caster (Fig. 1, Fig. 2).

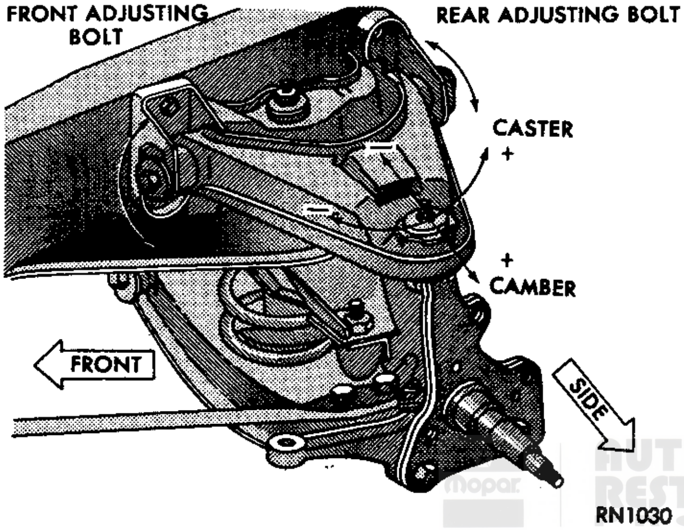


Fig. 2 Caster & Camber Adjustment Location—2WD Vehicles

The **camber** angle is the number of degrees the top of the wheel is tilted inward or outward from the vertical plane (i.e., from 0 degrees). Inward tilt of the top of the wheel from the vertical plane is a negative camber angle. Outward tilt of the top of the wheel from the vertical plane is a positive camber angle. An excessive camber angle will cause abnormal tire tread wear. An excessive negative camber angle will cause thread wear at the inside of the tire, while an excessive positive camber angle will cause thread wear at the outside of the tire (Fig. 1, Fig. 2).

The **wheel "toe" position** is the linear distance differential between the leading inside edges of the front tires and the trailing inside edges of the front tires. Incorrect wheel "toe" position is the most serious cause for excessive tire thread wear. The wheel "toe" position is the final front wheel alignment adjustment.

The **steering axis inclination** is measured in degrees and is the angle that the steering knuckle (wheel spindle support) is tilted from the vertical plane (i.e., from 0 degrees). It has a fixed relationship with the camber angle and will not change except when the spindle or ball stud is damaged or bent. The angle is not adjustable and the damaged components must be replaced to correct misalignment.

The **wheel "toe-out" on turns** (turning radius) is measured in degrees and is the difference between the two front wheel turning angles. This turning angle difference is provided by the design of the steering linkage and is based on the wheelbase of the vehicle. It is not adjustable. When the wheel "toe-out" on turns (turning radius) is not within the recommended specification, inspect for possible bent or damaged components.

PRE-ALIGNMENT INSPECTION

Before initiating front wheel alignment, the following inspection and the necessary corrections must be completed for those components that interact with the steering of the vehicle.

(1) Check and inflate all the tires with the same recommended pressure. All the tires should be the same size, in good condition and have approximately the same thread wear. If abnormal, note the type of tire tread wear, which will aid in the diagnosis (refer to Group 22—Tires And Wheels).

(2) Inspect and adjust (if necessary) the front wheel bearings.

(3) Inspect the front wheels/tires for evidence of excessive radial and lateral "runout" (refer to Group 22—Tires And Wheels for measurement procedures).

(4) Inspect the wheels/tires for evidence of "unbalance". Both static and dynamic unbalance can affect the vehicle steering.

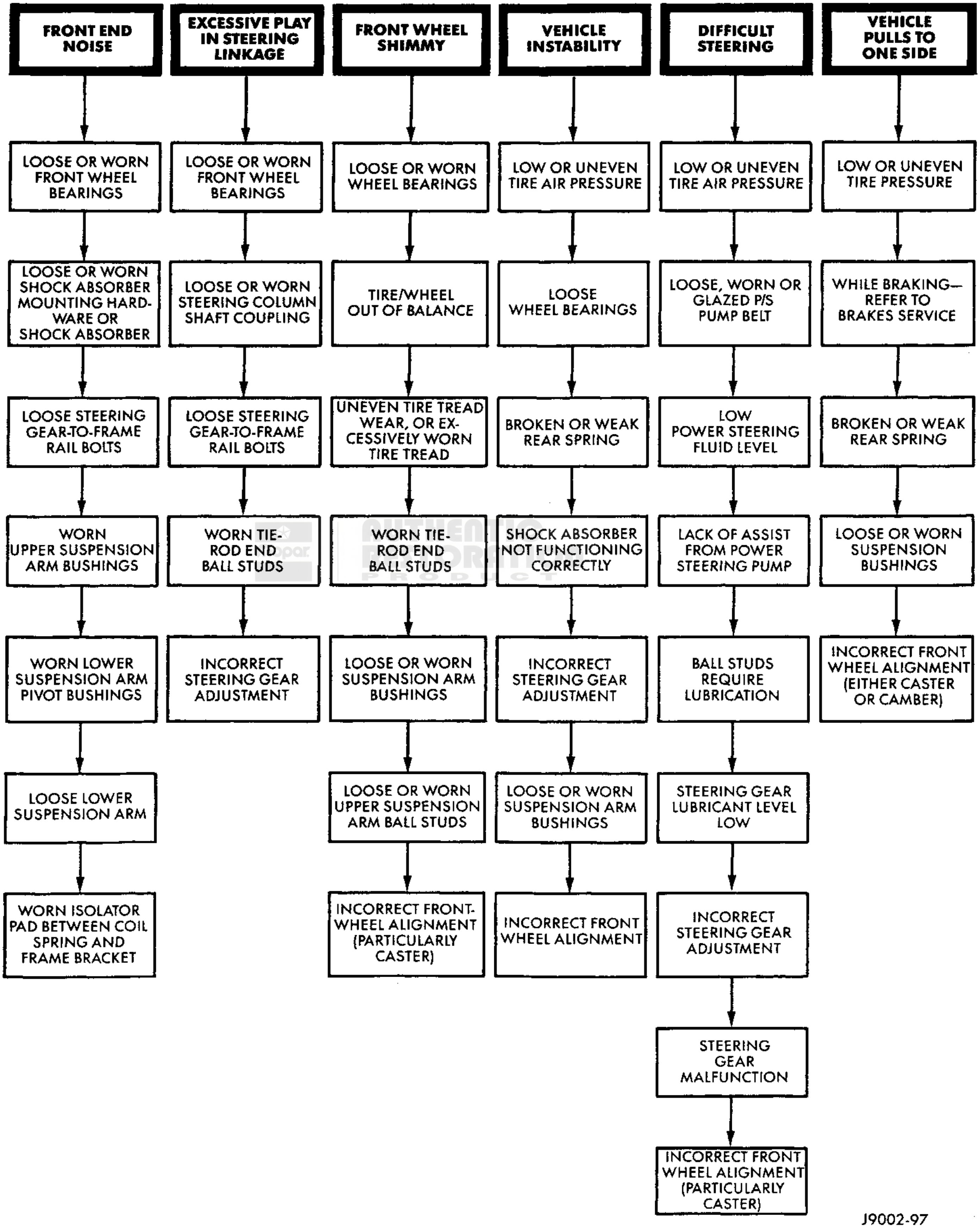
(5) Inspect the ball studs and all the steering linkage pivot locations for excessive looseness.

(6) Inspect the shock absorbers for leaks and jounce the vehicle to determine if the shock absorbers properly dampen vehicle body movement.

(7) Inspect the steering gear operation for roughness, binding or a "sticking" condition. Adjust/repair as necessary.

(8) Inspect the rear springs for cracked or broken leaves, and the U-bolt nuts for correct tightness (torque).

FRONT SUSPENSION DIAGNOSIS



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WHEEL ALIGNMENT MEASUREMENTS/ADJUSTMENTS

The front wheel alignment positions must be retained within the specified limits to prevent abnormal tire tread wear, and to ensure steering ease and safe operation of the vehicle.

The equipment manufacturer's recommendations for use of their equipment should always be followed. All damaged front suspension system components should be replaced. Do not attempt to straighten any bent component.

CAMBER AND CASTER ANGLES

2WD VEHICLES

For 2WD vehicles, camber and caster angle adjustments involve repositioning the upper suspension arm eccentric (cam) adjustment bolts. The eccentric (cam) bolts are inserted into "slotted" holes in a frame-mounted bracket (Fig. 2). Alignment adjustments are accomplished by loosening the retaining nuts and changing the position of the eccentric (cam) bolt.

(1) Remove all foreign material from the eccentric (cam) adjustment bolt threads.

(2) Record the camber and caster measurements before loosening the eccentric (cam) adjustment bolt retaining nuts.

(3) The camber angle should be adjusted as near as possible to the "preferred" angle. The caster should be the same at both sides of the vehicle. Refer to the Specifications chart.

4WD VEHICLES

For 4WD vehicles, the correct wheel camber (vertical tilt) angle is factory "preset" at positive one degree (+1°) and cannot be altered by adjustment.

CAUTION: Do not attempt to adjust the camber angle by heating or bending the axle or any suspension component. If the camber angle is incorrect, the component(s) causing an incorrect camber angle must be replaced.

(1) It is important that the camber (vertical tilt) angle be the same for both front wheels.

(2) The camber angle should be measured with accurate wheel alignment equipment. The acceptable range is +1/2° to +1 1/2°. Refer to the Specifications chart.

If the caster angle appears to be correct and the axle is not bent or twisted, a satisfactory test for assurance can be made by road testing the vehicle and observing the steering wheel "return-to-center" position.

Before road testing, check and correct the tire inflation pressures. Be particularly careful to inflate both of the front tires with exactly the same pressure.

During the road test, turn the steering wheel from side-to-side and make vehicle turns to both the left and right. If the wheels turn easily to either side and the steering wheel returns toward the center position unassisted, the caster angle is correct. However, if the wheels turn to either side easily but the steering wheel does not return toward the center position unassisted, an incorrect caster angle is probable.

(1) The caster angle is factory "preset" at positive two degrees (+2°). The acceptable range is +1/2° to +3 1/2°.

(2) The caster angle should be measured with accurate wheel alignment equipment.

(3) If the caster angle is incorrect, it can be adjusted by installing appropriate size, tapered shims between the front axle pads and the spring brackets. The caster angle should be adjusted as near as possible to the "preferred" angle.

(4) Record the caster measurement before removing the original shims from the spring pads.

(5) The caster should be the same at both sides of the vehicle. Refer to the Specifications chart.

WHEEL "TOE" POSITION

The wheel "toe" position adjustment should be the final front wheel alignment adjustment. In all instances, follow the equipment manufacturer's recommended procedure.

(1) Secure the steering wheel with the front wheels in the straight-ahead position. For vehicles equipped with power steering, start the engine before straightening the wheels.

With power steering, the engine should be operating during the wheel "toe" position adjustment.

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

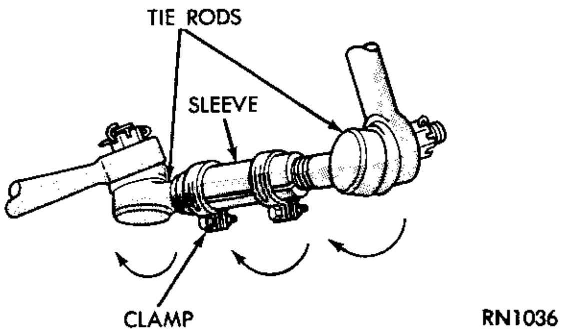

Fig. 3 "Toe" Position Adjustment

(3) Adjust the wheel "toe" position by rotating the tie rod adjustment sleeve (Fig. 3).

To avoid a binding condition at either tie rod, also rotate each tie-rod end in the direction of sleeve rotation during the adjustment (Fig. 3). This will ensure that both tie-rod ends are at the center of their travel when the adjustment sleeve clamps are tightened.

(4) If applicable, turn the ignition switch off.

(5) Position the adjustment sleeve clamps so that the clamp ends **are not located** at the sleeve slot and tighten the clamp bolt nuts with 18 N•m (160 in-lbs) torque. Tighten Model D350 and all 4WD vehicle (i.e.,"heavy duty" tie rods) tie-rod sleeve clamp bolt nuts with 34 N•m (25 ft-lbs) torque. Ensure that the clamp bolts are located at the underside of the sleeve.

FRONT SUSPENSION COMPONENT SERVICE—2WD VEHICLES

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LOWER SUSPENSION ARM STRUT REMOVAL/ INSTALLATION

REMOVAL

(1) Raise and support the vehicle.

(2) Use a small drift and a hammer to drive the spring pin from the front of the strut. Remove the spring pin, the nut, the retainer and the bushing from the end of the strut (Fig. 1).

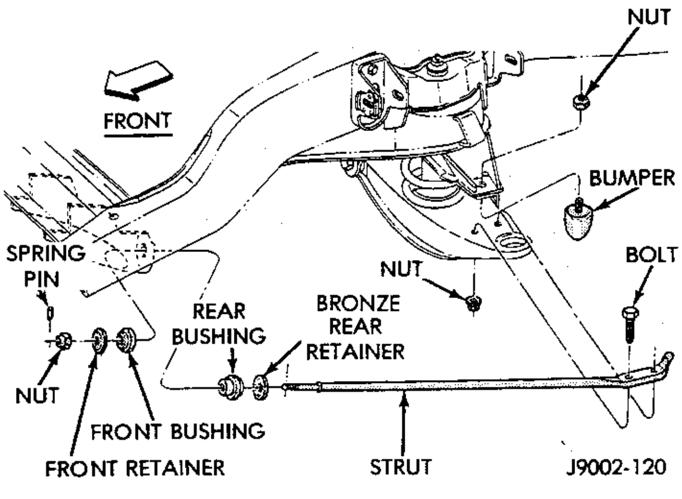


Fig. 1 Lower Suspension Arm Strut Removal/ Installation

(3) Remove the strut rear attaching bolts and the jounce bumper from the bracket. Remove the strut from the vehicle (Fig. 1).

INSTALLATION

(1) Position the rear retainer and the rear bushing on the front end of the strut (Fig. 1).

(2) Carefully slide the strut into position for installation (Fig. 1). Install the jounce bumper and the rear attaching bolts. Tighten the bolts with 129 N•m (95 ft-lbs) torque.

(3) Install the front bushing, the front retainer and the nut at the front end of the strut (Fig. 1). Tighten the nut with 68 N•m (50 ft-lbs) torque.

(4) Install the spring pin.

(5) Remove the supports and lower the vehicle.

LOWER SUSPENSION ARM REMOVAL/INSTALLATION

REMOVAL

(1) Block the brake pedal in the "up" (non-depressed) position. Raise the vehicle on a hoist. Position supports at the extreme front ends of the frame rails and lower the hoist. Remove the applicable wheel cover and wheel/tire.

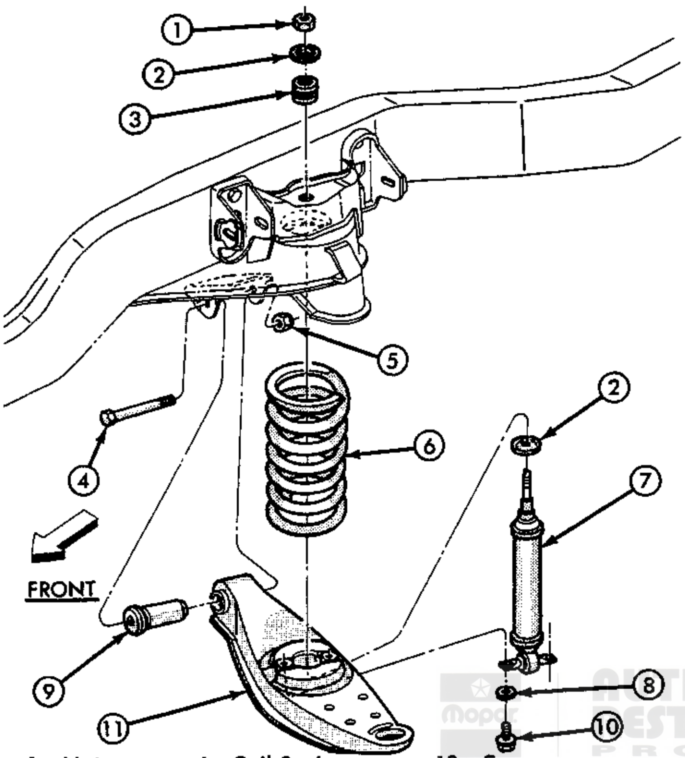
(2) Remove the brake caliper retainer and the anti-rattle spring. Remove the brake caliper from the disc rotor by sliding it out and then away from the rotor. If necessary, refer to Group 5—Brakes for removal information. Support the brake caliper out-of-the-way. **Do not allow the caliper to hang from or be supported by the brake fluid hose.** Remove the inboard brake pad.

(3) Remove the dust cap, the cotter pin, the nut lock, the adjustment nut, the washer, and the outer wheel bearing.

(4) Carefully slide the hub/rotor from the steering knuckle spindle. **Do not allow the seal or the inner wheel bearing to contact the steering knuckle spindle threads, otherwise the threads, the bearing, and the seal could be damaged.**

(5) Remove the attaching screws and the brake splash shield.

(6) Remove the shock absorber from the vehicle and the shock absorber upper bushing from the bracket (Fig. 2). If necessary, refer to the removal procedure.



1—Nut
2—Retainer
3—Bushing
4—Bolt
5—Nut
6—Coil Spring
7—Shock Absorber
8—Washer
9—Bushing
10—Capscrew
11—Lower Suspension Arm

Fig. 2 Coil Spring Suspension—2WD Vehicles

(7) Remove the strut bar (Fig. 1). If necessary, refer to the removal procedure. If equipped, disconnect the stabilizer bar from the lower suspension arm (Fig. 3).

(8) Install Spring Compressor Tool DD-1278 in the spring (Fig. 4) and tighten the nut “finger-tight”, and then loosen the nut 1/2 of-a-turn.

(9) Remove the cotter pins and the lower and upper ball stud nuts at the steering knuckle.

(10) Install Ball Stud Loosening Tool C-3564-A on the lower ball stud (Fig. 4). Turn the threaded portion of the tool and “lock” the tool securely against the lower stud (Fig. 4).

(11) Expand the tool sufficiently enough to place force on the lower ball stud and then strike the steering knuckle sharply with a hammer to loosen the stud. **Do not attempt to force the stud out of the steering knuckle with the loosening tool.**

(12) Remove the loosening tool and remove the ball stud from the steering knuckle with an appropriate tool.

(13) Slowly loosen the coil spring compressor tool (Fig. 4) until all tension is relieved from the spring.

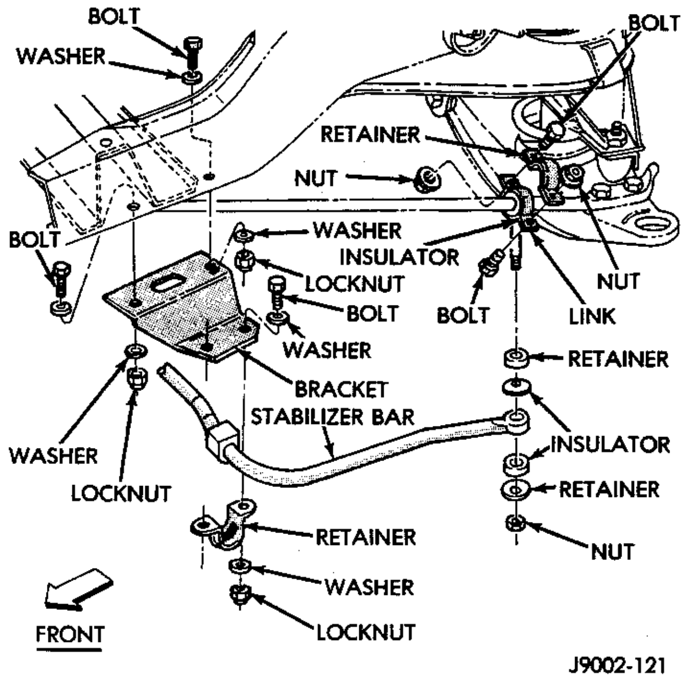


Fig. 3 Stabilizer Bar

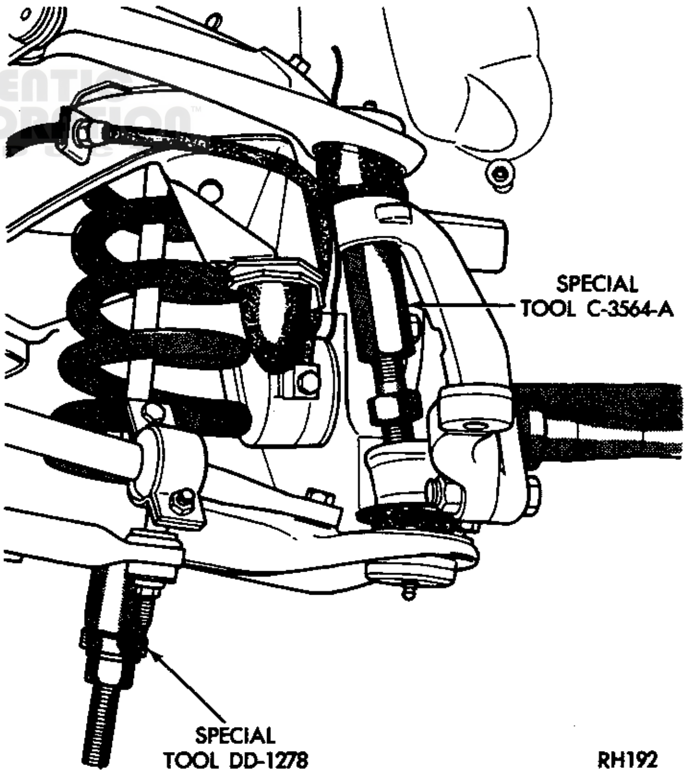


Fig. 4 Spring Compressor & Ball Stud Loosening Tools Installed

(14) Remove the spring compressor tool and the spring with the rubber isolation pad (Fig. 4).

(15) Remove the lower suspension arm hex-head attaching bolt from the frame crossmember bracket (Fig. 2).

(16) Remove the lower suspension arm from the vehicle (Fig 2).

INSTALLATION

(1) Position the lower suspension arm at the frame crossmember bracket (Fig. 2).

(2) Install the hex-head attaching bolt and tighten "finger-tight" (Fig. 2).

(3) After the vehicle has been lowered to the surface and with the wheels/tires supporting the vehicle weight, tighten the hex head attaching bolt with 305 N•m (225 ft-lbs) torque.

(4) Position the spring (with the rubber isolation pad) on the suspension arm (Fig. 2) and install the spring compressor tool (Fig. 4). Compress the spring until the lower suspension arm ball stud can be properly positioned in the steering knuckle bore.

(5) Install the retaining nuts on the ball studs and tighten the upper nut with 142 N•m (105 ft-lbs) torque and the lower nut, if a 11/16-16 bolt, with 183 N•m (135 ft-lbs) torque or, if a 3/4-16 bolt, with 237 N•m (175 ft-lbs) torque. Install replacement cotter pins.

(6) Install the strut (Fig. 1). Tighten the strut-to-lower suspension arm bolts with 136 N•m (100 ft-lbs) torque. Tighten the strut front nut with 70 N•m (50 ft-lbs) torque. Install the spring pin.

(7) Connect the stabilizer bar (if equipped) and tighten the link with 11 N•m (100 in-lbs) torque (Fig. 3). Remove the spring compressor tool (Fig. 4).

(8) Install the shock absorber bushing in the frame rail bracket. Place the lower retainer on the stud and position the shock absorber inside the coil spring (Fig. 2). Install and tighten the upper stud nut and the lower retaining bolts "finger-tight".

After the vehicle has been lowered to the surface and with the wheels/tires supporting the vehicle weight, tighten the shock absorber stud nut with 34 N•m (25 ft-lbs) torque and the lower retaining bolts with 23 N•m (17 ft-lbs/200 in-lbs).

(9) Position the brake splash shield on the steering knuckle, install and tighten the attaching screws with 23 N•m (200 in-lbs) torque.

(10) Carefully install the hub/rotor on the steering knuckle spindle, followed by the outer wheel bearing, the washer and the adjustment nut. Tighten the adjustment nut with 48 N•m (35 ft-lbs) torque while rotating hub/rotor. Stop the hub/rotor rotation and loosen the adjustment nut to completely release the wheel bearing "preload". Next, tighten the adjustment nut "finger-tight", and install nut lock and cotter pin. The result of the adjustment should be 0.0001 to 0.003 inch (0.0025 to 0.76 mm) "end play". Clean the dust cap, apply a light coat of wheel bearing lubricant to the inside surface and install it on the hub.

(11) Position the inboard brake pad on the brake caliper adapter with the pad flanges engaged with the adapter rails. Slowly slide the caliper into position in the adapter and over the brake rotor. Align the caliper on the adapter rails. Use care to avoid pulling the protective dust boot from the grooves as the caliper piston and boot slide over the inboard brake pad.

If necessary, refer to Group 5—Brakes for additional installation information.

(12) Install the anti-rattle springs and the retainer clips, and tighten with 20 N•m (15 ft-lbs/180 in-lbs) torque.

The inboard shoe anti-rattle spring must always be installed on top of the retainer spring plate.

(13) Install the wheel/tire and the wheel cover. Raise the vehicle, remove the supports, lower the vehicle and remove the block from the brake pedal.

(14) Tighten the shock absorber nut and bolts with stud nut with 34 N•m (25 ft-lbs) torque and the lower retaining bolts with 23 N•m (17 ft-lbs/200 in-lbs) torque. Tighten the suspension arm hex-head attaching bolt with 305 N•m (225 ft-lbs) torque (Fig. 2).

(15) Test the vehicle brakes and the suspension for proper operation.

LOWER BALL STUD REPLACEMENT

REMOVAL

(1) Block the brake pedal in the "up" (non-depressed) position. Raise the vehicle on a hoist. Position supports at the extreme front ends of the frame rails and lower the hoist. Remove the applicable wheel cover and wheel/tire.

(2) Remove the brake caliper retainer and the anti-rattle spring. Remove the brake caliper from the disc rotor by sliding it out and then away from the rotor. If necessary, refer to Group 5—Brakes for removal information. Support the brake caliper out-of-the-way. **Do not allow the caliper to hang from or be supported by the brake fluid hose.** Remove the inboard brake pad.

(3) Remove the dust cap, the cotter pin, the nut lock, the adjustment nut, the washer, and the outer wheel bearing.

(4) Carefully slide the hub/rotor from the steering knuckle spindle. **Do not allow the seal or the inner wheel bearing to contact the steering knuckle spindle threads, otherwise the threads, the bearing, and the seal could be damaged.**

(5) Remove the attaching screws and the brake splash shield.

(6) Remove the shock absorber from the vehicle and the shock absorber upper bushing from the frame rail bracket (Fig. 2). If necessary, refer to the removal procedure.

(7) Remove the strut bar (Fig. 1). If necessary, refer to the removal procedure. If equipped, disconnect the stabilizer bar from the lower suspension arm (Fig. 3).

(8) Install Spring Compressor Tool DD-1278 in the spring (Fig. 4) and tighten the nut “finger-tight”, and then loosen the nut 1/2 of-a-turn.

(9) Remove the cotter pins and the lower and upper ball stud nuts at the steering knuckle.

(10) Install Ball Stud Loosening Tool C-3564-A on the lower ball stud (Fig. 4). Turn the threaded portion of the tool and “lock” the tool securely against the lower stud (Fig. 4).

(11) Expand the tool sufficiently enough to place force on the lower ball stud and then strike the steering knuckle sharply with a hammer to loosen the stud. **Do not attempt to force the stud out of the steering knuckle with the loosening tool.**

(12) Remove the loosening tool and remove the ball stud from the steering knuckle bore with an appropriate tool.

(13) Slowly loosen the coil spring compressor tool (Fig. 4) until all tension is relieved from the spring.

(14) Remove the ball stud seal. Use assembled Tool C-4212 to force the ball stud out of the lower suspension arm bore (Fig. 5).

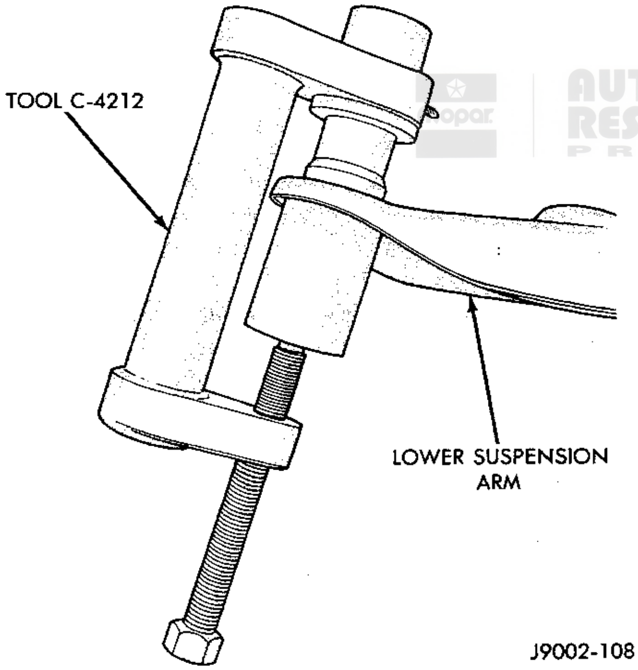


Fig. 5 Lower Ball Stud Removal

INSTALLATION

(1) Force the replacement ball stud into the lower suspension arm bore with assembled Tool C-4212 (Fig. 6).

(2) Position the seal over the ball stud (if necessary, use a replacement seal), force the retaining portion of the seal downward on the ball stud housing with an appropriate size socket wrench until it is securely locked in-place.

(3) Compress the spring with the spring compressor tool (Fig. 4) until the lower suspension arm ball stud can be properly positioned in the steering knuckle bore.

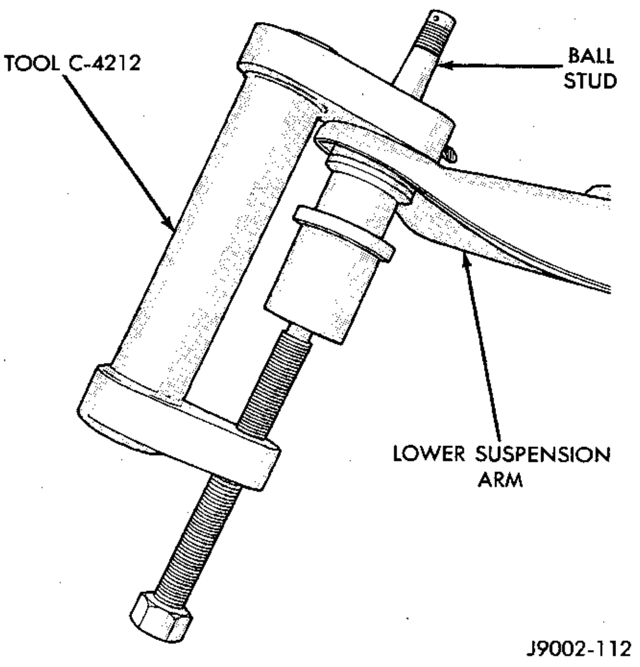


Fig. 6 Lower Ball Stud Installation

(4) Install the retaining nuts on the ball studs and tighten the upper nut with 142 N•m (105 ft-lbs) torque and the lower nut, if a 11/16-16 bolt, with 183 N•m (135 ft-lbs) torque or, if a 3/4-16 bolt, with 237 N•m (175 ft-lbs) torque. Install replacement cotter pins.

(5) Install the strut (Fig. 1). Tighten the strut-to-lower suspension arm bolts with 136 N•m (100 ft-lbs) torque. Tighten the strut front nut with 70 N•m (50 ft-lbs) torque. Install the spring pin.

(6) Connect the stabilizer bar (if equipped) and tighten the link with 11 N•m (100 in-lbs) torque (Fig. 3). Remove the spring compressor tool (Fig. 4).

(7) Install the shock absorber bushing in the frame rail bracket. Place the lower retainer on the stud and position the shock absorber inside the coil spring (Fig. 2). Install and tighten the upper stud nut and the lower retaining bolts “finger-tight”.

After the vehicle has been lowered to the surface and with the wheels/tires supporting the vehicle weight, tighten the shock absorber stud nut with 34 N•m (25 ft-lbs) torque and the lower retaining bolts with 23 N•m (17 ft-lbs/200 in-lbs).

(8) Position the brake splash shield on the steering knuckle, install and tighten the attaching screws with 23 N•m (200 in-lbs) torque.

(9) Carefully install the hub/rotor on the steering knuckle spindle, followed by the outer wheel bearing, the washer and the adjustment nut. Tighten the adjustment nut with 48 N•m (35 ft-lbs) torque while rotating hub/rotor. Stop the hub/rotor rotation and

loosen the adjustment nut to completely release the wheel bearing "preload". Next, tighten the adjustment nut "finger-tight", and install nut lock and cotter pin. The result of the adjustment should be 0.0001 to 0.003 inch (0.0025 to 0.76 mm) "end play". Clean the dust cap, apply a light coat of wheel bearing lubricant to the inside surface and install it on the hub.

(10) Position the inboard brake pad on the brake caliper adapter with the pad flanges engaged with the adapter rails. Slowly slide the caliper into position in the adapter and over the brake rotor. Align the caliper on the adapter rails. Use care to avoid pulling the protective dust boot from the grooves as the caliper piston and boot slide over the inboard brake pad.

If necessary, refer to Group 5—Brakes for additional installation information.

(11) Install the anti-rattle springs and the retainer clips, and tighten with 20 N•m (15 ft-lbs/180 in-lbs) torque.

The inboard shoe anti-rattle spring must always be installed on top of the retainer spring plate.

(12) Install the wheel/tire and the wheel cover. Raise the vehicle, remove the supports, lower the vehicle and remove the block from the brake pedal.

(13) Tighten the shock absorber stud nut with 34 N•m (25 ft-lbs) torque and the lower attaching bolts with 23 N•m (17 ft-lbs/200 in-lbs) torque.

(14) Test the vehicle brakes and the front suspension for proper operation.

LOWER SUSPENSION ARM BUSHING REPLACEMENT

REMOVAL

(1) Remove the lower suspension arm according to instructions provided within the removal procedure.

(2) Use an arbor press and an appropriate size sleeve to force the original bushing from the lower suspension arm bore.

INSTALLATION

(1) Use an arbor press and an appropriate size sleeve to force the replacement bushing into the lower suspension arm bore. Ensure that it is completely "seated" in the bore.

(2) Install the lower suspension arm according to instructions provided within the installation procedure.

UPPER SUSPENSION ARM REMOVAL/INSTALLATION

REMOVAL

(1) Raise the vehicle. Position support stands under the frame rail and lower the front of the hoist. Remove the wheel/tire.

(2) Remove the upper bushing, the sleeve and the shock absorber (Fig. 2).

(3) Install Spring Compressor Tool DD-1278 (Fig. 4), tighten the nut "finger-tight" and then loosen it 1/2 of-a-turn.

(4) Remove the cotter pins and the ball stud retaining nuts.

(5) Install Ball Stud Loosening Tool C-3564-A (Fig. 7), turn the threaded portion of the tool to "lock" it securely against the upper ball stud (Fig. 7). Spread the tool enough to apply force against the upper ball stud, then strike the steering knuckle sharply with a hammer to loosen the upper ball stud. Do not attempt to force the ball stud out of the steering knuckle bore with the loosening tool.

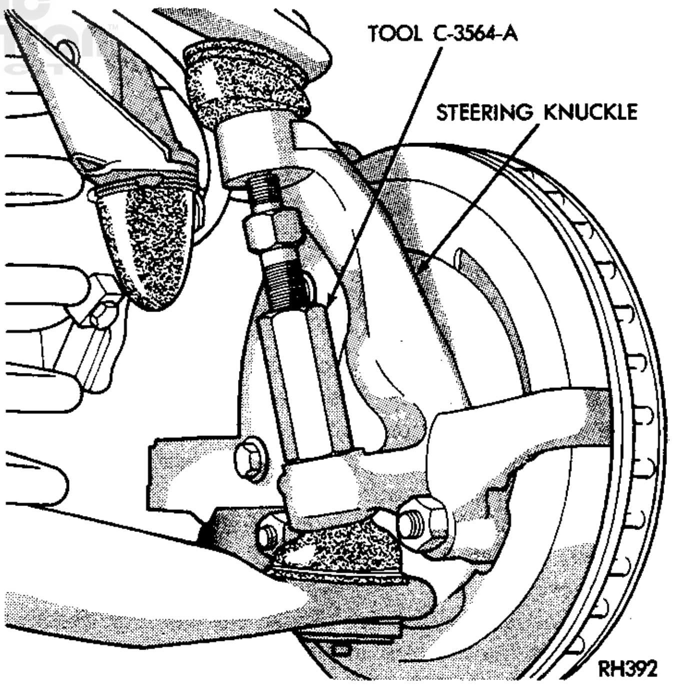


Fig. 7 Ball Stud Loosening Tool Installed

(6) Remove the loosening tool from the steering knuckle.

(7) Remove the upper ball stud from the steering knuckle bore with an appropriate tool.

(8) Remove the retaining nuts, the eccentric (cam) bolts and the upper suspension arm from the vehicle (Fig. 8).

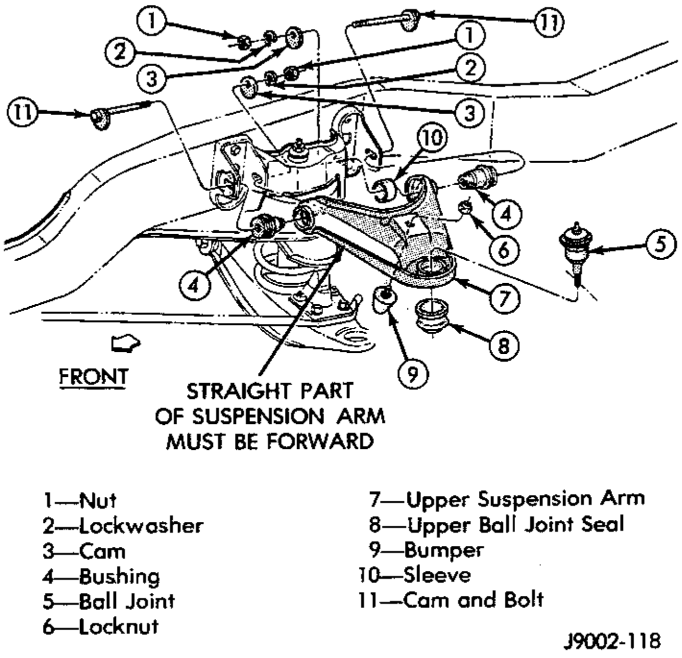


Fig. 8 Upper Suspension Arm Removal/Installation

INSTALLATION

(1) Position the upper suspension arm at the frame rail bracket and install the eccentric (cam) bolts (Fig. 8). Install and tighten the retaining nuts "finger-tight".

(2) Install the retaining nuts on the ball studs and tighten them with 183 N• (135 ft-lbs) torque. Install replacement cotter pins.

(3) Remove the spring compressor tool (Fig. 4).

(4) Install the shock absorber upper bushing and sleeve (Fig. 2). Position the shock absorber inside the coil spring, install the upper retainer and nut and install the lower attaching bolts. Tighten the shock absorber stud nut with 34 N•m (25 ft-lbs) torque and the lower attaching bolts with 23 N•m (17 ft-lbs/200 in-lbs) torque.

(5) Install the wheel/tire. Raise the vehicle, remove the support stands and lower the vehicle to the surface.

(6) Adjust the caster and camber angles. If necessary, refer to the procedure (also refer to the Specifications chart). Tighten the eccentric (cam) retaining nuts with 95 N•m (70 ft-lbs) torque.

UPPER BALL STUD REPLACEMENT

REMOVAL

(1) Raise the vehicle, position a support under the outer end of the lower suspension arm and lower the vehicle so that the support compresses the coil spring.

(2) Remove the wheel/tire.

(3) Remove the ball stud nuts. Use Ball Stud Loosening Tool C-3564-A to loosen the upper ball stud (Fig. 7).

(4) Use Tool C-3561 to un-thread the upper ball stud from the upper suspension arm (Fig. 8).

INSTALLATION

(1) Thread the replacement ball stud into the upper suspension arm bore as far as possible by hand, then use Tool C-3561 to tighten the ball stud with 169 N•m (125 ft-lbs) torque. Ensure that the ball stud is completely "seated" against the arm.

(2) Install and "seat" the replacement ball stud seal.

(3) Insert the upper ball stud into steering knuckle and install ball stud nuts. Tighten the nuts with 183 N•m (135 ft-lbs) torque. Install replacement cotter pins.

(4) Install the wheel/tire. Raise the vehicle, remove the support and lower the vehicle to the surface.

UPPER SUSPENSION ARM BUSHING REPLACEMENT

REMOVAL

(1) Remove the upper suspension arm according to the instructions provided in the removal procedure.

(2) Place the upper suspension arm in a vise and assemble Tool C-3962 and Adaptor Tool SP-3953 (Fig. 9) over the bushing. Tighten the nuts and force the bushing out of the arm bore.

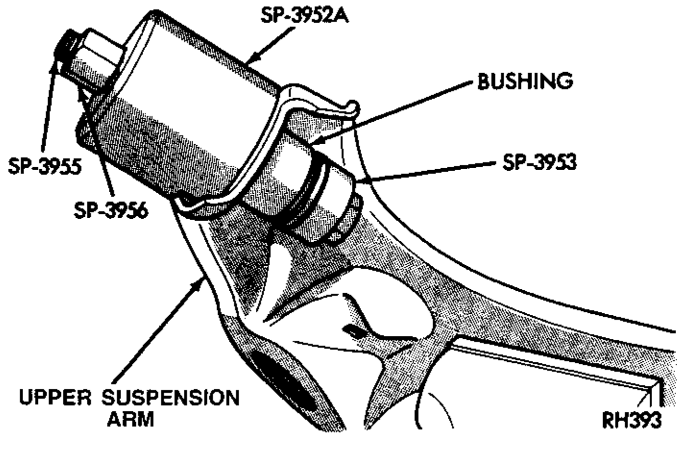


Fig. 9 Upper Suspension Arm Bushing Removal

INSTALLATION

When installing a replacement bushing in the upper suspension arm bore, ensure the suspension arm is supported firmly at the area where the bushing is being forced in the bore. Do not use oil or any other lubricant to aid the installation.

(1) Position the flange end of the replacement bushing in Tool C-3962, support suspension arm firmly, and force the bushing in the suspension arm bore (from outside) until the flanged end is "seated" on the arm (Fig. 10).

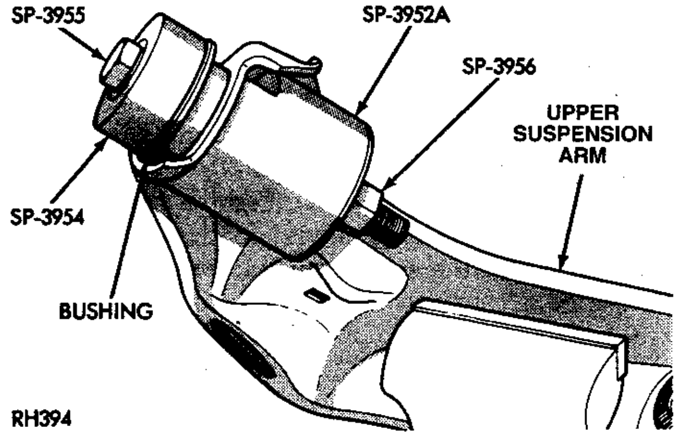


Fig. 10 Upper Suspension Arm Bushing Installation

(2) Install the upper suspension arm according to the instructions provided in the installation procedure.

STEERING KNUCKLE REMOVAL/INSTALLATION

REMOVAL

(1) Block the brake pedal in the "up" (non-depressed) position. Raise the vehicle on a hoist. Position supports at the extreme front ends of the frame rails and lower the hoist. Remove the applicable wheel cover and wheel/tire.

(2) Remove the brake caliper retainer and the anti-rattle spring. Remove the brake caliper from the disc rotor by sliding it out and then away from the rotor. If necessary, refer to Group 5—Brakes for removal information. Support the brake caliper out-of-the-way. **Do not allow the caliper to hang from or be supported by the brake fluid hose.** Remove the inboard brake pad.

(3) Remove the dust cap, the cotter pin, the nut lock, the adjustment nut, the washer, and the outer wheel bearing.

(4) Carefully slide the hub/rotor from the steering knuckle spindle. **Do not allow the seal or the inner wheel bearing to contact the steering knuckle spindle threads, otherwise the threads, the bearing, and the seal could be damaged.**

(5) Remove the attaching screws and the brake splash shield. Remove and discard the dust seal.

(6) Remove the cotter pin and the nut from the tie-rod end ball stud.

(7) Install Puller Tool C-3894A (Fig. 11) and apply sufficient force with the tool to loosen the tie-rod end ball stud from the steering knuckle arm bore.

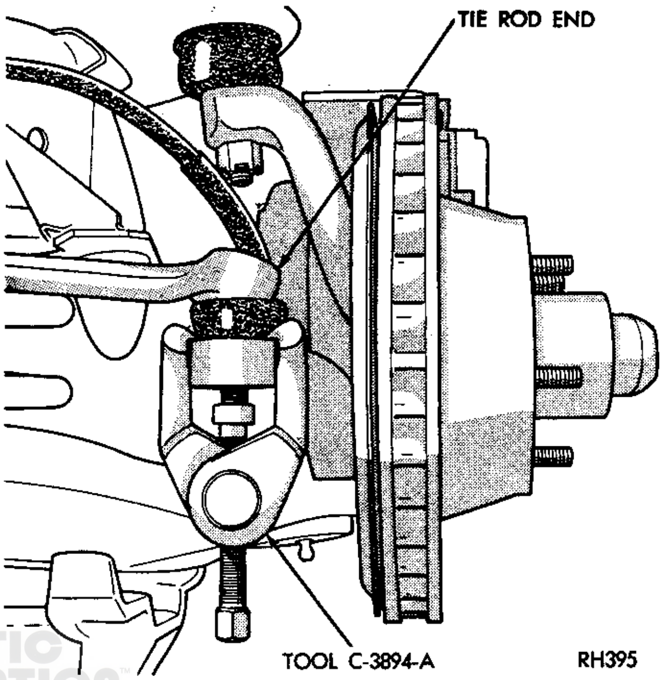


Fig. 11 Tie-Rod End Ball Stud Removal

(8) Remove the shock absorber from the vehicle and the shock absorber upper bushing from the frame rail bracket (Fig. 2). If necessary, refer to the removal procedure.

(9) Remove the strut bar (Fig. 1). If necessary, refer to the removal procedure. If equipped, disconnect the stabilizer bar from the lower suspension arm (Fig. 3).

(10) Install Spring Compressor Tool DD-1278 in the spring (Fig. 4) and tighten the nut "finger-tight", and then loosen the nut 1/2 of-a-turn.

(11) Remove the cotter pins and the lower and upper ball stud nuts at the steering knuckle.

(12) Install Ball Stud Loosening Tool C-3564-A on the lower ball stud (Fig. 4). Turn the threaded portion of the tool and "lock" the tool securely against the lower stud (Fig. 4).

(13) Expand the tool sufficiently enough to place force on the lower ball stud and then strike the steering knuckle sharply with a hammer to loosen the stud. **Do not attempt to force the ball stud out of the steering knuckle bore with the loosening tool.**

(14) Remove the loosening tool and remove the lower ball stud from the steering knuckle bore with an appropriate tool.

(15) Reverse the position of Ball Stud Loosening Tool C-3564-A (Fig. 12), turn the threaded portion of the tool to "lock" it securely against the upper ball stud. Spread the tool enough to apply force against the upper ball stud, then strike the steering knuckle sharply with a hammer to loosen the ball stud. Do not attempt to force the stud out of the steering knuckle bore with the loosening tool.

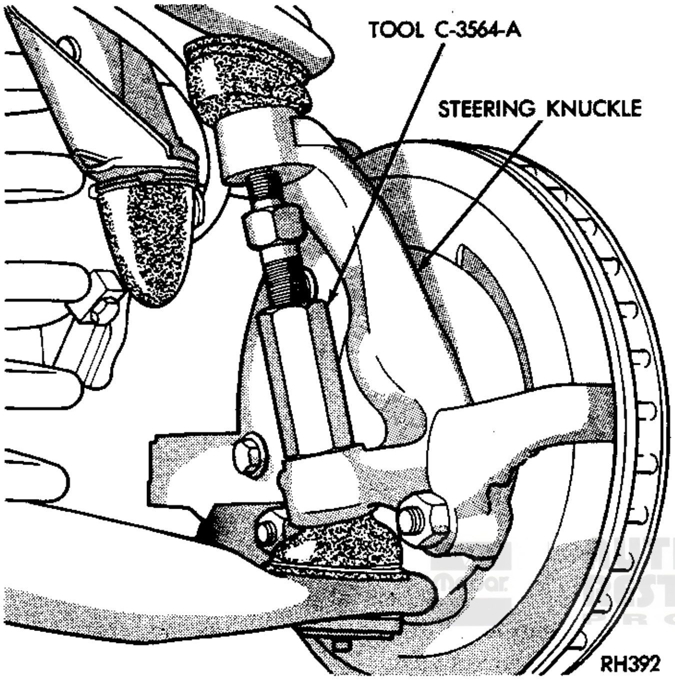


Fig. 12 Loosening Upper Ball Stud

(16) Remove the loosening tool.

(17) Remove the upper ball stud from the steering knuckle bore with an appropriate tool.

(18) Slowly loosen the coil spring compressor tool (Fig. 4) until all tension is relieved from the spring.

(19) Separate the steering knuckle and the steering knuckle arm from the ball studs and position it on a bench or other work surface.

(20) Remove the brake adapter and steering knuckle attaching bolts from the steering knuckle. Separate the components.

INSTALLATION

(1) Install the brake adaptor on the steering knuckle and tighten the attaching bolts with 136 N•m (100 ft-lbs) torque.

(2) Align the steering knuckle arm bolt holes with the steering knuckle bolt holes. Install the attaching bolts and tighten with 291 N•m (215 ft-lbs) torque.

(3) Position the steering knuckle between the suspension arms.

(4) Compress the coil spring with the spring compressor tool (Fig. 4) until the suspension arm ball studs can be inserted in the steering knuckle bores. Insert the ball studs in the bores. Install the retaining nuts. Tighten the upper nut with 142 N•m (105 ft-lbs) torque and the lower nut, if a 11/16-16 bolt, with 183 N•m (135 ft-lbs) torque or, if a 3/4-16 bolt, with 237 N•m (175 ft-lbs) torque. Install replacement cotter pins.

(5) Connect the tie-rod end ball stud to the steering knuckle arm bore. Install and tighten the retaining nut with 61 N•m (45 ft-lbs) torque. Install a replacement cotter pin.

(6) Position a replacement dust seal on the steering knuckle. Install the splash shield and tighten the attaching bolts with 25 N•m (220 in-lbs) torque.

(7) Install the strut (Fig. 1). Tighten the strut-to-lower suspension arm bolts with 136 N•m (100 ft-lbs) torque. Tighten the strut front nut with 70 N•m (50 ft-lbs) torque. Install the spring pin.

(8) Connect the stabilizer bar (if equipped) and tighten the link nut with 11 N•m (100 in-lbs) torque (Fig. 3). Remove the spring compressor tool (Fig. 4).

(9) Install the shock absorber bushing in the frame rail bracket. Place the lower retainer on the stud and position the shock absorber inside the coil spring (Fig. 2). Install and tighten the upper stud nut and the lower retaining bolts "finger-tight".

After the vehicle has been lowered to the surface and with the wheels/tires supporting the vehicle weight, tighten the shock absorber stud nut with 34 N•m (25 ft-lbs) torque and the lower retaining bolts with 23 N•m (17 ft-lbs/200 in-lbs).

(10) Carefully install the hub/rotor on the steering knuckle spindle, followed by the outer wheel bearing, the washer and the adjustment nut. Tighten the adjustment nut with 48 N•m (35 ft-lbs) torque while rotating hub/rotor. Stop the hub/rotor rotation and loosen the adjustment nut to completely release the wheel bearing "preload". Next, tighten the adjustment nut "finger-tight", and install nut lock and cotter pin. The result of the adjustment should be 0.0001 to 0.003 inch (0.0025 to 0.76 mm) "end play". Clean the dust cap, apply a light coat of wheel bearing lubricant to the inside surface and install it on the hub.

(11) Position the inboard brake pad on the brake caliper adapter with the pad flanges engaged with the adapter rails. Slowly slide the caliper into position in the adapter and over the brake rotor. Align the caliper on the adapter rails. **Use care to avoid pulling the protective dust boot from the grooves as the caliper piston and boot slide over the inboard brake pad.**

If necessary, refer to Group 5—Brakes for additional installation information.

(12) Install the anti-rattle springs and the retainer clips, and tighten with 20 N•m (15 ft-lbs/180 in-lbs) torque.

The inboard shoe anti-rattle spring must always be installed on top of the retainer spring plate.

(13) Install the wheel/tire and the wheel cover. Raise the vehicle, remove the supports, lower the vehicle and remove the block from the brake pedal.

(14) Tighten the shock absorber stud nut with 34 N•m (25 ft-lbs) torque and the lower attaching bolts with 23 N•m (17 ft-lbs/200 in-lbs) torque.

(15) Test the vehicle brakes and the front suspension for proper operation.

MODEL 44 FRONT AXLE SERVICE—4WD VEHICLES

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GENERAL INFORMATION

The Model 44 front axle used for Ram Truck and Ramcharger vehicles equipped for standard duty 4WD operation has a hypoid gear differential and the centerline of the drive pinion gear shaft is located below the centerline of the ring gear. The differential housing is an iron casting with tubes "pressed" into and welded to it to produce a one-piece axle housing. A removable stamped steel cover is attached to the differential housing to allow visual inspection of the differential without removing the complete axle from the vehicle.

A small metal tag is attached to the differential housing (by one of the cover screws) to identify the axle ratio. This tag is stamped with the number of teeth on the drive pinion and ring gear, and the axle ratio.

The drive pinion gear shaft is supported by two "preloaded", tapered roller bearings. The inner bearing has a tight "press-fit" on the drive pinion gear shaft. The outer bearing has a light "press-fit"-to-a close "sliding-fit" on the shaft. The outer and inner bearing cups are "press-fitted" against a shoulder that is recessed in the differential housing.

The drive pinion gear depth of mesh (with the ring gear) adjustment is controlled by shims, which are installed between the inner drive pinion gear shaft bearing cup and the differential housing shoulder.

The drive pinion gear shaft bearing "preload" torque is maintained by placing appropriate thickness of shims between the differential housing shoulder and the outer bearing.

The differential case is supported by two tapered, roller bearings that are "press-fitted" on the differential case hubs. The shims placed between the bearing and the differential case hub shoulder provide three functions:

- they eliminate the differential case "side play";
- they adjust and maintain the "backlash" between the ring gear and the drive pinion gear; and
- they establish a means for obtaining and then retaining the differential bearing "preload" torque.

The axle shaft disconnect housing is welded to the left axle shaft tube between the differential housing and the spring pad. A splined, two-piece axle shaft is located on the left side and it is mechanically engaged or disengaged by a shift collar that is moved by a vacuum shift motor controlled shift fork. The shift motor is operated by vacuum that is controlled by a vacuum switch located at the transfer case.

CAUTION: Whenever front axle service is necessary, or when the axle is being rotated via the engine or other means, raise all four wheels off the surface.

ROTOR/HUB AND BEARING SERVICE

REMOVAL/DISASSEMBLY

(1) Block the brake pedal in the "up" (non-depressed) position. Raise the vehicle on a hoist. Position supports at the extreme front ends of the frame rails and lower the hoist. Remove the applicable wheel cover and wheel/tire.

(2) Remove the brake caliper retainer and the anti-rattle spring. Remove the brake caliper from the disc rotor by sliding it out and then away from the rotor. If necessary, refer to Group 5—Brakes for removal information. Support the brake caliper out-of-the-way. **Do not allow the caliper to hang from or be supported by the brake fluid hose.** Remove the inboard brake pad.

(3) Remove the dust cap and the driving hub snap ring.

(4) Remove the driving hub and the retaining spring.

(5) Use Tool C-4170-A to remove the wheel bearing nut lock (Fig. 1). Remove the retaining washer and the wheel bearing adjusting nut (Fig. 2).

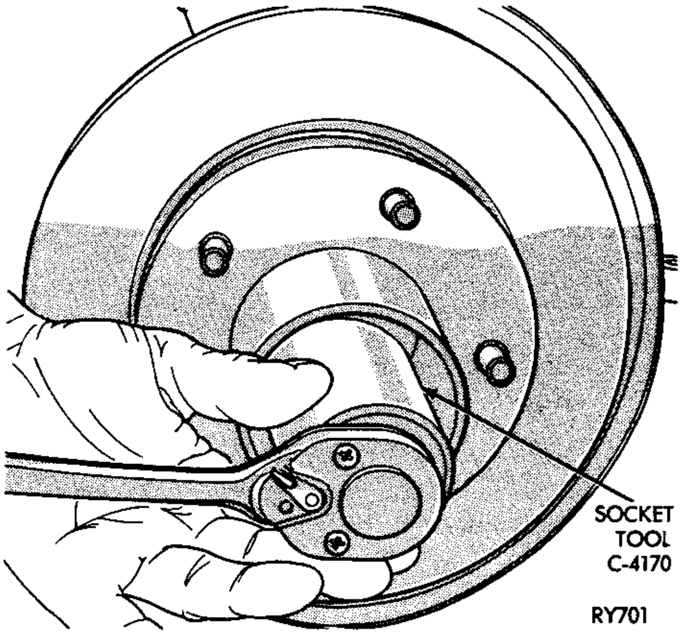


Fig. 1 Wheel Bearing Nut Lock Removal

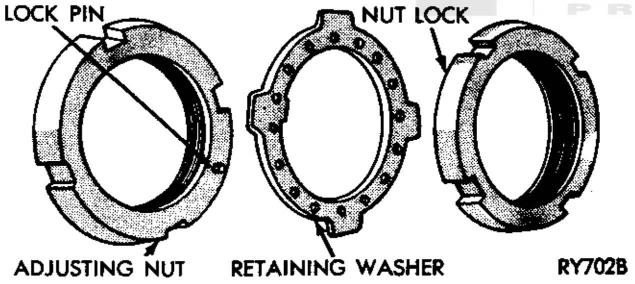


Fig. 2 Wheel Bearing Adjusting Nut, Retaining Washer & Nut Lock

(6) Remove rotor/hub. The outer wheel bearing and the retainer spring plate will slide out as rotor/hub is removed.

(7) Pry the inner wheel bearing seal from hub and remove the inner wheel bearing.

(8) Remove the inner and outer bearing cups.

INSPECTION

(1) Wash the bearings in clean mineral spirits. Inspect and "re-pack" the bearings. If necessary, refer to Group 0—Lubrication And Maintenance for additional information.

ASSEMBLY/INSTALLATION

(1) Install inner and outer bearing cups in the rotor/hub.

(2) Place the "re-packed" inner bearing into position in the hub and, using Tool D-359 and C-4171 Handle, install the bearing seal.

(3) Position the rotor/hub on the steering knuckle spindle and install the "re-packed" inner wheel bearing.

(4) Install the adjusting nut and, using Tool C-4170, tighten it with 68 N•m (50 ft-lbs) torque to "seat" the wheel bearings. Loosen adjusting nut and re-tighten it with 41-54 N•m (30-40 ft-lbs) torque while rotating rotor/hub. Loosen the adjusting nut 135° to 150°. Position the retaining washer on the adjusting nut by rotating the nut so that the alignment pin pressed into the nut will enter the nearest hole in the retaining washer. Install and tighten the nut lock with 68 N•m (50 ft-lbs) torque. The wheel bearing "end play" after the final bearing adjustment should be within 0.001 inch to 0.010 inch (0.03 to 0.25 mm).

(5) Install the retaining spring, the driving hub and the retaining ring.

(6) Apply RTV sealant to the sealing edge of the dust cap and install it on the hub.

(7) Position the inboard brake pad on the brake caliper adapter with the pad flanges engaged with the adapter rails. Slowly slide the caliper into position in the adapter and over the brake rotor. Align the caliper on the adapter rails. **Use care to avoid pulling the protective dust boot from the grooves as the caliper piston and boot slide over the inboard brake pad.**

If necessary, refer to Group 5—Brakes for additional installation information.

(8) Install the anti-rattle springs and the retainer clips, and tighten with 20 N•m (15 ft-lbs/180 in-lbs) torque.

The inboard shoe anti-rattle spring must always be installed on top of the retainer spring plate.

(9) Install the wheel/tire. Tighten the lug nuts with 149 N•m (110 ft-lbs). Install the wheel cover. Raise the vehicle, remove the supports, lower the vehicle and remove the block from the brake pedal.

STEERING KNUCKLE, SPINDLE AND BALL STUD SERVICE

REMOVAL/DISASSEMBLY

(1) Block the brake pedal in the "up" (non-depressed) position. Raise the vehicle on a hoist. Position supports at the extreme front ends of the frame rails and lower the hoist. Remove the applicable wheel cover and wheel/tire.

(2) Remove the brake caliper retainer and the anti-rattle spring. Remove the brake caliper from the disc rotor by sliding it out and then away from the rotor. If necessary, refer to Group 5—Brakes for removal

information. Support the brake caliper out-of-the-way. **Do not allow the caliper to hang from or be supported by the brake fluid hose.** Remove the inboard brake pad.

(3) Remove the dust cap and the driving hub snap ring.

(4) Remove the driving hub and the retaining spring.

(5) Use Tool C-4170-A to remove the wheel bearing nut lock (Fig. 1). Remove the retaining washer and the wheel bearing adjusting nut (Fig. 2).

(6) Remove rotor/hub. The outer wheel bearing and the retainer spring plate will slide out as rotor/hub is removed.

(7) Remove brake caliper adaptor from the steering knuckle.

(8) Remove the six "torque retaining" nuts and washers from the spindle-to-steering knuckle attaching bolts.

(9) Remove the brake splash shield.

(10) Use a soft-faced hammer to lightly strike the spindle and loosen it from the steering knuckle (Fig. 3).

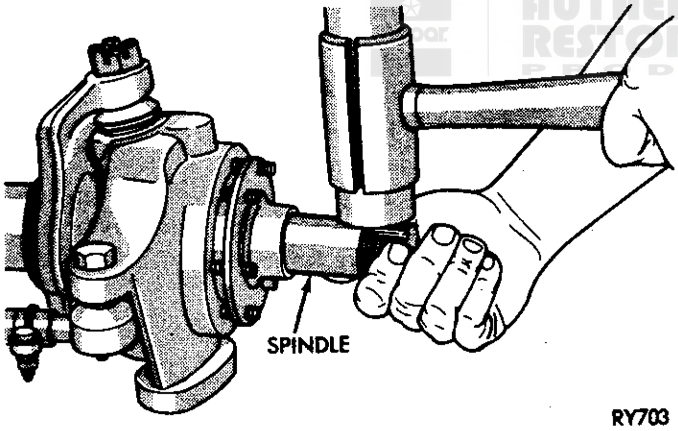


Fig. 3 Spindle Removal From Steering Knuckle

(11) Clamp the spindle in a "soft-jawed" vise. Do not clamp at the bearing contact surfaces. Remove the bearing seal.

(12) Use Tool D-131 the remove needle bearings from the spindle (Fig. 4).

(13) Carefully remove the axle shaft from the axle shaft tube. Remove the seal from the axle shaft.

(14) Right side only: disconnect the tie-rod end ball stud from the steering knuckle arm bore. Left side: disconnect the drag link ball stud from the steering knuckle arm bore. If necessary, refer to the removal procedures within this section of Group 2.

(15) Left side only: remove the nuts and the washers from the steering knuckle arm. Tap the steering knuckle arm to loosen it from the steering knuckle. Remove steering knuckle arm.

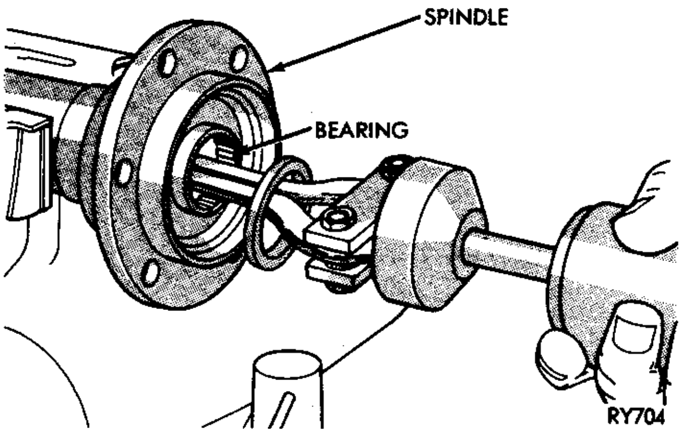


Fig. 4 Needle Bearing Removal (Right-Side Spindle)

(16) Remove the cotter pin from the upper ball stud nut. Remove the upper and lower ball stud nuts. Discard the lower nut.

(17) Use a brass drift and a hammer to separate the steering knuckle from the axle shaft tube yoke. Use Tool C-4169 to remove the sleeve from the axle shaft tube upper yoke arm. Discard the sleeve.

(18) Clamp the steering knuckle upside down in a vise and remove the "snap" retaining ring from the lower ball stud with Snap Ring Pliers Tool C-4020 (Fig. 5).

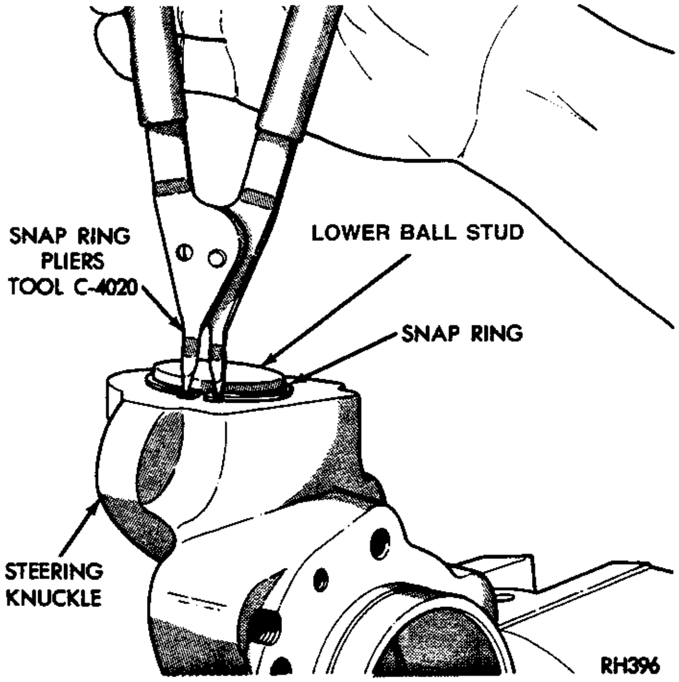


Fig. 5 "Snap" Retaining Ring Removal/Installation

(19) Use Tool C-4212-L and Adaptor Tool Set C-4288 (positioned as illustrated in Figure 6) to force the lower ball stud from the steering knuckle bore. Re-position the tools as illustrated in Figure 7 and force the upper ball stud from the steering knuckle bore. Replace the ball studs if any looseness or "end play" exists.

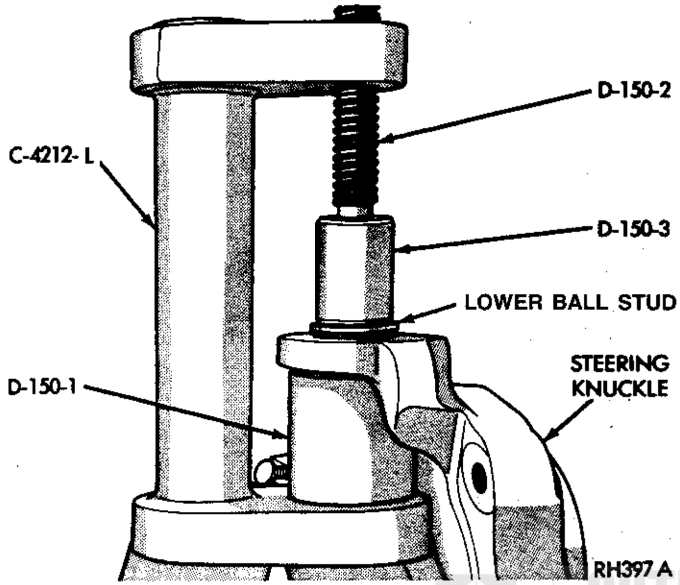


Fig. 6 Lower Ball Stud Removal

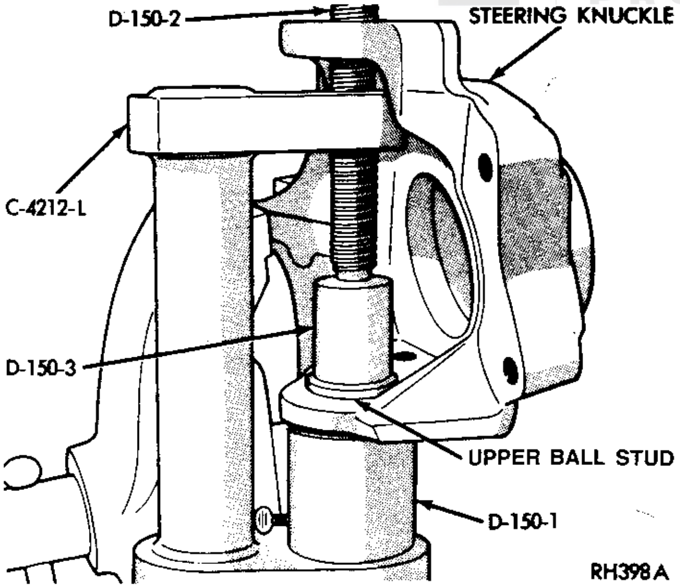


Fig. 7 Upper Ball Stud Removal

(20) Clean all the components with an appropriate cleaning solvent and air dry them with compressed air. Inspect all the components for burrs, chips, excessive wear and cracks. Replace components as necessary during assembly.

ASSEMBLY/INSTALLATION

(1) Clamp the steering knuckle right side up in a vise. Use Tool C-4212-L and Adaptor Tool Set C-4288 (positioned as illustrated in Figure 8) to carefully force the lower ball stud into the steering knuckle bore. Install the "snap" retaining ring with Snap Ring Pliers Tool C-4020.

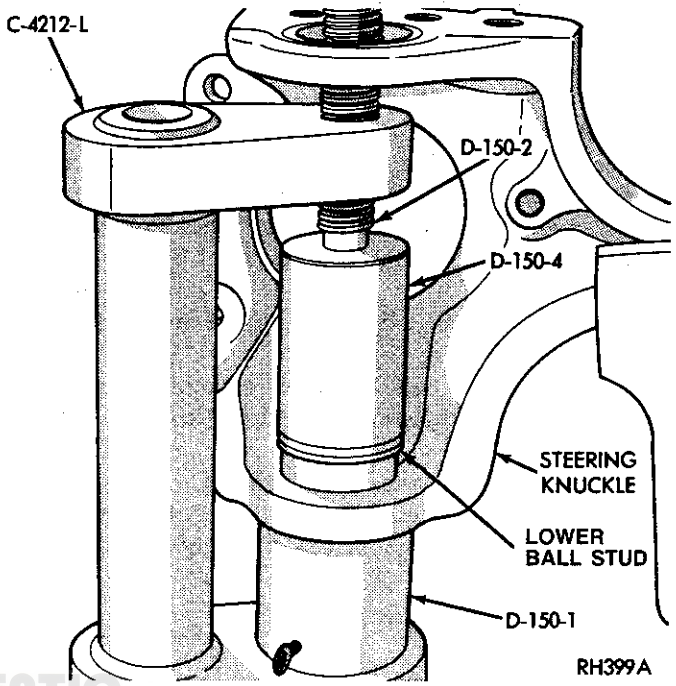


Fig. 8 Lower Ball Stud Installation

(2) Use Tool C-4212-L and Adaptor Tool Set C-4288 (positioned as illustrated in Figure 9) to carefully force the upper ball stud into the steering knuckle bore. Install replacement rubber boots over both ball studs. Remove the steering knuckle from the vise.

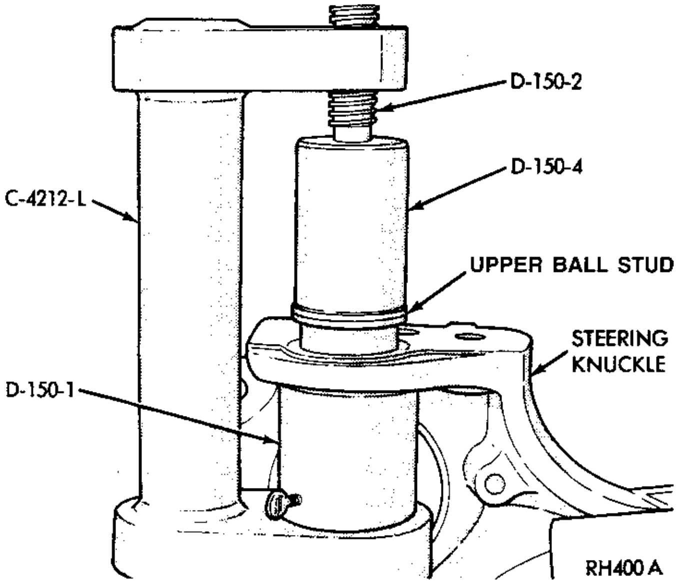


Fig. 9 Upper Ball Stud Installation

(3) Thread a replacement sleeve into the axle shaft tube yoke upper arm bore. Allow approximately two threads to remain exposed at the top of the arm.

(4) Position the steering knuckle on the axle shaft tube yoke arms and install a replacement lower ball stud nut. Tighten the nut with 108 N•m (80 ft-lbs) torque.

(5) Use Tool C-4169 and a torque wrench to tighten the sleeve in the yoke upper arm bore with 54 N• (40 ft-lbs) torque. Install the upper ball stud nut and tighten it with 136 N•m (100 ft-lbs) torque.

(6) Continue to tighten the nut until the cotter pin hole in the stud and the slot in castellated nut are aligned. Do not loosen the nut to align the hole and the slot. Install a replacement cotter pin.

(7) Left side: position the steering knuckle arm over the studs on the steering knuckle. Install the washer and the nuts. Tighten the nuts with 122 N•m (90 ft-lbs) torque. Connect the drag link ball stud to the steering knuckle arm bore. Install the retaining nut and tighten it with 81 N•m (60 ft-lbs) torque. Install a replacement cotter pin.

(8) Connect the tie-rod end ball stud to the steering knuckle arm bore. Install the retaining nut and tighten it with 61 N•m (45 ft-lbs) torque. Install a replacement cotter pin.

(9) Install the seal on the axle shaft shield with the lip facing toward the axle shaft splines (Fig. 10). Lubricate the complete circumference of the seal (Fig. 11) with multi-purpose lubricant (NLGI Grade 2, EP or an equivalent lubricant).

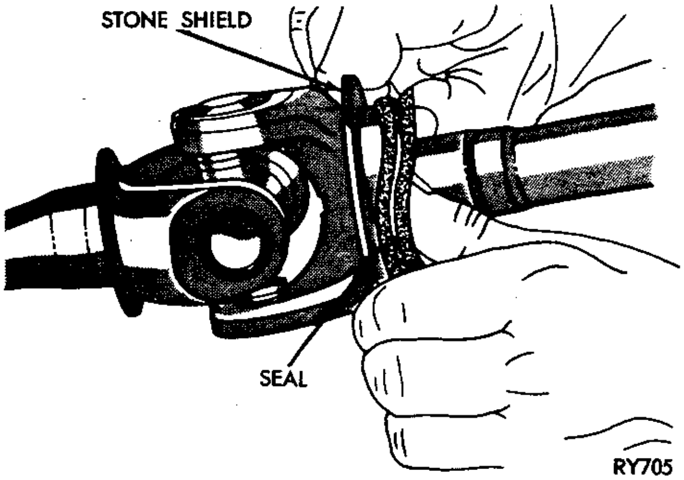


Fig. 10 Seal Installation On Axle Shaft Shield

(10) Right side only: carefully insert the axle shaft into the axle shaft tube and avoid damaging the differential housing seal.

(11) Left side only—proceed with the following instructions:

- remove the shift motor housing cover;
- position the shift collar on the splined end of the inner axle shaft;
- insert the intermediate (outer) axle shaft through axle shaft seal (use care to avoid damaging the seal during this step);

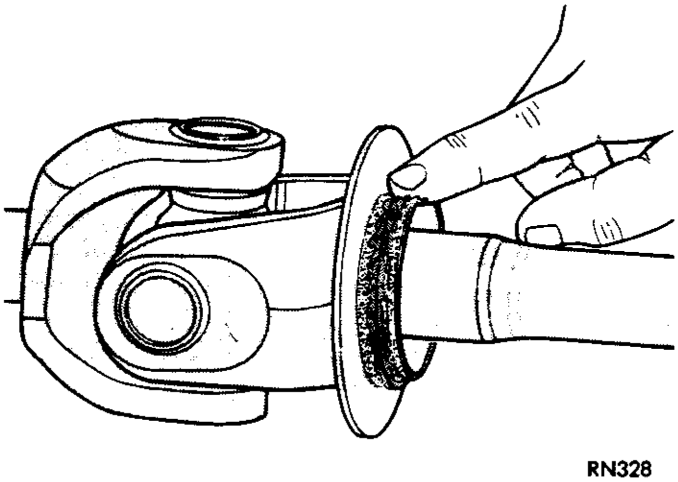


Fig. 11 Lubricating Seal

- install the shift motor housing gasket and cover (ensure that the shift fork is correctly guided into the shift collar groove);
- install the shift motor housing cover shield and bolts, and tighten the bolts with 14 N•m (10 ft-lbs) torque; and
- connect the vacuum hoses to the shift motor ports and the wire connector to the 4WD indicator switch (wrap the retaining clip securely around switch connector).

(12) Install replacement needle bearings in the spindle with Installation Tool D-122 and Handle Tool C-4171.

(13) Use Tool D-155 and Handle Tool C-4171 to install the replacement brake hub seal. Lubricate the complete circumference of the seal and the contact surface on the spindle with multi-purpose lubricant (NLGI Grade 2, EP or an equivalent lubricant).

(14) Position the replacement spacer on the axle shaft, and install the spindle and brake splash shield.

(15) Install replacement nuts and tighten them with 34-41 N•m (25-35 ft-lbs) torque.

(16) Position the rotor/hub and the outer wheel bearing on the spindle.

(17) Install the adjusting nut and, using Tool C-4170, tighten it with 68 N•m (50 ft-lbs) torque to "seat" the wheel bearings. Loosen adjusting nut and re-tighten it with 41-54 N•m (30-40 ft-lbs) torque while rotating rotor/hub. Loosen the adjusting nut 135° to 150°. Position the retaining washer on the adjusting nut by rotating the nut so that the alignment pin pressed into the nut will enter the nearest hole in the retaining washer. Install and tighten the nut lock with 68 N•m (50 ft-lbs) torque. The wheel bearing "end play" after the final bearing adjustment should be within 0.001 inch to 0.010 inch (0.03 to 0.25 mm).

(18) Install the retaining spring, the driving hub and the retaining ring.

(19) Apply RTV sealant to the sealing edge of the dust cap and install it on the hub.

(20) Position the inboard brake pad on the brake caliper adapter with the pad flanges engaged with the adapter rails. Slowly slide the caliper into position in the adapter and over the brake rotor. Align the caliper on the adapter rails. **Use care to avoid pulling the protective dust boot from the grooves as the caliper piston and boot slide over the inboard brake pad.**

If necessary, refer to Group 5—Brakes for additional installation information.

(21) Install the anti-rattle springs and the retainer clips, and tighten with 20 N•m (15 ft-lbs/180 in-lbs) torque.

The inboard shoe anti-rattle spring must always be installed on top of the retainer spring plate.

(22) Install the wheel/tire. Tighten the lug nuts with 149 N•m (110 ft-lbs). Install the wheel cover. Raise the vehicle, remove the supports, lower the vehicle and remove the block from the brake pedal.

RIGHT AXLE SHAFT REMOVAL/INSTALLATION

REMOVAL

(1) Block the brake pedal in the "up" (non-depressed) position. Raise the vehicle on a hoist. Position supports at the extreme front ends of the frame rails and lower the hoist. Remove the applicable wheel cover and wheel/tire.

(2) Remove the brake caliper retainer and the anti-rattle spring. Remove the brake caliper from the disc rotor by sliding it out and then away from the rotor. If necessary, refer to Group 5—Brakes for removal information. Support the brake caliper out-of-the-way. **Do not allow the caliper to hang from or be supported by the brake fluid hose.** Remove the inboard brake pad.

(3) Remove the dust cap and the driving hub snap ring.

(4) Remove the driving hub and the retaining spring.

(5) Use Tool C-4170-A to remove the wheel bearing nut lock (Fig. 1). Remove the retaining washer and the wheel bearing adjusting nut (Fig. 2).

(6) Remove the rotor/hub. The outer wheel bearing and the retainer spring plate will slide out as rotor/hub is removed.

(7) Remove the six nuts that attach the splash shield and the spindle to the steering knuckle.

(8) Remove the splash shield and the spindle.

(9) Remove the brake caliper adaptor from the steering knuckle.

(10) Carefully remove the axle shaft from the axle shaft tube. Remove the seal and the stone shield from the shaft.

INSTALLATION

(1) Install the seal on the axle shaft stone shield with the lip facing toward the axle shaft splines.

(2) Carefully insert the axle shaft into the axle shaft tube and avoid damaging the differential housing seal.

(3) Install the spindle and the splash shield. Install the nuts and tighten them with 34-41 N•m (25-30 ft-lbs) torque.

(4) Position the rotor/hub and the outer wheel bearing on the spindle.

(5) Install the adjusting nut and, using Tool C-4170, tighten it with 68 N•m (50 ft-lbs) torque to "seat" the wheel bearings. Loosen adjusting nut and re-tighten it with 41-54 N•m (30-40 ft-lbs) torque while rotating rotor/hub. Loosen the adjusting nut 135° to 150°. Position the retaining washer on the adjusting nut by rotating the nut so that the alignment pin pressed into the nut will enter the nearest hole in the retaining washer. Install and tighten the nut lock with 68 N•m (50 ft-lbs) torque. The wheel bearing "end play" after the final bearing adjustment should be within 0.001 inch to 0.010 inch (0.03 to 0.25 mm).

(6) Install the retaining spring, the driving hub and the retaining ring.

(7) Apply RTV sealant to the sealing edge of the dust cap and install it on the hub.

(8) Position the inboard brake pad on the brake caliper adapter with the pad flanges engaged with the adapter rails. Slowly slide the caliper into position in the adapter and over the brake rotor. Align the caliper on the adapter rails. **Use care to avoid pulling the protective dust boot from the grooves as the caliper piston and boot slide over the inboard brake pad.**

If necessary, refer to Group 5—Brakes for additional installation information.

(9) Install the anti-rattle springs and the retainer clips, and tighten with 20 N•m (15 ft-lbs/180 in-lbs) torque.

The inboard shoe anti-rattle spring must always be installed on top of the retainer spring plate.

(10) Install the wheel/tire. Tighten the lug nuts with 149 N•m (110 ft-lbs). Install the wheel cover. Raise the vehicle, remove the supports, lower the vehicle and remove the block from the brake pedal.

U-JOINT SERVICE

DISASSEMBLY

(1) Remove the "snap" retaining rings from the yoke arm bores.

(2) Position the U-joint between open vise jaws with one yoke horizontal and supported by the top of the vise jaws (Fig. 12). Do not tighten the vise.

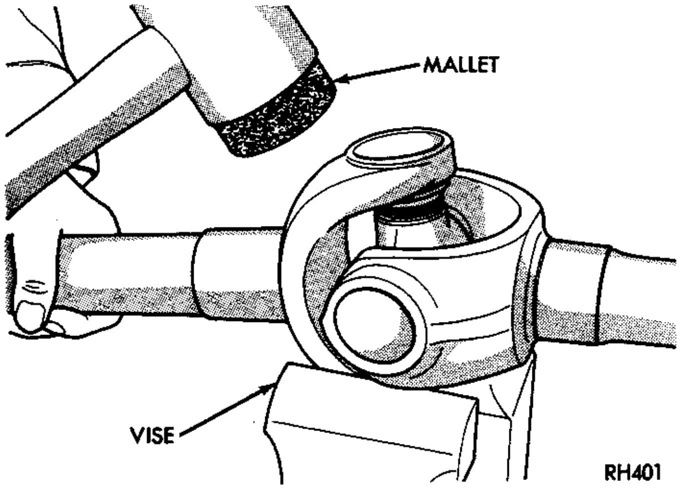


Fig. 12 Bearing Cap Removal

(3) Use a mallet to tap the vertical yoke upper arm several times and drive the vertical yoke downward (Fig. 12). This will force the upper needle bearing and cap out of the yoke.

(4) Reverse the position of the vertical yoke and remove opposite needle bearing and cap (Fig. 12).

(5) Remove the yoke from the spider.

(6) To complete the disassembly, position the open ends of the spider in a "soft-jawed" vise and repeat steps 3 and 4 (above) to remove remaining bearings and caps.

(7) Remove the spider from the yoke.

(8) Clean and inspect all the components. Clean any rust from the axle shaft splines. Retain each bearing and cap separate. If any component is excessively worn or damaged, a complete replacement U-joint should be installed.

(9) Re-pack the U-joint with MOPAR Multi-Mileage Lubricant, or an equivalent lubricant.

ASSEMBLY

(1) Insert the needle bearing and cap in one yoke arm bore.

(2) Place the yoke in a vise (Fig. 13) and force the needle bearing and cap into the correct position. Install the "snap" retaining ring.

(3) Remove the yoke from the vise and insert one end of the spider into the bearing. Insert opposite bearing and cap in the yoke arm bore by hand and align it with the spider.

(4) Place the yoke in a vise and force the cap into the yoke arm bore and onto the spider (Fig. 14).

(5) Use a short plug or a socket wrench to force the bearing cap into the correct position and install the "snap" retaining ring.

(6) Repeat the instructions in steps 1 through 5 for installing remaining bearings, caps and yoke.

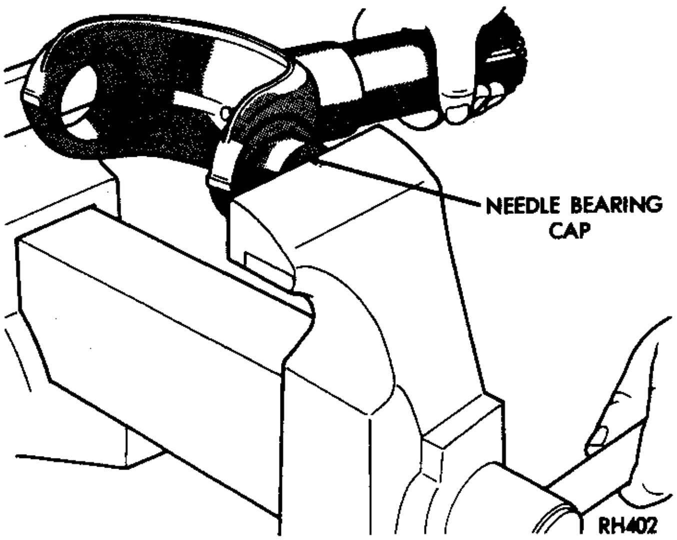


Fig. 13 Bearing Cap Installation

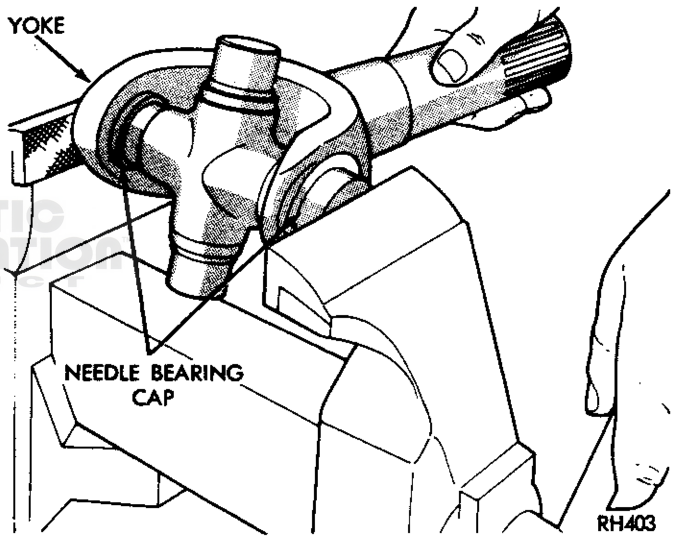


Fig. 14 Bearing Cap & Spider Installation

LEFT (DISCONNECT) AXLE SHAFT SERVICE

REMOVAL AND DISASSEMBLY

(1) Block the brake pedal in the "up" (non-depressed) position. Raise the vehicle on a hoist. Position supports at the extreme front ends of the frame rails and lower the hoist. Remove the applicable wheel cover and wheel/tire.

(2) Remove the brake caliper retainer and the anti-rattle spring. Remove the brake caliper from the disc rotor by sliding it out and then away from the rotor. If necessary, refer to Group 5—Brakes for removal information. Support the brake caliper out-of-the-way. **Do not allow the caliper to hang from or be supported by the brake fluid hose.** Remove the inboard brake pad.

(3) Remove the dust cap and the driving hub snap ring.

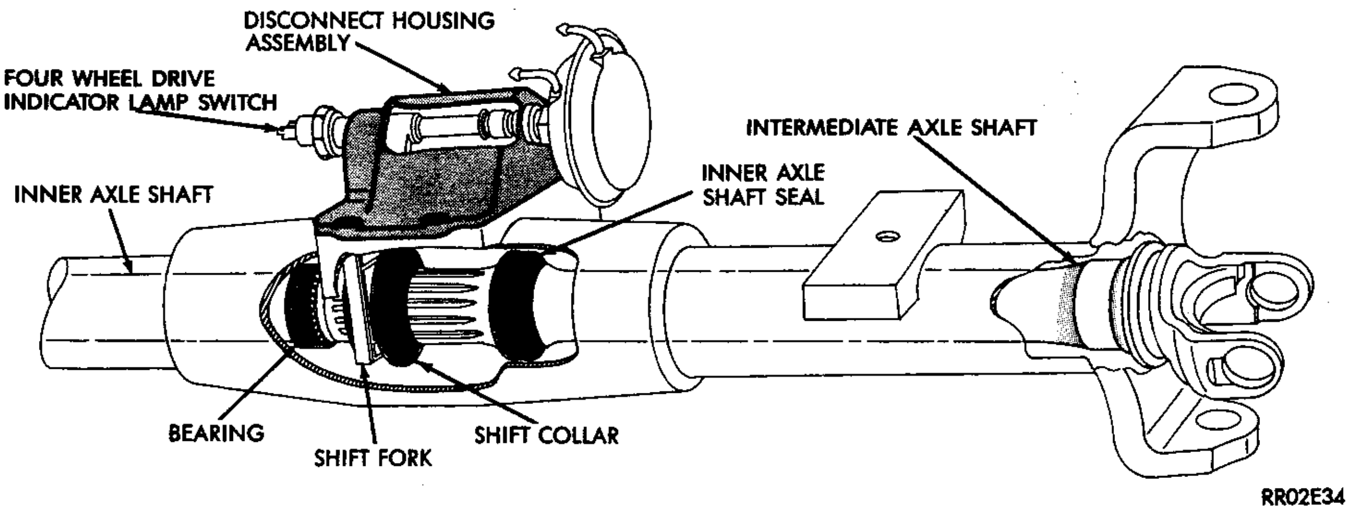


Fig. 15 Left (Disconnect) Axle

(4) Remove the driving hub and the retaining spring.

(5) Use Tool C-4170-A to remove the wheel bearing nut lock (Fig. 1). Remove the retaining washer and the wheel bearing adjusting nut (Fig. 2).

(6) Remove the rotor/hub. The outer wheel bearing and the retainer spring plate will slide out as rotor/hub is removed.

(7) Remove the six nuts that attach the splash shield and the spindle to the steering knuckle.

(8) Remove the splash shield and the spindle.

(9) Remove the brake caliper adaptor from the steering knuckle.

(10) Disconnect the vacuum hoses from the shift motor ports and the wire connector from the 4WD indicator switch.

(11) Remove the shift motor housing cover, gasket and shield (Fig. 15).

(12) Carefully remove the intermediate axle shaft from the axle shaft tube. Carefully slide the axle shaft through axle shaft seal to avoid damage to the seal.

(13) Remove the shift collar from the shift motor housing.

(14) Remove the inner axle shaft seal from the axle shaft tube and remove it from the shift motor housing. Certain vehicles could also have a seal guard; discard both components. The guard is not used with a replacement seal. Always replace the inner axle shaft seal whenever the axle shaft is removed from the axle shaft tube.

(15) Remove the needle bearing from intermediate axle shaft with Tool D-330 (Figs. 16 and 17).

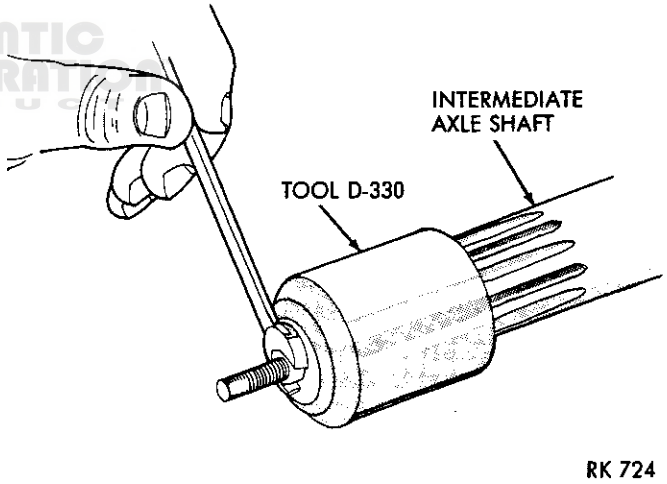


Fig. 16 Intermediate Shaft Bearing Removal

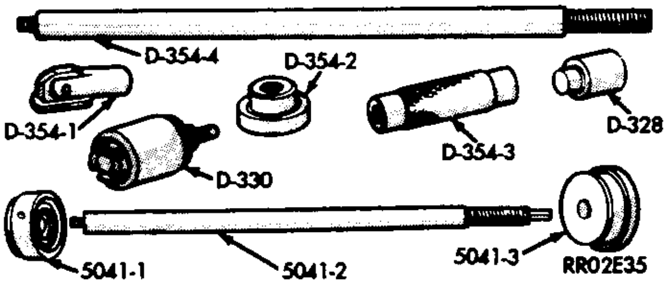


Fig. 17 Right (Disconnect) Axle Housing Service Tools

(16) Remove the differential housing cover screws and the cover. Drain the lubricant into a clean container.

(17) Force the inner axle shaft toward the center of the vehicle and remove the "C" lock from the recessed groove in the shaft.

(18) Use Tool D-354-4 and Adaptor Tool D-354-3 to remove the inner axle shaft (Fig. 18).

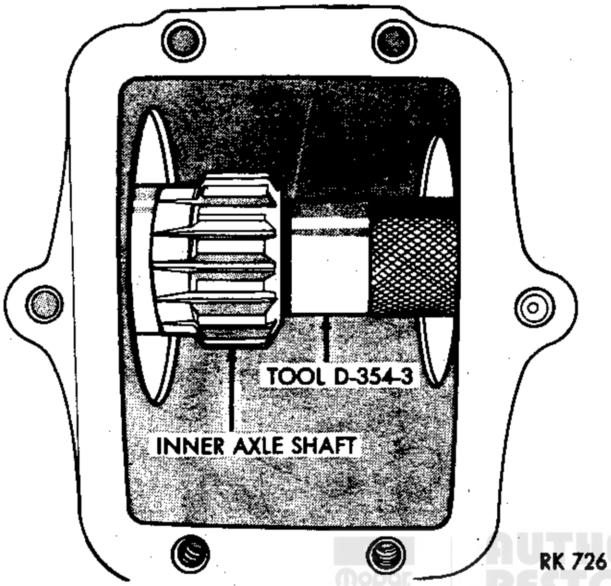


Fig. 18 Inner Axle Shaft Removal/Installation

(19) Use Tool D-354-4, Tool D-354-1, and Puller Tool C-637 to remove the inner axle shaft bearing (Figs. 16 and 18).

ASSEMBLY/INSTALLATION

(1) Use Tool D-354-4, Tool 354-2 and Tool C-637 to install the inner axle shaft bearing (Figs. 16 and 18).

(2) Insert the inner axle shaft into the axle shaft tube with Tool D-354-4 and Adaptor Tool D-354-3 (Fig. 18). Carefully slide the axle shaft in the side gear and install the "C" lock in the axle shaft recessed groove.

(3) Inspect the inner axle shaft seal contact surface and remove any material that could have remained in the axle shaft tube bore after the original seal was removed. Clean the outer axle shaft tube bore with crocus cloth and remove the rust from the area where the seal installation tool will be located.

(4) Install the replacement axle shaft seal on Tool 5041-1 and position it in the shift motor housing. Insert Threaded Bar Tool 5041-2 through the seal thread it into Tool 5041-1. Install Tool 5041-3 and the retaining nut on the end of the threaded bar tool and tighten the nut until the tool contacts the threaded bar shoulder.

(5) Install the shift collar on the splined end of the inner axle shaft.

(6) Install the needle bearing in the end of the intermediate shaft with Tool D-328 and Handle Tool C-4171 (Fig. 19).

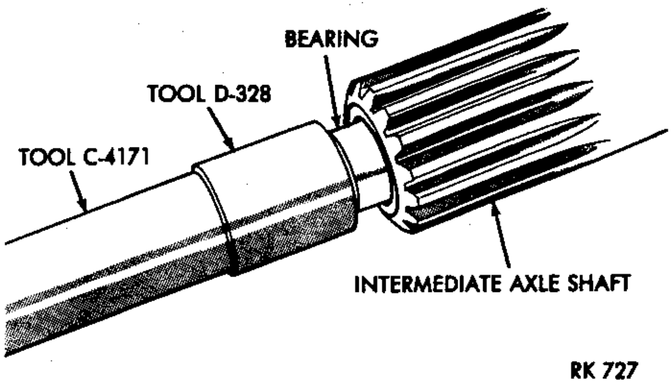


Fig. 19 Intermediate Shaft Bearing Installation

(7) Lubricate the splined end of the intermediate axle shaft with a liberal amount of multi-purpose lubricant and insert it through inner axle shaft seal. **Use care to avoid damaging the seal.**

(8) Install the shift motor housing gasket and cover. **Ensure that the shift fork is correctly guided into the shift collar groove.**

(9) Install the shift motor housing cover shield and bolts. Tighten the bolts with 14 N•m (10 ft-lbs) torque.

(10) Connect the vacuum hoses to the shift motor ports and the wire connector to the 4WD indicator switch. Wrap the retaining clip securely around the 4WD indicator switch connector.

(11) Install the splash shield and the spindle. Install the washers and replacement nuts. Tighten the nuts with 34-41 N•m (25-30 ft-lbs) torque.

(12) Position the rotor/hub and the outer wheel bearing on the spindle.

(13) Install the adjusting nut and, using Tool C-4170, tighten it with 68 N•m (50 ft-lbs) torque to "seat" the wheel bearings. Loosen adjusting nut and re-tighten it with 41-54 N•m (30-40 ft-lbs) torque while rotating rotor/hub. Loosen the adjusting nut 135° to 150°. Position the retaining washer on the adjusting nut by rotating the nut so that the alignment pin pressed into the nut will enter the nearest hole in the retaining washer. Install and tighten the nut lock with 68 N•m (50 ft-lbs) torque. The wheel bearing "end play" after the final bearing adjustment should be within 0.001 inch to 0.010 inch (0.03 to 0.25 mm).

(14) Install the retaining spring, the driving hub and the retaining ring.

(15) Apply RTV sealant to the sealing edge of the dust cap and install it on the hub.

(16) Position the inboard brake pad on the brake caliper adapter with the pad flanges engaged with the adapter rails. Slowly slide the caliper into position in the adapter and over the brake rotor. Align

the caliper on the adapter rails. **Use care to avoid pulling the protective dust boot from the grooves as the caliper piston and boot slide over the inboard brake pad.**

If necessary, refer to Group 5—Brakes for additional installation information.

(17) Install the anti-rattle springs and the retainer clips, and tighten with 20 N•m (15 ft-lbs/180 in-lbs) torque.

The inboard shoe anti-rattle spring must always be installed on top of the retainer spring plate.

(18) Remove the residual gasket material from the differential housing and the cover, thoroughly clean the contact surfaces with mineral spirits (or an equivalent solution) and dry the surfaces completely.

(19) Apply a 1/16-inch to 3/32-inch (1.6-mm to 2.4-mm) thick "bead" of MOPAR Silicone Rubber Sealant (or an equivalent sealant) around the bolt circle on the housing cover (Fig. 20).

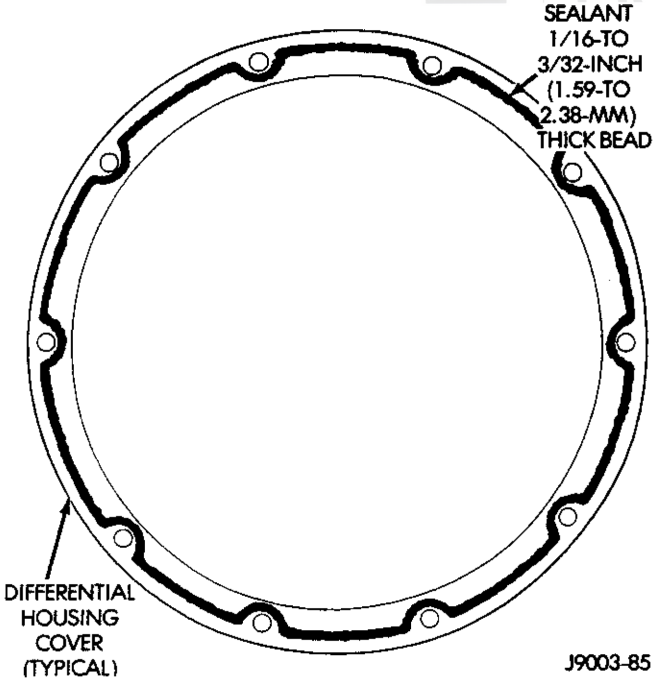


Fig. 20 Sealant On Housing Cover

Allow the sealant to "cure" for few minutes.

If for any reason the housing cover is not installed within 20 minutes after applying the sealant, the sealant must be removed and another "bead" of sealant applied.

(20) Install the housing cover on the differential housing with the attaching bolts. Install the axle gear ratio identification tag with one of the cover bolts. Tighten the cover bolts with 47 N•m (35 ft-lbs) torque.

(21) Install the wheel/tire. Tighten the lug nuts in the correct sequence (Fig. 21) with 149 N•m (110 ft-lbs). Install the wheel cover. Raise the vehicle, remove the supports and raise or lower the hoist until the vehicle is level. Remove the block from the brake pedal.

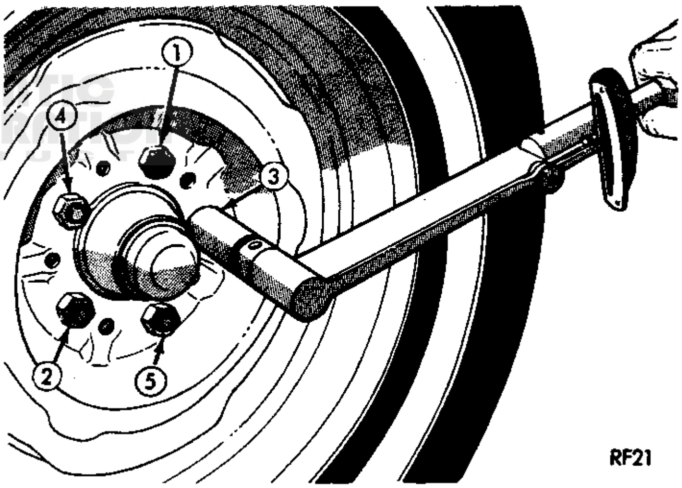


Fig. 21 Wheel Lug Nut Tightening Sequence

(22) Remove the fill hole plug and fill the differential housing and the axle tubes with lubricant (refer to the Specifications chart for the type and the quantity). Install the fill hole plug.

(23) Lower the vehicle and test the brakes and the axle for correct operation.

DISCONNECT AXLE VACUUM CONTROL SYSTEM SERVICE

DESCRIPTION

The disconnect axle vacuum control system consists of a vacuum control switch on the transfer case, an air vent filter, a vacuum shift motor (located on the left front axle tube), a 4WD indicator light and vacuum switch, two vacuum check valves, a reservoir and an interconnecting vacuum harness (Fig. 22).

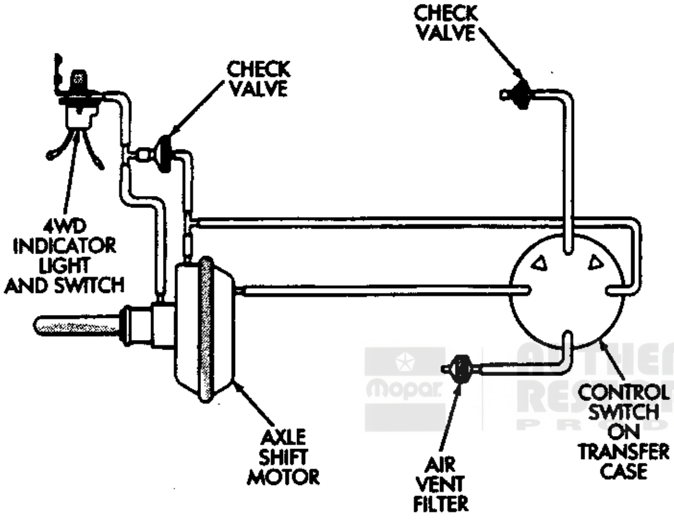


Fig. 22 Disconnect Axle Vacuum Control System

Refer to Group 21 for additional service information involving the disconnect axle control system.

AXLE SHIFT MOTOR FUNCTIONAL TEST

(1) Raise and support the vehicle. Disconnect the vacuum harness from the axle shift motor and connect a vacuum pump to the vacuum shift motor front port (Fig. 23).

(2) Apply 51 kPa (15 in. Hg) of vacuum to the front port and rotate the left front wheel to fully disengage the inner and intermediate axle shafts (i.e., shift to two-wheel drive operation).

(3) The shift motor should maintain the vacuum applied to the front port for a minimum of 30 seconds. If the motor does not maintain the vacuum, replace it. If the motor does maintain the vacuum, proceed to the next step.

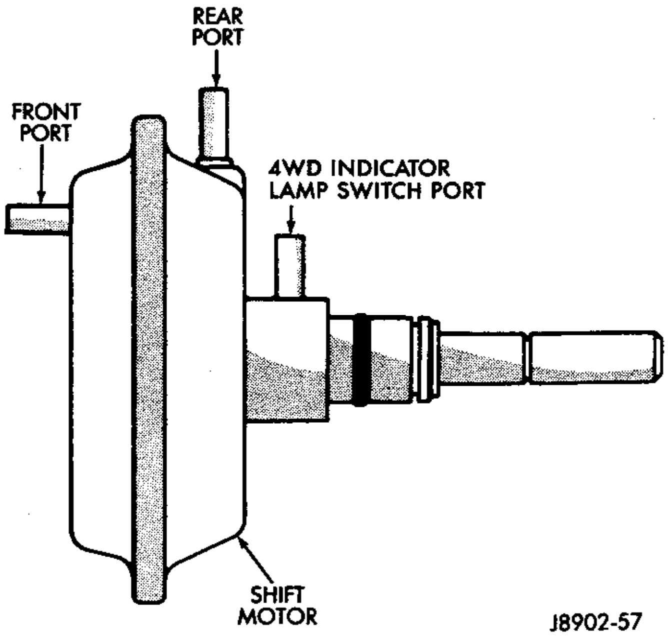


Fig. 23 Axle Vacuum Shift Motor

(4) Disconnect the vacuum pump from the vacuum shift motor front port (Fig. 23). Connect the vacuum pump to the vacuum shift motor rear port, cap the port for the 4WD indicator lamp switch, and apply 51 kPa (15 in. Hg) of vacuum to the rear port.

(5) The shift motor should maintain the vacuum applied to the rear port for a minimum of 30 seconds. If the shift motor does not maintain the vacuum, replace it. If the motor does maintain the vacuum, proceed to the next step.

(6) Remove the cap from the port for the 4WD indicator lamp switch and determine if vacuum was present at this port. If vacuum was present, the shift motor functions normally. If vacuum was not present, proceed to the next step.

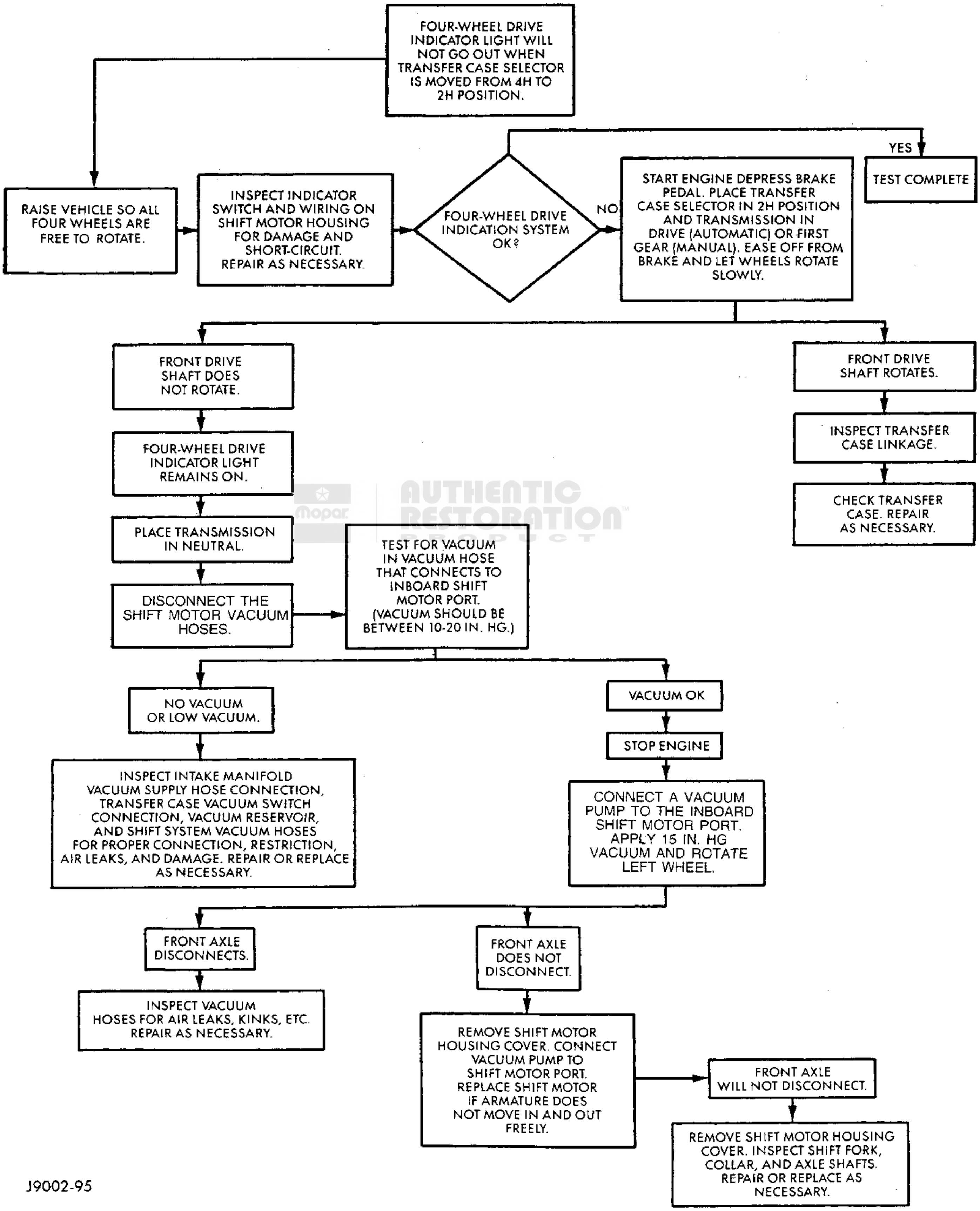
(7) Apply 51 kPa (15 in. Hg) of vacuum to the shift motor rear port. Rotate the left front wheel as necessary and ensure that the inner and intermediate axle shafts are completely engaged. The axles must be completely engaged (i.e., shifted to 4WD operation) to open the port for the 4WD indicator lamp switch.

(8) Determine if vacuum is present at the port for the 4WD indicator lamp switch again. If vacuum was present at the port, the shift motor functions normally. If vacuum was not present at the port, replace the shift motor.

(9) Connect the vacuum harness to the shift motor (Fig. 24), remove the supports and lower the vehicle.

DISCONNECT AXLE/SHIFT MOTOR DIAGNOSIS

TWO-WHEEL DRIVE OPERATION DIAGNOSIS



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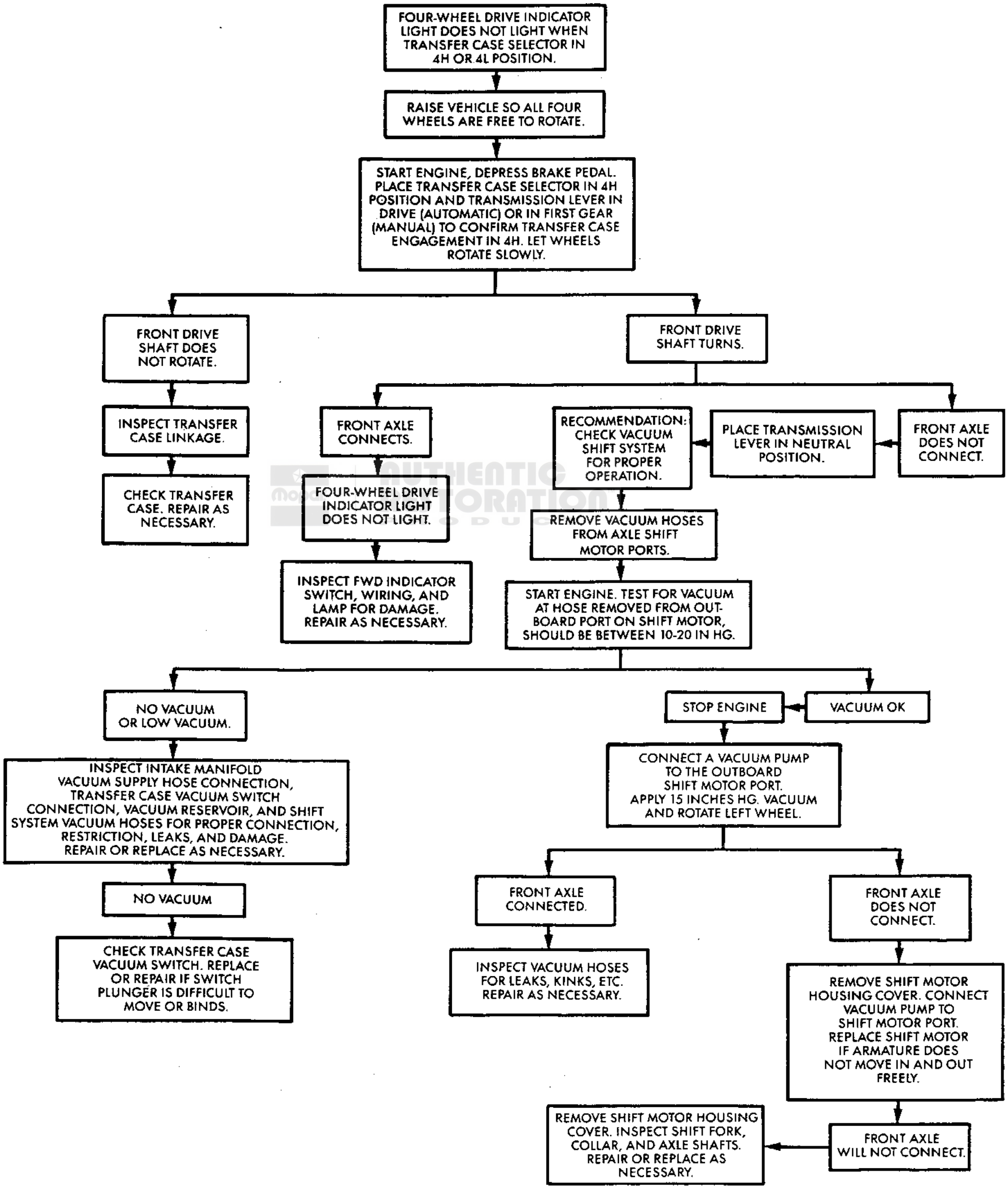
DISCONNECT AXLE/SHIFT MOTOR DIAGNOSIS (CONT'D)

FOUR-WHEEL DRIVE OPERATION DIAGNOSIS



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LET.	TORQUE	
	POUNDS	NEWTON METRES
A	FULLY SEATED HAND TIGHTENED	
B	55 IN.	6
C	15 FT.	20

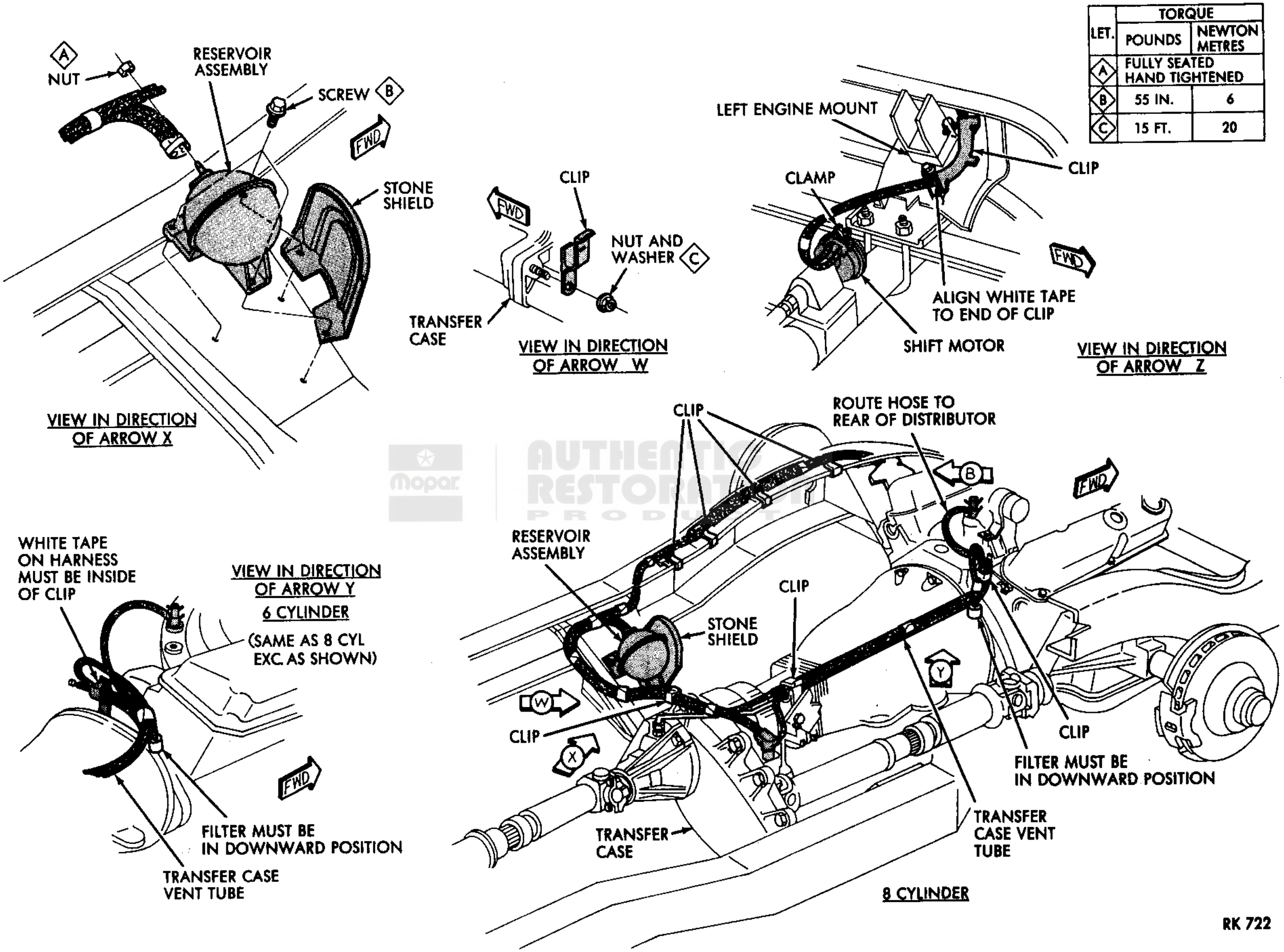


Fig. 24 Disconnect Axle Vacuum Hose Routing

SHIFT MOTOR SERVICE

REMOVAL/DISASSEMBLY

(1) Raise and support the vehicle at a comfortable working height.

(2) Disconnect the vacuum hoses from the shift motor ports and the wire connector from the 4WD indicator switch.

(3) Remove the shift motor housing cover, gasket and shield from the housing.

(4) Remove the E-clips from the shift motor housing and shaft, and remove shift motor and shift fork from the housing (Fig. 25).

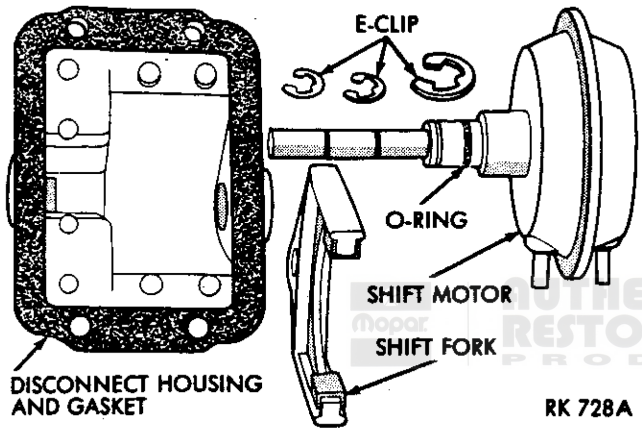


Fig. 25 Shift Motor & Axle Disconnect Components

(5) Remove the O-ring seal from the shift motor shaft (Fig. 25).

(6) Clean and inspect all the components (Fig. 25). If any component is excessively worn or damaged, it should be replaced.

ASSEMBLY/INSTALLATION

(1) Install a replacement O-ring seal on the shift motor shaft (Fig. 25).

(2) Insert the shift motor shaft through the hole in the housing and through the hole in the shift fork (Fig. 25). The shift fork offset should be toward the differential.

(3) Install the E-clips on the shift motor shaft and housing.

(4) Install the shift motor housing gasket and cover (Fig. 25). **Ensure that the shift fork is correctly guided into the shift collar groove.**

(5) Install the shift motor housing shield and attaching bolts. Tighten the bolts with 14 N•m (10 ft-lbs) torque.

STEERING KNUCKLE ARM REMOVAL/INSTALLATION

REMOVAL

The drag-link ball stud seals should be inspected for damage when the engine oil is changed.

(1) Raise and support the vehicle at a comfortable working height. Remove the wheel cover and wheel/tire.

(2) Turn the front wheels to the left. Remove the cotter pin and the retaining nut from the drag-link ball stud.

Removal of a drag-link ball stud from the steering knuckle arm by methods other than using Tool C-4150 could damage the seal.

(3) Install Puller Tool C-4150 on the drag-link ball stud (Fig. 26). Apply sufficient force with the tool to loosen the drag-link ball stud from the steering knuckle arm.

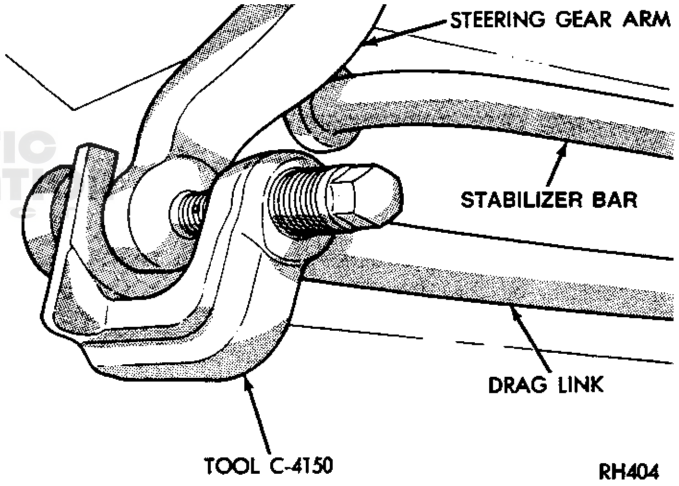


Fig. 26 Drag-Link Ball Stud Removal With Tool C-4150

(4) Remove the three steering knuckle arm-to-steering knuckle nuts and washers (Fig. 27). Tap the steering knuckle arm to loosen it from the steering knuckle. Pry upward and remove the steering knuckle arm from the vehicle.

INSTALLATION

(1) Position the steering knuckle arm on the steering knuckle. Install the washers and attaching nuts. Tighten the nuts with 122 N•m (90 ft-lbs).

(2) Connect the drag-link ball stud to the steering knuckle arm. Install the retaining nut and tighten it with 81 N•m (60 ft-lbs). Install a replacement cotter pin.

(3) Remove the supports, lower the vehicle and test the vehicle steering.

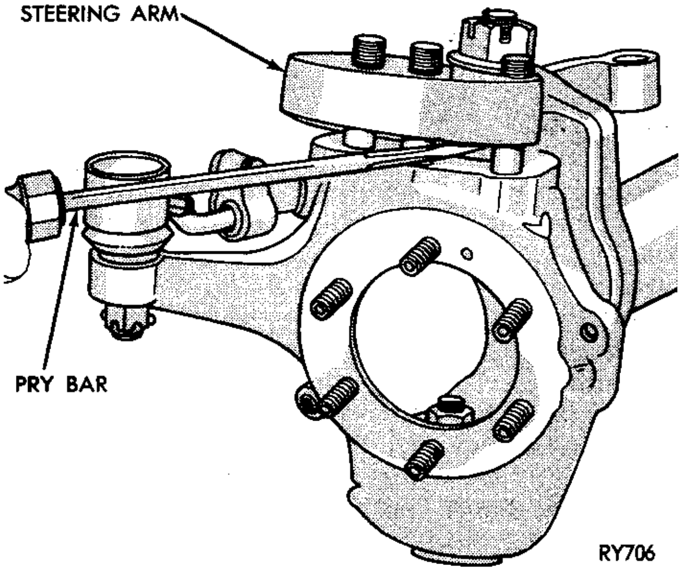


Fig. 27 Steering Knuckle Arm Removal

DRAG LINK REMOVAL/INSTALLATION

SERVICE INFORMATION

The drag-link ball stud seals should be inspected for damage when the engine oil is changed.

A damaged seal requires removal of the seal and inspection of the drag-link ball stud at the throat opening. If all the lubricant has not escaped (or is not contaminated) or the ball stud is not excessively worn or rusted, install a replacement seal. Otherwise a replacement complete drag link should be installed. Lubricate the ball studs after installation with MOPAR Multi-Mileage Lubricant or an equivalent lubricant.

REMOVAL

Removal of a drag-link ball stud from the steering knuckle arm or the pitman (steering gear) arm by methods other than using Tool C-4150 could damage the seal.

(1) Raise and support the vehicle at a comfortable working height. Remove the applicable wheel cover and wheel/tire.

(2) Turn the front wheels in the direction that will provide the best possible access to the drag link. Remove the cotter pins and the retaining nuts from the drag-link ball studs.

(3) Install Puller Tool C-4150 on each drag-link ball stud (Fig. 26). Apply sufficient force with the tool to loosen the drag-link ball stud from the steering knuckle arm and the pitman (steering gear) arm. Remove the drag link from the vehicle.

INSTALLATION

(1) Position the drag link at steering knuckle arm (Fig. 28) so that the distance "A" to the bend in the link is the shortest distance to the steering knuckle arm and the distance "B" is the closest to the pitman (steering gear) arm.

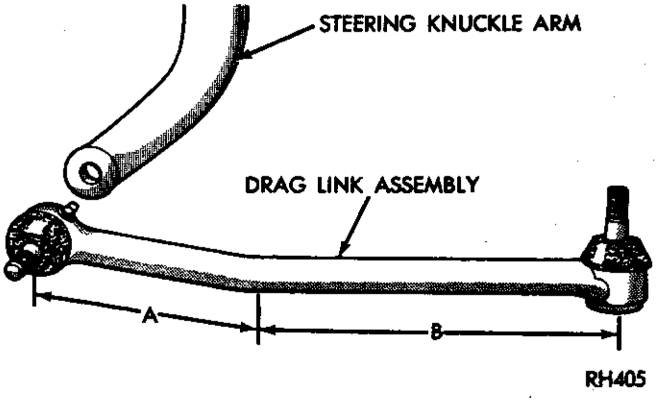


Fig. 28 Correct Drag Link Installation

(2) Install and tighten the ball stud retaining nuts with 81 N•m (60 ft-lbs) torque. Install replacement cotter pins.

(3) Install the wheel/tire and the wheel cover. Remove the supports and lower the vehicle.

TIE-ROD END REPLACEMENT

SERVICE INFORMATION

The tie-rod ball stud seals should be inspected for damage when the engine oil is changed.

A damaged seal requires removal of the seal and inspection of the tie-rod ball stud at the throat opening. If all the lubricant has not escaped (or is not contaminated) or the ball stud is not excessively worn or rusted, install a replacement seal. Otherwise a replacement complete tie-rod end should be installed. Lubricate the ball studs after installation with MOPAR Multi-Mileage Lubricant or an equivalent lubricant.

REMOVAL

Removal of a tie-rod end ball stud from the steering knuckle arm by methods other than using Tool C-3894-A could damage the seal.

(1) Raise and support the vehicle at a comfortable working height. Remove the applicable wheel cover and wheel/tire.

(2) Turn the front wheels in the direction that will provide the best possible access to the tie-rod end. Remove the cotter pin and the retaining nut from the tie-rod end ball stud.

(3) Install Puller Tool C-3894-A on the tie-rod end ball stud (Fig. 29). Apply sufficient force with the tool to loosen the tie-rod end ball stud from the steering knuckle arm.

(4) Measure and record the approximate distance from the end of the tie rod to the outside edge of the tie-rod end. Loosen the adjustment sleeve clamp nut

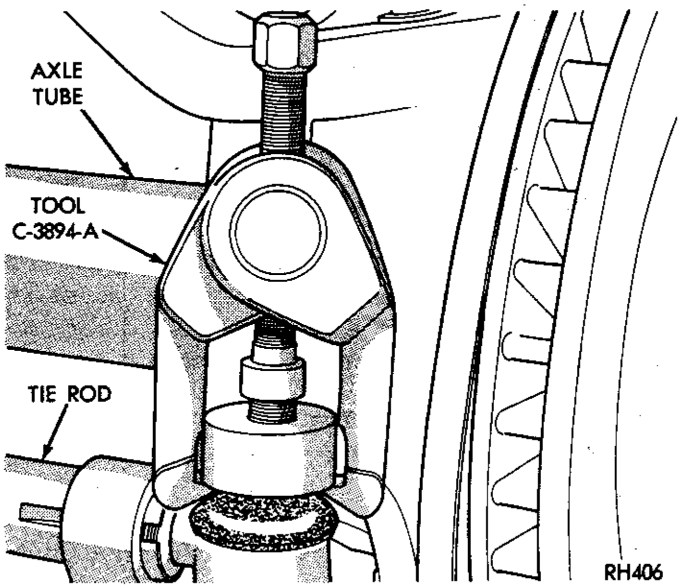


Fig. 29 Tie-Rod End Removal

and bolt. Un-thread the tie-rod end from the adjustment sleeve and remove it from the vehicle.

INSTALLATION

(1) Thread the replacement tie-rod end into the adjustment sleeve so that the length approximates the distance previously measured and recorded.

(2) Connect the tie-rod end ball stud to the steering knuckle arm and install the retaining nut. Tighten the nut with 61 N•m (45 ft-lbs) torque.

(3) Remove the supports and lower vehicle to the surface.

(4) Adjust the "toe" position. Refer to the procedure and the Specifications chart. Position the adjustment sleeve clamp bolt at the bottom of the tie-rod end. Tighten the clamp bolt and nut with 34-41 N•m (25-30 ft-lbs) torque. Test the vehicle steering.

STABILIZER BAR REMOVAL/INSTALLATION

REMOVAL

(1) Raise and support the vehicle at a comfortable working height.

(2) Remove the nut, the outer retainer and the outer insulator from the link at each side of the vehicle (Fig. 30).

(3) Remove the attaching nuts, bolts, and the retainer from each frame rail (Fig. 30). Lower the stabilizer bar and remove it from the vehicle.

INSTALLATION

(1) Position the stabilizer bar at the frame rails. Install the retainer, the bolts and the nuts at each side of the vehicle (Fig. 30). Tighten the nuts with 102 N• (75 ft-lbs) torque.

(2) Position the ends of the stabilizer bar over the links. Install the outer insulator, the outer retainer and the nut on each link (Fig. 30). Tighten the nuts with 11 N•m (100 in-lbs) torque.

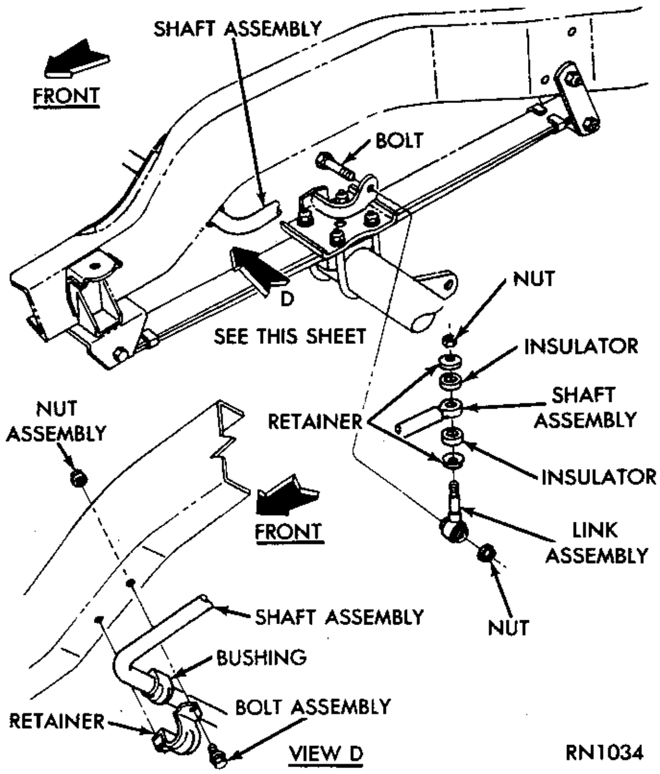


Fig. 30 Stabilizer Bar—4WD Vehicles

(3) Remove the supports and lower the vehicle.

COMPLETE AXLE REMOVAL/INSTALLATION

SERVICE INFORMATION

It is not necessary to remove the complete front axle from the vehicle for routine service. However, if the differential housing or the axle shaft tubes are damaged, the complete axle can be removed and installed via the following procedures.

REMOVAL

(1) Block the brake pedal in the "up" position. Raise and support the vehicle at a comfortable working height.

(2) Remove the front wheels/tires.

(3) Mark the front drive shaft and the drive pinion gear shaft (axle) yoke for installation alignment reference.

(4) Disconnect the front drive shaft from the axle yoke. Attach the drive shaft to the frame rail with wire.

(5) Remove the cotter pin, the retaining nut, and disconnect the drag link from the steering knuckle arm (left side only). Discard the cotter pin.

(6) Disconnect flexible brake fluid hose fittings at the frame crossmember. Plug the hoses at the fittings.

(7) Remove the shock absorber lower attaching nut and detach the stud from the axle shaft tube bracket. Remove the retaining nuts and disconnect the stabilizer bar links from the spring brackets (Fig. 30).

(8) Disconnect the vacuum hoses from the shift motor ports and the wire connector from 4WD indicator lamp switch on the shift motor housing.

(9) Remove nuts and the washers from the spring U-bolts. Remove the complete front axle from the vehicle.

INSTALLATION

(1) Position the front axle under the front of the vehicle with the axle spring pads under the springs. Place the spring brackets over the springs with the stabilizer bar link bolt holes facing toward the rear of the vehicle (Fig. 30).

(2) Install the spring U-bolts, washers and retaining nuts. Tighten the nuts with 149 N•m (110 ft-lbs) torque.

(3) Insert the shock absorber lower studs in the axle shaft tube brackets. Install the attaching nuts and tighten them with 75 N•m (55 ft-lbs) torque.

(4) Connect the stabilizer bar links to the spring brackets with the bolts and nuts (Fig. 30). Tighten the nuts with 271 N•m (200 ft-lbs) torque.

(5) Remove plugs and connect the brake hose fittings. Tighten the fittings with 9-17 N•m (80-150 in-lbs) torque.

(6) Connect the drag-link ball stud to the steering knuckle arm. Install the retaining nut and tighten it with 81 N•m (60 ft-lbs) torque. To align the cotter pin hole in the ball stud with the slot in the castellated nut (if the slot and the hole are not aligned), continue to tighten the nut until they are aligned. Do not loosen the nut to align the hole and the slot. Install a replacement cotter pin.

(7) Connect the drive shaft to the drive pinion gear shaft (axle) yoke with the installation reference marks aligned. Install the washers and the nuts and tighten with 34 N•m (300 in-lbs) torque.

(8) Connect the vacuum hoses to the shift motor ports and the wire connector to the 4WD indicator lamp switch.

(9) Remove the supports, lower the vehicle and remove the block from the brake pedal.

(10) Raise the vehicle, bleed and adjust the brakes, lubricate all the ball stud fittings, inspect the differential housing lubricant level. Refer to the Specifications chart.

(11) Lower the vehicle and test the axle and suspension operation.

DIFFERENTIAL SERVICE

SERVICE INFORMATION

It is not necessary to remove the complete front axle from the vehicle for routine axle or differential service. To replace the differential side gears, it is necessary to remove only the axle shafts, the differential housing cover, the lubricant and the differential case. To replace the differential bearings, it is necessary to remove only the axle shafts, the differential housing cover, the lubricant, the differential case and to adjust the ring gear “backlash”.

REMOVAL/DISASSEMBLY

(1) Raise and support the vehicle at a comfortable working height.

(2) Remove the front wheels/tires.

(3) Mark the front drive shaft and the drive pinion gear shaft (axle) yoke for installation alignment reference.

(4) Disconnect the front drive shaft from the axle yoke. Attach the drive shaft to the frame rail with wire.

(5) Thoroughly clean the outer area of the differential housing and axle shaft tubes with an appropriate cleaning solvent and blow dry with compressed air.

(6) Loosen the differential housing cover bolts and drain the lubricant into a container. Remove the bolts and the differential housing cover.

A close examination of the differential prior to disassembly can often reveal valuable information concerning the extent and type of repairs or adjustments that will be necessary. Because the most frequent causes of axle noise are improper “backlash” or differential bearing “preload”, or both, a few minor adjustments could be all that is necessary to correct the defect.

Therefore, before disassembly, the following information should be available:

- ring gear “backlash” measurement,
- drive pinion gear shaft bearing “preload” torque measurement, and
- ring gear/drive pinion gear teeth contact patterns.

The results (above) should be recorded and analyzed. It is expected that these measurements will be helpful when making necessary repairs to the differential. Refer to the applicable procedures within this section for instructions.

If, after the measurements and adjustments, the defect still exists, proceed with the following disassembly, inspection and assembly procedures.

(7) Thoroughly flush and clean the differential gears, bearings and the other differential components with an appropriate solvent.

(8) Install a pilot stud in the differential housing and attach Dial Indicator Tool C-3339 to the housing (Fig. 31) with the indicator plunger slightly “loaded”

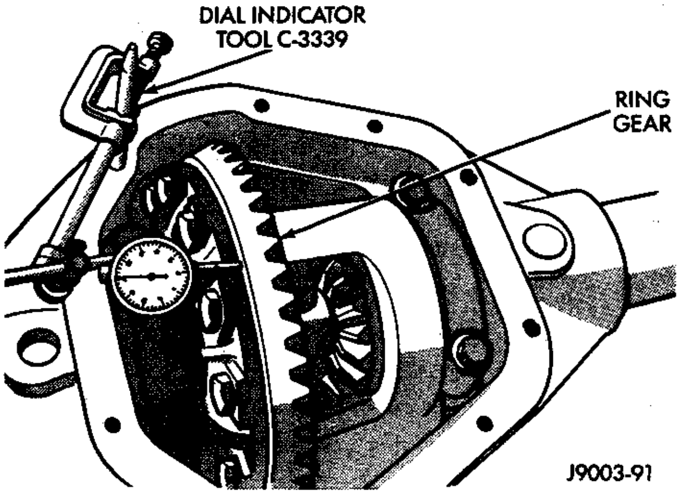


Fig. 31 Ring Gear "Runout" Measurement

and at a right angle (i.e., perpendicular) to the back side of the ring gear. "Zero" the dial indicator pointer.

(9) Measure the ring gear "runout" by rotating the ring gear several complete revolutions and observing the dial indicator pointer. Mark both the ring gear and the differential case flange at the location of maximum "runout".

The mark on the differential case flange will be very useful when measuring the differential case "runout". The differential case flange "runout" measurement procedure is described below.

If the combined ring gear "runout" (i.e., peak-to-peak) exceeds of 0.006 inch (0.150 mm), possible causes could be that the ring gear is not tightly attached to the differential case flange or the differential case is damaged.

(10) Determine if the clearance between the differential bearing caps and bearing cups is excessive by attempting to insert a 0.003- inch (0.076-mm) thick feeler gauge blade between them. Normally, a 0.003-inch (0.076-mm) thick feeler gauge blade should be too thick to be inserted between a bearing cap and cup.

If the clearance is more than 0.003 inch (0.076 mm), the cause could be that the applicable bearing cup rotated in the differential housing "seat" and caused excessive wear.

(11) Note the installation reference letters stamped into the differential bearing caps and into the differential housing machined sealing surface (Fig. 32). The letters are stamped horizontally on the left side and are stamped vertically on the right side of the differential housing. Always match the reference letters when installing the differential bearing caps.

(12) Remove the differential bearing caps.

(13) Position Spreader Tool W-291-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 33). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

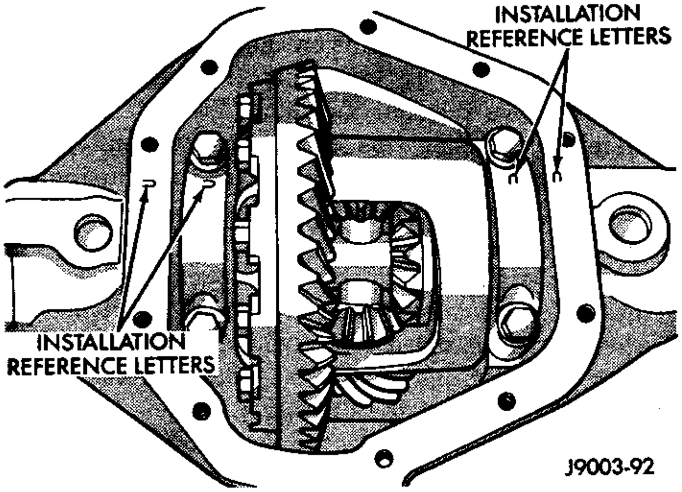


Fig. 32 Bearing Cap Identification

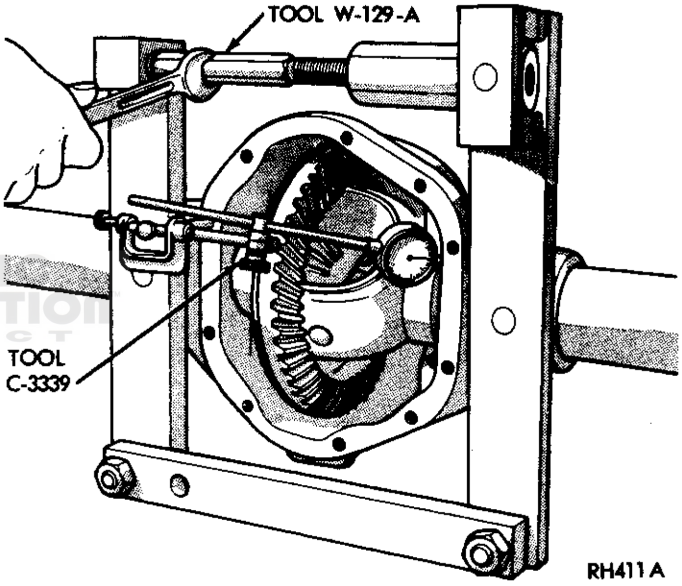


Fig. 33 Differential Housing Separation

(14) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 33). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(15) Tighten the spreader tool turnbuckle (Fig. 33) and separate the differential housing only enough to remove the differential case from the housing. **Separate the differential housing a maximum dis-**

tance of 0.38 mm (0.015 in) with the spreader tool. Measure the separation distance with the dial indicator (Fig. 33) as the housing is being separated.

(16) Remove the dial indicator (Fig. 33) when the differential housing has been separated sufficiently to remove the differential case from the housing.

(17) Pry the differential case loose from the housing. A light prying action with a small pry bar or pinch bar will loosen the case sufficiently for easy removal. To prevent damage, pry the differential case outward toward the opening with the pry bar pivoting on the differential housing and with the end of the pry bar against the differential case.

(18) Remove the differential case from the differential housing. If they are reusable, retain the differential bearing cups and bearings together as "matched sets".

(19) Remove the inner seal from the right-side axle shaft tube with a long rod or a non-reusable axle shaft.

(20) Clamp the differential case in a vise equipped with soft jaws and remove **(and discard)** the ring gear bolts. "Tap" the ring gear with a rawhide mallet to loosen it from the differential case flange. Remove the ring gear.

(21) If the ring gear "runout" exceeded 0.006 inch (0.15 mm) when measured (above), the differential case flange "runout" should be measured at this time.

(22) Install the differential case (with the original bearing cups) in the differential housing.

(23) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 33).

(24) Install the differential bearing caps and tighten the bolts "finger-tight" until each bolt head is lightly "seated" on the bearing cap.

(25) Install a pilot stud at the right side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the inner face of the flange (Fig. 34). "Zero" the dial indicator pointer.

(26) Measure the differential case flange "runout" by rotating the flange several complete revolutions and observing the dial indicator pointer. Mark the flange at the location of maximum "runout". The flange maximum "runout" should not exceed 0.003 inch (0.076 mm).

When installing the ring gear on the differential case, it is often possible to reduce excessive ring gear "runout" by positioning the ring gear with its maximum "runout" mark located 180 degrees opposite the flange maximum "runout" mark.

(27) Remove the drive pinion gear shaft (axle) yoke nut and washer (Fig. 35). Use Removal Tool C-452 and Holding Tool C-3281 to remove the drive pinion gear shaft (axle) yoke (Fig. 36).

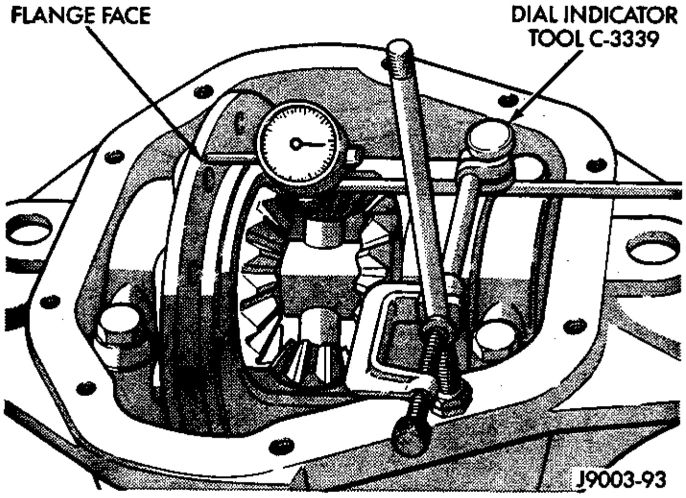


Fig. 34 Differential Case Flange "Runout" Measurement

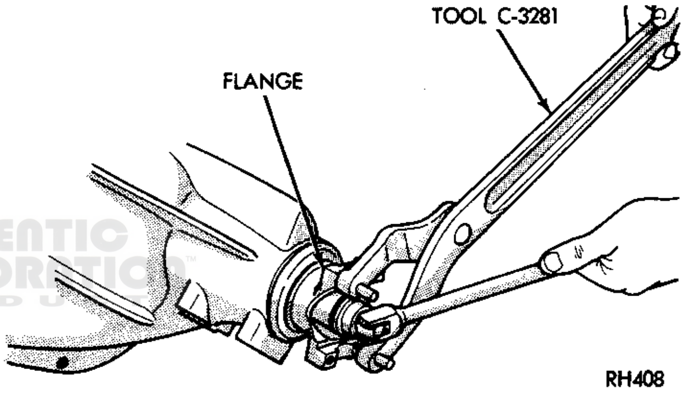


Fig. 35 Drive Pinion Gear Shaft Yoke Nut Removal

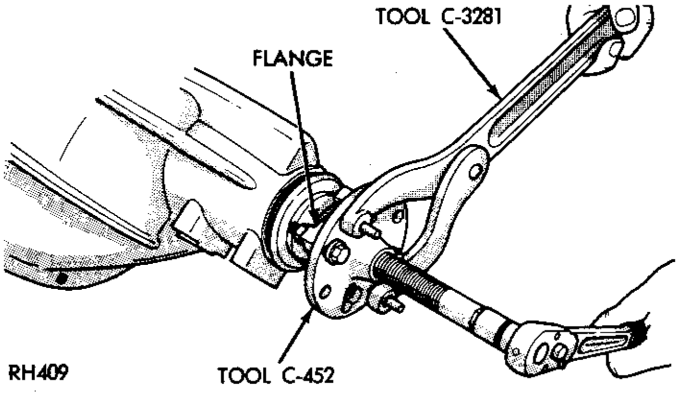
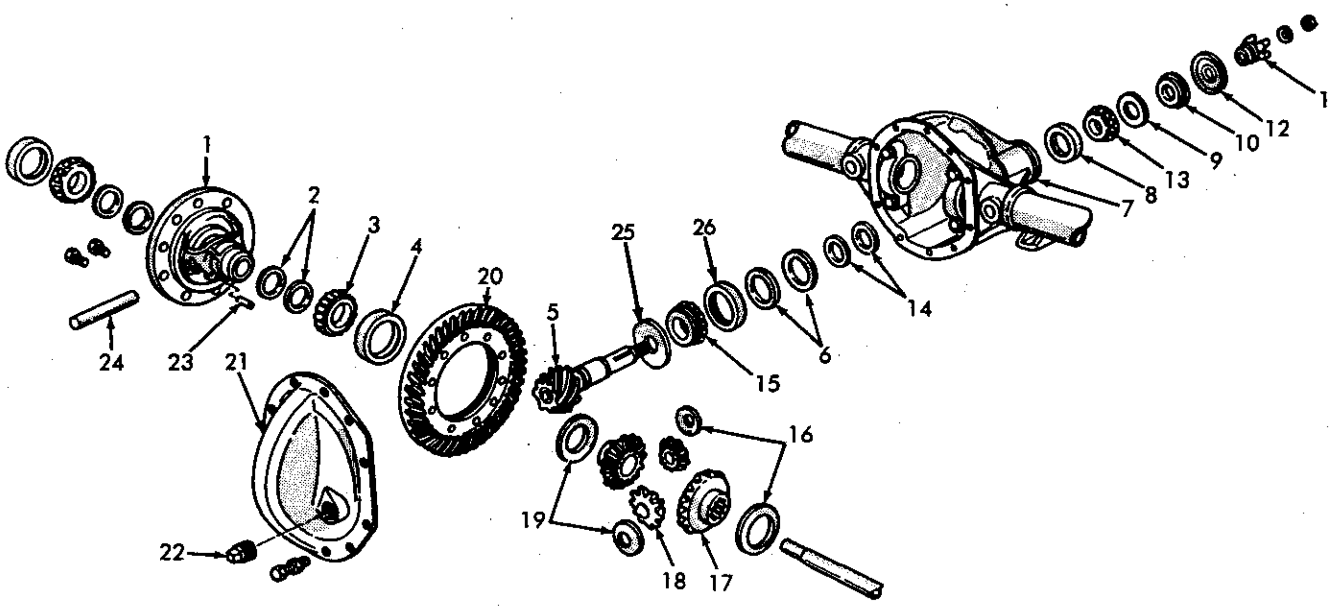


Fig. 36 Drive Pinion Gear Shaft Yoke Removal

(28) Use Removal Tool C-748 to remove the drive pinion gear shaft seal (Fig. 37).

(29) Remove the oil slinger, the shaft front bearing and the "preload" torque shims (Fig. 37). Record the thickness of the shims. **This will save time if they should become misplaced.**

(30) Use an appropriate tool to force the drive pinion gear shaft (with the rear bearing) from the dif-



1. DIFFERENTIAL CASE
2. DIFFERENTIAL BEARING SHIMS
3. DIFFERENTIAL BEARING
4. BEARING CUP
5. DRIVE PINION GEAR SHAFT
6. DRIVE PINION GEAR DEPTH SHIMS
7. DIFFERENTIAL HOUSING
8. DRIVE PINION GEAR SHAFT FRONT BEARING CUP
9. SLINGER
10. SEAL
11. YOKE
12. DUST CAP
13. DRIVE PINION GEAR SHAFT FRONT BEARING
14. DRIVE PINION GEAR BEARING PRELOAD SHIMS
15. DRIVE PINION GEAR SHAFT REAR BEARING
16. THRUST WASHERS
17. DIFFERENTIAL SIDE GEAR
18. DIFFERENTIAL PINION GEAR
19. THRUST WASHERS
20. RING GEAR
21. COVER
22. PLUG
23. LOCKPIN
24. PINION MATE SHAFT
25. SLINGER
26. REAR BEARING CUP

J9002-33

Fig. 37 Model 44 Axle Differential—Exploded View

ferential housing bore (Fig. 37).

(31) Use Removal Tool D-158 and Handle Tool C-4171 to remove the drive pinion gear shaft front bearing cup from the differential housing bore (Fig. 37).

(32) Use Removal Tool D-162 and Handle Tool C-4171 to remove the drive pinion gear shaft rear bearing cup from the differential housing bore (Fig. 37).

(33) Remove the drive pinion gear depth shims from the differential housing bore (Fig. 37). Record the thickness of the depth shims.

(34) Remove the inner bearing from the drive pinion gear shaft with Removal Tool C-293-PA and Plate Tools C-293-39 (Fig. 38).

(35) Clamp the differential case in a vise equipped with soft jaws. Use a pin punch to force the pinion gear mate shaft lock pin from the differential case bore (Fig. 39).

(36) Remove the differential pinion gear mate shaft from the differential case bores, remove the differential pinion gears and remove the thrust washers (located adjacent to the differential case internal surface) from the differential case.

(37) Remove the differential side gears and the thrust washers (located adjacent to the differential case internal surface) from the differential case.

(38) Remove the differential case from the vise.

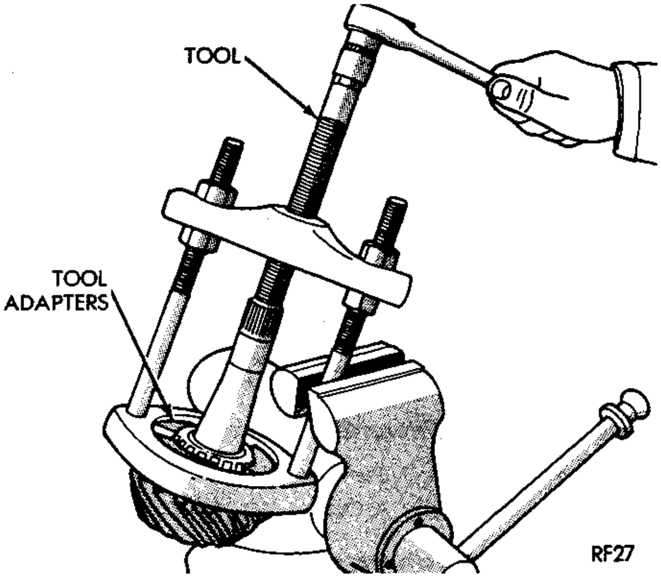


Fig. 38 Inner Bearing Removal

(39) Remove the bearings from the differential case with Press Tool C-293-PA, Plug Tool C-293-3, Plate Tools C-293-18 and a vise (Fig. 40).

Use care and ensure that the adapter rings are situated so that they do not cause force to be exerted on the bearing race.

(40) Remove the differential bearing shims from each of the differential case hubs and mark them

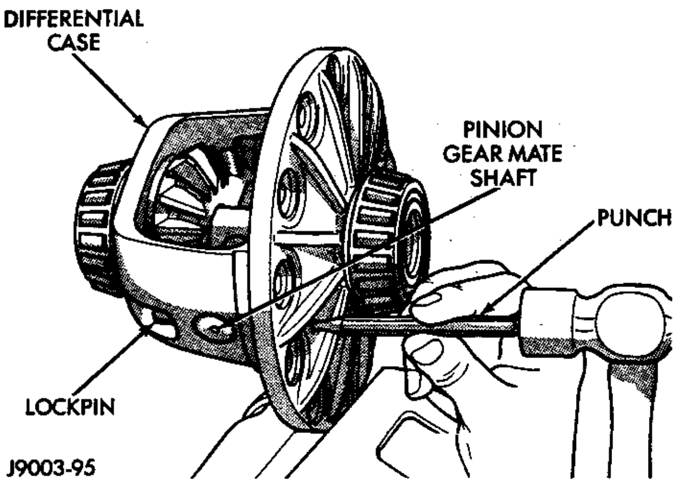


Fig. 39 Pinion Gear Mate Shaft Lock Pin Removal

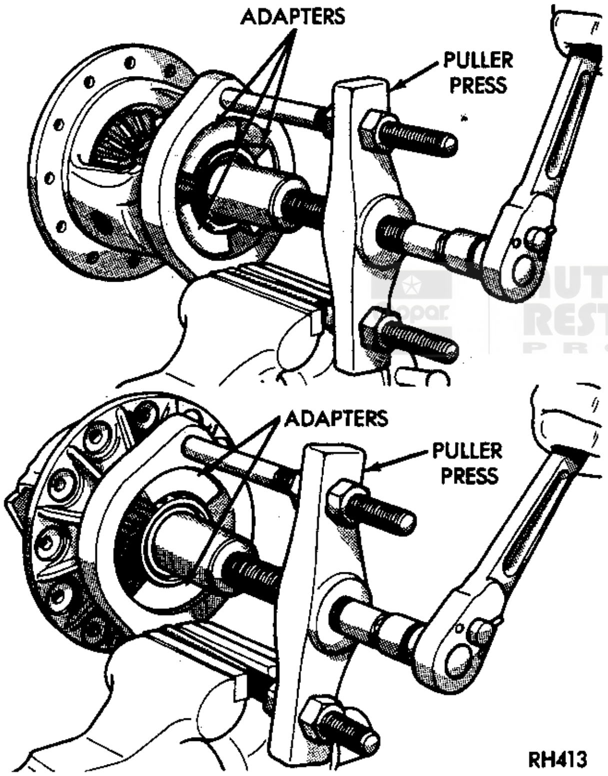


Fig. 40 Differential Bearing Removal

(with hub identity) for assembly reference. Record the thickness of the shims.

CLEANING/INSPECTION

(1) Wash and clean all the differential components (Fig. 37) with an appropriate cleaning solvent and, with the exception of the bearings, dry with compressed air.

Do not steam clean the differential components.

(2) To clean the axle shaft tubes, insert a stiff wire into each tube, attach a clean cloth to the wire at the differential housing opening and withdraw the wire (and cloth) from the housing outward through the tube.

(3) Inspect the differential bearings and the drive pinion gear shaft bearings, and the differential case and housing (Fig. 37):

- the differential bearings and the drive pinion gear shaft front and rear bearings and cups should have a smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces;
- the bearing races must not be distorted or cracked;

If a differential bearing must be replaced, the cup and the bearing must be replaced as a "matched set" only.

- all the machined contact surfaces in the differential housing and on the differential bearing caps should be smooth and without any raised edges;
- the drive pinion gear shaft front and rear bearing cup bores in the differential housing should be smooth; and
- if it exists, raised metal on the shoulders of the bearing cup bores incurred during removal of the cups should be removed with a hand stone.

(4) Examine the differential pinion gear mate shaft, pinion gears, side gears and thrust washers (Fig. 37) for wear and damage. Replace all defective components.

If either of the differential pinion gears is not reusable, both gears must be replaced as a "matched set" only. Do not replace only one gear.

(5) Examine the ring gear and the drive pinion gear shaft (Fig. 37) for excessively worn and chipped teeth. Examine the ring gear for damaged bolt threads.

If replacement of either gear is necessary, both the ring gear and the drive pinion gear shaft must be replaced because they are available as a "matched set" only.

(6) Inspect the drive pinion gear shaft (axle) yoke (Fig. 37) for cracks, excessively worn splines, "pitted" areas, and a rough/corroded seal contact surface. Repair or replace the yoke as necessary.

(7) Inspect the drive pinion gear shaft bearing "preload" torque shims (Fig. 37) for cracks, damage and distortion. Install replacement shims (if necessary) for the "preload" torque adjustment.

ASSEMBLY

(1) Lubricate all the differential components with hypoid gear lubricant.

(2) Install the differential side gears and thrust washers, pinion gears and thrust washers and pinion gear mate shaft in the differential case (Fig. 37).

(3) Align the lock pin hole in the pinion gear mate shaft with the hole in the differential case (Fig. 37). Insert and "seat" the lock pin in the case and the shaft.

If replacement gears and thrust washers were installed, it is not necessary to measure the gear "backlash". The gear meshing will be correct because "close" machining tolerances are used during manufacture of the gears.

(4) Position the ring gear on the differential case flange and align the ring gear threaded holes with those in the differential case flange (Fig. 37).

(5) Insert **replacement** ring gear bolts (Fig. 37) through the differential case flange and thread them into the ring gear.

After all the bolts are initially correctly threaded into the ring gear bolt holes, "tap" the ring gear with a non-metallic mallet and ensure that it is flush against the flange.

(6) Clamp the differential case in a vise equipped with soft jaws and alternately tighten each ring gear bolt with 61-81 N•m (45-60 ft-lbs) torque.

(7) Place Master Differential Bearing Tools D-135 on the differential case hubs (Fig. 41).

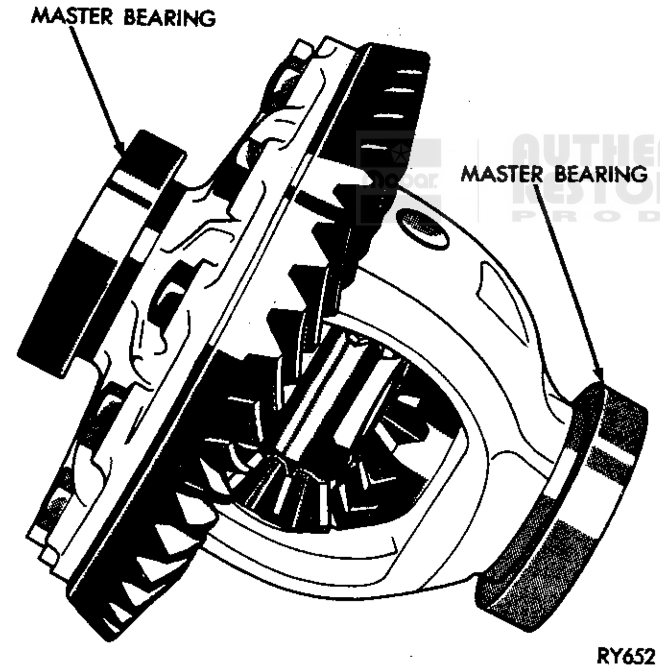


Fig. 41 Master Bearing Tools On Hubs

(8) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 42). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(9) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 42). "Zero" the dial indicator pointer.

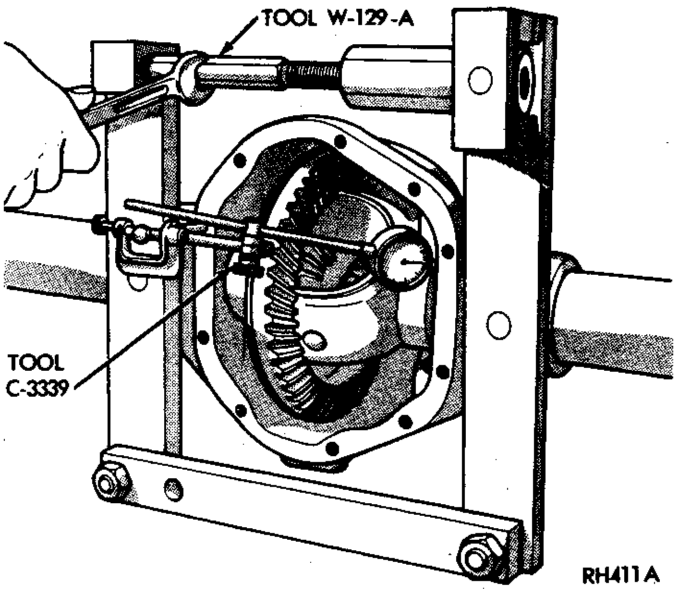


Fig. 42 Differential Housing Separation

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(10) Tighten the spreader tool turnbuckle (Fig. 42) and separate the differential housing only enough to install the differential case in the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 42) as the housing is being separated.

(11) Remove the dial indicator tool and the pilot stud (Fig. 42) when the differential housing has been separated sufficiently to install the differential case in the housing.

(12) Install the differential case in the differential housing.

(13) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 42).

(14) Observe the assembly reference marks and position the bearing caps at their original locations. Tighten the bearing cap bolts "finger-tight".

(15) Install a pilot stud at the right side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the back of the ring gear (Fig. 43).

(16) Insert a small pry bar between the bearing cap and the left side of the differential case. Pry the differential case as far as possible toward the right side of the differential housing (Fig. 43). "Zero" the dial indicator pointer.

(17) Pry the differential case toward the left side of the housing with the pry bar and **record** the travel distance indicated by the dial indicator pointer.

The measurement above indicates the shim thickness necessary for differential case "zero" "end-play" (i.e., to eliminate the space/gap that

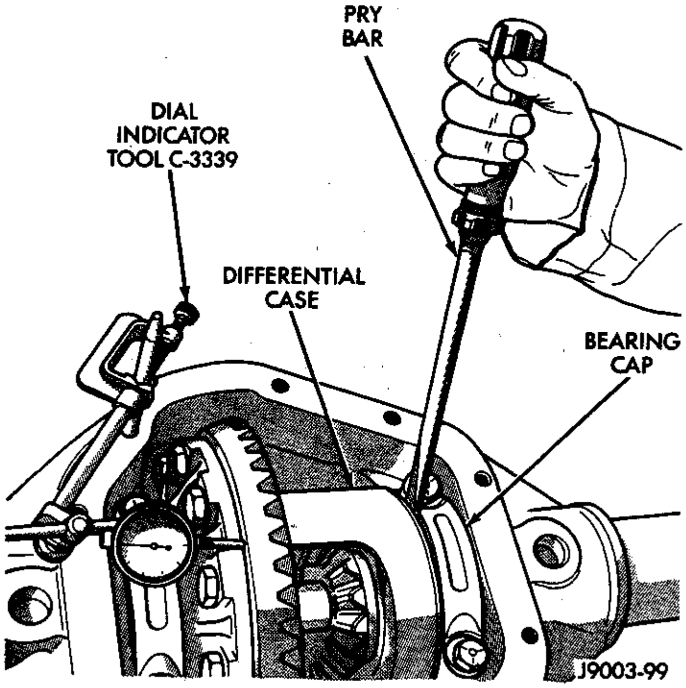


Fig. 43 Differential Case "End Play" Measurement

exists between the differential bearings and the differential case). The actual total shim thickness will be determined during the ring gear "backlash" adjustment (after installation of the drive pinion gear shaft).

(18) Remove the dial indicator tool and the pilot stud from the differential housing.

(19) Remove the differential bearing caps.

(20) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 42). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(21) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 42). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(22) Tighten the spreader tool turnbuckle (Fig. 42) and separate the differential housing only enough to remove the differential case from the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 42) as the housing is being separated.

(23) Remove the dial indicator tool and the pilot stud (Fig. 42) when the differential housing has been separated sufficiently to remove the differential case from the housing.

(24) Remove the differential case from the differential housing.

(25) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 42).

(26) Install a replacement seal in the right-side axle shaft tube with Tool DD-1243-B.

DRIVE PINION GEAR DEPTH INFORMATION

Drive pinion gear shafts and ring gears are supplied as "matched sets" only. The identifying numbers for both the drive pinion gear and the ring gear are etched into the face of each gear (Fig. 44). In addition, either a plus ("+") number, a minus ("-") number or a zero ("0") is also etched into the face of the drive pinion gear. This number indicates the amount (in thousandths of an inch) that the drive pinion gear depth of mesh varies from the standard depth "setting" of 2.625 inches (66.68 mm) for Model 44 axles. The standard depth of mesh provides the best teeth contact between the drive pinion gear teeth and the ring gear teeth. The depth variance of a drive pinion gear can be either greater (+), zero (0) or less than (-) the standard depth.

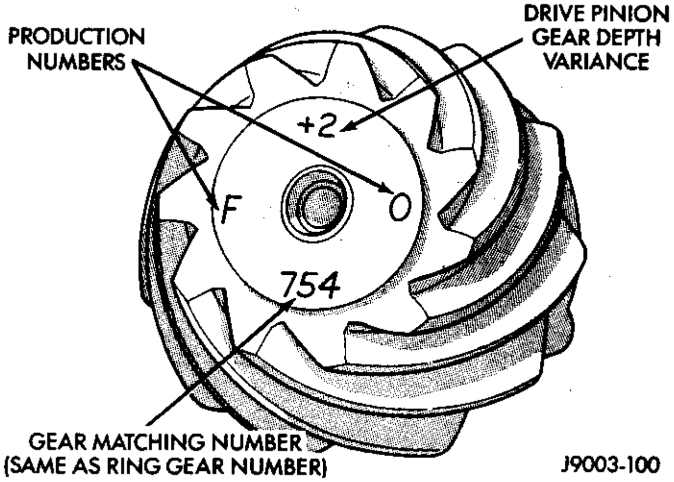


Fig. 44 Drive Pinion Gear ID Numbers

The standard depth is the distance (Fig. 45) from the centerline of the axle shaft/ring gear to the face of the drive pinion gear. For a Model 44 axle, the standard depth/distance is 2.625 inches (66.68 mm).

Compensation for the depth variance is achieved by shims placed adjacent to the drive pinion gear shaft rear bearing cup (Fig. 46).

For Example:

- **one complete "pack" of depth shims is required if the depth variance is "0";**
- **if the depth variance is "+3" (m+8), the drive**

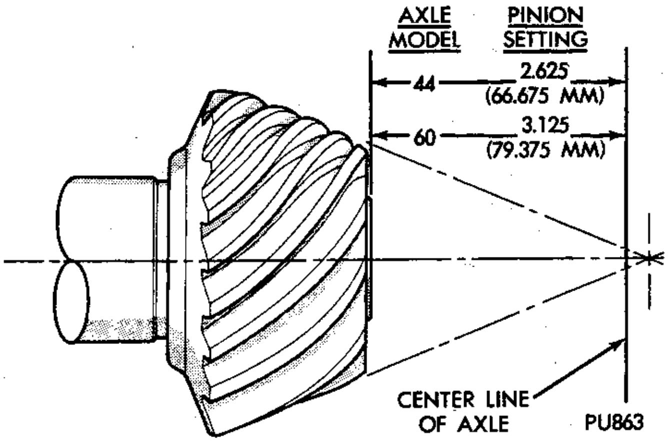


Fig. 45 Drive Pinion Gear Standard Depth/Distance

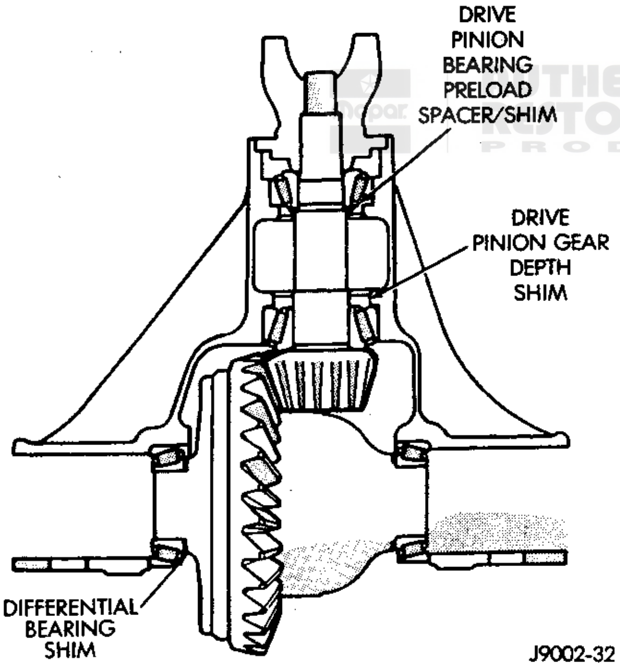


Fig. 46 Shim Locations

pinion gear would require 0.003 inch (0.08 mm) less in shim thickness than a depth variance of "0" (i.e., one complete shim "pack" minus 0.003 inch or 0.08 mm);

- **by reducing the thickness of the shims 0.003 inch (0.08 mm), the depth position of the drive pinion gear will be decreased from 2.628 inches (66.76 mm) to the standard depth of 2.625 inches (66.68 mm); or**
- **if the depth variance is "-3" (m-8), the drive pinion gear would require 0.003 inch (0.08 mm) more in shim thickness than a depth variance of "0" (i.e., one complete shim "pack" plus 0.003 inch or 0.08 mm);**
- **by increasing the thickness of the shims 0.003 inch (0.08 mm), the depth position of the drive pinion gear will be increased from 2.622 inches (66.60 mm) to the standard depth of 2.625 inches (66.68 mm).**

If the original drive pinion gear shaft and ring gear set will be installed but the depth shims must be replaced, measure the thickness of the original depth shims and "build" a replacement "pack" of depth shims with the same thickness.

If equipped, the oil slinger located between the rear bearing and the thrust face of drive pinion gear must be measured and the thickness included with the total shim "pack" thickness.

If the original drive pinion/ring gear set is not reusable, the depth shim thickness for the replacement drive pinion gear must be determined before installing the differential case in the housing.

If a replacement gear set is being installed, note the depth variance etched into both the original and the replacement drive pinion gear, and alter the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Drive Pinion Gear Depth Variance chart.

For Example:

- **if the original drive pinion gear has a depth variance of "+2" (m+5) and the replacement drive pinion gear has a depth variance of "-2" (m-5), add 0.004-inch (0.10-mm) thickness to the original depth shims.**

Individual depth shims are available in 0.003-inch, 0.005-inch, 0.010-inch, and 0.030-inch (0.08-mm, 0.13-mm, 0.25-mm, and 0.76-mm) thicknesses.

DRIVE PINION GEAR DEPTH VARIANCE

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

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DRIVE PINION GEAR DEPTH MEASUREMENT AND ADJUSTMENT WITH TOOL SET D-271

The following drive pinion gear depth (i.e., the depth of the gear teeth mesh between the drive pinion gear and the ring gear) measurement and adjustment procedure involves using Tool Set D-271 (Fig. 47).

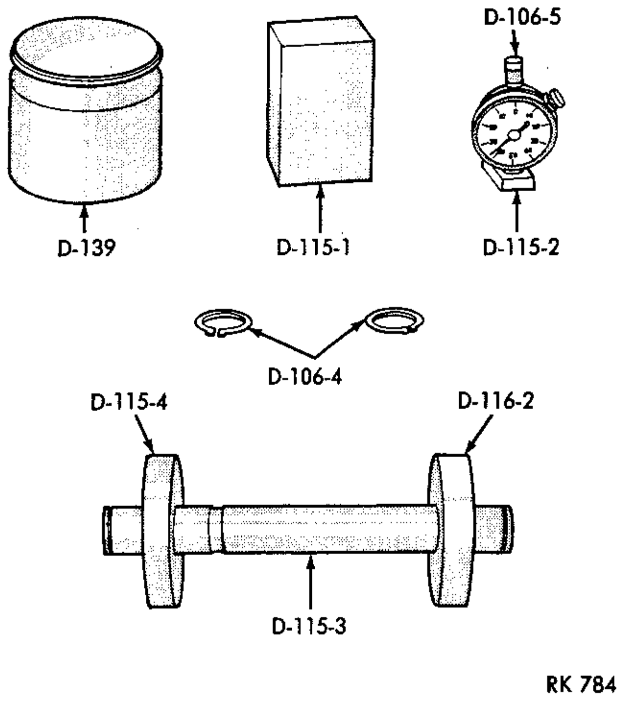

Fig. 47 Pinion Gear Depth Gauge Tool Set D-271

(1) Insert Master Pinion Block Tool D-139 into the drive pinion gear shaft bore in the differential housing (Fig. 48).

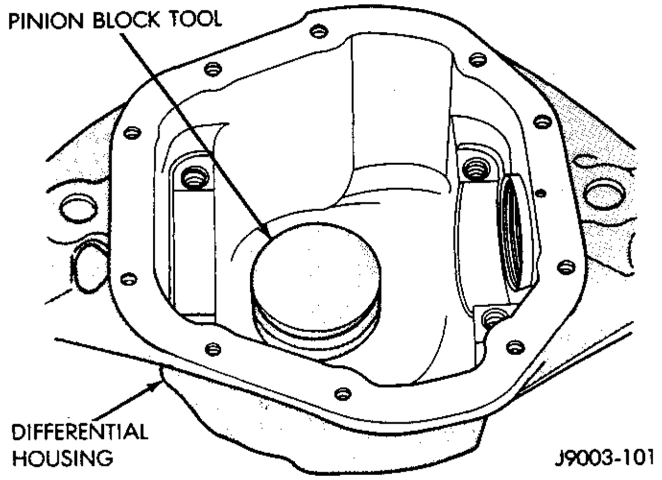

Fig. 48 Pinion Block Tool Inserted In Shaft Bore

(2) Place Arbor Disc Tools D-115-4 on Arbor Tool D-115-3 and position the tool set in the differential housing with the disc tools located in the differential bearing cradles (Fig. 49). This is the centerline of the ring gear/axle shaft.

(3) Place Pinion Height Block Tool D-115-1 on top of the master pinion block tool and against the arbor tool (Fig. 50).

(4) Place Gauge Block Tool D-115-2 and Dial Indicator Tool D-106-5 on **the lowest step** of the pinion height block tool (Fig. 51). Ensure that the gauge

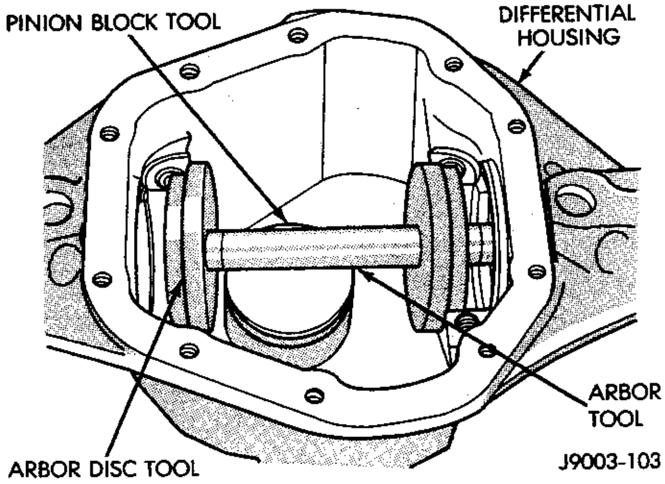

Fig. 49 Arbor Disc & Arbor Tools In Housing

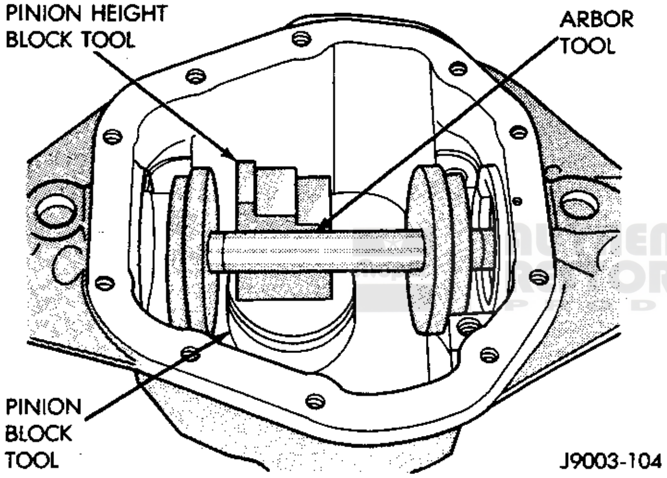

Fig. 50 Pinion Height Block Tool Against Arbor Tool

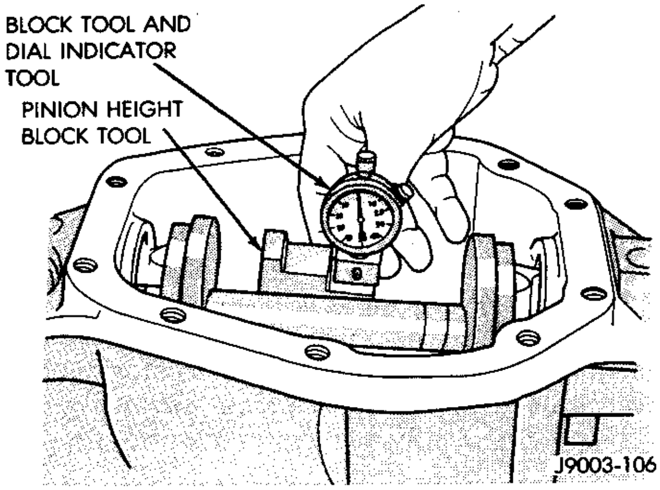

Fig. 51 Drive Pinion Gear Depth Measurement

block tool is resting firmly on the lowest step of pinion height block tool and "zero" the dial indicator pointer.

(5) With the dial indicator pointer "zeroed", move the gauge block tool toward the arbor tool until the tip of the dial indicator plunger contacts the arbor tool (Fig. 51). Slide the gauge block tool (with the dial indicator) across and back and forth along the arbor tool while observing the dial indicator pointer. Record the longest plunger travel distance, whether inward (oq-") or outward ("+"), indicated by the pointer.

The longest plunger travel distance indicated, plus or minus the depth variance etched into the face of the drive pinion gear, is the required thickness for the drive pinion gear depth shims.

(6) Measure the thickness of each depth shim separately with a micrometer and combine the shims necessary to obtain the total required depth shim "pack" thickness. **If equipped, the oil slinger located between the rear bearing and the thrust face of drive pinion gear must be measured and the thickness included with the total shim "pack" thickness.**

(7) Remove the measurement tools from the differential housing.

(8) Place the depth shims into the drive pinion gear shaft rear bearing bore in the differential housing and then force the rear bearing cup into the bore with Bearing Cup Installation Tool D-111 and Driver Handle Tool C-4171. Ensure that the cup is correctly "seated".

(9) Use Bearing Cup Installation Tool C-4203 and Driver Handle Tool C-4171 to force the drive pinion gear shaft front bearing cup into the differential housing bore (Fig. 52).

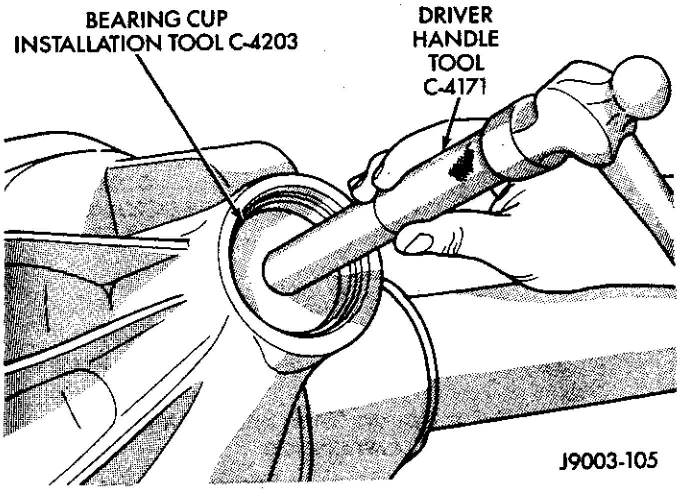

Fig. 52 Shaft Front Bearing Cup Installation

(10) Force the rear bearing onto the drive pinion gear shaft until it is completely "seated" with Bearing Installation Tool C-3095-A (Fig. 53).

(11) Install the drive pinion gear shaft in the differential housing.

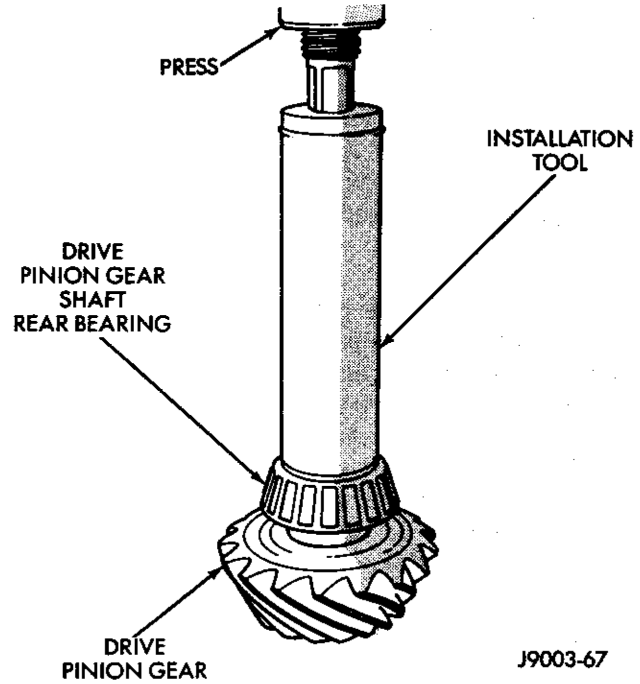

Fig. 53 Shaft Rear Bearing Installation

(12) Install the drive pinion gear shaft front bearing, oil slinger, (axle) yoke, washer and nut. Use Installation Tool C-3718 and Holding Tool 3281 to install the yoke (Fig. 54).

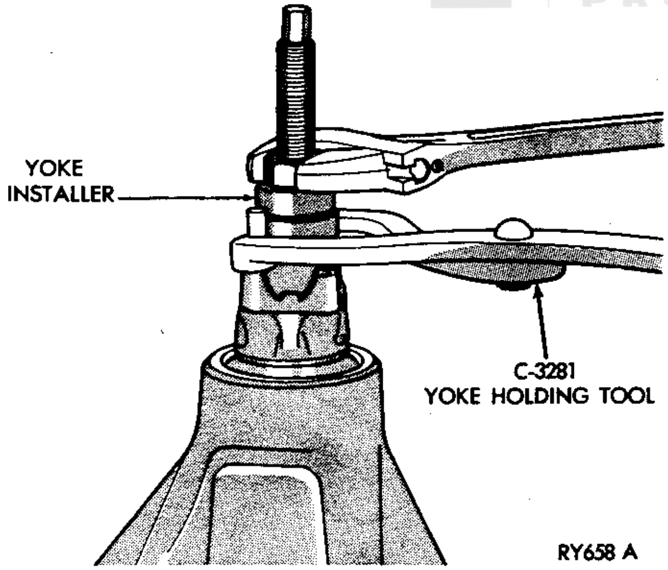

Fig. 54 Drive Pinion Gear Shaft (Axle) Yoke Installation

Do not install the "preload" torque shims or the drive pinion gear shaft seal at this time.

(13) "Seat" the shaft bearings by tightening the (axle) yoke nut until it requires 1 N•m (10 in-lbs) torque to rotate the drive pinion gear shaft (Fig. 55). Use a Newton-meter or an inch-pound torque wrench to measure the torque.

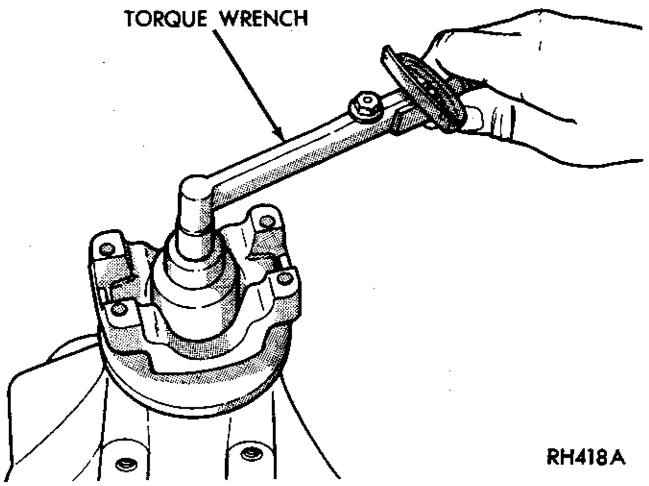

Fig. 55 Rotating Drive Pinion Gear Shaft

(14) Measure the drive pinion gear depth of mesh (with the ring gear). Place the pinion height block tool on the face of the drive pinion gear (Fig. 49). Place the arbor and disc tools into the differential bearing cradles in the differential housing (Fig. 50). Place the gauge block tool with the dial indicator tool on the lowest step of the pinion height block tool (Fig. 51). Ensure that the gauge block tool is resting firmly on the lowest step of the pinion height block tool and "zero" the dial indicator pointer.

(15) With the dial indicator pointer "zeroed", move the gauge block tool toward the arbor tool until the tip of the dial indicator plunger contacts the arbor tool (Fig. 51). Slide the gauge block tool (with the dial indicator) across and back and forth along the arbor tool while observing the dial indicator pointer. Record the longest plunger travel distance (whether inward or outward) indicated by the pointer.

The dial indicator pointer should indicate an inward ("-") or outward ("+") maximum travel distance that closely approximates the depth variance etched into the face of the drive pinion gear.

(16) If the measurement indicates that the actual depth variance is within 0.002 inch (0.05 mm) of the depth variance etched into the drive pinion gear face, it is acceptable.

(17) If the drive pinion gear actual depth variance is within the specified tolerance, continue with the differential assembly. If the actual depth variance is not within the specified tolerance, correct the shim thickness accordingly and then re-measure the depth variance.

Figure 56 depicts an arrow pointing outward and inward within the drive pinion gear shaft. The outward direction (pointing toward the yoke) indicates that if the drive pinion gear shaft depth shim thickness is decreased, the distance/depth from the centerline of the axle/ring gear to the drive pinion gear face would be in-

creased (i.e., it would increase the dial indicator plunger outward ("+") travel distance). The shaft bearing "preload" torque shim thickness does not affect the depth of mesh adjustment. The arrow on the ring gear indicates the method of increasing or decreasing shim thickness at the applicable side of the differential case to increase or decrease the ring gear "backlash" and the differential bearing "preload" torque.

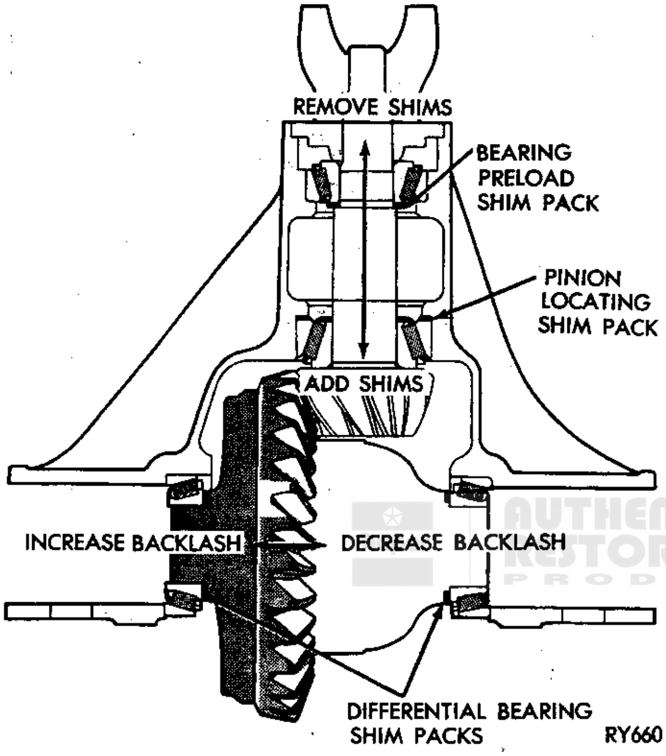

Fig. 56 Shim Locations

(18) Remove the measurement tools from the differential housing.

(19) Remove the drive pinion gear shaft nut, washer, (axle) yoke, oil slinger, and front bearing.

(20) Install the bearing "preload" torque shims that were removed during disassembly (Fig. 56), the shaft front bearing and the oil slinger on the drive pinion gear shaft.

(21) Apply a light coating of hypoid gear lubricant on the lip of drive pinion gear shaft seal, position it over the end of the shaft and install it in the differential housing bore with Seal Installation Tool W-147 and Driver Handle Tool C-4171 (Fig. 57).

(22) Install the drive pinion gear shaft (axle) yoke, washer, and a replacement nut on the shaft. Tighten the nut with 271 to 298 N•m (200 to 220 ft-lbs) torque.

(23) Use a Newton-meter or an inch pound torque wrench (Fig. 55) to rotate the drive pinion gear shaft and observe the indicated bearing "preload" torque. The torque necessary to rotate the drive pinion gear shaft should be between 2 to 5 N•m (20 to 40 in-lbs) with replacement bearings. The torque necessary to rotate the drive pinion gear shaft should be between 1 to 3 N•m (10 to 20 in-lbs) with original bearings.

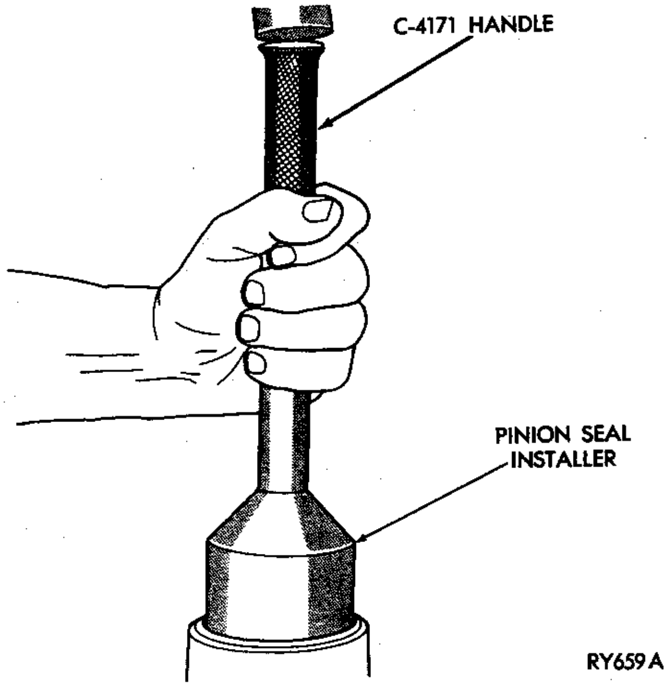

Fig. 57 Drive Pinion Gear Shaft Seal Installation

If the drive pinion gear shaft bearing "preload" torque is not within the specified tolerance, correct the shim thickness accordingly. To increase the "preload" torque, decrease the shim thickness; to decrease the "preload" torque, increase the shim thickness. Shims are available in the following thicknesses: 0.003, 0.005, 0.010, and 0.030 inch (0.076, 0.127, 0.254, and 0.762 mm).

DRIVE PINION GEAR DEPTH MEASUREMENT AND ADJUSTMENT WITH TOOL SET C-3715-B

The following drive pinion gear depth (i.e., the depth of the gear teeth mesh between the drive pinion gear and the ring gear) alternate measurement and adjustment procedure involves using Axle Measurement Gauge Tool Set C-3715-B. Tool Set C-3715-B is also used to install the drive pinion gear shaft bearing cups.

(1) Position each drive pinion gear shaft bearing cup in the applicable differential housing bore.

(2) Begin assembling Tool Set C-3715-B by positioning Drive Pinion Gear Shaft Locating Spacer Tool SP-5586 over the primary body of Screw Tool 5385.

(3) Position the drive pinion gear shaft rear (inner) bearing on the tool screw and insert the tool screw (with the bearing) into and through the differential housing bore.

(4) Position Shaft Locating Sleeve Tool SP-5585 and the drive pinion gear shaft front (outer) bearing

on the tool screw at the opposite side of the differential housing. Then install Compression Sleeve Tool SP-3194-B, Centralizing Washer Tool SP-534 and Compression Nut Tool SP-3193 on the tool screw.

(5) Lubricate the drive pinion gear shaft outer and inner bearings with MOPAR Hypoid Gear Lubricant (or an equivalent product).

(6) Tighten the compression nut tool, while retaining the compression sleeve tool with Tool C-3281, and force the drive pinion gear shaft bearing cups into the differential housing bearing cup bores. **Allow the compression tool to rotate several revolutions during the tightening process to permit the bearing rollers to properly align and prevent "brinelling" of the bearing cups.**

Do not remove the tool after installing the drive pinion gear shaft bearing cups. The drive pinion gear depth of mesh must be measured next.

(7) Loosen the nut tool and then re-tighten it sufficiently to obtain 1 to 3 N•m (10 to 30 in-lbs) of bearing "preload" torque. **While tightening the nut, rotate the tool to align the bearing rollers.**

(8) Install Gauge Block Tool SP-3250 on the end of Screw Tool SP-5385 and tighten the retaining screw securely with an Allen wrench.

(9) Position Cross Bore Arbor Tool SP-5183 (Fig. 58) in the differential bearing cradles (in the differential housing). Center the arbor tool in the cradles so that an approximately equal space exists at both ends.

(10) Observe the installation reference letters and position the differential bearing caps on the arbor tool (Fig. 58). Install the cap bolts and tighten them with 14 N•m (10 ft-lbs) torque.

(11) To measure the drive pinion gear depth of mesh, select and insert a feeler gauge blade that "snugly" fits between the arbor tool and the gauge block tool (Fig. 58). The "fit" must be "snug" but not excessively tight. **Record the thickness of the feeler gauge blade so that it can be used when determining the correct drive pinion gear depth shim thickness.**

(12) Observe the depth variance etched into the end of the drive pinion gear (e.g., 0, -1, -2, +1, +2, etc.). If the etched depth variance is a "-" (minus) value, add it to the thickness measured and recorded in step (11) above. If the etched depth variance is a "+" (plus) value, subtract it from the thickness measured and recorded in step (11) above.

(13) Remove the arbor tool from the differential housing cavity and the other tools (with the outer and inner bearings) from the housing bore.

(14) Use Removal Tool D-162 and Driver Handle Tool C-4171 to remove the drive pinion gear shaft inner (rear) bearing cup from the differential housing bore.

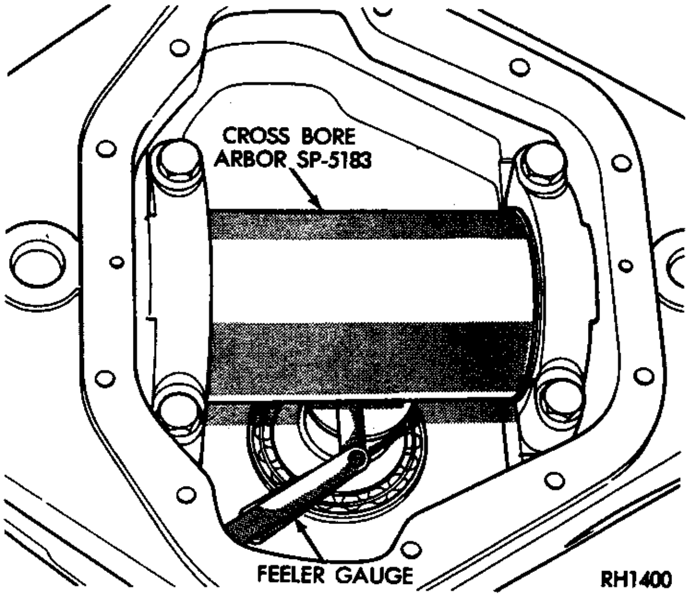

Fig. 58 Drive Pinion Gear Depth Measurement

(15) Position the depth shims in the differential housing Inner (rear) bearing cup bore and install the bearing cup according to the method previously described in steps (1) through (6) above. When the bearing cup is correctly "seated" in the housing bore, remove the tools and the drive pinion gear shaft bearings.

(16) If the drive pinion gear depth of mesh with the ring gear has been correctly established according to the instructions and information provided in the procedure above, good gear teeth contact should exist.

(17) Lubricate the drive pinion gear shaft inner (rear) bearing with MOPAR Hypoid Gear Lubricant (or an equivalent product) and install the bearing on the drive pinion gear shaft with Tool W-262. Use an arbor press with the installation tool (Fig. 59).

(18) Install the drive pinion gear shaft with the bearing in the differential housing bore.

(19) Install the original drive pinion gear shaft bearing "preload" torque shims followed by the outer (front) bearing. **Do not install the shaft oil slinger or seal at this time.**

(20) Install the drive pinion gear shaft (axle) yoke, washer and nut. Tighten the nut with 271 to 298 N•m (200 to 220 ft-lbs) torque. While tightening, rotate drive pinion gear shaft several complete revolutions to "seat" the bearing rollers.

(21) Use a Newton-meter or an inch-pound torque wrench to rotate the drive pinion gear shaft and measure the bearing "preload" torque (Fig. 60). Rotate the shaft several complete revolutions before recording the torque. With original bearings, the correct bearing "preload" torque is 1 to 3 N•m (10 to 20 in-lbs) torque. With replacement bearings, the correct bearing "preload" torque is 2 to 5 N•m (20 to 40 in-lbs) torque.

If the drive pinion gear shaft bearing "pre-

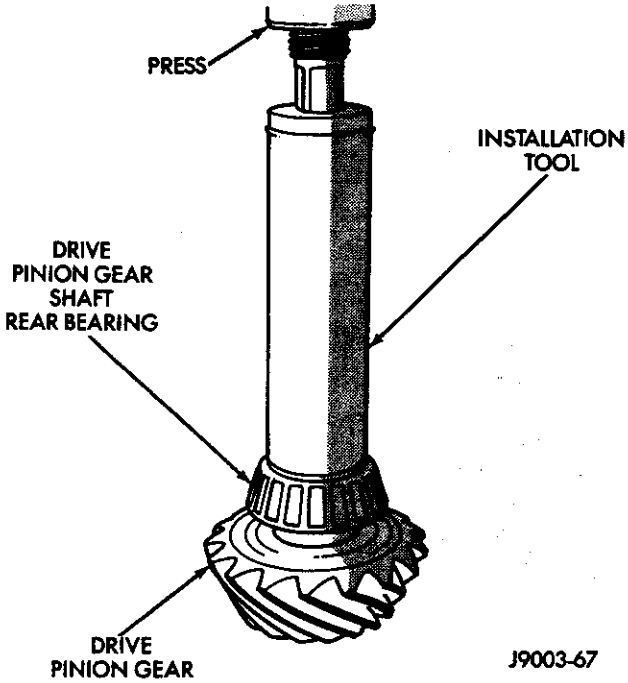

Fig. 59 Shaft Rear Bearing Installation

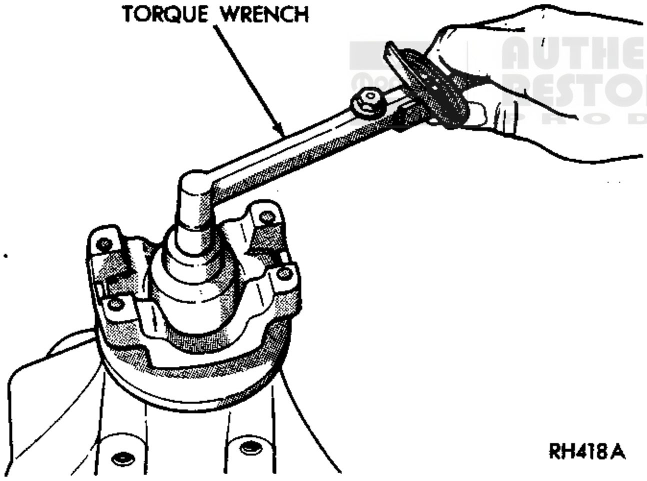

Fig. 60 Bearing "Preload" Measurement

load" torque is not within the specified tolerance, correct the shim thickness accordingly. To increase the "preload" torque, decrease the shim thickness; to decrease the "preload" torque, increase the shim thickness. Shims are available in the following thicknesses: 0.003, 0.005, 0.010, and 0.030 inch (0.076, 0.127, 0.254, and 0.762 mm).

(22) After the correct drive pinion gear shaft bearing "preload" torque has been established, remove the yoke, nut and washer.

(23) Install the oil slinger and the seal on the drive pinion gear shaft. Apply a light coating of hypoid gear lubricant on the lip of drive pinion gear shaft seal, position it over the end of the shaft and install it in the differential housing bore with Seal Installation Tool W-147 and Driver Handle Tool C-4171 (Fig. 61).

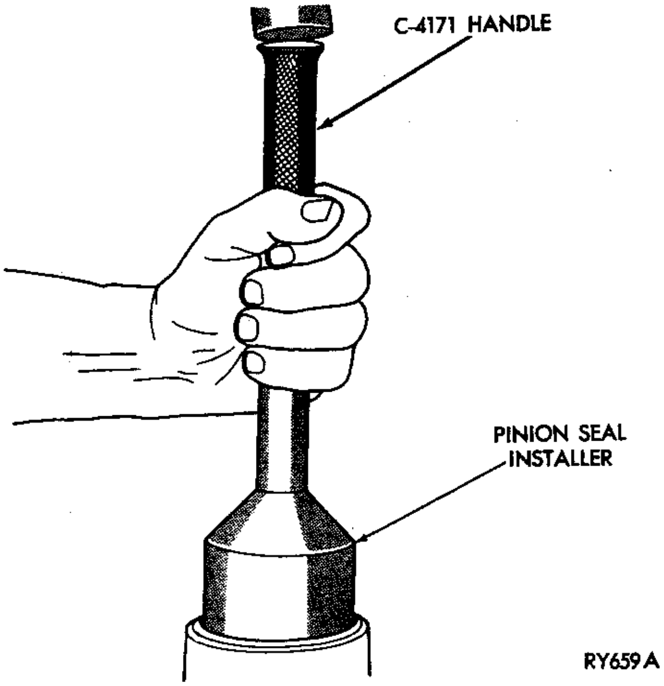

Fig. 61 Drive Pinion Gear Shaft Seal Installation

(24) Install the drive pinion gear shaft (axle) yoke, washer, and a replacement nut on the shaft. Tighten the nut with 271 to 298 N•m (200 to 220 ft-lbs) torque.

RING GEAR "BACKLASH" ADJUSTMENT

(1) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 62). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(2) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 62). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(3) Tighten the spreader tool turnbuckle (Fig. 62) and separate the differential housing only enough to install the differential case in the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 62) as the housing is being separated.

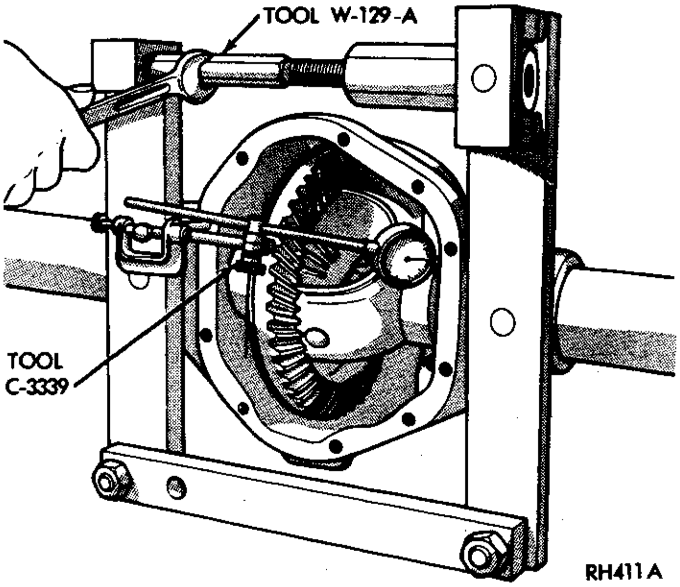

Fig. 62 Differential Housing Separation

(4) Remove the dial indicator tool and the pilot stud (Fig. 62) when the differential housing has been separated sufficiently to install the differential case in the housing.

(5) Install Master Bearing Tools D-135 on the differential case hubs and position the case in the differential housing with the ring gear teeth "meshed" with the drive pinion gear teeth. If necessary, "rock" the ring gear to "mesh" the gear teeth.

(6) Install a pilot stud at the right side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the back of the ring gear (Fig. 63). Ensure that the ring gear teeth and the drive pinion gear teeth are tightly "meshed" and "zero" the dial indicator pointer.

(7) Insert a small pry bar between the bearing cap and the left side of the differential case. Pry the differential case/ring gear as far as possible toward the right side of the differential housing and away from the drive pinion gear (Fig. 63). Observe the dial indicator plunger travel distance indicated by the pointer.

(8) Repeat the measurement several times until the indicated plunger travel distance is consistently the same for each measurement and then record the travel distance.

The measurement above indicates the shim thickness necessary to eliminate the ring gear "backlash". Subtract this thickness from the differential case "zero" "end-play" shim thickness. The ring gear "backlash" shims must be placed on the hub at the ring gear side of the differential case between the differential case and the differential bearing.

(9) Remove the dial indicator tool and the pilot stud (Fig. 63) from the differential housing.

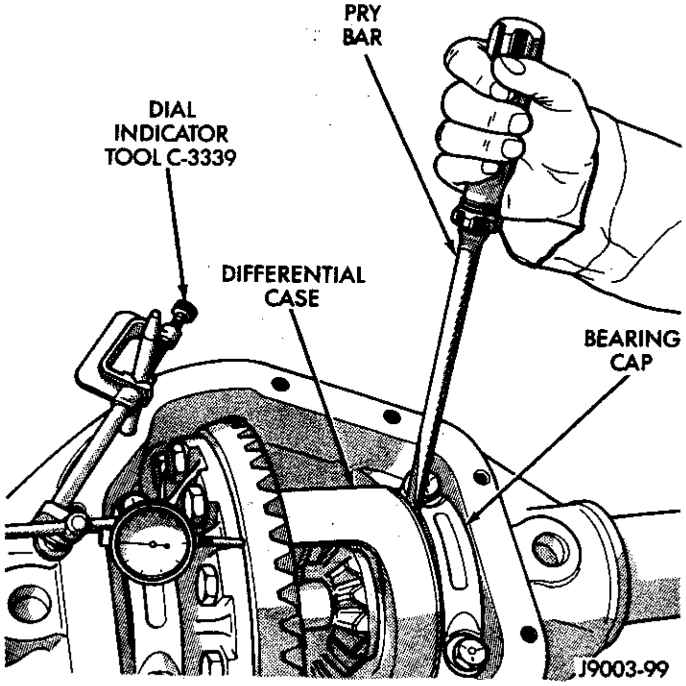

Fig. 63 Ring Gear "Backlash" Measurement

(10) Remove the differential bearing caps.

(11) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 62). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(12) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 62). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(13) Tighten the spreader tool turnbuckle (Fig. 62) and separate the differential housing only enough to remove the differential case from the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 62) as the housing is being separated.

(14) Remove the dial indicator tool and the pilot stud (Fig. 62) when the differential housing has been separated sufficiently to remove the differential case from the housing.

(15) Remove the differential case from the differential housing.

(16) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 62).

(17) Remove the master bearing tools from the differential case hubs.

(18) Position the "backlash" shims (with the required thickness determined above) on the differential case hub (ring gear side). Place the differential bearing on the hub and install it with Bearing Installation Tool C-4028-A and Driver Handle Tool C-4171 (Fig. 64).

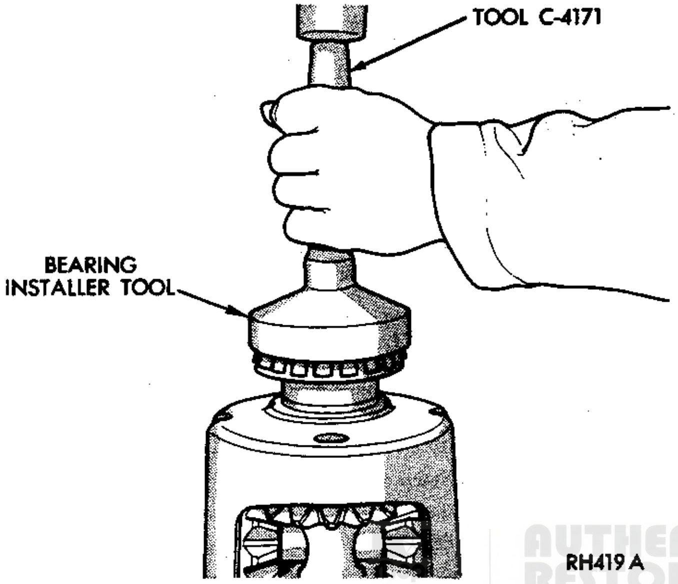

Fig. 64 Differential Bearing Installation

(19) Position the remaining "zero" "end-play" shims on the hub at the opposite side of the differential case. Include an additional 0.015-in (0.38-mm) thick shim on this hub to provide the required differential bearing "preload" torque.

(20) Install the other differential bearing on the hub with Bearing Installation Tool C-4028-A and Driver Handle Tool C-4171 (Fig. 64).

(21) Match each bearing cap with its differential bearing (original) counterpart and install the caps on the bearings.

(22) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 62). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(23) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 62). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(24) Tighten the spreader tool turnbuckle (Fig. 62) and separate the differential housing only enough to install the differential case in the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 62) as the housing is being separated.

(25) Remove the dial indicator tool and the pilot stud (Fig. 62) when the differential housing has been separated sufficiently to install the differential case in the housing.

(26) Install the differential case in the differential housing.

(27) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 62).

(28) Install the differential bearing caps. Ensure that the installation reference letter stamped in each cap corresponds to the letter stamped in the differential housing (Fig. 65). Tighten the bearing cap bolts with 95 to 122 N•m (70 to 90 ft-lbs) torque.

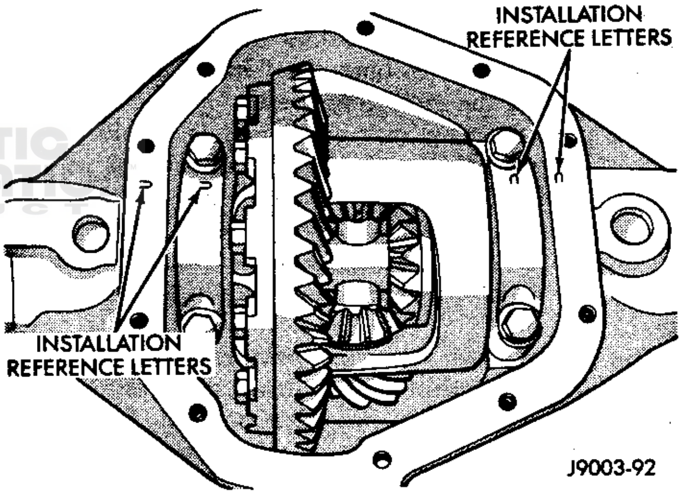

Fig. 65 Differential Bearing Cap Reference Letters

(29) Measure the ring gear "backlash" at four equally spaced locations around the perimeter of the ring gear with a dial indicator (Fig. 66).

The ring gear "backlash" must be within 0.005 - 0.009 inch (0.13 - 0.23 mm) and it cannot vary more than 0.003 inch (0.08 mm) at any of the measurement locations.

(30) Excessive "backlash" is corrected by moving the ring gear teeth closer to the drive pinion gear teeth. Insufficient "backlash" is corrected by moving the ring gear teeth away from the drive pinion gear teeth. "Backlash" correction is accomplished by transferring shims from one side of the differential case to the other (Fig. 56).

RING GEAR TEETH CONTACT PATTERNS

If the drive pinion gear depth of mesh and the ring gear "backlash" have been correctly established ac-

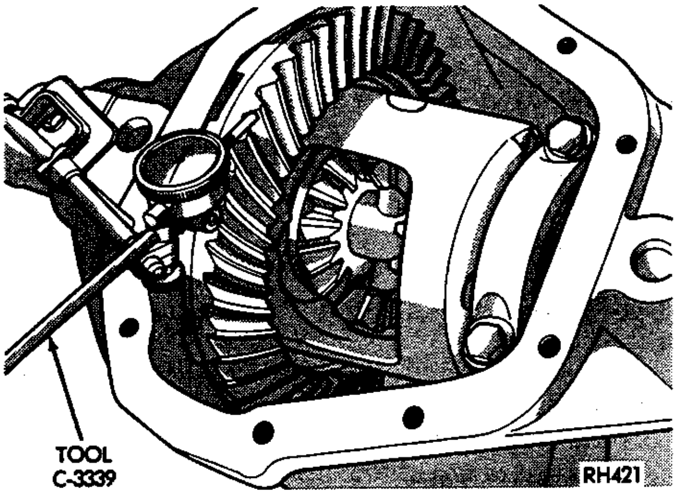

Fig. 66 Ring Gear "Backlash" Measurement

cording to the instructions and information provided in the procedures above, good gear teeth contact patterns should exist.

(1) Apply a thin coat of Hydrated Ferric Oxide (commonly referred to as Yellow Oxide of Iron), or an equivalent product, to both the "drive" side and the "coast" side of the ring gear teeth.

(2) Rotate the ring gear one complete revolution in both directions while a load is being applied with a round bar or screwdriver inserted between the differential housing and the differential case flange. This action will produce a distinct contact pattern on both the "drive" side and the "coast" side of the ring gear teeth.

The gear teeth contact pattern will disclose whether or not the drive pinion gear shaft rear bearing depth shim has the correct thickness and whether or not the ring gear "backlash" has been adjusted correctly. The "backlash" between the ring gear and the drive pinion gear must be maintained within the specified limits until the correct teeth contact pattern is obtained.

(3) Examine the contact patterns on the ring gear teeth and compare them with those in Figures 67 through 71 to determine if the patterns are correct. With the drive pinion gear depth of mesh correct and the ring gear "backlash" adjusted correctly, the teeth contact patterns should closely resemble the patterns illustrated in Fig. 67. Notice that the illustrated teeth contact patterns are well centered on both the "drive" side and the "coast" side of the teeth.

When the teeth contact patterns are obtained by the method described above, they are likely to be rather small. With an actual operating load, however, the contact area increases.

(4) If, after examining the ring gear contact patterns, it is determined that the patterns resemble those illustrated in Fig. 68, the drive pinion gear is separated too much from the centerline of the ring gear. This condition will cause the contact patterns to be "high" on the "drive" side and near the "heel" of the tooth, and "high" on the "coast" side and near the "toe" of the tooth. To correct for this type teeth contact patterns, increase the thickness of the depth shim (located between the drive pinion gear and the drive pinion gear shaft inner/rear bearing). This will cause the "high" contact pattern on the "drive" side to be lowered and to move toward the "toe" of the tooth, and the "high" contact pattern on the "coast" side to be lowered and to move toward the "heel" of the tooth (Fig. 69).

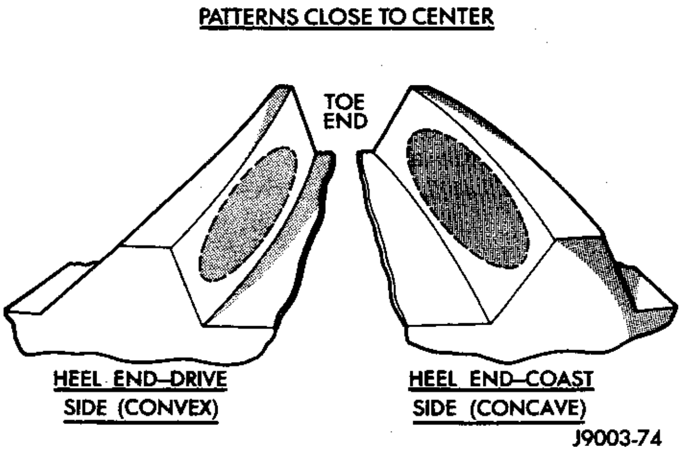

Fig. 67 Desired Teeth Contact Patterns (With Light Load)

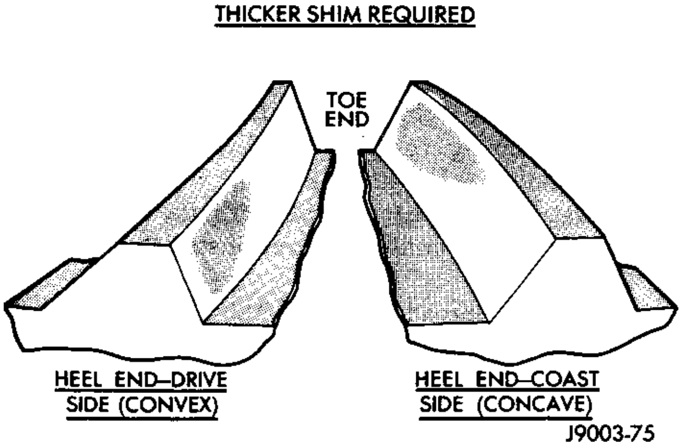

Fig. 68 Incorrect Teeth Contact Patterns—Increase Depth Shim Thickness

(5) If, after examining the contact patterns, it is determined that the patterns resemble those illustrated in Fig. 70, the drive pinion gear is too close to the centerline of the ring gear. This condition will cause the contact patterns to be "low" on the "drive" side and near the "toe" of the tooth, and "low" on "coast" side and near the "heel" of the tooth. To correct for this type of teeth contact patterns, decrease the thickness of the depth shim (located between the

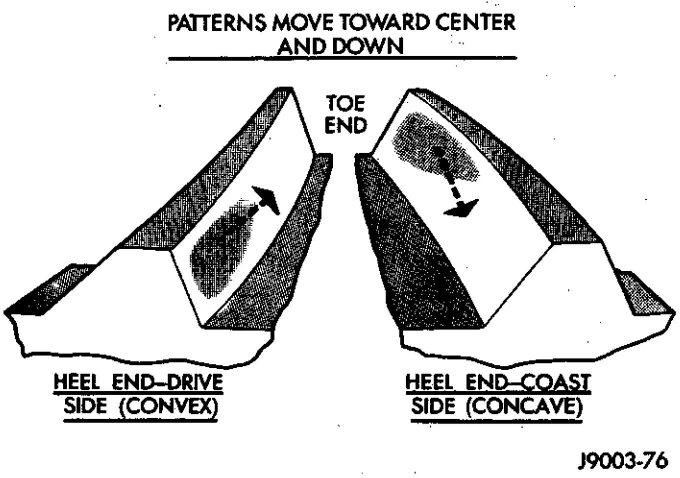

Fig. 69 Teeth Contact Patterns After Depth Shim Thickness Is Increased

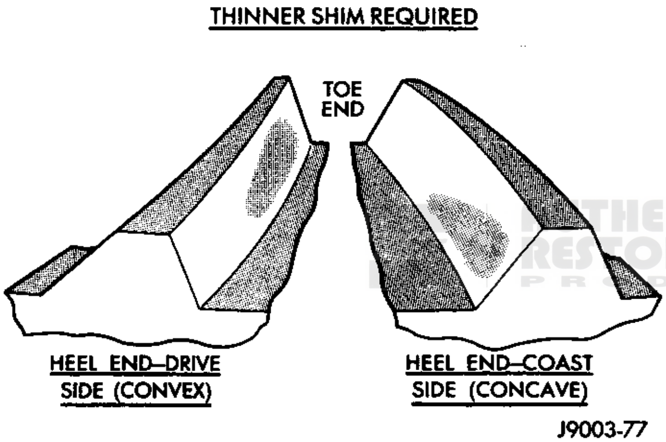

Fig. 70 Incorrect Teeth Contact Patterns—Decrease Depth Shim Thickness

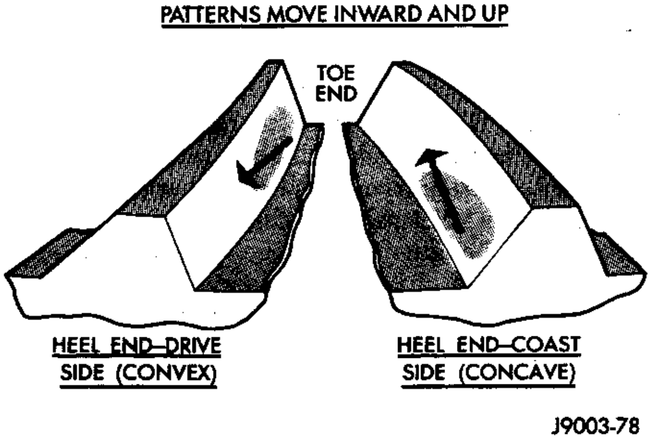

Fig. 71 Teeth Contact Patterns After Depth Shim Thickness Is Decreased

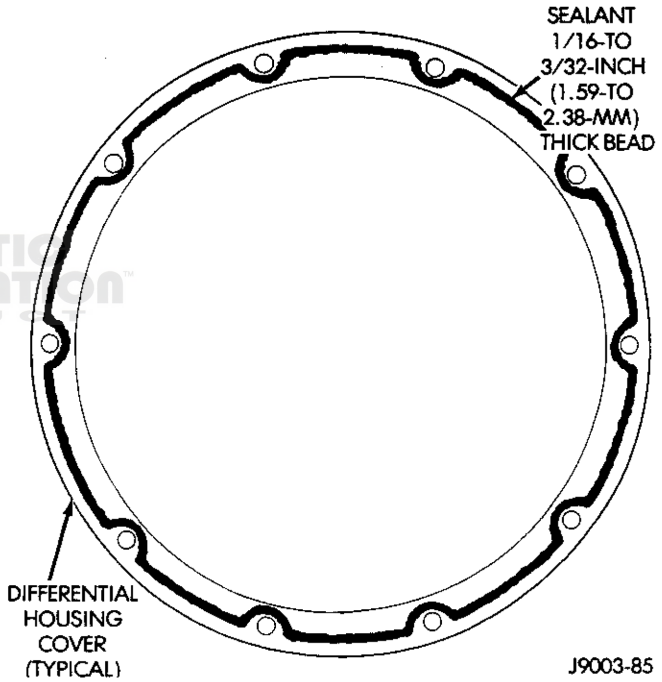

Fig. 72 Sealant On Housing Cover.

drive pinion gear and the drive pinion gear shaft inner/rear bearing). This will cause the “low” contact pattern on the “drive” side to be raised and to move toward the “heel” of the tooth, and the “low” contact pattern on the “coast” side to be raised and to move toward the “toe” of the tooth (Fig. 71).

INSTALLATION

(1) Install the axle shafts in the axle shaft tubes. If necessary, refer to the installation procedures.

(2) Remove any residual RTV sealant/gasket material from the differential housing and cover mating surfaces, thoroughly clean the surfaces with mineral spirits (or an equivalent cleaning solution) and dry the surfaces completely.

(3) Apply a thin “bead” of MOPAR RTV Sealant (or an equivalent sealant) around the bolt circle on the housing and on the cover (Fig. 72). **Allow the sealant to “cure” for a few minutes.**

If for any reason the differential housing cover is not installed within 20 minutes after applying the sealant, the sealant must be removed and another “bead” of sealant applied.

(4) Install the housing cover on the differential housing with the attaching bolts. **Install the axle gear ratio identification tag under one of the cover bolts.** Tighten the cover bolts with 47 N•m (35 ft-lbs) torque.

(5) Remove the supports and raise or lower the hoist until the vehicle is level.

(6) Remove the fill hole plug and fill the differential housing with the specified quantity of MOPAR Hypoid Gear Lubricant (or an equivalent product). Install the fill hole plug and tighten with 34 N•m (25 ft-lbs) torque.

(7) Lower the vehicle and test the brakes and the axle for proper operation.

LUBRICANT

Multi-purpose, hypoid gear lubricant, as defined by MIL-L-2105-B and by API GL 5 quality specifications, should be used for Model 44 front axles. MOPAR Hypoid Gear Lubricant conforms with both of these specifications and is highly recommended for use with both Ram Truck and Ramcharger vehicles.

Each time a 4WD vehicle is serviced for other reasons (e.g., an engine oil change), inspect the front axle for evidence of lubricant leakage. If leakage exists, observe the lubricant level in the differential housing through the fill hole. When observing the level, ensure that the vehicle is level on the hoist. The lubricant level should be maintained at the bottom of fill hole.

CAUTION: If the front axle is submerged in water, the axle lubricant must be replaced immediately to avoid the possibility of premature axle failure resulting from water contamination of the lubricant.

DRAIN AND REFILL

(1) Drive the vehicle with the front axle shafts engaged (i.e., in 4WD) until the gear lubricant in the axle attains the normal operating temperature.

(2) Raise and support the vehicle.

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

(4) Remove the differential housing cover and allow the original lubricant to completely drain from the housing and the axle shaft tubes.

(5) Flush the differential and the housing cavity with a "flushing" oil (or light engine oil) to remove residual lubricant and foreign matter. **Do not use water, steam, kerosene or gasoline for flushing.**

(6) Install the differential housing cover and tighten the bolts with 47 N•m (35 ft-lbs) Torque.

(7) Refill the differential housing with the specified quantity of MOPAR Hypoid Gear Lubricant. Refer to the Specifications chart.

(8) Install and tighten the fill hole plug with 34 N•m (25 ft-lbs) torque.

(9) Remove the supports and lower the vehicle.

MODEL 60 FRONT AXLE SERVICE—4WD VEHICLES

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GENERAL INFORMATION

Ram Truck and Ramcharger vehicles equipped for heavy duty 4WD operation have a Model 60 front axle. The housing for Model 60 front axles consists of an iron center casting (differential housing) with axle shaft tubes extending from either side. The axle shaft tubes are pressed into and welded to the differential housing to form a one-piece axle housing. The removable, stamped steel cover located at the front of the differential housing provides a means for inspection and for differential service without removing the complete front axle from the vehicle. The axle has a hypoid gear differential and the centerline of the drive pinion gear shaft is located below the centerline of the ring gear.

A small, stamped metal axle gear ratio identification tag is attached to the housing cover via one of the cover bolts. This tag also identifies the number of ring gear and drive pinion gear teeth.

The drive pinion gear shaft rotates within two tapered, roller bearings. The drive pinion gear shaft rear bearing is tightly "press-fitted" on the drive pinion gear shaft. The drive pinion gear shaft front bearing is very lightly "press-fitted" (which is similar to a "close, sliding fit") on the drive pinion gear shaft. The drive pinion gear shaft inner and outer bearing cups are "press-fitted" in the differential housing bore and against a recessed shoulder. The drive pinion gear shaft depth of mesh adjustment is controlled by the use of metal depth shims that are installed between the drive pinion gear shaft inner bearing and the differential housing.

The drive pinion gear shaft bearing "preload" torque is provided via metal shims that are located between the drive pinion gear shaft outer bearing cup and the differential housing.

The differential case hubs rotate in the differential housing via two tapered, roller bearings that are "press-fitted" on the case hubs. The shims that are installed between the bearings and the hub shoulder provide three functions:

- to adjust and maintain the "backlash" between the ring gear and the drive pinion gear;
- to establish a means for obtaining and then retaining the differential bearing "preload" torque; and
- to eliminate the differential "side play".the differential housing and axle shaft tubes (the axle housing), the differential case and the drive pinion gear shaft.

A Model 60 front axle has "locking" hubs that must be engaged for 4WD operation.

CAUTION: Whenever front axle service is necessary, or when the axle is being rotated via the engine or other means, raise all four wheels off the surface.

DUALMATIC LOCKING HUB SERVICE

REMOVAL/DISASSEMBLY

(1) Turn the shift knob to the ENGAGE position (Fig. 1).

(2) Apply pressure to the face of the shift knob and remove the three retaining screws located nearest to the flange (Fig. 1).

(3) Pull outward and remove the shift knob from the base (Fig. 1).

(4) Remove the "snap" ring from the axle shaft (Fig.1).

(5) Remove the capscrews and lockwashers from the base flange.

(6) Separate and remove locking hub from the rotor/hub. Remove and discard the gasket.

INSPECTION

(1) Wash all the components (Fig. 1) in mineral spirits and blow them dry with compressed air.

(2) Examine the splines, the shift knob, the cam, the sliding gear, the drive shaft gear, and the base for damage (Fig. 1). Replace as necessary.

ASSEMBLY/INSTALLATION

(1) Lubricate the components (Fig. 1) lightly with MOPAR Multi-Purpose Lubricant (or an equivalent lubricant).

(2) Position a replacement gasket and the locking hub onto rotor/hub (Fig. 1).

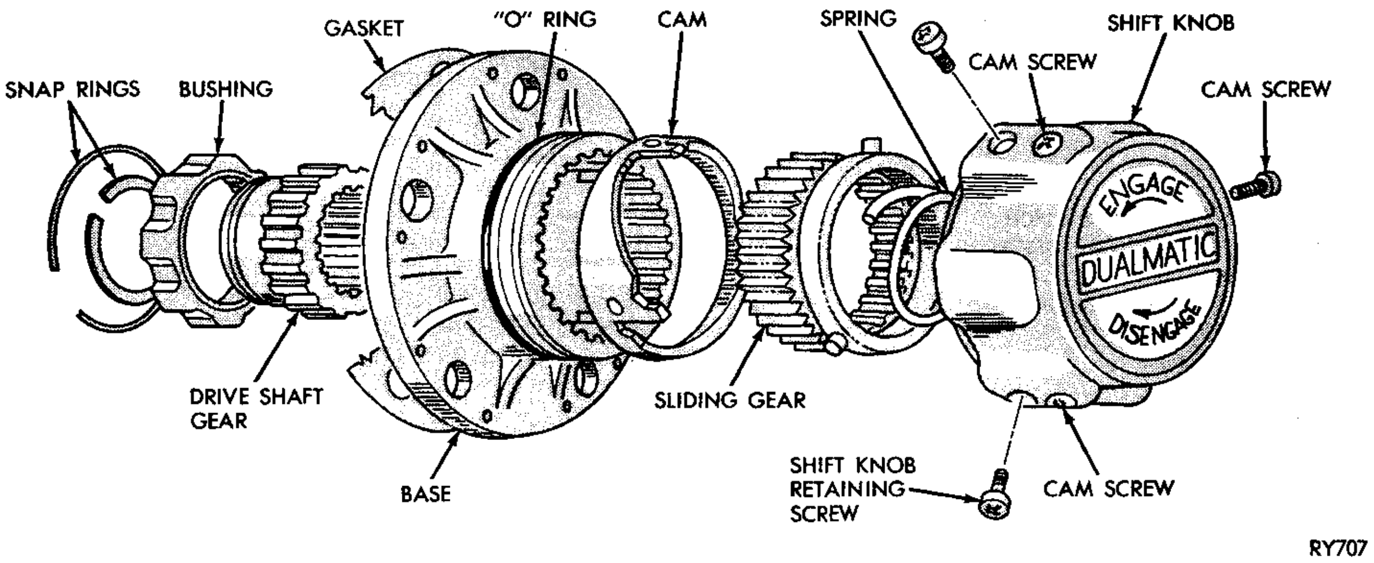

Fig. 1 Dualmatic Locking Hub

(3) Install the lockwashers and the attaching capscrews. Tighten the capscrews with 41-54 N•m (30-40 ft-lbs) torque.

(4) Install the axle shaft "snap" ring (Fig. 1).

(5) Position the shift knob on the base. Align the splines by pushing inward on the shift knob and rotating it clockwise to "lock" it in-place.

(6) Install and tighten the three shift knob retaining screws.

WHEEL BEARING ADJUSTMENT

(1) Raise and support the vehicle.

(2) Remove the hub cap. Use Tool C-4020 to remove the "snap" ring.

(3) Remove the flange nuts and the lockwashers. Remove the drive flange and discard the gasket, or (if equipped) remove the locking hub. If necessary, refer to the Dualmatic locking hub removal/disassembly procedure.

(4) Straighten the lock ring tangs and use Tool DD-1241-JD (Fig. 2) to remove the outer locknut and the lock ring.

(5) Use Tool DD-1241-JD and Tool C-3952 to tighten the inner locknut with 68 N•m (50 ft-lbs) torque to seat the wheel bearings. Loosen the locknut and then re-tighten with 41-54 N•m (30-40 ft-lbs) torque while rotating rotor/hub. Loosen the locknut 135° to 150°.

(6) Install the lock ring and the outer locknut. Tighten the locknut with 88 N•m (65 ft-lbs) torque minimum. Bend one lock ring tang over the inner locknut and one tang over the outer locknut.

(7) The wheel bearing adjustment should produce an "end-play" of 0.001 to 0.010 inch (0.025 to 0.254 mm).

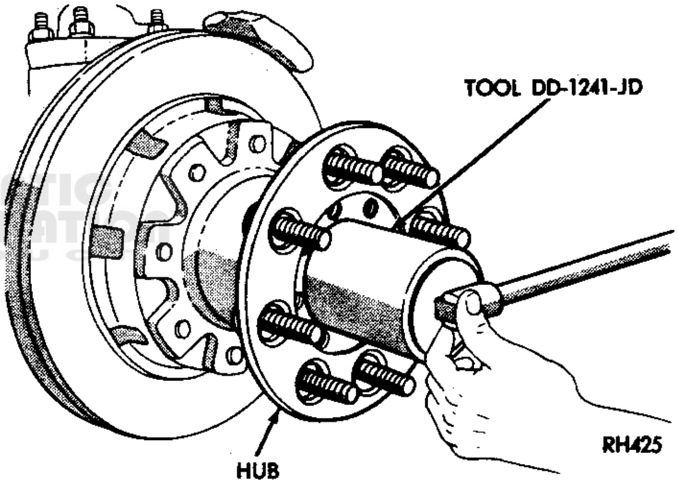

Fig. 2 Outer Locknut Removal/Installation

(8) Install a replacement gasket on the hub. Install the drive flange, the lockwashers and the nuts. Tighten the nuts with 41 to 54 N•m (30 to 40 ft-lbs) torque.

(9) Use Tool C-4020 to install the "snap" ring.

(10) Install the hub cap, or (if equipped) install the Dualmatic locking hub. If necessary, refer to the Dualmatic locking hub assembly/installation procedure.

(11) Remove the supports, lower the vehicle and test drive the vehicle.

ROTOR/HUB AND WHEEL BEARING SERVICE

REMOVAL/DISASSEMBLY

(1) Block the brake pedal in the "up" position.

(2) Raise and support the vehicle.

(3) Remove the applicable wheel/tire.

(4) Remove the brake caliper-to-adaptor hex-head screw (Fig. 3).

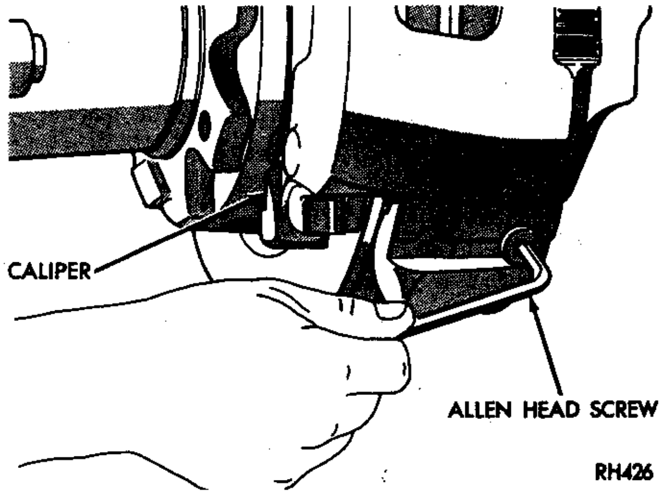

Fig. 3 Hex-Head Screw Removal/Installation

(5) Tap the adaptor lock and spring with a punch to remove them from between the brake caliper and the adaptor (Fig. 4).

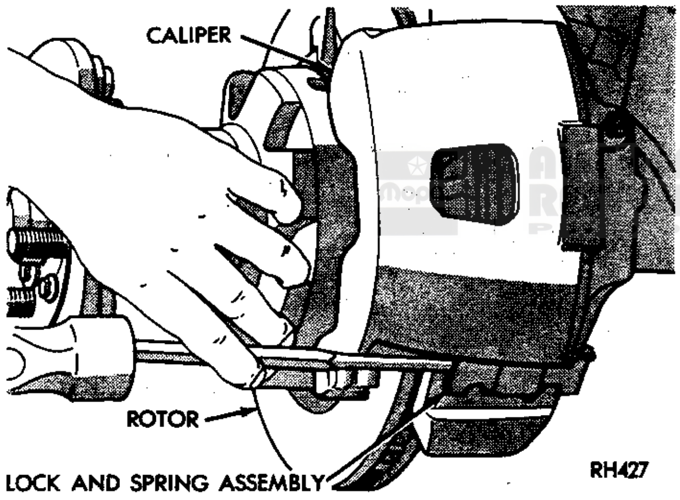

Fig. 4 Caliper Lock & Spring Removal

(6) Carefully separate the brake caliper from the adaptor. Support the caliper out of the way. **Do not allow the caliper to hang or be supported by the brake fluid hose.** The inner brake pad will remain on the adaptor.

(7) Remove the hub cap. Use Tool C-4020 to remove the "snap" ring.

(8) Remove the flange nuts and the lockwashers. Remove the drive flange and discard the gasket, or (if equipped) remove the locking hub. If necessary, refer to the Dualmatic locking hub removal/ disassembly procedure.

(9) Straighten the lock ring tangs and use Tool DD-1241-JD (Fig. 2) to remove the outer locknut and the lock ring. Remove the inner locknut and the outer wheel bearing. Carefully slide the rotor/hub from the steering knuckle spindle.

(10) Remove the seal and the inner wheel bearing from the hub.

CLEANING/INSPECTION

(1) Thoroughly clean the wheel bearings and the interior of the hub. Remove all the old lubricant. Soak the wheel bearings in cleaning solvent to loosen the lubricant. Strike the flat of the wheel bearings against a wooden block several times and immerse them in the solvent between blows to jar loose and wash particles of hardened lubricant from each wheel bearing. Repeat the procedure until the wheel bearings are clean.

(2) Dry the wheel bearings with compressed air but do not spin them with the air.

(3) After cleaning and drying, apply engine oil to the wheel bearings.

(4) Turn the wheel bearings slowly while applying pressure to inspect them for pitting and roughness. Replace all excessively worn and defective wheel bearings. If a wheel bearing is pitted and/or rough, replace both the wheel bearing and the cup.

(5) If the wheel bearings are acceptable for additional use, remove the engine oil and "pack" them with MOPAR Multi- Mileage Lubricant (or an equivalent lubricant) and place them in a clean covered container until ready for installation. If a wheel bearing "packer" is not available, hand "pack" lubricant into all the cavities between the cage and the rollers.

(6) If the wheel bearings and cups must be replaced, remove the cups from the hub with a brass drift or use an appropriate removal tool.

(7) Replace the wheel bearing cups with a an appropriate installation tool.

ASSEMBLY/INSTALLATION

(1) Apply a coat of MOPAR Multi-Mileage Lubricant (or an equivalent lubricant) to the hub bore. Install the inner wheel bearing in the lubricant coated hub bore and install a replacement seal with an appropriate seal installation tool. **Exercise extreme care to avoid damaging the seal during installation.**

(2) Apply a coat of MOPAR Multi-Mileage Lubricant (or an equivalent lubricant) to the spindle. Carefully install the rotor/hub onto the lubricant coated spindle. Install the outer wheel bearing and the inner locknut.

(3) Use Tool DD-1241-JD and Tool C-3952 to tighten the inner locknut with 68 N•m (50 ft-lbs) torque to seat the wheel bearings. Loosen the locknut and then re-tighten with 41-54 N•m (30-40 ft-lbs) torque while rotating rotor/hub. Loosen the locknut 135° to 150°.

(4) Install the lock ring and the outer locknut (Fig. 2). Tighten the locknut with 88 N•m (65 ft-lbs) torque minimum. Bend one lock ring tang over the inner locknut and one tang over the outer locknut.

(5) The wheel bearing adjustment should produce an "end-play" of 0.001 to 0.010 inch (0.025 to 0.254 mm).

(6) Install a replacement gasket on the hub. Install the drive flange, the lockwashers and the nuts. Tighten the nuts with 41 to 54 N•m (30 to 40 ft-lbs) torque.

(7) Use Tool C-4020 to install the "snap" ring.

(8) Install the hub cap, or (if equipped) install the Dualmatic locking hub. If necessary, refer to the Dualmatic locking hub assembly/installation procedure.

(9) Carefully position the brake caliper on the adaptor. Position the adaptor lock and spring between the caliper and the adaptor and tap them in-place (Fig. 5). Install hex-head screw and tighten it with 16 to 24 N•m (12 to 18 ft-lbs) torque.

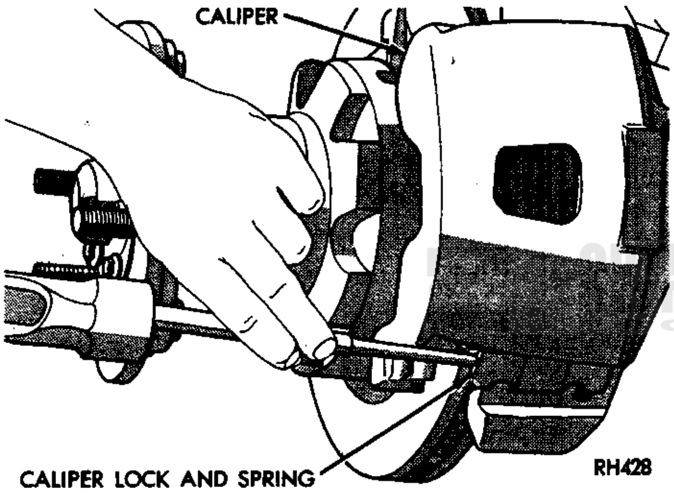

Fig. 5 Caliper Lock & Spring Installation

(10) Install the wheel/tire. Tighten the lug nuts with 102 N•m (75 ft-lbs) torque.

(11) Lubricate all the fittings. Remove the supports and lower the vehicle. Remove block from brake pedal and test drive the vehicle.

AXLE SHAFT AND U-JOINT SERVICE

REMOVAL

(1) Block the brake pedal in the "up" position.

(2) Raise and support the vehicle.

(3) Remove the applicable wheel/tire.

(4) Remove the brake caliper-to-adaptor hex-head screw (Fig. 3).

(5) Tap the adaptor lock and spring with a punch to remove them from between the brake caliper and the adaptor (Fig. 4).

(6) Carefully separate the brake caliper from the adaptor. Support the caliper out of the way. **Do not allow the caliper to hang or be supported by the brake fluid hose.** The inner brake pad will remain on the adaptor.

(7) Remove the hub cap. Use Tool C-4020 to remove the "snap" ring.

(8) Remove the flange nuts and the lockwashers. Remove the drive flange and discard the gasket, or (if equipped) remove the locking hub. If necessary, refer to the Dualmatic locking hub removal/disassembly procedure.

(9) Straighten the lock ring tangs and use Tool DD-1241-JD (Fig. 2) to remove the outer locknut and the lock ring. Remove the inner locknut and the outer wheel bearing. Carefully slide the rotor/hub from the steering knuckle spindle.

(10) Remove the inner brake pad from the adaptor.

(11) Remove the nuts and washers that attach the brake splash shield, the brake adaptor and the spindle to steering knuckle (Fig. 6).

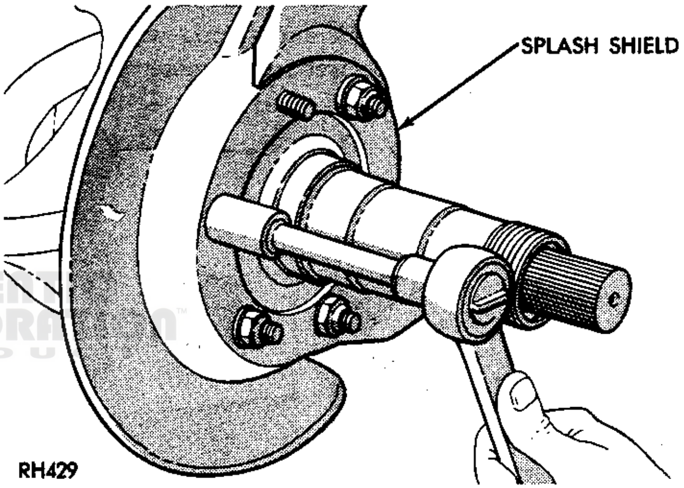

Fig. 6 Spindle & Splash Shield Removal/Installation

(12) Remove the spindle from the steering knuckle. Slide the inner and outer axle shaft with the bronze spacer, seal and slinger from the axle shaft tube and the steering knuckle (Fig. 7).

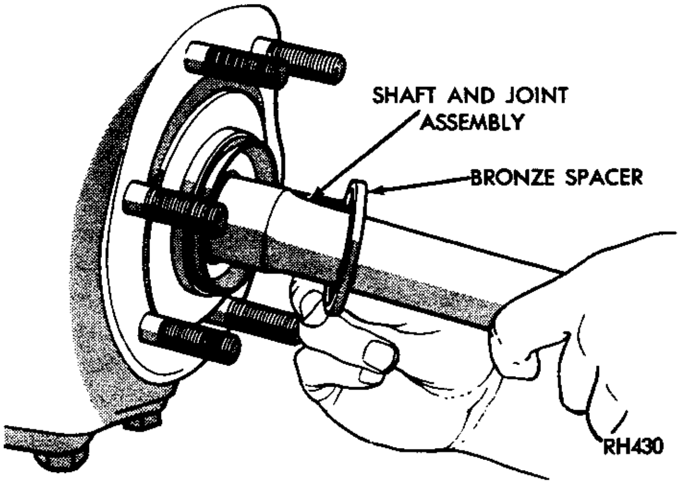

Fig. 7 Axle Shaft & U-Joint Removal/Installation

DISASSEMBLY

(1) Remove the "snap" retaining rings from the yoke arm bores.

(2) Position the U-joint between open vise jaws with one yoke horizontal and supported by the top of the vise jaws (Fig. 8). Do not tighten the vise.

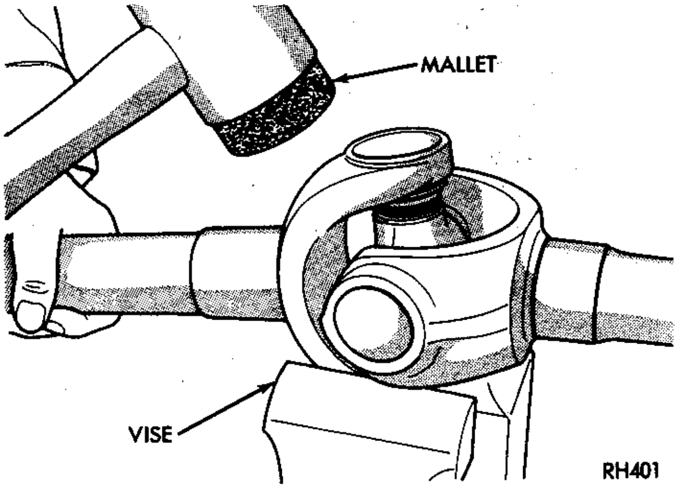

Fig. 8 Bearing Cap Removal

(3) Use a mallet to tap the vertical yoke upper arm several times and drive the vertical yoke downward (Fig. 8). This will force the upper needle bearing and cap out of the yoke.

(4) Reverse the position of the vertical yoke and remove opposite needle bearing and cap (Fig. 8).

(5) Remove the yoke from the spider.

(6) To complete the disassembly, position the open ends of the spider in a "soft-jawed" vise and repeat steps 3 and 4 (above) to remove remaining bearings and caps.

(7) Remove the spider from the yoke.

(8) Clean and inspect all the components. Clean any rust from the axle shaft splines. Retain each bearing and cap separate. If any component is excessively worn or damaged, a complete replacement U-joint should be installed.

(9) Re-pack the U-joint with MOPAR Multi-Mileage Lubricant, or an equivalent lubricant.

ASSEMBLY

(1) Insert the needle bearing and cap in one yoke arm bore.

(2) Place the yoke in a vise (Fig. 9) and force the needle bearing and cap into the correct position. Install the "snap" retaining ring.

(3) Remove the yoke from the vise and insert one end of the spider into the bearing. Insert opposite bearing and cap in the yoke arm bore by hand and align it with the spider.

(4) Place the yoke in a vise and force the cap into the yoke arm bore and onto the spider (Fig. 10).

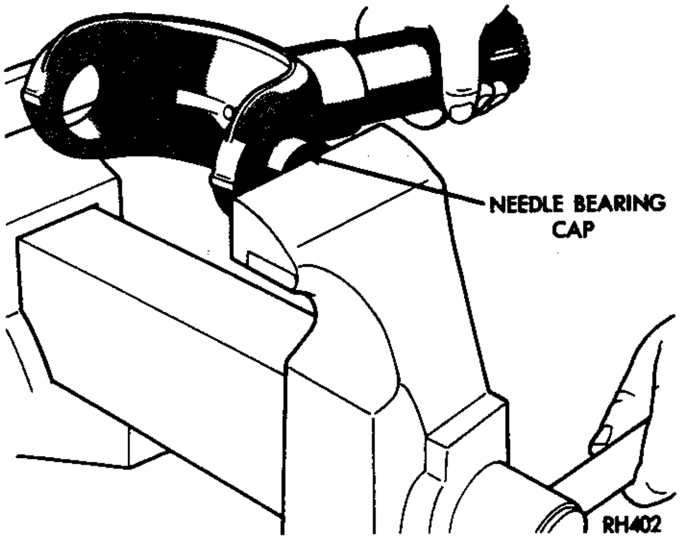

Fig. 9 Bearing Cap Installation

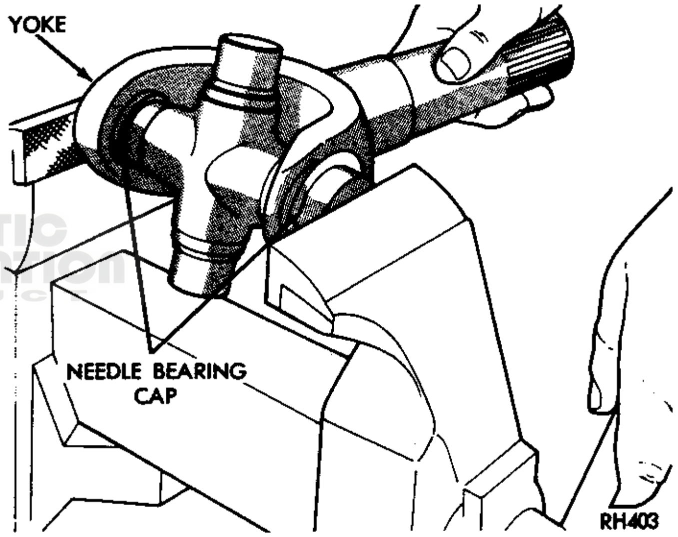

Fig. 10 Bearing Cap & Spider Installation

(5) Use a short plug or a socket wrench to force the bearing cap into the correct position and install the "snap" retaining ring.

(6) Repeat the instructions in steps 1 through 5 for installing remaining bearings, caps and yoke.

INSTALLATION

(1) Position the bronze spacer on the axle shaft with chamfer facing toward the U-joint. Slide the axle shaft into the steering knuckle and the axle shaft tube (Fig. 7).

(2) Install the spindle, the brake adaptor and the brake splash shield. Install washers and nuts and tighten them with 68 to 95 N•m (50 to 70 ft-lbs) torque.

(3) Position the inner brake pad on the adaptor.

(4) Carefully install rotor/hub on the spindle. Install the outer wheel bearing and the inner locknut.

(5) Use Tool DD-1241-JD and Tool C-3952 to tighten the inner locknut with 68 N•m (50 ft-lbs)

torque to "seat" the wheel bearings. Loosen the locknut and then re-tighten with 41-54 N•m (30-40 ft-lbs) torque while rotating rotor/hub. Loosen the locknut 135° to 150°.

(6) Install the lock ring and the outer locknut (Fig. 2). Tighten the locknut with 88 N•m (65 ft-lbs) torque minimum. Bend one lock ring tang over the inner locknut and one tang over the outer locknut.

(7) The wheel bearing adjustment should produce an "end-play" of 0.001 to 0.010 inch (0.025 to 0.254 mm).

(8) Install a replacement gasket on the hub. Install the drive flange, the lockwashers and the nuts. Tighten the nuts with 41 to 54 N•m (30 to 40 ft-lbs) torque.

(9) Use Tool C-4020 to install the "snap" ring.

(10) Install the hub cap, or (if equipped) install the Dualmatic locking hub. If necessary, refer to the Dualmatic locking hub assembly/installation procedure.

(11) Carefully position the brake caliper on the adaptor. Position the adaptor lock and spring between the caliper and the adaptor and tap them inplace (Fig. 5). Install hex-head screw and tighten it with 16 to 24 N•m (12 to 18 ft-lbs) torque.

(12) Install the wheel/tire. Tighten the lug nuts with 102 N•m (75 ft-lbs) torque.

(13) Remove the supports and lower the vehicle. Remove block from brake pedal and test drive the vehicle.

STEERING KNUCKLE SERVICE

REMOVAL/DISASSEMBLY

(1) Block the brake pedal in the "up" position.

(2) Raise and support the vehicle.

(3) Remove the applicable wheel/tire.

(4) Remove the brake caliper-to-adaptor hex-head screw (Fig. 3).

(5) Tap the adaptor lock and spring with a punch to remove them from between the brake caliper and the adaptor (Fig. 4).

(6) Carefully separate the brake caliper from the adaptor. Support the caliper out of the way. **Do not allow the caliper to hang or be supported by the brake fluid hose.** The inner brake pad will remain on the adaptor.

(7) Remove the hub cap. Use Tool C-4020 to remove the "snap" ring.

(8) Remove the flange nuts and the lockwashers. Remove the drive flange and discard the gasket, or (if equipped) remove the locking hub. If necessary, refer to the Dualmatic locking hub removal/ disassembly procedure.

(9) Straighten the lock ring tangs and use Tool DD-1241-JD (Fig. 2) to remove the outer locknut and the lock ring. Remove the inner locknut and the outer wheel bearing. Carefully slide the rotor/hub from the steering knuckle spindle.

(10) Remove the inner brake pad from the adaptor.

(11) Remove the nuts and washers that attach the brake splash shield, the brake adaptor and the spindle to steering knuckle (Fig. 6).

(12) Remove the spindle from the steering knuckle. Slide the inner and outer axle shaft with the bronze spacer, seal and slinger from the axle shaft tube and the steering knuckle (Fig. 7).

(13) Remove the cotter pin and the retaining nut from the tie- rod end ball stud. Use Tool C-3894-A to loosen the ball stud and remove the tie-rod end from the steering knuckle. Left side only, remove the cotter pin and the retaining nut from drag link ball stud. Use Tool C-4150 to loosen the ball stud and remove the drag link from the steering knuckle arm.

(14) Remove the nuts and the steering knuckle upper cap (left side steering knuckle arm). Discard the gasket. Remove the spring and the upper socket sleeve.

(15) Remove the capscrews from the steering knuckle lower cap. Dislodge the cap from the steering knuckle and the axle shaft tube yoke.

(16) To remove the steering knuckle from the axle shaft tube yoke, swing it out at the bottom, then lift it up and off the upper socket pin.

(17) Use Tool D-192 to loosen and remove the upper socket pin from the axle shaft tube upper arm bore (Fig. 11). Remove the seal.

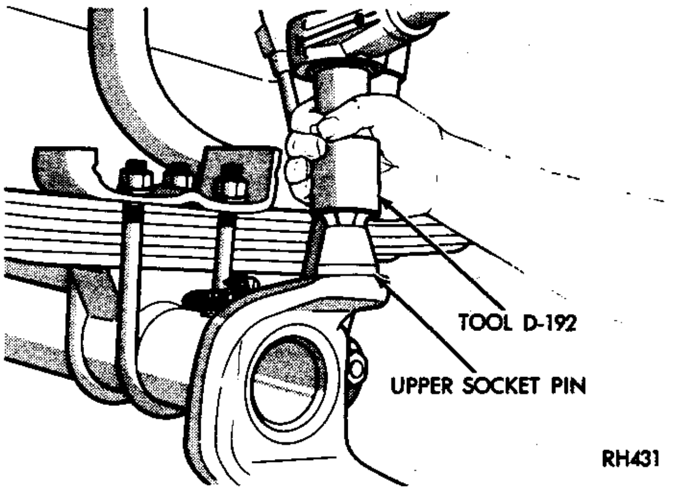

Fig. 11 Upper Socket Pin Removal/Installation

(18) Use Tools C-4212-1, C-4366-1 and C-4366-2 (positioned as illustrated in Figure 12) to force the lower ball socket from the axle shaft tube yoke lower arm bore.

(19) Clean all the components with an appropriate solvent and blow them dry with compressed air. Inspect all the components for burrs, chips, excessive wear, flat spots and cracks. Replace the components as necessary during steering knuckle assembly.

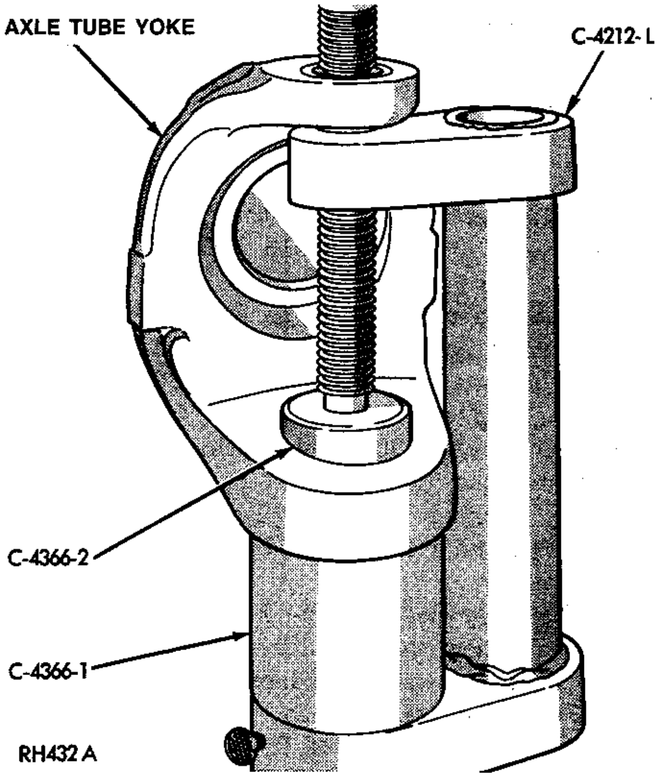

Fig. 12 Lower Ball Socket Removal

ASSEMBLY/INSTALLATION

(1) Lubricate the lower ball socket with MOPAR Multi-Mileage Lubricant (or an equivalent lubricant).

(2) Use Tools C-4212-L, C-4366-3, and C-4366-4 (positioned as illustrated in Figure 13) to force the seal and the lower bearing cup into the axle shaft tube yoke lower arm bore.

(3) Reposition Tools C-4212-L, C-4366-3 and C-4366-5 (as illustrated in Figure 14) and force the lower bearing and seal into axle shaft tube yoke lower arm bore.

(4) Use Tool D-192 and Torque Wrench Tool DD-994 to install the upper socket pin in the axle shaft tube yoke upper arm bore. Tighten the socket pin with 668 to 813 N•m (500 to 600 ft-lbs) torque. Install the seal over the socket pin.

(5) Position the steering knuckle over the socket pin. Fill the socket lower cavity with MOPAR Multi-Mileage Lubricant (or an equivalent lubricant). Maneuver the lower cap into place on the steering knuckle and the axle shaft tube yoke. Install the capscrews and tighten them with 95 to 122 N•m (70 to 90 ft-lbs) torque.

(6) Liberally lubricate upper socket pin with MOPAR Multi-Mileage Lubricant (or an equivalent lubricant). Align the upper socket sleeve keyway with the steering knuckle (Fig. 15) and slide it into position.

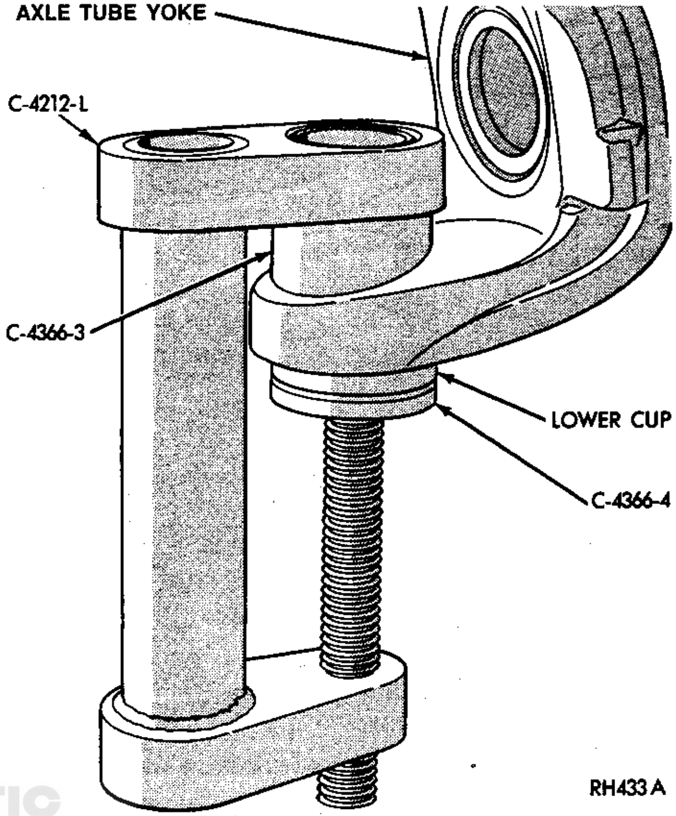

Fig. 13 Seal & Lower Bearing Cup Installation

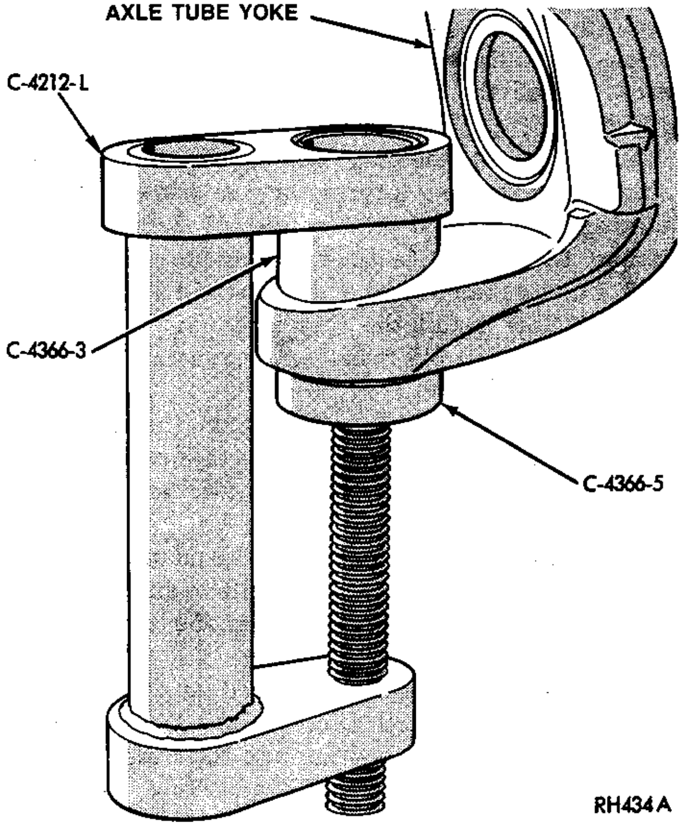

Fig. 14 Lower Bearing & Seal Installation

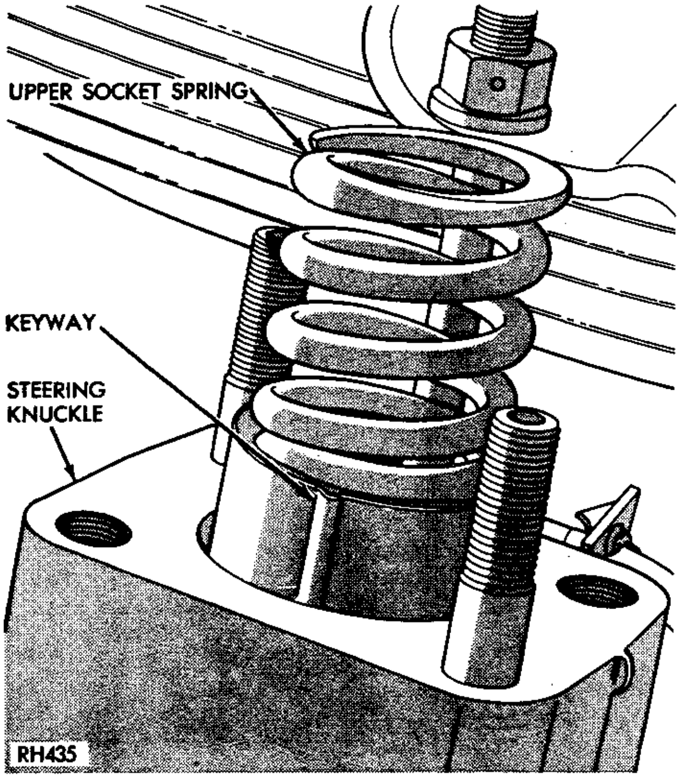

Fig. 15 Sleeve Keyway Alignment On Steering Knuckle

(7) Install a replacement gasket over the steering knuckle upper studs. Position the spring over the sleeve. Install the cap (left side steering knuckle arm). Install the nuts and tighten them with 96 to 122 N•m (70 to 90 ft-lbs) torque.

(8) At the left side only, connect the drag-link ball stud to the steering knuckle arm and install the retaining nut. Tighten the nut with 81 N•m (60 ft-lbs) torque. Install a replacement cotter pin.

(9) Connect the tie-rod end ball stud to the steering knuckle and install the retaining nut. Tighten the nut with 61 N•m (45 ft-lbs) torque. Install a replacement cotter pin.

(10) Position the bronze spacer on the axle shaft with chamfer facing toward the U-joint. Slide the axle shaft into the steering knuckle and the axle shaft tube (Fig. 7).

(11) Install the spindle, the brake adaptor and the brake splash shield. Install washers and nuts and tighten them with 68 to 95 N•m (50 to 70 ft-lbs) torque.

(12) Position the inner brake pad on the adaptor.

(13) Carefully install rotor/hub on the spindle. Install the outer wheel bearing and the inner locknut.

(14) Use Tool DD-1241-JD and Tool C-3952 to tighten the inner locknut with 68 N•m (50 ft-lbs) torque to "seat" the wheel bearings. Loosen the locknut and then re-tighten with 41-54 N•m (30-40 ft-lbs) torque while rotating rotor/hub. Loosen the locknut 135° to 150°.

(15) Install the lock ring and the outer locknut (Fig. 2). Tighten the locknut with 88 N•m (65 ft-lbs) torque minimum. Bend one lock ring tang over the inner locknut and one tang over the outer locknut.

(16) The wheel bearing adjustment should produce an "end-play" of 0.001 to 0.010 inch (0.025 to 0.254 mm).

(17) Install a replacement gasket on the hub. Install the drive flange, the lockwashers and the nuts. Tighten the nuts with 41 to 54 N•m (30 to 40 ft-lbs) torque.

(18) Use Tool C-4020 to install the "snap" ring.

(19) Install the hub cap, or (if equipped) install the Dualmatic locking hub. If necessary, refer to the Dualmatic locking hub assembly/installation procedure.

(20) Carefully position the brake caliper on the adaptor. Position the adaptor lock and spring between the caliper and the adaptor and tap them inplace (Fig. 5). Install hex-head screw and tighten it with 16 to 24 N•m (12 to 18 ft-lbs) torque.

(21) Install the wheel/tire. Tighten the lug nuts with 102 N•m (75 ft-lbs) torque.

(22) Apply lubricant to all the fittings. Remove the supports and lower the vehicle. Remove block from brake pedal and test drive the vehicle.

STEERING KNUCKLE ARM REMOVAL/INSTALLATION

REMOVAL

The drag-link ball stud seals should be inspected for damage when the engine oil is changed.

(1) Raise and support the vehicle at a comfortable working height. Remove the wheel cover and wheel/tire.

(2) Turn the front wheels to the left. Remove the cotter pin and the retaining nut from the drag-link ball stud.

Removal of a drag-link ball stud from the steering knuckle arm by methods other than using Tool C-4150 could damage the seal.

(3) Install Puller Tool C-4150 on the drag-link ball stud (Fig. 16). Apply sufficient force with the tool to loosen the drag-link ball stud from the steering knuckle arm.

(4) Remove the three steering knuckle arm-to-steering knuckle nuts and washers (Fig. 17). Tap the steering knuckle arm to loosen it from the steering knuckle. Pry upward and remove the steering knuckle arm from the vehicle.

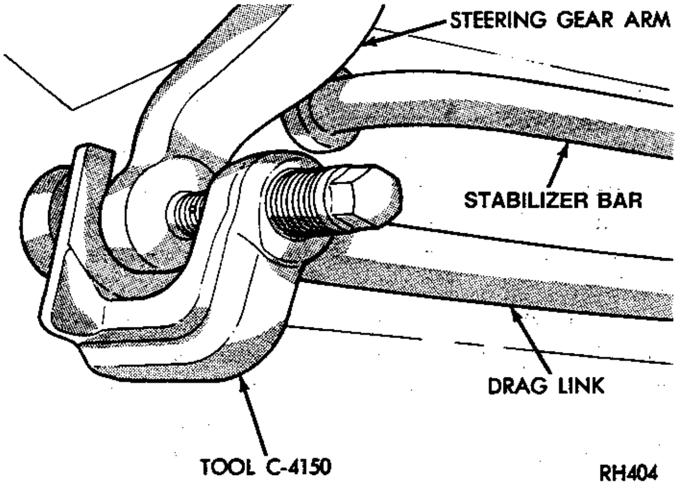

Fig. 16 Drag-Link Ball Stud Removal With Tool C-4150

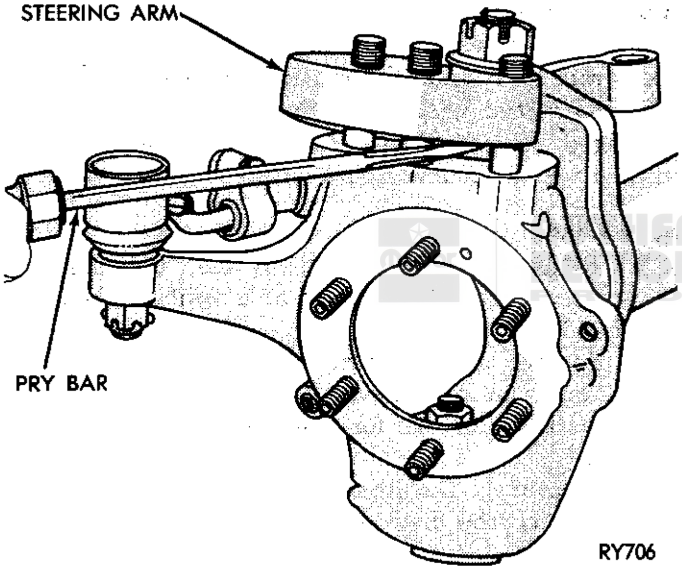

Fig. 17 Steering Knuckle Arm Removal

INSTALLATION

(1) Position the steering knuckle arm on the steering knuckle. Install the washers and attaching nuts. Tighten the nuts with 122 N•m (90 ft-lbs).

(2) Connect the drag-link ball stud to the steering knuckle arm. Install the retaining nut and tighten it with 81 N•m (60 ft-lbs). Install a replacement cotter pin.

(3) Remove the supports, lower the vehicle and test the vehicle steering.

DRAG LINK REMOVAL/INSTALLATION

SERVICE INFORMATION

The drag-link ball stud seals should be inspected for damage when the engine oil is changed.

A damaged seal requires removal of the seal and inspection of the drag-link ball stud at the throat opening. If all the lubricant has not escaped (or is not contaminated) or the ball stud is not excessively worn or rusted, install a replacement seal. Otherwise a replacement complete drag link should be installed. Lubricate the ball studs after installation with MOPAR Multi-Mileage Lubricant or an equivalent lubricant.

REMOVAL

Removal of a drag-link ball stud from the steering knuckle arm or the pitman (steering gear) arm by methods other than using Tool C-4150 could damage the seal.

(1) Raise and support the vehicle at a comfortable working height. Remove the applicable wheel cover and wheel/tire.

(2) Turn the front wheels in the direction that will provide the best possible access to the drag link. Remove the cotter pins and the retaining nuts from the drag-link ball studs.

(3) Install Puller Tool C-4150 on each drag-link ball stud (Fig. 16). Apply sufficient force with the tool to loosen the drag-link ball stud from the steering knuckle arm and the pitman (steering gear) arm. Remove the drag link from the vehicle.

INSTALLATION

(1) Position the drag link at steering knuckle arm (Fig. 18) so that the distance "A" to the bend in the link is the shortest distance to the steering knuckle arm and the distance "B" is the closest to the pitman (steering gear) arm.

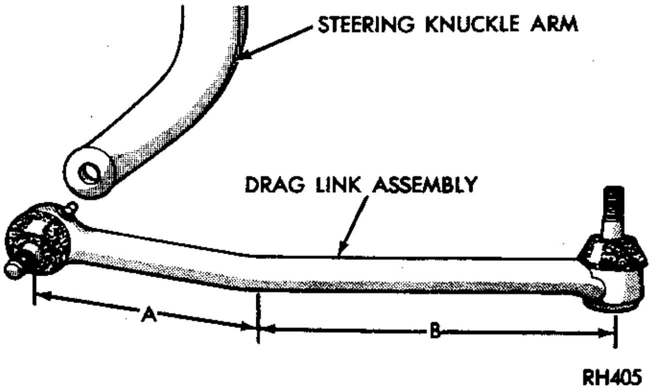

Fig. 18 Correct Drag Link Installation

(2) Install and tighten the ball stud retaining nuts with 81 N•m (60 ft-lbs) torque. Install replacement cotter pins.

(3) Install the wheel/tire and the wheel cover. Remove the supports and lower the vehicle.

TIE-ROD END REPLACEMENT

SERVICE INFORMATION

The tie-rod ball stud seals should be inspected for damage when the engine oil is changed.

A damaged seal requires removal of the seal and inspection of the tie-rod ball stud at the throat opening. If all the lubricant has not escaped (or is not contaminated) or the ball stud is not excessively worn or rusted, install a replacement seal. Otherwise a replacement complete tie-rod end should be installed. Lubricate the ball studs after installation with MOPAR Multi-Mileage Lubricant or an equivalent lubricant.

REMOVAL

Removal of a tie-rod end ball stud from the steering knuckle arm by methods other than using Tool C-3894-A could damage the seal.

(1) Raise and support the vehicle at a comfortable working height. Remove the applicable wheel cover and wheel/tire.

(2) Turn the front wheels in the direction that will provide the best possible access to the tie-rod end. Remove the cotter pin and the retaining nut from the tie-rod end ball stud.

(3) Install Puller Tool C-3894-A on the tie-rod end ball stud (Fig. 19). Apply sufficient force with the tool to loosen the tie-rod end ball stud from the steering knuckle arm.

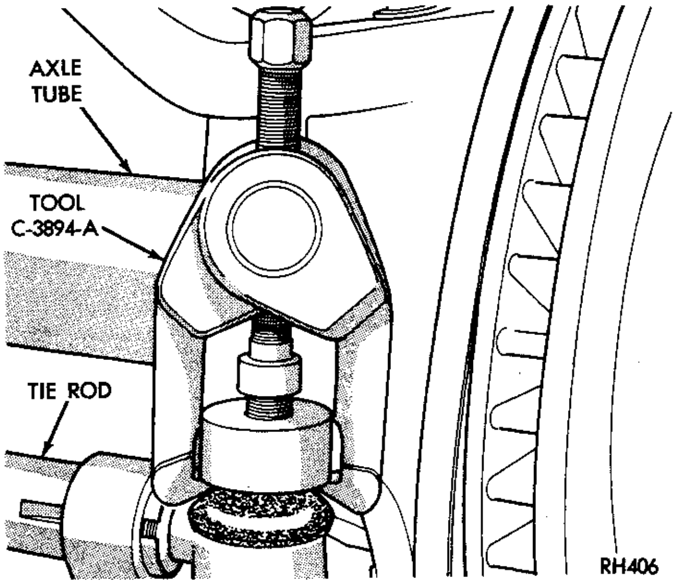

Fig. 19 Tie-Rod End Removal

(4) Measure and record the approximate distance from the end of the tie rod to the outside edge of the tie-rod end. Loosen the adjustment sleeve clamp nut and bolt. Un-thread the tie-rod end from the adjustment sleeve and remove it from the vehicle.

INSTALLATION

(1) Thread the replacement tie-rod end into the adjustment sleeve so that the length approximates the distance previously measured and recorded.

(2) Connect the tie-rod end ball stud to the steering knuckle arm and install the retaining nut. Tighten the nut with 61 N•m (45 ft-lbs) torque.

(3) Remove the supports and lower vehicle to the surface.

(4) Adjust the "toe" position. Refer to the procedure and the Specifications chart. Position the adjustment sleeve clamp bolt at the bottom of the tie-rod end. Tighten the clamp bolt and nut with 34-41 N•m (25-30 ft-lbs) torque. Test the vehicle steering.

COMPLETE AXLE REMOVAL/INSTALLATION

SERVICE INFORMATION

It is not necessary to remove the complete front axle from the vehicle for routine service. However, if the differential housing or the axle shaft tubes are damaged, the complete axle can be removed and installed via the following procedures.

REMOVAL

(1) Block the brake pedal in the "up" position. Raise and support the vehicle at a comfortable working height.

(2) Remove the front wheels/tires.

(3) Mark the front drive shaft and the drive pinion gear shaft (axle) yoke for installation alignment reference.

(4) Disconnect the front drive shaft from the axle yoke. Attach the drive shaft to the frame rail with wire.

(5) Remove the cotter pin, the retaining nut, and disconnect the drag link from the steering knuckle arm (left side only). Discard the cotter pin.

(6) Disconnect flexible brake fluid hose fittings at the frame crossmember. Plug the hoses at the fittings.

(7) Remove the shock absorber lower attaching nut and detach the stud from the axle shaft tube bracket.

(8) Remove nuts and the washers from the spring U-bolts. Remove the complete front axle from the vehicle.

INSTALLATION

(1) Position the front axle under the front of the vehicle with the axle spring pads under the springs. Place the spring brackets over the springs.

(2) Install the spring U-bolts, washers and retaining nuts. Tighten the nuts with 149 N•m (110 ft-lbs) torque.

(3) Insert the shock absorber lower studs in the axle shaft tube brackets. Install the attaching nuts and tighten them with 75 N•m (55 ft-lbs) torque.

(4) Remove plugs and connect the brake hose fittings. Tighten the fittings with 9-17 N•m (80-150 in-lbs) torque.

(5) Connect the drag-link ball stud to the steering knuckle arm. Install the retaining nut and tighten it with 81 N•m (60 ft-lbs) torque. To align the cotter pin hole in the ball stud with the slot in the castellated nut (if the slot and the hole are not aligned), continue to tighten the nut until they are aligned. Do not loosen the nut to align the hole and the slot. Install a replacement cotter pin.

(6) Connect the drive shaft to the drive pinion gear shaft (axle) yoke with the installation reference marks aligned. Install the washers and the nuts and tighten with 34 N•m (300 in-lbs) torque.

(7) Remove the supports, lower the vehicle and remove the block from the brake pedal.

(8) Raise the vehicle, bleed and adjust the brakes, lubricate all the ball stud fittings, inspect the differential housing lubricant level. Refer to the Specifications chart.

(9) Lower the vehicle and test the axle and front suspension operation.

DIFFERENTIAL SERVICE

SERVICE INFORMATION

It is not necessary to remove the complete front axle from the vehicle for routine axle or differential service. To replace the differential side gears, it is necessary to remove only the axle shafts, the differential housing cover, the lubricant and the differential case. To replace the differential bearings, it is necessary to remove only the axle shafts, the differential housing cover, the lubricant, the differential case and to adjust the ring gear "backlash".

REMOVAL/DISASSEMBLY

(1) Raise and support the vehicle at a comfortable working height.

(2) Remove the front wheels/tires.

(3) Mark the front drive shaft and the drive pinion gear shaft (axle) yoke for installation alignment reference.

(4) Disconnect the front drive shaft from the axle yoke. Attach the drive shaft to the frame rail with wire.

(5) Thoroughly clean the outer area of the differential housing and axle shaft tubes with an appropriate cleaning solvent and blow dry with compressed air.

(6) Loosen the differential housing cover bolts and drain the lubricant into a container. Remove the bolts and the differential housing cover.

A close examination of the differential prior to disassembly can often reveal valuable information concerning the extent and type of repairs or adjustments that will be necessary. Because the most frequent causes of axle noise are improper "backlash" or differential bearing "preload" torque, or both, a few minor adjustments could be all that is necessary to correct a defect.

Therefore, before disassembly, the following information should be available:

- ring gear "backlash" measurement,
- drive pinion gear shaft bearing "preload" torque measurement, and
- ring gear/drive pinion gear teeth contact patterns.

The results (above) should be recorded and analyzed. It is expected that these measurements will be helpful when making necessary repairs to the differential. Refer to the applicable procedures within this section for instructions.

If, after the measurements and adjustments, the defect still exists, proceed with the following disassembly, inspection and assembly procedures.

(7) Thoroughly flush and clean the differential gears, bearings and the other differential components with an appropriate solvent.

(8) Install a pilot stud in the differential housing and attach Dial Indicator Tool C-3339 to the housing (Fig. 20) with the indicator plunger slightly "loaded" and at a right angle (i.e., perpendicular) to the back side of the ring gear. "Zero" the dial indicator pointer.

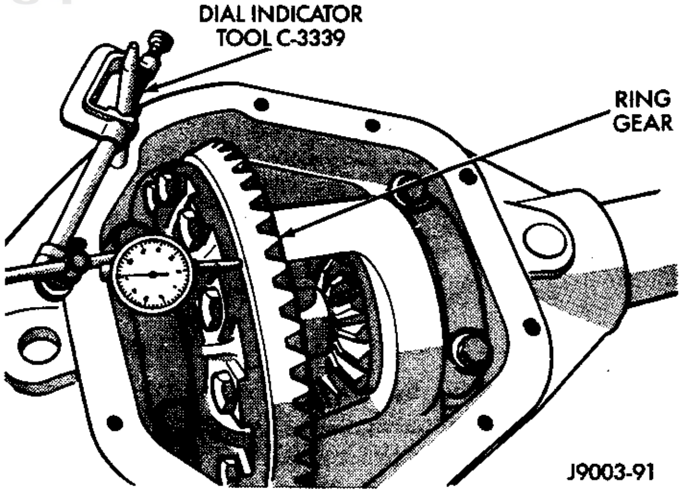

Fig. 20 Ring Gear "Runout" Measurement

(9) Measure the ring gear "runout" by rotating the ring gear several complete revolutions and observing the dial indicator pointer. Mark both the ring gear and the differential case flange at the location of maximum "runout".

The mark on the differential case flange will be very useful when measuring the differential case "runout". The differential case flange "runout" measurement procedure is described below.

If the combined ring gear "runout" (i.e., peak-to-peak) exceeds of 0.006 inch (0.150 mm), possi-

ble causes could be that the ring gear is not tightly attached to the differential case flange or the differential case is damaged.

(10) Determine if the clearance between the differential bearing caps and bearing cups is excessive by attempting to insert a 0.003- inch (0.076-mm) thick feeler gauge blade between them. Normally, a 0.003-inch (0.076-mm) thick feeler gauge blade should be too thick to be inserted between a bearing cap and cup.

If the clearance is more than 0.003 inch (0.076 mm), the cause could be that the applicable bearing cup rotated in the differential housing "seat" and caused excessive wear.

(11) Note the installation reference letters stamped into the differential bearing caps and into the differential housing machined sealing surface (Fig. 21). The letters are stamped horizontally on the right side and are stamped vertically on the left side of the differential housing. Always match the reference letters when installing the differential bearing caps.

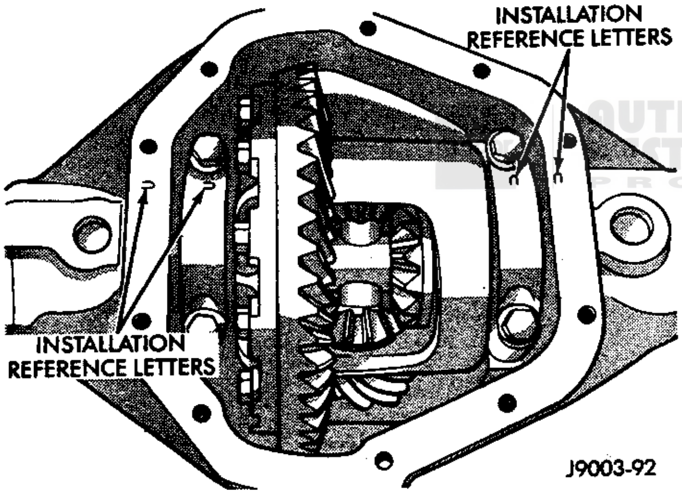

Fig. 21 Bearing Cap Identification

(12) Remove the differential bearing caps.

(13) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 22). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(14) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 22). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

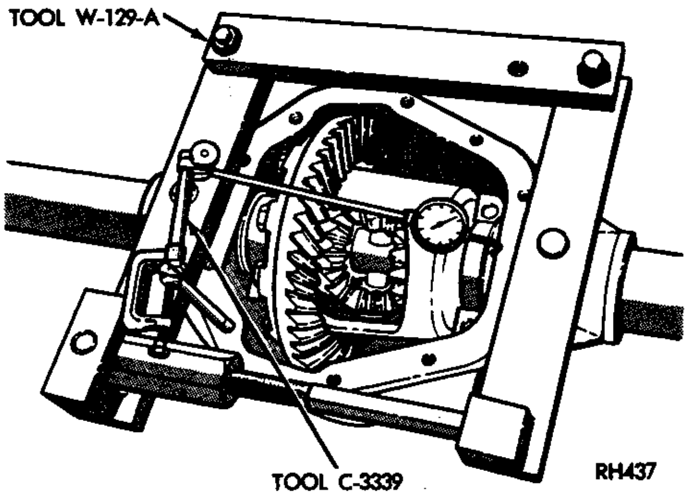

Fig. 22 Differential Housing Separation

(15) Tighten the spreader tool turnbuckle (Fig. 22) and separate the differential housing only enough to remove the differential case from the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 22) as the housing is being separated.

(16) Remove the dial indicator (Fig. 22) when the differential housing has been separated sufficiently to remove the differential case from the housing.

(17) Pry the differential case loose from the housing. A light prying action with a small pry bar or pinch bar will loosen the case sufficiently for easy removal. To prevent damage, pry the differential case outward toward the opening with the pry bar pivoting on the differential housing and with the end of the pry bar against the differential case.

(18) Remove the differential case from the differential housing. If they are reusable, retain the differential bearing cups and bearings together as "matched sets".

(19) Clamp the differential case in a vise equipped with soft jaws and remove **(and discard)** the ring gear bolts. "Tap" the ring gear with a rawhide mallet to loosen it from the differential case flange. Remove the ring gear.

(20) If the ring gear "runout" exceeded 0.006 inch (0.15 mm) in Step 9 (above), the differential case flange "runout" should be measured at this time.

(21) Install the differential case (with the original bearing cups). in the differential housing.

(22) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 22).

(23) Install the differential bearing caps and tighten the bolts "finger-tight" until each bolt head is lightly "seated" on the bearing cap.

(24) Install a pilot stud at the right side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with

the indicator plunger slightly "loaded" against the inner face of the flange (Fig. 23). "Zero" the dial indicator pointer.

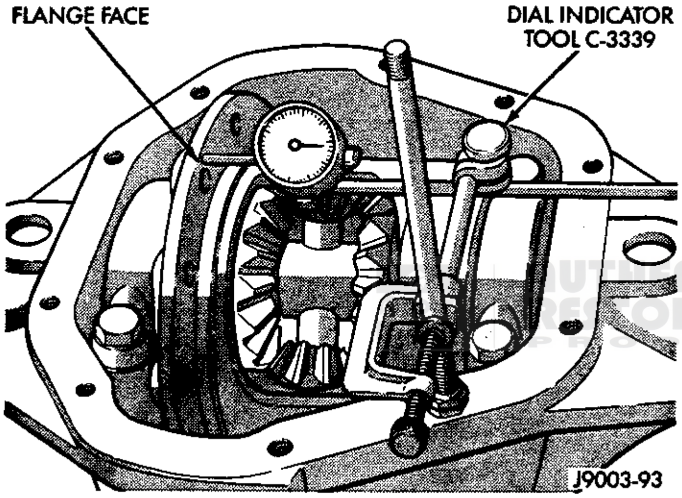

Fig. 23 Differential Case Flange "Runout" Measurement

(25) Measure the differential case flange "runout" by rotating the flange several complete revolutions and observing the dial indicator pointer. Mark the flange at the location of maximum "runout". The flange maximum "runout" should not exceed 0.003 inch (0.076 mm).

When installing the ring gear on the differential case, it is often possible to reduce excessive ring gear "runout" by positioning the ring gear with its maximum "runout" mark located 180 degrees opposite the flange maximum "runout" mark.

(26) Remove the drive pinion gear shaft (axle) yoke nut and washer. Use Removal Tool C-452 and Holding Tool C-3281 to remove the drive pinion gear shaft (axle) yoke (Fig. 24).

(27) Use Removal Tool C-748 to remove the drive pinion gear shaft seal (Fig. 25).

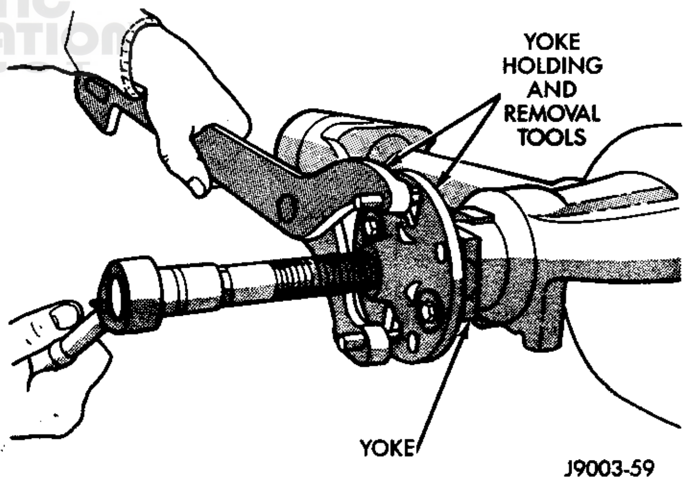

Fig. 24 Drive Pinion Gear Shaft (Axle) Yoke Removal

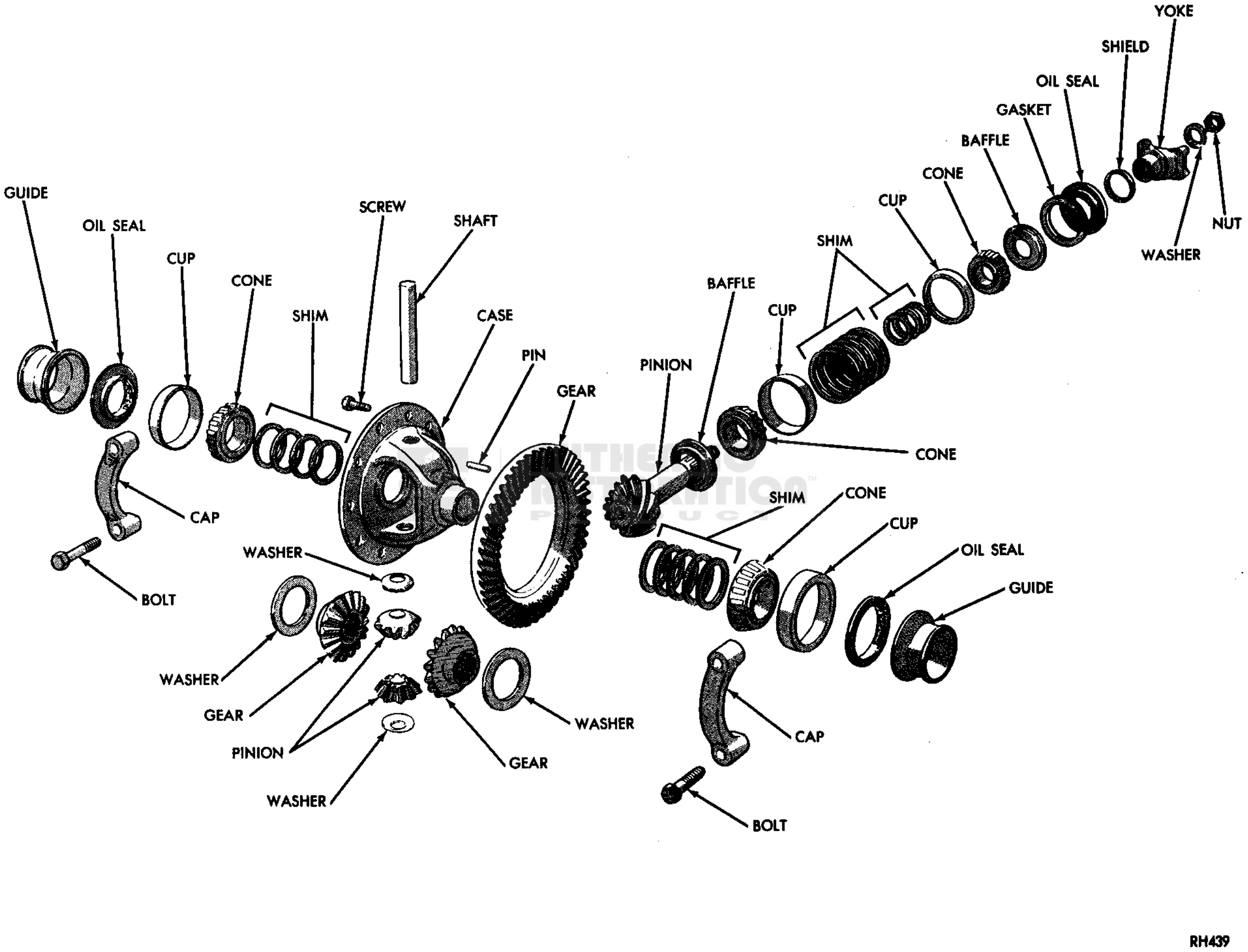

Fig. 25 Model 60 Axle Differential—Exploded View

(28) Remove the oil slinger, the shaft front bearing and the "preload" torque shims (Fig. 25). Record the thickness of the shims. **This will save time if they should become misplaced.**

(29) Use an appropriate tool to force the drive pinion gear shaft (with the rear bearing) from the differential housing bore (Fig. 25).

(30) Use Removal Tool D-158 and Handle Tool C-4171 to remove the drive pinion gear shaft outer (front) bearing cup from the differential housing bore (Fig. 25).

(31) Use Removal Tool D-162 and Handle Tool C-4171 to remove the drive pinion gear shaft inner (rear) bearing cup from the differential housing bore (Fig. 25).

(32) Remove the drive pinion gear depth shims from the differential housing bore (Fig. 25). Record the thickness of the depth shims.

(33) Remove the inner (rear) bearing from the drive pinion gear shaft with Removal Tool DD-914-P, Adapter Ring Tools DD-914-9 and Plate Tools DD-914-37 (or Tool C-293-P and Adapter Tools C-293-37).

(34) Clamp the differential case in a vise equipped with soft jaws. Use a pin punch to force the pinion gear mate shaft lock pin from the differential case bore (Fig. 26).

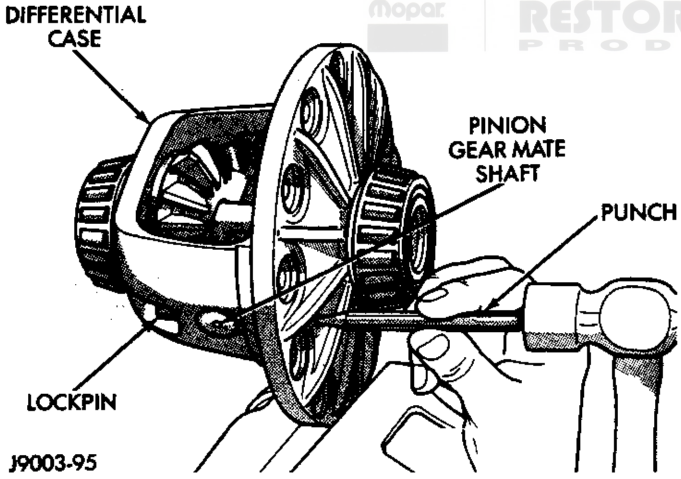

Fig. 26 Pinion Gear Mate Shaft Lock Pin Removal

(35) Remove the differential pinion gear mate shaft from the differential case bores, remove the differential pinion gears and remove the thrust washers (located adjacent to the differential case internal surface) from the differential case.

(36) Remove the differential side gears and the thrust washers (located adjacent to the differential case internal surface) from the differential case.

(37) Remove the differential case from the vise.

(38) Remove the bearings from the differential case with Removal Tool DD-914-P, Adapter Ring Tools DD-914-8, Plate Tools DD-914-62, Screw Extension Tool DD-914-7, Button Tool DD-914-42 and a vise (Fig. 27).

Use care and ensure that the adapter rings are situated so that they do not cause force to be exerted on the bearing race.

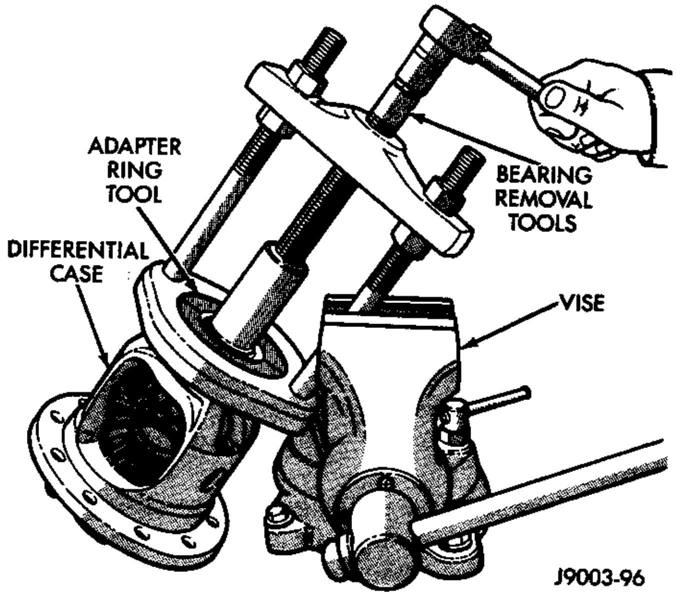

Fig. 27 Differential Bearing Removal

(39) Remove the differential bearing shims from each of the differential case hubs and mark them (with hub identity) for assembly reference. Record the thickness of the shims.

(40) Remove the seals from the axle shaft tubes.

CLEANING/INSPECTION

(1) Wash and clean all the differential components (Fig. 25) with an appropriate cleaning solvent and, with the exception of the bearings, dry with compressed air.

Do not steam clean the differential components.

(2) To clean the axle shaft tubes, insert a stiff wire into each tube, attach a clean cloth to the wire at the differential housing opening and withdraw the wire (and cloth) from the housing outward through the tube.

(3) Inspect the differential bearings and the drive pinion gear shaft bearings, and the differential case and housing (Fig. 25):

- the differential bearings and the drive pinion gear shaft outer (front) and inner (rear) bearings and cups should have a smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces;
- the bearing races must not be distorted or cracked;

If a differential bearing must be replaced, the cup and the bearing must be replaced as a "matched set" only.

- all the machined contact surfaces in the differential housing and on the differential bearing caps should be smooth and without any raised edges;

- the drive pinion gear shaft outer (front) and inner (rear) bearing cup bores in the differential housing should be smooth; and
- if it exists, raised metal on the shoulders of the bearing cup bores incurred during removal of the cups should be removed with a hand stone.

(4) Examine the differential pinion gear mate shaft, pinion gears, side gears and thrust washers (Fig. 25) for wear and damage. Replace all defective components.

If either of the differential pinion gears is not reusable, both gears must be replaced as a "matched set" only. Do not replace only one gear.

(5) Examine the ring gear and the drive pinion gear shaft (Fig. 25) for excessively worn and chipped teeth. Examine the ring gear for damaged attaching bolt threads.

If replacement of either gear is necessary, both the ring gear and the drive pinion gear shaft must be replaced because they are available as a "matched set" only.

(6) Inspect the drive pinion gear shaft (axle) yoke (Fig. 25) for cracks, worn splines, "pitted" areas, and a rough/corroded seal contact surface. Repair or replace the yoke as necessary.

(7) Inspect the drive pinion gear shaft bearing "preload" torque shims (Fig. 25) for cracks, damage and distortion. Install replacement shims (if necessary) for the "preload" torque adjustment.

ASSEMBLY

(1) Lubricate all the differential components with hypoid gear lubricant.

(2) Install the differential side gears and thrust washers, pinion gears and thrust washers and pinion gear mate shaft in the differential case (Fig. 25).

(3) Align the lock pin hole in the pinion gear mate shaft with the hole in the differential case (Fig. 25). Insert and "seat" the lock pin in the case and the shaft.

If replacement gears and thrust washers were installed, it is not necessary to measure the gear "backlash". The gear meshing will be correct because "close" machining tolerances are used during manufacture of the gears.

(4) Position the ring gear on the differential case flange and align the ring gear threaded holes with those in the differential case flange (Fig. 25).

(5) Insert **replacement** ring gear bolts (Fig. 25) through the differential case flange and thread them into the ring gear.

After all the bolts are initially correctly threaded into the ring gear bolt holes, "tap" the ring gear with a non-metallic mallet and ensure that it is flush against the flange.

(6) Clamp the differential case in a vise equipped with soft jaws and alternately tighten each ring gear bolt with 110 N•m (81 ft-lbs) torque.

(7) Place Master Differential Bearing Tools D-117 on the differential case hubs (Fig. 28).

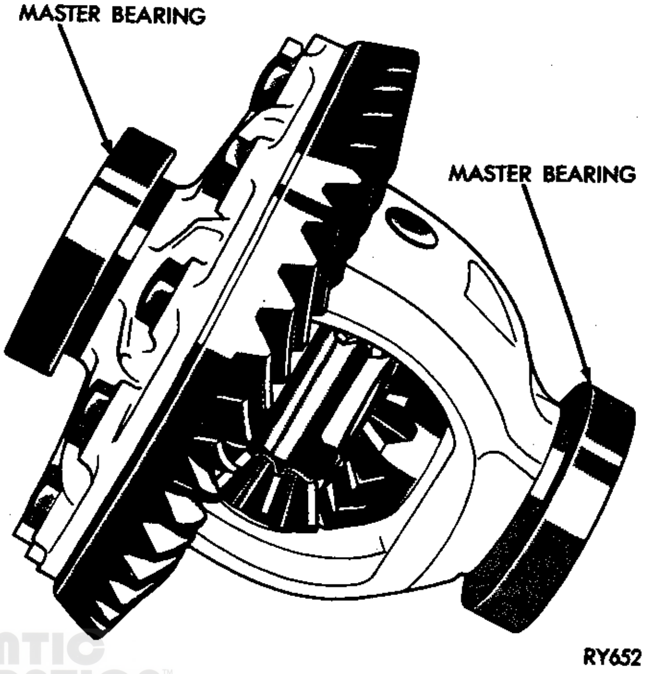

Fig. 28 Master Bearing Tools On Hubs

(8) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 29). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

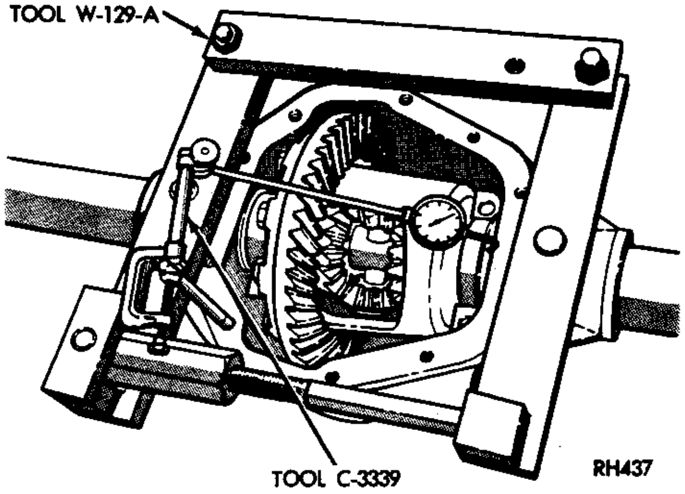

Fig. 29 Differential Housing Separation

(9) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 29). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(10) Tighten the spreader tool turnbuckle (Fig. 29) and separate the differential housing only enough to install the differential case in the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 29) as the housing is being separated.

(11) Remove the dial indicator tool and the pilot stud (Fig. 29) when the differential housing has been separated sufficiently to install the differential case in the housing.

(12) Install the differential case in the differential housing.

(13) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 29).

(14) Observe the assembly reference marks and position the bearing caps at their original locations. Tighten the bearing cap bolts "finger-tight".

(15) Install a pilot stud at the right side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the back of the ring gear (Fig. 30).

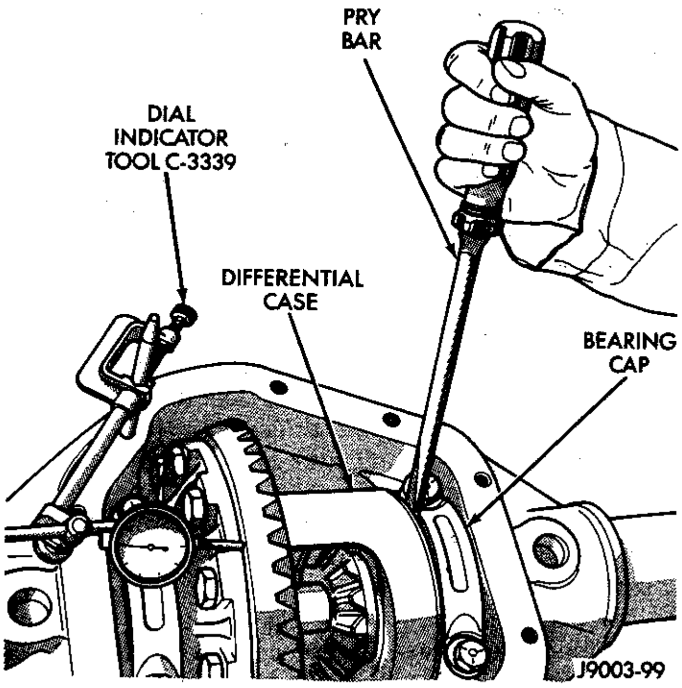

Fig. 30 Differential Case "End Play" Measurement

(16) Insert a small pry bar between the bearing cap and the left side of the differential case. Pry the differential case as far as possible toward the right side of the differential housing (Fig. 30). "Zero" the dial indicator pointer.

(17) Pry the differential case toward the left side of the housing with the pry bar and **record** the travel distance indicated by the dial indicator pointer.

The measurement above indicates the shim thickness necessary for differential case "zero" "end-play" (i.e., to eliminate the space/gap that exists between the differential bearings and the differential case). The actual total shim thickness will be determined during the ring gear "backlash" adjustment (after installation of the drive pinion gear shaft).

(18) Remove the dial indicator tool and the pilot stud from the differential housing.

(19) Remove the differential bearing caps.

(20) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 29). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(21) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 29). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(22) Tighten the spreader tool turnbuckle (Fig. 29) and separate the differential housing only enough to remove the differential case from the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 29) as the housing is being separated.

(23) Remove the dial indicator tool and the pilot stud (Fig. 29) when the differential housing has been separated sufficiently to remove the differential case from the housing.

(24) Remove the differential case from the differential housing.

(25) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 29).

(26) Install the axle shaft seals in the tubes with Tool C-4026-A and Handle Tool C-4171.

DRIVE PINION GEAR DEPTH INFORMATION

Drive pinion gear shafts and ring gears are supplied as "matched sets" only. The identifying numbers for both the drive pinion gear and the ring gear are etched into the face of each gear (Fig. 31). In addition, either a plus ("+") number, a minus ("-") number or a zero ("0") is also etched into the face of the drive pinion gear. This number indicates the amount (in thousandths of an inch) that the drive pinion gear depth of mesh varies from the standard depth "setting" of 3.125 inches (79.37 mm) for Model 60 axles. The standard depth of mesh provides the best teeth contact between the drive pinion gear teeth and the ring gear teeth. The depth variance of a drive pinion gear can be either greater (+), zero (0) or less than (-) the standard depth.

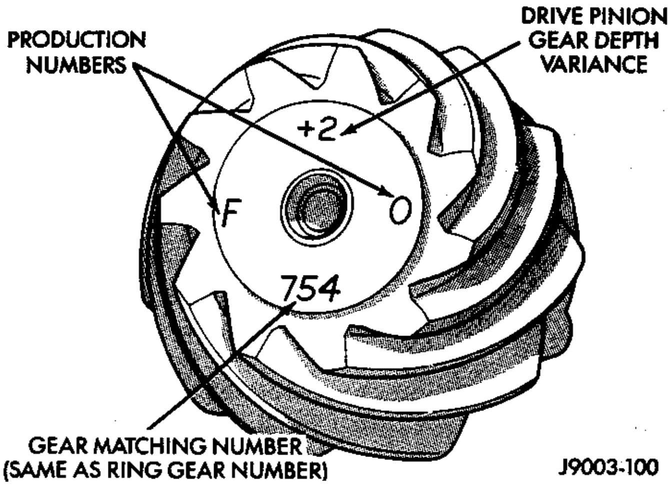

Fig. 31 Drive Pinion Gear ID Numbers

The standard depth is the distance (Fig. 32) from the centerline of the axle shaft/ring gear to the face of the drive pinion gear. For a Model 60 axle, the standard depth/distance is 3.125 inches (79.37 mm).

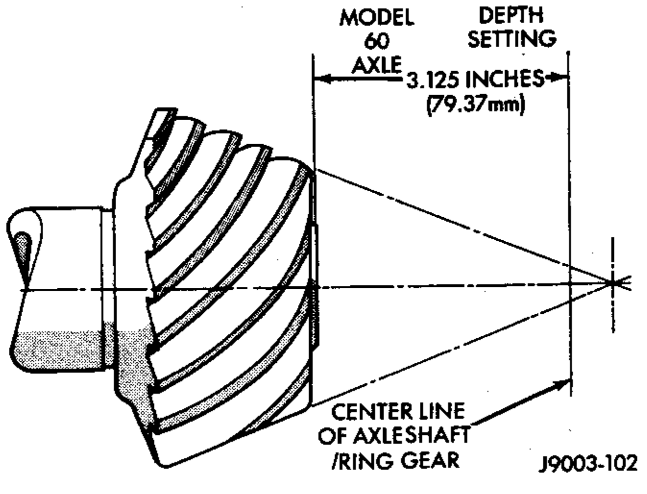

Fig. 32 Drive Pinion Gear Standard Depth/Distance

Compensation for the depth variance is achieved by shims placed adjacent to the drive pinion gear shaft rear bearing cup (Fig. 33).

For Example:

- **one complete "pack" of depth shims is required if the depth variance is "0";**
- **if the depth variance is "+3" (m+8), the drive pinion gear would require 0.003 inch (0.08 mm) less in shim thickness than a depth variance of "0" (i.e., one complete shim "pack" minus 0.003 inch or 0.08 mm);**

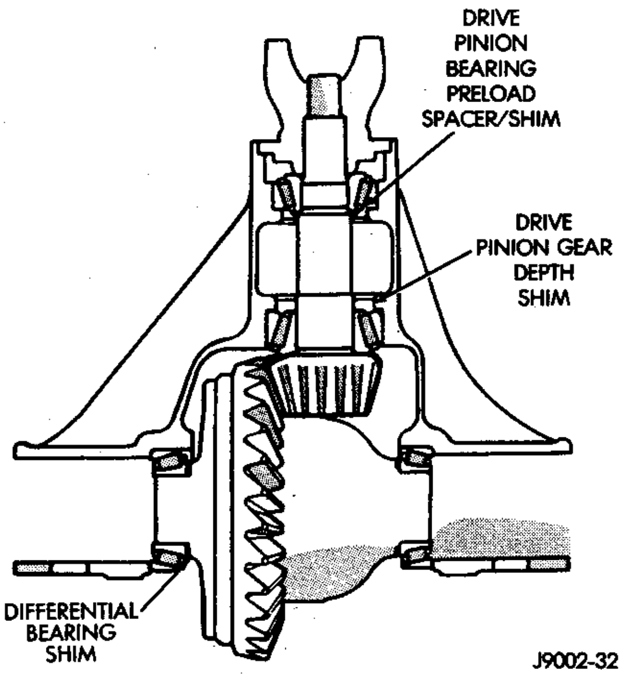

Fig. 33 Shim Locations

- **by reducing the thickness of the shims 0.003 inch (0.08 mm), the depth position of the drive pinion gear will be decreased from 3.128 inches (79.45 mm) to the standard depth of 3.125 inches (79.37 mm); or**
- **if the depth variance is "-3" (m-8), the drive pinion gear would require 0.003 inch (0.08 mm) more in shim thickness than a depth variance of "0" (i.e., one complete shim "pack" plus 0.003 inch or 0.08 mm);**
- **by increasing the thickness of the shims 0.003 inch (0.08 mm), the depth position of the drive pinion gear will be increased from 3.122 inches (79.34 mm) to the standard depth of 3.125 inches (79.37 mm).**

If the original drive pinion gear shaft and ring gear set will be installed but the depth shims must be replaced, measure the thickness of the original depth shims and "build" a replacement "pack" of depth shims with the same thickness.

If equipped, the oil slinger located between the rear bearing and the thrust face of drive pinion gear must be measured and the thickness included with the total shim "pack" thickness.

If the original drive pinion/ring gear set is not reusable, the depth shim thickness for the replacement drive pinion gear must be determined before installing the differential case in the housing.

If a replacement gear set is being installed, note the depth variance etched into both the original and the replacement drive pinion gear, and alter the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Drive Pinion Gear Depth Variance chart.

For Example:

- **if the original drive pinion gear has a depth variance of "+2" (m+5) and the replacement drive pinion gear has a depth variance of "-2" (m-5), add 0.004-inch (0.10-mm) thickness to the original depth shims.**

Individual depth shims are available in 0.003-inch, 0.005-inch, 0.010-inch, and 0.030-inch (0.08-mm, 0.13-mm, 0.25-mm, and 0.76-mm) thicknesses.

DRIVE PINION GEAR DEPTH VARIANCE

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

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DRIVE PINION GEAR DEPTH MEASUREMENT AND ADJUSTMENT WITH TOOL SET D-271

The following drive pinion gear depth (i.e., the depth of the gear teeth mesh between the drive pinion gear and the ring gear) measurement and adjustment procedure involves using Tool Set D-271 (Fig. 34).

(1) Insert Master Pinion Block Tool D-120 into the drive pinion gear shaft bore in the differential housing (Fig. 35).

(2) Place Arbor Disc Tools D-116-2 on Arbor Tool D-115-3 and position the tool set in the differential housing with the disc tools located in the differential bearing cradles (Fig. 36). This is the centerline of the ring gear/axle shaft.

(3) Place Pinion Height Block Tool D-116-1 on top of the master pinion block tool and against the arbor tool (Fig. 37).

(4) Place Gauge Block Tool D-115-2 and Dial Indicator Tool D-106-5 on **the lowest step** of the pinion height block tool (Fig. 38). Ensure that the gauge block tool is resting firmly on the lowest step of pinion height block tool and "zero" the dial indicator pointer.

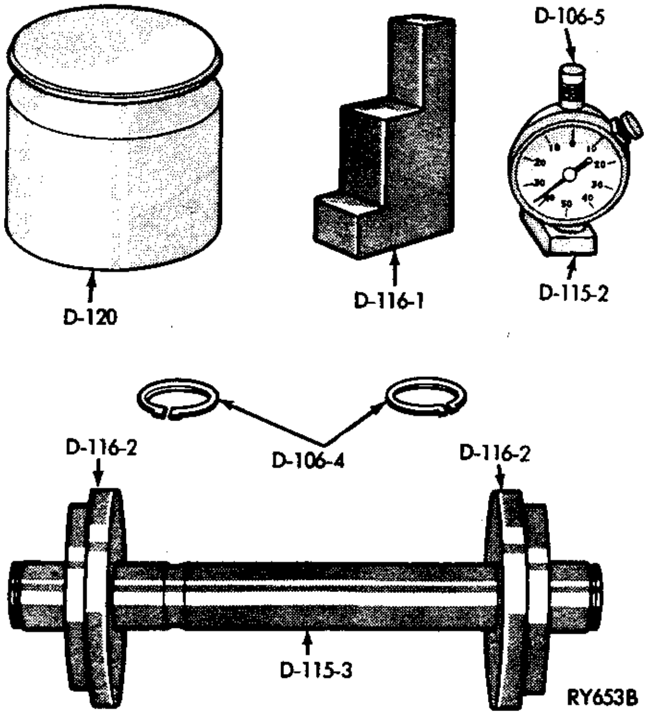

Fig. 34 Pinion Gear Depth Gauge Tool Set D-271

(5) With the dial indicator pointer "zeroed", move the gauge block tool toward the arbor tool until the tip of the dial indicator plunger contacts the arbor tool (Fig. 38). Slide the gauge block tool (with the

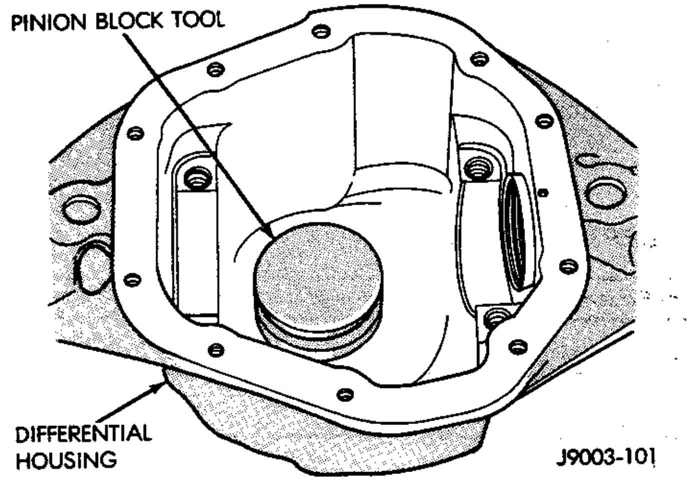

Fig. 35 Pinion Block Tool Inserted In Shaft Bore

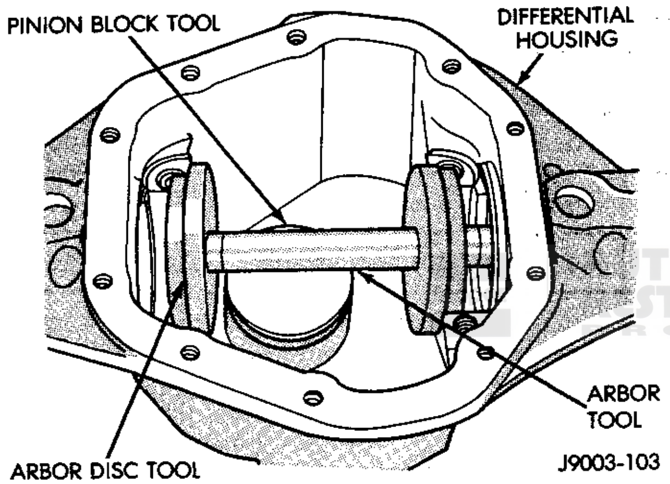

Fig. 36 Arbor Disc & Arbor Tools In Housing

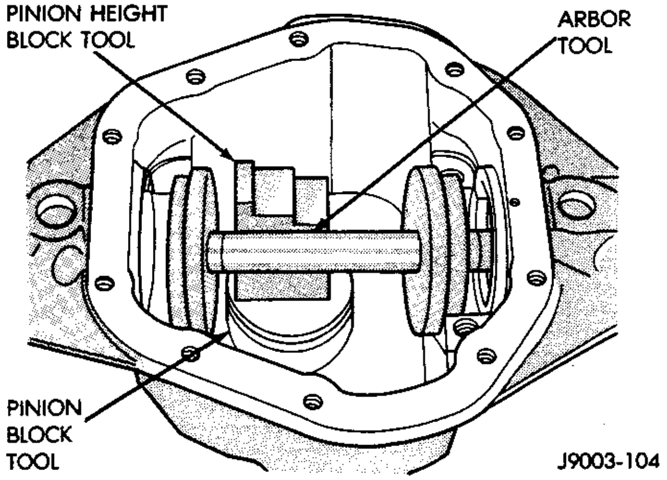

Fig. 37 Pinion Height Block Tool Against Arbor Tool

dial indicator) across and back and forth along the arbor tool while observing the dial indicator pointer. Record the longest plunger travel distance, whether inward ("-") or outward ("+"), indicated by the pointer.

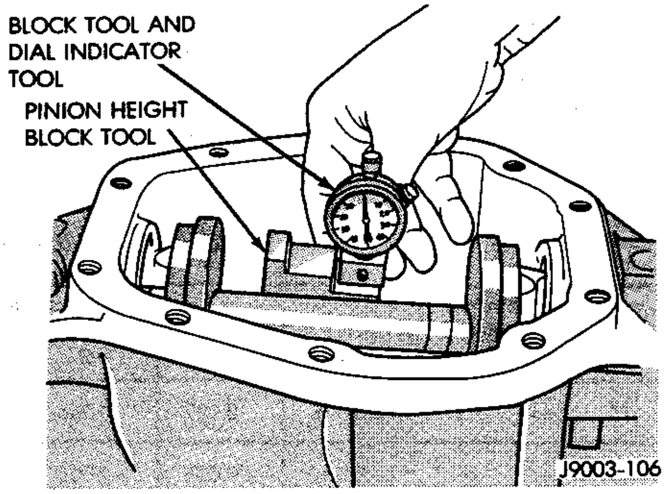

Fig. 38 Drive Pinion Gear Depth Measurement

The longest plunger travel distance indicated, plus or minus the depth variance etched into the face of the drive pinion gear, is the required thickness for the drive pinion gear depth shims.

(6) Measure the thickness of each depth shim separately with a micrometer and combine the shims necessary to obtain the total required depth shim "pack" thickness. **If equipped, the oil slinger located between the rear bearing and the thrust face of drive pinion gear must be measured and the thickness included with the total shim "pack" thickness.**

(7) Remove the measurement tools from the differential housing.

(8) Place the depth shims into the drive pinion gear shaft rear bearing bore in the differential housing and then force the rear bearing cup into the bore with Bearing Cup Installation Tool D-111 and Driver Handle Tool C-4171. Ensure that the cup is correctly "seated".

(9) Use Bearing Cup Installation Tool C-4203 and Driver Handle Tool C-4171 to force the drive pinion gear shaft outer (front) bearing cup into the differential housing bore (Fig. 39).

(10) Force the inner (rear) bearing onto the drive pinion gear shaft until it is completely "seated" with Bearing Installation Tool C-3095-A (Fig. 40).

(11) Install the drive pinion gear shaft in the differential housing.

(12) Install the drive pinion gear shaft outer (front) bearing, oil slinger, (axle) yoke, washer and nut. Use Installation Tool C-3718 and Holding Tool 3281 to install the yoke (Fig. 41).

Do not install the "preload" torque shims or the drive pinion gear shaft seal at this time.

(13) "Seat" the shaft bearings by tightening the (axle) yoke nut until it requires 1 N•m (10 in-lbs) torque to rotate the drive pinion gear shaft (Fig. 42). Use a Newton-meter or an inch-pound torque wrench to measure the torque.

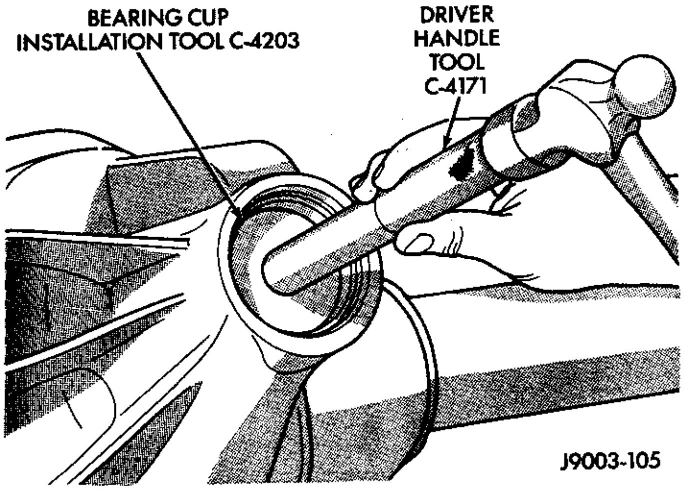

Fig. 39 Shaft Outer (Front) Bearing Cup Installation

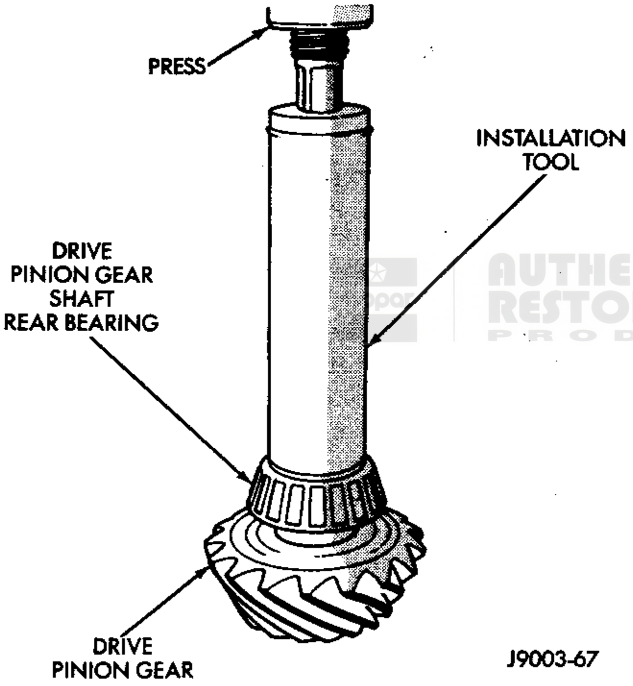

Fig. 40 Shaft Inner (Rear) Bearing Installation

(14) Measure the drive pinion gear depth of mesh (with the ring gear). Place the pinion height block tool on the face of the drive pinion gear (Fig. 35). Place the arbor and disc tools into the differential bearing cradles in the differential housing (Fig. 36). Place the gauge block tool with the dial indicator tool on the lowest step of the pinion height block tool (Fig. 38). Ensure that the gauge block tool is resting firmly on the lowest step of the pinion height block tool and "zero" the dial indicator pointer.

(15) With the dial indicator pointer "zeroed", move the gauge block tool toward the arbor tool until the tip of the dial indicator plunger contacts the arbor tool (Fig. 38). Slide the gauge block tool (with the dial indicator) across and back and forth along the arbor tool while observing the dial indicator pointer.

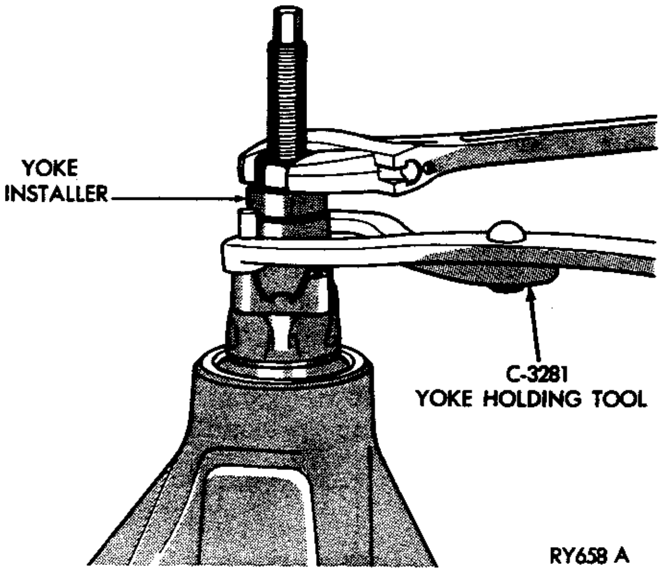

Fig. 41 Drive Pinion Gear Shaft (Axle) Yoke Installation

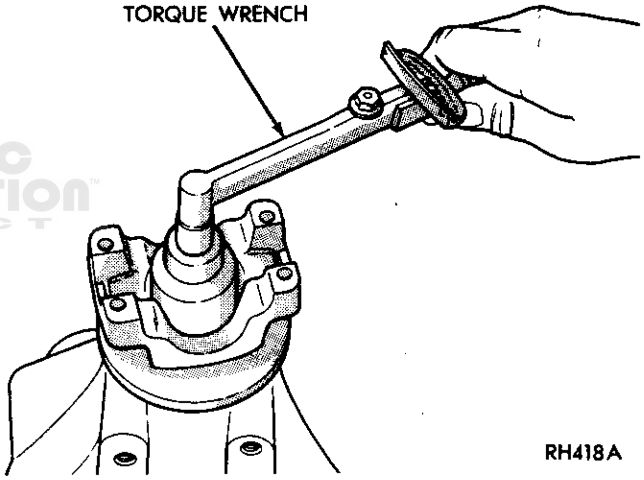

Fig. 42 Rotating Drive Pinion Gear Shaft

Record the longest plunger travel distance (whether inward or outward) indicated by the pointer.

The dial indicator pointer should indicate an inward ("-") or outward ("+") maximum travel distance that closely approximates the depth variance etched into the face of the drive pinion gear.

(16) If the measurement indicates that the actual depth variance is within 0.002 inch (0.05 mm) of the depth variance etched into the drive pinion gear face, it is acceptable.

(17) If the drive pinion gear actual depth variance is within the specified tolerance, continue with the differential assembly. If the actual depth variance is not within the specified tolerance, correct the shim thickness accordingly and then re-measure the depth variance.

Figure 43 depicts an arrow pointing outward and inward within the drive pinion gear shaft.

The outward direction (pointing toward the yoke) indicates that if the drive pinion gear shaft depth shim thickness is decreased, the distance/depth from the centerline of the axle/ring gear to the drive pinion gear face would be increased (i.e., it would increase the dial indicator plunger outward ("+") travel distance). The shaft bearing "preload" torque shim thickness does not affect the depth of mesh adjustment. The arrow on the ring gear indicates the method of increasing or decreasing shim thickness at the applicable side of the differential case to increase or decrease the ring gear "backlash" and the differential bearing "preload" torque.

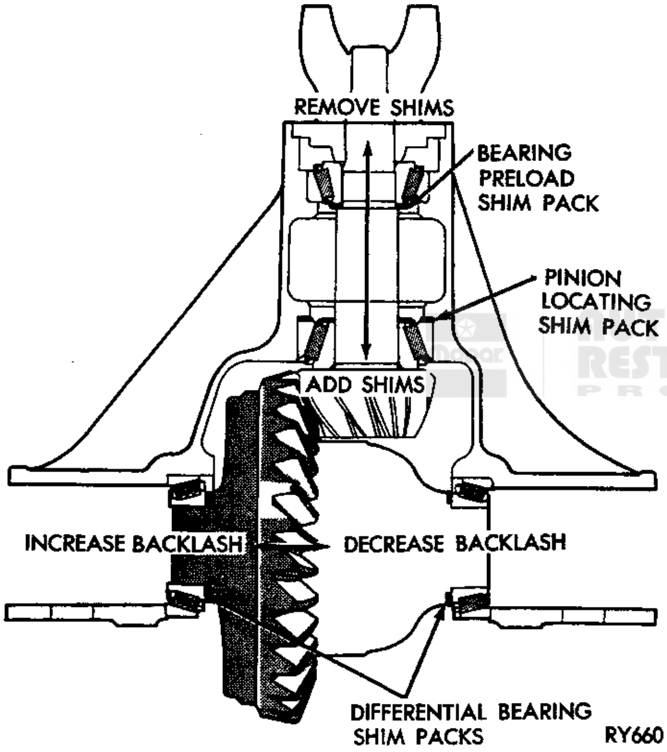

Fig. 43 Shim Locations

(18) Remove the measurement tools from the differential housing.

(19) Remove the drive pinion gear shaft nut, washer, (axle) yoke, oil slinger, and outer (front) bearing.

(20) Install the bearing "preload" torque shims that were removed during disassembly (Fig. 43), the shaft outer (front) bearing and the oil slinger on the drive pinion gear shaft.

(21) Apply a light coating of hypoid gear lubricant on the lip of drive pinion gear shaft seal, position it over the end of the shaft and install it in the differential housing bore with Seal Installation Tool C-3719-A and Driver Handle Tool C-4171 (Fig. 44).

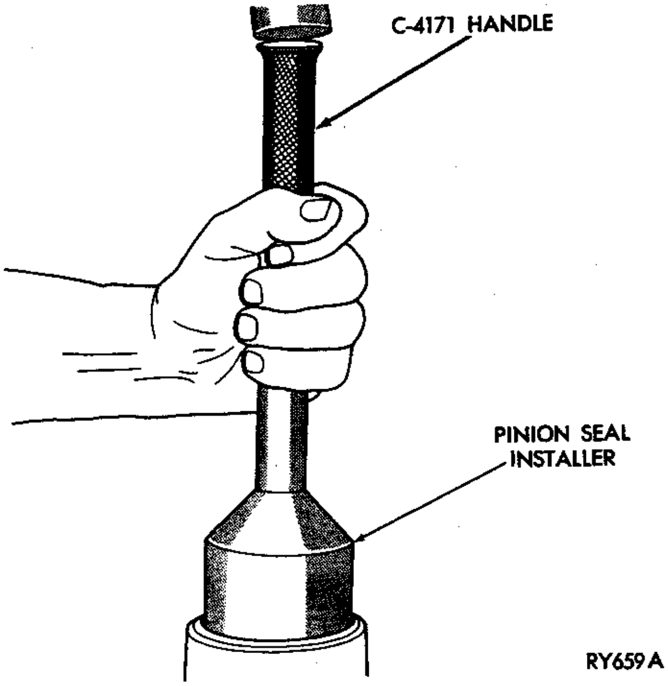

Fig. 44 Drive Pinion Gear Shaft Seal Installation

(22) Install the drive pinion gear shaft (axle) yoke, washer, and a replacement nut on the shaft. Tighten the nut with 325 to 406 N•m (240 to 300 ft-lbs) torque.

(23) Use a Newton-meter or an inch pound torque wrench (Fig. 42) to rotate the drive pinion gear shaft and observe the indicated bearing "preload" torque. The torque necessary to rotate the drive pinion gear shaft should be between 1 to 3 N•m (10 to 20 in-lbs).

If the drive pinion gear shaft bearing "preload" torque is not within the specified tolerance, correct the shim thickness accordingly. To increase the "preload" torque, decrease the shim thickness; to decrease the "preload" torque, increase the shim thickness. Shims are available in the following thicknesses: 0.003, 0.005, 0.010, and 0.030 inch (0.076, 0.127, 0.254, and 0.762 mm).

DRIVE PINION GEAR DEPTH MEASUREMENT AND ADJUSTMENT WITH TOOL SET C-758-D6

The following drive pinion gear depth (i.e., the depth of the gear teeth mesh between the drive pinion gear and the ring gear) alternate measurement and adjustment procedure involves using Axle Measurement Gauge Tool Set C-758-D6. Tool Set C-758-D6 is also used to install the drive pinion gear shaft bearing cups.

(1) Position each drive pinion gear shaft bearing cups in the applicable differential housing bore.

(2) Begin assembling Tool Set C-758-D6 by positioning Drive Pinion Gear Shaft Locating Spacer Tool SP-5184 on the tool primary screw.

(3) Position the drive pinion gear shaft inner (rear) bearing on the tool primary screw and insert the screw (with the bearing) into and through the differential housing bore.

(4) Position the drive pinion gear shaft outer (front) bearing on the tool primary screw at the opposite side of the differential housing. Install Compression Sleeve Tool SP-535-A, Centralizing Washer Tool SP-534 and Primary Screw Nut Tool SP-533 on the tool primary screw.

(5) Lubricate the drive pinion gear shaft outer and inner (front and rear) bearings with MOPAR Hypoid Gear Lubricant (or an equivalent product).

(6) Tighten the nut tool, while retaining the compression sleeve tool with Tool C-3281, and force the drive pinion gear shaft bearing cups into the differential housing bearing cup bores. **Allow the compression tool to rotate several revolutions during the tightening process to permit the bearing rollers to properly align and prevent "brinelling" of the bearing cups.**

Do not remove the tool after installing the drive pinion gear shaft bearing cups. The drive pinion gear depth of mesh must be measured next.

(7) Loosen the nut tool and then re-tighten it sufficiently to obtain 1 to 3 N•m (10 to 30 in-lbs) of bearing "preload" torque. **While tightening the nut, rotate the tool to align the bearing rollers.**

(8) Install Gauge Block Tool SP-5260 on Tool Set C-758-D6 (Fig. 45) and tighten the retaining screw securely with an Allen wrench.

(9) Position Cross Bore Arbor Tool SP-5183 (Fig. 45) in the differential bearing cradles (in the differential housing). Center the arbor tool in the cradles so that an approximately equal space exists at both ends.

(10) Observe the installation reference letters and position the differential bearing caps on the arbor tool (Fig. 45). Install the cap bolts and tighten them with 95 to 122 N•m (70 to 90 ft-lbs) torque.

(11) To measure the drive pinion gear depth of mesh, select and insert a feeler gauge blade that "snugly" fits between the arbor tool and the gauge block tool (Fig. 45). The "fit" must be "snug" but not excessively tight. **Record the thickness of the feeler gauge blade so that it can be used when determining the correct drive pinion gear depth shim thickness.**

(12) Observe the depth variance etched into the end of the drive pinion gear (e.g., 0, -1, -2, +1, +2, etc.). If the etched depth variance is a "-" (minus) value, add it to the thickness measured and recorded in step (11) above. If the etched depth variance is a "+" (plus) value, subtract it from the thickness measured and recorded in step (11) above.

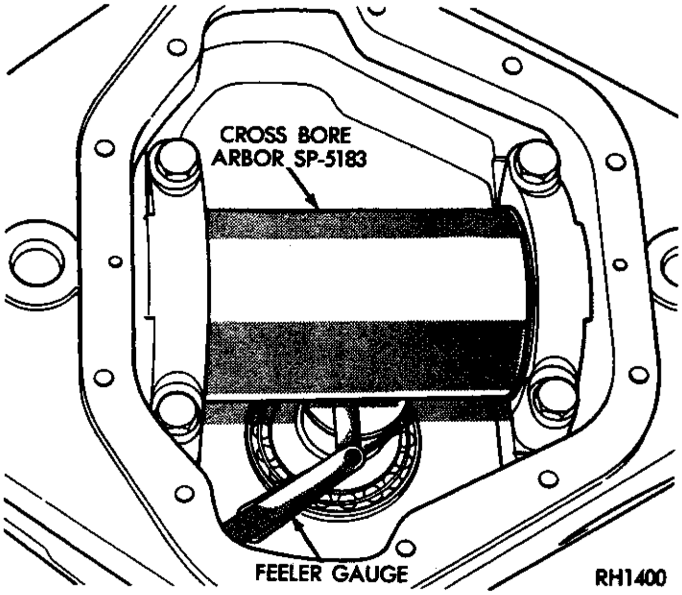

Fig. 45 Drive Pinion Gear Depth Measurement

(13) Remove the arbor tool from the differential housing cavity and the tool set (with the outer and inner/front and rear bearings) from the housing bore.

(14) Use Removal Tool D-162 and Driver Handle Tool C-4171 to remove the drive pinion gear shaft rear bearing cup from the differential housing bore.

(15) Position the depth shims in the differential housing rear bearing cup bore and install the bearing cup according to the method previously described in steps (1) through (6) above. When the bearing cup is correctly "seated" in the housing bore, remove the tool set and the drive pinion gear shaft bearings.

(16) If the drive pinion gear depth of mesh with the ring gear has been correctly established according to the instructions and information provided in the procedure above, good gear teeth contact should exist.

(17) Lubricate the drive pinion gear shaft inner (rear) bearing with MOPAR Hypoid Gear Lubricant (or an equivalent product) and install the bearing on the drive pinion gear shaft with Tool C-3095-A. Use an arbor press with the installation tool (Fig. 46).

(18) Install the drive pinion gear shaft with the bearing in the differential housing bore.

(19) Install the original drive pinion gear shaft bearing "preload" torque shims followed by the outer (front) bearing.

Do not install the shaft oil slinger or seal at this time.

(20) Install the drive pinion gear shaft (axle) yoke, washer and nut. Tighten the nut with 339 to 366 N•m (250 to 270 ft-lbs) torque. While tightening, rotate drive pinion gear shaft several complete revolutions to "seat" the bearing rollers.

(21) Use a Newton-meter or an inch-pound torque wrench to rotate the drive pinion gear shaft and measure the bearing "preload" torque (Fig. 47). Rotate the shaft several complete revolutions before re-

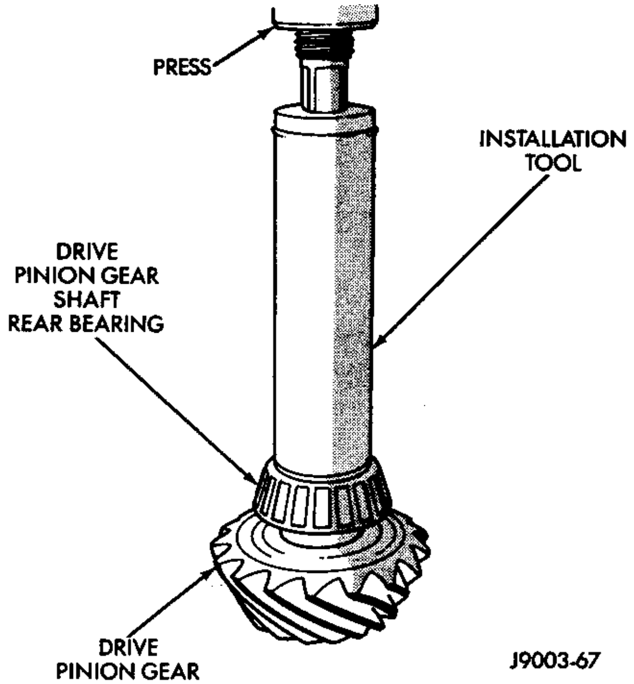

Fig. 46 Shaft Inner (Rear) Bearing Installation

cording the torque. The Correct bearing "preload" torque is 1 to 3 N•m (10 to 20 in-lbs) torque.

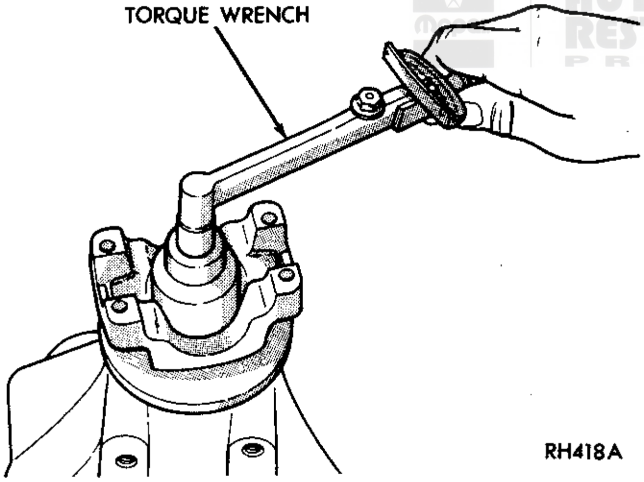

Fig. 47 Rotating Drive Pinion Gear Shaft

If the drive pinion gear shaft bearing "preload" torque is not within the specified tolerance, correct the shim thickness accordingly. To increase the "preload" torque, decrease the shim thickness; to decrease the "preload" torque, increase the shim thickness. Shims are available in the following thicknesses: 0.003, 0.005, 0.010, and 0.030 inch (0.076, 0.127, 0.254, and 0.762 mm).

(22) After the correct drive pinion gear shaft bearing "preload" torque has been established, remove the yoke, nut and washer.

(23) Install the oil slinger and the seal on the drive pinion gear shaft with Seal Installation Tool C-3719-A and Driver Handle C-4171.

(24) Install the drive pinion gear shaft (axle) yoke, washer and nut. Tighten the nut with 339 to 366 N•m (250 to 270 ft-lbs) torque.

RING GEAR "BACKLASH" ADJUSTMENT

(1) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 48). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(2) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 48). "Zero" the dial indicator pointer.

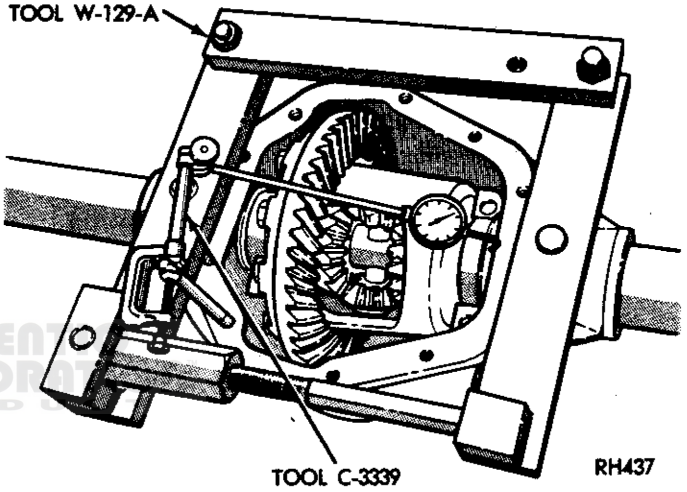

Fig. 48 Differential Housing Separation

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(3) Tighten the spreader tool turnbuckle (Fig. 48) and separate the differential housing only enough to install the differential case in the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 48) as the housing is being separated.

(4) Remove the dial indicator tool and the pilot stud (Fig. 48) when the differential housing has been separated sufficiently to install the differential case in the housing.

(5) Install Master Bearing Tools D-117 on the differential case hubs and position the case in the differential housing with the ring gear teeth "meshed" with the drive pinion gear teeth. If necessary, "rock" the ring gear to "mesh" the gear teeth.

(6) Install a pilot stud at the right side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the

back of the ring gear (Fig. 49). Ensure that the ring gear teeth and the drive pinion gear teeth are tightly "meshed" and "zero" the dial indicator pointer.

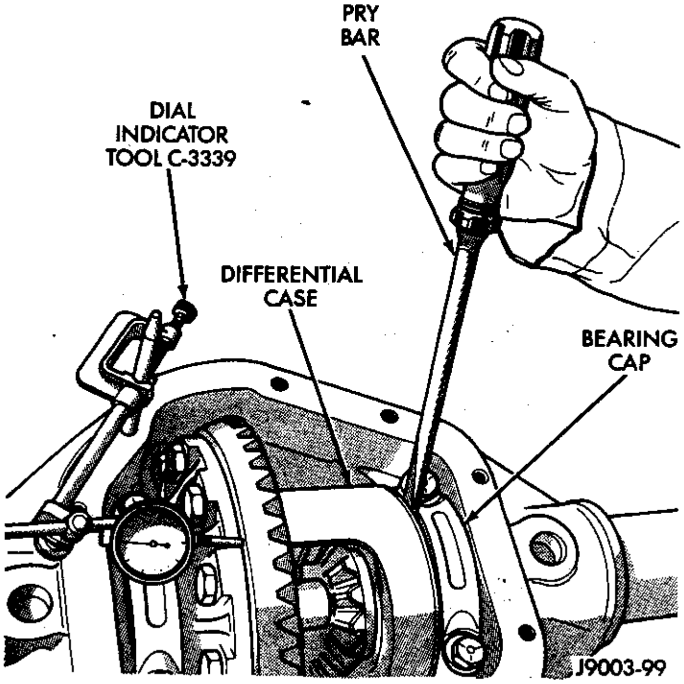

Fig. 49 Ring Gear "Backlash" Measurement

(7) Insert a small pry bar between the bearing cap and the left side of the differential case. Pry the differential case/ring gear as far as possible toward the right side of the differential housing and away from the drive pinion gear (Fig. 49). Observe the dial indicator plunger travel distance indicated by the pointer.

(8) Repeat the measurement several times until the indicated plunger travel distance is consistently the same for each measurement and then record the travel distance.

The measurement above indicates the shim thickness necessary to eliminate the ring gear "backlash". Subtract this thickness from the differential case "zero" "end-play" shim thickness. The ring gear "backlash" shims must be placed on the hub at the ring gear side of the differential case between the differential case and the differential bearing.

(9) Remove the dial indicator tool and the pilot stud (Fig. 49) from the differential housing.

(10) Remove the differential bearing caps.

(11) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 48). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(12) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 48). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(13) Tighten the spreader tool turnbuckle (Fig. 48) and separate the differential housing only enough to remove the differential case from the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 48) as the housing is being separated.

(14) Remove the dial indicator tool and the pilot stud (Fig. 48) when the differential housing has been separated sufficiently to remove the differential case from the housing.

(15) Remove the differential case from the differential housing.

(16) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 48).

(17) Remove the master bearing tools from the differential case hubs.

(18) Position the "backlash" shims (with the required thickness determined above) on the differential case hub (ring gear side). Place the differential bearing on the hub and install it with Bearing Installation Tool C-4025-A and Driver Handle Tool C-4171 (Fig. 50).

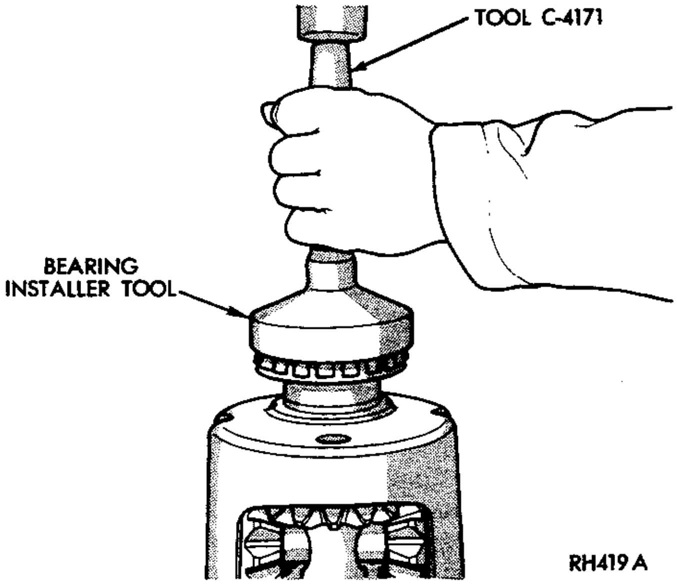

Fig. 50 Differential Bearing Installation

(19) Position the remaining "zero" "end-play" shims on the hub at the opposite side of the differential case. Include an additional 0.015-in (0.38-mm) thick shim on this hub to provide the required differential bearing "preload" torque.

(20) Install the other differential bearing on the hub with Bearing Installation Tool C-4025-A and Driver Handle Tool C-4171 (Fig. 50).

(21) Match each bearing cup with its differential bearing (original) counterpart and install the cups on the bearings.

(22) Position Spreader Tool W-129-A on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 48). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(23) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 48). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(24) Tighten the spreader tool turnbuckle (Fig. 48) and separate the differential housing only enough to install the differential case in the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 48) as the housing is being separated.

(25) Remove the dial indicator tool and the pilot stud (Fig. 48) when the differential housing has been separated sufficiently to install the differential case in the housing.

(26) Install the differential case in the differential housing.

(27) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 48).

(28) Install the differential bearing caps. Ensure that the installation reference letter stamped in each cap corresponds to the letter stamped in the differential housing (Fig. 51). Tighten the bearing cap bolts with 95 to 122 N•m (70 to 90 ft-lbs) torque.

(29) Measure the ring gear "backlash" at four equally spaced locations around the perimeter of the ring gear with a dial indicator (Fig. 52).

The ring gear "backlash" must be within 0.004 - 0.009 inch (0.10 - 0.23 mm) and it cannot vary more than 0.002 inch (0.05 mm) at any of the measurement locations.

(30) Excessive "backlash" is corrected by moving the ring gear teeth closer to the drive pinion gear teeth. Insufficient "backlash" is corrected by moving the ring gear teeth away from the drive pinion gear teeth. "Backlash" correction is accomplished by transferring shims from one side of the differential case to the other (Fig. 53).

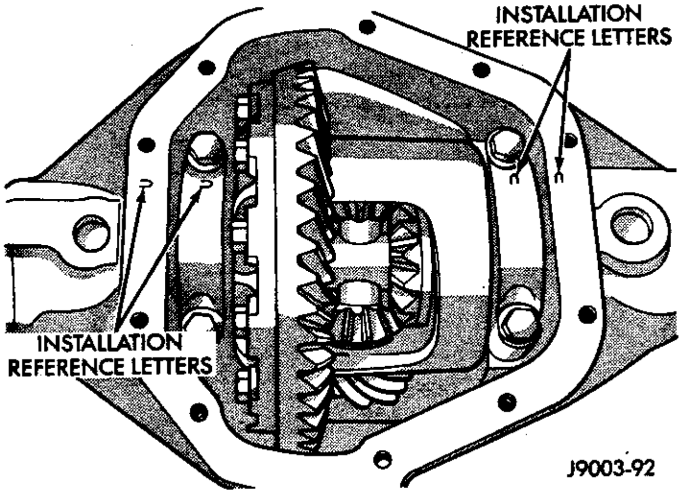

Fig. 51 Differential Bearing Cap Reference Letters

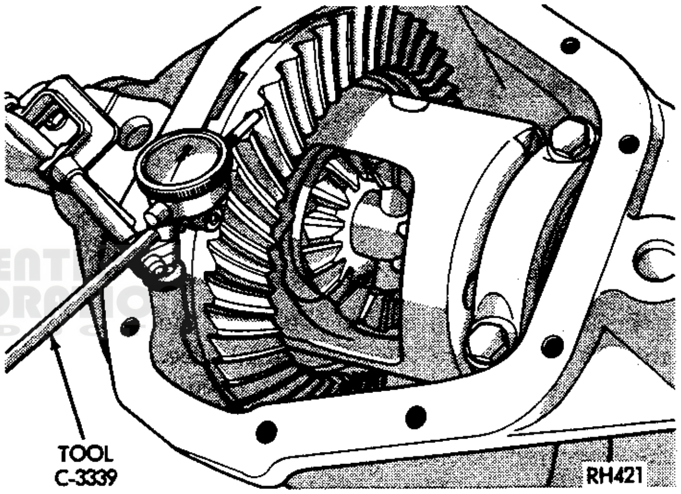

Fig. 52 Ring Gear "Backlash" Measurement

GEAR TEETH CONTACT PATTERNS

If the drive pinion gear depth of mesh and the ring gear "backlash" have been correctly established according to the instructions and information provided in the procedures above, good gear teeth contact patterns should exist.

(1) Apply a thin coat of Hydrated Ferric Oxide (commonly referred to as Yellow Oxide of Iron), or an equivalent product, to both the "drive" side and the "coast" side of the ring gear teeth.

(2) Rotate the ring gear one complete revolution in both directions while a load is being applied with a round bar or screwdriver inserted between the differential housing and the differential case flange. This action will produce a distinct contact pattern on both the "drive" side and the "coast" side of the ring gear teeth.

The gear teeth contact pattern will disclose whether or not the drive pinion gear shaft rear bearing depth shim has the correct thickness and whether or not the ring gear "backlash" has been adjusted correctly. The "backlash" be-

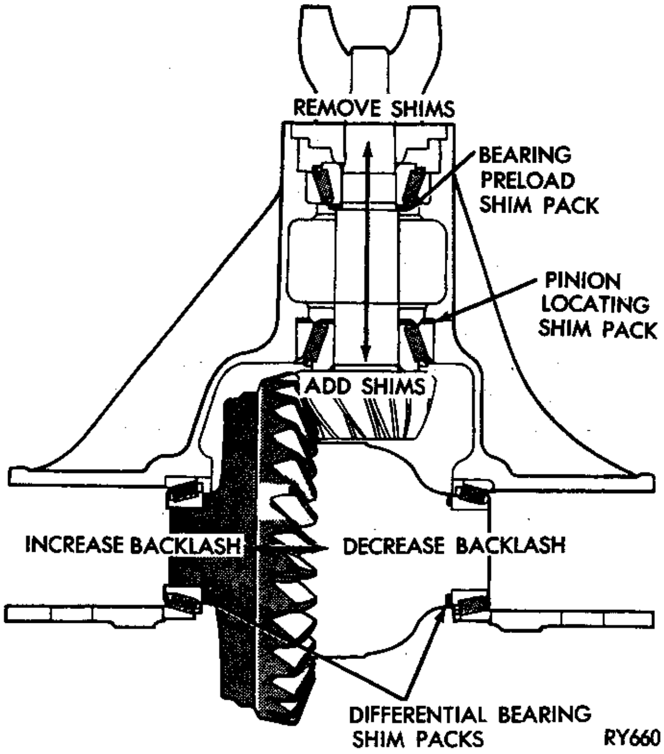

Fig. 53 Shim Locations

tween the ring gear and the drive pinion gear must be maintained within the specified limits until the correct teeth contact pattern is obtained.

(3) Examine the contact patterns on the ring gear teeth and compare them with those in Figures 54 through 58 to determine if the patterns are correct. With the drive pinion gear depth of mesh correct and the ring gear "backlash" adjusted correctly, the teeth contact patterns should closely resemble the patterns illustrated in Fig. 54. Notice that the illustrated teeth contact patterns are well centered on both the "drive" side and the "coast" side of the teeth.

When the teeth contact patterns are obtained by the method described above, they are likely to be rather small. With an actual operating load, however, the contact area increases.

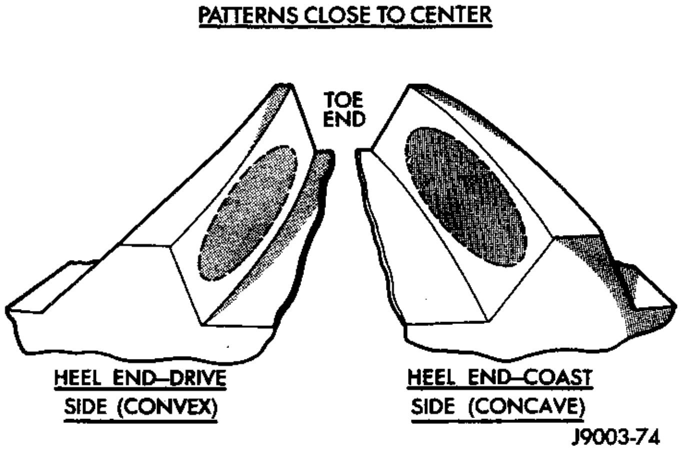

Fig. 54 Desired Teeth Contact Patterns (With Light Load)

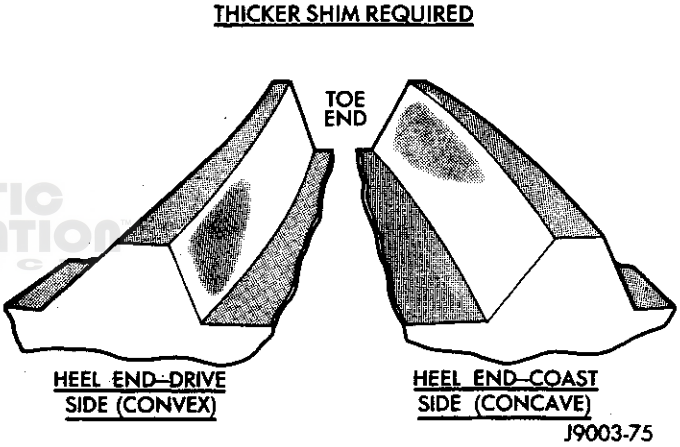

Fig. 55 Incorrect Teeth Contact Patterns—Increase Depth Shim Thickness

(4) If, after examining the ring gear contact patterns, it is determined that the patterns resemble those illustrated in Fig. 55, the drive pinion gear is separated too much from the centerline of the ring gear. This condition will cause the contact patterns to be "high" on the "drive" side and near the "heel" of the tooth, and "high" on the "coast" side and near the "toe" of the tooth. To correct for this type teeth contact patterns, increase the thickness of the depth shim (located between the drive pinion gear and the drive pinion gear shaft inner/rear bearing). This will cause the "high" contact pattern on the "drive" side to be lowered and to move toward the "toe" of the tooth, and the "high" contact pattern on the "coast" side to be lowered and to move toward the "heel" of the tooth (Fig. 56).

(5) If, after examining the contact patterns, it is determined that the patterns resemble those illustrated in Fig. 57, the drive pinion gear is too close to the centerline of the ring gear. This condition will cause the contact patterns to be "low" on the "drive" side and near the "toe" of the tooth, and "low" on "coast" side and near the "heel" of the tooth. To correct for this type of teeth contact patterns, decrease the thickness of the depth shim (located between the drive pinion gear and the drive pinion gear shaft inner/rear bearing). This will cause the "low" contact pattern on the "drive" side to be raised and to move toward the "heel" of the tooth, and the "low" contact pattern on the "coast" side to be raised and to move toward the "toe" of the tooth (Fig. 58).

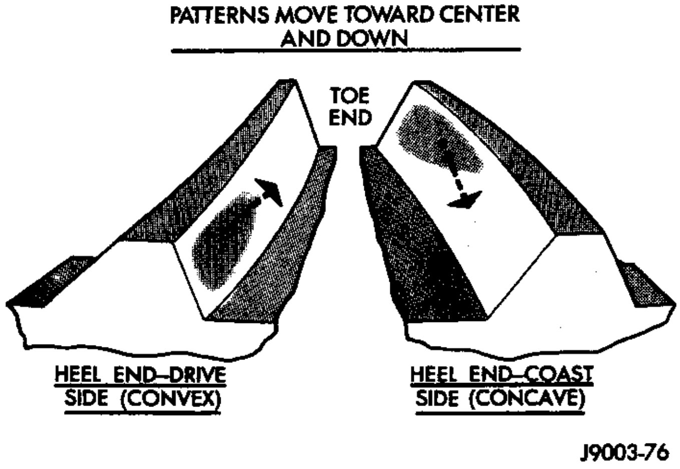

Fig. 56 Teeth Contact Patterns After Depth Shim Thickness Is Increased

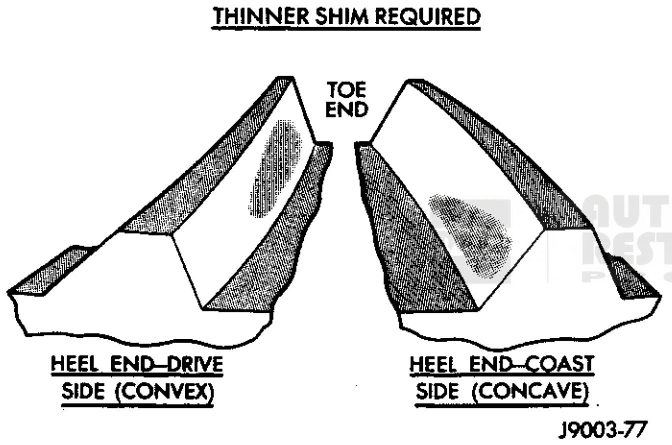

Fig. 57 Incorrect Teeth Contact Patterns—Decrease Depth Shim Thickness

INSTALLATION

(1) Install the axle shafts in the axle shaft tubes. If necessary, refer to the installation procedures.

(2) Remove any residual RTV sealant/gasket material from the differential housing and cover mating surfaces, thoroughly clean the surfaces with mineral spirits (or an equivalent cleaning solution) and dry the surfaces completely.

(3) Apply a thin "bead" of MOPAR RTV Sealant (or an equivalent sealant) around the bolt circle on the housing and on the cover (Fig. 59). **Allow the sealant to "cure" for a few minutes.**

If for any reason the differential housing cover is not installed within 20 minutes after applying the sealant, the sealant must be removed and another "bead" of sealant applied.

(4) Install the housing cover on the differential housing with the attaching bolts. **Install the axle gear ratio identification tag under one of the cover bolts.** Tighten the cover bolts with 47 N•m (35 ft-lbs) torque.

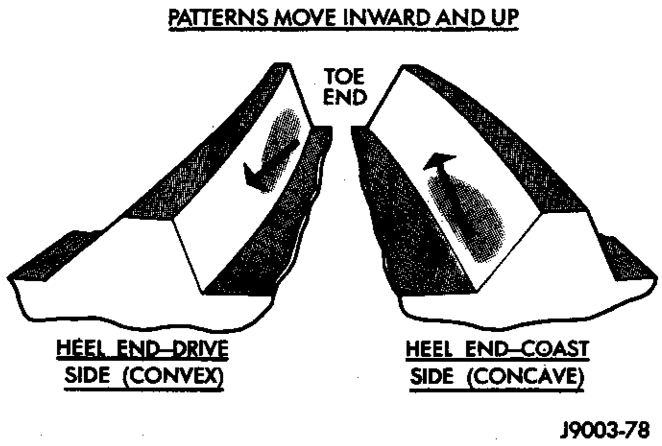

Fig. 58 Teeth Contact Patterns After Depth Shim Thickness Is Decreased

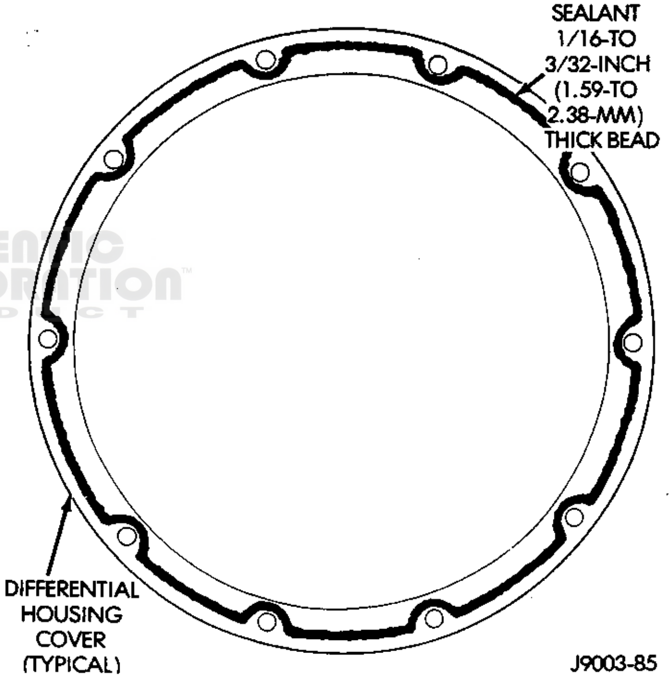

Fig. 59 Sealant On Housing Cover

(5) Remove the supports and raise or lower the hoist until the vehicle is level.

(6) Remove the fill hole plug and fill the differential housing with the specified quantity of MOPAR Hypoid Gear Lubricant (or an equivalent product). Install the fill hole plug and tighten with 34 N•m (25 ft-lbs) torque.

(7) Lower the vehicle and test the brakes and the axle for proper operation.

LUBRICANT

Multi-purpose, hypoid gear lubricant, as defined by MIL-L-2105-B and by API GL 5 quality specifications, should be used for Model 60 front axles. MOPAR Hypoid Gear Lubricant conforms with both of these specifications and is highly recommended for use with both Ram Truck and Ramcharger vehicles.

Each time a 4WD vehicle is serviced for other reasons (e.g., an engine oil change), inspect the front axle for evidence of lubricant leakage. If leakage exists, observe the lubricant level in the differential housing through the fill hole. When observing the level, ensure that the vehicle is level on the hoist. The lubricant level should be maintained at the bottom of fill hole.

CAUTION: If the front axle is submerged in water, the axle lubricant must be replaced immediately to avoid the possibility of premature axle failure resulting from water contamination of the lubricant.

DRAIN AND REFILL

(1) Drive the vehicle with the front axle shafts engaged (i.e., in 4WD) until the gear lubricant in the axle attains the normal operating temperature.

(2) Raise and support the vehicle.

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

(4) Remove the differential housing cover and allow the original lubricant to completely drain from the housing and the axle shaft tubes.

(5) Flush the differential and the housing cavity with a “flushing” oil (or light engine oil) to remove residual lubricant and foreign matter. **Do not use water, steam, kerosene or gasoline for flushing.**

(6) Install the differential housing cover and tighten the bolts with 47 N•m (35 ft-lbs) Torque.

(7) Refill the differential housing with the specified quantity of MOPAR Hypoid Gear Lubricant. Refer to the Specifications chart.

(8) Install and tighten the fill hole plug with 34 N•m (25 ft-lbs) torque.

(9) Remove the supports and lower the vehicle.

SPECIFICATIONS

TORQUE SPECIFICATIONS

COMPONENT	SET-TO-TORQUE	RECHECK TORQUE
Differential Housing Cover Bolt Model 44 Axle	27 N•m (20 ft-lbs)	
Ball Stud Nut		
Lower		
AD150, D150 & D250	183 N•m (135 ft-lbs)	
D350	237 N•m (175 ft-lbs)	
Upper		
D150 & D250	183 N•m (135 ft-lbs)	
D350	305 N•m (225 ft-lbs)	
Brake Support-to-Steering Knuckle Bolt		
AD150, D150 & D250	291 N•m (215 ft-lbs)	
D350	305 N•m (225 ft-lbs)	
Drive Pinion Gear Shaft Yoke Nut Model 44 Axle	285 N•m (210 ft-lbs)	
Differential Bearing Cap Bolt Model 44 Axle	108 N•m (80 ft-lbs)	
Lower Suspension Arm Bolt	285 N•m (210 ft-lbs)	
Drive Shaft U-Joint Clamp Screw		
AW150, W150 & W250	19 N•m (170 in-lbs)	
W350	34 N•m (300 in-lbs)	
Shock Absorber Lower Nut		
AD150, D150, D250 & D350	23 N•m (200 in-lbs)	
AW150, W150 & W250 with Model 44 Axle	75 N•m (55 ft-lbs)	
W250 & W350 with Model 60 Axle	75 N•m (55 ft-lbs)	
Shock Absorber Upper Nut		
AD150, D150, D250 & D350	34 N•m (25 ft-lbs)	
AW150, W150 & W250 with Model 44 Axle	75 N•m (55 ft-lbs)	
W250 & W350 with Model 60 Axle	75 N•m (55 ft-lbs)	
Spring U-Bolt Nut	149 N•m (110 ft-lbs)	
Steering Linkage Ball Stud Nut		
AD150, D150 & D250	64 N•m (47 ft-lbs)	
D350	75 N•m (55 ft-lbs)	
AW150, W150, W250 & W350	81 N•m (60 ft-lbs)	
Strut Nut (Front)		
AD150, D150, D250 & D350	68 N•m (50 ft-lbs)	
Strut Nut (Rear)		
AD150, D150, D250 & D350	115 N•m (85 ft-lbs)	
Tie-Rod Clamp Nut		
AD150, D150 & D250	18 N•m (160 ft-lbs)	
Tie-Rod End Ball Stud Nut		
2WD	54 N•m (40 ft-lbs)	
4WD	81 N•m (60 ft-lbs)	
Stabilizer Bar		
2WD		
At Frame	31 N•m (270 in-lbs)	
At Link	11 N•m (100 in-lbs)	
Upper Suspension Arm Cam Bolt (2WD)	95 N•m (70 ft-lbs)	

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AXLE SPECIFICATIONS

Front Axle (4WD)	**W150 W250 W350 131 Inch W.B. and 149 Inch W.B.**	**(Optional Equip. W250) W350 135 Inch W.B. and 149 Inch W.B.**
Type	Hypoid	Hypoid
Model	44-8FD	60
Differential Lubrication Capacity (Pts.)	3 (1.4L)	6 (2.8L)
Axle Load Capacity (Lbs.)	3500 (1586 kg) 4000 (1812 kg) with Snow-Plow Package	4500 (2039 kg)
Alignment (4WD)	**Acceptable Range**	**Preferred**
Camber	+1/2° to 1-1/2°	+1°
*Caster	+1/2° to 3-1/2°	+2°
King Pin Inclination	8.5°	8.5°
Toe-In (At Hub Height)	−0.05° to +0.45°	0.20°

Independent Front Suspension (2WD)	**AD150 D150 D250 D350**	
Load Capacity (lbs.)	3000 (AD) 3300 (D150, D250) 4000 (D350, Ex. Eqt. D250)	
Alignment (2WD)	**Acceptable Range**	**Preferred**
Camber	0 to 1°	+1/2°
*Caster	−1° to +2°	+1/2°
Toe-in (at Hub Height)	0.0 to 0.50°	0.25°
Turning Angle (Base Tire) Left & Right	33° 33°	

*If vehicle wanders, caster should be increased. If steering effort is very high (especially when cornering), caster should be decreased.

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REAR AXLES

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8 3/8- AND 9 1/4-INCH DIAMETER RING GEAR AXLES

The housing for rear axles with an 8 3/8- or a 9 1/4-inch diameter ring gear consists of an iron center casting (differential housing) with axle shaft tubes extending from either side. The axle shaft tubes are pressed into and welded to the differential housing to form a one-piece axle housing.

The removable, stamped steel cover located at the rear of the differential housing provides a means for inspection and for differential service without removing the complete rear axle from the vehicle.

Both axles have a hypoid gear differential and the centerline of the drive pinion gear shaft is located below the centerline of the ring gear.

A 9 1/4-inch diameter ring gear rear axle equipped with a **Sure-Grip** differential is optionally available for Ram Truck and Ramcharger vehicles. A **Sure-Grip** differential has a two-piece differential case that is completely interchangeable with a standard differential case.

MODEL 60, 60M AND 70 AXLES

The housing for Model 60, 60M and 70 rear axles consists of an iron center casting (differential housing) with axle shaft tubes extending from either side. The axle shaft tubes are pressed into and welded to the differential housing to form a one-piece axle housing. Both axles have a hypoid gear differential and the centerline of the drive pinion gear shaft is located below the centerline of the ring gear. The removable, stamped steel cover located at the rear of the differential housing provides a means for inspection and for differential service without removing the complete rear axle from the vehicle.

A small, stamped metal axle gear ratio identification tag is attached to the housing cover via one of the cover bolts. This tag also identifies the number of ring gear and drive pinion gear teeth.

Model 60, 60M and 70 rear axles equipped with a **Trac-Lok** differential are optionally available for Ram Truck vehicles. A **Trac-Lok** differential has a one-piece differential case, the same internal components as a standard differential, plus two clutch disc packs.

NOISE DIAGNOSIS

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GENERAL INFORMATION

The most important part of rear axle service is correctly identifying the cause of failures and noise complaints. The cause of most rear axle failures is relatively easy to identify, but the cause of rear axle noise is normally more difficult to identify.

If vehicle noise becomes objectionable, or if it occurs at all vehicle speeds, an effort should be made to isolate the noise to one particular area of the vehicle. Many noises that are reported as coming from the rear axle actually originate at other sources (e.g., tires, road surfaces, wheel bearings, engine, transmission, exhaust, drive shaft (vibration), U-joint or vehicle body ("drumming"). Axle noises are normally divided into two categories: gear noise or bearing noise. A thorough and careful inspection should be completed to determine the actual source of the noise before axle disassembly and component inspection is attempted.

The rear suspension rubber bushings and spring insulators help to "dampen-out" rear axle noise when correctly installed. Inspect to confirm that no metal contact exists between the springs and the spring hangers, the shackles or the U-bolts. Metal-to-metal contact at any of these locations can result in a means of transferring road noise and normal axle noise that would not normally be objectionable if the components were correctly installed and tightened.

The complete isolation of noise to any one area requires considerable expertise and experience. Identifying certain types of vehicle noise baffles even the most experienced mechanics. Often such practices as:

- increasing tire inflation pressure to eliminate tire noise;
- listening for noise at varying vehicle speeds with different driveline load conditions (e.g., "drive", "float" and "coast") and with different road/street conditions; and
- "swerving" the vehicle from left to right to detect wheel bearing noise will aid even the beginner in isolating axle shaft bearing noise with axles shafts that have tapered roller bearings.

All rear axles produce noise to a certain extent. Axles can be noisy if they are not correctly adjusted or if they lack sufficient lubrication. Usually, when incorrectly adjusted replacement gears are causing noise, the noise can be eliminated by correctly adjusting the gears.

If axle noise occurs within the first 1,500 miles (2 413 km) of vehicle operation for both 8 3/8-inch and standard or heavy duty 9 1/4-inch (212.72-mm and 234.95-mm) diameter ring gear axles, or within the first 5,000 miles (8 050 km) for Model 60, 60M and 70 axles, and the gears are not scored because of lack of lubrication, the gear adjustment should be suspected and corrected, if necessary.

Unacceptable gear meshing (teeth contact), incorrect ring gear "backlash" and a loose drive pinion gear shaft yoke nut are the primary causes of gear noise with replacement axles.

Regardless of what has been written to the contrary, noisy axle gears will not produce less noise with additional usage. **They will either remain the same or become worse.**

Slight axle noise that is noticeable only at certain speeds or in isolated situations must be considered normal. Axle noise tends to "peak" at a variety of vehicle speeds and noise is **NOT ALWAYS** indicative of a problem within the axle.

A good diagnostic test for rear axle noise includes a thorough road test. Select a level and smooth "blacktop" road/street. This type of surface will reduce tire noise and vehicle body "drumming". Drive far enough to thoroughly warm up the axle lubricant to the normal operating temperature.

Note the vehicle speed when the noise occurs. Then stop and, with the clutch disengaged or with the automatic transmission shifted to "NEUTRAL", vary the engine speed (rpm) slowly up and down in an attempt to duplicate and identify the engine speed when the noise occurs. This will determine if the noise is caused by the exhaust or another engine related component. If a noise can not be produced, repeat the road test while engaging and disengaging the clutch or shifting the transmission into and out of "NEUTRAL". If the noise can not be isolated by this method, the noise most likely can only be isolated by removing the drive shaft and operating the engine with the transmission "in-gear".

TIRE NOISE

Tire noise is often mistaken for rear axle noise even though the noisy tires are actually located on the front wheels. Tires that are unbalanced, worn unevenly or have surfaces of non-skid type design, or are worn in a "saw-tooth" manner are usually noisy and often produce a noise that appears to originate in the rear axle.

Tire noise changes with different road surfaces, but rear axle noise does not. Inflate all four tires with approximately 20 psi (138 kPa) more than the recommended inflation pressure (for test purposes only). This will alter noise caused by tires, but will not affect noise caused by the rear axle. Rear axle noise usually ceases when coasting at speeds less than 30 mph (48 km/h); however, tire noise continues, but at a lower frequency, as the speed is reduced. Rear axle noise usually will change when it is compared during "drive" and "coast" conditions, but tire noise remains approximately the same.

Discern between tire noise and axle noise by noting if the noise varies with vehicle speed, or sudden acceleration and deceleration. Exhaust and axle noise will change with the vehicle speed while tire noise will remain constant and is more pronounced at speeds of 20 to 30 mph (32 to 48 km/h). Test additionally for tire noise by driving over smooth pavements or dirt roads (not gravel) with the tires at normal inflation pressure. If the noise is caused by the tires, it will noticeably change or disappear and reappear with changes in the road surface.

FRONT WHEEL BEARING NOISE

Loose or "rough" front wheel bearings will cause noise that can be confused with rear axle noise; however, front wheel bearing noise (2WD or disengaged 4WD) does not change when it is compared during "drive" and "coast" conditions.

Light application of the brake pedal while maintaining constant speed will often cause wheel bearing noise to diminish because this action will remove some weight from the bearings. Front wheel bearings can easily be tested for noise by raising and supporting the vehicle and "spinning" the front wheels (also by "shaking" the wheels to determine if the bearings are loose).

GEAR NOISE (DRIVE PINION AND RING)

Abnormal gear noise is rare and, if it exists, it is usually caused by "scoring" on the ring and drive pinion gears as a result of insufficient or incorrect lubricant in the differential housing. The differential side gears and pinion gears very seldom are damaged because they are only "loaded" when the rear wheels rotate at different speeds (e.g., when the vehicle is turning).

Abnormal gear noise can be recognized easily because it produces a "cycling" tone that will be very pronounced within the vehicle speed range that it occurs. The noise can occur during one or more of the following driving conditions:

- "drive",
- "road load",
- "float", or
- "coast".

Abnormal gear noise usually tends to peak within a narrow vehicle speed range or ranges and is more pronounced between 30 to 40 mph (48 to 64 km/h) and 50 to 60 mph (80-96 km/h). When objectionable gear noise occurs, note the driving conditions and the speed range.

Conduct a gear teeth contact pattern test to determine if the best possible gear teeth contact patterns exist. If the patterns are not acceptable, adjust the ring gear and the drive pinion gear "meshing" to obtain the best possible teeth patterns. If the noise still exists after the adjustment, replace the gears with a "matched" replacement gear set.

BEARING NOISE (DRIVE PINION GEAR SHAFT AND DIFFERENTIAL)

Defective or damaged bearings will normally produce a rough "growl" or grating noise that is constant in pitch and varies with the speed of the vehicle. Being aware of this will enable a mechanic to discern between bearing noise and gear noise.

Drive pinion gear shaft bearing noise that results from defective or damaged bearings can usually be identified by its constant, rough sound. Drive pinion gear shaft front bearing noise is usually more pronounced during a "coast" condition, where as drive pinion gear shaft rear bearing noise is more pronounced during a "drive" condition. The drive pinion gear shaft bearings are rotating at a higher rate of speed than either the differential side bearings or the axle shaft bearings.

Differential side bearing noise will usually produce a constant, rough sound that is much lower in frequency than the noise caused by drive pinion gear shaft bearings.

Bearing noise can best be detected by road testing the vehicle on a smooth road (black top). However, it is relatively easy to mistake tire noise for bearing noise. If a doubt exists, the tire treads should be examined for the irregularities that often produce a noise that resembles bearing noise.

PRE-DISASSEMBLY INSPECTION

A close inspection of the rear axle differential prior to disassembly can often reveal valuable information concerning the extent and type of repairs or adjustments that are necessary. This information combined with the road test results will provide a basis for determining the degree of disassembly required.

Because the most frequent causes of axle differential noise are incorrect ring gear "backlash" and/or differential bearing "preload" torque, a few routine adjustments could be all that is necessary to correct the problem. Therefore, before axle differential disassembly, the following measurements should be made:

- ring gear "backlash", and
- drive pinion gear shaft bearing "preload" torque.

Record and analyze the results. The result of these measurements will aid in determining the extent the required axle differential service.

AXLE SHAFT BEARING NOISE

Defective or damaged axle shaft bearings produce a vibration or "growl" noise that will continue after the transmission is shifted to "NEUTRAL" and the vehicle is coasting. A "brinelled" axle shaft bearing causes a "whirring" noise. "Spalled" axle shaft bearings normally produce a noise similar to a "growl" that is caused by either flaked or pitted bearing rollers or bearing races. Unless the damage is severe, axle shaft bearing noise is seldom noticed at vehicle speeds exceeding 30 mph (48 km/h).

To differentiate between axle shaft bearing noise and differential gear noise, road test the vehicle on a smooth road (black-top) at medium and low speed. With traffic permitting, "swerve" the vehicle sharply right-to-left. If the noise is caused by axle shaft bearings, it will usually increase in loudness when the vehicle is "swerved" and it will probably be more pronounced at the "loaded" bearing side of the axle shaft (with tapered roller bearings only).

If the source of the noise can not be determined, an inspection of the bearings will be necessary.

"KNOCK" AT LOW SPEEDS

Low speed "knock" is usually caused by either a "brinelled" U-joint spider or excessive differential side gear hub-to-counterbore clearance. Inspect and replace the U-joint or the differential case and side gear, as applicable.

BACKLASH "CLUNK"

A loud "clunk" noise upon vehicle acceleration and deceleration can be caused by excessive clearance involving any of the following components (or in combination):

- differential pinion mate gear shaft-to-differential case bore,
- axle shaft splines-to-differential side gear splines,
- differential side gear hub-to-differential case counterbore,
- differential side gears-to-pinion gears,
- worn thrust washers, and
- excessive ring gear "backlash".

Measure the clearances, inspect the components and replace as required (or, if applicable, adjust to specifications).

DRIVELINE "SNAP"

A driveline "snap" noise resulting from sudden vehicle start from stop, either forward or reverse, can be caused by a loose drive pinion gear shaft (axle) yoke. Remove the drive shaft and the yoke, and install the yoke 180 degrees from its original position. The drive pinion gear shaft bearing "preload" torque and the shaft nut torque must be adjusted to the specified values after installation.

ENGINE AND TRANSMISSION NOISE

Occasionally noise that appears to originate in the rear axle is actually caused by the engine or the transmission. To identify the true source of the noise, note the approximate vehicle speed and the conditions when the noise occurs or when it is the most pronounced. Stop the vehicle in a quiet place (to avoid any interfering noise) and, with the transmission in "NEUTRAL", accelerate the engine slowly up through and then decelerate down through the engine speed that approximately corresponds to the vehicle speed noted when the noise occurred or was the most pronounced. If a similar noise is produced by this method, it will usually indicate that the noise is being caused by the engine or the transmission and not the rear axle.

DRIVE SHAFT VIBRATION

Objectional vibration, while traveling on roads/streets with a "good" surface, can be caused by the wheels/tires, the engine or the drive shaft.

A systematic method of identifying the source of the vibration will aid in a fast and correct repair. The order of analysis should be:

- wheels/tires,
- engine, and
- drive shaft.

Tires that are "out-of-round" (i.e., radial "runout") or wheels/tires that are excessively unbalanced will cause a low frequency vibration that will induce prominent mirror and door "shake". Tire and/or wheel faults must be corrected before proceeding with the analysis.

Engine vibration faults can be located by accelerating the engine (transmission in "NEUTRAL") through the speed range and noting the speed when (if) the vibration occurs.

Drive shaft vibration will increase in intensity as the vehicle speed is increased and it is not sensitive to engine torque. A vibration that occurs within a specific speed range ((e.g., 55 to 65 mph or 88 to 105 km/h) and does not occur above that speed range is not caused by drive shaft unbalance. Defective U-joints or an incorrect drive shaft angle are usually the cause of vibration that occurs within a specific speed range.

SERVICE DIAGNOSIS

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

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SERVICE DIAGNOSIS (CONT'D)

Condition	Possible Cause	Correction
	(b) Worn axle shaft seals.	(b) Replace worn seals.
	(c) Cracked differential housing.	(c) Repair or replace housing as necessary.
	(d) Worn drive pinion gear shaft seal.	(d) Replace worn drive pinion gear shaft seal.
	(e) Scored and worn yoke.	(e) Replace worn or scored yoke and seal.
	(f) Axle cover not properly sealed.	(f) Remove cover and clean flange and reseal.
AXLE OVERHEATING	(a) Lubricant level too low.	(a) Refill differential housing.
	(b) Incorrect grade of lubricant.	(b) Drain, flush and refill with correct amount of the correct lubricant.
	(c) Bearings adjusted too tight.	(c) Readjust bearings.
	(d) Excessive gear wear.	(d) Inspect gears for excessive wear or scoring. Replace as necessary.
	(e) Insufficient ring gear backlash.	(e) Readjust ring gear backlash and inspect gears for possible scoring.
GEAR TEETH BROKE (RING GEAR AND PINION)	(a) Overloading.	(a) Replace gears. Examine other gears and bearings for possible damage. Replace parts as needed. Avoid overloading of vehicle.
	(b) Erratic clutch operation.	(b) Replace gears and examine the remaining parts for possible damage. Avoid erratic clutch operation.
	(c) Ice-spotted pavements.	(c) Replace gears. Examine the remaining parts for possible damage. Replace parts as required.
	(d) Improper adjustments.	(d) Replace gears. Examine other parts for possible damage. Ensure ring gear backlash is correct.
AXLE NOISE	(a) Insufficient lubricant.	(a) Refill axle with correct amount of the proper lubricant. Also inspect for leaks and correct as necessary.
	(b) Improper ring gear and drive pinion gear adjustment.	(b) Check ring gear and pinion gear teeth contact pattern.
	(c) Unmatched ring gear and drive pinion gear.	(c) Remove unmatched ring gear and drive pinion gear. Replace with matched gear and drive pinion gear set.
	(d) Worn teeth on ring gear or drive pinion gear.	(d) Check teeth on ring gear and drive pinion gear for correct contact. If necessary, replace with new matched set.
	(e) Loose drive pinion gear shaft bearings.	(e) Adjust drive pinion gearshaft bearing preload torque.
	(f) Loose differential bearings.	(f) Adjust differential bearing preload torque.
	(g) Misaligned or sprung ring gear.	(g) Measure ring gear runout.
	(h) Loose differential bearing cap bolts.	(h) Tighten with specified torque.

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REAR AXLE ALIGNMENT

MEASUREMENT

The following procedure for measuring rear axle alignment can be used to determine if a complaint of abnormal rear tire wear is the result of a "bent" or deformed rear axle shaft.

(1) Raise both rear wheels off the surface with a frame contact hoist.

(2) Attach a one-inch long piece of masking tape at the center of each tire tread for use as "reference marks".

(3) Rotate the rear wheels until both "reference marks" face the front of the vehicle and measure the distance between the outside edges of the two pieces of tape. Record this measurement as the "front of tire" (FTR) measurement.

(4) Rotate the rear wheels until both "reference marks" face the rear of the vehicle and measure the distance between the outside edges of the two pieces of tape. Record this measurement as the "rear of tire" (RTR) measurement.

(5) Subtract the "rear of tire" (RTR) measurement from the "front of tire" (FTR) measurement to obtain the amount of wheel "toe". The acceptable rear wheel "toe" position is 1/16 inch (1.6 mm) "toe-in" to 3/16 inch (4.8 mm) "toe-out".

(6) Rotate the rear wheels until the "reference marks" are facing downward and measure the distance between the outside edges of the two pieces of tape. Record this measurement as the "bottom of tire" (BTR) measurement.

(7) Average the "front of tire" (FTR) and the "rear of tire" (RTR) distance measurements. Subtract the "bottom of tire" (BTR) measurement from this average distance to obtain the camber. The acceptable amount of camber is 1/16 inch to 3/32 inch (1.6 to 2.4 mm).

(FTR + RTR) / 2 - BTR = CAMBER

If the "bottom of tire" (BTR) distance measurement is less than the average FTR and RTR distance measurement, the camber will be positive ("+"). If the "bottom of tire" (BTR) distance measurement is greater than the average FTR and RTR distance measurement, the camber will be negative ("-").

If the "toe" position and/or the amount of camber is/are not acceptable in conjunction with the abnormal tire wear, a "bent" or deformed rear axle shaft is most likely the cause.

TIRE/WHEEL BALANCE

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GENERAL INFORMATION

The "off-vehicle" (static) rear tire/wheel balancing method is preferred for Ram RWD van and wagon vehicles. If the "on-vehicle" (dynamic) rear tire balancing method is employed, both front wheels must be securely blocked to prevent any vehicle movement. For vehicles equipped with a standard type differential (i.e., not equipped with a **Sure-Grip** or a **Trac-Lok** differential), only the rear wheel/tire that is to be balanced should be lifted off the surface. **When involved in "on-vehicle" (dynamic) rear wheel/tire balancing, be aware that a 35 mph (56 km/h) speedometer indication represents a 70 mph (113 km/h) rear wheel speed.** A speed of 35 mph (56 km/h) is the maximum necessary for dynamic wheel/tire balance.

If the vehicle is equipped with dual rear wheels, it is absolutely necessary that the wheel/tire be removed from the vehicle when balancing is necessary.

Balancing a wheel/tire with the "on-vehicle" (dynamic) method essentially balances the tire, the wheel and the brake drum. The "balanced" condition is lost when the wheels/tires are rotated to equalize tire tread wear, or when the wheels/tires are removed from the vehicle for any reason and then not installed at the original location on the brake drum/hub (i.e., before removal, the wheel and a stud are indexed/marked for installation reference and then the wheel/tire are installed at the original location).

WARNING: WITH NO LOAD ON THE ENGINE, IT IS POSSIBLE TO ATTAIN A TIRE ROTATIONAL SPEED (ANGULAR VELOCITY) THAT IS SUFFICIENT TO CAUSE VIOLENT TIRE FAILURE AND CREATE A HAZARDOUS SITUATION.

SURE-GRIP/TRAC-LOK DIFFERENTIALS

When the "on-vehicle" (dynamic) rear wheel/tire balance method is employed for vehicles equipped with a Sure-Grip or Trac-Lok differential, raise both rear wheels/tires off the surface and remove the wheel/tire that is not being balanced.

Both front wheels/tires must be securely blocked to prevent any vehicle movement.

CAUTION: Do not exceed 35 mph (56 km/h) for Sure-Grip or Trac-Lok differentials.

When employing rear wheel/tire balance of this type (with the rear wheels/tires off the surface), a 35 mph (56 km/h) speedometer indication represents a 70 mph (113 km/h) rear wheel rotational speed. A speed of 35 mph (56 km/h) (speedometer indication) is the maximum necessary for dynamic wheel/tire balance.

When the wheel/tire is satisfactorily balanced, install the unbalanced wheel/tire (tighten the wheel lug nuts with the specified torque) and balance it with the same "on-vehicle" method. It is not necessary to remove the balanced wheel/tire.

For additional information, refer to Group 22—Tires And Wheels, and the instructions supplied by the manufacturer of the balancing equipment being used.

8 3/8- AND 9 1/4-INCH DIAMETER RING GEAR AXLE SERVICE

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SERVICE INFORMATION

The rear axle housings for axles with an 8 3/8- or a 9 1/4-inch diameter ring gear (Fig. 1, Fig. 2) consist of an iron center casting (differential housing) with axle shaft tubes extending from either side. The axle shaft tubes are pressed into and welded to the differential housing to form a one-piece axle housing. Both axles have a hypoid gear differential and the centerline of the drive pinion gear shaft is located below the centerline of the ring gear. The removable, stamped steel cover located at the rear of the differential housing provides a means for inspection and for differential service without removing the complete rear axle from the vehicle.

A small, stamped metal axle gear ratio identification tag is attached to the housing cover via one of the cover bolts.

The drive pinion gear shaft rotates within two tapered roller bearings (Fig. 1, Fig. 2). The drive pinion gear shaft front and rear bearings are "press-fitted" on the drive pinion gear shaft. The drive pinion gear shaft front and rear bearing cups are "press-fitted" in the differential housing bore and against a recessed shoulder. The drive pinion gear shaft depth of mesh adjustment is controlled by the use of metal depth shims that are installed between the drive pinion gear shaft rear bearing and the drive pinion gear.

The drive pinion gear shaft bearing "preload" torque is provided via a metal, collapsible spacer that is located between the drive pinion gear shaft front and rear bearings (Fig. 1, Fig. 2). The spacer is compressed (i.e., collapsed) by tightening the drive pinion gear shaft (axle) yoke nut until the specified "preload" torque is obtained.

The one-piece differential case contains two side gears, two pinion gears and two pairs of thrust washers (Fig. 1, Fig. 2). The side gears rotate in machined counterbores in the differential case and have internal splines that "mesh" with (and drive) the axle shafts. The pinion gears have a smooth surface and are held in place by a solid pinion mate gear shaft that is inserted into and then "locked" in the differential case by means of a lock screw. All four gears are "meshed" with each other and, because they rotate freely on the pinion mate gear shaft, the pinion gears function as idler gears when the rear wheels are rotating at different speeds (e.g., during a vehicle turn).

The differential case hubs rotate in the differential housing via two tapered roller bearings that are

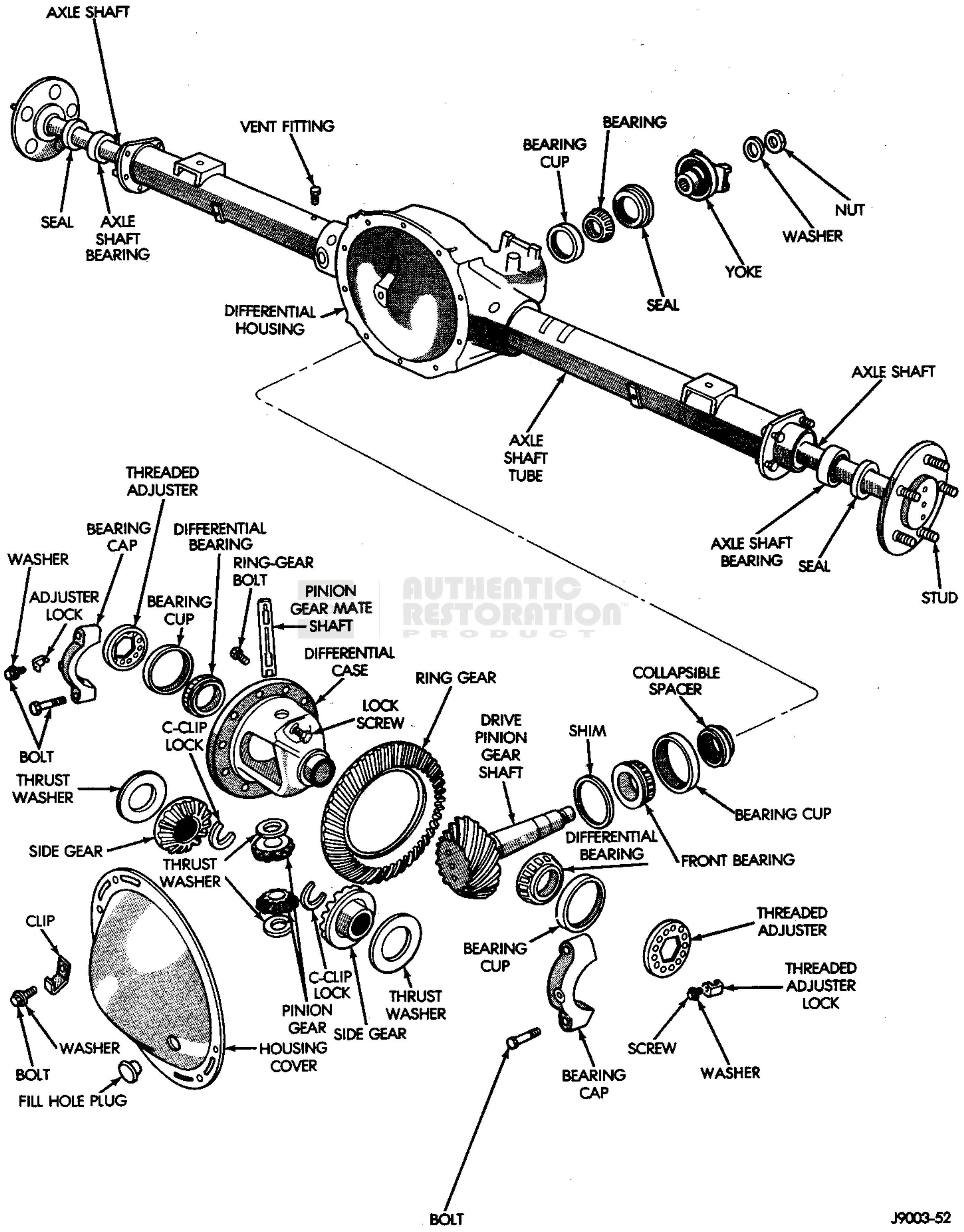

Fig. 1 Rear Axle With 8 3/8-Inch Ring Gear

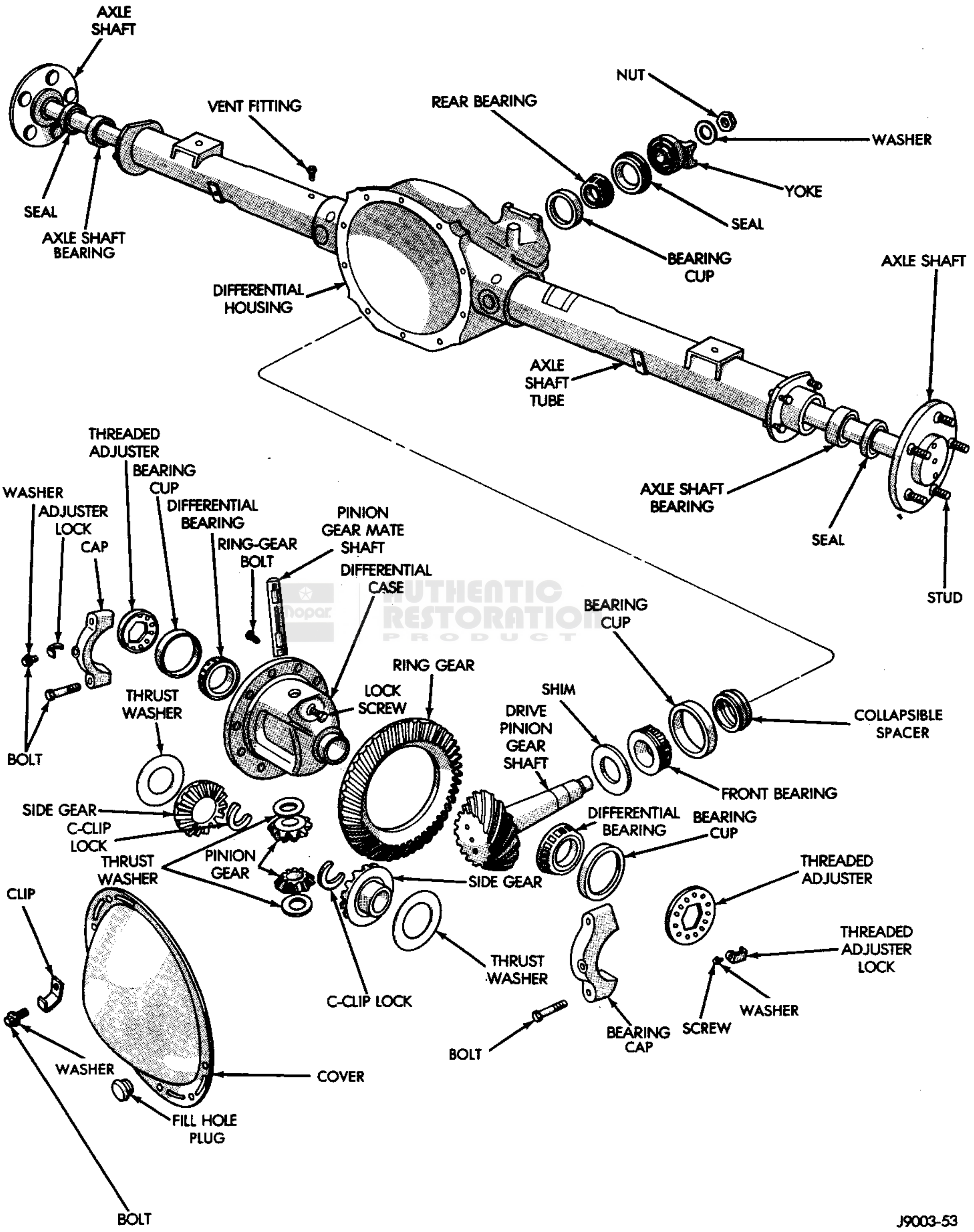

Fig. 2 Rear Axle With 9 1/4-Inch Ring Gear

"press-fitted" on the case hubs (Fig. 1, Fig. 2). A threaded differential bearing adjuster (with a hex-shaped drive hole) is located in each bearing cap to provide two functions:

- to adjust and maintain the "backlash" between the ring gear and the drive pinion gear; and
- to establish a means for obtaining and then retaining the differential bearing "preload" torque.

The rear axle shaft bearings are the straight-roller bearing type and "roll" directly on the axle shaft (Fig. 1, Fig. 2). Each bearing consists of an outer race, a bearing cage and the rollers. The bearing is "press-fitted" in the axle shaft tube. Each axle shaft is mated with the differential side gear by sliding it through the tube seal and the bearing bore. Both the seal and the bearing rollers are in contact with the axle shaft. The axle shaft splines "mesh" with the differential side gear splines with a semi-loose fit. Each axle shaft has a machined circular groove near its end and they are retained in the side gears via C-clip "lock"s that are inserted in the grooves. When the axle shafts and the C-clip "locks" are correctly positioned, the C-clip "locks" will be located in the side gear machined counterbores and, when the pinion gear mate shaft is inserted in the differential case (and retained by the lock screw), the axle shafts are "locked" in place. Therefore, with axle shaft lateral movement prevented, axle shaft bearing "end play" adjustment is not required.

The axle shaft bearings are lubricated via the differential housing gear lubricant that is always present in the axle shaft tubes.

Both axle types are equipped with a remote vent fitting. For an 8 3/8-inch diameter ring gear axle, the fitting is located on the right axle shaft tube. For a 9 1/4-inch diameter ring gear axle, the fitting is located on the left axle shaft tube.

If the rear axle is submerged in water, the lubricant must be replaced immediately to avoid the possibility of premature axle failure resulting from water contamination of the lubricant.

"Sure-Grip" differentials are optionally available for both axle types. Refer to the **Sure-Grip Differential** section within this Group for service procedures.

AXLE SHAFT, SEAL AND BEARING SERVICE

CAUTION: When rear axle service is necessary, or when the axle is being rotated either via the engine or by other means, both rear wheels must be raised off the surface so that they are free to rotate.

AXLE SHAFT REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel/tire.

(3) Remove the brake drum.

(4) Clean all the foreign material from the area where the differential housing cover mates with the differential housing.

(5) Loosen the housing cover bolts and drain the lubricant from the housing and the axle shaft tubes. Remove the housing cover.

(6) Rotate the differential case so that the differential pinion mate gear shaft lock screw is accessible. Remove the lock screw and the pinion mate gear shaft from the differential case (Fig. 3).

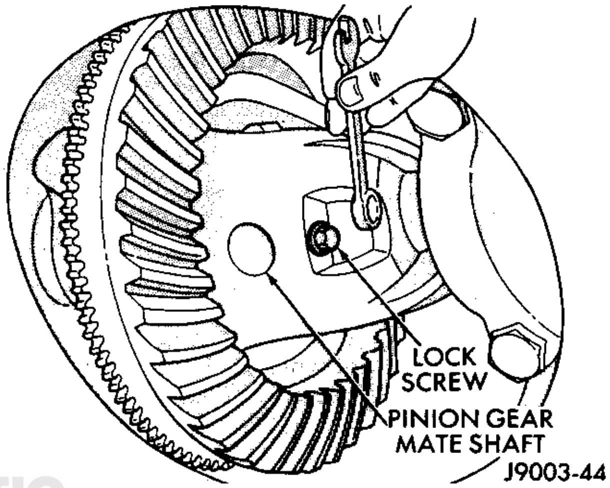

Fig. 3 Pinion Gear Mate Shaft Lock Screw

(7) Force the applicable axle shaft toward the center of the vehicle and remove the axle shaft C-clip "lock" from the recessed groove in the axle shaft (Fig. 4) with two screwdrivers or another appropriate tool.

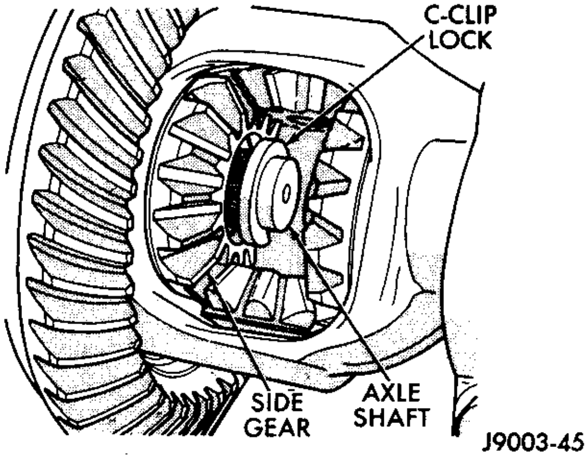

Fig. 4 Axle Shaft C-Clip Lock

(8) Remove the axle shaft from the differential side gear and the axle shaft tube. Use care to prevent damage to the axle shaft bearing, which will remain in the axle tube.

(9) Inspect the roller bearing contact surface on the axle shaft for evidence of "brinelling", "spalling" and "pitting".

(10) If any of these conditions exist, both the axle shaft and the bearing must be replaced.

The normal appearance (from roller bearing contact) of the shaft will be a dull gray surface area that could appear slightly dented.

AXLE SHAFT SEAL AND BEARING REMOVAL

(1) With the axle shaft removed from the axle shaft tube, remove the axle shaft seal from the end of the axle shaft tube with a small pry bar.

(2) Remove the bearing if it appears damaged or if the axle shaft exhibits any of the conditions described in the axle shaft removal procedure (above).

(3) To remove the axle shaft bearing from an 8 3/8-inch diameter ring gear axle tube (Fig. 5), use Removal Tool C-4167.

Attach Slide Hammer Tool C-637 to the end of the removal tool. Use a slide hammer motion to remove the bearing.

(4) For a 9 1/4-inch diameter ring gear axle tube, use Removal Tool C-4828 to remove the bearing (Fig. 6).

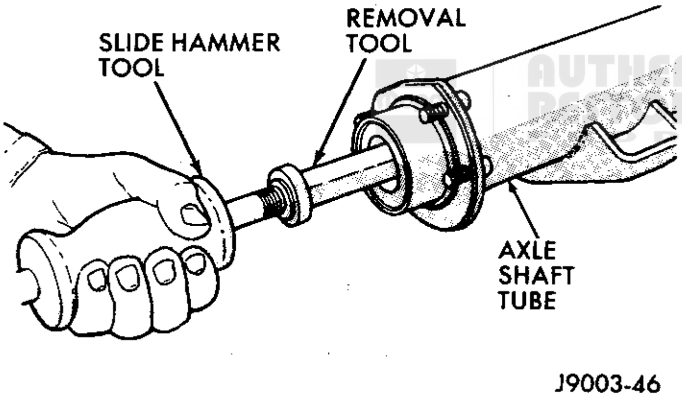

Fig. 5 Axle Shaft Bearing Removal (8 3/8-Inch Ring Gear)

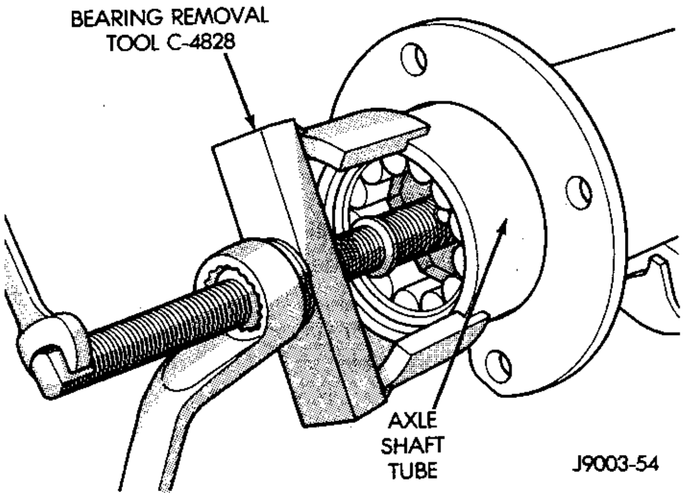

Fig. 6 Axle Shaft Bearing Removal (9 1/4-Inch Ring Gear)

AXLE SHAFT BEARING AND SEAL INSTALLATION

Do not install the original axle shaft seal or bearing. Always install a replacement seal and bearing.

(1) Wipe the bearing bore in the axle shaft tube clean.

(2) Insert a replacement axle shaft bearing onto the pilot of the appropriate bearing installation (Tool C-4198 for an 8 3/8-inch diameter ring gear axle tube or Tool C-4826 with Handle C-4171 for a 9 1/4-inch diameter ring gear axle tube).

CAUTION: DO NOT use the replacement axle shaft seal to position or "seat" the bearing in the axle shaft bore because this will damage the seal and cause lubricant leakage from the axle shaft tube.

(3) Insert the axle shaft bearing into the axle shaft tube bore. Ensure that the bearing is not "cocked" in the bore and that it is "seated" firmly against the "shoulder" in the axle tube.

(4) Install the replacement axle shaft seal (Fig. 7) in an 8 3/8-inch diameter ring gear axle shaft tube with Installation Tool C-4203 and Handle Tool C-4171. Use Installation Tool C-4826 to install the seal in a 9 1/4-inch diameter ring gear axle shaft tube. **The flat side of the installation tool must face the seal.**

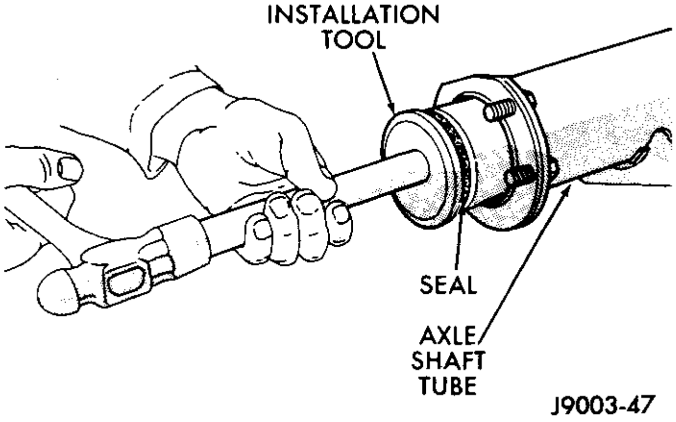

Fig. 7 Axle Shaft Seal Installation

(5) When the installation tool contacts the axle tube "face", the seal will be positioned at the correct depth in the bore.

AXLE SHAFT INSTALLATION

(1) Lubricate the bearing bore and the seal lip, insert the axle shaft into the axle shaft tube and engage its splines with the differential side gear splines. **Use care to prevent the shaft splines from damaging the axle shaft seal lip.**

(2) With the axle shaft in place, insert the C-clip "lock" in the recessed groove at the end of the axle shaft. Force the axle shaft outward to "seat" the C-clip "lock" in the differential side gear counterbore.

(3) Insert the differential pinion gear mate shaft into the case and through the thrust washers and the pinion gears. Align the hole in the shaft with the lock screw hole in the differential case and install the lock screw. Tighten the screw with 19 N•m (14 ft-lbs) torque.

(4) Remove the residual gasket material from the differential housing and the cover, thoroughly clean the contact surfaces with mineral spirits (or an equivalent solution) and dry the surfaces completely.

(5) Apply a 1/16-inch to 3/32-inch (1.6-mm to 2.4-mm) thick "bead" of MOPAR Silicone Rubber Sealant (or an equivalent sealant) around the bolt circle on the housing cover (Fig. 8).

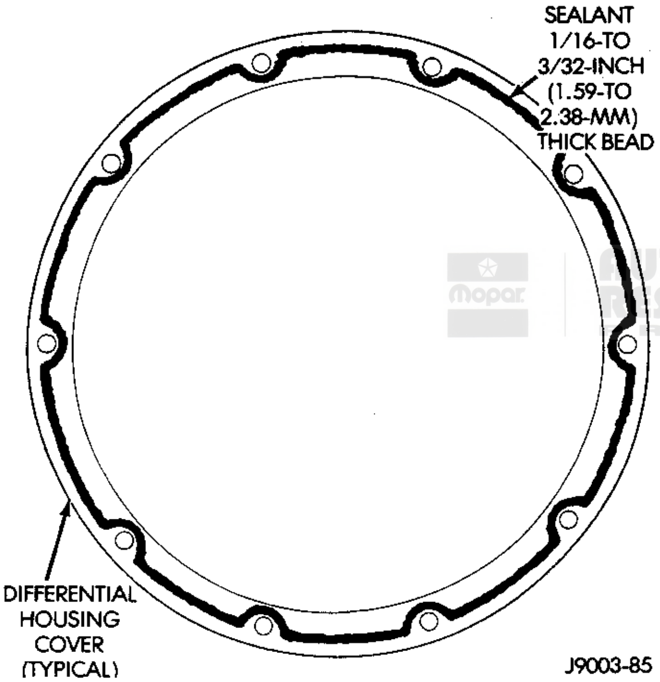

Fig. 8 Sealant On Housing Cover

Allow the sealant to "cure" for few minutes.

If for any reason the housing cover is not installed within 20 minutes after applying the sealant, the sealant must be removed and another "bead" of sealant applied.

(6) Install the housing cover on the differential housing with the attaching bolts. Install the axle gear ratio identification tag with one of the cover bolts. Tighten the cover bolts with 47 N•m (35 ft-lbs) torque.

(7) Install the brake drum and the wheel/tire. Tighten the wheel lug nuts in the correct sequence (Fig. 9) with the specified torque for the vehicle (Refer to Group 22—Tires And Wheels).

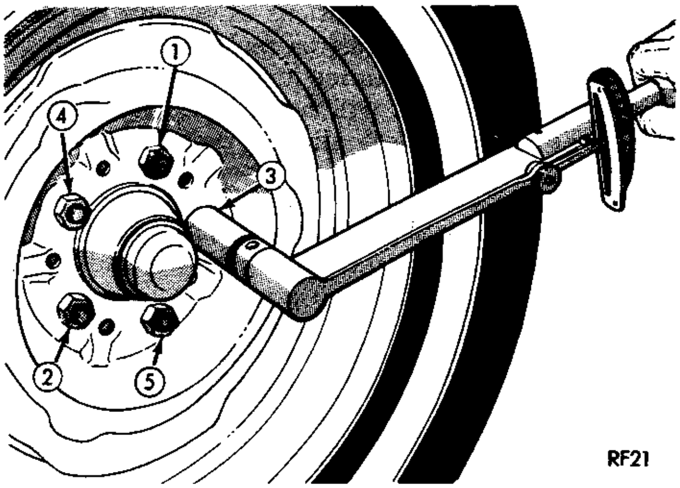

Fig. 9 Wheel Lug Nut Tightening Sequence

(8) Remove the supports and raise or lower the hoist until the vehicle is level.

(9) Remove the fill hole plug and fill the differential housing and the axle tubes with lubricant (refer to the Specifications chart for the type and the quantity). Install the fill hole plug.

(10) Lower the vehicle and test the brakes and the axle for correct operation.

DRIVE PINION GEAR SHAFT SEAL REPLACEMENT

CAUTION: The following procedures for replacement of the drive pinion gear shaft seal must be used without exception to ensure that the correct bearing "preload" torque is retained for the drive pinion gear shaft bearings. If this procedure is not completely followed, the result can be premature failure of the rear axle.

REMOVAL

(1) Raise and support the vehicle.

(2) Score installation alignment reference marks on the drive shaft, the drive shaft front U-joint, the drive pinion gear shaft (axle) yoke and the end of the drive pinion gear shaft.

(3) Disconnect the drive shaft from the drive pinion gear shaft (axle) yoke and secure in an upright position to prevent damage to the front U-joint.

(4) Remove the rear wheels/tires and the brake drums to prevent any "drag" from causing a possible false bearing "preload" torque measurement.

(5) Use a Newton-meter or an inch-pound torque wrench (e.g., C-685-A) to measure the drive pinion gear shaft bearing "preload" torque. Rotate the drive pinion gear shaft with the torque wrench and note (and record) the torque indication as the wrench moves through several complete revolutions. **This measurement is very important because the**

bearing "preload" torque must be carefully readjusted after the replacement seal is installed.

(6) Retain (axle) yoke with Holding Tool C-3281 and remove drive pinion gear shaft nut and the "Belleville" washer.

(7) Remove the yoke with Yoke Removal Tool C-452.

(8) Lower the rear of the vehicle to prevent lubrication leakage.

(9) Remove the drive pinion gear shaft seal from the differential housing with a small pry bar and a hammer. Clean the seal contact surface in the housing.

INSTALLATION

(1) Examine the splines at the end of the drive pinion gear shaft to ensure that they are without burrs and are not worn excessively.

(2) If burrs do exist, remove them with crocus cloth by moving it with a rotational motion. Clean the drive pinion gear shaft with a clean shop cloth.

(3) Inspect the drive pinion gear shaft (axle) yoke for cracks, worn splines and worn seal contact surface. Repair or replace the (axle) yoke as necessary.

The outer perimeter of the seal is pre-coated with a special sealant, therefore an application of sealant is not required.

(4) Install the replacement drive pinion gear shaft seal (Fig. 10).

Use Seal Installation Tool C-4076 for 8 3/8-inch diameter ring gear axles. Use Seal Installation Tool C-3980 or C-4109 for 9 1/4-inch diameter ring gear axles. The seal is correctly installed when the seal flange contacts the face of the differential housing flange.

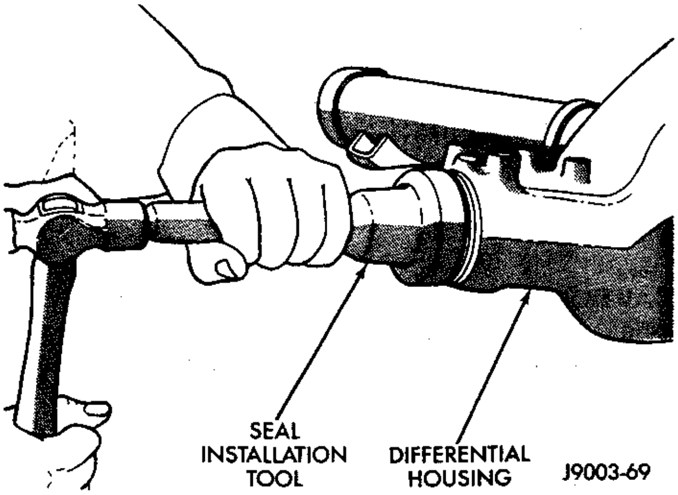

Fig. 10 Drive Pinion Gear Shaft Seal Installation

(5) Position the drive pinion gear shaft (axle) yoke on the end of the shaft with the installation reference marks aligned.

(6) "Seat" the (axle) yoke on the drive pinion gear shaft with Tool C-3718 and Holding Tool C-3281.

(7) Remove the tools and install the "Belleville" washer (the convex side of the washer must face outward) and the drive pinion gear shaft nut.

(8) Retain the drive pinion gear shaft (axle) yoke with Holding Tool C-3281 and tighten the shaft nut with 285 N•m (210 ft-lbs) torque (Fig. 11). Rotate the drive pinion gear shaft several complete revolutions to ensure that the bearing rollers are "seated".

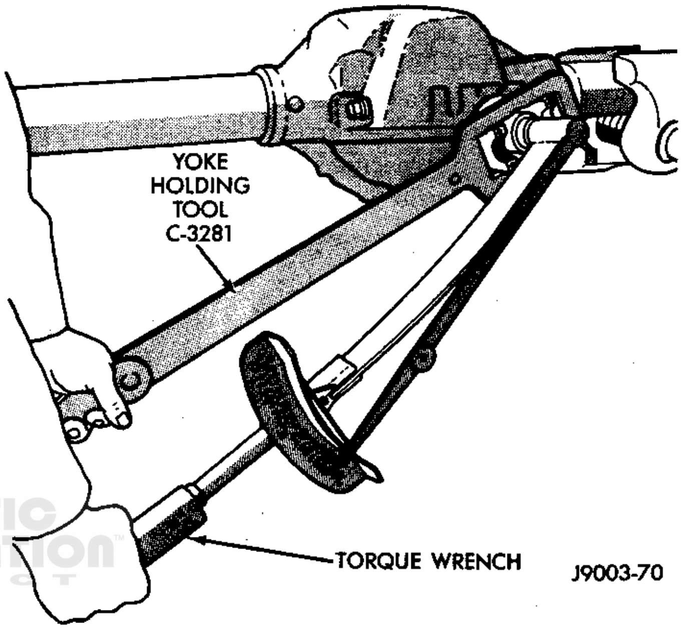

Fig. 11 Tightening Drive Pinion Gear Shaft Nut

Use a Newton-meter or an inch-pound torque wrench (e.g., C-685-A) to measure the drive pinion gear shaft bearing "preload" torque.

CAUTION: Never loosen the drive pinion gear shaft nut to decrease the drive pinion gear shaft bearing "preload" torque. If the specified "preload" torque is exceeded, a replacement collapsible spacer must be installed and the nut re-tightened until the specified bearing "preload" torque is obtained.

(9) Continue alternately tightening the drive pinion gear shaft nut and measuring the bearing "preload" torque until the torque is the same as that measured and recorded prior to yoke and seal removal. **The bearing "preload" torque should never be greater than 1 N•m (10 in-lbs) more than the recorded amount.**

The bearing "preload" torque should be constant during a complete revolution of the drive pinion gear shaft. If the "preload" torque varies during rotation of the shaft, this indicates an internal "binding" condition and it must be corrected before continuing with the installation of the drive shaft.

(10) If the specified bearing "preload" torque is not obtained after tightening the drive pinion gear shaft nut with 285 N•m (210 ft-lbs) torque, continue tightening the nut in small increments until the recorded bearing "preload" torque is obtained.

(11) The seal replacement is unacceptable if the final drive pinion gear shaft nut torque is less than 285 N•m (210 ft-lbs) or if the drive pinion gear shaft bearing "preload" torque is not correct.

(12) Install the drive shaft with the installation reference marks aligned. Tighten the clamp screws with 19 N•m (170 in-lbs) torque.

(13) Install the brake drums and the wheels/tires. Tighten the nuts in the correct tightening sequence (Fig. 12) with the specified torque (Refer to Group 22—Tires and Wheels for the torque specification).

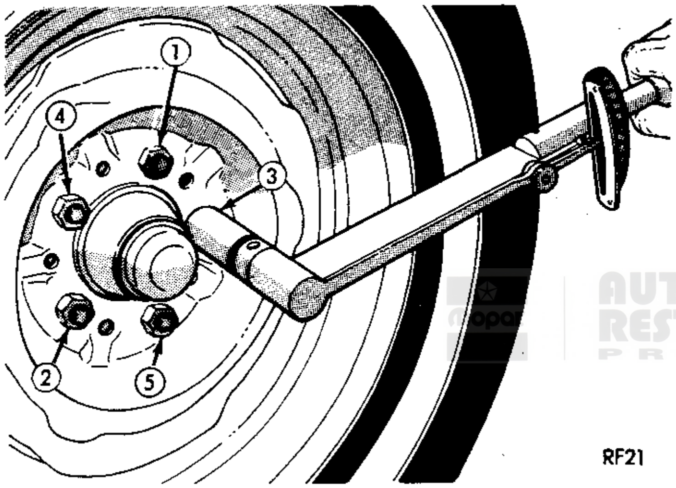

Fig. 12 Wheel Lug Nut Tightening Sequence

(14) Adjust the hoist so that the vehicle is in a level position and check the differential housing lubricant level. If necessary, add a sufficient amount of MOPAR Hypoid Gear Lubricant (or an equivalent product that conforms to MIL-L-2105-B and API GL 5 quality specifications) to increase the lubricant to the correct level.

COMPLETE AXLE REMOVAL/INSTALLATION

It is not necessary to remove the complete axle from the vehicle for routine service. However, if the differential housing or the axle shaft tubes are damaged, the complete axle can be removed and installed via the following procedures.

REMOVAL

(1) Raise the vehicle to a comfortable working height that will also enable support stands to be installed at the front of the rear springs.

(2) Block the brake pedal in the "up" (non-depressed) position with a wooden block.

(3) Remove the rear wheels/tires.

(4) Disconnect the brake fluid tube fittings from the wheel cylinders and cap the fittings to prevent loss of brake fluid.

(5) Disconnect the parking brake cables.

To ensure the correct driveline balance, scribe alignment marks into the drive shaft U-joint yoke and the drive pinion gear shaft (axle) yoke before removal of the drive shaft for installation reference.

(6) Disconnect the drive shaft yoke from the drive pinion gear shaft (axle) yoke and secure the drive shaft in an upright position to prevent damage to the front U-joint.

(7) Remove the shock absorber lower attaching bolts and the rear spring U-bolt nuts and the U-bolts.

(8) Remove the complete axle from the vehicle.

(9) Wash and clean the outer surface of the axle with an appropriate cleaning solution and dry the surface with compressed air.

INSTALLATION

(1) With the vehicle supported at the front of the rear springs, position the rear axle spring pads over the spring center bolts.

(2) Install the spring U-bolts and nuts, and the shock absorber lower bolts. Tighten the nuts with the specified torque (Refer to Group 17—Springs and Shock Absorbers).

(3) Connect the parking brake cables.

(4) Connect the brake fluid tube fittings to the wheel cylinders, and "bleed" and adjust the brakes.

(5) Align the installation reference marks and attach the drive shaft yoke to the drive pinion gear shaft (axle) yoke. Tighten the U-joint clamp bolts with 19 to 23 N•m (170 to 200 in-lbs) torque.

(6) Install the rear wheels/tires and tighten the nuts in the correct tightening sequence (Fig. 12) with the specified torque (Refer to Group 22—Tires And Wheels for the specification).

STANDARD DIFFERENTIAL SERVICE

CAUTION: When rear axle service is necessary, or when the axle is being rotated either via the engine or by other means, both rear wheels must be raised off the surface so that they are free to rotate.

REMOVAL/DISASSEMBLY

It is not necessary to remove the complete axle to service a standard differential.

(1) Raise the vehicle on a hoist, position supports under the vehicle frame at the front of the rear springs and then lower the rear of the hoist.

(2) Remove the rear wheels/tires and the brake drums.

(3) To ensure the correct driveline balance, scribe alignment marks into the drive shaft U-joint yoke and the drive pinion gear shaft (axle) yoke before removal of the drive shaft for installation reference.

(4) Disconnect the drive shaft yoke from the drive pinion gear shaft (axle) yoke and secure in an upright position to prevent damage to the front U-joint.

(5) Remove the differential housing cover bolts, drain the lubricant and remove the cover.

(6) Wash and clean the inside of the differential housing and the differential case with an appropriate cleaning solution.

(7) Turn the differential case so that pinion gear mate shaft lock screw is accessible (Fig. 13). Remove the lock screw and pinion gear mate shaft. Force both axle shafts toward the center of the vehicle and remove the C-clip "locks" from the recessed grooves at the ends of the axle shafts (Fig. 14).

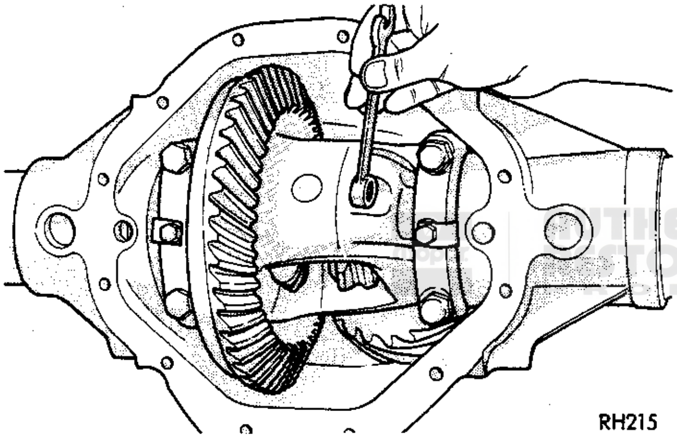

Fig. 13 Pinion Gear Mate Shaft Lock Screw

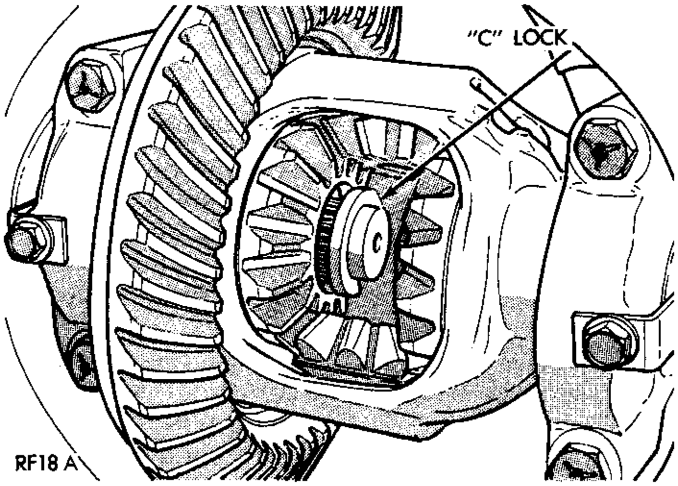

Fig. 14 Axle Shaft C-Clip Lock

(8) Remove the axle shafts from the differential housing. **Use care to prevent damaging the axle shaft bearing, which will remain in the axle shaft tube.**

Record the differential case "side play" and the ring gear "runout" measurements, they will be very useful during assembly.

(9) Test for differential case "side play" with a small pry bar or pinch bar (Fig. 15) placed between the left side of the differential housing and the differential case flange. Use a prying motion to determine if any "side play" exists. Ideally, there should be no "side play".

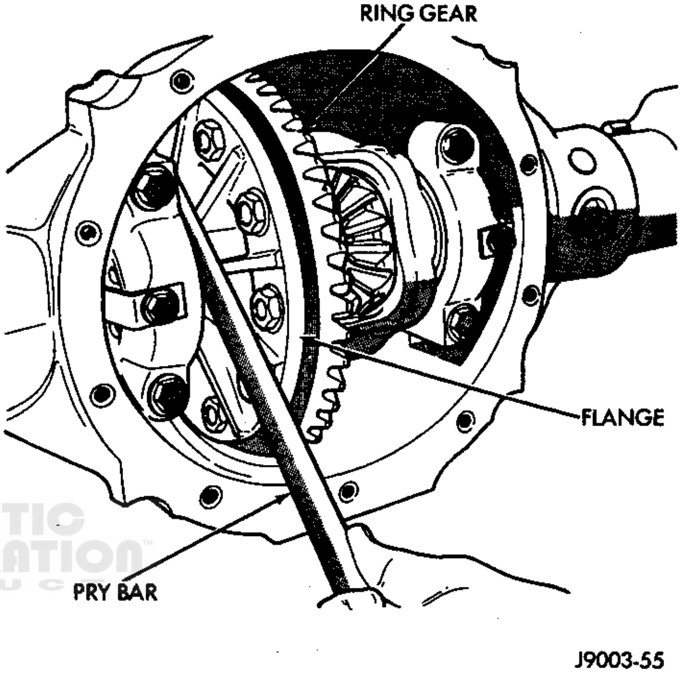

Fig. 15 Differential "Side Play" Test

Differential case "side play" that is the result of the bearing(s) becoming loose from the differential case hubs requires replacement of the differential case. Otherwise, use the threaded differential bearing adjuster to remove the "side play" before measuring the ring gear "runout".

(10) In preparation for measuring the ring gear "runout" (after any existing differential case "side play" has been eliminated), attach Dial Indicator Tool C-3339 to Pilot Stud Tool C-3288-B with the indicator plunger at a right angle (90°) to back face of the ring gear (Fig. 16). The plunger should exert a slight force against the ring gear back face.

(11) Measure the ring gear "runout" by turning the ring gear several complete revolutions and observing the dial indicator pointer. Mark the ring gear and the differential case at the location of maximum "runout". The ring gear "runout" should be no more than 0.005 inch (0.13 mm). If the "runout" exceeds 0.005 inch (0.13 mm), a damaged differential case could be the cause. A procedure for measuring the differential case flange "runout" is explained below.

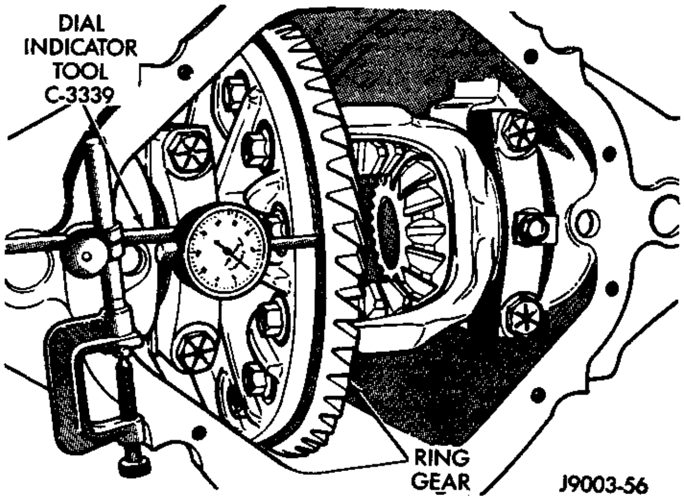

Fig. 16 Ring Gear "Runout" Measurement

The maximum "runout" mark on the differential case will be very useful later during the differential case flange "runout" measurement (below).

(12) Mark the differential housing and the differential bearing caps for installation reference (Fig. 17).

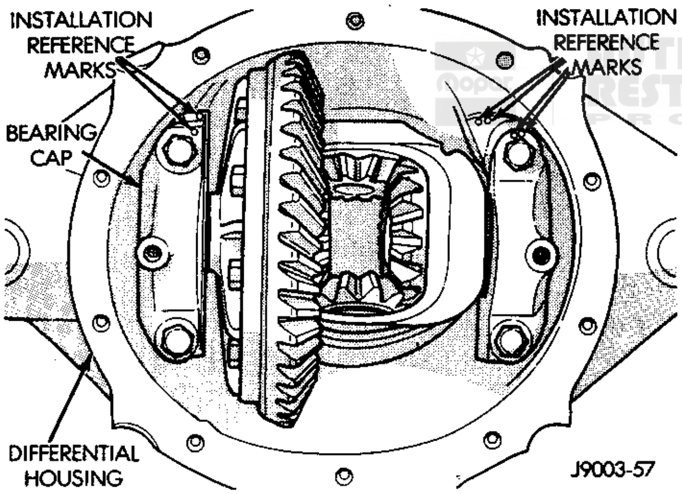

Fig. 17 Housing & Caps Marked For Installation Reference

(13) Remove the differential bearing threaded adjuster "lock" from each bearing cap. Loosen, but do not remove the bearing caps.

(14) Insert Tool C-4164 through each axle shaft tube and into the threaded adjuster hex-shaped drive hole (Fig. 18). Loosen the threaded adjusters with the tool.

(15) Retain the differential case in place and, with **extreme caution**, remove the differential bearing caps (Fig. 19), the threaded adjusters and the differential case.

The differential bearing cup and the threaded adjuster must be retained with their respective bearing as a "matched set".

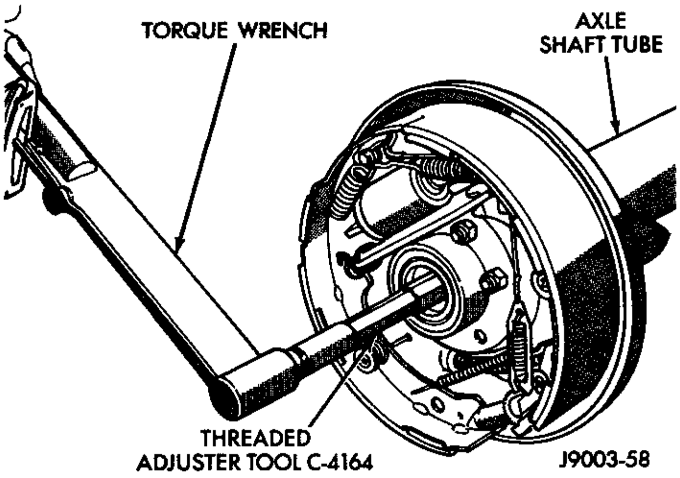

Fig. 18 Tool C-4164 In Axle Shaft Tube

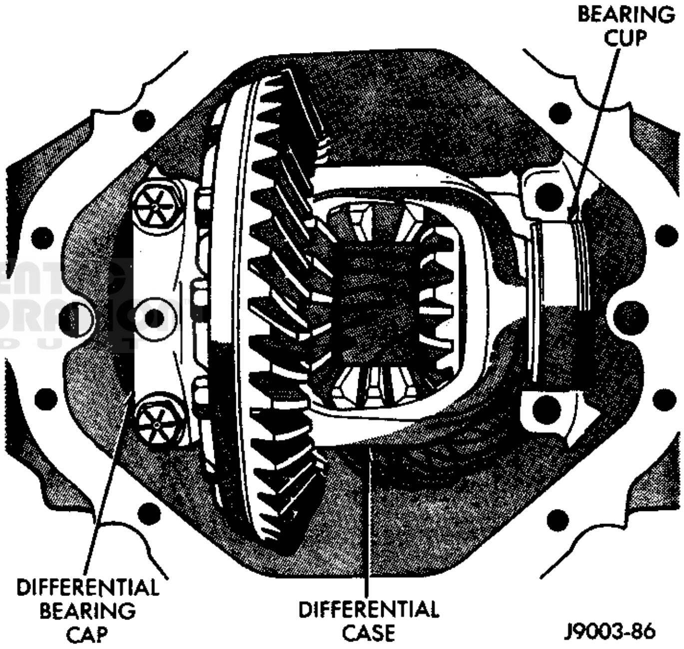

Fig. 19 Differential Bearing Cap Removed

(16) Use a Newton-meter or an inch-pound torque wrench to measure the drive pinion gear shaft bearing "preload" torque. Rotate the drive pinion gear shaft (axle) yoke nut slowly with the torque wrench and record the maximum torque. Remove the drive pinion gear shaft nut and washer. Use Tool C-452 and Holding Tool C-3281 to remove the drive pinion gear shaft (axle) yoke (Fig. 20).

(17) Use a small pry bar and a hammer to remove the drive pinion gear shaft seal from the differential housing bore and discard it.

(18) Force the drive pinion gear shaft rearward and out of the front bearing to remove the shaft and the front bearing from the differential housing. **This will result in damage to the front bearing rollers and the bearing cup, therefore, both the front bearing and the cup must be replaced.** Discard the bearing "preload" torque collapsible spacer.

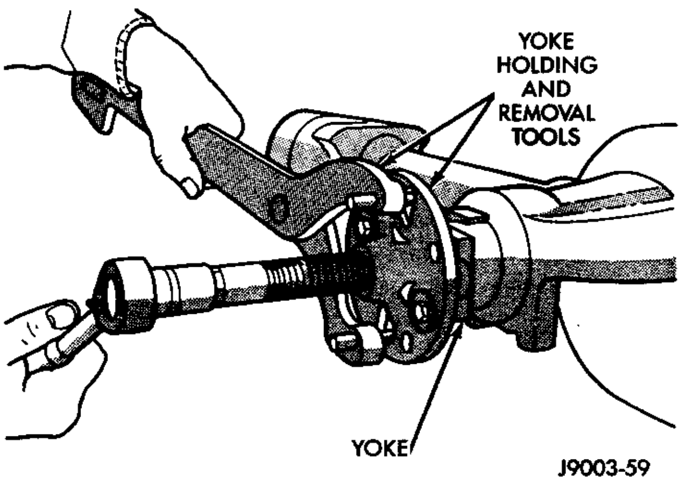

Fig. 20 Drive Pinion Gear Shaft (Axle) Yoke Removal

(19) Use the removal tools from Tool Set C-4306 and Handle Tool C-4171 to remove the front and rear bearing cups from the differential housing.

(20) Remove the rear bearing from the drive pinion gear shaft. For 8 3/8-inch diameter ring gear axles, use Tool C-293-PA and Adapter Tools C-293-42. For 9 1/4-inch diameter ring gear axles, use Tool C-293-PA and Adapter Tools C-293-37. Care must be taken to ensure that the adapter tools are positioned so that they will not exert excessive force on the bearing cage (Fig. 21).

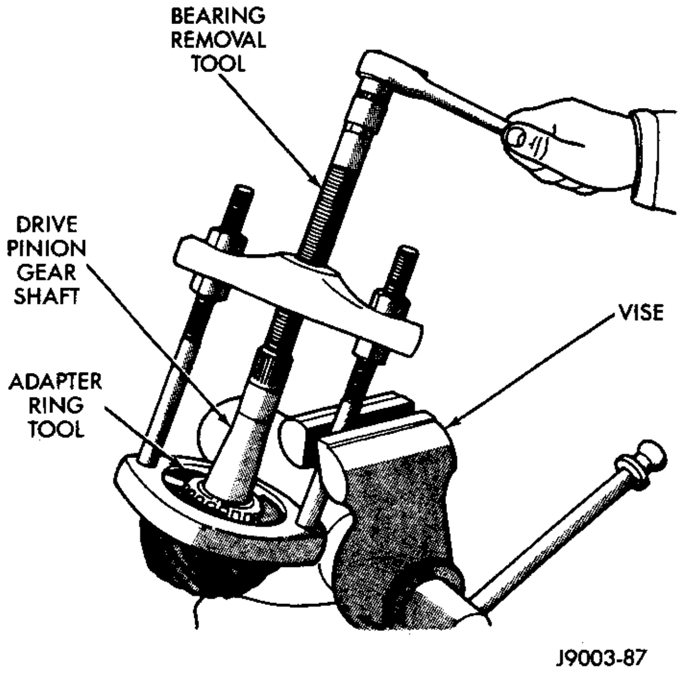

Fig. 21 Drive Pinion Gear Shaft Rear Bearing Removal

Do not remove the ring gear from the differential case unless either the differential case or the ring gear/drive pinion gear shaft set must be replaced, or unless the ring gear "runout" measured in item 10 (above) exceeds 0.005 inch (0.13 mm).

(21) Clamp the differential case (with the ring gear) in a vise equipped with soft jaws (i.e., brass).

(22) Remove and discard the ring gear bolts. **The bolts have left-hand threads.** Use a non-metallic hammer or a brass drift to "tap" the ring gear loose from the differential case flange and remove it.

(23) If the ring gear "runout" exceeded 0.005 inch (0.13 mm) in item 10 (above), the differential case flange "runout" should be measured. Install the differential case with the original bearing cups and threaded adjusters in housing.

(24) Install the differential bearing caps and the bearing cap bolts. Tighten the bearing cap bolts "lightly" and, with Tool C-4164, thread both of the threaded adjusters inward until all the bearing "side play" has been eliminated.

(25) Attach Dial Indicator Tool C-3339 to the differential housing with the indicator plunger "squarely" (i.e., perpendicular) contacting the ring gear mating surface (on the differential case flange) between the outer edge of the flange and the ring gear attaching bolt holes.

(26) Rotate the differential case several complete revolutions while observing the dial indicator pointer. Mark the location of maximum flange "runout". The differential case flange "runout" must not exceed 0.003 inch (0.08 mm). If the "runout" exceeds 0.003 inch (0.08 mm), the differential case must be replaced.

In a situation where the flange "runout" is considered excessive but does not exceed 0.003 inch (0.08 mm), it is often possible to reduce the combined ring gear "runout" by positioning the (marked) location of the maximum ring gear "runout" 180 degrees opposite the (marked) location of maximum flange "runout" when installing the ring gear on the differential case flange (Fig. 22).

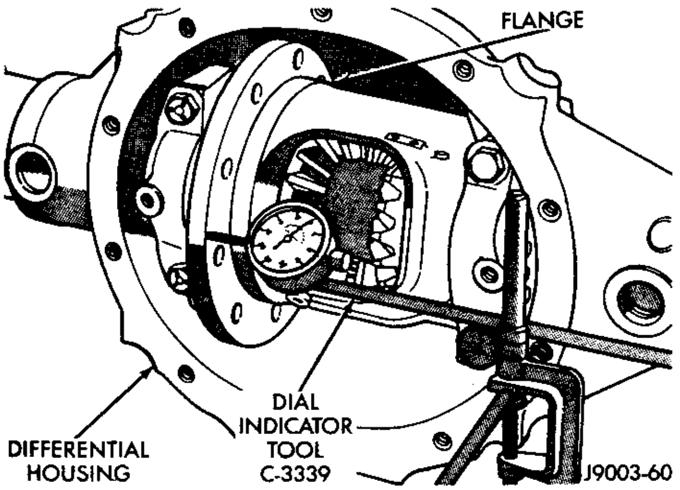

Fig. 22 Differential Case Flange "Runout" Measurement

(27) Remove the bearing cap bolts and remove the differential case from the differential housing.

(28) Rotate the differential side gears until the differential pinion gears are located at the differential case opening and remove them.

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

(30) Remove the differential bearings from the case hubs. For differential cases with 8 3/8-inch diameter ring gears, use Tool C-293-PA with Adapter Tools C-293-48 and Plug Tool SP-3289. For differential cases with 9 1/4-inch diameter ring gears, use Tool C-293-PA with Adapter Tools C-293-47 and Plug Tool C-293-3 (Fig. 23).

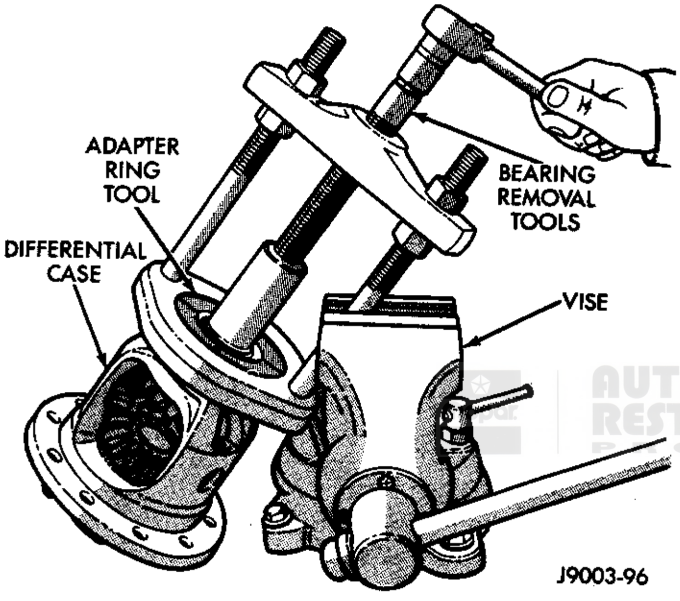

Fig. 23 Differential Bearing Removal

CLEANING/INSPECTION

(1) Wash and clean all the differential components with an appropriate cleaning solvent and, **with the exception of the bearings**, dry them with compressed air. To clean the axle shaft tubes, insert a stiff wire into each tube, attach a clean cloth to the wire at the differential housing opening and withdraw the wire with the cloth from housing outward to the end of the tube.

(2) All the machined contact surfaces in the differential housing and the differential bearing caps should be smooth and without any raised edges. The drive pinion gear shaft front and rear bearing cup bores (machined surfaces) should also be smooth. If applicable, the raised metal on the bore shoulders caused by removal of the bearing cups should be flattened with a "flat nose" punch.

(3) The axle shaft seal contact surfaces located at each outer end of the axle shaft tubes should be smooth and without any rust and corrosion. This also applies to the brake support plate and the axle tube flange mating surface.

(4) The bearing contact surfaces on the axle shafts and the axle shaft bearing rollers should be cleaned and inspected for "pitting", "spalling" and other visible damage. If either the shaft or the bearing is damaged, discard both of them and obtain replacement components.

Never reuse an axle shaft bearing after it has been removed from an axle shaft tube.

(5) The axle shaft splines should be smooth and without any excessive wear. The seal contact surfaces on the axle shaft should be smooth and without any nicks, scratches or blemishes.

Polish the axle shaft with No. 600 crocus cloth to remove slight surface damage without reducing the diameter of the axle shaft seal contact surface.

(6) The differential bearings and the drive pinion gear shaft front and rear bearings and cups should have smooth surfaces with no broken or dented areas on the rollers or the roller contact surfaces. The bearing cages must not be distorted or cracked.

When replacing a drive pinion gear bearing, always replace the bearing and the cup as a "matched set" only.

(7) Inspect the ring gear and the drive pinion gear shaft gear for worn and chipped teeth, and damaged attaching bolt threads. **If replacement is necessary, replace both the ring gear and the drive pinion gear shaft as a "matched set" only.**

(8) Inspect the drive pinion gear shaft (axle) yoke for cracks, worn splines, and worn seal contact surface. Repair or replace the drive pinion gear shaft (axle) yoke as necessary.

(9) Inspect the drive pinion gear shaft bearing "preload" torque shim for damage and distortion. Replace it if necessary.

(10) The differential side gears and pinion gears should have smooth teeth and a uniform contact pattern without excessive wear or broken surfaces. The differential side gear hub surfaces and thrust washer contact surfaces should be smooth and without any scoring or metal deposits.

(11) The machined thrust washer contact surfaces inside the differential case should be polished and without any surface irregularities. The pinion gear mate shaft bore in the differential case should be round and without excessive wear from the shaft contact surfaces. The differential pinion gear bores should also be round and without excessive wear from the shaft contact surfaces.

(12) Inspect the axle shaft C-clip "locks" for cracks and wear. Replace them if necessary.

(13) Test each threaded adjuster to determine if it rotates freely. If an adjuster binds, either repair the damaged threads or replace the adjuster, as necessary, to ensure that the threaded will adjusters rotate freely.

ASSEMBLY/INSTALLATION

(1) Liberally lubricate all the components with gear lubricant.

(2) Place the thrust washers on the differential side gears and position the gears in the differential case counterbores.

If replacement differential side gears or thrust washers are being used, refer to Differential Side Gear Clearance Measurement And Adjustment.

(3) Position the thrust washers on the differential pinion gears and mesh the pinion gears with the side gears. **Ensure that the pinion gears are exactly 180 degrees opposite each other.**

(4) Rotate the differential side gears to align the pinion gears and the thrust washers with the differential pinion gear mate shaft bores in the differential case.

(5) The contact surfaces on the ring gear and on the differential case flange must be clean and without any burrs.

(6) Use an "Arkansas" stone to remove any sharp areas from the chamfered edge on the inside diameter of the ring gear (Fig. 24).

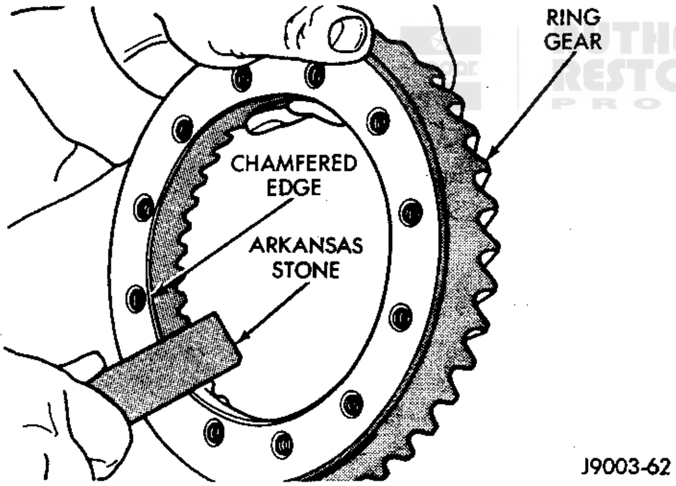

Fig. 24 Sharp Edge Removal

This precaution (above) is very important, because otherwise, during the installation of the ring gear on the differential case flange, a sharp edge could "shave" metal from the flange and, if the metal becomes imbedded between the differential case flange and the ring gear, cause the ring gear not to "seat" correctly on the flange.

(7) Heat the ring gear with a heat lamp or by immersing it in a hot fluid (water or oil). The ring gear temperature should not exceed 300°F (149°C). **Do not use a torch.**

(8) Position the differential case and the ring gear between the brass jaws of a vise and use pilot studs (equally spaced at three locations) to align the heated ring gear with the differential case (Fig. 25).

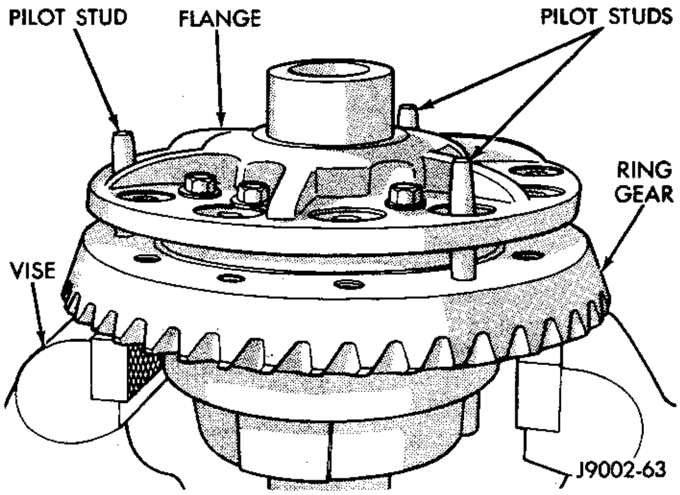

Fig. 25 Differential Case-To-Heated Ring Gear Alignment

(9) Insert replacement ring gear bolts (with left hand threads) through the differential case flange and thread them into the ring gear. Alternately tighten each bolt with 95 N•m (70 ft-lbs) torque.

CAUTION: When installing a differential bearing, never apply force to the bearing cage because bearing damage will result.

(10) Place a differential bearing on each differential case hub (bearing taper facing away from the ring gear) and carefully "seat" the bearings on the hubs. For differential cases with 8 3/8-inch diameter ring gears, use Bearing Installation Tool C-4340 and Driver Handle Tool C-4171. For differential cases with 9 1/4-inch diameter ring gears, use Bearing Installation Tool C-4213 and Driver Handle Tool C-4171. An arbor press should be used with the installation Tools (Fig. 26).

(11) Select the correct drive pinion gear shaft gear adjustment gauge set (Figs. 27 and 28) and continue the assembly according to the following instructions:

- insert both drive pinion gear shaft bearing cups into the differential housing bores (ensure that they are not cocked);
- for 8 3/8-inch diameter ring gear axles, position Locating Spacer Tool SP-6030 over the shaft of Tool SP-5385 and follow it with the drive pinion gear shaft rear bearing; and
- position the tools (with the bearing) in the differential housing, install Shaft Locating Sleeve Tool SP-5382, install the drive pinion gear shaft front bearing, install Washer Tool SP-6022 followed by Compression Sleeve Tool SP-3194-B, and install Centralizing Washer Tool SP-534 followed by Compression Nut Tool SP-3193.

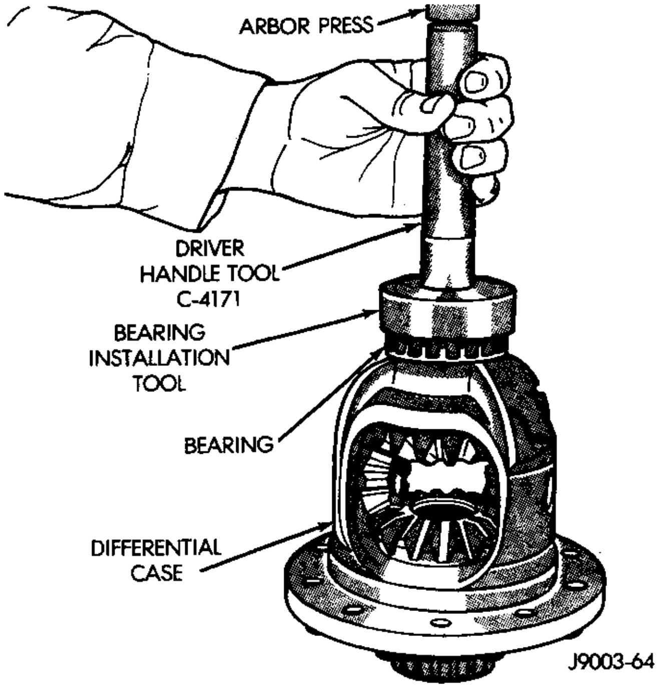

Fig. 26 Differential Bearing Installation

- for 9 1/4-inch diameter ring gear axles, position Locating Spacer Tool SP-6017 over the shaft of Tool SP-526 and follow it with the drive pinion gear shaft rear bearing; and
- position the tools (with the bearing) in the differential housing, install Shaft Locating Sleeve Tool SP-1730, install the drive pinion gear shaft front bearing, install Washer Tool SP-6022 followed by Compression Sleeve Tool SP-535-A, and install Centralizing Washer Tool SP-534 followed by Compression Nut Tool SP-533.

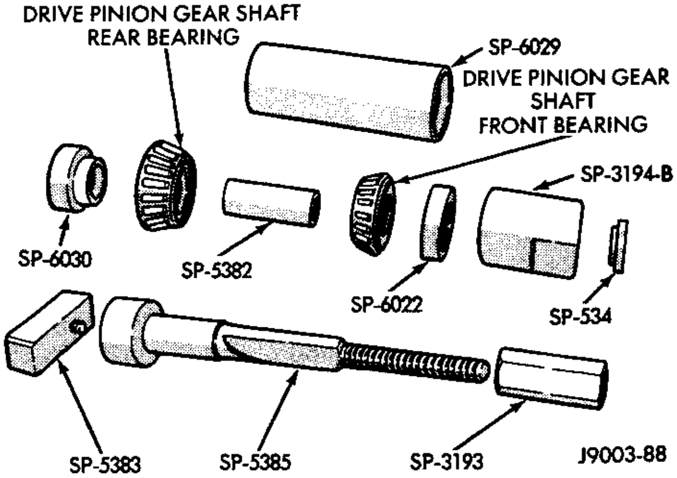

Fig. 27 8 3/8-Inch Ring Gear/Pinion Gear Adjustment Tools

(12) While preventing the compression sleeve tool from rotating with Tool C-3281, tighten the nut to force and "seat" the drive pinion gear shaft bearing cups in the differential housing bores (Fig. 29). Permit the sleeve tool to rotate several revolutions during the tightening operation to prevent "brinelling" the bearing cups or the bearings.

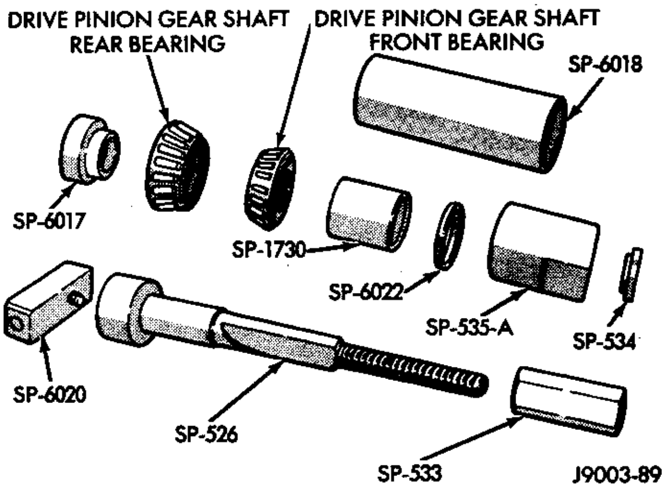

Fig. 28 9 1/4-Inch Ring Gear/Pinion Gear Adjustment Tools

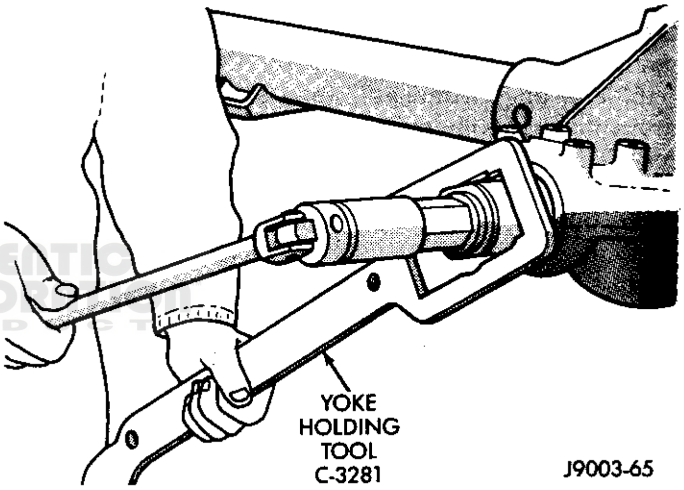

Fig. 29 Bearing Cup Installation

The position of the drive pinion gear in relation to the ring gear (depth of gear mesh) is determined by the location of the bearing cup shoulders in the differential housing bores and by the drive pinion gear shaft length that is located forward of the rear bearing. A depth shim is positioned between the drive pinion gear shaft rear bearing and the drive pinion gear. The required thickness of this depth shim is determined according to the following information.

(13) Loosen the compression nut tool (Figs. 22 and 23). Lubricate the drive pinion gear shaft front and rear bearings with gear lubricant. Re-tighten the compression nut tool until 1 to 3 N•m (15 to 25 in-lbs) torque is indicated. Rotate the drive pinion gear shaft several complete revolutions to align the bearing rollers.

(14) For 8 3/8-inch diameter ring gear axles:

- install Gauge Block Tool SP-5383 at the end of Tool SP-5385;
- install Cap Screw Tool SP-536; and
- tighten it securely with Wrench Tool SP-531.

(15) For 9 1/4-inch diameter ring gear axles:

- install Gauge Block Tool SP-6020 at the end of Tool SP-526;
- install Cap Screw SP-536; and
- tighten it securely with Wrench Tool SP-531.

(16) For 8 3/8-inch diameter ring gear axles, position Crossbore Arbor Tool SP-6029 in the differential bearing bores in the differential housing (Fig. 30).

(17) For 9 1/4-inch diameter ring gear axles, position Crossbore Arbor Tool SP-6018 in the differential bearing bores in the differential housing (Fig. 30).

Center the crossbore arbor tool to provide an approximately equal open space at each bore. Place a piece of 0.002 inch shim stock at each end of the arbor tool, position the bearing caps on the arbor tool and install the attaching bolts. Tighten the cap bolts with 14 N•m (10 ft-lbs) torque.

(18) Select (trial fit) a drive pinion gear shaft rear bearing depth shim that will "fit" between the crossbore arbor tool and the gauge block tool (Fig. 30). **The depth shim "fit" must be "snug" but not excessively tight (e.g., similar to the "drag" friction of a feeler gauge blade).**

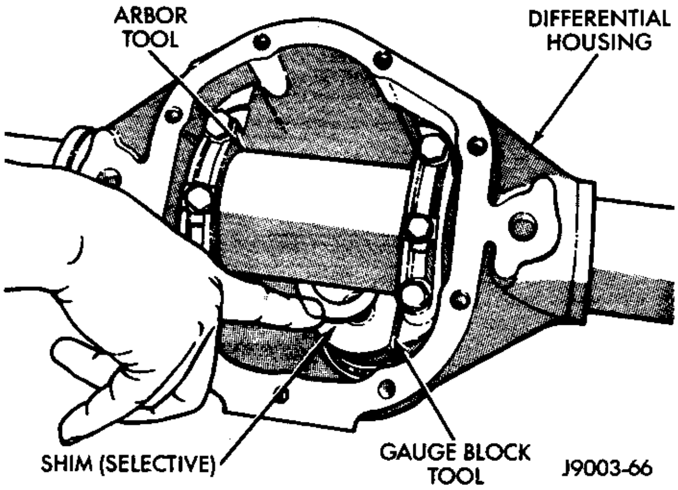

Fig. 30 Drive Pinion Gear Shaft Bearing Depth Shim Selection

Depth shims are available in 0.001-inch increments from 0.020 inch to 0.038 inch.

(19) Note the etched number on the face of the drive pinion gear (e.g., -0, -1, -2, +1, +2, etc.). The etched numbers represent 0.001 of-an-inch deviation from the standard. If the number is "-" (negative), add that value to the thickness of the depth shim selected in item 20 (above). If the number is "+" (positive), subtract that value from the thickness of the depth shim selected in item 20 (above). If the number is "0", no change is required. Evaluate other drive pinion gear etched numbers in a similar manner.

(20) Remove the tools from the differential housing.

(21) Position the depth shim selected above on the drive pinion gear shaft followed by the rear bearing (ensure that the drive pinion gear contact surface, the bearing and the depth shim are clean and without foreign particles). Use Bearing Installation Tool C-4040 for 8 3/8-inch diameter ring gear axles or Tool C-3095-A for 9 1/4-inch diameter ring gear axles and force the rear bearing onto the drive pinion gear shaft. An arbor press can be used with the installation tool (Fig. 31).

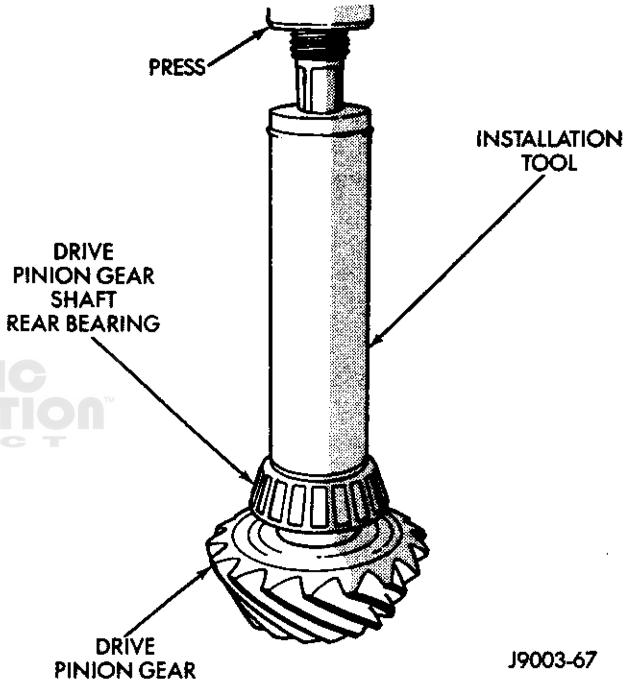

Fig. 31 Shaft Rear Bearing Installation

(22) Lubricate the drive pinion gear shaft front and rear bearings with gear lubricant.

(23) Insert the drive pinion gear shaft with the rear bearing into and through the differential housing bore. Position the bearing "preload" torque "replacement" collapsible spacer at the end of the drive pinion gear shaft. Position drive pinion gear shaft front bearing at the end of the drive pinion gear shaft.

(24) Install the (axle) yoke on 8 3/8-inch diameter ring gear axles with Removal/Installation Tool C-3718 and Holding Tool C-3281. For 9 1/4-inch diameter ring gear axles, use Removal/Installation Tool C-496 and Holding Tool C-3281.

Because of the front bearing "interference fit" on the drive pinion gear shaft, it is necessary to use the tools (above) to correctly "seat" the front bearing on the drive pinion gear shaft (Fig. 32).

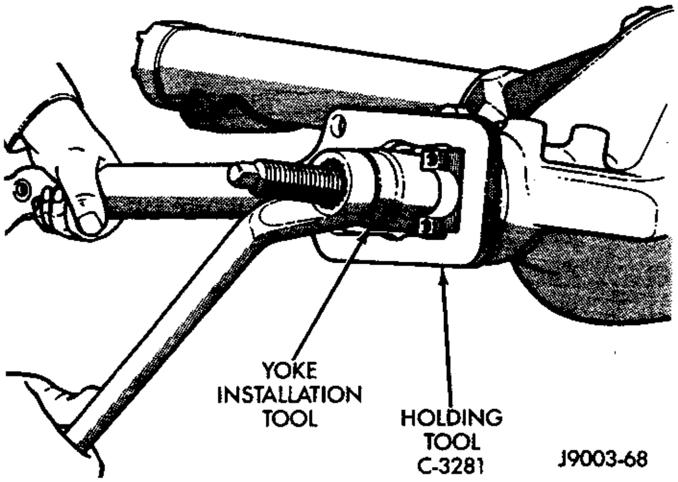

Fig. 32 Drive Pinion Gear Shaft (Axle) Yoke Installation

AUTION: During installation of the drive pinion ear shaft (axle) yoke and "seating" the front bearng, use care to prevent collapsing the "preload" orque spacer.

(25) Remove the (axle) yoke and the tools from the rive pinion gear shaft.

(26) Install the drive pinion gear shaft seal:

for 8 3/8-inch diameter ring gear axles, use Instalation Tool C-4076; and

for 9 1/4-inch diameter ring gear axles, use Instalation Tool C-3980 or C-4109.

(27) The seal is correctly installed when the seal ange contacts the face of the differential housing ange (Fig. 33).

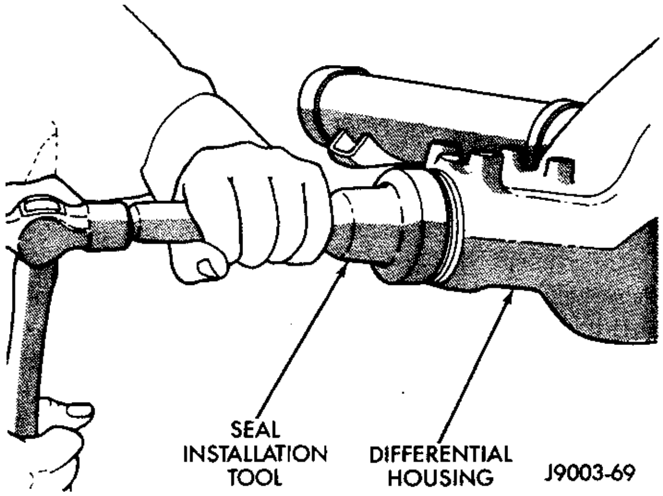

Fig. 33 Drive Pinion Gear Shaft Seal Installation

The outer perimeter of the seal is pre-coated ith a special sealant, therefore an application sealant is not required.

(28) Install the (axle) yoke on 8 3/8-inch diameter ng gear axles with Removal/Installation Tool C-18 and Holding Tool C-3281. For 9 1/4-inch diameter ring gear axles, use Removal/Installation Tool C-496 and Holding Tool C-3281.

(29) Remove the tools and install a "Belleville" washer with the convex side of the washer facing outward and the retaining nut on the end of the drive pinion gear shaft.

(30) Retain drive pinion gear shaft (axle) yoke with Holding Tool C-3281 and initially tighten the drive pinion gear shaft nut enough to remove the bearing "end play". While initially tightening the nut, rotate the drive pinion gear shaft to ensure that the bearing rollers are correctly "seated" (Fig. 34).

(31) Tighten the drive pinion gear shaft nut with 285 N•m (210 ft-lbs) torque (minimum).

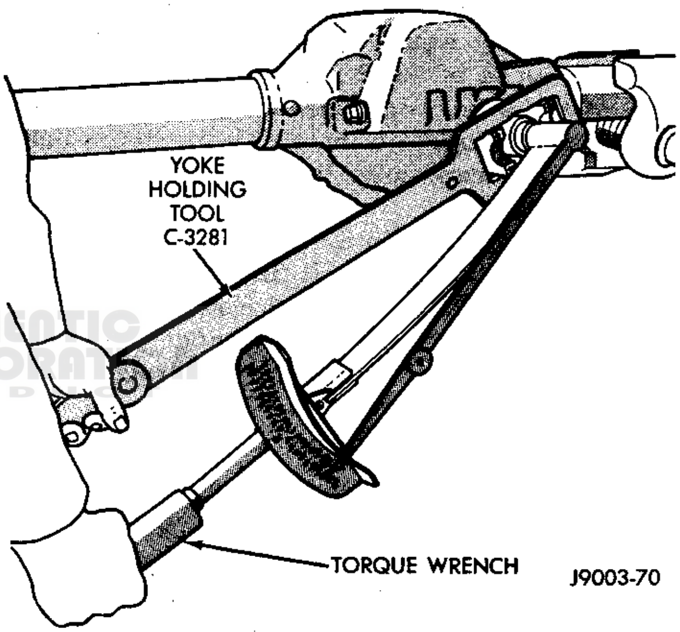

Fig. 34 Tightening Drive Pinion Gear Shaft Nut

(32) Remove the tools and rotate the drive pinion gear shaft several complete revolutions in both directions to additionally "seat" the bearing rollers.

CAUTION: Never loosen the drive pinion gear shaft nut to decrease the drive pinion gear shaft bearing "preload" torque. If the specified "preload" torque is exceeded, a replacement collapsible spacer must be installed and the nut re-tightened until the specified bearing "preload" torque is obtained.

(33) Measure the drive pinion gear shaft bearing "preload" torque by rotating drive pinion gear shaft with a Newton-meter or an inch-pound torque wrench. The correct bearing "preload" torque is 2 to 4 N•m (20 to 35 in-lbs) for both 8 3/8-inch and 9 1/4-inch diameter ring gear axles with replacement bearings and the drive pinion gear shaft nut tightened with a minimum of 285 N•m (210 ft-lbs) torque (Fig. 35).

If the original the drive pinion gear shaft rear bearing and a replacement front bearing are used, with a minimum of 285 N•m (210 ft-lbs) torque, the correct bearing "preload" torque is 1 N•m (10 in-lbs) torque in addition to the torque recorded during disassembly.

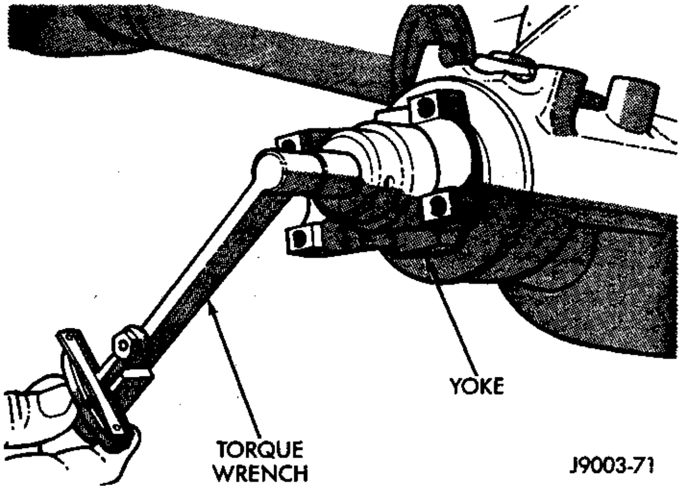

Fig. 35 Drive Pinion Gear Shaft Bearing "Preload" Torque Measurement

The bearing "preload" torque should be constant during a complete revolution of the drive pinion gear shaft. If the "preload" torque varies during rotation of the shaft, this indicates an internal "binding" condition and it must be corrected before continuing with the assembly of the differential.

(34) If the specified bearing "preload" torque is not obtained with 285 N•m (210 ft-lbs) torque, continue tightening the drive pinion gear shaft nut in small increments until the correct bearing "preload" torque is obtained.

The assembly of the differential is unacceptable if the final drive pinion gear shaft nut torque is less than 285 N•m (210 ft-lbs) torque or if the drive pinion gear shaft bearing "preload" torque is not correct.

(35) Apply a coating of gear lubricant to the differential bearings, the bearing cups and the threaded adjusters. Carefully position the assembled differential case in the housing.

(36) Note the installation reference marks and install the differential bearing caps at their original locations.

(37) Install the bearing cap bolts. Tighten the upper bolts with 14 N•m (10 ft-lbs) torque. Tighten the lower bolts "finger-tight" until the bolt head is lightly "seated" on the bearing cap.

DIFFERENTIAL BEARING "PRELOAD" TORQUE AND RING GEAR "BACKLASH" ADJUSTMENT

There are precautions that must be observed when adjusting the differential bearing "preload" torque and the ring gear "backlash":

- the maximum permissible ring gear "backlash" variation is 0.003 inch;
- for example, if the minimum "backlash" is 0.006 inch at one location, the maximum can be no more than 0.009 inch at another location;
- this variation represents the maximum permissible "runout" and it is important to index the gears so that the same teeth are engaged during all "backlash" measurements;
- it is also important to maintain the specified threaded adjuster torque while adjusting the differential bearing "preload" torque and the ring gear "backlash";
- excessive torque will introduce a high bearing "load" and cause premature bearing failure, while insufficient torque will not support the ring gear correctly and this can result in excessive differential case "free-play" and ring gear noise.

The differential bearing cups will not always respond directly to adjustment of the threaded adjusters, therefore to ensure accurate adjustment responses and to maintain the gear mesh index, the bearings must be "seated" by rotating the drive pinion gear shaft a half turn in each direction five to ten times each time the threaded adjusters are adjusted.

(1) Use Tool C-4164 to adjust each threaded adjuster inward (Fig. 36) until the excessive differential bearing "free-play" is eliminated, but with some ring gear "backlash" (approximately 0.010 inch) remaining between the ring gear and drive pinion gear. "Seat" the bearing rollers as described above.

(2) Install Dial Indicator Tool C-3339 (Fig. 37) and position the plunger against the drive side of a ring gear tooth. Measure the "backlash" at 4 positions around the perimeter of the ring gear (with an arc interval of approximately 90 degrees between each position) to locate the area of minimum "backlash".

(3) After the measurement is completed, rotate the ring gear to the position of least "backlash" (as indicated by the dial indicator pointer) and mark the gear so that all future "backlash" measurements will be taken with the same teeth meshed.

(4) Loosen the right-side threaded adjuster and tighten the left-side threaded adjuster until the ring gear "backlash" is 0.003 to 0.004 inch (0.08 to 0.10 mm) after each adjuster has been tightened with 14 N•m (10 ft-lbs) torque. "Seat" the bearing rollers as described above.

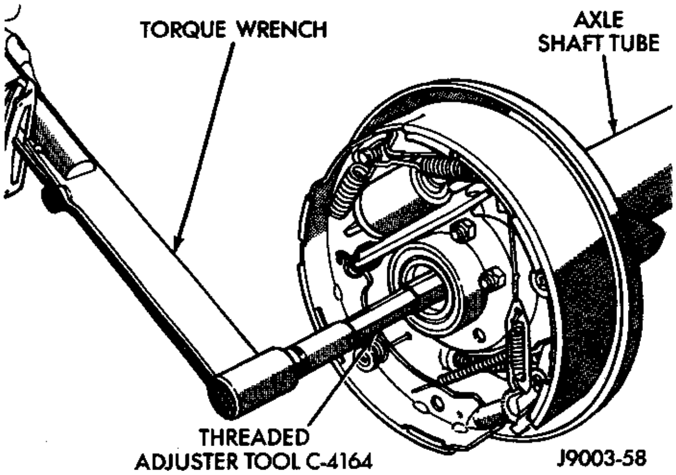

Fig. 36 Threaded Adjuster Tool C-4164

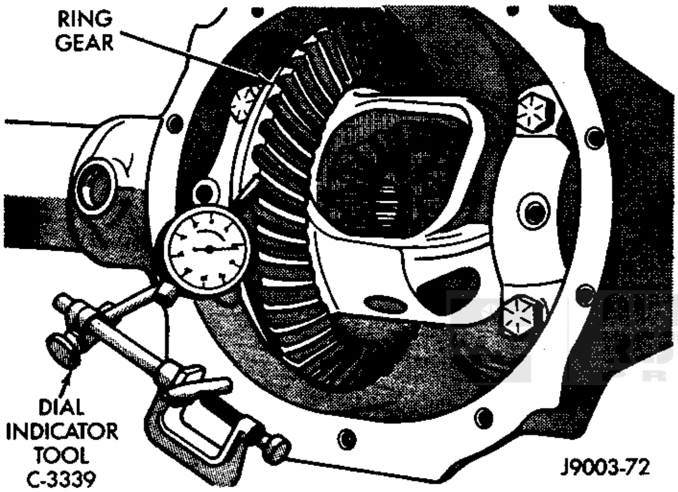

Fig. 37 Ring Gear "Backlash" Measurement

(5) Tighten the differential bearing cap bolts with 95 N•m (70 ft-lbs) torque for 8 3/8-inch diameter ring gear axles and with 136 N•m (100 ft-lbs) torque for 9 1/4-inch diameter ring gear axles.

(6) Use Tool C-4164 to tighten the right-side threaded adjuster with 102 N•m (75 ft-lbs) torque. "Seat" the bearing rollers as described above. Continue to tighten the right-side adjuster and "seat" bearing rollers until the torque remains constant at 102 N•m (75 ft-lbs).

(7) Measure the ring gear "backlash". If the "backlash" is not 0.006 to 0.008 inch (0.15 to 0.20 mm), continue increasing the torque at the right-side threaded adjuster (and "seat" the bearing rollers as described above) until the specified "backlash" is obtained.

If all the previous instructions have been correctly completed, the initial torque indication for the left-side threaded adjuster should be approximately 102 N•m (75 ft-lbs). If the torque is substantially less, the complete procedure must be repeated.

(8) Tighten the left-side threaded adjuster with 102 N•m (75 ft-lbs) torque (and "seat" the bearing rollers as described above) until torque remains constant.

(9) After the adjustments are completed, install the threaded adjuster "locks". Ensure that the "lock teeth" for 9 1/4-inch diameter ring gear axles are engaged with the adjuster threads and that the "lock finger" is engaged with adjuster hole for 8 3/8-inch diameter ring gear axles. Tighten the "lock" screws with 10 N•m (90 in-lbs) torque.

DIFFERENTIAL SIDE GEAR CLEARANCE MEASUREMENT/ADJUSTMENT

The correct differential side gear clearance is obtained by selection of a side gear thrust washer that has the correct thickness. Refer to the replacement parts catalog for the required side gear thrust washer package.

When measuring side gear clearance, evaluate each gear independently. It is possible for one side gear to have an acceptable clearance and for the other side gear to have an unacceptable clearance. If it necessary to replace a side gear, replace both gears as a "matched set".

(1) Install the axle shafts and the C-clip "locks". In necessary, refer to the installation located within this group.

(2) With the axle shafts and the C-clip "locks" in place, measure each side gear clearance by selectively inserting a "matched pair" of feeler gauge blades between the gear and the differential housing on opposite sides of the hub (Fig. 38).

(3) If either of the side gear clearances is no more than 0.005 inch, inspect the end of the axle shaft on the same side of the differential housing to determine if it is contacting the pinion gear mate shaft. **Do not remove the feeler gauges, inspect the axle shaft with the feeler gauge blades inserted behind the side gear.** If the end of the axle shaft is

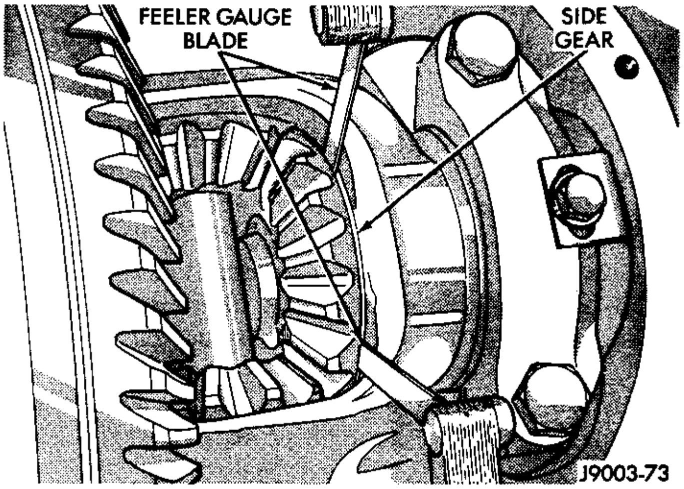

Fig. 38 Side Gear Clearance Measurement

not contacting the pinion gear mate shaft, the side gear clearance is acceptable.

(4) If a side gear clearance is more than 0.005 inch (and the axle shaft is not contacting the differential pinion gear 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 the gear clearance and the washer thickness will determine the required thickness of the replacement thrust washer.

For example, if the side gear clearance is 0.007 inch and the thrust washer thickness is 0.033 inch, the sum is 0.04 inch. Install the "thickest" thrust washer from the service package that does not exceed the sum calculated above. In the example situation, a 0.037-inch thick washer from the service package should be installed because the next larger washer size is 0.042-inch thick, which would be too thick. When the replacement thrust washer is installed, the side gear clearance should be 0.003 inch.

(5) In some instances, the end of the axle shaft will move and contact the pinion gear mate shaft when the feeler gauge blades are inserted behind the side gear. When this occurs, the C-clip "lock" on the axle shaft is preventing the side gear from sliding on the axle shaft and moving independently inward.

To determine the total side gear clearance with this situation (above), re-measure the clearance with the C-clip "lock" removed. Compare this measurement with the measurement when the C-clip "lock" was installed.

(6) Remove the C-clip "lock" from the axle shaft(s) that have no "end play". With the differential case disassembled, use a micrometer to measure the thrust washer thickness. Record the thickness and return the thrust washer behind the side gear. Assemble the differential case without the C-clip "lock" installed and re-measure the side gear clearance.

(7) Compare the clearances. If the clearance difference is less than 0.012 inch, add the side gear clearance recorded when the C-clip "lock" was installed to the thrust washer thickness measured with the micrometer. The sum will determine the required thickness of the replacement thrust washer.

For example, if the side gear clearance is 0.006 inch with the axle shaft C-clip "lock" installed and 0.015 inch with the C-clip "lock" removed, the difference is 0.009 inch, which is less than 0.012 inch. Add 0.006 inch (the clearance with the C-clip "lock" installed) to the thrust washer thickness (e.g., 0.032 inch). The sum is 0.038 inch. The closest thrust washer thickness that does not exceed 0.038 inch is 0.037 inch.

(8) If the clearance difference is 0.012 inch or greater, both side gears must be replaced ("matched set") and the clearance measurements repeated.

(9) If the side gear clearance difference (above) continues to be 0.012 inch or greater with replacement side gears and the "thickest" thrust washers from the service package installed, the differential case must be replaced.

RING GEAR TEETH CONTACT PATTERNS

(1) Apply a thin coat of Hydrated Ferric Oxide (commonly referred to as Yellow Oxide of Iron), or an equivalent product, to both the "drive" side and the "coast" side of the ring gear teeth.

(2) Rotate the ring gear one complete revolution in both directions while a load is being applied with a round bar or screwdriver inserted between the differential housing and the differential case flange. This action will produce a distinct contact pattern on both the "drive" side and the "coast" side of the ring gear teeth.

The gear teeth contact pattern will disclose whether or not the drive pinion gear shaft rear bearing depth shim has the correct thickness and whether or not the ring gear "backlash" has been adjusted correctly. The "backlash" between the ring gear and the drive pinion gear must be maintained within the specified limits until the correct teeth contact pattern is obtained.

(3) Examine the contact patterns on the ring gear teeth and compare them with those in Figs. 39 through 43 to determine if the patterns are correct. With the drive pinion gear depth of mesh correct and the ring gear "backlash" adjusted correctly, the teeth contact patterns should closely resemble the patterns illustrated in Fig. 39. Notice that the illustrated teeth contact patterns are well centered on both the "drive" side and the "coast" side of the teeth.

When the teeth contact patterns are obtained by the method described above, they are likely to be rather small. With an actual operating load, however, the contact area increases.

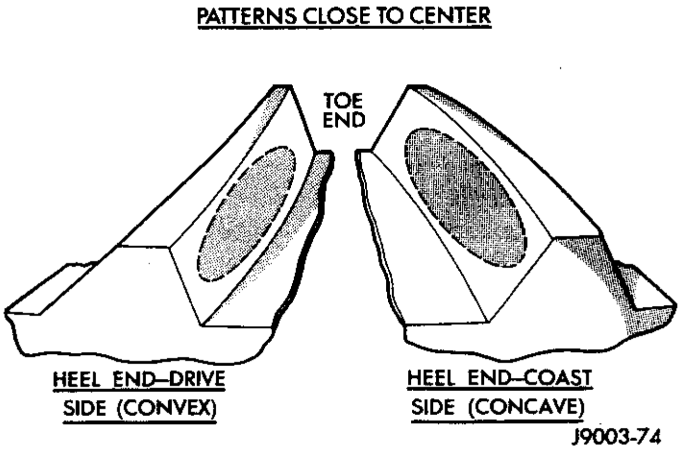

Fig. 39 Desired Teeth Contact Patterns (With Light Load)

(4) If, after examining the ring gear contact patterns, it is determined that the patterns resemble those illustrated in Fig. 40, the drive pinion gear is separated too much from the centerline of the ring gear. This condition will cause the contact patterns to be "high" on the "drive" side and near the "heel" of the tooth, and "high" on the "coast" side and near the "toe" of the tooth. To correct for this type teeth contact patterns, increase the thickness of the depth shim (located between the drive pinion gear and the drive pinion gear shaft rear bearing). This will cause the "high" contact pattern on the "drive" side to be lowered and to move toward the "toe" of the tooth, and the "high" contact pattern on the "coast" side to be lowered and to move toward the "heel" of the tooth (Fig. 41).

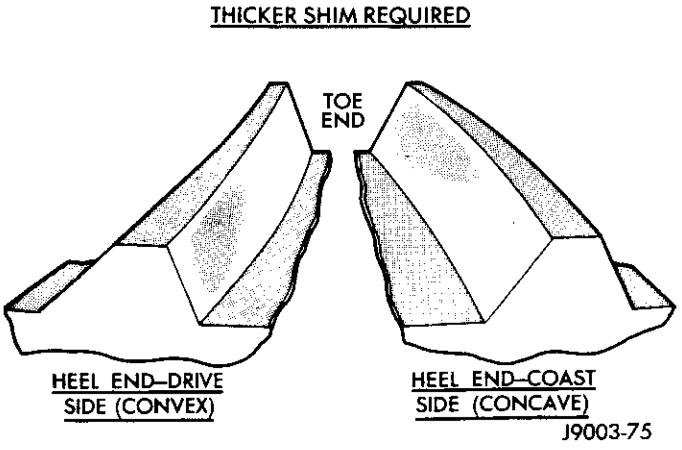

Fig. 40 Incorrect Teeth Contact Patterns—Increase Depth Shim Thickness

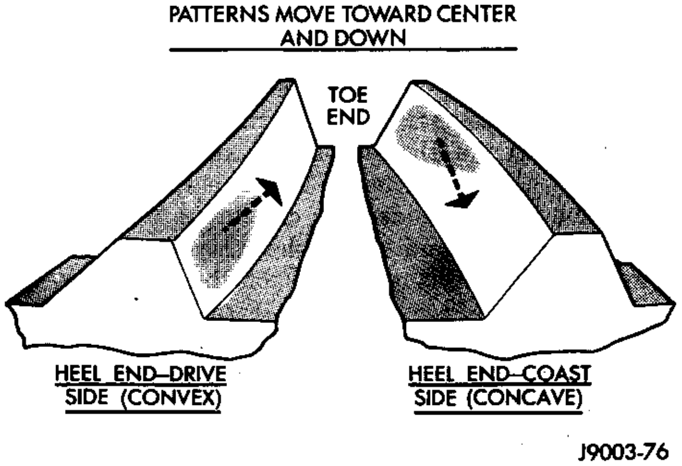

Fig. 41 Teeth Contact Patterns After Depth Shim Thickness Is Increased

(5) If, after examining the contact patterns, it is determined that the patterns resemble those illustrated in Fig. 42, the drive pinion gear is too close to the centerline of the ring gear. This condition will cause the contact patterns to be "low" on the "drive" side and near the "toe" of the tooth, and "low" on "coast" side and near the "heel" of the tooth. To correct for this type of teeth contact patterns, decrease the thickness of the depth shim (located between the drive pinion gear and the drive pinion gear shaft rear bearing). This will cause the "low" contact pattern on the "drive" side to be raised and to move toward the "heel" of the tooth, and the "low" contact pattern on the "coast" side to be raised and to move toward the "toe" of the tooth (Fig. 43).

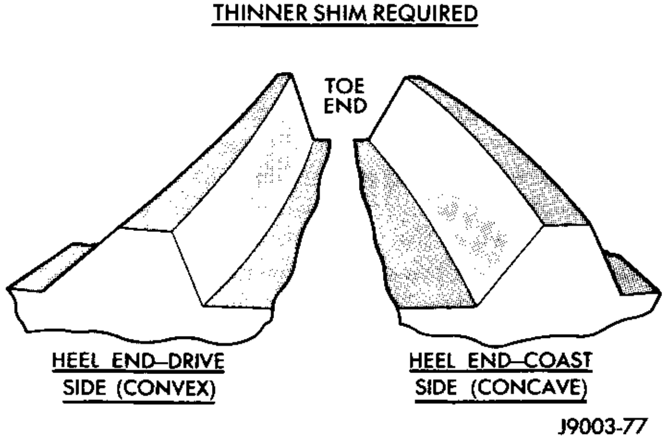

Fig. 42 Incorrect Teeth Contact Patterns—Decrease Depth Shim Thickness

(6) When the correct teeth contact patterns are obtained, install the drive shaft with the installation reference marks aligned. Tighten the clamp screws with 19 N•m (170 in-lbs) torque.

(7) For 8 3/8-inch diameter ring gear axles, install the replacement axle shaft seals with Seal Installa-

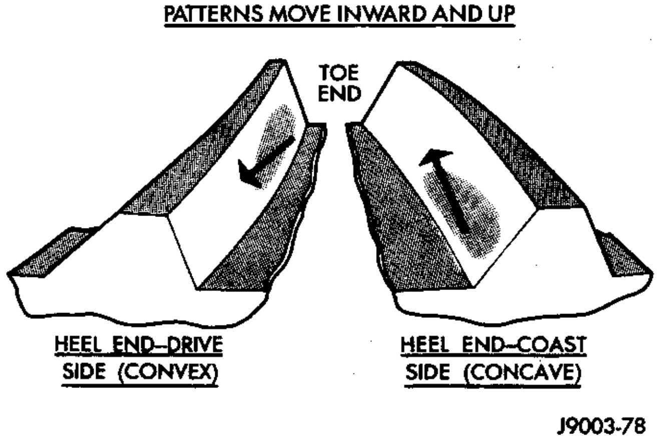

Fig. 43 Teeth Contact Patterns After Depth Shim Thickness Is Decreased

tion Tool C-4203 and Driver Handle Tool C-4171. The flat side of the installation tool must face the seal (Fig. 44). Use Seal Installation Tool C-4826 for 9 1/4-inch diameter ring gear axles.

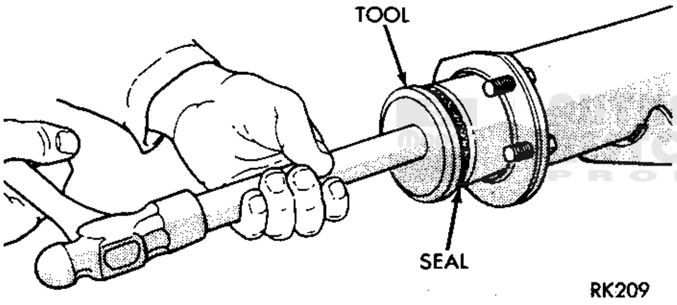

Fig. 44 Axle Shaft Seal Installation

(8) Carefully slide the axle shafts through the seals and engage them with the side gears, insert the C-clip "lock"s in the axle shaft recessed grooves, and pull outward on each shaft to "seat" the C-clip "locks" in the side gear counterbores.

(9) Insert the differential pinion gear mate shaft into and through the differential case and the pinion gears, align the hole in the shaft with the lock screw hole, and install the lock screw. Tighten the lock screw with 11 N•m (100 in-lbs) torque.

(10) Remove any residue gasket material and/or sealant from the differential housing and cover, thoroughly clean the mating surfaces with mineral spirits (or an equivalent product) and dry the surfaces completely.

(11) Apply a 1/16-inch to 3/32-inch thick "bead" of MOPAR Silicone Rubber Sealant, or an equivalent product, along the bolt circle of the cover (Fig. 45). **Allow the sealant to "cure" for a few minutes.**

If for any reason the housing cover is not installed within 20 minutes after applying the sealant, the sealant must be removed and another "bead" of sealant applied.

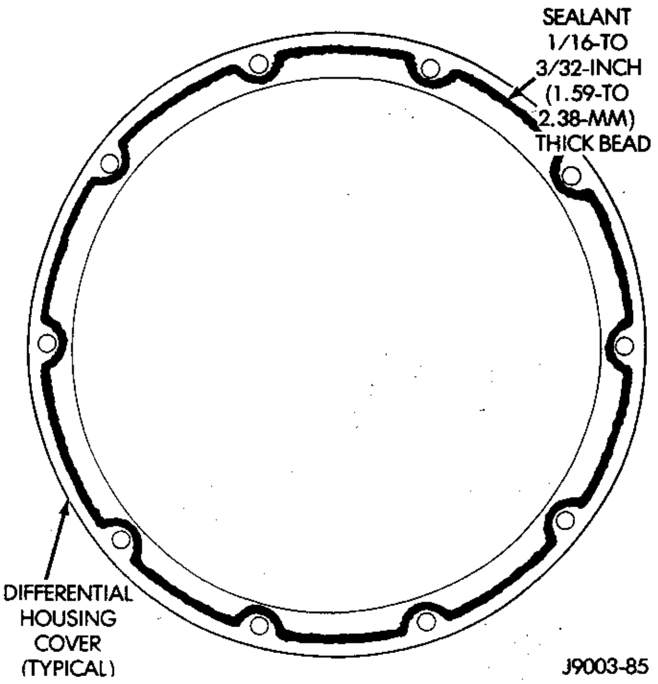

Fig. 45 Sealant On Housing Cover

29

(12) Install the cover on the differential housing and tighten cover bolts with 47 N•m (35 ft-lbs) torque. Install the axle gear ratio identification tag under one of the cover bolts.

(13) Install the brake drums and the wheels/tires. Tighten the wheel lug nuts in the correct sequence (Fig. 46) with the specified torque (Refer to Group 22—Tires and Wheels for the torque specification).

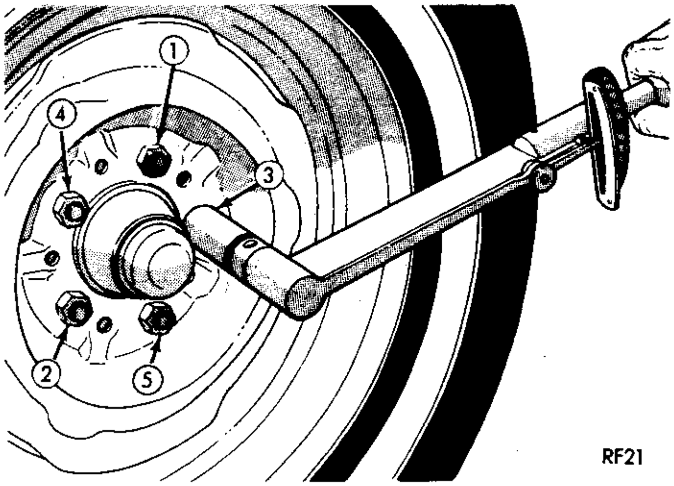

Fig. 46 Wheel Lug Nut Tightening Sequence

(14) Remove the block from the brake pedal.

(15) Adjust the hoist so that the vehicle is in a level position.

(16) Remove the fill hole plug and fill the differential housing with lubricant (refer to the Specifications chart for the capacity). Install the fill hole plug.

(17) Lower the vehicle and test the brakes and the axle for proper operation.

SURE-GRIP DIFFERENTIAL SERVICE

GENERAL INFORMATION

Rear axles equipped with a **Sure-Grip** differential are optionally available for Ram Truck and Ramcharger vehicles (Fig. 47).

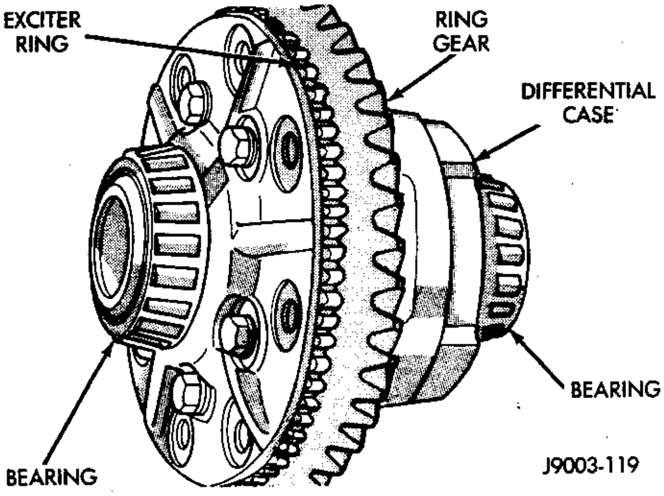

Fig. 47 Sure-Grip Differential

A **Sure-Grip** differential has a two-piece differential case that is completely interchangeable with a standard differential case (Fig. 48).

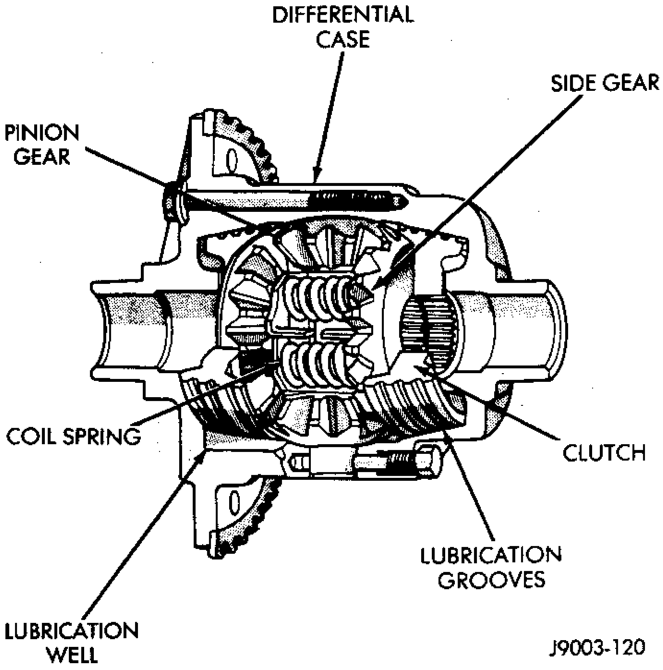

Fig. 48 Sure-Grip Differential Components

The "differential action" of a standard differential will allow the rear wheels/tires to rotate at different speeds (when the vehicle is turning) and, at the same time, divide the engine torque equally between them. This is ordinarily a desirable and normal function of a differential. However, when the surface traction condition (e.g., mud or snow) is not the same at both rear wheels/tires, part of the available engine torque cannot be utilized because of this same "differential action". A **Sure-Grip** differential transfers additional engine torque to the rear wheel/tire that has the better traction surface and decreases the torque applied to the other wheel/tire. Therefore, the total utilized engine torque is significantly greater than it would be with a standard differential.

Sure-Grip differentials are engineered to function (with the benefit of increased traction) with a minimal effect on normal vehicle driving operation. A **Sure-Grip** differential is not a positive "locking" type of differential. During normal driving conditions, the "controlled" internal friction is easily overcome during vehicle turns so that standard "differential action" allows the rear wheels to rotate at different speeds. Also, an **extreme** difference between the surface traction conditions at the rear wheels/tires will cause one wheel to "spin" similarly to the action of a standard differential.

Sure-Grip differentials are similar to standard differentials except for the inclusion of the helix-grooved clutches that "semi-control" the rotation of the differential side gears. The helix-grooves provide maximum lubrication of the clutch surface during axle operation. The clutches and the side gears are statically "spring-load" to provide an internal resistance that partially averts standard "differential action". When a low traction surface is encountered (e.g., mud or snow), this internal resistance is the means for transferring more of the engine torque to the rear wheel/tire that has the better traction surface and less torque to the wheel/tire with the lower traction surface.

When engine torque is applied to the ring gear, the initial spring "loading" of the clutches is supplemented by the gear-separating friction between the differential side gears and the pinion gears and this progressively increases the total friction in the differential. Because a **Sure-Grip** differential is not a positive "locking" type of differential, the friction will decrease and the clutches will release the side gears before excessive engine torque is applied to either one of the wheels/tires.

IDENTIFICATION

Positive identification of a **Sure-Grip** differential can be accomplished by raising both rear wheels off the surface and rotating them. If both rear wheels rotate in the same direction simultaneously, the vehicle is equipped with a **Sure-Grip** differential. Another method of identification is by removing the differential housing cover fill hole plug and examining (with a flashlight) the differential case components via the fill hole plug hole.

SERVICE INFORMATION

The service procedures for a **Sure-Grip** differential are essentially the same as those used for a standard differential, therefore, only information/procedures involving the differences that exist between the two differential types will be provided in this section.

CAUTION: Whenever a rear axle is being serviced or anytime it is to be rotated via the engine (or by another means), RAISE BOTH REAR WHEELS off the surface.

DIFFERENTIAL TEST

A **Sure-Grip** differential can be tested to determine if it is functioning normally without removing the differential case from the housing.

(1) Position the vehicle on a hoist with the ignition **OFF** and the transmission selector lever in "PARK" (automatic transmission) or in first gear (manual transmission).

(2) Attempt to manually rotate each rear wheel by gripping the tire tread area and applying a rotating force with your hands.

(3) If it is extremely difficult (or impossible) to manually rotate either wheel, consider that the **Sure-Grip** differential is functioning normally. If it is relatively easy to manually rotate either wheel continuously, the differential is not functioning normally and should be replaced.

A **Sure-Grip** differential case is not repairable and, if defective, must be replaced as a complete unit only. Do not attempt to disassemble and repair/replace the differential case components.

DIFFERENTIAL NOISE

Noise complaints involving rear axles equipped with a **Sure-Grip** differential should be evaluated to determine the source of the noise. If, during a test ride, a similar noise occurs while the vehicle is "turning" but not during straight-ahead motion, the probable cause is incorrect or insufficient gear lubricant. The following drain and clean procedure should be used for possible elimination of the noise before replacing the differential.

WARNING: WHEN SERVICING VEHICLES WITH AN AXLE EQUIPPED WITH A SURE-GRIP DIFFERENTIAL, DO NOT USE THE ENGINE TO ROTATE THE AXLE AND WHEELS UNLESS BOTH REAR WHEELS ARE RAISED FROM THE SURFACE AND THE VEHICLE SUPPORTED. A SURE-GRIP DIFFERENTIAL EQUIPPED AXLE CAN EXERT ENOUGH DRIVING FORCE (IF ONE WHEEL IS IN CONTACT WITH THE SURFACE) TO CAUSE THE VEHICLE TO MOVE.

(1) With the rear axle lubricant at normal operating temperature, raise and support the vehicle (rear wheels free to rotate).

(2) Remove the differential housing cover and drain (and discard) the lubricant. Rotate the differential until the opening in the differential case is facing downward. Wipe and remove the lubricant from all accessible surface areas in the differential housing.

The purpose of draining and discarding the lubricant is to eliminate any solid particles or liquid contaminants that could be causing the noise.

(3) Scrape the residual gasket and/or sealant from the housing and cover mating surfaces, thoroughly clean the mating surfaces with mineral spirits (or an equivalent product) and dry the surfaces completely. Apply a 1/16-inch to 3/32-inch (1.6-mm to 2.4-mm) thick "bead" of MOPAR Silicone Rubber Sealant (or an equivalent sealant) around the bolt circle on the housing cover (Fig. 49). **Allow the sealant to "cure" for a few minutes.**

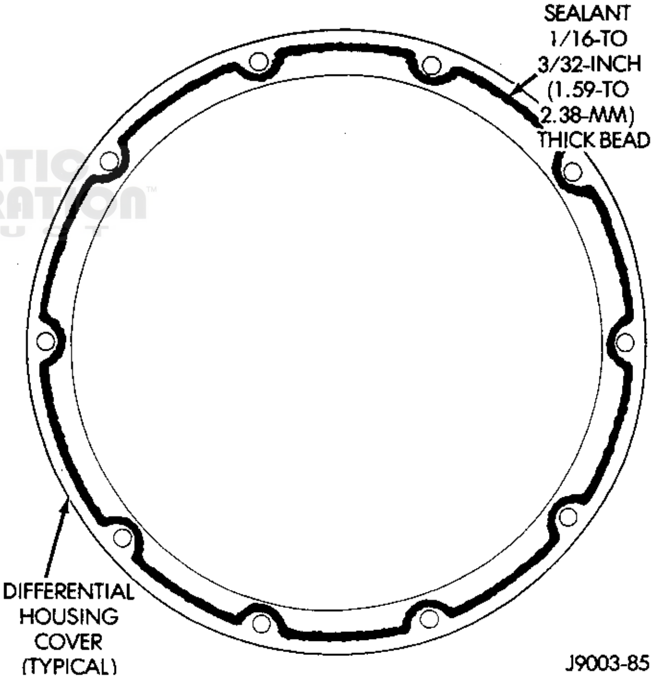

Fig. 49 Sealant On Housing Cover

If for any reason the housing cover is not installed within 20 minutes after applying the sealant, the sealant must be removed and another "bead" of sealant applied.

(4) Install the housing cover on the differential housing with the attaching bolts. Install the axle gear ratio identification tag with one of the cover bolts. Tighten the cover bolts with 47 N•m (35 ft-lbs) torque.

(5) Remove the supports. Raise or lower the hoist until the vehicle is level and then support the vehicle.

(6) Remove the fill hole plug from the differential

housing cover. Add 4 ounces of MOPAR Hypoid Gear Lubricant Additive (a friction modifier), or an equivalent product, to the differential housing. Fill the differential housing to the correct level with MOPAR Hypoid Gear Lubricant, or an equivalent product.

(7) Install the fill hole plug. Remove the supports and lower the vehicle.

DIFFERENTIAL CASE SERVICE

CAUTION: During removal and installation of the axle shafts, do not rotate either axle shaft unless both are properly in-place. Rotation of one axle shaft without the other being installed can result in misalignment of the side gears/splines; and, for correct axle shaft-to-side gear spline engagement, this will necessitate side gear re-alignment before the axle shaft can be installed.

REMOVAL

Refer to the differential case removal procedure for a standard differential.

CLEANING/INSPECTION

(1) Clean **Sure-Grip** differential components and case (Fig. 48) with fast evaporating mineral spirits or a dry cleaning solvent. With the exception of the differential bearings, dry the case and the components with compressed air.

(2) Inspect the differential bearing rollers and cups for "pitting", "spalling" and other visible damage. If differential bearing replacement is necessary, remove the bearings from the differential case according to the procedure for a standard differential bearing.

(3) Inspect the differential case for cracks and other visible damage that could cause it to be unusable.

INSTALLATION

Refer to the differential case installation procedure for provided for a standard differential.

LUBRICANTS

Multi-purpose, hypoid gear lubricant, as defined by MIL-L-2105-B and by API GL 5 quality specifications, should be used for rear axles with a standard or a **Sure-Grip** differential. MOPAR Hypoid Gear Lubricant conforms to both of these specifications and is highly recommended for use with Ram Truck and Ramcharger vehicles. In addition, 4 ounces of MOPAR Hypoid Gear Lubricant Additive (a friction modifier), or an equivalent product, must be included with a re-fill for a **Sure-Grip** differential.

CAUTION: If a rear axle is submerged in water, the axle lubricant must be replaced immediately to avoid the possibility of premature axle failure resulting from water contamination of the lubricant.

DRAIN/REFILL

(1) Drive the vehicle until the gear lubricant in the axle attains the normal operating temperature.

(2) Raise and support the vehicle.

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

(4) Remove the differential housing cover and allow the original lubricant to completely drain from the housing and the axle shaft tubes.

CAUTION: DO NOT FLUSH Sure-Grip differentials. Sure-Grip differentials may be cleaned only by disassembling the unit and wiping with clean, lint-free cloths.

(5) For standard differentials, flush the differential and the housing cavity with a "flushing" oil (or light engine oil) to remove residual lubricant and foreign matter. **Do not use water, steam, kerosene or gasoline for flushing.**

(6) Install the differential housing cover and tighten the bolts with 47 N•m (35 ft-lbs) Torque.

(7) Refill the differential housing with the specified quantity of MOPAR Hypoid Gear Lubricant. For **Sure-Grip** differentials, a container of MOPAR Hypoid Gear Lubricant Additive (a friction modifier) must also be added.

(8) Install and tighten the fill hole plug with 34 N•m (25 ft-lbs) torque.

(9) Remove the supports and lower the vehicle.

MODEL 60, 60M AND 70 AXLES SERVICE

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GENERAL INFORMATION

The axle housing for Model 60, 60M and 70 rear axles (Figs. 1 and 2) consists of an iron center casting (differential housing) with axle shaft tubes extending from either side. The axle shaft tubes are pressed into and welded to the differential housing to form a one-piece axle housing. All three axles have a hypoid gear differential and the centerline of the drive pinion gear shaft is located below the centerline of the ring gear. The removable, stamped steel cover located at the rear of the differential housing provides a means for inspection and for differential service without removing the complete rear axle from the vehicle.

A small, stamped metal axle gear ratio identification tag is attached to the housing cover via one of the cover bolts. This tag also identifies the number of ring gear and drive pinion gear teeth.

The drive pinion gear shaft rotates within two tapered roller bearings (Figs. 1 and 2). The drive pinion gear shaft rear bearing is tightly "press-fitted" on the drive pinion gear shaft. The drive pinion gear shaft front bearing is very lightly "press-fitted" (which is similar to a "close, sliding fit") on the drive pinion gear shaft. The drive pinion gear shaft front and rear bearing cups are "press-fitted" in the differential housing bore and against a recessed shoulder. The drive pinion gear shaft depth of mesh adjustment is controlled by the use of metal depth shims

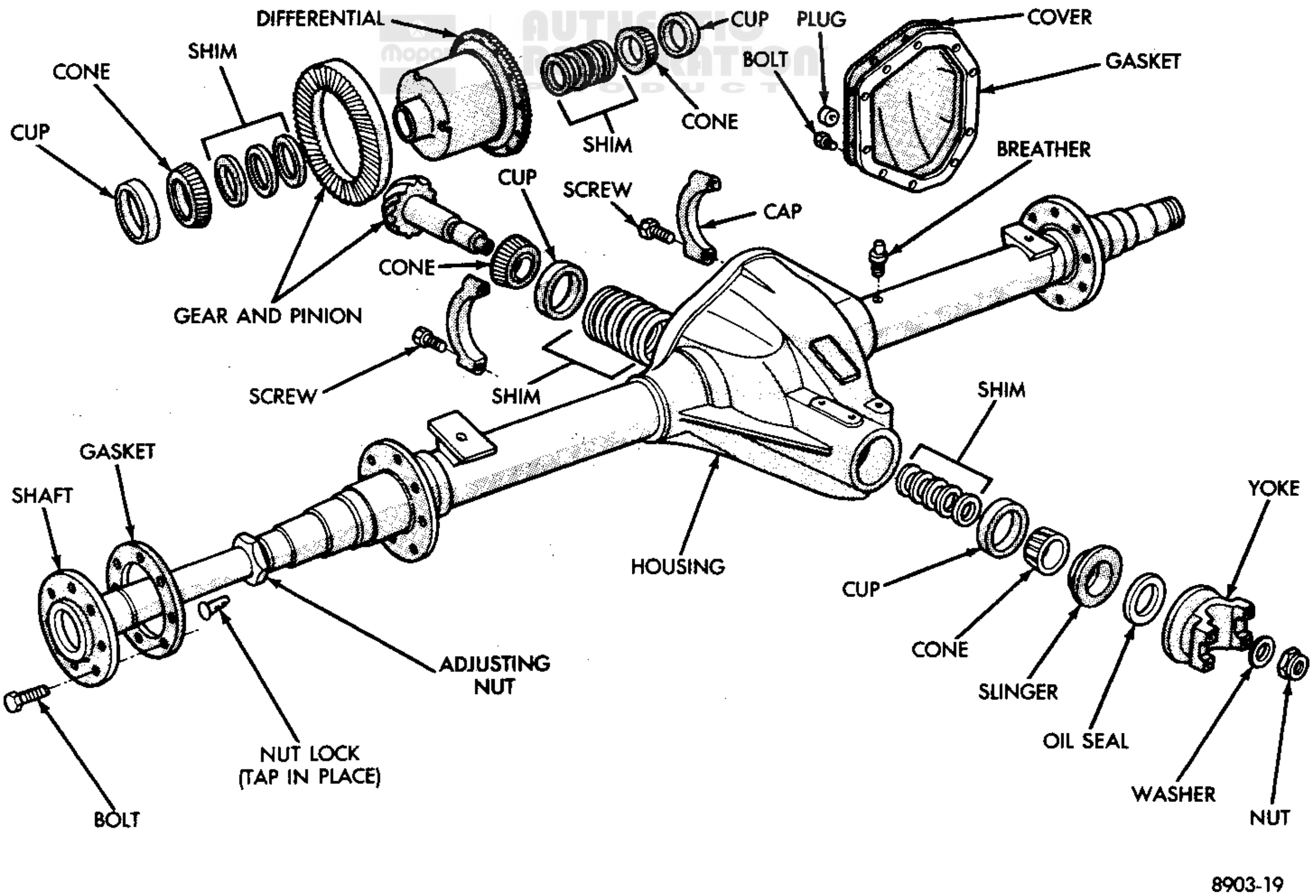

Fig. 1 Model 60 & 60M Axle—Exploded View

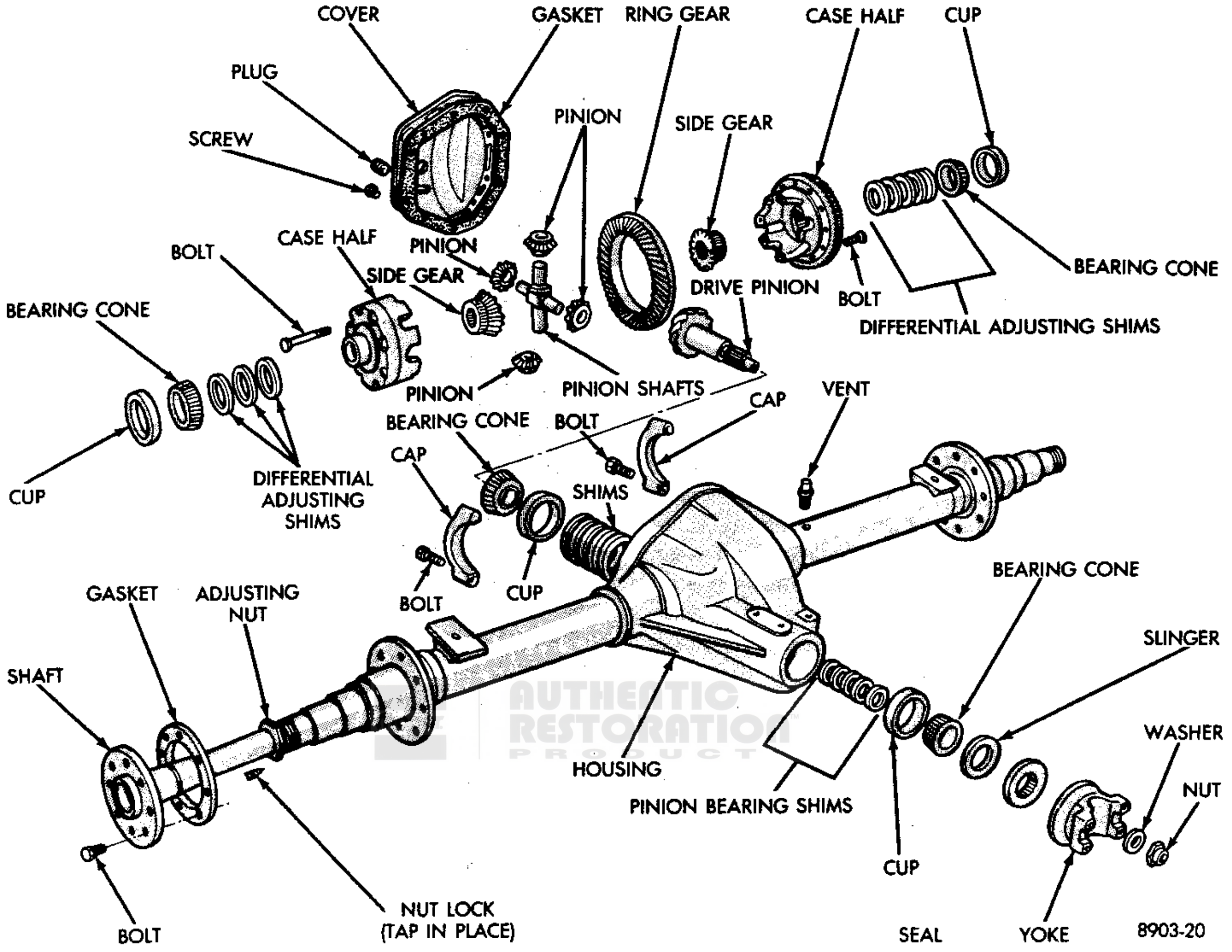

Fig. 2 Model 70 Axle—Exploded View

that are installed between the drive pinion gear shaft rear bearing and the differential housing (Figs. 1 and 2).

The drive pinion gear shaft bearing "preload" torque is provided via metal shims that are located between the drive pinion gear shaft front and the differential housing (Figs. 1 and 2).

The differential case hubs rotate in the differential housing via two tapered roller bearings that are "press-fitted" on the case hubs (Figs. 1 and 2). The shims that are installed between the bearings and the hub shoulder (Figs. 1 and 2) have three functions:

- to adjust and maintain the "backlash" between the ring gear and the drive pinion gear;
- to establish a means for obtaining and then retaining the differential bearing "preload" torque; and
- to eliminate the differential "side play".

AXLE SHAFT—REMOVAL/INSTALLATION

CAUTION: Whenever a rear axle is being serviced or anytime it is to be rotated via the engine (or by another means), RAISE BOTH REAR WHEELS off the surface.

REMOVAL

(1) Remove the axle shaft flange bolts.

(2) Remove the axle shaft (Figs. 1 and 2).

INSTALLATION

(1) Clean the gasket contact surface area on the flange with an appropriate solvent. Install a replacement flange gasket and slide the axle shaft into the axle shaft tube (Figs. 1 and 2).

(2) Install the Durlock bolts and tighten with 95 N•m (70 ft-lbs) torque.

WHEEL BEARING SERVICE

CAUTION: Whenever a rear axle is being serviced or anytime it is to be rotated via the engine (or by another means), RAISE BOTH REAR WHEELS off the surface.

(1) Raise and support the vehicle.

(2) Remove the axle shaft. If necessary, refer to the removal procedure.

(3) Remove the nut lock and loosen the adjustment nut.

(4) Tighten the adjustment nut with 163 to 190 N•m (120 to 140 ft-lbs) torque while rotating the wheel.

(5) Loosen the adjustment nut 1/3 of-a-turn (120 degrees) to provide 0.001-inch to 0.008-inch wheel bearing "end play".

(6) "Tap" the nut lock into the spindle keyway.

(7) Install a replacement flange gasket and the axle shaft. If necessary, refer to the installation procedure.

(8) Remove the supports and lower the vehicle.

COMPLETE AXLE REMOVAL/INSTALLATION

REMOVAL

If it is necessary to remove the complete rear axle from the vehicle, use the following procedure.

(1) Raise the rear of the vehicle until the rear wheels/tires are not contacting the surface. Support the vehicle body at the front of the rear springs.

(2) Use a wooden block to retain the brake pedal in the "up" position (i.e., the disengaged position).

(3) Remove the axle shafts, the wheels/tires, the hubs and the brake drums. If necessary, refer to the applicable removal procedures.

(4) Disconnect the brake fluid tubing from the brake fluid flexible hose fittings and "cap" the fittings to prevent loss of brake fluid.

(5) Disconnect the parking brake cables.

To ensure that the driveline balance is retained when the drive shaft is installed, scribe installation alignment reference marks on the drive shaft U-joint and on the drive pinion gear shaft (axle) yoke before removal.

(6) Disconnect the drive shaft U-joint from the drive pinion gear shaft (axle) yoke and secure it in an upright position to prevent damage to the U-joint.

(7) Remove the rear shock absorbers and the rear spring U-bolts from the axle.

(8) Remove the rear axle from the vehicle.

INSTALLATION

(1) If the differential housing cover was removed, ensure that the differential housing and cover mating surfaces are clean.

(2) If the differential housing cover was removed, apply a "bead" of MOPAR Silicone Rubber Sealant (or an equivalent sealant) around the cover bolt circle. Install the differential housing cover. Tighten the cover bolts with 47 N•m (35 ft-lbs) torque. **Install the axle gear ratio identification tag under one of the cover bolts.**

(3) With the vehicle body supported at the front of the rear springs, position the axle under the rear springs.

(4) Install the spring U-bolts and tighten the nuts with the specified torque (refer to Group 17—Springs And Shock Absorbers).

(5) Install the shock absorbers. Tighten the retaining nuts with the specified torque (refer to Group 17—Springs And Shock Absorbers).

(6) Connect the parking brake cables.

(7) Connect the brake fluid tubing to the brake fluid flexible hose fittings. Install the hubs and brake drums. Adjust the wheel bearings (refer to Wheel Bearing Adjustment).

(8) Remove the block from the brake pedal. "Bleed" and adjust the brakes.

(9) Connect the drive shaft to the drive pinion gear shaft (axle) yoke with the installation reference marks aligned. Tighten the U-joint clamp bolts with 21 N•m (16 ft-lbs/186 in-lbs) torque.

(10) Install the rear wheels/tires and tighten the lug nuts with the specified torque (refer to Group 22—Wheels And Tires).

(11) Clean the axle shaft flange gasket contact surface areas with a an appropriate cleaning solvent, install replacement flange gaskets and slide the axle shafts into the axle shaft tubes.

(12) Install the Durlock bolts. Tighten the bolts with 95 N•m (70 ft-lbs) torque.

(13) Raise the rear of the vehicle, remove the supports, level the vehicle and position the supports.

(14) Remove the fill hole plug from the differential housing cover. Fill the differential housing to the correct level with MOPAR Hypoid Gear Lubricant, or an equivalent product.

In addition, for Trac-Lok differential equipped axles, 4 ounces of MOPAR Hypoid Gear Lubricant Additive (a friction modifier), or an equivalent product, must be included if the differential housing is being re-filled.

(15) Install the fill hole plug. Remove the supports and lower the vehicle.

(16) Road test the vehicle to evaluate the results of the repair.

STANDARD DIFFERENTIAL SERVICE

CAUTION: Whenever a rear axle is being serviced or anytime it is to be rotated via the engine (or by another means), RAISE BOTH REAR WHEELS off the surface.

It is not necessary to remove the complete axle from the vehicle to service a standard differential. To replace the differential side gears, it is necessary to remove only the axle shafts, the differential housing cover, the lubricant and the differential case. To replace the differential bearings, it is necessary to remove only the axle shafts, the differential housing cover, the lubricant, the differential case and to adjust the ring gear "backlash".

REMOVAL/DISASSEMBLY

(1) Thoroughly clean the outside surface area of the differential housing and the axle shaft tubes with a an appropriate cleaning solvent and then dry the surface with compressed air.

(2) Remove the differential housing cover screws and the cover, and drain the lubricant into a container.

(3) Remove the RWAL brake sensor hold-down bolt and pull the sensor from the differential housing. The sensor must be removed to prevent damage when disassembling or assembling the differential components.

(4) Wash and clean the differential case, the bearings, the ring gear, the drive pinion gear and the internal surface of the housing with a an appropriate cleaning solvent. Dry with compressed air.

(5) Determine if the clearance between the differential bearing caps and bearing cups is excessive by attempting to insert a 0.003- inch (0.076-mm) thick feeler gauge blade between them. Normally, a 0.003-inch (0.076-mm) thick feeler gauge blade should be too thick to be inserted between a bearing cap and cup.

If the clearance is more than 0.003 inch (0.076 mm), the cause could be that the applicable bearing cup rotated in the differential housing "seat" and caused excessive wear.

(6) Note the installation reference letters stamped into the differential bearing caps and into the differential housing machined sealing surface (Fig. 3). The letters are stamped horizontally on the left side and are stamped vertically on the right side of the differential housing. Always match the reference letters when installing the differential bearing caps.

(7) Remove the differential bearing caps.

(8) Position Spreader Tool D-167 on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 4). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

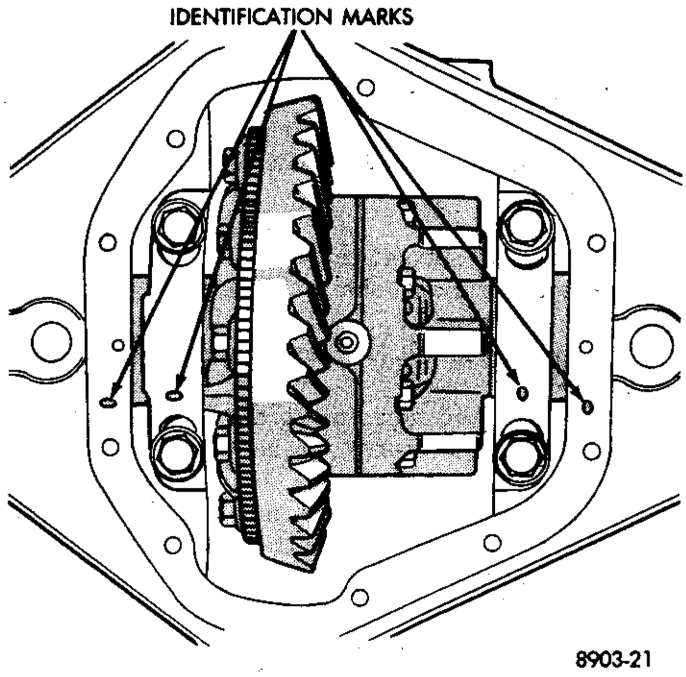

Fig. 3 Bearing Cap Identification

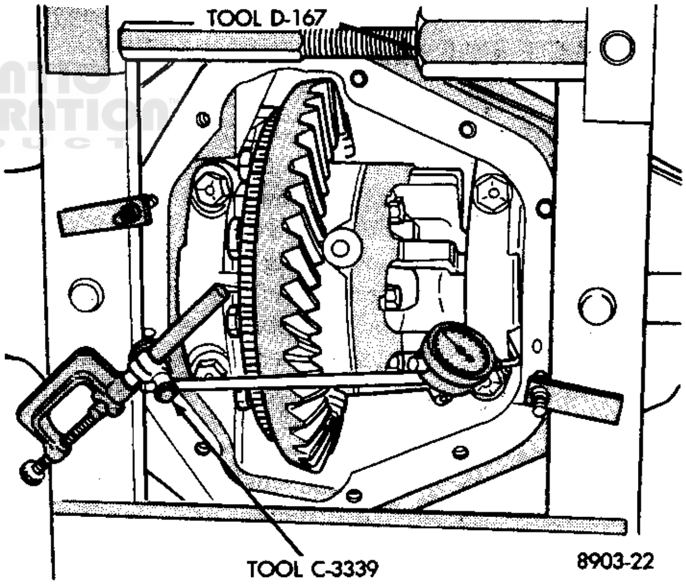

Fig. 4 Differential Housing Separation

(9) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 4). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(10) Tighten the spreader tool turnbuckle (Fig. 4) and separate the differential housing only enough to

remove the differential case from the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 4) as the housing is being separated.

(11) Remove the dial indicator (Fig. 4) when the differential housing has been separated sufficiently to remove the differential case from the housing.

(12) Pry the differential case loose from the housing. A light prying action with a small pry bar or pinch bar will loosen the case sufficiently for easy removal. To prevent damage, pry the differential case outward toward the opening with the pry bar pivoting on the differential housing and with the end of the pry bar against the differential case.

(13) Remove the differential case from the differential housing. If they are reusable, retain the differential bearing cups and bearings together as "matched sets".

(14) Clamp the differential case in a vise equipped with soft jaws and remove **(and discard)** the ring gear bolts. Use a punch to loosen and remove the ring gear from the differential case flange (Fig. 5). Remove the ring gear. **The ring gear can be removed without removing the RWAL brake excitor ring.**

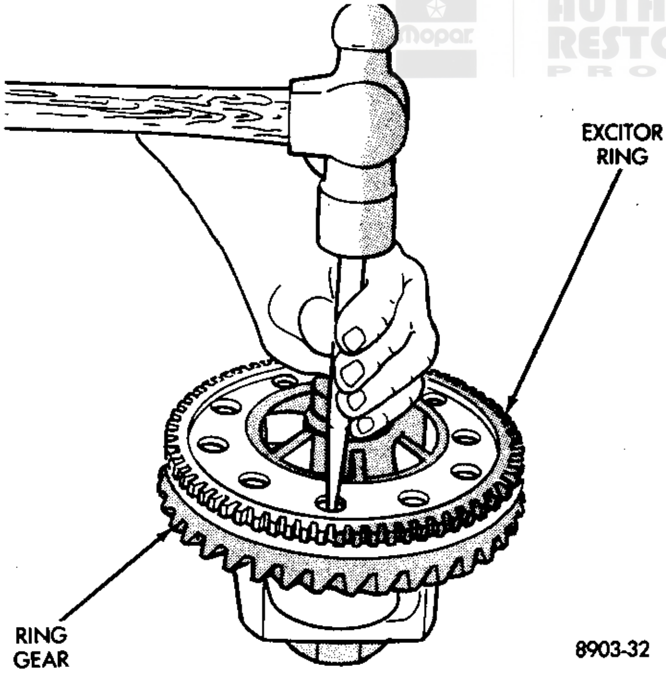

Fig. 5 Ring Gear Removal

(15) The excitor ringer can be removed with a soft-faced hammer (Fig. 6). Discard after removal.

(16) Install the differential case (with the original bearing cups) in the differential housing.

(17) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 4).

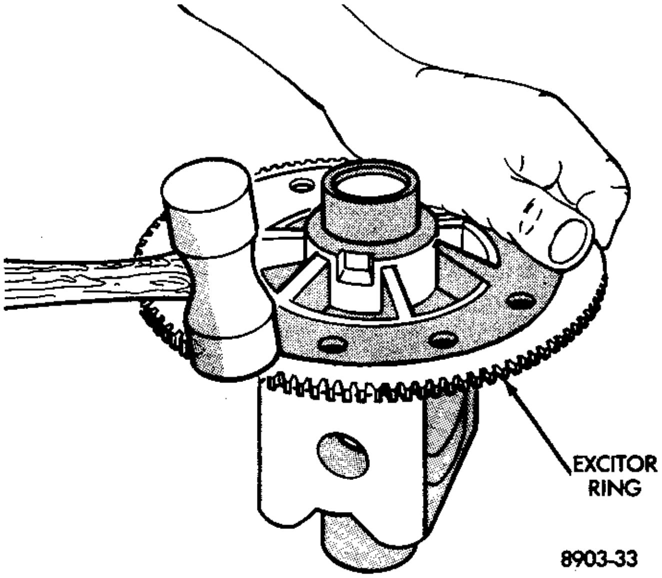

Fig. 6 Excitor Ring Removal

(18) Install the differential bearing caps and tighten the bolts "finger-tight" until each bolt head is lightly "seated" on the bearing cap.

(19) Install a pilot stud at the right side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the inner face of the flange (Fig. 7). "Zero" the dial indicator pointer.

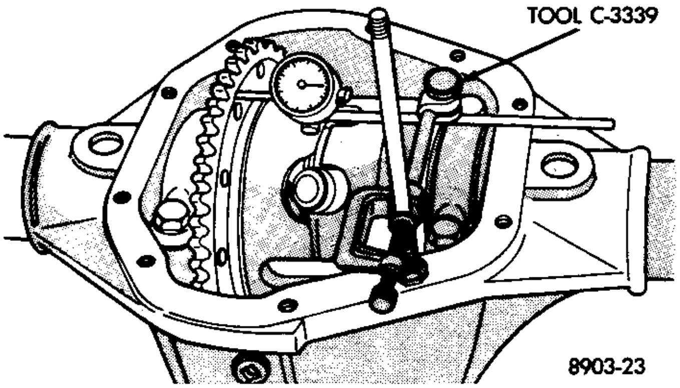

Fig. 7 Differential Case Flange "Runout" Measurement

(20) Measure the differential case flange "runout" by rotating the case and flange several complete revolutions and observing the dial indicator pointer. Mark the flange at the location of maximum "runout". The flange maximum "runout" should not exceed 0.003 inch (0.076 mm).

(21) Remove the drive pinion gear shaft (axle) yoke nut and washer. Use Removal Tool C-452 and Holding Tool C-3281 to remove the drive pinion gear shaft (axle) yoke (Fig. 1).

(22) Use Removal Tool C-748 to remove the drive pinion gear shaft seal (Figs. 1 and 2).

(23) Remove the oil slinger, the shaft front bearing

and the "preload" torque shims (Figs. 1 and 2). Record the thickness of the shims. **This will save time if they should become misplaced.**

(24) Use an appropriate tool to force the drive pinion gear shaft (with the rear bearing) from the differential housing bore (Figs. 1 and 2).

(25) Use Removal Tool D-158 and Handle Tool C-4171 to remove the drive pinion gear shaft front bearing cup from the differential housing bore (Figs. 1 and 2).

(26) For Model 60 and 60M axles, use Removal Tool D-162 and Handle Tool C-4171 to remove the drive pinion gear shaft rear bearing cup from the differential housing bore (Fig. 1). For Model 70 axles, use Removal Tool D-159 and Handle Tool C-4171 to remove the drive pinion gear shaft rear bearing cup from the differential housing bore (Fig. 2).

(27) Remove the drive pinion gear depth shims from the differential housing bore (Figs. 1 and 2). Record the thickness of the depth shims.

(28) Remove the rear bearing from the drive pinion gear shaft with Removal Tool DD-914-P, Adapter Ring Tools DD-914-9 and Plate Tools DD-914-37. Use Plate Tools DD-914-95 for Model 70 axles.

(29) For Model 60 and 60M axles, clamp the differential case in a vise equipped with soft jaws. Use a pin punch to force the pinion gear mate shaft lock pin from the differential case bore (Fig. 8). For Model 70 axles, mark the differential case halves (Fig. 9) for assembly reference; remove the studs retaining the differential case halves together; and separate the differential case.

(30) Remove the differential pinion gear mate shaft from the differential case bores, remove the differential pinion gears and remove the thrust washers (located adjacent to the differential case internal surface) from the differential case.

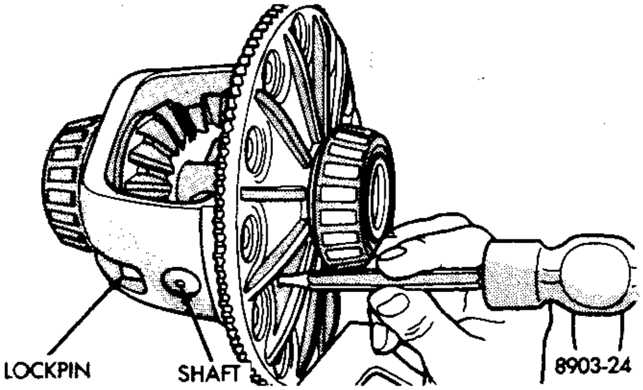

Fig. 8 Pinion Gear Mate Shaft Lock Pin Removal (Model 60 & 60M Axles)

(31) Remove the differential side gears and the thrust washers (located adjacent to the differential case internal surface) from the differential case.

(32) Remove the differential case from the vise.

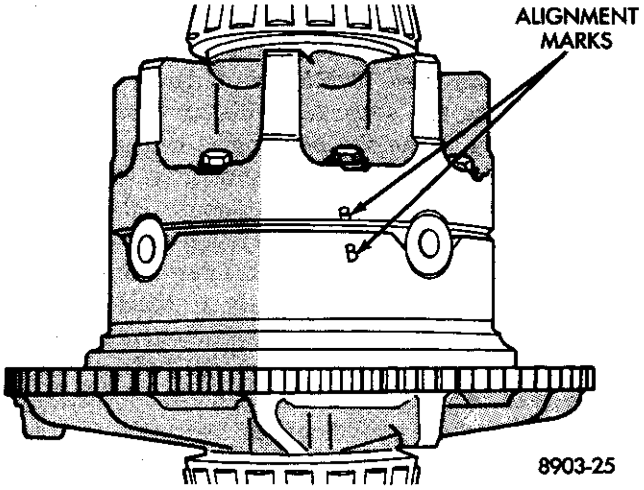

Fig. 9 Differential Case Halves—Identification (Model 70 Axle)

(33) Remove the bearings from the differential case with Removal Tool DD-914-P, Adapter Ring Tools DD-914-8, Plate Tools DD-914-62, Screw Extension Tool DD-914-7, Button Tool DD-914-42 and a vise (Fig. 10).

Use care and ensure that the adapter rings are situated so that they do not cause force to be exerted on the bearing race.

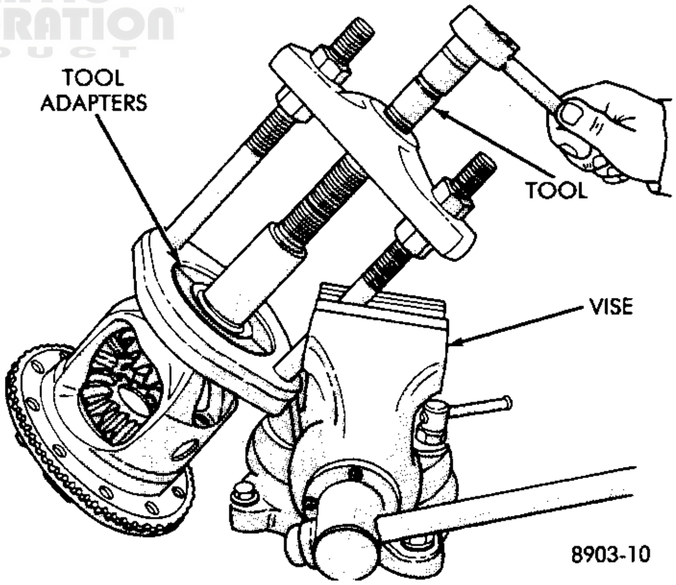

Fig. 10 Differential Bearing Removal

(34) Remove the differential bearing shims from each of the differential case hubs and mark them (with hub identity) for assembly reference. Record the thickness of the shims.

CLEANING/INSPECTION

(1) Wash and clean all the differential components (Figs. 11 and 12) with an appropriate cleaning solvent and, with the exception of the bearings, dry with compressed air.

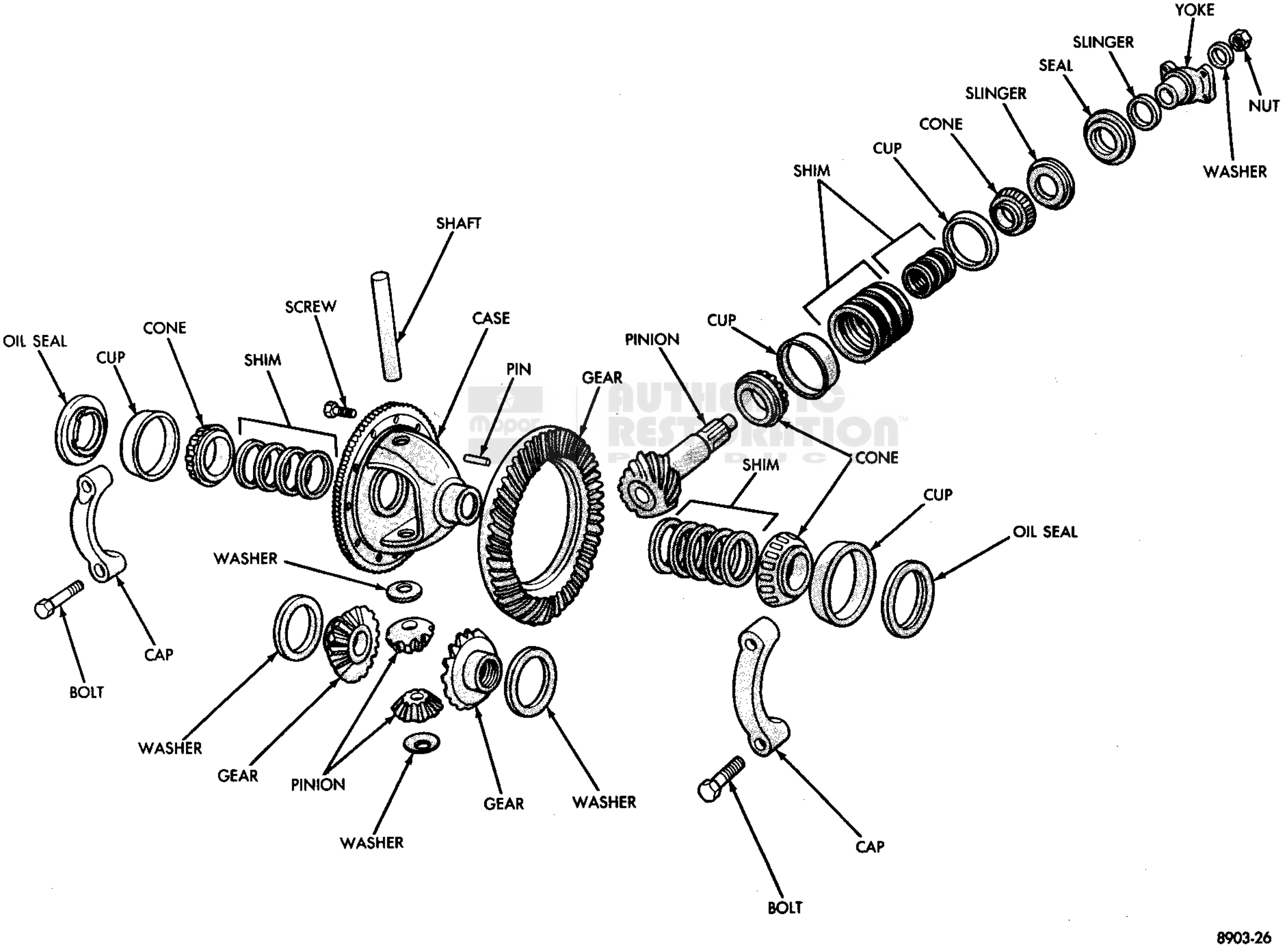

Fig. 11 Model 60 & 60M Axle Differential—Exploded View

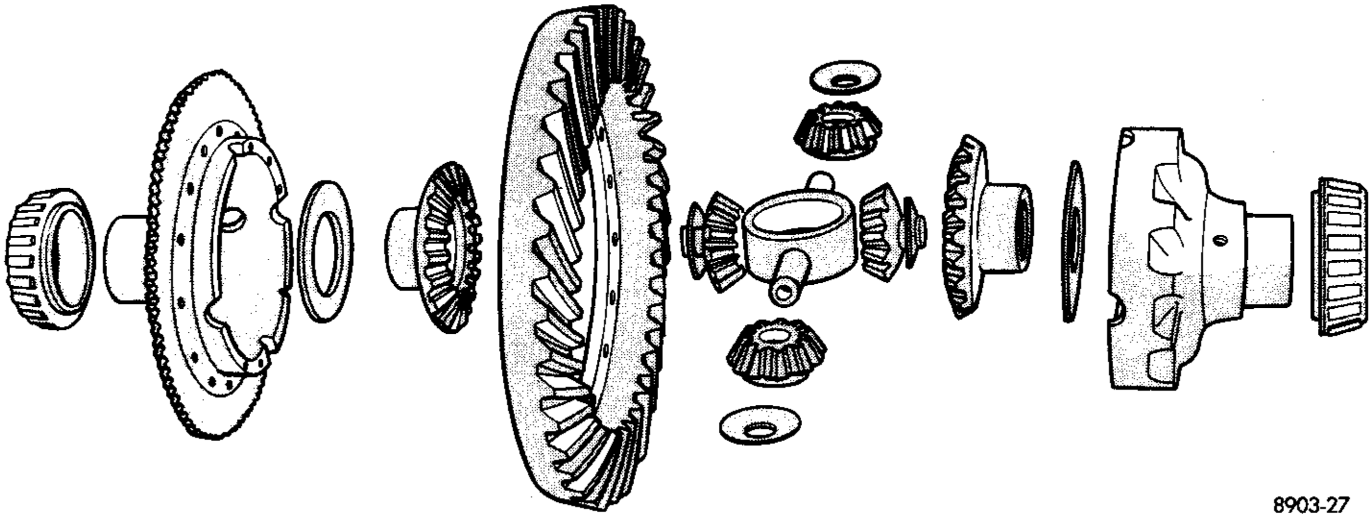

Fig. 12 Model 70 Axle Differential—Exploded View

Do not steam clean the differential components.

(2) To clean the axle shaft tubes (Figs. 1 and 2), insert a stiff wire into each tube, attach a clean cloth to the wire at the differential housing opening and withdraw the wire (and cloth) from the housing outward through the tube.

(3) Inspect the differential bearings and the drive pinion gear shaft bearings, and the differential case and housing (Figs. 11 and 12):

- the differential bearings and the drive pinion gear shaft front and rear bearings and cups should have a smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces;
- the bearing races must not be distorted or cracked;

If a differential bearing must be replaced, the cup and the bearing must be replaced as a "matched set" only.

- all the machined contact surfaces in the differential housing and on the differential bearing caps should be smooth and without any raised edges;
- the drive pinion gear shaft front and rear bearing cup bores in the differential housing should be smooth; and
- if it exists, raised metal on the shoulders of the bearing cup bores incurred during removal of the cups should be removed with a hand stone.

(4) Examine the differential pinion gear mate shaft, pinion gears, side gears and thrust washers (Figs. 11 and 12) for wear and damage. Replace all defective components.

If either of the differential pinion gears is not reusable, both gears must be replaced as a "matched set" only. Do not replace only one gear.

(5) Examine the ring gear and the drive pinion gear shaft (Figs. 11 and 12) for worn and chipped teeth. Examine the ring gear for damaged attaching bolt threads.

If replacement of either gear is necessary, both the ring gear and the drive pinion gear shaft must be replaced because they are available as a "matched set"s only.

(6) Inspect the drive pinion gear shaft (axle) yoke (Figs. 11 and 12) for cracks, worn splines, "pitted" areas, and a rough/corroded seal contact surface. Repair or replace the yoke as necessary.

(7) Inspect the drive pinion gear shaft bearing "preload" torque shims (Figs. 11 and 12) for cracks, damage and distortion. Install replacement shims (if necessary) for the "preload" torque adjustment.

(8) Inspect the RWAL brake exciter ring for damage and missing teeth. If installed, ensure that the ring is firmly pressed onto the differential case. Replace the ring if it is either loose or damaged.

RWAL BRAKE EXCITER RING REPLACEMENT

(1) If replacement of the rwal brake exciter ring is necessary, align the exciter ring tab with the slot the in differential case (Fig. 13).

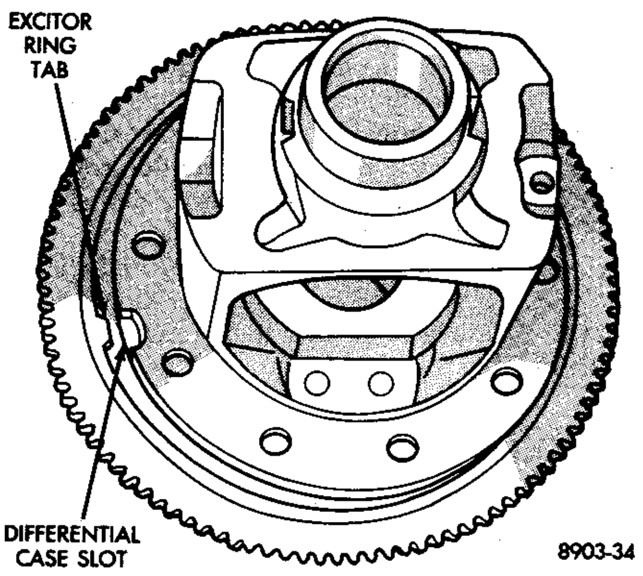

Fig. 13 Exciter Ring Alignment

(2) Invert the differential case and start two ring gear bolts through the differential case into the ring gear to provide case-to-ring gear bolt hole alignment (Fig. 14).

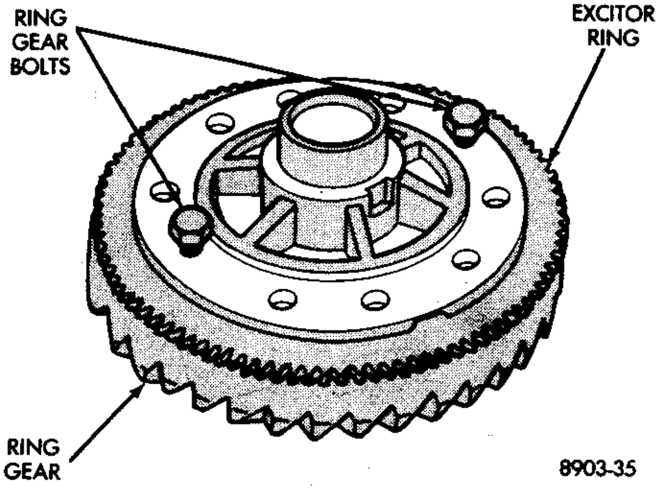

Fig. 14 Ring Gear Bolt Hole Alignment

(3) Press the exciter ring onto the differential case using the ring gear as a pilot (Fig. 15).

(4) Install the ring gear bolts and tighten with the specified torque.

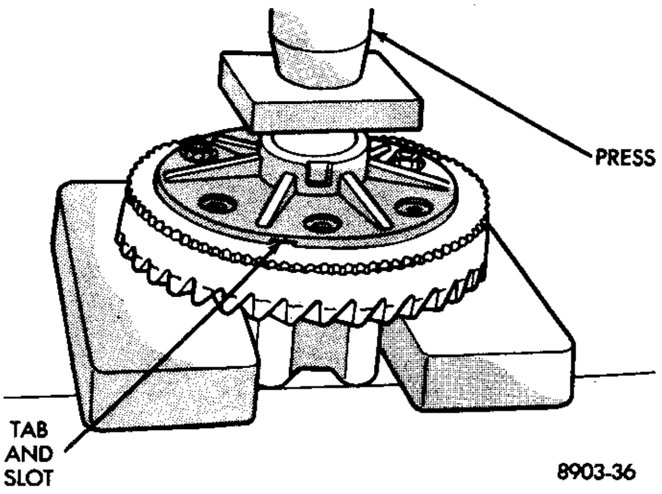

Fig. 15 Ring Gear Bolt Hole Alignment

ASSEMBLY

(1) Lubricate all the differential components with hypoid gear lubricant.

(2) Install the differential side gears and thrust washers, pinion gears and thrust washers and, for Model 60 and 60M axles, install the pinion gear mate shaft in the differential case (Fig. 8).

(3) For Model 60 and 60M axles, align the lock pin hole in the pinion gear mate shaft with the hole in the differential case (Fig. 8). Insert and "seat" the lock pin in the case and the shaft. For Model 70 axles, align the reference marks (Fig. 9), install the studs and tighten them evenly with 91 N•m (67 ft-lbs).

If replacement gears and thrust washers were installed, it is not necessary to measure the gear "backlash". The gear meshing will be correct because "close" machining tolerances are used during manufacture of the gears.

(4) If not previously positioned during exciter ring replacement, position the ring gear on the differential case flange and align the ring gear threaded holes with those in the differential case flange.

(5) Insert **replacement** ring gear bolts through the differential case flange and thread them into the ring gear.

After all the bolts are initially correctly threaded into the ring gear bolt holes, "tap" the ring gear with a non-metallic mallet and ensure that it is flush against the flange.

(6) Clamp the differential case in a vise equipped with soft jaws and alternately tighten each ring gear bolt with 110 N•m (81 ft-lbs) torque.

(7) Place Master Differential Bearing Tools D-117 on the differential case hubs (Fig. 16).

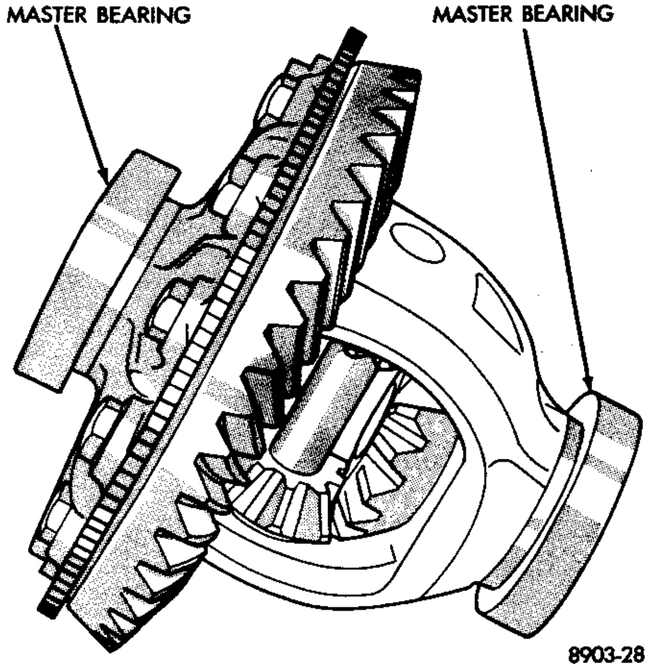

Fig. 16 Master Bearing Tools On Hubs

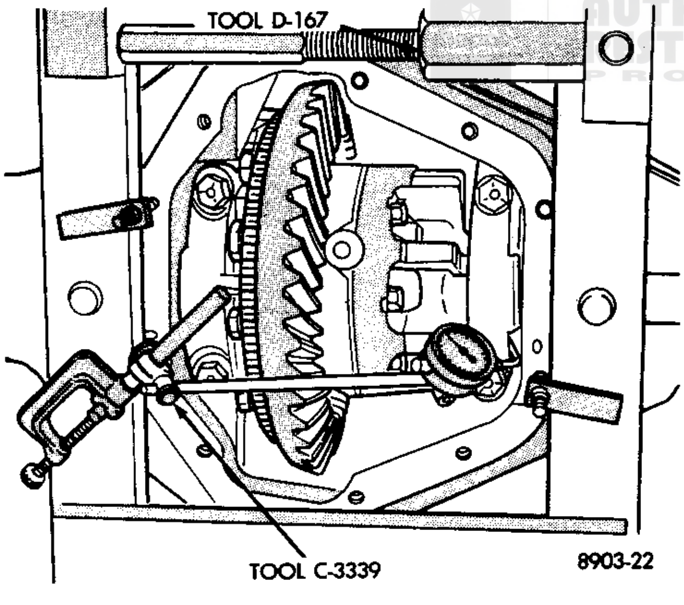

Fig. 17 Differential Housing Separation

(8) Position Spreader Tool D-167 on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 17). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(9) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 17). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(10) Tighten the spreader tool turnbuckle (Fig. 17) and separate the differential housing only enough to install the differential case in the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 17) as the housing is being separated.

(11) Remove the dial indicator tool and the pilot stud (Fig. 17) when the differential housing has been separated sufficiently to install the differential case in the housing.

(12) Install the differential case in the differential housing.

(13) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 17).

(14) Observe the assembly reference marks and position the bearing caps at their original locations. Tighten the bearing cap bolts "finger-tight".

(15) Install a pilot stud at the right side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the back of the ring gear (Fig. 18).

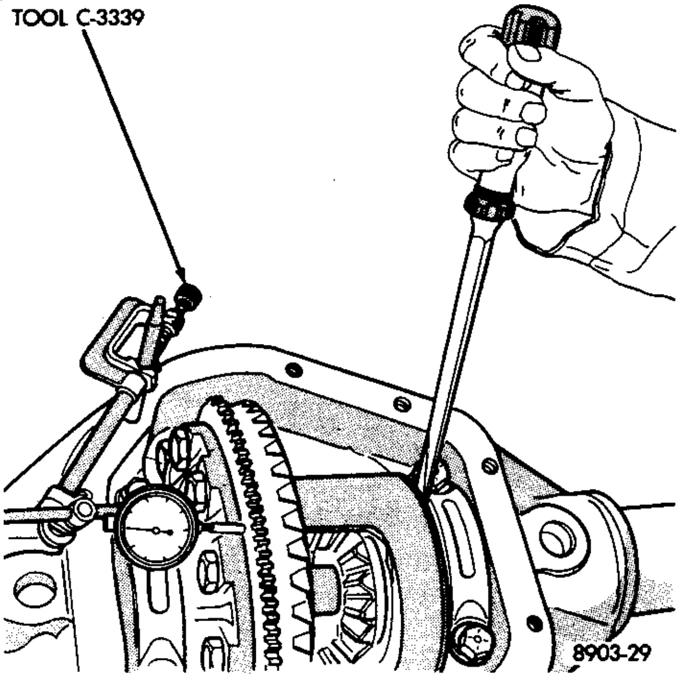

Fig. 18 Differential Case "End Play" Measurement

(16) Insert a small pry bar between the bearing cap and the left side of the differential case. Pry the differential case as far as possible toward the right side of the differential housing (Fig. 18). "Zero" the dial indicator pointer.

(17) Pry the differential case toward the left side of the housing with the pry bar and **record** the travel distance indicated by the dial indicator pointer.

The measurement above indicates the shim thickness necessary for differential case "zero" "end-play" (i.e., to eliminate the space/gap that exists between the differential bearings and the differential case). The actual total shim thickness will be determined during the ring gear "backlash" adjustment (after installation of the drive pinion gear shaft).

(18) Remove the dial indicator tool and the pilot stud from the differential housing.

(19) Remove the differential bearing caps.

(20) Position Spreader Tool D-167 on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 17). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(21) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 17). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(22) Tighten the spreader tool turnbuckle (Fig. 17) and separate the differential housing only enough to remove the differential case from the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 17) as the housing is being separated.

(23) Remove the dial indicator tool and the pilot stud (Fig. 17) when the differential housing has been separated sufficiently to remove the differential case from the housing.

(24) Remove the differential case from the differential housing.

(25) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 17).

DRIVE PINION GEAR DEPTH INFORMATION

Drive pinion gear shafts and ring gears are supplied as "matched sets" only. The identifying numbers for both the drive pinion gear and the ring gear are etched into the face of each gear (Fig. 19). In addition, either a plus ("+") number, a minus ("-") number or a zero ("0") is also etched into the face of the drive pinion gear. This number indicates the amount (in thousandths of an inch) that the drive pinion gear depth of mesh varies from the standard depth "setting" of 3.125 inches (79.37 mm) for Model 60 axles. The standard depth of mesh provides the best teeth contact between the drive pinion gear teeth and the ring gear teeth. The depth variance of a drive pinion gear can be either greater (+), zero (0) or less than (-) the standard depth.

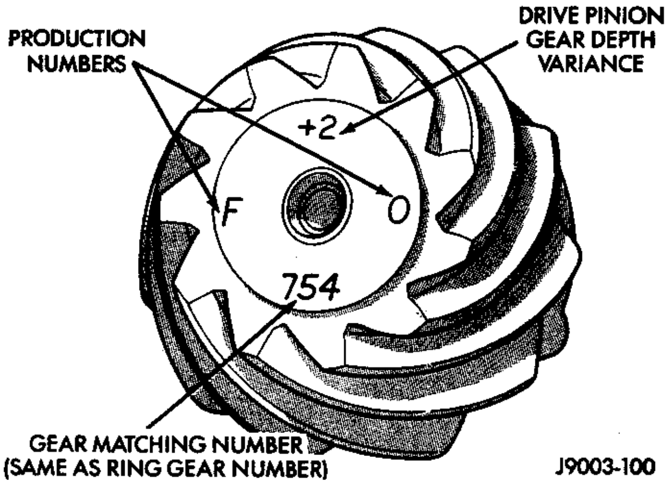

Fig. 19 Drive Pinion Gear ID Numbers

The standard depth is the distance (Fig. 20) from the centerline of the axle shaft/ring gear to the face of the drive pinion gear. For a Model 60 axle, the standard depth/distance is 3.125 inches (79.37 mm). For a Model 70 axle, the standard depth/distance is 3.5 inches (88.9 mm).

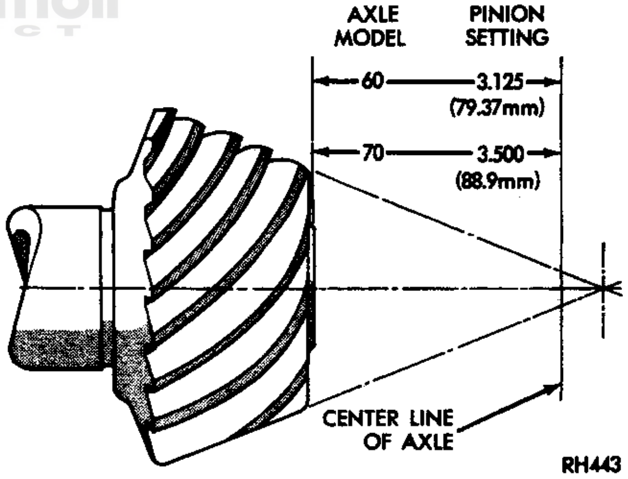

Fig. 20 Drive Pinion Gear Standard Depth/Distance

Compensation for the depth variance is achieved by shims placed adjacent to the drive pinion gear shaft rear bearing cup (Fig. 21).

For example:

- **one complete "pack" of depth shims is required if the depth variance is "0";**
- **if the depth variance is "+3" (m+8), the drive pinion gear would require 0.003 inch (0.08 mm) less in shim thickness than a depth variance of "0" (i.e., one complete shim "pack" minus 0.003 inch or 0.08 mm);**
- **by reducing the thickness of the shims 0.003 inch (0.08 mm), the depth position of the drive**

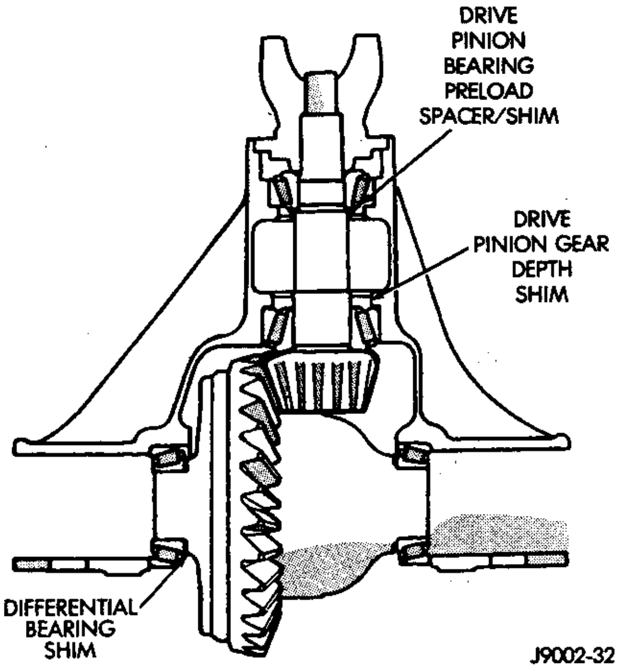

Fig. 21 Shim Locations

pinion gear will be decreased from 3.128 inches (79.45 mm) to the standard depth of 3.125 inches (79.37 mm); or

- **if the depth variance is "-3" (m-8), the drive pinion gear would require 0.003 inch (0.08 mm) more in shim thickness than a depth variance of "0" (i.e., one complete shim "pack" plus 0.003 inch or 0.08 mm);**
- **by increasing the thickness of the shims 0.003 inch (0.08 mm), the depth position of the drive pinion gear will be increased from 3.122 inches (79.34 mm) to the standard depth of 3.125 inches (79.37 mm).**

If the original drive pinion gear shaft and ring gear set will be installed but the depth shims must be replaced, measure the thickness of the original depth shims and "build" a replacement "pack" of depth shims with the same thickness.

If equipped, the oil slinger located between the rear bearing and the thrust face of drive pinion gear must be measured and the thickness included with the total shim "pack" thickness.

If the original drive pinion/ring gear set is not reusable, the depth shim thickness for the replacement drive pinion gear must be determined before installing the differential case in the housing.

If a replacement gear set is being installed, note the depth variance etched into both the original and the replacement drive pinion gear, and alter the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Drive Pinion Gear Depth Variance chart.

For example:

- **if the original drive pinion gear has a depth variance of "+2" (m+5) and the replacement drive pinion gear has a depth variance of "-2" (m-5), add 0.004-inch (0.10-mm) thickness to the original depth shims.**

Individual depth shims are available in 0.003-inch, 0.005-inch, 0.010-inch, and 0.030-inch (0.08-mm, 0.13-mm, 0.25-mm, and 0.76-mm) thicknesses.

DRIVE PINION GEAR DEPTH VARIANCE

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

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DRIVE PINION GEAR DEPTH MEASUREMENT AND ADJUSTMENT WITH TOOL SET D-116

The following drive pinion gear depth (i.e., the depth of the gear teeth mesh between the drive pinion gear and the ring gear) measurement and adjustment procedure involves using Special Tool Set D-116.

(1) Insert Master Pinion Block Tool D-120 (for Model 60 and 60M axles) or Tool D-137 (for Model 70 axles) into the drive pinion gear shaft bore in the differential housing (Fig. 22).

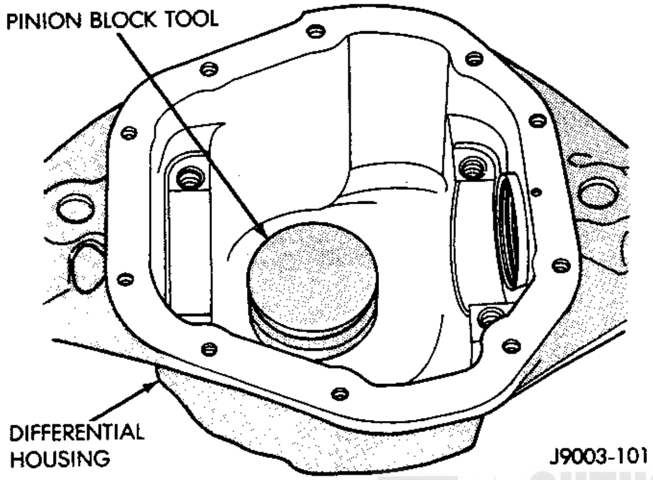


Fig. 22 Pinion Block Tool Inserted In Shaft Bore

(2) Place Arbor Disc Tools D-116-2 on Arbor Tool D-115-3 and position the tool set in the differential housing with the disc tools located in the differential bearing cradles (Fig. 23). This is the centerline of the ring gear/axle shaft.

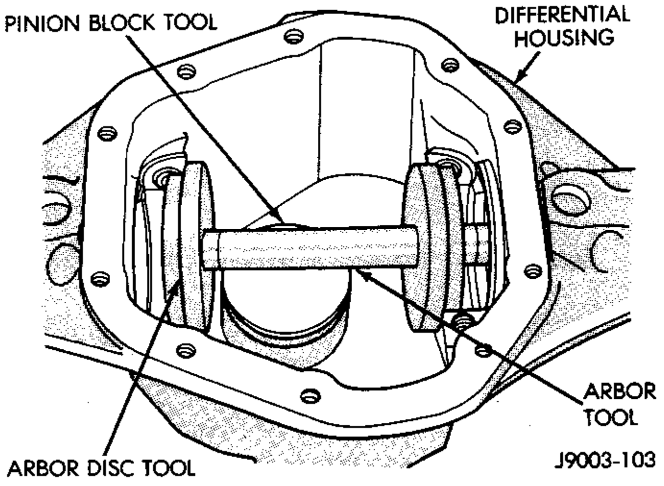


Fig. 23 Arbor Disc & Arbor Tools In Housing

(3) Place Pinion Height Block Tool D-116-1 on top of the master pinion block tool and against the arbor tool (Fig. 24).

(4) Place Gauge Block Tool D-115-2 and Dial Indicator Tool D-106-5 on **the lowest step** of the pinion height block tool (Fig. 25). Ensure that the gauge block tool is resting firmly on the lowest step of pinion height block tool and "zero" the dial indicator pointer.

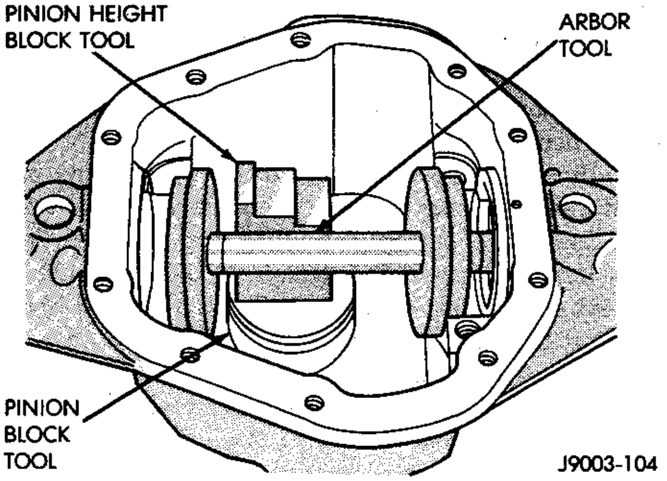


Fig. 24 Pinion Height Block Tool Against Arbor Tool

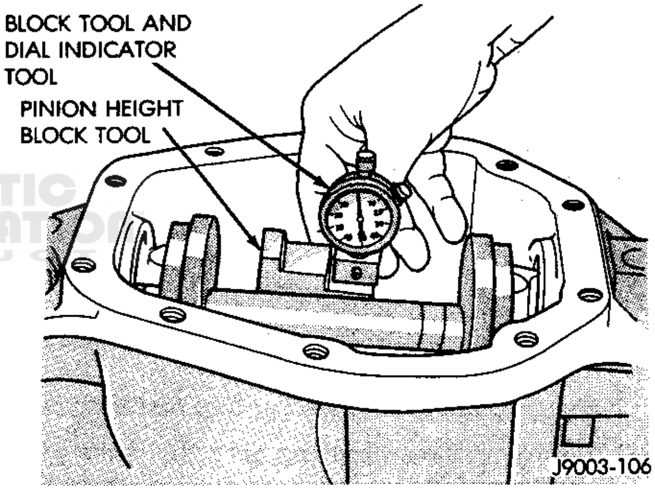


Fig. 25 Drive Pinion Gear Depth Measurement

(5) With the dial indicator pointer "zeroed", move the gauge block tool toward the arbor tool until the tip of the dial indicator plunger contacts the arbor tool (Fig. 25). Slide the gauge block tool (with the dial indicator) across and back and forth along the arbor tool while observing the dial indicator pointer. Record the longest plunger travel distance, whether inward ("-") or outward ("+"), indicated by the pointer.

The longest plunger travel distance indicated, plus or minus the depth variance etched into the face of the drive pinion gear, is the required thickness for the drive pinion gear depth shims.

(6) Measure the thickness of each depth shim separately with a micrometer and combine the shims necessary to obtain the total required depth shim "pack" thickness. **If equipped, the oil slinger located between the rear bearing and the thrust**

face of drive pinion gear must be measured and the thickness included with the total shim "pack" thickness.

(7) Remove the measurement tools from the differential housing.

(8) Place the depth shims into the drive pinion gear shaft rear bearing bore in the differential housing and then force the rear bearing cup into the bore with Bearing Cup Installation Tool D-111 (for Model 60 and 60M axles) or Tool C-4204 (for Model 70 axles) and Driver Handle Tool C-4171. Ensure that the cup is correctly "seated".

(9) Use Bearing Cup Installation Tool C-4203 and Driver Handle Tool C-4171 to force the drive pinion gear shaft front bearing cup into the differential housing bore (Fig. 26).

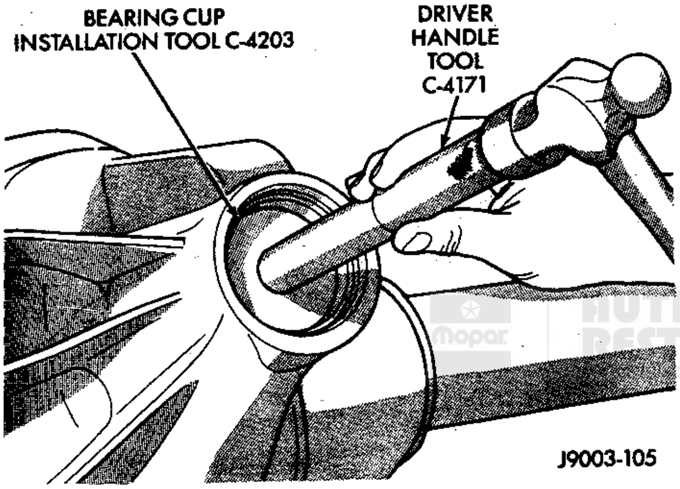


Fig. 26 Shaft Front Bearing Cup Installation

(10) Force the rear bearing onto the drive pinion gear shaft until it is completely "seated" with Bearing Installation Tool C-3095-A (Fig. 27).

(11) Install the drive pinion gear shaft in the differential housing.

(12) Install the drive pinion gear shaft front bearing, oil slinger, (axle) yoke, washer and nut. Use Installation Tool C-3718 and Holding Tool 3281 to install the yoke (Fig. 28).

Do not install the bearing "preload" torque shims or the drive pinion gear shaft seal at this time.

(13) "Seat" the shaft bearings by tightening the (axle) yoke nut until it requires 1 N•m (10 in-lbs) torque to rotate the drive pinion gear shaft (Fig. 29). Use a Newton-meter or an inch-pound torque wrench to measure the torque.

(14) Measure the drive pinion gear depth of mesh (with the ring gear). Place the pinion height block tool on the face of the drive pinion gear (Fig. 22). Place the arbor and disc tools into the differential bearing cradles in the differential housing (Fig. 23). Place the gauge block tool with the dial indicator tool on the lowest step of the pinion height block tool. Ensure that the gauge block tool is resting firmly on the lowest step of the pinion height block tool and "zero" the dial indicator pointer.

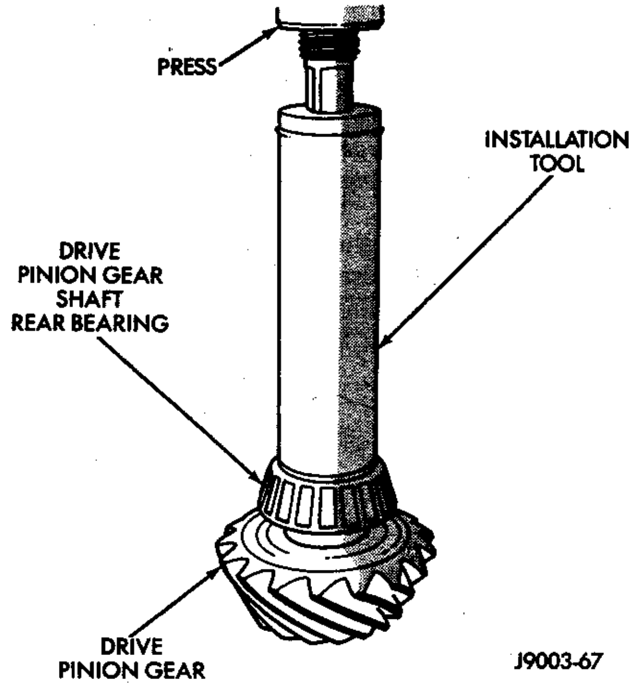


Fig. 27 Shaft Rear Bearing Installation

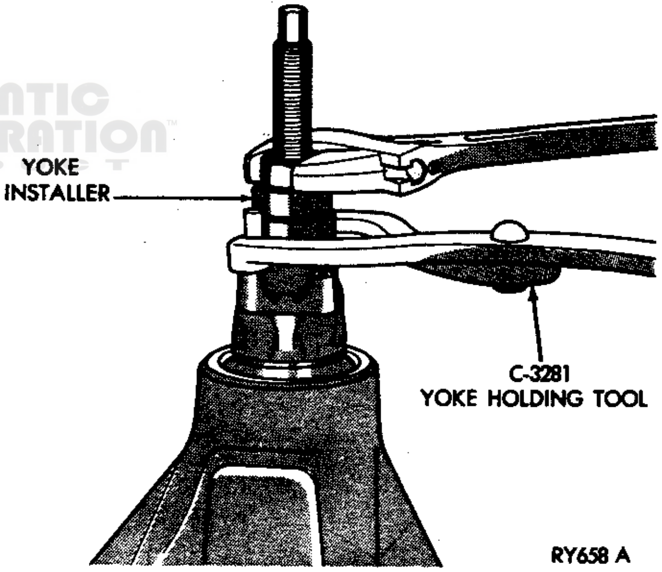


Fig. 28 Drive Pinion Gear Shaft (Axle) Yoke Installation

(15) With the dial indicator pointer "zeroed", move the gauge block tool toward the arbor tool until the tip of the dial indicator plunger contacts the arbor tool (Fig. 25). Slide the gauge block tool (with the dial indicator) across and back and forth along the arbor tool while observing the dial indicator pointer. Record the longest plunger travel distance (whether inward or outward) indicated by the pointer.

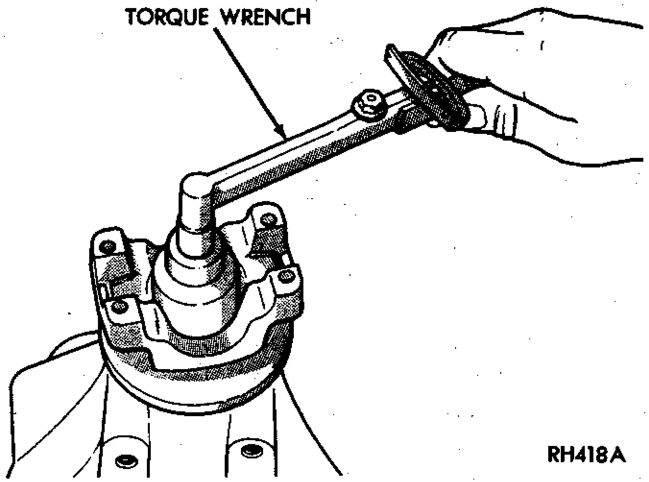


Fig. 29 Rotating Drive Pinion Gear Shaft

The dial indicator pointer should indicate an inward ("-") or outward ("+") maximum travel distance that closely approximates the depth variance etched into the face of the drive pinion gear.

(16) If the measurement indicates that the actual depth variance is within 0.002 inch (0.05 mm) of the depth variance etched into the drive pinion gear face, it is acceptable.

(17) If the drive pinion gear actual depth variance is within the specified tolerance, continue with the differential assembly. If the actual depth variance is not within the specified tolerance, correct the shim thickness accordingly and then re-measure the depth variance.

Figure 30 depicts an arrow pointing outward and inward within the drive pinion gear shaft. The outward direction (pointing toward the yoke) indicates that if the drive pinion gear shaft depth shim thickness is decreased, the distance/depth from the centerline of the axle/ring gear to the drive pinion gear face would be increased (i.e., it would increase the dial indicator plunger outward ("+") travel distance). The shaft bearing "preload" torque shim thickness does not affect the depth of mesh adjustment. The arrow on the ring gear indicates the method of increasing or decreasing shim thickness at the applicable side of the differential case to increase or decrease the ring gear "backlash" and the differential bearing "preload" torque.

(18) Remove the measurement tools from the differential housing.

(19) Remove the drive pinion gear shaft nut, washer, (axle) yoke, oil slinger, and front bearing.

(20) Install the bearing "preload" torque shims (Fig. 30) that were removed during disassembly, the shaft front bearing and the oil slinger on the drive pinion gear shaft.

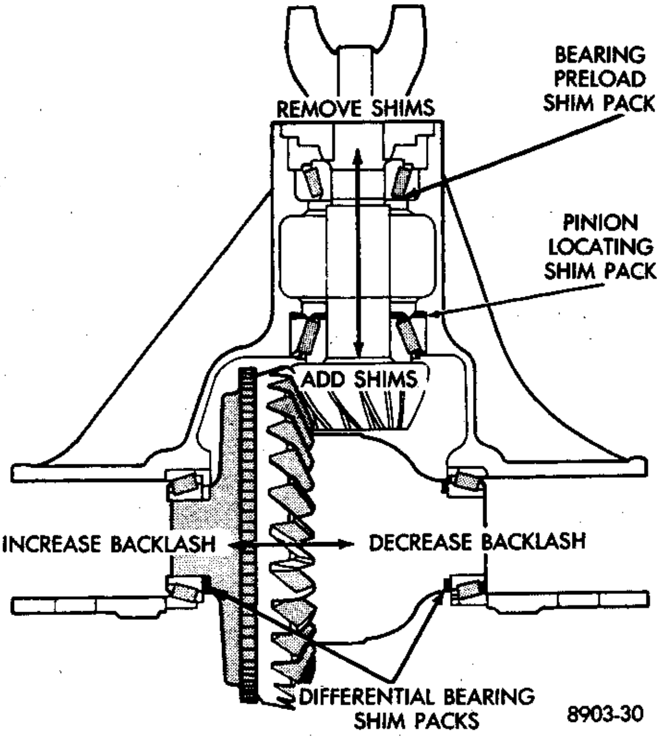


Fig. 30 Shim Locations

(21) Apply a light coating of hypoid gear lubricant on the lip of drive pinion gear shaft seal, position it over the end of the shaft and install it in the differential housing bore with Seal Installation Tool C-3719 (for Model 60 and 60M axles) or Tool C-359 (for Model 70 axles) and Driver Handle Tool C-4171 (Fig. 31).

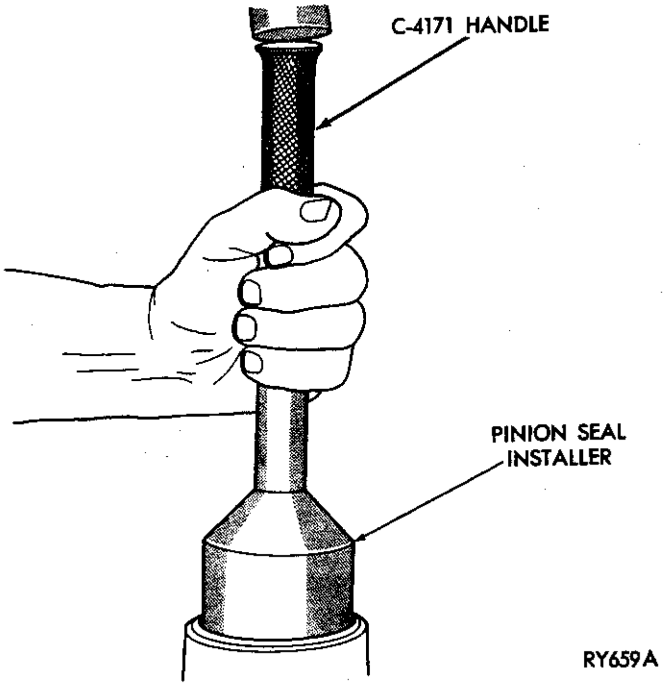


Fig. 31 Drive Pinion Gear Shaft Seal Installation

(22) Install the drive pinion gear shaft (axle) yoke, washer, and a replacement nut on the shaft. Tighten the nut with 339 to 366 N•m (250 to 270 ft-lbs) torque.

(23) Use a Newton-meter or an inch pound torque wrench (Fig. 29) to rotate the drive pinion gear shaft and observe the indicated bearing "preload" torque. The torque necessary to rotate the drive pinion gear shaft should be between 2.26 to 4.53 N•m (20 to 40 in-lbs).

If the drive pinion gear shaft bearing "preload" torque is not within the specified tolerance, correct the shim thickness accordingly. To increase the "preload" torque, decrease the shim thickness; to decrease the "preload" torque, increase the shim thickness (Fig. 30). Shims are available in the following thicknesses: 0.003, 0.005, 0.010, and 0.030 inch (0.076, 0.127, 0.254, and 0.762 mm).

DRIVE PINION GEAR DEPTH MEASUREMENT AND ADJUSTMENT WITH TOOL SET C-758-D6

The following drive pinion gear depth (i.e., the depth of the gear teeth mesh between the drive pinion gear and the ring gear) alternate measurement and adjustment procedure involves using Axle Measurement Gauge Tool Set C-758-D6. Tool Set C-758-D6 is also used to install the drive pinion gear shaft bearing cups.

(1) Position each drive pinion gear shaft bearing cups in the applicable differential housing bore.

(2) Begin assembling Tool Set C-758-D6 by positioning Drive Pinion Gear Shaft Locating Spacer Tool SP-5184 (for Model 60 and 60M axles) or Tool SP-5587 (for Model 70 axles) on the tool primary screw.

(3) Position the drive pinion gear shaft rear bearing on the tool primary screw and insert the screw (with the bearing) into and through the differential housing bore.

(4) Position the drive pinion gear shaft front bearing on the tool primary screw at the opposite side of the differential housing. Install Compression Sleeve Tool SP-535-A, Centralizing Washer Tool SP-534 and Primary Screw Nut Tool SP-533 on the tool primary screw.

(5) Lubricate the drive pinion gear shaft front and rear bearings with MOPAR Hypoid Gear Lubricant (or an equivalent product).

(6) Tighten the nut tool, while retaining the compression sleeve tool with Tool C-3281, and force the drive pinion gear shaft bearing cups into the differential housing bearing cup bores. **Allow the compression tool to rotate several revolutions during the tightening process to permit the bearing rollers to properly align and prevent "brinelling" of the bearing cups.**

Do not remove the tool after installing the drive pinion gear shaft bearing cups. The drive pinion gear depth of mesh must be measured next.

(7) Loosen the nut tool and then re-tighten it sufficiently to obtain 1 to 3 N•m (10 to 30 in-lbs) of bearing "preload" torque. **While tightening the nut, rotate the tool to align the bearing rollers.**

(8) Install Gauge Block Tool SP-5260 on Tool Set C-758-D6 (Fig. 32) and tighten the retaining screw securely with an Allen wrench.

(9) Position Cross Bore Arbor Tool SP-5183 (Fig. 32) in the differential bearing cradles (in the differential housing). Center the arbor tool in the cradles so that an approximately equal space exists at both ends.

(10) Observe the installation reference letters and position the differential bearing caps on the arbor tool (Fig. 32). Install the cap bolts and tighten them with 14 N•m (10 ft-lbs) torque.

(11) To measure the drive pinion gear depth of mesh, select and insert a feeler gauge blade that "snugly" fits between the arbor tool and the gauge block tool (Fig. 32). The "fit" must be "snug" but not excessively tight. **Record the thickness of the feeler gauge blade so that it can be used when determining the correct drive pinion gear depth shim thickness.**

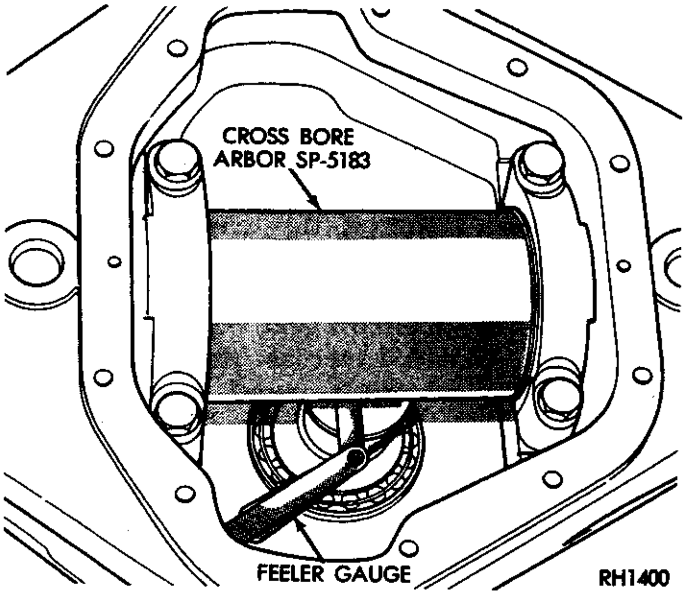


Fig. 32 Drive Pinion Gear Depth Measurement

(12) Observe the depth variance etched into the end of the drive pinion gear (e.g., 0, -1, -2, +1, +2, etc.). If the etched depth variance is a "-" (minus) value, add it to the thickness measured and recorded in step (11) above. If the etched depth variance is a "+" (plus) value, subtract it from the thickness measured and recorded in step (11) above.

(13) Remove the arbor tool from the differential housing cavity and the tool set (with the front and rear bearings) from the housing bore.

(14) Use Removal Tool D-162 and Driver Handle Tool C-4171 to remove the drive pinion gear shaft rear bearing cup from the differential housing bore.

(15) Position the depth shims in the differential housing rear bearing cup bore and install the bearing cup according to the method previously described in steps (1) through (6) above. When the bearing cup is correctly "seated" in the housing bore, remove the tool set and the drive pinion gear shaft bearings.

(16) If the drive pinion gear depth of mesh with the ring gear has been correctly established according to the instructions and information provided in the procedure above, good gear teeth contact should exist.

(17) Lubricate the drive pinion gear shaft rear bearing with MOPAR Hypoid Gear Lubricant (or an equivalent product) and install the bearing on the drive pinion gear shaft with Tool C-3095-A. Use an arbor press with the installation tool (Fig. 33).

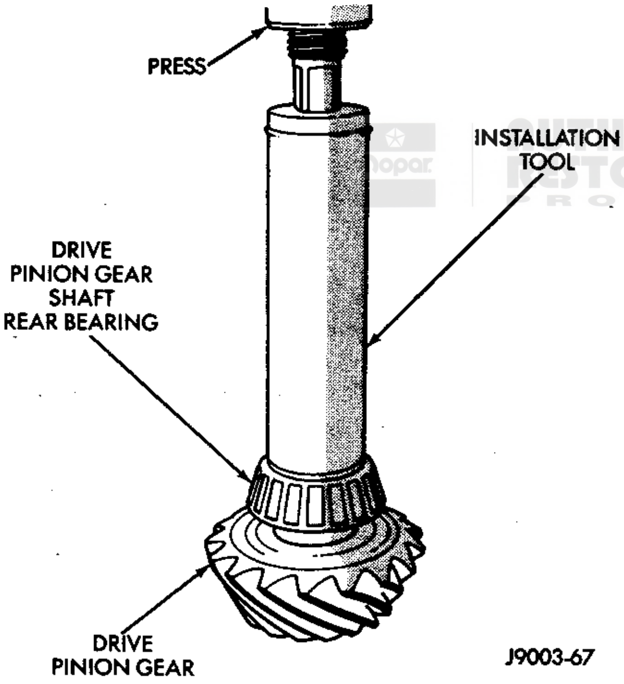


Fig. 33 Shaft Rear Bearing Installation

(18) Install the drive pinion gear shaft with the bearing in the differential housing bore.

(19) Install the original drive pinion gear shaft bearing "preload" torque shims followed by the front bearing. **Do not install the shaft oil slinger or seal at this time.**

(20) Install the drive pinion gear shaft (axle) yoke, washer and nut. Tighten the nut with 339 to 366 N•m (250 to 270 ft-lbs) torque. While tightening, rotate drive pinion gear shaft several complete revolutions to "seat" the bearing rollers.

(21) Use a Newton-meter or an inch-pound torque wrench to rotate the drive pinion gear shaft and measure the bearing "preload" torque (Fig. 34). Rotate the shaft several complete revolutions before recording the torque. The Correct bearing "preload" torque is 1 to 3 N•m (10 to 20 in-lbs) torque.

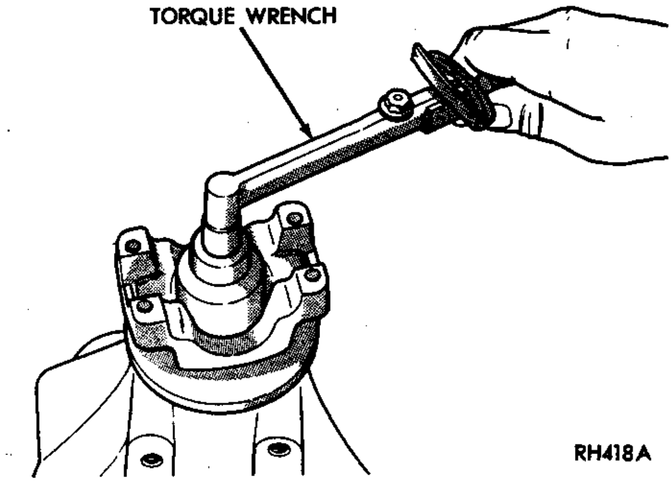


Fig. 34 Rotating Drive Pinion Gear Shaft

If the drive pinion gear shaft bearing "preload" torque is not within the specified tolerance, correct the shim thickness accordingly. To increase the "preload" torque, decrease the shim thickness; to decrease the "preload" torque, increase the shim thickness. Shims are available in the following thicknesses: 0.003, 0.005, 0.010, and 0.030 inch (0.076, 0.127, 0.254, and 0.762 mm).

(22) After the correct drive pinion gear shaft bearing "preload" torque has been established, remove the yoke, nut and washer.

(23) Install the oil slinger and the seal on the drive pinion gear shaft with Seal Installation Tool C-3719-A (for Model 60 and 60M axles) or Tool C-359 (for Model 70 axles) and Driver Handle C-4171.

(24) Install the drive pinion gear shaft (axle) yoke, washer and nut. Tighten the nut with 339 to 366 N•m (250 to 270 ft-lbs) torque.

RING GEAR "BACKLASH" ADJUSTMENT

(1) Position Spreader Tool D-167 on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 35). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(2) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 35). "Zero" the dial indicator pointer.

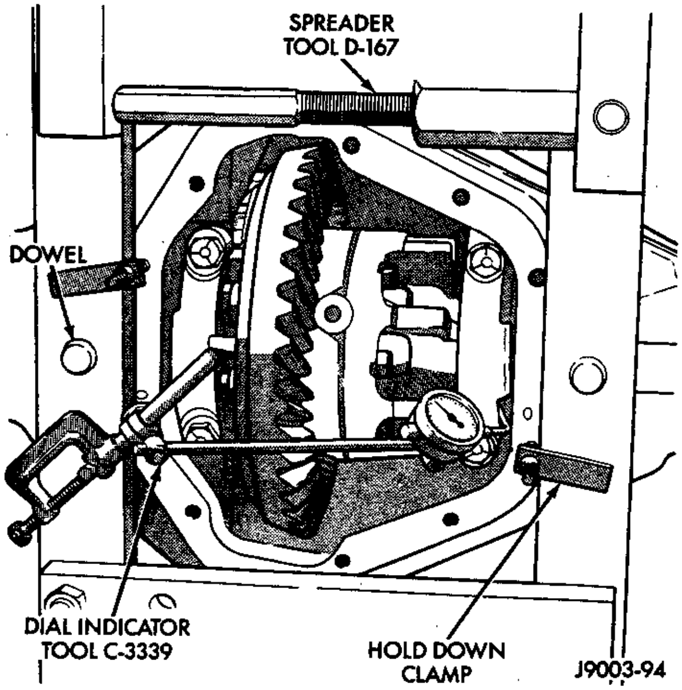


Fig. 35 Differential Housing Separation

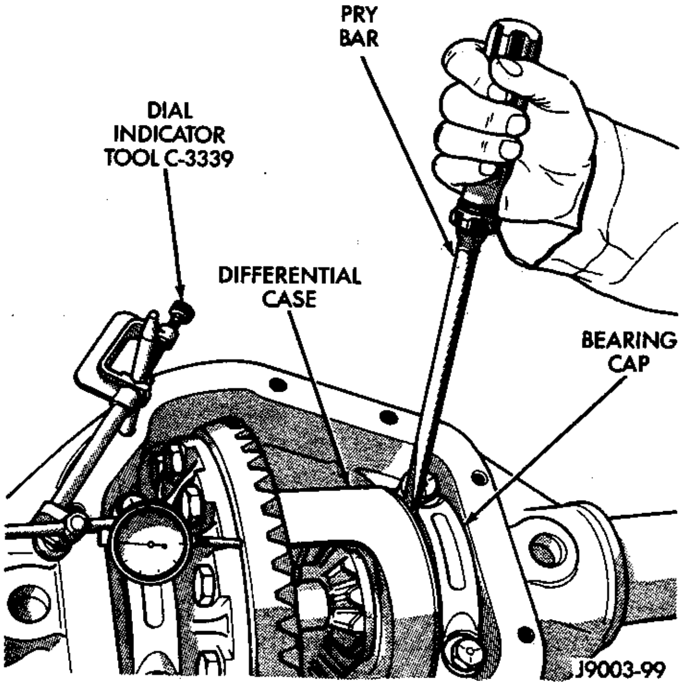


Fig. 36 Ring Gear "Backlash" Measurement

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(3) Tighten the spreader tool turnbuckle (Fig. 35) and separate the differential housing only enough to install the differential case in the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 35) as the housing is being separated.

(4) Remove the dial indicator tool and the pilot stud (Fig. 35) when the differential housing has been separated sufficiently to install the differential case in the housing.

(5) Install Master Bearing Tools D-117 on the differential case hubs and position the case in the differential housing with the ring gear teeth "meshed" with the drive pinion gear teeth. If necessary, "rock" the ring gear to "mesh" the gear teeth.

(6) Install a pilot stud at the right side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the back of the ring gear (Fig. 36). Ensure that the ring gear teeth and the drive pinion gear teeth are tightly "meshed" and "zero" the dial indicator pointer.

(7) Insert a small pry bar between the bearing cap and the left side of the differential case. Pry the differential case/ring gear as far as possible toward the right side of the differential housing and away from the drive pinion gear (Fig. 36). Observe the dial indicator plunger travel distance indicated by the pointer.

(8) Repeat the measurement several times until the indicated plunger travel distance is consistently the same for each measurement and then record the travel distance.

The measurement above indicates the shim thickness necessary to eliminate the ring gear "backlash". Subtract this thickness from the differential case "zero" "end-play" shim thickness. The ring gear "backlash" shims must be placed on the hub at the ring gear side of the differential case between the differential case and the differential bearing.

(9) Remove the dial indicator tool and the pilot stud (Fig. 36) from the differential housing.

(10) Remove the differential bearing caps.

(11) Position Spreader Tool D-167 on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 35). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(12) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 25). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would necessitate replacement.

(13) Tighten the spreader tool turnbuckle (Fig. 35) and separate the differential housing only enough to remove the differential case from the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 35) as the housing is being separated.

(14) Remove the dial indicator tool and the pilot stud (Fig. 35) when the differential housing has been separated sufficiently to remove the differential case from the housing.

(15) Remove the differential case from the differential housing.

(16) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 35).

(17) Remove the master bearing tools from the differential case hubs.

(18) Position the "backlash" shims (with the required thickness determined above) on the differential case hub (ring gear side). Place the differential bearing on the hub and install it with Bearing Installation Tool C-4025-A and Driver Handle Tool C-4171 (Fig. 37).

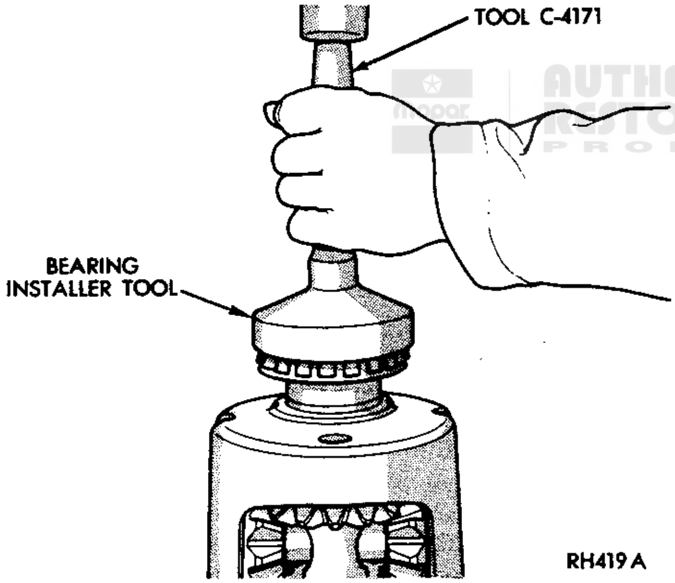


Fig. 37 Differential Bearing Installation

(19) Position the remaining "zero" "end-play" shims on the hub at the opposite side of the differential case. Include an additional 0.015-in (0.38-mm) thick shim on this hub to provide the required differential bearing "preload" torque.

(20) Install the other differential bearing on the hub with Bearing Installation Tool C-4025-A and Driver Handle Tool C-4171 (Fig. 37).

(21) Match each bearing cup with its differential bearing (original) counterpart and install the cups on the bearings.

(22) Position Spreader Tool D-167 on the differential housing with the tool dowel pins "seated" in the locating holes (Fig. 35). Install the holddown clamps and tighten the tool turnbuckle "finger-tight".

(23) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator Tool C-3339 to the differential housing (via the pilot stud) with the indicator plunger slightly "loaded" against the opposite side of the differential housing (Fig. 35). "Zero" the dial indicator pointer.

CAUTION: Do not exceed the specified separation distance when separating the differential housing. If the housing is over-separated, it could be distorted or damaged, which would nécessitate replacement.

(24) Tighten the spreader tool turnbuckle (Fig. 35) and separate the differential housing only enough to install the differential case in the housing. **Separate the differential housing a maximum distance of 0.38 mm (0.015 in) with the spreader tool.** Measure the separation distance with the dial indicator (Fig. 35) as the housing is being separated.

(25) Remove the dial indicator tool and the pilot stud (Fig. 35) when the differential housing has been separated sufficiently to install the differential case in the housing.

(26) Install the differential case in the differential housing.

(27) Remove the holddown clamps and the spreader tool from the differential housing (Fig. 35).

(28) Install the differential bearing caps. Ensure that the installation reference letter stamped in each cap corresponds to the letter stamped in the differential housing (Fig. 38). Tighten the bearing cap bolts with 108 to 122 N•m (80 to 90 ft-lbs) torque.

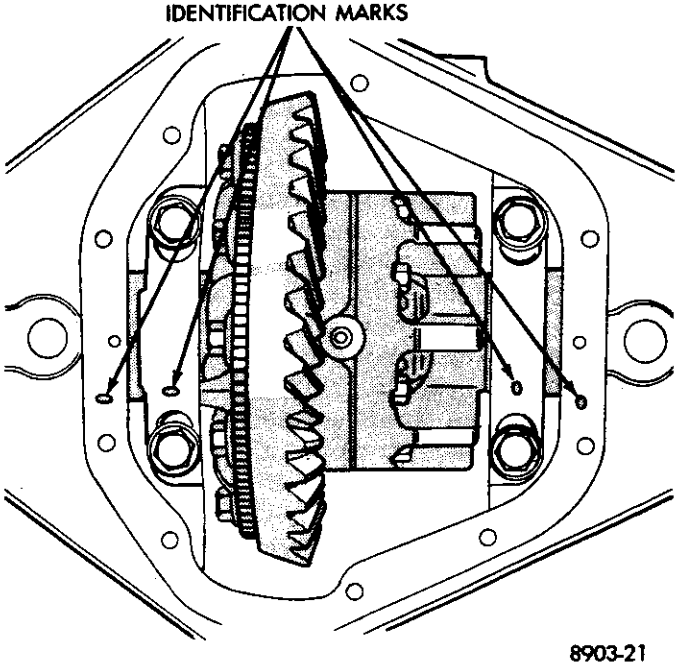


Fig. 38 Differential Bearing Cap Reference Letters

(29) Measure the ring gear "backlash" at three equally spaced locations around the perimeter of the ring gear with a dial indicator (Fig. 39).

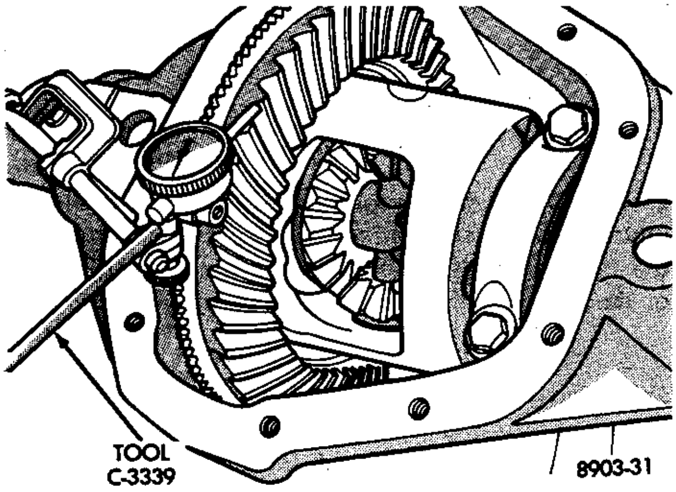


Fig. 39 Ring Gear "Backlash" Measurement

The ring gear "backlash" must be within 0.004 - 0.009 inch (0.10 - 0.23 mm) and it cannot vary more than 0.002 inch (0.05 mm) at any of the measurement locations.

(30) Excessive "backlash" is corrected by moving the ring gear teeth closer to the drive pinion gear teeth. Insufficient "backlash" is corrected by moving the ring gear teeth away from the drive pinion gear teeth. "Backlash" correction is accomplished by transferring shims from one side of the differential case to the other (Fig. 30).

GEAR TEETH CONTACT PATTERNS

If the drive pinion gear depth of mesh and the ring gear "backlash" have been correctly established according to the instructions and information provided in the procedures above, good gear teeth contact patterns should exist.

INSTALLATION

(1) Install the axle shafts in the axle shaft tubes. If necessary, refer to the installation procedure.

(2) Remove any residual RTV sealant/gasket material from the differential housing and cover mating surfaces, thoroughly clean the surfaces with mineral spirits (or an equivalent cleaning solution) and dry the surfaces completely.

(3) Apply a thin "bead" of MOPAR RTV Sealant (or an equivalent sealant) around the bolt circle on the housing and on the cover. **Allow the sealant to "cure" for few minutes.**

If for any reason the differential housing cover is not installed within 20 minutes after applying the sealant, the sealant must be removed and another "bead" of sealant applied.

(4) Install the housing cover on the differential housing with the attaching bolts. **Install the axle gear ratio identification tag under one of the cover bolts.** Tighten the cover bolts with 47 N•m (35 ft-lbs) torque.

(5) Remove the supports and raise or lower the hoist until the vehicle is level.

(6) Remove the fill hole plug and fill the differential housing and the axle tubes with the specified quantity of MOPAR Hypoid Gear Lubricant (or an equivalent product). Refer to Rear Axle Specifications. Install the fill hole plug and tighten with 34 N•m (25 ft-lbs) torque.

(7) Lower the vehicle and test the brakes and the axle for proper operation.

TRAC-LOK DIFFERENTIAL SERVICE

GENERAL INFORMATION

Model 60, 60M and 70 rear axles equipped with a **Trac-Lok** differential are optionally available for Ram Truck vehicles.

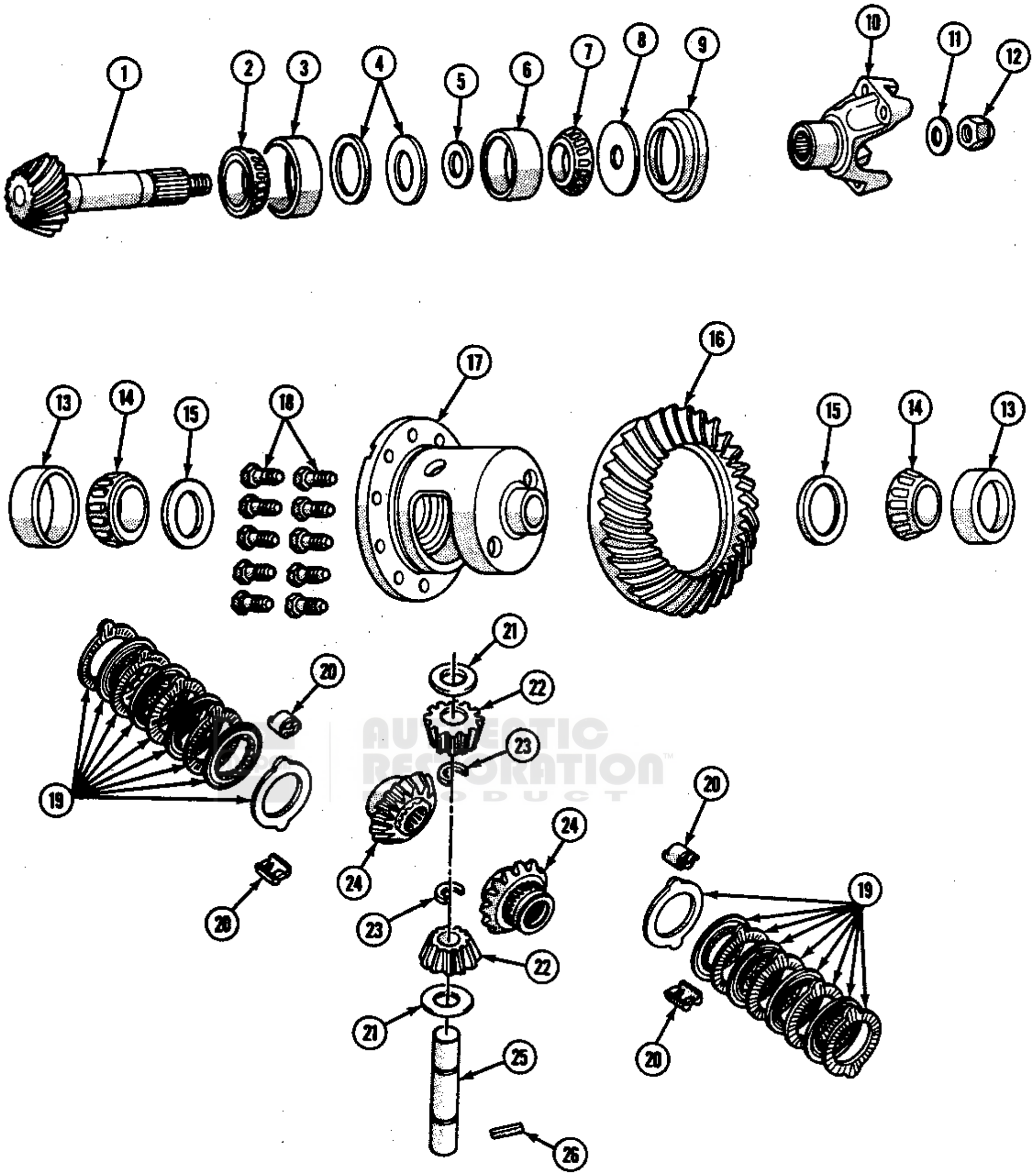
A **Trac-Lok** differential has a one-piece differential case, the same internal components as a standard differential, plus two clutch disc packs (Fig. 40).

When engine torque is applied to the differential ring gear, the initial spring "loading" of the clutches is supplemented by the gear-separating friction between the differential side gears and the pinion gears, and this progressively increases the total friction in the differential. When a low traction surface is encountered (e.g., mud or snow), this internal friction is the means for transferring more of the engine torque to the rear wheel/tire that has the better traction surface and less torque to the wheel/tire with the lower traction surface. Because a **Trac-Lok** differential is not a positive "locking" type of differential, the friction will decrease and the clutches will release the side gears before excessive engine torque is applied to either one of the wheels/tires. **The wheel/tire with the least traction will "spin" similarly to the action of a standard differential when extreme differences in surface traction are encountered.** During normal driving conditions, the controlled internal friction is easily overcome when a vehicle is turning a corner so that the driving wheels can rotate at different speeds.

SERVICE INFORMATION

The service information/procedures for a **Trac-Lok** differential are essentially the same as those used for a standard differential, therefore, only information/procedures involving the differences that exist between the two differential types will be provided within this section.

The rear wheel anti-lock (RWAL) brake sensor is attached to the top, forward exterior area of the differential housing. There is a seal located between the sensor and the wire connector. **This seal must be**



1 PINION GEAR
2 PINION REAR BEARING
3 BEARING CUP
4 PINION DEPTH SHIMS
5 PINION PRELOAD SHIM
6 BEARING CUP
7 PINION FRONT BEARING
8 SLINGER
9 PINION SEAL
10 YOKE
11 WASHER
12 PINION NUT
13 BEARING CUP
14 DIFFERENTIAL BEARING
15 BACKLASH/PRELOAD SHIM
16 RING GEAR
17 DIFFERENTIAL CASE
18 RING GEAR BOLTS
19 CLUTCH PACKS
20 CLUTCH PACK RETAINERS
21 PINION THRUST WASHER
22 DIFFERENTIAL PINIONS
23 PINION SHAFT SNAP RINGS
24 DIFFERENTIAL SIDE GEARS
25 PINION SHAFT
26 PINION SHAFT LOCK PIN

J8903-41

Fig. 40 Trac-Lok Differential (Exploded View)

in-place before connecting the wire connector. The RWAL brake exciter ring is "press fitted" on the differential case.

CAUTION: Whenever a rear axle is being serviced or anytime it is to be rotated via the engine (or by another means), RAISE BOTH REAR WHEELS off the surface.

DIFFERENTIAL DIAGNOSIS

With normal tire traction conditions, engine torque is divided evenly. With low-traction surfaces, engine torque is transferred to the wheel with the most tire traction. When diagnosing a suspected **Trac-Lok** differential problem condition, it is important to remember: **if the tire traction is unequal (or low) at both wheels, both wheels will "slip" or "spin"**. When extreme differences in wheel-to-wheel tire traction exist, the wheel with the least tire traction will continue "spinning" regardless of the fact that maximum torque was transferred to the opposite wheel.

Noise complaints involving rear axles equipped with a **Trac-Lok** differential should be thoroughly evaluated to determine the source of the noise. Before the differential is disassembled for any type of noise complaint, the lubricant should be replaced. An incorrect (or insufficient) lubricant can cause noises such as "chatter" and "moan" as well as scoring of the differential clutch plates and discs (which can result in failure of the complete unit).

Generally, the most common **Trac-Lok** differential noise encountered is a "chatter" noise when turning a street corner (i.e., turning the vehicle 90 degrees). A common cause of this is incorrect or contaminated lubricant. Replacing the axle gear lubricant (and adding MOPAR Hypoid Gear Lubricant Additive or an equivalent friction modifier additive) will correct the condition in most instances. However, if the "chatter" persists, clutch disc damage could have occurred.

The following drain and lubricant replacement procedure should be used for possible elimination of noise before replacing the differential.

WARNING: WHEN SERVICING VEHICLES WITH AN AXLE EQUIPPED WITH A TRAC-LOK DIFFERENTIAL, DO NOT USE THE ENGINE TO ROTATE THE AXLE AND WHEELS UNLESS BOTH REAR WHEELS ARE RAISED FROM THE SURFACE AND THE VEHICLE SUPPORTED. A TRAC-LOK DIFFERENTIAL EQUIPPED AXLE CAN EXERT ENOUGH DRIVING FORCE (IF ONE WHEEL IS IN CONTACT WITH THE SURFACE) TO CAUSE THE VEHICLE TO MOVE.

(1) With the rear axle lubricant at normal operating temperature, raise and support the vehicle (rear wheels free to rotate).

(2) Remove the fill hole plug from the differential housing cover and remove as much of the lubricant as possible with a suction pump.

(3) Fill the differential housing with MOPAR Hypoid Gear Lubricant, or an equivalent product. Install the fill hole plug in the cover and tighten it with 34 N•m (25 ft-lbs) torque.

(4) Start the engine, shift the transmission to DRIVE (or a forward gear) and increase the speed to approximately 40 mph (64 km/h) for 10 minutes. This will thoroughly circulate the lubricant and cause the temperature to increase to the normal operating range.

(5) Stop the engine, remove the fill hole plug and (with a suction pump) remove as much of the lubricant as possible.

(6) Install 4 ounces of MOPAR Hypoid Gear Lubricant Additive (or an equivalent friction modifier additive) in the differential housing. Refill the differential housing to the correct level with MOPAR Hypoid Gear Lubricant (or an equivalent product). Install the fill hole plug and tighten it with 34 N•m (25 ft-lbs) torque.

If sufficient time is available, after replacing the lubricant in a Trac-Lok differential, drive the vehicle and make 10 to 12 slow, figure-eight turns. This type of maneuver ensures that the replacement lubricant is pumped through the clutch disc packs.

(7) Lower the vehicle and return it to the owner to drive and evaluate for approximately 100 miles (160 km) to determine if replacing the lubricant corrects the noise condition.

If, after driving the vehicle approximately 100 miles (160 km), the differential noise still occurs, replace the differential case (with its internal components). With the exception of the ring gear and the differential bearings, the differential case and its internal components are serviced as a unit only and should not be disassembled.

DIFFERENTIAL TEST

(1) Drive the vehicle to thoroughly warm up the lubricant in the rear axle.

(2) Place a large piece of Kraft paper (or an equivalent product) over a smooth Formica board (or an equivalent product). **Ensure that the Formica board is on a flat and level surface.**

(3) Drive the vehicle over the Formica board until one rear wheel/tire is in the center of the board and the paper.

(4) Place a block of wood that is 2-inches high and a minimum of 3-inches wide in front of one of the front tires.

(5) With a "gradual" throttle opening, attempt to slowly drive the vehicle over the block of wood.

(6) If the Kraft paper slips out from under the rear wheel/tire before the front wheel/tire moves over the block of wood; reposition the vehicle so that the paper and board are under the opposite rear wheel/tire; and attempt to drive over the block of wood the second time.

(7) If the front wheel/tire moves over the block of wood on either the first or second attempt, the axle can be considered to be functioning normally.

DIFFERENTIAL CASE SERVICE

REMOVAL

Refer to the differential case removal procedure for a standard differential.

CLEANING/INSPECTION

(1) Clean the **Trac-Lok** differential case and components (Fig. 40) with fast evaporating mineral spirits or a dry cleaning solvent. With the exception of the differential bearings, dry the case and the components with compressed air.

(2) Inspect the differential bearing rollers and cups for "pitting", "spalling" and other visible damage. If differential bearing replacement is necessary, remove the bearings from the differential case according to the procedure provided for a standard differential bearing.

(3) Inspect the differential case for cracks and other visible damage that could cause it to be unusable.

ASSEMBLY

(1) If the ring gear was removed for any reason from the differential case (or if it is being replaced), replacement ring gear bolts must be installed.

(2) Place the differential case in an appropriate fixture. Install the ring gear with replacement bolts. Tighten the bolts with 136 to 203 N•m (100 to 120 ft-lbs) torque.

INSTALLATION

Refer to the differential case installation procedure provided for a standard differential.

LUBRICANTS

TYPE

Multi-purpose, hypoid gear lubricant, as defined by MIL-L-2105-B and by API GL 5 quality specifications, should be used for Model 60, 60M and 70 rear axles with standard or Trac-Lok differentials. MOPAR Hypoid Gear Lubricant conforms to both of these specifications and is highly recommended for use with Ram Truck and Ramcharger vehicles. In addition, 4 ounces of MOPAR Hypoid Gear Lubricant Additive (or an equivalent friction modifier product) can be included with a re-fill for **Trac-Lok** differentials.

CAUTION: If the rear axle is submerged in water, the axle lubricant must be replaced immediately to avoid the possibility of premature axle failure resulting from water contamination of the lubricant.

DRAIN AND REFILL

(1) Drive the vehicle until the gear lubricant in the axle attains the normal operating temperature.

(2) Raise and support the vehicle.

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

(4) Remove the differential housing cover and allow the original lubricant to completely drain from the housing and the axle shaft tubes.

CAUTION: DO NOT FLUSH Trac-Lok differentials. Trac-Lok differentials may be cleaned only by disassembling the unit and wiping with clean, lint-free cloths.

(5) For standard differentials (only), flush the differential and the housing cavity with a "flushing" oil (or light engine oil) to remove residual lubricant and foreign matter. **Do not use water, steam, kerosene or gasoline for flushing.**

(6) Install the differential housing cover and tighten the bolts with 47 N•m (35 ft-lbs) Torque.

(7) Refill the differential housing with the specified quantity of MOPAR Hypoid Gear Lubricant (or an equivalent product). Refer to Rear Axle Specifications. A container of MOPAR Hypoid Gear Lubricant Additive (a friction modifier) can also be added for Trac-Lok differentials.

(8) Install and tighten the fill hole plug with 34 N•m (25 ft-lbs) torque.

(9) Remove the supports and lower the vehicle. of MOPAR Hypoid Gear Lubricant.

(10) If equipped with a Trac-Lok differential, drive the vehicle and make 10 to 12 slow, figure-eight turns. This type of maneuver will ensure that the replacement lubricant is pumped through the Trac-Lok clutch discs.

SPECIFICATIONS

TORQUE SPECIFICATIONS

COMPONENT	SET-TO-TORQUE	RECHECK TORQUE
Differential Bearing Cap Bolt		
8-3/8 Inch Axle	95 N•m (70 ft-lbs)	
9-1/4 Inch Axle (Std. & HD)	136 N•m (100 ft-lbs)	
Model 60 & 60M Axle	115 N•m (85 ft-lbs)	108-122 N•m (80-90 ft-lbs)
Model 70 Axle	119 N•m (88 ft-lbs)	115-122 N•m (85-90 ft-lbs)
Ring Gear-to-Differential Case Bolt (LH Thread)		
8-3/8 Inch Axle	95 N•m (70 ft-lbs)	
9-1/4 Inch Axle	95 N•m (70 ft-lbs)	
Model 60 & 60M Axle	153 N•m (113 ft-lbs)	149-156 N•m (100-115 ft-lbs)
Model 70 Axle	142 N•m (105 ft-lbs)	136-149 N•m (100-110 ft-lbs)
Drive Pinion Gear Shaft Flange/Yoke Nut		
8-3/8 Inch Axle	285 N•m (210 ft-lbs) Min.	
9-1/4 Inch Axle	285 N•m (210 ft-lbs) Min.	
Model 60, 60M & 70 Axle	352 N•m (260 ft-lbs)	339-366 (250-270 ft-lbs)
Differential Housing Cover Bolt		
8-3/8 Inch Axle	47 N•m (35 ft-lbs)	
9-1/4 Inch Axle	47 N•m (35 ft-lbs)	
Model 60, 60M & 70 Axle	47 N•m (35 ft-lbs)	41-54 N•m (30-40 ft-lbs)
Brake Support Plate Retainer Nut		
8-3/8 Inch Axle	44 N•m (33 ft-lbs)	41-47 N•m (30-35 ft-lbs)
9-1/4 Inch Axle	47 N•m (35 ft-lbs)	
Model 60, 60M & 70 Axle	115 N•m (85 ft-lbs)	88-142 N•m (65-105 ft-lbs)
Drive Shaft U-Joint Clamp Screw	21 N•m (185 in-lbs)	19-23 N•m (170-200 in-lbs)
Spring U-Bolt Nut		
8-3/8 Inch Axle	61 N•m (45 ft-lbs)	
9-1/4 Inch Axle	88 N•m (65 ft-lbs) Min.	
Model 60, 60M & 70 Axle	244 N•m (180 ft-lbs)	203-285 N•m (150-210 ft-lbs)
Wheel Lug Nut		
8-3/8 Inch Axle	142 N•m (105 ft-lbs)	
9-1/4 Inch Axle	142 N•m (105 ft-lbs)	
Model 60, 60M & 70 Axle		
Coned Nut	281 N•m (200 ft-lbs)	237-305 N•m (175-225 ft-lbs)
Flanged 5/8 x 18 Nut	441 N•m (325 ft-lbs)	407-475 N•m (300-350 ft-lbs)
Flanged 1-1/8 x 16 Nut	644 N•m (475 ft-lbs)	610-678 N•m (450-500 ft-lbs)
Shock Absorber Stud Nut		
8-3/8 Inch Axle	68 N•m (50 ft-lbs)	
9-1/4 Inch Axle	68 N•m (50 ft-lbs)	
Model 60, 60M & 70 Axle	68 N•m (50 ft-lbs)	47-88 N•m (35-65 ft-lbs)
Axle Shaft Flange Bolt		
Model 60, 60M & 70 Axle	99 N•m (72 ft-lbs)	75-122 N•m (55-90 ft-lbs)
Differential Case Half Bolt		
Model 60, 60M & 70 Axle	92 N•m (68 ft-lbs)	88-95 N•m (65-70 ft-lbs)
RWAL Brake Sensor Cover Screw	24 N•m (200 in-lbs)	19-29 N•m (170-230 in-lbs)

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REAR AXLE SPECIFICATIONS

Vehicle Model	**D150** **AD150**	**D150** **W150** **AD150** **AW150**	**D250** **W250**	**D250** **W250** **W350**	**D350** **W350**	**D350**
Type	SFH	SFH	SFH	FFH	FFH	FFH
Capacity (Load)	3400	3600	5500	5500	7500	5800
Axle Designation	8-3/8	9-1/4	9-1/4 HD	60	70	60M
Number of Differential Pinion Gears	2	2	2	2	2	2
Ring Gear Pitch Diameter	8.375	9.25	9.25	9.75	10.5	9.75
Number of Teeth						
Ring Gear	45	—	—	41	39	41
Drive Pinion Gear	14	—	—	10	8	10
Ratio to 1	3.21	—	—	4.1**	4.88**	4.10**
Number of Teeth						
Ring Gear	39	45	39	—	41	—
Drive Pinion Geär	11	14	11	—	9	—
Ratio to 1	3.55	3.21*	3.55*	—	4.56(1)	—
Number of Teeth						
Ring Gear	47	39	39	—	41	—
Drive Pinion Gear	16	11	10	—	10	—
Ratio to 1	2.94	3.55*	3.90	—	4.10(1)	—
Lubricant Capacity (Pints)	4.4	4	4	6	7	6
(Liters)	2.1	1.9	1.9	2.8	3.3	3.3

(1) Not available for Model W350
SFH—Semi-Floating Hypoid.
FFH—Full-Floating Hypoid.
*Sure-Grip Differential Available.
**Trac-Loc Differential Available.

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BRAKES

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BRAKE COMPONENTS

All AD models are equipped with front disc and rear drum brakes. Power assist brakes and rear wheel antilock brakes are also standard on all models. A dual reservoir master cylinder and single or dual diaphragm, vacuum operated power brake booster is used for all applications.

The front disc brake units consist of single piston, sliding-type calipers with semi metallic brakeshoe lining. Vented disc brake rotors are used on all models. Bendix calipers are used on four wheel drive W250/W350 models. Chrysler disc brake calipers are used for all other applications.

The rear drum brakes are dual shoe units with an automatic adjustment mechanism. Bendix and Chrysler drum brake assemblies are used.

A combination valve is used on all models. The valve consists of a front brake metering (hold-off) valve and a front/rear pressure differential switch.

A red, brake indicator and warning light is used to alert the driver if a pressure differential exists between the front and rear hydraulic systems. The light also alerts the driver when the parking brakes are applied. The light is located at the left side of the instrument cluster.

An additional indicator light is used for the antilock system. This light is amber and is located in the same side of the instrument cluster as the red indicator light. The anti-lock light alerts the driver if an anti-lock system fault occurs.

ANTILOCK REAR WHEEL BRAKE SYSTEM (RWAL)

All truck models are equipped with antilock rear brakes. The RWAL system is designed to retard wheel lockup during periods of high wheel slip when braking. Retarding wheel lockup is accomplished by modulating fluid pressure to the wheel brake units. Refer to the Rear Wheel AntiLock Brake section for operation and service information.

BRAKE FLUID/LUBRICANTS/CLEANING SOLVENTS

Recommended fluid for all AD models is Mopar brake fluid or equivalent meeting SAE J1703 and DOT 3 standards.

When servicing rear brakes, use Mopar multi purpose grease to lubricate caliper slide surfaces, drum brake pivot pins and shoe contact points on the backing plates. Use GE 661 or Dow 111 silicone grease on caliper bushings and slide pins.

Use fresh brake fluid or Mopar brake cleaner to clean or flush brake system components. These are the only cleaning materials recommended.

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. If system contamination is suspected, check the fluid for dirt, discoloration, or separation into distinct layers. Drain and flush the system with new brake fluid if contamination is suspected.

BRAKE SAFETY PRECAUTIONS

WARNING: DUST AND DIRT ON BRAKE PARTS GENERATED DURING THE NORMAL USE AND WEAR OF MOTOR VEHICLE BRAKE SYSTEMS MAY CONTAIN ASBESTOS FIBERS. BREATHING EXCESSIVE CONCENTRATIONS OF ASBESTOS FIBERS CAN CAUSE SERIOUS BODILY HARM. EXTREME CARE SHOULD BE EXERCISED WHILE SERVICING BRAKE ASSEMBLIES OR COMPONENTS. DO NOT CLEAN BRAKE ASSEMBLIES OR COMPONENTS WITH COMPRESSED AIR OR BY DRY BRUSHING. USE A VACUUM CLEANER SPECIFICALLY RECOMMENDED FOR USE WITH ASBESTOS FIBERS. IF A SUITABLE VACUUM CLEANER IS NOT AVAILABLE, CLEANING SHOULD BE DONE WET USING A WATER DAMPENED CLOTH. DO NOT CREATE DUST BY SANDING, GRINDING, AND/OR SHAVING BRAKE LININGS OR PADS UNLESS SUCH OPERATION IS DONE WHILE USING PROPERLY EXHAUST VENTILATED EQUIPMENT. DISPOSE OF ALL DUST AND DIRT SUSPECTED TO CONTAIN ANY ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS TO MINIMIZE DUST EXPOSURE TO YOURSELF AND OTHERS. FOLLOW ALL RECOMMENDED PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION AND THE ENVIRONMENTAL PROTECTION AGENCY FOR THE HANDLING, PROCESSING, AND DISPOSITION OF DUST OR DIRT WHICH MAY CONTAIN ASBESTOS FIBERS.

SERVICE DIAGNOSIS

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DIAGNOSIS PROCEDURES

Brake diagnosis involves determining if the problem is related to a mechanical, hydraulic or vacuum operated component. A preliminary check, road testing and component inspection can all be used to determine a problem cause.

Road testing will either verify proper brake operation or confirm the existence of a problem. Component inspection will, in most cases, identify the actual part causing a problem.

The first diagnosis step is the preliminary check. This involves inspecting fluid level, parking brake action, wheel and tire condition, checking for obvious leaks or component damage and testing brake pedal response. A road test will confirm or deny the existence of a problem. The final diagnosis procedure involves road test analysis and a visual inspection of brake components.

PRELIMINARY BRAKE CHECK

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

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

(3) Inspect brake fluid level and condition. Note that the front disc brake reservoir fluid level will drop in proportion to normal lining wear.

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

(b) If fluid appears contaminated, drain out a sample. If fluid is separated into layers, or obviously contains oil or a substance other than brake fluid, the system seals and cups will have to be replaced and the hydraulic system flushed.

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

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

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

ROAD TESTING

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

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

(3) During road test, make normal and firm brake stops in 25-40 mph (40-64 Km/h) range. Note faulty brake operation such as pull, grab, drag, noise, low pedal, hard pedal, fade, pedal pulsation, etc.

(4) Inspect suspect brake components and refer to problem diagnosis information for causes of various brake conditions.

COMPONENT INSPECTION

Fluid leak points and dragging brake units can usually be located without removing any components. The area around a leak point will be wet with fluid. The components at a dragging brake unit (wheel, tire, rotor) will be quite warm or hot to the touch.

Other brake problem conditions will require component removal for proper inspection. Raise the vehicle and remove the necessary wheels for better visual access.

DIAGNOSING BRAKE PROBLEMS

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 brakeline, fitting, hose, or caliper. Internal leakage in the master cylinder caused by worn or damaged piston cups, may also be the problem cause.

If leakage is severe, fluid will be evident at or around the leaking component. However internal leakage in the master cylinder will not be physically evident. Refer to the cylinder test procedure in this section.

LOW PEDAL

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

A decrease in fluid level in the master cylinder reservoirs may only be the result of normal lining wear. Fluid level can be expected to decrease in proportion to wear. It is a result of the outward movement of caliper and wheel cylinder pistons to compensate for normal wear. Top off the reservor fluid level and check brake operation to verify proper operation.

SPONGY PEDAL

A spongy pedal is most often caused by air in the system. 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 suspect quality brake lines and hoses.

HARD PEDAL OR HIGH PEDAL EFFORT

A hard pedal or high pedal effort may be due to lining that is water soaked, contaminated, glazed, or badly worn. The power booster or check valve could also be faulty. Test the booster and valve as described in this section.

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

Brake drag also has a direct effect on fuel economy. If undetected, minor brake drag can be misdiagnosed as an engine or transmission/torque converter problem.

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.

Some 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 bracket, drum brakeshoes binding on worn or damaged support plates, or misassembled components.

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

BRAKE FADE

Brake fade is a product of overheating caused by brake drag. However, brake overheating and subsequent 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 additional causes.

PEDAL PULSATION

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

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

PULL

A front pull condition could be the result of contaminated lining in one caliper, seized caliper piston, binding caliper, loose caliper, loose or corroded slide pins, improper brakeshoes, or a 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, efficency 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.

When diagnosing a change in pull condition, 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 an improperly adjusted or seized parking brake cable, 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 lightly applied for a mile or two. However, if the lining is both wet and dirty, disassembly and cleaning will be necessary.

BRAKE NOISE

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 can 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 brakeshoes in spots, metal-to-metal contact occurs. If the condition is allowed to continue, rotors can become so scored that replacement is necessary.

Thump/Clunk

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 pins can generate a thump or clunk noise. In addition, worn out, improperly adjusted, or improperly assembled rear brakeshoes can also produce noise a thump noise.

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.

BRAKELINING CONTAMINATION

Brakelining contamination is usually a product of leaking calipers or wheel cylinders, driving through deep water puddles, or lining that has become covered with grease and grit during repair.

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 wheel tramp and generate shudder during brake operation.

A tire with internal damage such as a severe bruise or ply separation can cause pull and vibration.

MASTER CYLINDER/POWER BOOSTER TEST

(1) Start engine and check booster vacuum hose connections. 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.

(a) If pedal holds firm, proceed to step (5).

(b) If pedal does not hold firm and falls away, master cylinder is faulty (internal leakage).

(5) Start engine and note pedal action.

(a) If pedal falls away slightly under light foot pressure then holds firm, proceed to step (6).

(b) If no pedal action is discernible, power booster or vacuum check valve is faulty. Install known good check valve and repeat steps (2) through (5).

(6) Rebuild booster vacuum reserve as follows: Release brake pedal. Increase engine speed to 1500 rpm, close the throttle and immediately turn off ignition.

(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, perform booster and check valve vacuum tests.

POWER BOOSTER CHECK VALVE TEST

(1) Disconnect the vacuum hose from check valve.

(2) Remove check valve and valve seal from booster (Fig. 1).

(3) Hand operated vacuum pump can be used for test (Fig. 2).

(4) Apply 15-20 inches (50-67 kPa) vacuum at large end of check valve (Fig. 1).

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

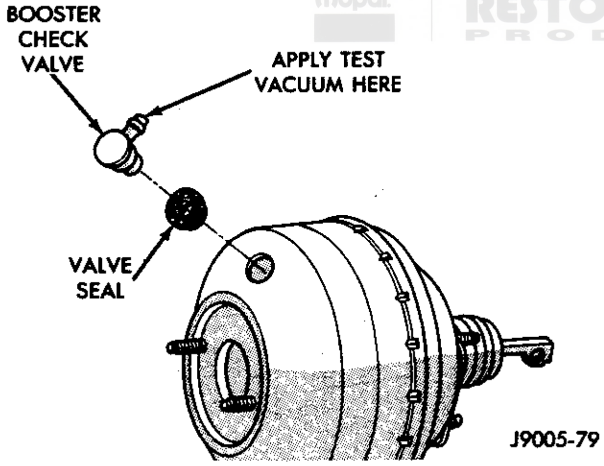

Fig. 1 Vacuum Check Valve And Seal (Typical)

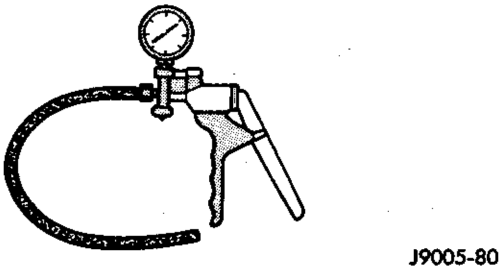

Fig. 2 Hand Operated Vacuum Pump (Typical)

POWER BOOSTER VACUUM TEST

(1) Connect a vacuum gauge to the booster check valve with a short length of hose and a T-fitting (Fig. 3).

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

(3) Clamp hose shut between vacuum source and check valve (Fig. 3).

(4) Stop engine and observe vacuum gauge.

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

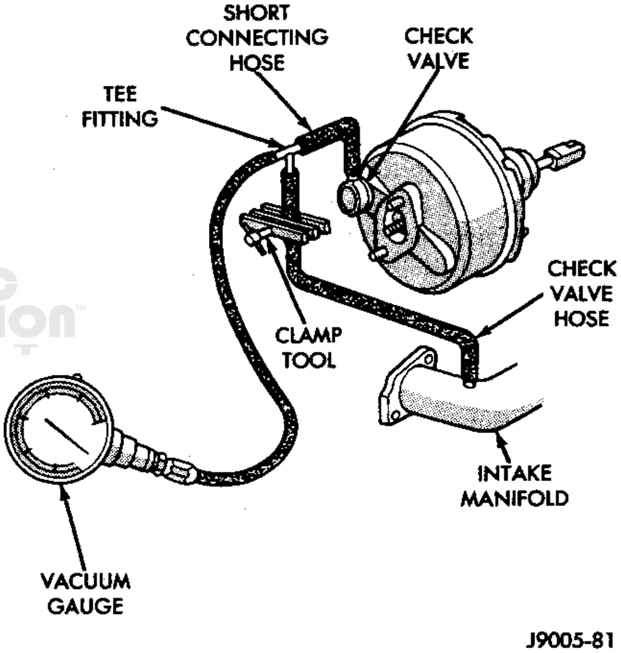

Fig. 3 Typical Booster Vacuum Test Connections

SERVICE ADJUSTMENTS

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BRAKE FLUID AND LEVEL

RECOMMENDED FLUID

The only brake fluid recommended for AD models is Mopar brake fluid, or an equivalent fluid meeting SAE J1703 and DOT 3 standards.

Use new brake fluid only, to top off the master cylinder or refill the system. Never use reclaimed fluid, fluid not meeting the SAE/DOT standards, fluid marked 70R1, or fluid from a container that has been left open for any length of time. Using non recommended or unspecified fluid can result in brake failure after hard prolonged braking.

BRAKE FLUID LEVEL

Always clean the master cylinder cover before checking fluid level. If not cleaned, dirt from the cover could enter the fluid. Also check the cover seal and replace it if torn or distorted.

Correct fluid level is to the bottom of the ring indicators on models with a plastic reservoir and to within 1/4 inch of the reservoir rim on all others.

If necessary, add fluid to bring up to the proper level. Note that on disc brake equipped vehicles, fluid level can be expected to fall as the brake pads wear.

BRAKE FLUID CONTAMINATION

Oil in the fluid will cause brake system rubber seals to soften and swell. The seals may also become porous and begin to deteriorate.

If fluid contamination is suspected, drain off a sample from the master cylinder. A suction gun can or similar device can be used for this purpose.

Empty the drained fluid into a glass container. Contaminants in the fluid will cause the fluid to separate into distinct layers. If contamination has occurred, the system rubber seals, hoses and cups must be replaced and the system thoroughly flushed with clean brake fluid.

REAR BRAKE ADJUSTMENT

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

Adjustment can be performed with a standard brake gauge or with adjusting tool C-3784.

ADJUSTMENT WITH STANDARD BRAKE GAUGE

(1) Verify that the left/right automatic adjuster lever and cable are properly connected and that the parking brakes are fully released. Be sure there is slack in the cables.

(2) Insert the brake gauge in the drum. Expand the gauge until the gauge inner legs contact the drum braking surface. Then lock the gauge in position (Fig. 1).

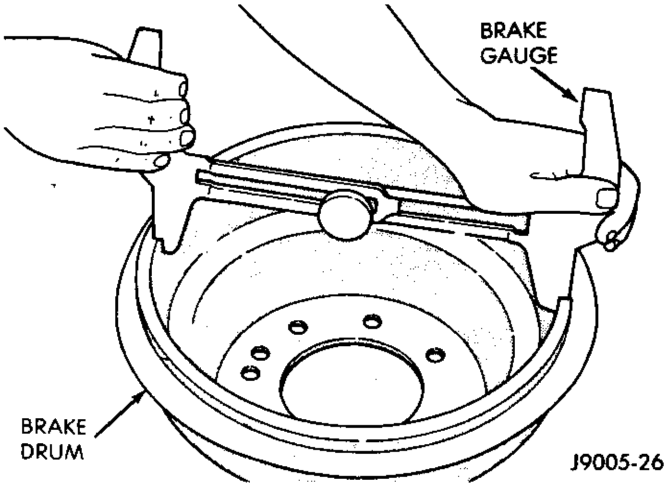

Fig. 1 Adjusting Gauge To Brake Drum

(3) Reverse the gauge and install it on the brakeshoes (Fig. 2). Position the gauge legs at the shoe centers as shown. If the gauge does not fit (too loose/too tight), adjust the shoes.

(4) Pull the shoe adjuster star wheel away from the automatic adjuster lever.

(5) Turn the adjuster star wheel (by hand) to expand or retract the brakeshoes. Continue adjustment until the gauge outside legs are a light drag-fit on the shoes (Fig. 2).

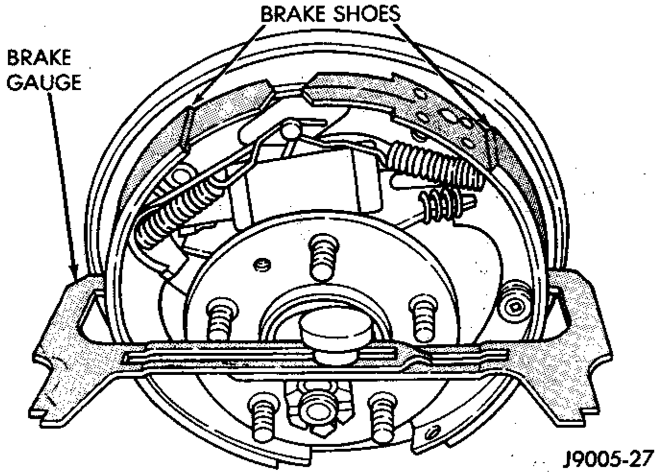

Fig. 2 Adjusting Brakeshoes To Gauge

(6) Repeat adjustment at the opposite brakeshoe assembly.

(7) Install the brake drums and wheels and lower the vehicle.

(8) Make final adjustment. Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to actuate adjuster mechanism and equalize adjustment. Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate the automatic adjusters.

ADJUSTMENT WITH TOOL C-3784

(1) Release parking brakes fully, if applied. Be sure there is slack in the cables.

(2) Raise vehicle so all wheels are free to turn.

(3) Remove rubber plugs from access holes in support plates.

(4) Insert adjusting Tool C-3784 into star wheel of adjuster screw. Turn star wheel counterclockwise (move tool upward) until a slight drag is felt when road wheel is rotated.

(5) Insert a thin screwdriver or length of welding rod into support plate access hole and push adjuster lever out of engagement with star wheel (Fig. 3). Do not bend the lever or distort the lever spring.

(6) Hold adjuster lever away from star wheel. Then back off star wheel to until shoe drag on the drum is eliminated.

(7) Repeat above adjustment at the opposite wheel. Be sure adjustment is equal.

(8) Install access hole plugs in support plate.

(9) Adjust the parking brake after wheel brake adjustment.

(10) Make final adjustment. Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to actuate adjuster mechanism and equalize adjustment. Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate the automatic adjusters.

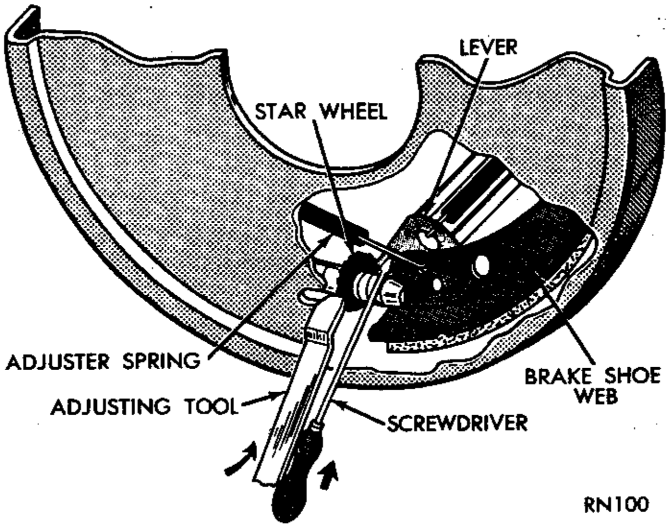

Fig. 3 Rear Brake Adjustment With Tool C-3784

TESTING DRUM BRAKE ADJUSTER OPERATION

Place the vehicle on a hoist, with a helper in the driver seat to apply the brakes.

(2) Remove the access plugs from the support plates.

(3) Back off the adjuster screw star wheel approximately 30 notches.

(4) Observe the adjuster screw star wheel and spin the drum and road wheel wheel rapidly in the reverse direction. Have the helper apply the brakes with quickly and with more than normal force. Firm brake application will cause the secondary shoe to move and engage the rotating drum. The resulting shoe wrap-up effect should move the secondary shoe enough to cause the adjuster cable to pull the adjuster lever up and turn the star wheel.

BRAKE SYSTEM BLEEDING

The brake system can be bled manually or with pressure equipment. Manual bleeding requires the aid of a helper. Pressure equipment allows the system to be bled by one person.

All models are equipped with a front brake metering (hold off) valve. The metering valve is located within the combination valve. The metering valve balances brake action between the front disc and rear drum brakes during initial brake application.

The metering valve is designed to hold off fluid flow to the front disc brakes at pressures between 3 and 135 psi (20.68 and 930.8 kPa). The pressures generated by gravity or manual type bleeding techniques will not affect the valve. However, pressure bleeding equipment will generate enough fluid pressure (20 to 30 psi) to close the valve and prevent fluid flow to the front brakes. As a result, the valve must be held open with special tool C-4121 when using pressure bleeding equipment.

BLEEDING PROCEDURE

(1) If a new or overhauled master cylinder will be used, be sure to bleed the cylinder before installing it in the vehicle. Refer to the procedure in the Master Cylinder section.

(2) If master cylinder has not been serviced, clean all dirt and foreign material from master cylinder and cover to prevent dirt entering the cylinder reservoirs. Then remove the cover.

(3) If pressure bleeding tank C-3496-B will be used, install adapter C-4578 on the master cylinder and prepare the tank for bleeding according to instructions provided by the supplier.

(4) If pressure bleeding equipment will be used, hold the metering valve open with tool C-4121. The tool is installed on the valve stem to hold it (and the valve) open (Fig. 4).

CAUTION: Under no condition should a rigid clamp, wedge or block be used to press the valve stem inward tyo hold the valve open. This practice could damage the valve resulting in valve failure and complete loss of front brake action. Note that the valve stem is in its innermost position when there is no pressure present. No attempt should be made to further depress the valve stem.

(5) Bleed the system in the following sequence and bleed only one wheel or valve at a time:

- RWAL hydraulic valve
- right rear wheel
- left rear wheel
- right front wheel
- left front wheel

(6) Clean the bleed screw on the RWAL hydraulic valve. Connect a bleed hose to the screw and insert the opposite end of the bleed hose in a glass container partially filled with brake fluid. Be sure the end of the bleed hose is fully submerged in fluid otherwise air will be drawn back into the system.

(7) Perform bleeding operations as follows:

(a) If **manual bleeding**, have the helper press the brake pedal to the floorpan. Tighten the bleed screw at this point and and have the helper release the pedal. Open the bleed screw and have the helper press the pedal down again. Continue bleeding until only clear, bubble free fluid flows into the container. Move on to the right rear wheel after valve bleeding is completed.

(b) If **pressure bleeding**, open the bleed screw and allow fluid to flow through the valve. Stop bleeding when only clear, bubble free fluid flows into the fluid container.

(8) Continue bleeding operations in the recommended sequence at the wheel brake units.

(9) Repeat the bleeding procedure if the system indicator lights remain on or if the pedal is spongy.

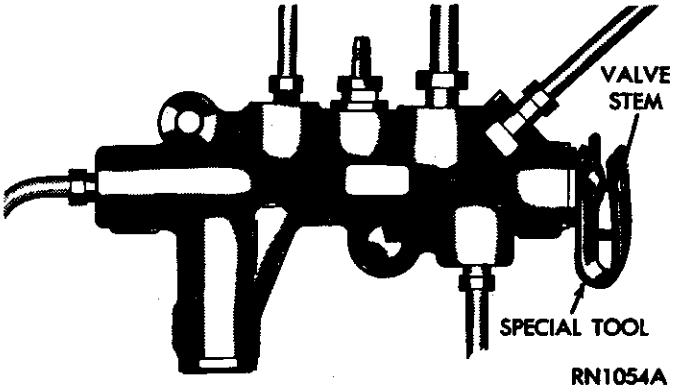

Fig. 4 Metering Valve Tool C-4121

WHEEL NUT TIGHTENING

The wheel attaching nuts must be tightened properly to ensure efficient brake operation. Overtightening the nuts or tightening them in the wrong sequence can cause distortion of the brake rotors and drums.

Impact wrenches are not recommended for tightening wheel nuts. A torque wrench should be used for this purpose at all times.

The correct tightening sequence is important in avoiding rotor and drum distortion. The correct sequence is in a diagonal crossing pattern (Fig. 5).

Seat the wheel and install the wheel nuts finger tight. Tighten the nuts in the sequence to 1/2 required torque. Then repeat the tightening sequence to final specified torque.

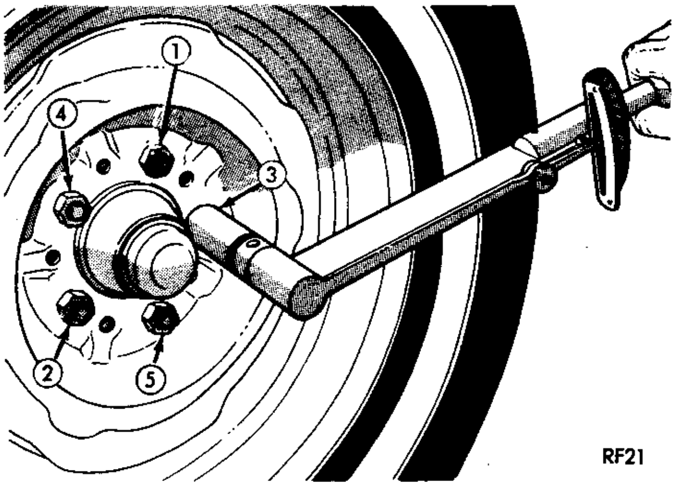

Fig. 5 Wheel Nut Tightening Sequence

STOP LAMP SWITCH ADJUSTMENT

The stop lamp (or stop lamp/speed control) switch and mounting bracket assembly is attached to the brake pedal bracket. The switch is actuated by the brake pedal blade on all models and is adjusted as follows:

WITHOUT SPEED CONTROL

(1) Loosen switch assembly to pedal bracket attaching screw and slide assembly away from pedal blade or striker plate.

(2) Push brake pedal down and allow to return to free position, do not pull brake pedal back at any time.

(3) Place appropriate spacer gauge on pedal brake.

(4) Slide switch assembly toward pedal blade until switch plunger is fully depressed against spacer gauge without moving the pedal.

(5) Retighten the switch bracket screw to 9 N•m (82 in-lbs).

(6) Remove spacer. Be sure that stop lamp switch does not prevent full pedal return. Incomplete pedal return can cause brake drag and premature lining and rotor wear.

WITH SPEED CONTROL

(1) Push switch through clip in mounting bracket until switch is sealed against bracket. The brake pedal will move forward slightly.

(2) Gently pull back on the brake pedal as far as it will go.

(3) The switch will ratchet backwards to the correct position and no further adjustment is required.

MASTER CYLINDER—COMBINATION VALVE—BRAKE LINES

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GENERAL INFORMATION

Two master cylinders are used on AD truck models. A two-section master cylinder with a removable reservoir is used on D and W 100/150 models (Fig. 1). An integral (one-piece) master cylinder with built-in fluid reservoirs is used on D and W 250/350 models (Fig. 2).

Two-Section Master Cylinder

The two-section master cylinder consists of the cylinder body and a removable fluid reservoir. The primary and secondary pistons are located in the aluminum body section. The removable reservoir is made of nylon reinforced with glass fiber and 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/rear brake malfunction. The reservoir compartments are designed to retain the necessary quantity of fluid needed to operate the functioning circuit.

Care must be excercised when removing/installing the master cylinder connecting lines. The threads in the fluid ports can be damaged if care is not practiced. Start all brake line fittings by hand to avoid cross threading.

The aluminum body section of the master cylinder is not a repairable component. If diagnosis indicates that an internal malfunction has occurred, the aluminum body section must be replaced as an assembly.

Integral Master Cylinder

The cast, one-piece master cylinder is a venting type with integral fluid reservoirs. The primary and secondary piston assemblies are located in the cylinder bore. The cylinder is a fully serviceable component and can be overhauled when necessary.

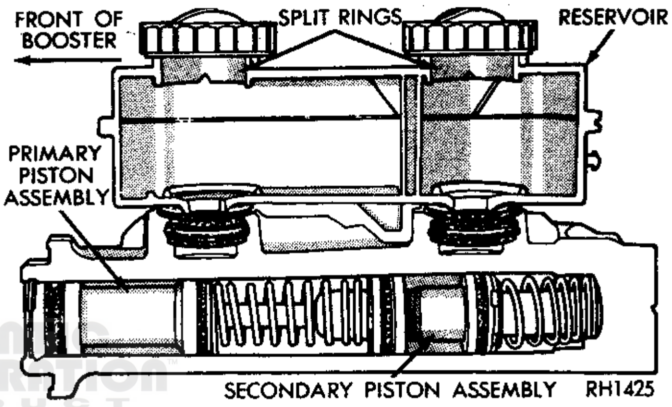


Fig. 1 Two-Section Master Cylinder

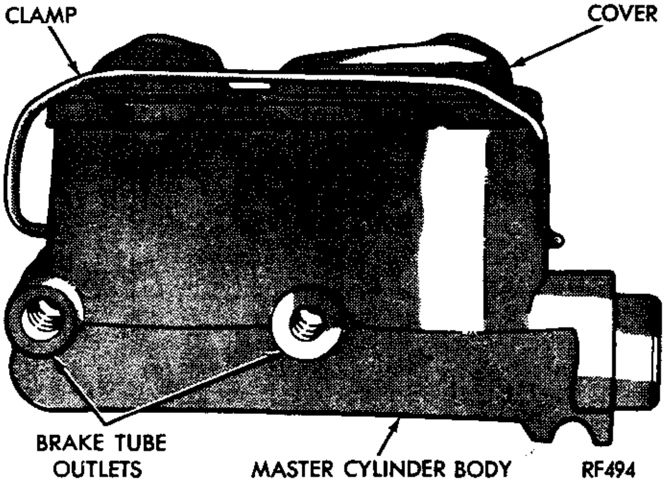


Fig. 2 Integral Master Cylinder

Combination Valve

A two-way combination valve is used on all AD models (Fig. 3). The two-way valve contains a front brake metering valve and a pressure differential valve and switch.

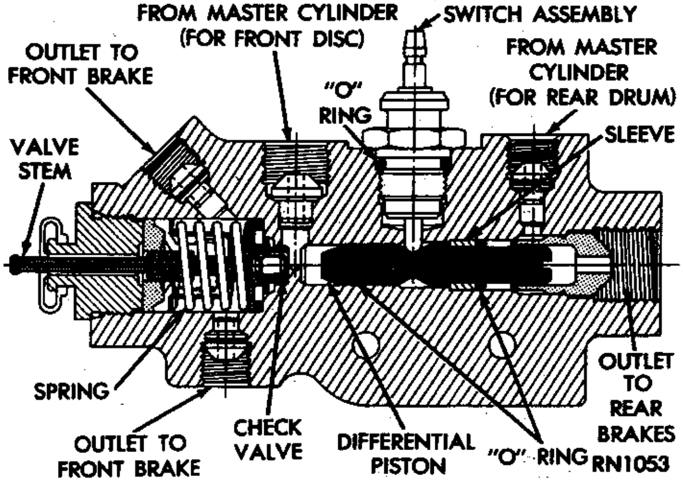


Fig. 3 Two-Way Combination Valve

MASTER CYLINDER REMOVAL

(1) Disconnect the primary and secondary brake tubes at the master cylinder.

(2) Install plugs in the cylinder outlet ports and brake tubes to prevent dirt entry.

(3) Remove the nuts attaching master cylinder to the power brake booster.

(4) Remove the master cylinder from the power brake booster mounting studs.

MASTER CYLINDER SERVICE—TWO-SECTION CYLINDER

The only serviceable component on the two-section cylinder is the nylon reservoir. If the cylinder body or internal components are worn or damaged, the cylinder body must be replaced as an assembly.

RESERVOIR REPLACEMENT—TWO-SECTION CYLINDER

(1) Clean the reservoir exterior and master cylinder body.

(2) Remove the reservoir caps and drain all fluid from the reservoir.

(3) Mount the master cylinder in a vise. Clamp the vise jaws on the aluminum body.

(4) Note position of the reservoir before removal.

(5) Remove the reservoir by firmly rocking it from side to side (Fig. 4). Continue rocking until the reservoir is free of the grommets.

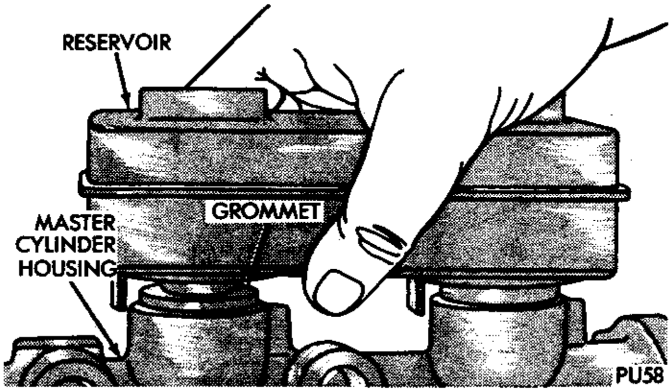


Fig. 4 Removing/Installing Cylinder Reservoir

(6) Remove and discard the grommets that secure the reservoir in the cylinder body.

(7) Install new reservoir grommets in the cylinder body.

(8) Lubricate the new reservoir grommets with clean brake fluid.

CAUTION: The reservoir can be installed backwards if care is not excercised. Install the reservoir so the fluid fill information (on the reservoir side) is on the same side as the fluid outlet ports in the cylinder body (Fig. 4).

(9) Start the reservoir into the grommets. Then rock the reservoir side to side until fully seated. The reservoir bottom surface should touch the grommets.

(10) Bleed the master cylinder before installing it on the vehicle. Refer to the procedure in this section.

MASTER CYLINDER SERVICE—INTEGRAL CYLINDER

The integral (one-piece) cylinder is a fully serviceable component. It can be overhauled to restore performance when necessary. Overhaul procedure is as follows.

INTEGRAL CYLINDER DISASSEMBLY AND INSPECTION

(1) Remove the cylinder cover (Fig. 5).

(2) Drain the fluid from the cylinder reservoirs.

(3) Mount the cylinder in a vise.

(4) Press the cylinder pistons inward with a wood dowel and remove the the piston snap ring (Fig. 6).

(5) Remove the primary piston assembly from the cylinder bore. Discard the piston assembly.

(6) If cylinder is equipped with piston stop screw for secondary piston, remove the stop screw before proceeding.

(7) Remove the secondary piston with compressed air applied through the brakeline port or the compensator port at the bottom of the reservoir. Discard the piston assembly after removal.

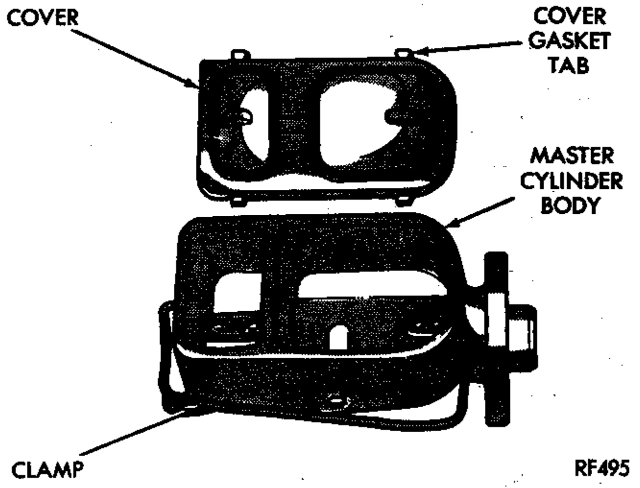


Fig. 5 Removing/Installing Cylinder Cover

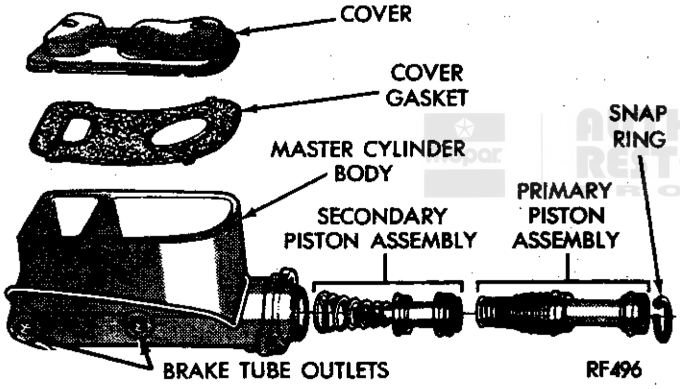


Fig. 6 Integral Cylinder Components

Cylinder Cleaning And Inspection

Clean the cylinder body and cover with brake fluid or brake cleaner only. Do not use any other type of solvents, or cleaning agent.

Inspect the cylinder body and bore. Light discoloration of the cylinder bore is normal and is an acceptable condition. The bore should be smooth and free of scores, scratches, corrosion and rust. Replace the cylinder if the bore is worn, scored, or corroded. **Do not hone the bore** in an attempt to restore the surface finish. Replace the cylinder if the bore is damaged in any way. Also replace the cylinder if the body is cracked, porous, or the compensator ports at the bottom of each reservoir is blocked or damaged.

Inspect the cover and gasket. Replace the gasket if distorted, cut, or torn. Replace the cover and retaining wire if either component is distorted or damaged in any way.

Do not reuse the old piston assemblies. Discard these parts as soon as they are removed. Install replacement primary and secondary piston assemblies only.

INTEGRAL CYLINDER ASSEMBLY

(1) Coat the cylinder bore and replacement piston assemblies with a liberal quantity of clean brake fluid.

(2) Install the secondary piston assembly in the bore with a turning motion. Do not use metal tools of any kind to help ease the piston into place. Sharp edge tools will scratch the bore and cut the piston.

(3) If the cylinder is equipped with a stop screw for the secondary piston, press the piston to the bottom of the bore and install the screw.

(4) Install the primary piston in the bore.

(5) Press the pistons inward with a wood dowel and install the piston snap ring. Be sure the snap ring is fully seated.

(6) Install a new gasket on the cover if necessary.

(7) Install the cover retaining wire on the cylinder if removed.

(8) Fill and bleed the master cylinder on the bench and before installation on the vehicle. Refer to the procedure in this section.

MASTER CYLINDER BLEEDING

Master cylinder bleeding should be performed on the bench before installation in the vehicle. For the integral master cylinder, required bleeding tools include fabricated bleed tubes and a wood dowel. For the two-section master cylinder, required bleeding tools include bleed tubes C-4029 and a wood dowel (Fig. 7).

CYLINDER BLEEDING PROCEDURE

(1) Mount the master cylinder assembly in a vise.

(2) Attach the bleed tubes to the cylinder outlet ports and insert the tubes in the reservoir fluid compartments (Fig. 7).

(3) Fill the reservoir with fresh brake fluid.

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

MASTER CYLINDER INSTALLATION

(1) Bleed master cylinder on bench before installation.

(2) Position master cylinder on studs of power brake unit.

(3) Align power brake push rod with master cylinder piston.

(4) Install and tighten cylinder attaching nuts to 23 N•m (200 in-lbs).

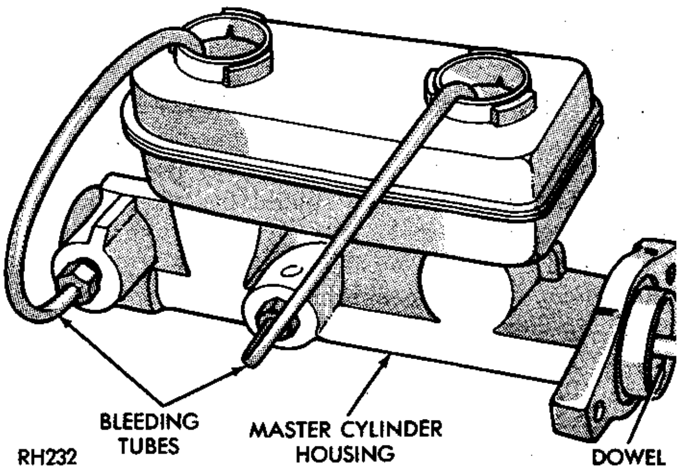


Fig. 7 Master Cylinder Bleeding—Two-Section Cylinder Shown

(5) Connect front and rear brakelines to cylinder. Start brakeline fittings by hand.

(6) Tighten brakeline fittings to 19 N•m (170 in-lbs).

(7) Bleed brakes.

COMBINATION VALVE OPERATION

METERING (HOLD-OFF) VALVE

The metering valve is used to balance brake action between the front disc and rear drum brakes. The valve meters (holds-off) full apply pressure to the front disc brakes until the rear brakeshoes are in full contact with the drums. The valve is designed to maintain front brake fluid pressure at 3-30 psi until the hold-off limit of 117 psi is reached. At this point, the metering valve opens completly permitting full fluid apply pressure to the front disc brakes.

PRESSURE DIFFERENTIAL SWITCH AND VALVE

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

A decrease or loss of fluid pressure in either hydraulic circuit will cause the switch valve to shuttle forward or rearward in response to a pressure differential. Movement of the switch valve will push the switch plunger upward. This closes the switch internal contacts completing the electrical circuit to the warning light. The switch valve will remain in an actuated position until repair restores system pressures to normal levels.

COMBINATION VALVE TESTING

TESTING METERING VALVE

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

TESTING PRESSURE DIFFERENTIAL SWITCH

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

(2) Raise the vehicle on a hoist.

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

(4) Have the helper press and hold the brake pedal all the way down and observe the warning light.

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

(b) If the light fails to illuminate, check the circuit fuse, bulb and wiring. Repair as necessary and repeat test steps (3) and (4).

(5) If the warning light still fails to illuminate, check the brakelight and parking brake switches and wiring with a test lamp. Repair or replace parts as necessary and test differential pressure switch operation again.

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

COMBINATION VALVE REMOVAL/INSTALLATION

VALVE REMOVAL

(1) Raise the vehicle on a hoist.

(2) Mark or tag the brake lines connected to the valve for assembly reference.

(3) Disconnect the lines at the valve (Fig. 8).

(4) Disconnect the wires from the differential pressure switch.

(5) Remove the bolts attaching the valve to frame bracket and remove the valve.

(6) Mount the new valve on the bracket and tighten the valve and bracket screws/nuts securely.

(7) Connect the brakelines to the valve. Tighten the fittings to 16 N•m (145 in-lbs)

(8) Connect the wires to the pressure differential switch terminal.

(9) Bleed the brakes.

(10) Lower the vehicle and verify proper brake operation.

BRAKE LINES AND HOSES

BRAKE LINE AND HOSE INSPECTION

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

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

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

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

BRAKE LINE AND HOSE REPLACEMENT

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 (Fig. 9). Be sure brake line connections are properly made (not cross threaded) and tightened to recommended torque.

Brake line routing, connections and tightening reference information is outlined in Figures 9 through 12.

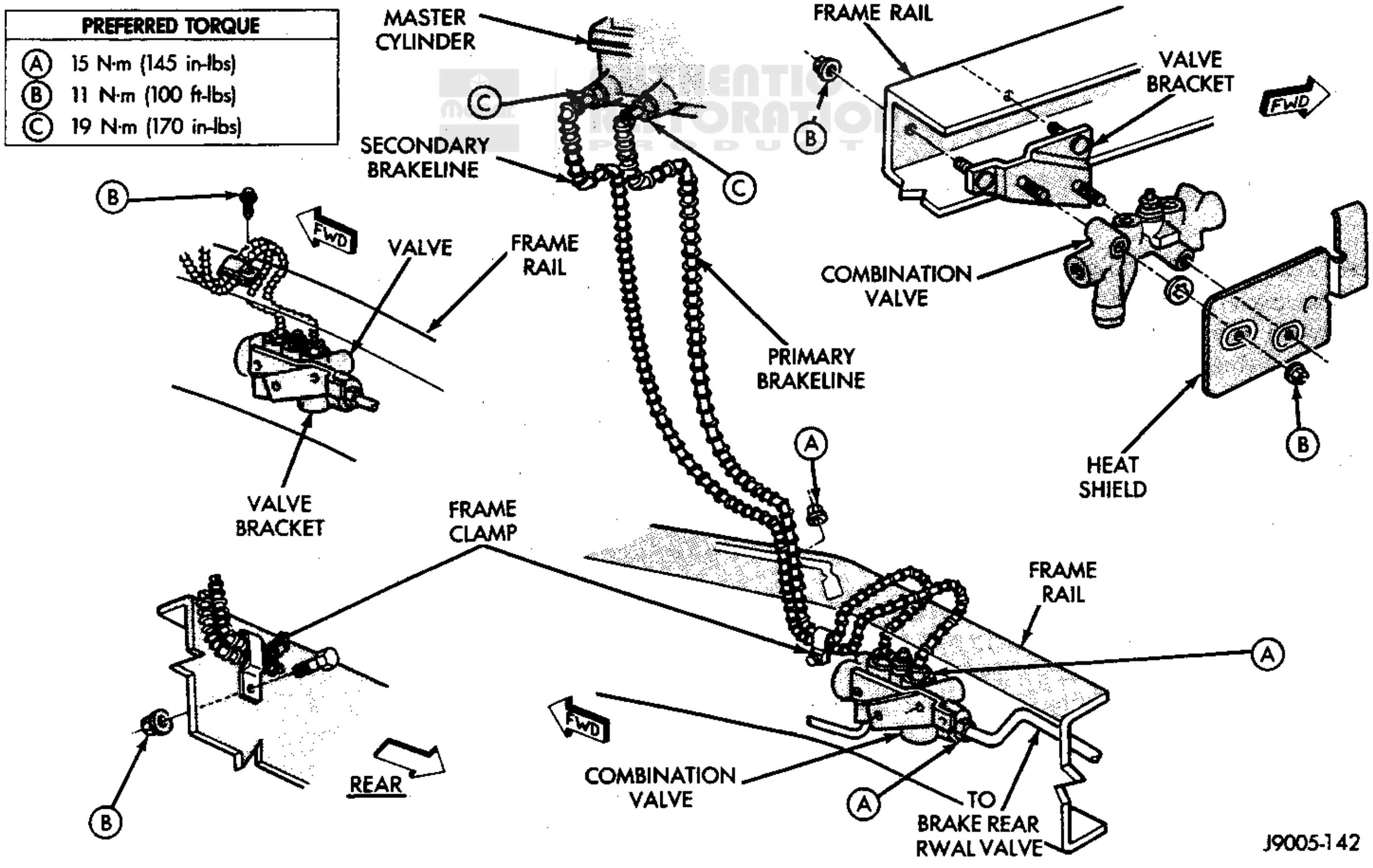
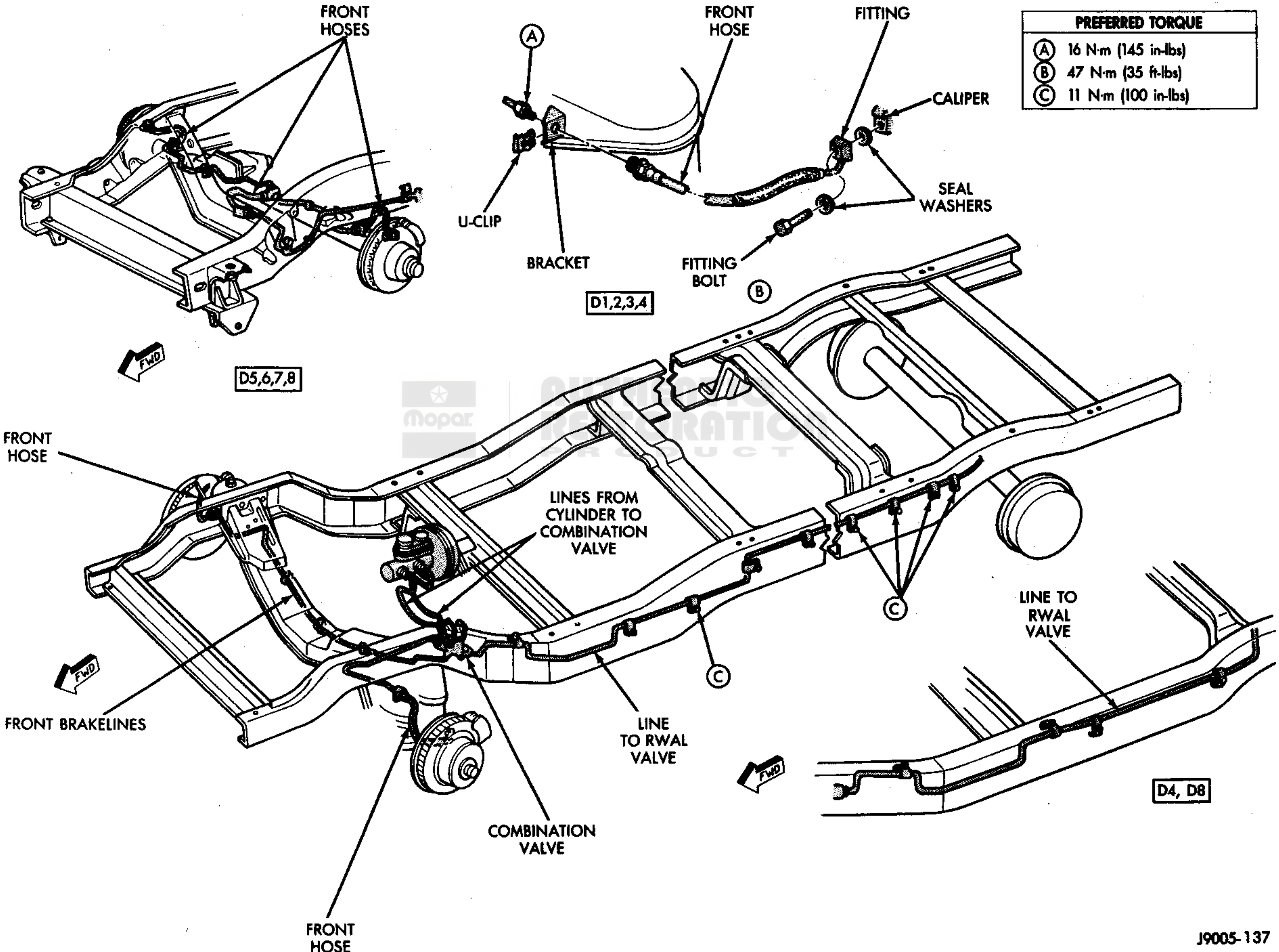
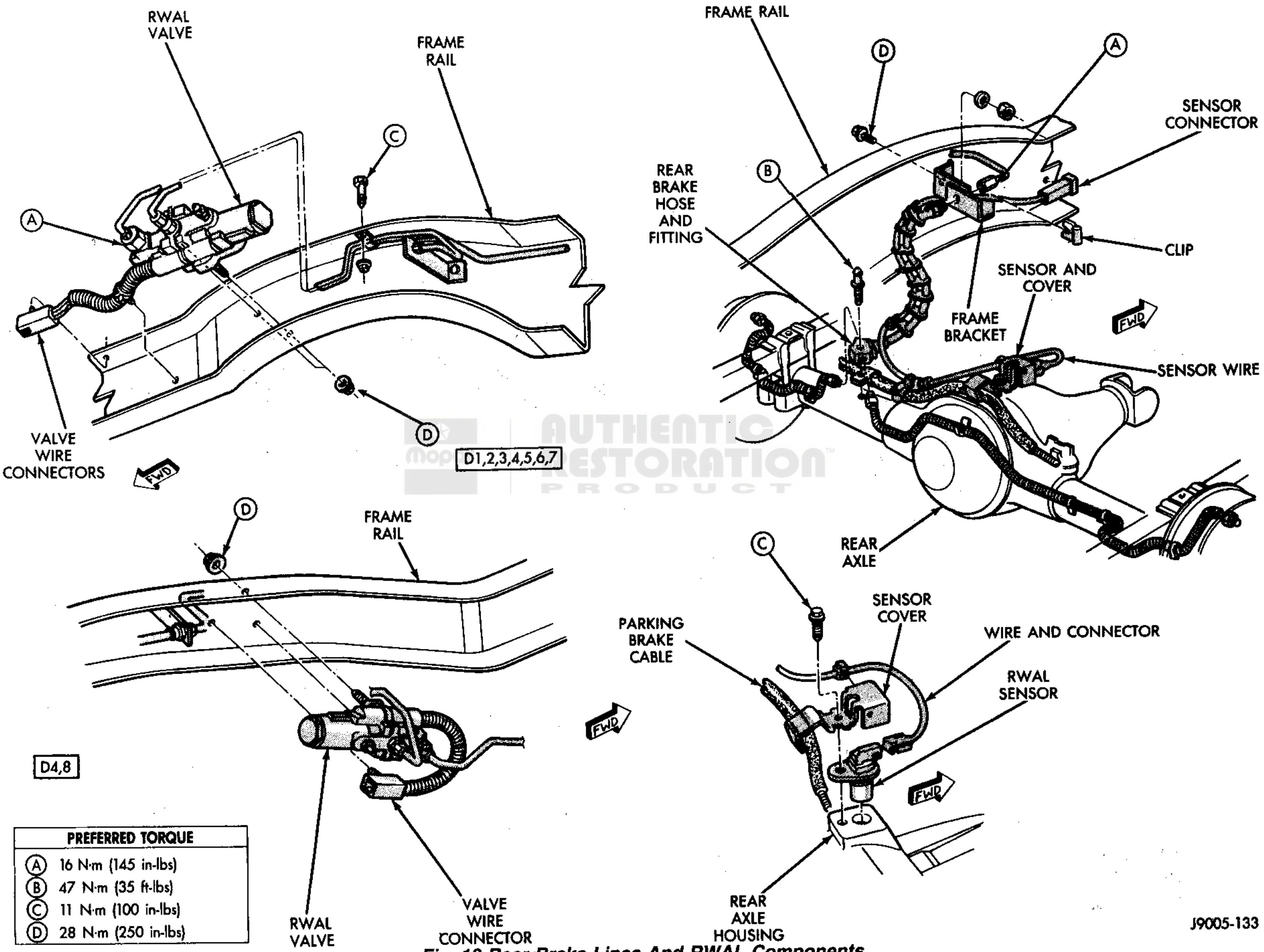


Fig. 8 Combination Valve Mounting



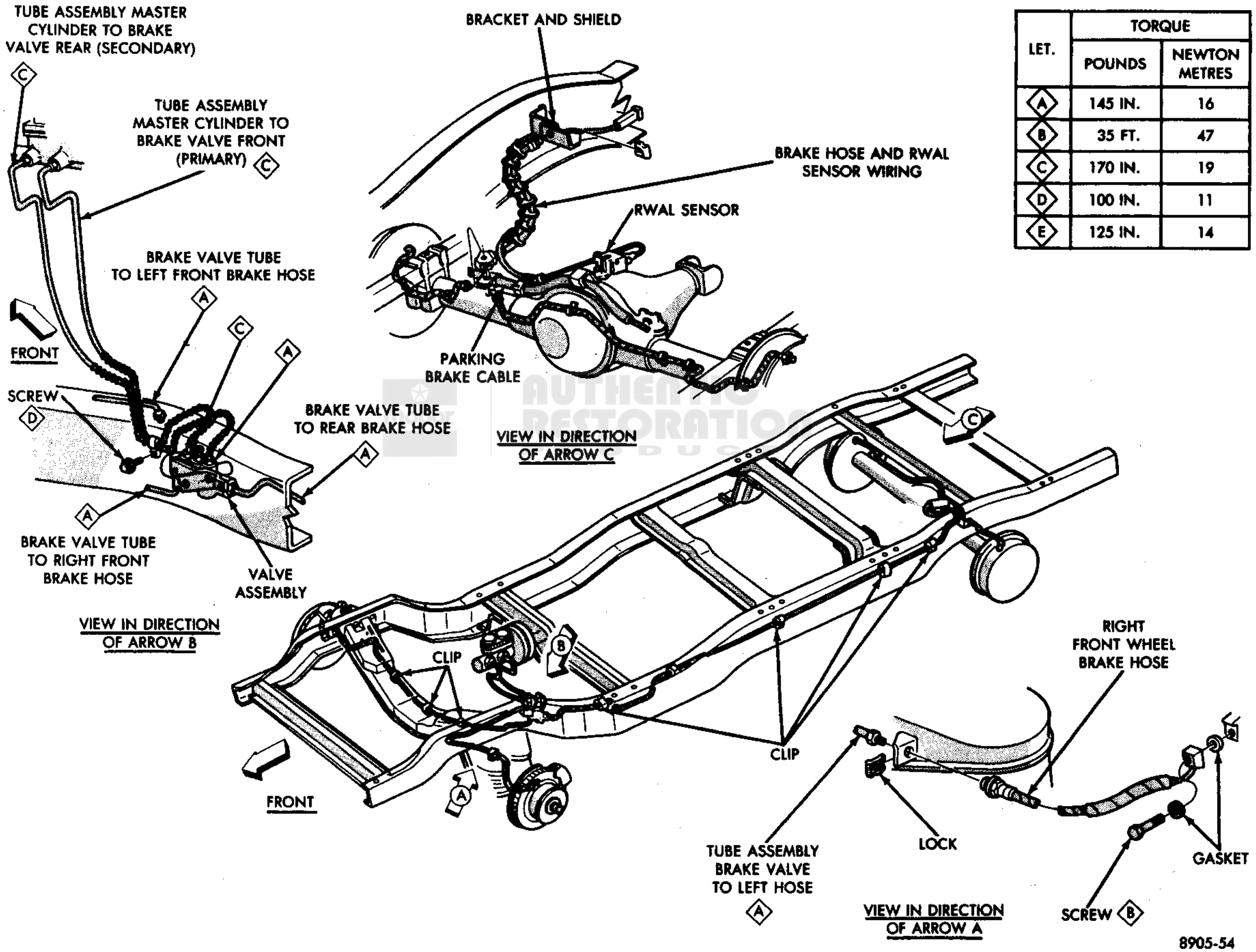
PREFERRED TORQUE	
Ⓐ	16 N·m (145 in-lbs)
Ⓑ	47 N·m (35 ft-lbs)
Ⓒ	11 N·m (100 in-lbs)

Fig. 9 Front Brake Lines



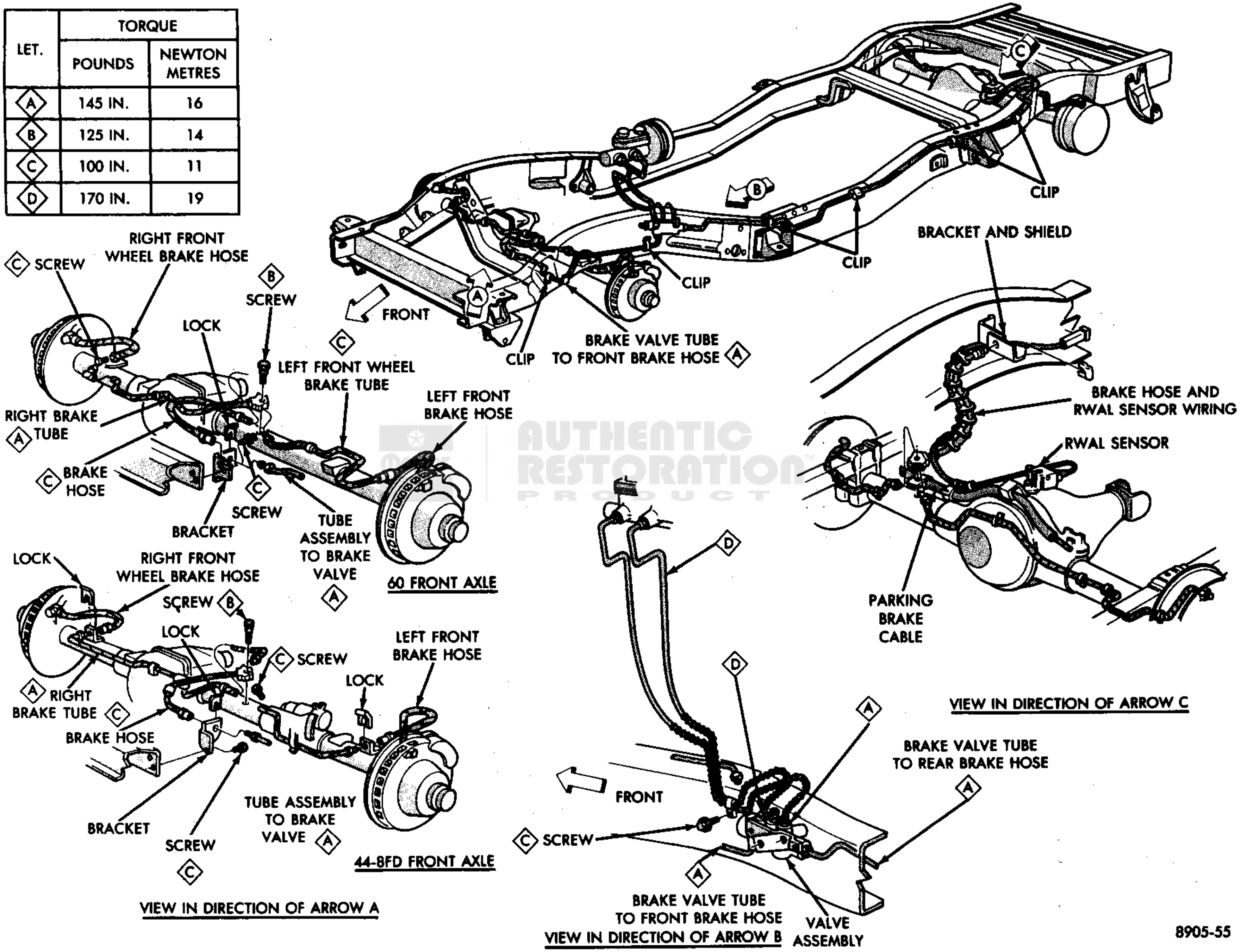
PREFERRED TORQUE	
Ⓐ	16 N·m (145 in-lbs)
Ⓑ	47 N·m (35 ft-lbs)
Ⓒ	11 N·m (100 in-lbs)
Ⓓ	28 N·m (250 in-lbs)

Fig. 10 Rear Brake Lines And RWAL Components



LET.	TORQUE	
	POUNDS	NEWTON METRES
A	145 IN.	16
B	35 FT.	47
C	170 IN.	19
D	100 IN.	11
E	125 IN.	14

Fig. 11 Brake Lines—Two-Wheel Drive Models



LET.	TORQUE	
	POUNDS	NEWTON METRES
A	145 IN.	16
B	125 IN.	14
C	100 IN.	11
D	170 IN.	19

Fig. 12 Brake Lines—Four-Wheel Drive Models

BRAKE LINE EMERGENCY REPAIR

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

Special, heavy duty tube bending and flaring equipment is required to prepare double wall brake line. Special bending tools are needed to avoid kinking or twisting metal brake line. In addition, special flaring tools are needed to provide the inverted-type, double flare required on metal brake lines.

Use tool C-4047 to provide the inverted, double flare (Fig. 8). Heavy duty tube bending tools are available through the dealer tool program.

Flaring Procedure

(1) Cut off damaged tube with tool C-3478-A or an equivalent tubing cutter.

(2) Ream cut edges of tubing to ensure proper flare.

(3) Install replacement tube nut on section of tube to be repaired.

(4) Insert tube in flaring tool. Center tube in area between vertical posts.

(5) Place gauge form A over the end of the tube (Fig. 13).

(6) Push tubing through flaring tool jaws until tube contacts recessed notch in gauge that matches tube diameter.

(7) Squeeze flaring tool jaws to lock tubing in place.

(8) Insert plug on gauge A in the tube. Then swing compression disc over gauge and center tapered flaring screw in recess of compression disc.

(9) Tighten tool handle until plug gauge is seated on jaws of flaring tool. This will start the inverted flare (Fig. 13).

(10) Remove the plug gauge and complete the inverted flare (Fig. 8).

(11) Remove the flaring tools and verify that the inverted flare is correct.

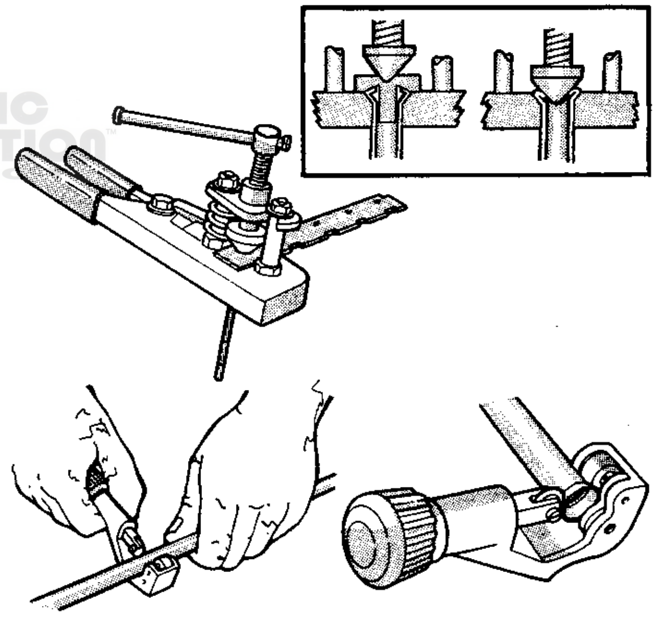


Fig. 13 Brakeline Flaring Tools

POWER BRAKE BOOSTER—BRAKE PEDAL

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GENERAL INFORMATION

Power brakes are standard on all AD models. A single or tandem diaphragm, vacuum power brake booster is used.

D and W100/150 models are equipped with a 250 mm (9.84 in), single diaphragm booster unit (Fig. 1). D and W250/350 models are equipped with a 200 mm (7.87 in), tandem (dual) diaphragm booster.

The booster unit consists of a single housing divided into separate chambers by one or two internal diaphragms. 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 utilizing a combination of vacuum and atmospheric pressure to boost brake assist.

The power brake booster is not a repairable component. The booster must be replaced as an assembly if diagnosis indicates a malfunction has occurred.

A suspended-type brake pedal is used for all applications. The pedal is attached to the pedal support bracket with a pivot shaft. The pedal, bolt and bushings are all serviceable components.

BOOSTER REMOVAL

(1) Disconnect vacuum hoses from booster check valve.

(2) Remove nuts attaching master cylinder to booster and move cylinder away from booster.

(3) Inside vehicle, remove clip that secures booster push rod to brake pedal (Fig. 1). Use screwdriver to pry clip off pedal pivot pin.

(4) Remove locknuts from booster mounting studs.

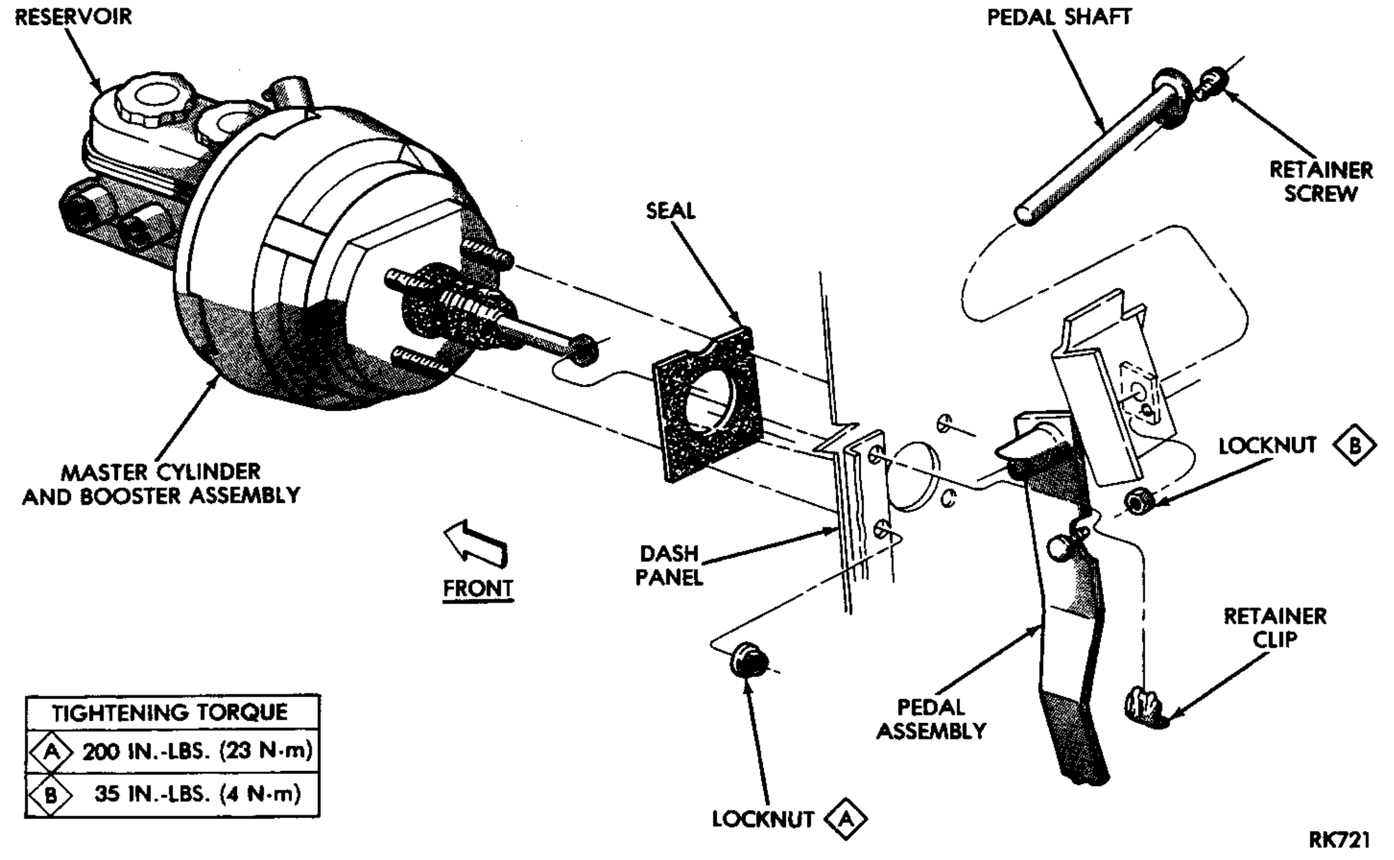

Fig. 1 Power Brake Booster And Pedal Mounting

(5) Slide booster away from dash and out of engine compartment.

(6) If booster is to be replaced, remove booster check valve and seal.

BOOSTER INSTALLATION

(1) If new booster is being installed, transfer check valve and seal to new booster.

(2) Align and position booster on dash panel.

(3) Install locknuts on booster mounting studs finger tight.

(4) Install booster push rod on brake pedal pin and secure the rod with a **new** retaining clip.

(5) Tighten the booster locknuts to 25 N•m (220 in-lbs) torque.

(6) Install master cylinder on booster. Then install and tighten cylinder mounting nuts to 19-23 N•m (170-200 in-lbs) torque.

(7) Connect vacuum hose to booster check valve.

BRAKE PEDAL REMOVAL/INSTALLATION

(1) Disconnect booster push rod from pedal.

(2) Remove screw attaching pedal shaft to brake support.

(3) Slide shaft out of support and remove brake pedal.

(4) Lubricate pedal shaft and shaft bore in pedal with Mopar multi-purpose grease.

(5) Position pedal in support and slide pedal shaft into place.

(6) Secure pedal shaft with retaining screw.

CHRYSLER DISC BRAKE

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GENERAL SERVICE INFORMATION

DISC BRAKE COMPONENTS

The Chrysler disc brake assembly is used on two-wheel drive models and four-wheel drive models with the 3300 and 4000 lb front axle. The caliper is a sliding type with a single, 3.1 inch (78.7 mm) diameter caliper piston (Figs. 1 and 2). Cast iron, ventilated dic brake rotors are used for all applications.

Each caliper is mounted on an adapter attached to the steering knuckle (Fig. 2). Each caliper slide laterally on surfaces machined on the caliper and mounting adapter. The adapters support the caliper and maintain fore and aft alignment of the caliper and brakeshoes. Two retainer clips are used to maintain caliper alignment but permit lateral movement needed for caliper operation.

Non-metallic caliper pistons are used for all applications. The pistons are made of a phenolic resin material.

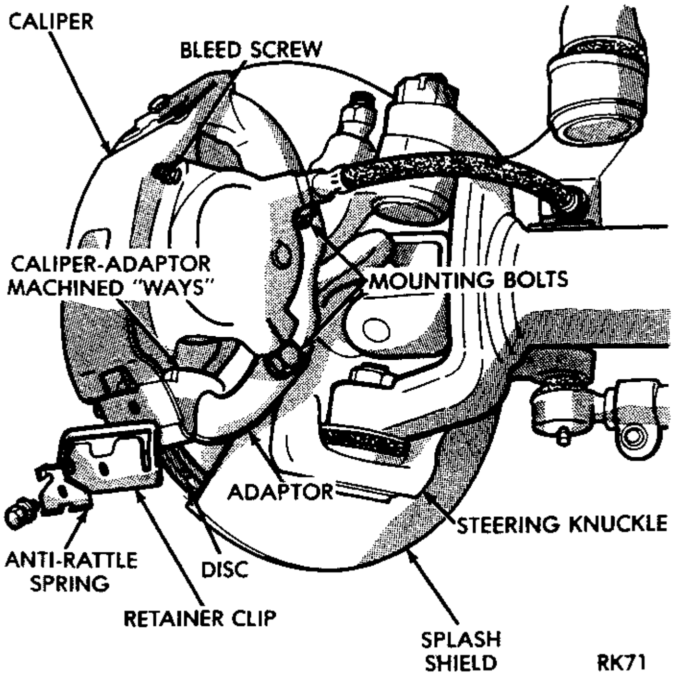

Fig. 1 Chrysler Disc Brake Caliper Mounting—Rear View

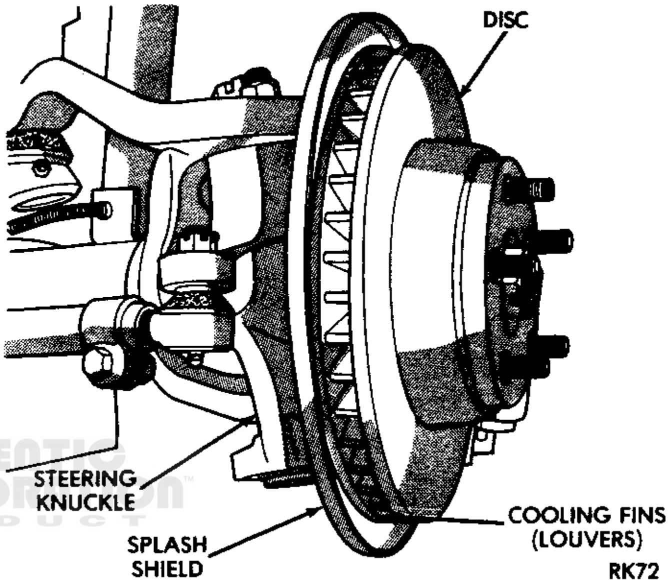

Fig. 2 Chrysler Disc Brake Caliper Mounting—Front View

Ventilated, cast iron disc brake rotors are used for all applications. The rotors are serviceable and can be machined to restore surface finish when necessary.

The outboard brake shoe has flanges that locate and position the shoe on the caliper fingers (Fig. 3). Braking force on this shoe is taken by the caliper. The inboard shoe is held in position by the adapter and reacts directly on the adapter.

The caliper is a one-piece casting with the inboard side containing the single piston cylinder bore (Fig. 3). A square-cut piston seal is located in a machined groove in the cylinder bore. A rubber dust boot is used to prevent dirt, water, road splash frtom entering the caliper piston bore. The boot is located in a counterbore machined into the outboard end of the caliper piston bore.

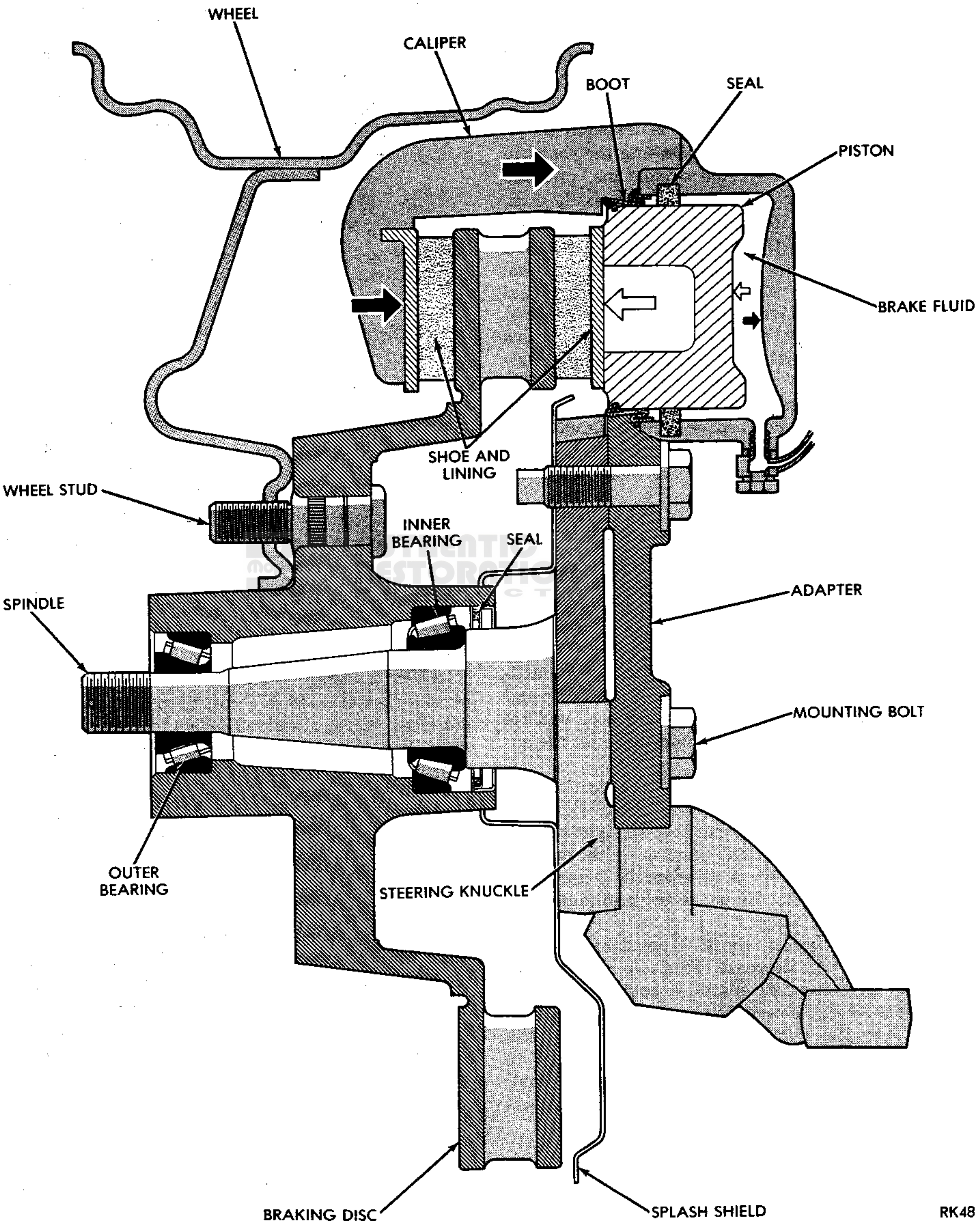

Fig. 3 Disc Brake Components

DISC BRAKE OPERATION

The significant feature of single piston caliper operation is that the caliper is free to move laterally on the slide surfaces.

At brake application, fluid pressure is exerted equally against the caliper piston and all surfaces of the caliper piston bore.

Pressure applied to the piston is transmitted directly to the inboard brakeshoe pressing the shoe lining against the rotor. At the same time, pressure applied to the caliper bore surfaces, causes the caliper to slide inward laterally. The inward movement presses the lining of the outboard shoe against the opposite side of the rotor to complete braking action.

The application or release of fluid pressure causes only a very slight movement of the caliper and piston. At brake release, the piston and caliper return to the non-appled position. The brakeshoes do not retract an appreciable distance from the rotor. The minimal running clearance between the lining and rotor provides improved response and reduced pedal travel; It also helps in preventing dirt and foreign material from lodging between the shoe and rotor surfaces.

DISC BRAKE LINING WEAR COMPENSATION

Normal lining wear is compensated for by extension of the caliper piston and by lateral movement of the caliper in the adapter. Piston position is also determined in part by the square cut piston seal (Fig. 4).

Normal disc brake lining wear will cause the caliper piston to extend enough to maintain proper pedal height and brake response. The caliper bore will receive the extra fluid needed to compensate for the additional piston extension.

As the piston extends during brake application, the square-cut seal is deflected outward (Fig. 4). When brake pressure is released, the seal straightens and returns to a normal relaxed position. Although the amount of seal movement is quite small, it is enough to retract the piston to the necessary minimum running clearance.

As lining wear occurs, the fluid level in the front brake reservoir will decrease. This is a normal condition and only requires adding enough fluid to restore proper level. However, when the brakeshoes are replaced and the caliper pistons bottomed in the bores, the added fluid must be compensated for to avoid overfill and overflow. Removing a small amount of fluid from the front brake reservoir beforehand will prevent this condition.

DISC BRAKE INSPECTION

Inspect the disc brake components whenever the caliper and brakeshoes are removed during service operations or routine maintenance.

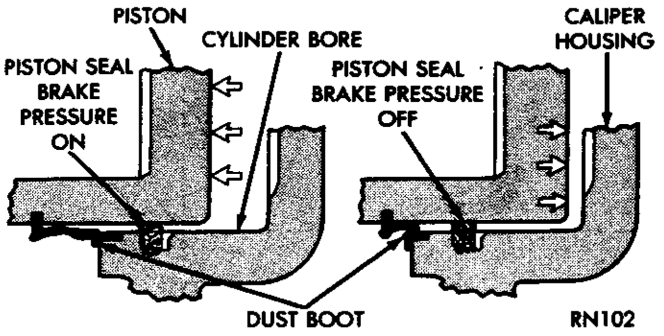

Fig. 4 Caliper Piston Seal Operation

Check condition of the rotor, brakeshoe lining, caliper and brake hoses. Front wheel bearing adjustment and condition can also be checked at this time. The bearings should be repacked and adjusted if necessary.

Brakeshoes

With the caliper and brakeshoes on the vehicle, check running clearance between the rotor and brakeshoes. The shoe lining should either be in very light contact with the rotor or have a maximum of .127 mm (.005 inch) running clearance. If clearance exceeds the stated amount, apply the brakes several times and recheck clearance. If clearance is still excessive, either the shoes are severely worn or the caliper piston could be binding in the bore.

Hoses And Adapter

Inspect condition of the brake lines and hoses. Replace either front hose if cut, torn, or the reinforcing fabric is visible. Check condition of the metal brakelines. Replace any line that is badly rusted, leaking or damaged in any way.

Clean and lubricate the slide surfaces of the caliper and adapter. Use Mopar high temperature grease for this purpose. Also verify that the caliper adapter bolts are secure and tightened to proper torque.

Fluid Level

Check the master cylinder fluid level. Maintain fluid level to the bottom of the indicator rings on the reservoir. Note that front disc brake fluid level can be expected to drop slightly as normal lining wear occurs. Use Mopar brake fluid or equivalent meeting SAE and DOT standards J1703 and DOT 3. Use clean brake fluid from a sealed container only.

Rotors

Check the rotor surfaces for excessive wear, discoloration, scoring, rust, scale, or cracks. Also look for damaged or severely rusted ventilating segments. If pedal pulsation was experienced, check wheel bearing adjustment and condition. If the bearings are OK, also check rotor runout and thickness variation.

BRAKE SHOE REMOVAL

(1) If front brakeshoes are to be replaced, remove approximately 1/3 of fluid from master cylinder front brake reservoir with suction gun.

(2) Raise and support vehicle.

(3) Remove front wheels.

(4) Bottom caliper pistons in bore with large C-clamp. Position clamp screw on outboard brakeshoe and opposite end of clamp frame on back of caliper.

(5) Remove bolts securing caliper retainer clips to caliper. Then remove clips and anti-rattle springs (Fig. 5).

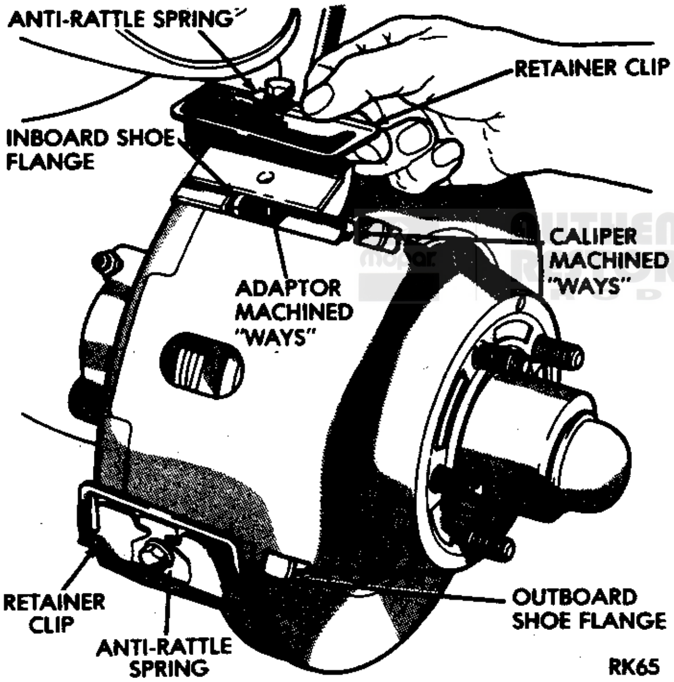

Fig. 5 Removing/Installing Retainer Clips and Anti-Rattle Springs

(6) Remove caliper by tilting it rearward and lifting up and off rotor (Fig. 6).

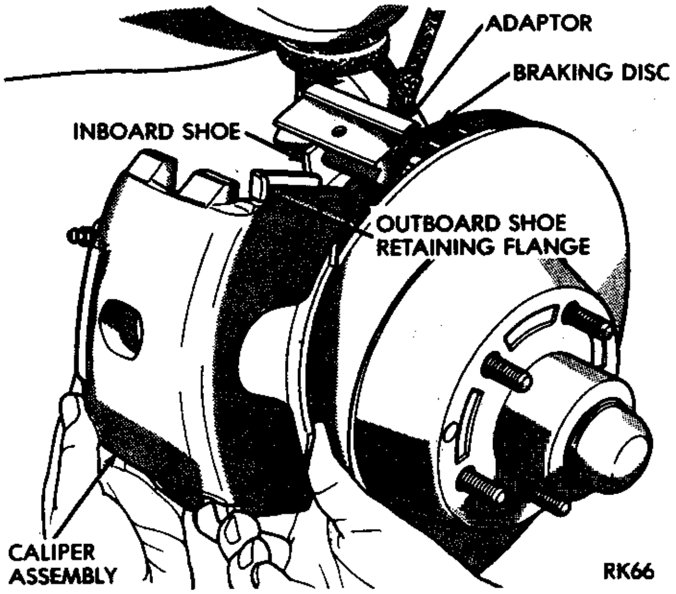

Fig. 6 Caliper Removal/Installation

(7) Remove outboard brakeshoe from caliper (Fig. 7). Use pry tool to remove shoe from caliper if flanges are tight.

(8) Remove inboard brakeshoe from caliper mounting adapter (Fig. 8).

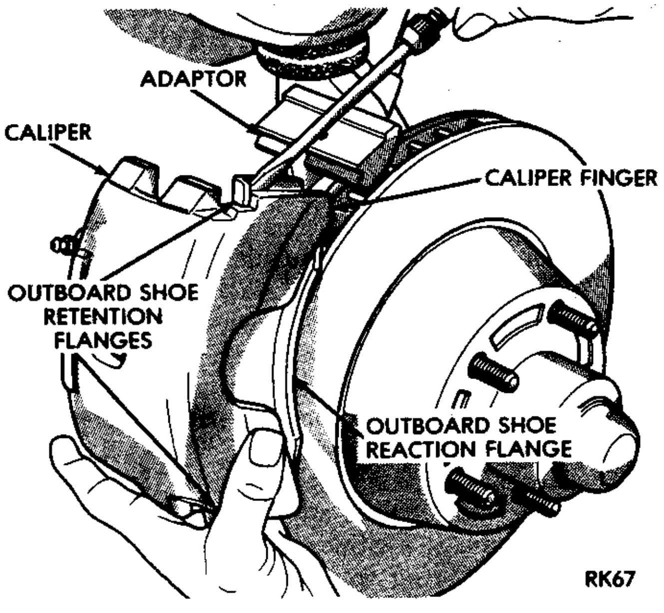

Fig. 7 Removing Outboard Brakeshoe

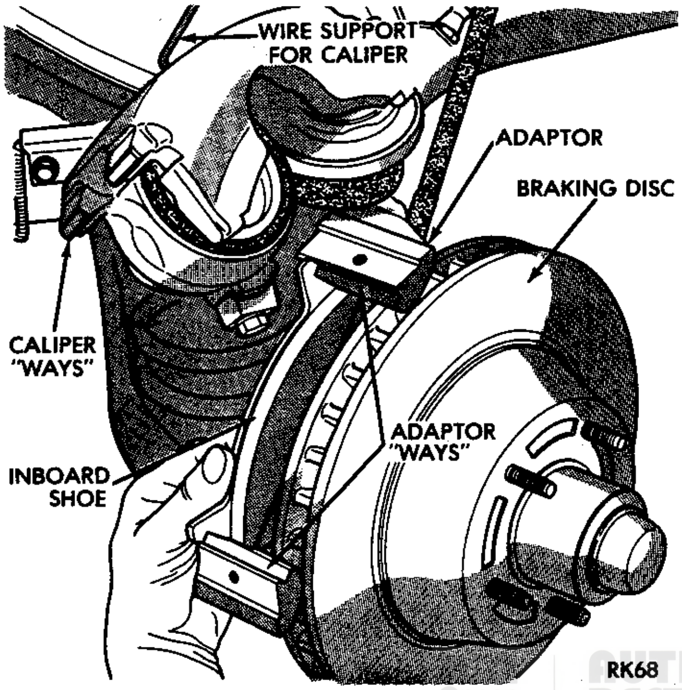

Fig. 8 Removing/Installing Inboard Brakeshoe

(9) Support caliper on box, stool, or front control arm. **Do not allow brake hose to support weight of caliper. This could damage the hose.**

(10) Remove O-ring from caliper adapter.

CLEANING AND INSPECTION

Replace the brakeshoes if the lining is worn to a thickness of 3.17 mm (1/8 inch) or less. If shoe replacement is necessary, replace the shoes on both sides at the same time. Do not replace the shoes on one side only. This practice could result in unequal braking effort and brake pull. Note that it is normal for the inboard shoe lining to exhibit slightly more wear than the outboard shoe lining.

Check for piston seal leaks which will be evident by brake fluid in and around the boot area and inboard lining. Also check condition of the caliper piston dust boot. If leakage is evident or if the boot is cut, torn, or damaged in any way, it will be necessary to overhaul the caliper.

Remove the O-ring from the caliper adapter and clean the slide surfaces of the adapter and the machined ways on the caliper with a wire brush and sandpaper.

BRAKESHOE INSTALLATION

(1) Install inboard brakeshoe in adapter (Fig. 8).

(2) If new brakeshoes are being installed, remove protective paper from noise suppresion gasket on outboard shoe.

(3) Install and adjust outboard brakeshoe in caliper as follows:

(a) Check vertical movement of outboard shoe in caliper. Shoe should fit tightly and not exhibit vertical movement (free play). Flange must also fit tightly on caliper finger to eliminate free play and prevent shoe rattle (Fig. 9).

(b) If free play is evident, remove shoe from caliper.

(c) Bend shoe retaining flange and trial fit shoe in caliper. Continue bending flange until shoe is light interference fit in caliper (Fig. 10).

(d) Reinstall outboard brakeshoe in caliper. If shoe is difficult to install, use C-clamp to seat shoe (Fig. 11).

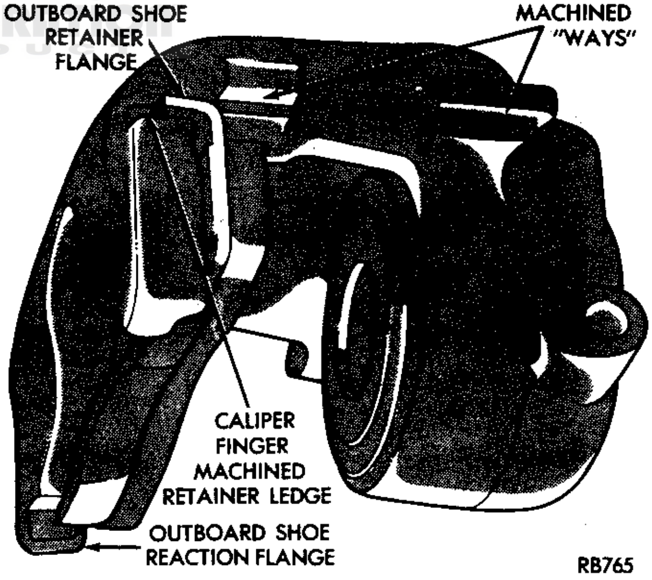

Fig. 9 Outboard Brakeshoe Positioned On Caliper Finger

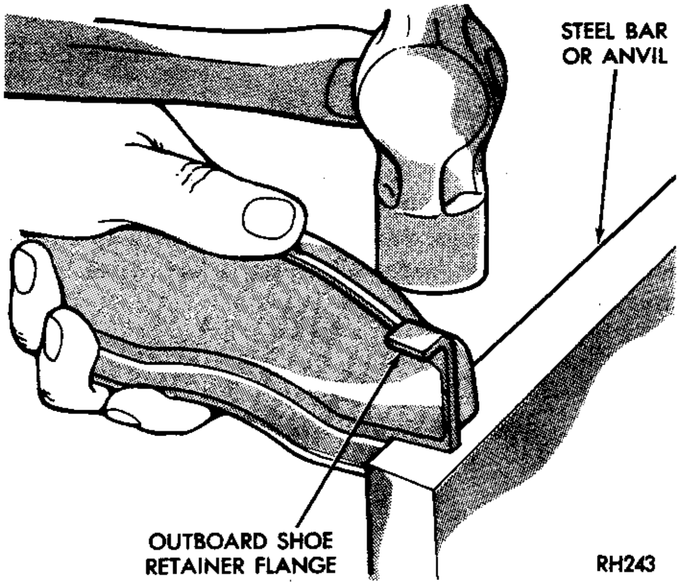

Fig. 10 Adjusting Outboard Brakeshoe Retaining Flange

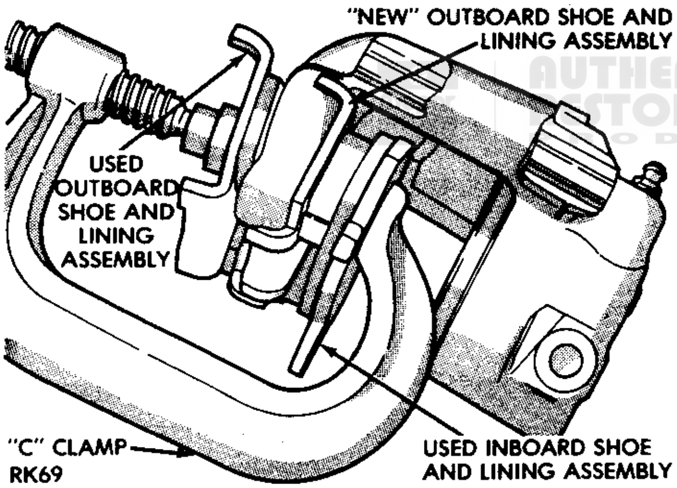

Fig. 11 Seating Outboard Brakeshoe

(4) Lubricate slide surfaces of caliper mounting adapter and machined ways on caliper with Mopar high temperature grease.

(5) Install O-ring in adapter, if removed.

(6) Carefully install caliper over rotor and into adapter. **Do not displace or damage the piston dust boot when installing the caliper.**

(7) Align caliper in adapter and install caliper retainer clips and anti-rattle springs (Fig. 5). Tighten retainer screws to 20 N•m (180 in-lbs) torque.

(8) Install wheels and lower vehicle.

(9) Top off master cylinder fluid level.

(10) Apply brakes several times to seat caliper pistons and brakeshoes and obtain firm pedal.

CALIPER REMOVAL

(1) Raise vehicle and remove front wheels.

(2) Remove caliper retainer clips and anti-rattle springs.

(3) Remove brakeshoes from caliper and adapter.

(4) Support caliper on box, stool or similar device. Place shop towels under caliper to absorb spilled brake fluid. Then insert small wood block between caliper piston and caliper frame.

(5) Slowly press brake pedal to push piston out of bore. Brake pedal will fall away when piston has passed seal and is approaching bore opening.

(6) Prop brake pedal to any position below first inch of pedal travel to prevent excessive brake fluid spill.

(7) Repeat piston removal procedure at opposite caliper.

(8) Disconnect brakeline at caliper and remove caliper.

CALIPER OVERHAUL

CALIPER DISASSEMBLY

(1) Remove piston dust boot. Collapse boot with screwdriver or punch and remove boot (Fig. 12).

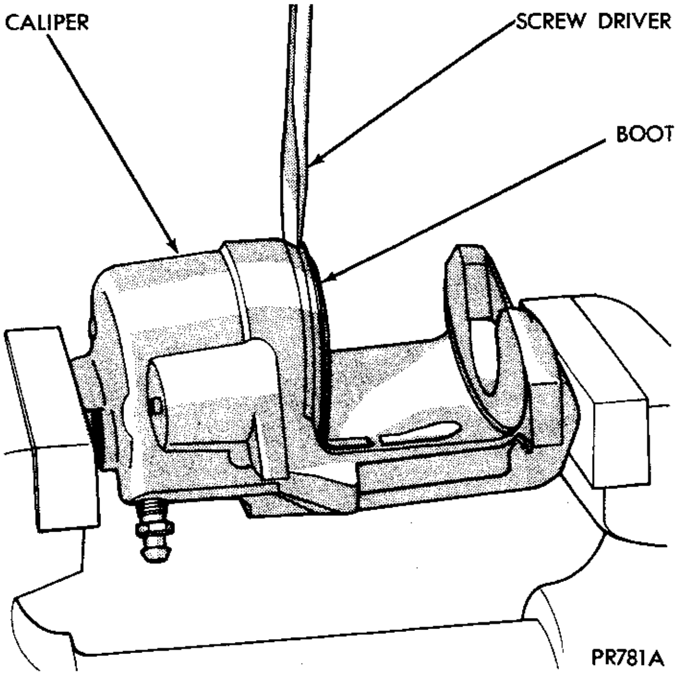

Fig. 12 Removing Caliper Piston Dust Boot

(2) Remove caliper piston seal with wood pencil or plastic tool (Fig. 13). Do not use metal tools as they could scratch piston bore.

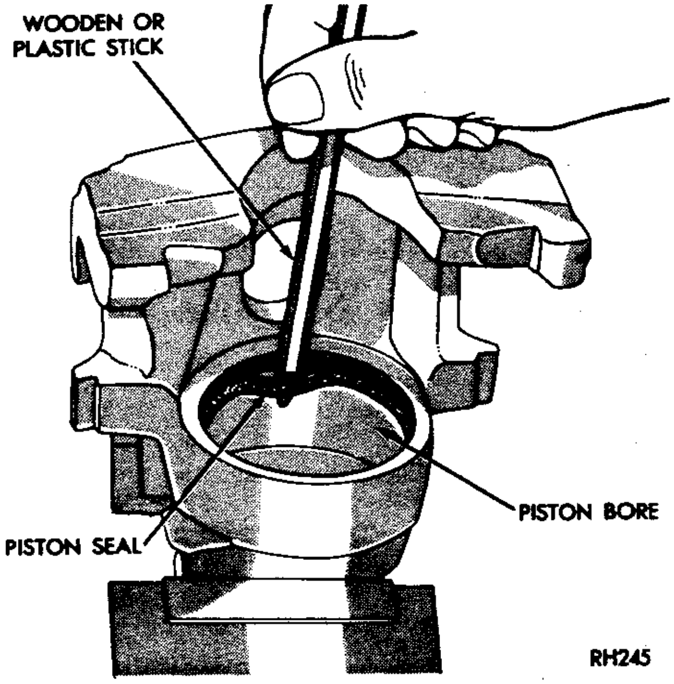

Fig. 13 Removing Caliper Piston Seal

CLEANING AND INSPECTION

Clean the caliper components (Fig. 14) with Mopar brake cleaner, fresh brake fluid, or denatured alcohol only. Do not use gasoline, kerosene, thinner, or any similar type of solvent. These products may leave a residue that could damage the piston and seal.

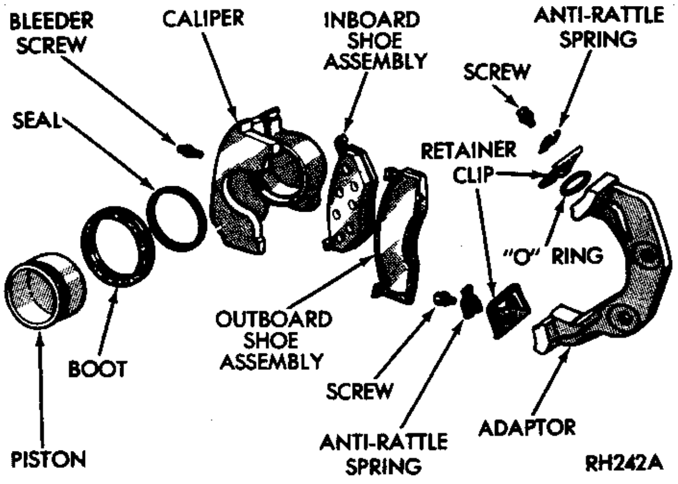

Fig. 14 Caliper Components

Dry the caliper and piston with compressed air or allow them to air dry. Do not use rags or shop towels. Lint from such materials can adhere to the caliper and piston.

Inspect the caliper piston. The piston is made from a phenolic resin (plastic material) and should be smooth and clean. Replace the piston if cracked or scored. Do not attempt to restore a scored piston by sanding or polishing. The piston must be replaced if damaged.

Inspect the caliper piston bore. The bore can be lightly polished with honing tool C-4095 to remove very minor surface imperfections (Fig. 15). **However, the caliper must be replaced if the bore is severely corroded, rusted, scored, or if polishing would increase bore diameter more than .025 mm (.001 inch).**

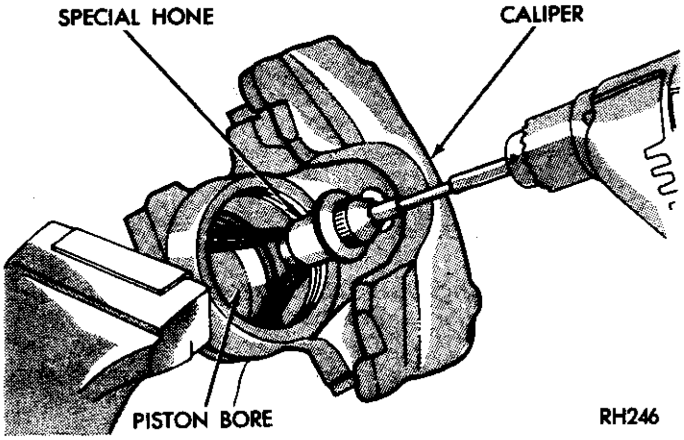

Fig. 15 Lightly Polishing Piston Bore With Tool C-4095

CALIPER ASSEMBLY

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

(2) Install new piston seal in caliper bore. Be sure seal is fully seated in groove (Fig. 16).

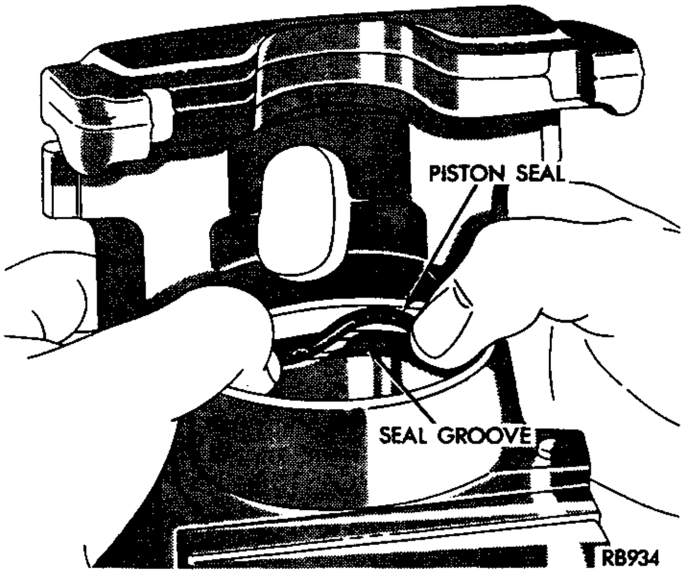

Fig. 16 Installing Caliper Piston Seal

(3) Install new dust boot on caliper piston.

(4) Start caliper piston in bore with a rotating motion. When piston is started in seal, push piston only part way into bore (Fig. 17). Maintain uniform pressure on piston to avoid cocking it in bore.

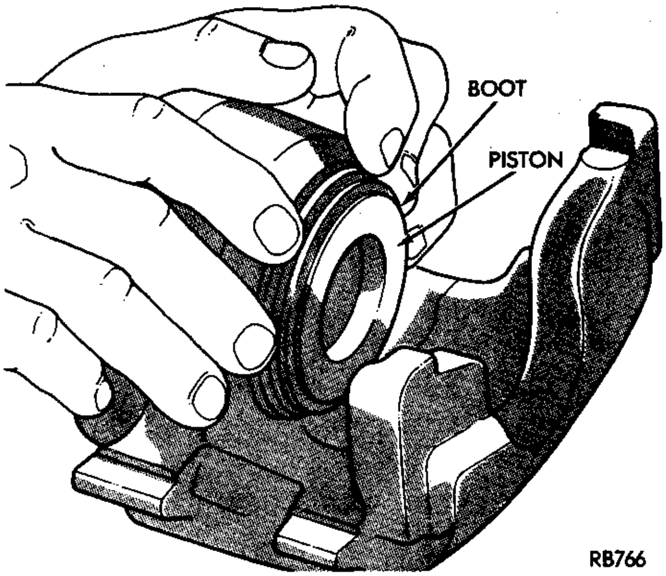

Fig. 17 Installing Caliper Piston

(5) Press caliper piston to bottom of bore and seat piston dust boot with installer tool C-4690 and tool handle C-4171 (Fig. 18).

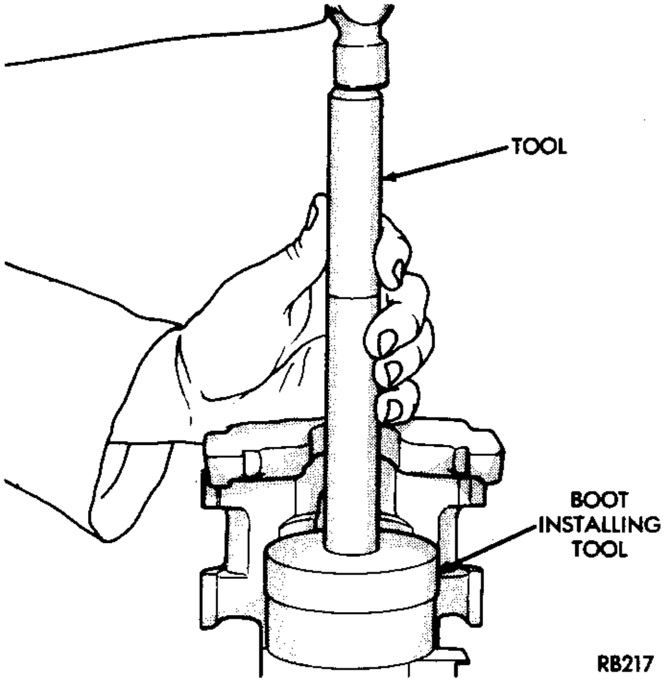

Fig. 18 Seating Piston Dust Boot

(6) Install caliper bleed screw if removed.

CALIPER INSTALLATION

(1) Clean slide surfaces of caliper mounting adapter with wire brush. Then lubricate adapter slide surfaces with Mopar high temperature wheel bearing grease.

(2) Install inboard brakeshoe in adapter.

(3) Install outboard brakeshoe in caliper. Be sure shoe is light press fit in caliper. Refer to installation procedure in Brakeshoe Replacement.

(4) Lubricate machined ways of caliper with Mopar high temperature grease.

(5) Install O-ring in adapter, if removed.

(6) Install caliper over rotor and into adapter.

(7) Align caliper in adapter and install caliper retainer clips and anti-rattle springs. Tighten retainer clip screws to 20 N•m (180 in-lbs) torque.

(8) Connect brake hose to caliper. Tighten fitting bolt to 47 N•m (35 ft-lbs) torque. **Be sure hose is clear of chassis and suspension components and use new seal washers to secure hose fitting to caliper. Do not reuse old washers.**

(9) Fill master cylinder with Mopar brake fluid or equivalent meeting SAE and DOT standards J1703 and DOT 3.

(10) Bleed brakes. Refer to procedure in Service And Adjustments section.

(11) Install wheels and lower vehicle.

(12) Apply brakes several times to seat caliper pistons and brakeshoes. Be sure firm pedal is obtained before moving vehicle.

ROTOR REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove caliper assembly but do not disconnect brake hose. Do not allow brake hose to support caliper. Support caliper on stool, or suspend caliper with wire attached to nearby body or suspension component.

(4) Remove grease cap, cotter pin, nut lock, nut, thrust washer and outer wheel bearing.

(5) Remove rotor from spindle.

(6) Remove rotor shield and seal if either is to be serviced.

ROTOR INSPECTION AND SERVICE

ROTOR CONDITION

The rotor braking surfaces should not be refinished unless actually necessary. Light surface rust and scale can be removed in 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. The rotor should be replaced if severely scored, tapered, has hard spots, is cracked, too thin, or if machining would cause rotor thickness to fall below minimum thickness requirements.

Check rotor lateral runout and thickness variation if pedal pulsation or an occaisional low pedal condition was experienced. Measure runout with a dial indicator. Measure thickness with a micrometer at a minimum of four points around the braking surfaces.

CHECKING ROTOR MINIMUM THICKNESS

Measure rotor thickness at the center of the brakeshoe contact surface. Replace the rotor if it is worn below minimum thickness, or if refinishing would reduce thickness below the allowable minimum. Rotor minimum thickness is usually specified on the rotor hub (Fig. 19).

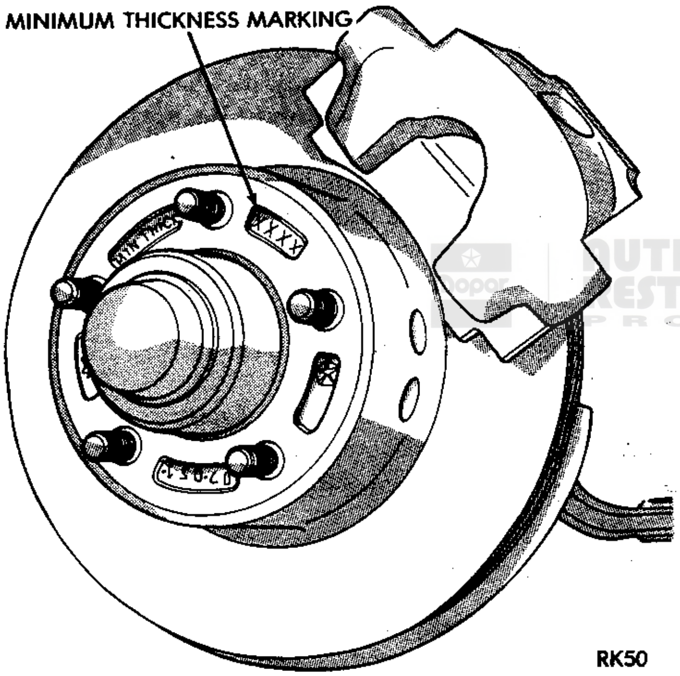

Fig. 19 Typical Location Of Rotor Minimum Thickness Limit

ROTOR RUNOUT

Check rotor lateral runout with dial indicator C-3339 as shown in the top view (Fig. 20). Excessive lateral runout will cause brake pedal pulsation and rapid, uneven wear of the brakeshoes. position the dial indicator plunger approximately 25.4 mm (one inch) in from the rotor edge.

Be sure wheel bearing adjustment is correct before checking rotor runout. Incorrect adjustment can create a condition similar to excessive lateral runout.

Maximum allowable rotor runout for all models is .102 mm (.004 inch).

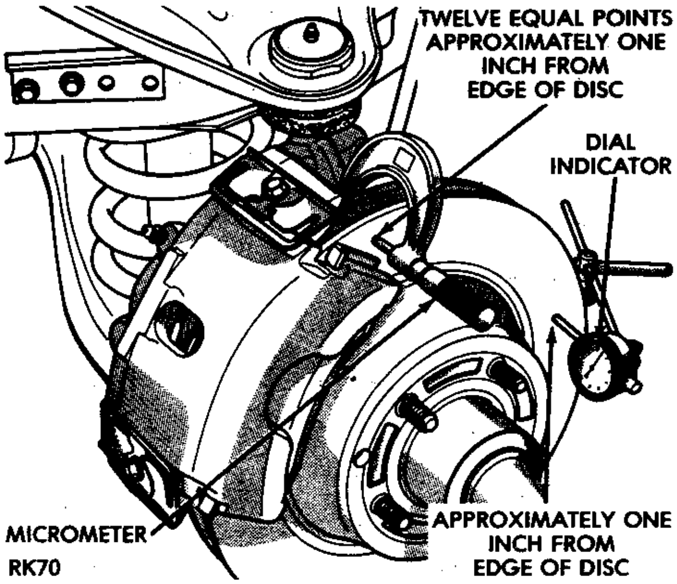

Fig. 20 Checking Rotor Runout And Thickness Variation

ROTOR THICKNESS VARIATION

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

Measure rotor thickness at 6 to 12 points around the rotor face (Fig. 20). Position the micrometer approximately 19.05 to 25.4 mm (3/4 to one inch) from the rotor outer circumference for each measurement as shown in the bottom view (Fig. 20).

Thickness should not vary by more than .013 mm (.0005 inch) from point-to-point on the rotor. Refinish or replace the rotor if necessary.

ROTOR REFINISHING

Rotor braking surfaces can be refinished by sanding and/or machining in a disc brake lathe. The lathe must be capable of machining both rotor surfaces simultaneously with dual cutter heads (Fig. 21). Equipment capable of machining only one side at a time will produce a tapered rotor. The lathe should also be equipped with a grinder attachment or dual sanding discs for final cleanup or light refinishing (Fig. 21).

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

CAUTION: Do not refinish a rotor if machining would cause the rotor to fall below minimum allowable thickness.

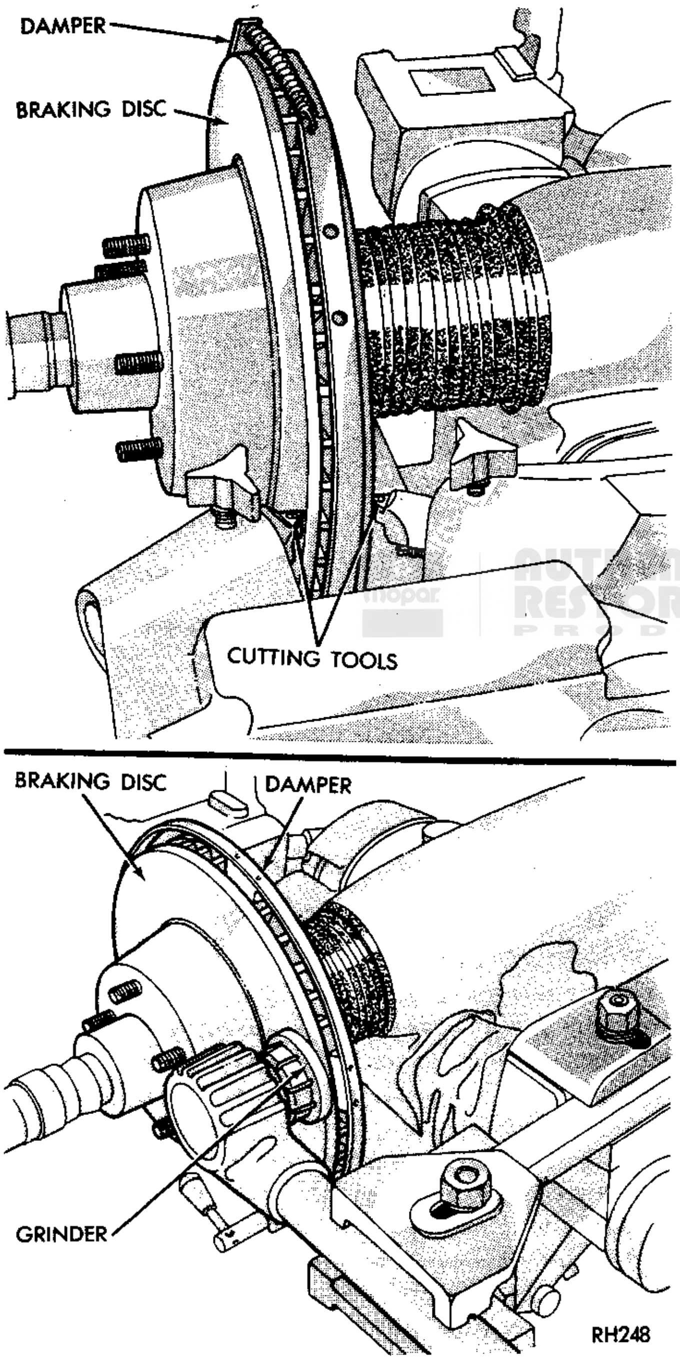

Fig. 21 Rotor Refinishing Equipment

ROTOR INSTALLATION

(1) Inspect and repack wheel bearings if necessary. Install new grease seal if inner bearing is removed for repacking.

(2) Install rotor on spindle.

(3) Install outer bearing, thrust washer and nut.

(4) Tighten wheel bearing adjusting nut to 27-34 N•m (240-300 in-lbs) while turning rotor.

(5) Recheck rotor runout as described previously.

(6) Loosen wheel bearing adjusting nut completely. Then retighten nut finger tight. Wheel bearing end play should be .0001 to .003 inch.

(7) Install nut lock on bearing adjusting nut. Align lock slots with cotter pin hole and secure nut and lock with new cotter pin.

(8) Clean grease cap. Then coat interior of cap with wheel bearing grease.

(9) Install caliper, wheel and tire assembly and lower vehicle.

(10) Check and adjust master cylinder fluid level.

(11) Apply brakes several times to seat brakeshoes. Be sure to obtain firm pedal before moving vehicle.

BENDIX DISC BRAKE

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GENERAL SERVICE INFORMATION

The Bendix disc brake assembly is used on W250/350 models with the Dana 60 front axle (Fig. 1). The assembly consists of a single piston sliding caliper, a mounting adapter attached to the steering knuckle, a ventilated rotor and a rotor splash shield. The splash shield, which is bolted to the adapter, protects the bearings and inboard surface of the rotor from road splash. The wheel protects the outboard surface of the rotor and brake assembly.

The caliper slides laterally on surfaces machined into the caliper and mounting adapter. The adapter is bolted to the steering knuckle (Fig. 2). The caliper is positioned in the adapter with a support key and spring (Fig. 1). A retaining screw is used to secure the support key.

The inboard brakeshoe is mounted in the caliper adapter. The outboard brakeshoe is mounted in the caliper. The linings are riveted to the shoes, and the inner and outer shoes are not interchangeable.

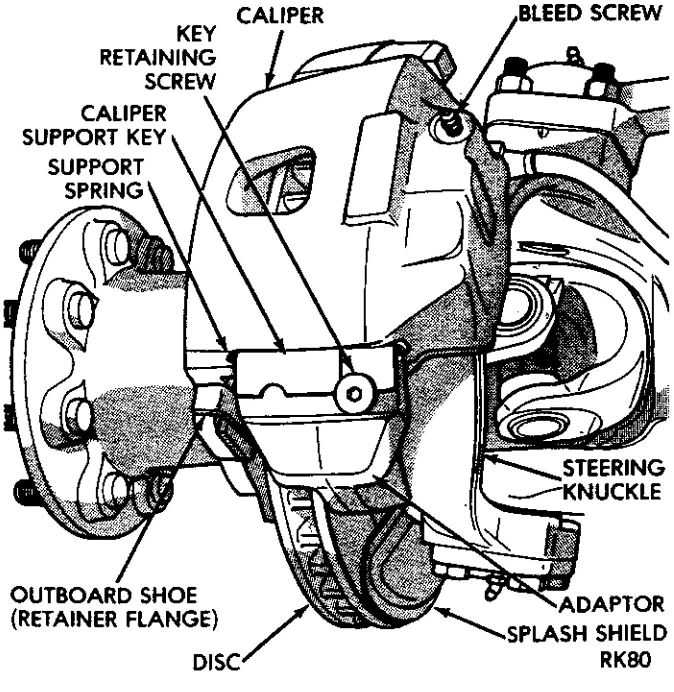

Fig. 1 Bendix Disc Brake Caliper

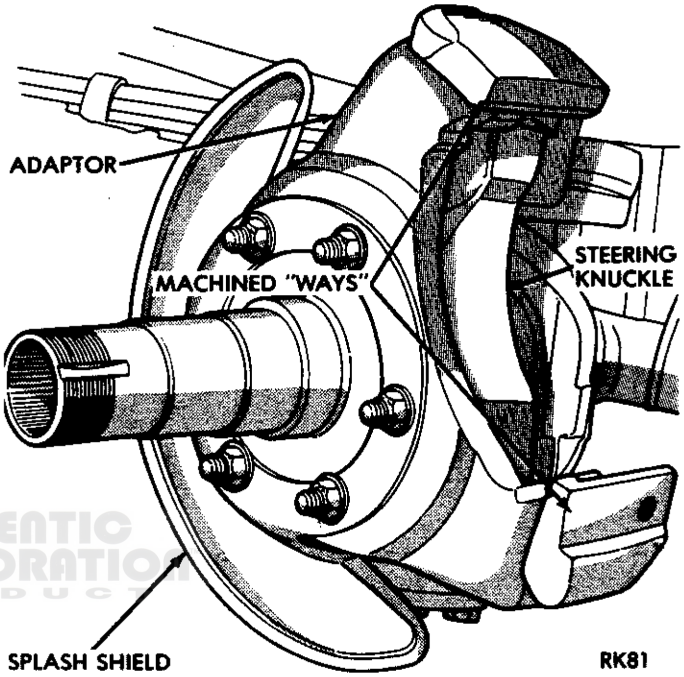

Fig. 2 Caliper Mounting Adapter Attachment

DISC BRAKE OPERATION

The significant feature of single piston caliper operation is that the caliper is free to move laterally on the adapter slide surfaces (Fig. 3).

At brake application, fluid pressure is exerted equally against the caliper piston and all surfaces of the caliper piston bore.

Pressure applied to the piston is transmitted directly to the inboard brakeshoe pressing the shoe lining against the rotor. At the same time, pressure applied to the caliper bore surfaces, causes the caliper to slide inward laterally. The inward movement presses the lining of the outboard shoe against the opposite side of the rotor to complete braking action (Fig. 3).

Any application or release of brake fluid pressure causes only a very modest movement of the caliper and piston. At brake release, the piston and caliper return to the non-appled position. The brakeshoes do not retract any appreciable distance from the rotor. The minimal running clearance provides the improved response and reduced pedal travel; It also helps in preventing dirt and foreign material from lodging between the shoe and rotor surfaces.

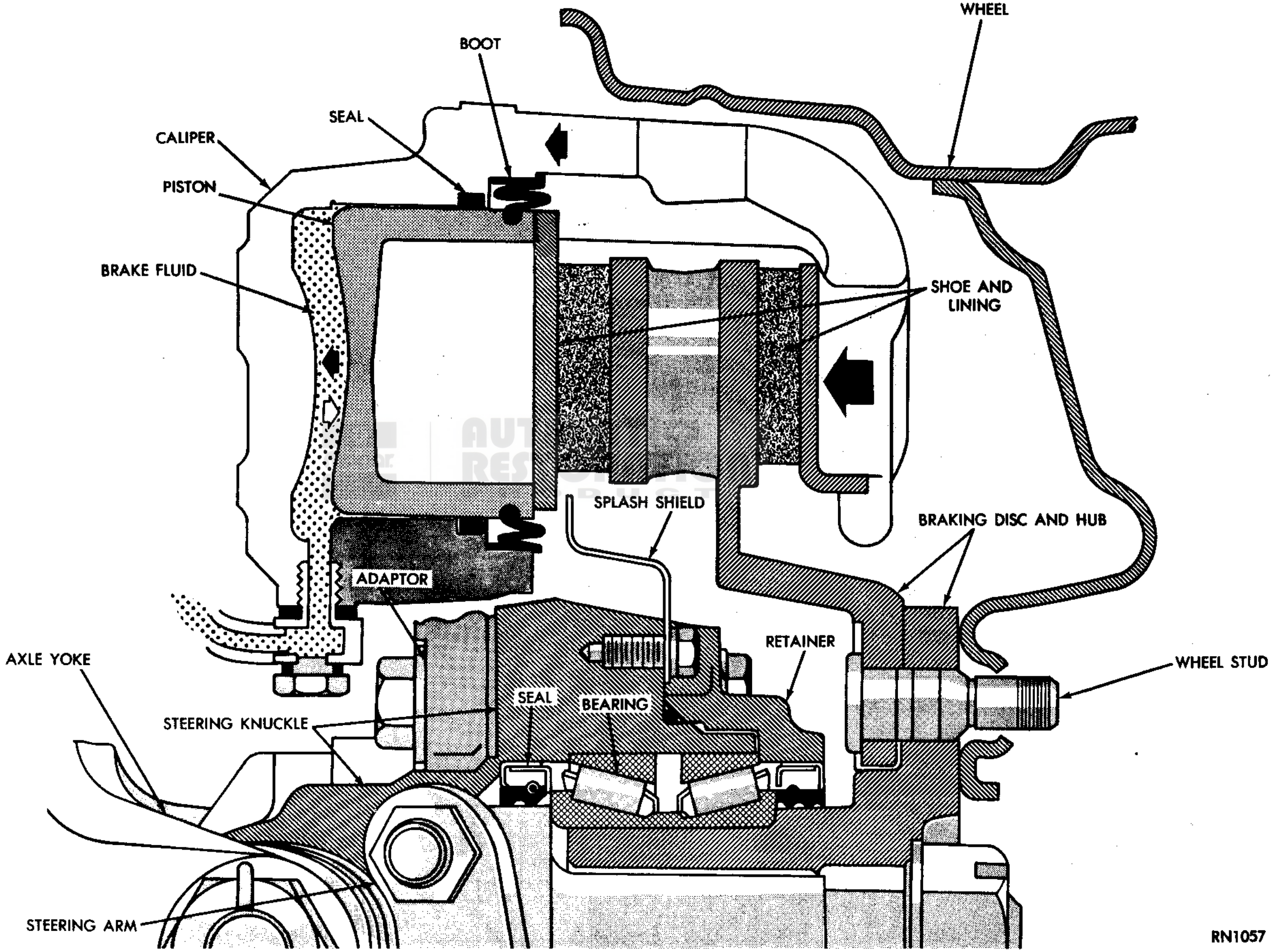

Fig. 3 Bendix Disc Brake Caliper Operation

DISC BRAKE LINING WEAR COMPENSATION

Normal lining wear is compensated for by extension of the caliper piston and by lateral movement of the caliper in the adapter. Piston position is also determined in part by the square cut piston seal (Fig. 4).

Normal disc brake lining wear will cause the caliper piston to extend enough to maintain proper pedal height and brake response. The caliper bore will receive the extra fluid needed to compensate for the additional piston extension.

As the piston extends during brake application, the square-cut seal is deflected outward (Fig. 4). When brake pressure is released, the seal straightens and returns to a normal relaxed position. Although the amount of seal movement is quite small, it is enough to retract the piston to the necessary minimum running clearance.

As lining wear occurs, the fluid level in the front brake reservoir will decrease. This is a normal condition and only requires adding enough fluid to restore proper level. However, when the brakeshoes are replaced and the caliper pistons bottomed in the bores, the added fluid must be compensated for to avoid overfill and overflow. Removing a small amount of fluid from the front brake reservoir beforehand will prevent this condition.

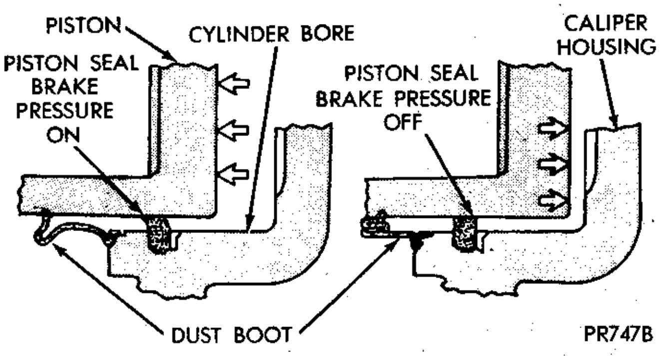

Fig. 4 Caliper Piston Seal Operation

DISC BRAKE INSPECTION

Inspect the disc brake components whenever the caliper and brakeshoes are removed during service operations or routine maintenance.

Check condition of the rotor, brakeshoe lining, caliper and brake hoses. Front wheel bearing adjustment and condition can also be checked at this time. The bearings should be repacked and adjusted if necessary.

Brakeshoes

With the caliper and brakeshoes on the vehicle, check running clearance between the rotor and brakeshoes. The shoe lining should either be in very light contact with the rotor or a maximum of .127 mm (.005 inch) running clearance. If clearance exceeds the stated amount, apply the brakes several times and recheck clearance. If clearance is still excessive, either the shoes are severely worn or the caliper piston could be binding in the bore.

Hoses And Adapter

Inspect condition of the brake lines and hoses. Replace either front hose if cut, torn, or the reinforcing fabric is visible. Check condition of the metal brakelines. Replace any line that is badly rusted, leaking or damaged in any way.

Clean and lubricate the slide surfaces of the mounting adapter. Use Mopar high temperature grease for this purpose. Also verify that the caliper adapter bolts are secure and tightened to proper torque.

Fluid Level

Check the master cylinder fluid level. Maintain fluid level to the bottom of the indicator rings on the reservoir. Note that front brake fluid level can be expected to drop slightly as normal lining wear occurs. Use Mopar brake fluid or equivalent meeting SAE and DOT standards J1703 and DOT 3. Use clean brake fluid from a sealed container only.

Rotors

Check the rotor surfaces for excessive wear, discoloration, scoring, rust, scale, or cracks. Also look for damaged or severely rusted ventilating segments. If pedal pulsation was experienced, check wheel bearing adjustment and condition. If the bearings are OK, also check rotor runout and thickness variation.

BRAKESHOE REMOVAL

(1) Remove approximately 1/4 of the fluid from the master cylinder front brake reservoir.

(2) Raise and support the vehicle.

(3) Remove the wheel and tire assemblies.

(4) Bottom the caliper pistons with a large C-clamp (Fig. 5).

(5) Remove the support key retaining screw (Fig. 6).

(6) Remove the caliper support key and spring. Use a pin punch or drift to tap the key out of the caliper (Fig. 7).

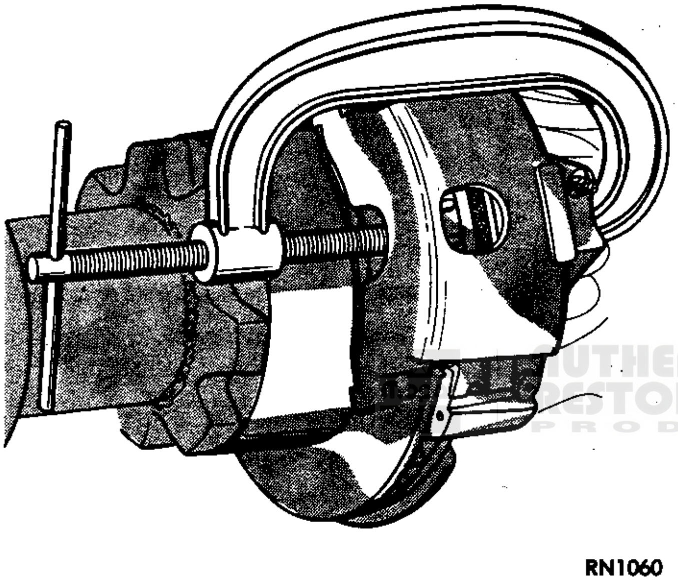

Fig. 5 Bottoming Caliper Piston

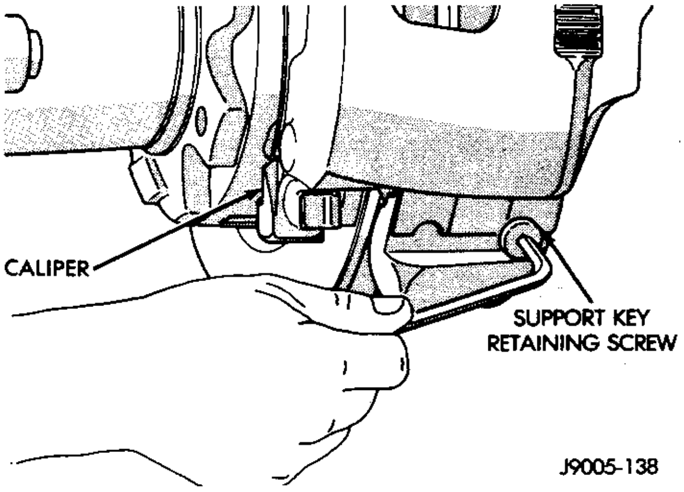

Fig. 6 Removing/Installing Support Key Retaining Screw

(7) Lift the caliper out of the adapter.

(8) Remove the outboard shoe from the caliper (Fig. 8).

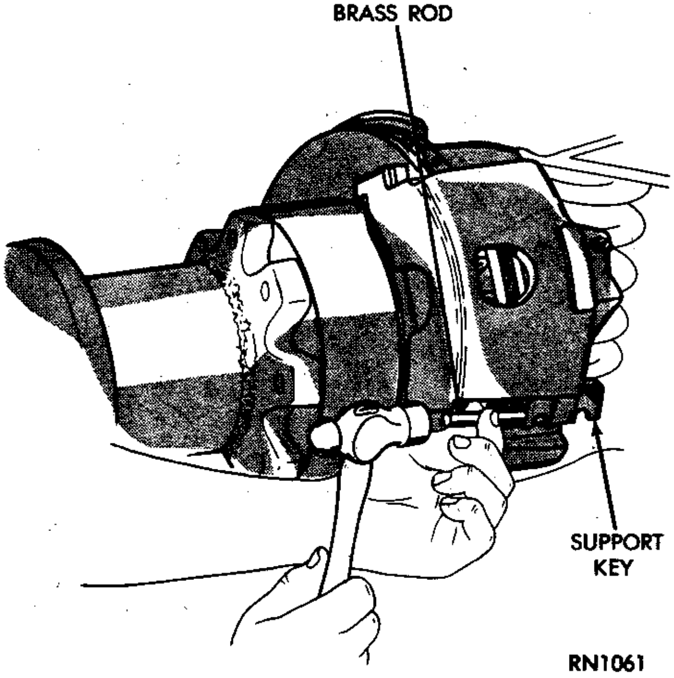

Fig. 7 Removing Caliper Support Key And Spring

(9) Secure the caliper to a convenient chassis component with wire. Do not allow the brake hose to support caliper weight.

(10) Remove the inboard shoe and anti-rattle spring from the caliper adapter (Fig. 9). Note position of the spring for installation reference.

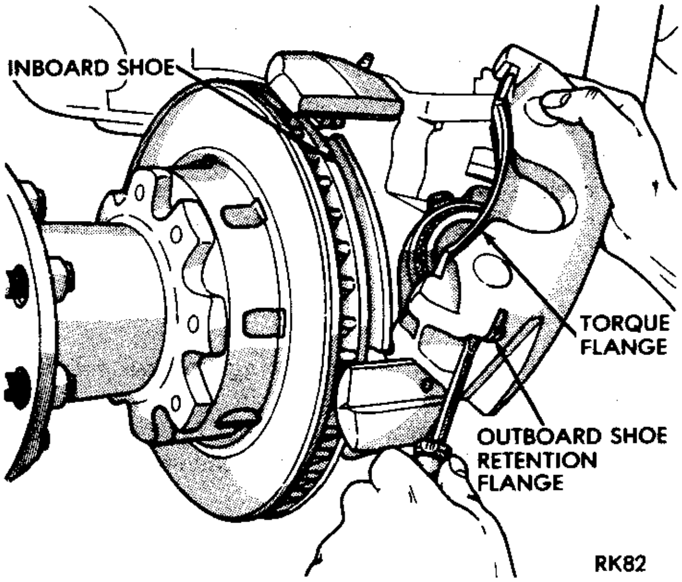

Fig. 8 Removing/Installing Outboard Brakeshoe

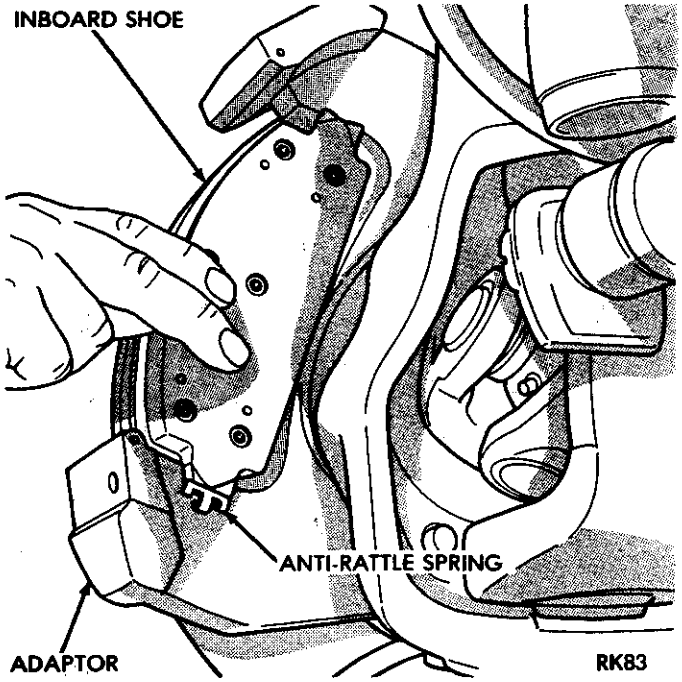

Fig. 9 Removing/Installing Inboard Brakeshoe

CLEANING AND INSPECTION

Examine the shoe lining for wear. Replace the shoes if the lining is worn to within 1.58 mm (1/16 inch) of the rivet heads. If the shoe lining will be reused, do not intermix the shoes. Keep them with the caliper they were removed from.

Examine the caliper piston area for evidence of leaks. Also check condition of the piston boot. Overhaul the caliper if leakage is evident or the boot is cut or torn.

Clean rust and corrosion from the support key and the caliper and adapter slide surfaces (machined ways) with a wire brush. Then lubricate the slide surfaces with Mopar multi-purpose grease, or equivalent.

BRAKESHOE INSTALLATION

(1) Install the anti-rattle spring on the inboard brakeshoe and install the shoe in the adapter. Be sure the spring remains in place and is positioned as shown (Fig. 9). The loop portion of the spring should face away from the rotor.

(2) Install the outboard shoe in the caliper. Free play should not exist between the shoe retaining flanges and machined surfaces on the caliper. If the shoe shoe cannot be pressed into place by hand, a C-Clamp may be used. If a C-Clamp is used, protect the shoe with a wooden block (Fig. 10).

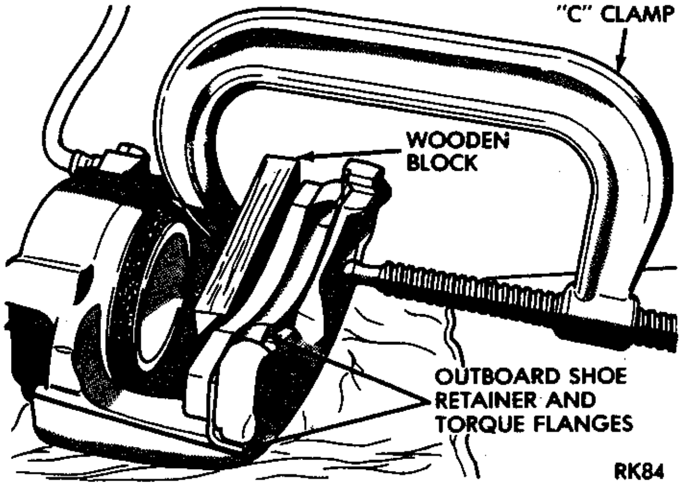

Fig. 10 Seating Outboard Brakeshoe In Caliper

(3) Position the caliper over the rotor and in the adapter (Fig. 11). Be careful to avoid damaging the piston dust boot during installation.

CAUTION: Verify that the brake hose is straight and not twisted or kinked.

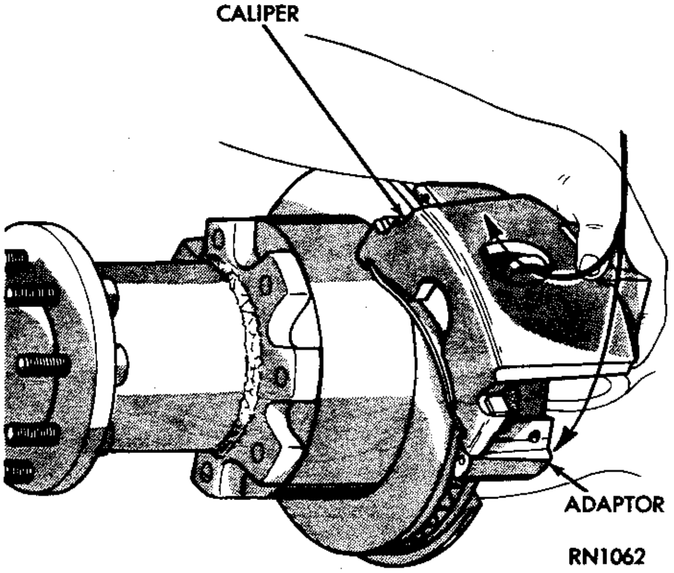

Fig. 11 Caliper Installation

(4) Seat the caliper in the adapter.

(5) Place the support spring on the support key. Then insert the spring and key between the caliper and adapter.

(6) Tap the support key and spring into place with a pin punch or drift (Fig. 12).

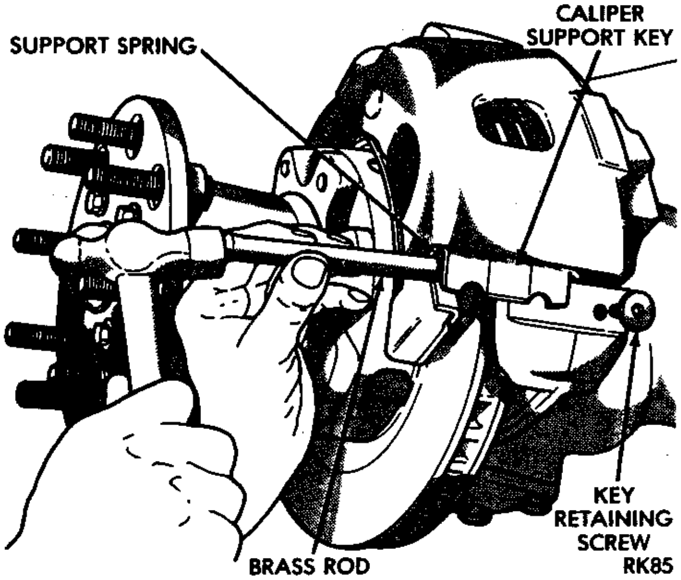

Fig. 12 Installing Support Key And Spring

(7) Align the notch in the support key with the screw hole in the caliper.

(8) Install the support key retaining screw. Tighten the screw to 20 N•m (15 ft-lbs) torque. **Be sure the boss on the screw is fully seated in the support key notch.**

(9) Install the wheel and tire assembly and lower the vehicle.

(10) Top off the master cylinder fluid level.

(11) Pump the brake pedal to seat the shoes and restore normal pedal height. Do not move the vehicle until a firm pedal is obtained.

CALIPER OVERHAUL

CALIPER AND PISTON REMOVAL

(1) Raise vehicle and support on hoist or jackstands.

(2) Remove wheel and tire assemblies.

(3) Clean brake hose and tubing connections at calipers and brake hoses.

(4) Remove screw retaining caliper support key and spring and tap support key and spring out with a drift or pin punch.

(5) Remove calipers and brakeshoes from adapters but do not disconnect caliper brake hoses at this time.

(6) Support calipers on front axle. Position shop towels under calipers to absorb spilled brake fluid.

(7) Press brake pedal to hydraulically push caliper pistons out of bore. Pedal will fall away when pistons pass cylinder bore opening. Place pistons on workbench for inspection.

(8) Prop and secure brake pedal to any position below first inch of travel to prevent loss of brake fluid.

(9) Disconnect caliper brake hoses at frame bracket.

(10) Cover brake lines to prevent dirt entry.

CALIPER DISASSEMBLY.

(1) Remove dust boot from caliper.

(2) Remove caliper piston seal from caliper bore with small wood or plastic tool. **Do not use metal tools to remove the seal. Metal tools can scratch/score the piston bore surface.**

(3) Remove the bleeder screw from the caliper.

CLEANING AND INSPECTION

Clean the slide surfaces of the caliper with a wire brush and emery cloth. Then clean the caliper and piston with Mopar brake cleaner, fresh brake fluid, or denatured alcohol only. Do not use any other type of solvent or cleaning agent.

Dry the caliper and piston with compressed air or allow them to air dry. Do not use rags or towels to dry the caliper and piston. Lint from such materials can adhere to the piston and caliper.

Inspect the caliper piston, piston bore and the seal and boot grooves. Replace the piston if corroded, pitted, scored, or worn. Do not attempt to restore the piston surface by sanding. Replace the piston if necessary.

Very light scratches or corrosion in the piston bore can usually be cleaned up with a fiber brush, or by polishing with a honing tool or crocus cloth. However, the caliper should be replaced if the bore is severely corroded, scored, or if honing and polishing would increase bore diameter by more than .002 inch (.050 mm).

Dark brown or black stains on the piston are caused by the piston seal and are a normal occurence. In addition, light discoloration of the piston bore is also normal. This discoloration is acceptable as long as the bore and piston surfaces are in good condition.

If it is necessary to polish the caliper bore, coat the crocus cloth or honing stones with fresh brake fluid only. Be sure to flush and clean the caliper thoroughly afterward. All residue generated by polishing must be removed to avoid potential damage to the piston, seal and bore after assembly.

Inspect and clean the inboard shoe anti-rattle spring, support key spring, retaining screw and caliper support key (Fig. 13). Replace these components if worn or damaged.

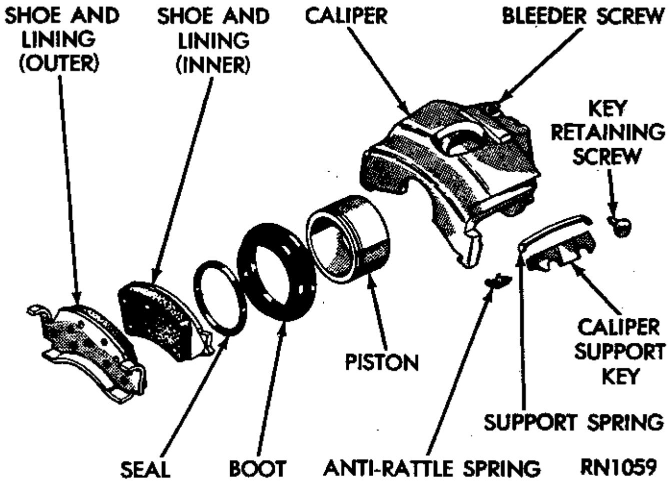

Fig. 13 Caliper Components

CALIPER ASSEMBLY

(1) Mount caliper in vise equipped with protective jaws. Do not overtighten vise. Excessive pressure could cause bore distortion and piston binding.

(2) Lubricate new piston seal and piston bore with fresh brake fluid.

(3) Install new piston seal in the bore (Fig. 14). Position seal in one area of groove and gently work it around and into groove until seated. Be sure seal is not twisted or rolled over.

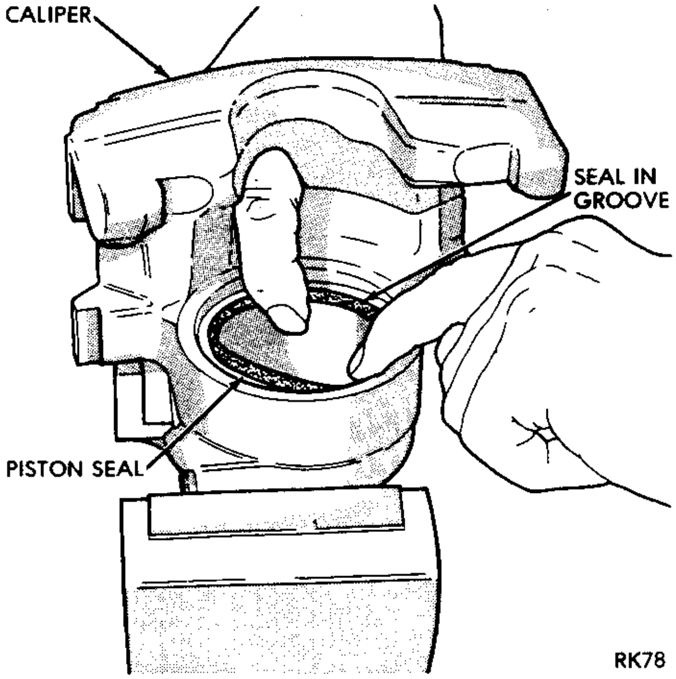

Fig. 14 Installing Caliper Piston Seal

(4) Lubricate new dust boot with fresh brake fluid and install it in caliper (Fig. 15). Work boot into the groove with fingers. Boot will seem larger than groove diameter at first but will snap into place when properly positioned.

(5) Plug fluid inlet port and install bleeder screw.

(6) Coat caliper piston with brake fluid.

(7) Start piston into dust boot and bore (Fig. 15). Spread dust boot with fingers. Then work piston through boot and into bore. Air trapped below piston will force boot around it and into groove as piston is installed.

(8) Remove plug from inlet port and loosen bleeder screw.

(9) Carefully press piston into bore until fully bottomed. Apply force uniformly to avoid cocking piston (Fig. 15).

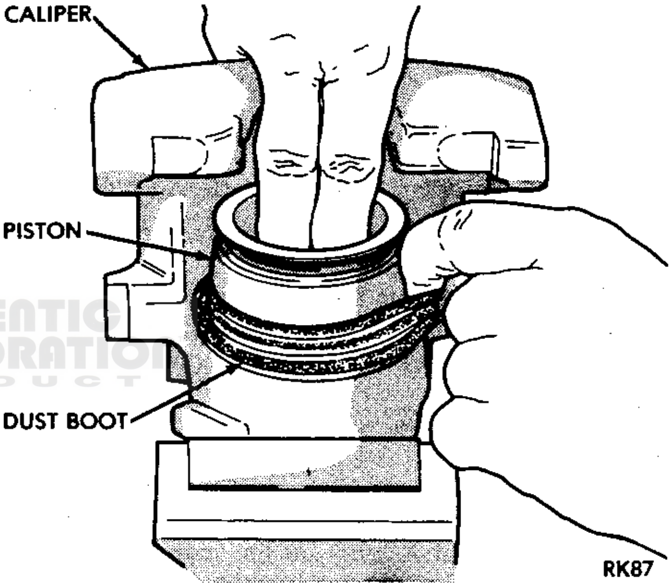

Fig. 15 Installing Caliper Piston

CALIPER INSTALLATION

(1) Install brakeshoes in caliper and adapter.

(2) Connect brake hose to brake line on frame bracket. Tighten hose fitting to 13-20 N•m (115-175 in-lbs) torque.

(3) Connect brake hose to caliper. Use new seal washers when conncting fitting to caliper. Do not tighten hose fitting at this time.

(4) Remove brake pedal prop.

(5) Lubricate caliper and adapter slide surfaces with Mopar high temperature grease, or an equivalent grease.

(6) Install and secure caliper in adapter.

(7) Fill master cylinder and bleed brakes.

(8) Install wheel and tire assemblies and lower vehicle.

ROTOR INSPECTION AND SERVICE

ROTOR CONDITION

Rotor condition and tolerances can be checked with the rotor mounted on the axle. However, wheel bearing end play should be reduced to zero before checking lateral runout.

The rotor braking surfaces should not be machined unless actually necessary. Light surface rust and scale can be removed in 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. The rotor should be replaced if severely scored, tapered, has hard spots, is cracked, too thin, or if machining would cause rotor thickness to fall below minimum thickness requirements.

Check rotor lateral runout and thickness variation if pedal pulsation or an occaisional low pedal condition was experienced. Measure runout with a dial indicator. Measure thickness with a micrometer at a minimum of four points around the braking surfaces. The rotor measurement points are shown in Figure 16.

CHECKING ROTOR MINIMUM THICKNESS

Measure rotor thickness at the center of the brakeshoe contact surface. Replace the rotor if it is worn below minimum thickness, or if refinishing would reduce thickness below the allowable minimum. Rotor minimum thickness is usually specified on the rotor hub.

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. 17). Position the micrometer approximately 25.4 mm (one inch) from the rotor outer circumference for each measurement (Figs. 16 and 17).

Thickness should not vary by more than .025 mm (.001 inch) from point-to-point on the rotor. Refinish or replace the rotor if necessary.

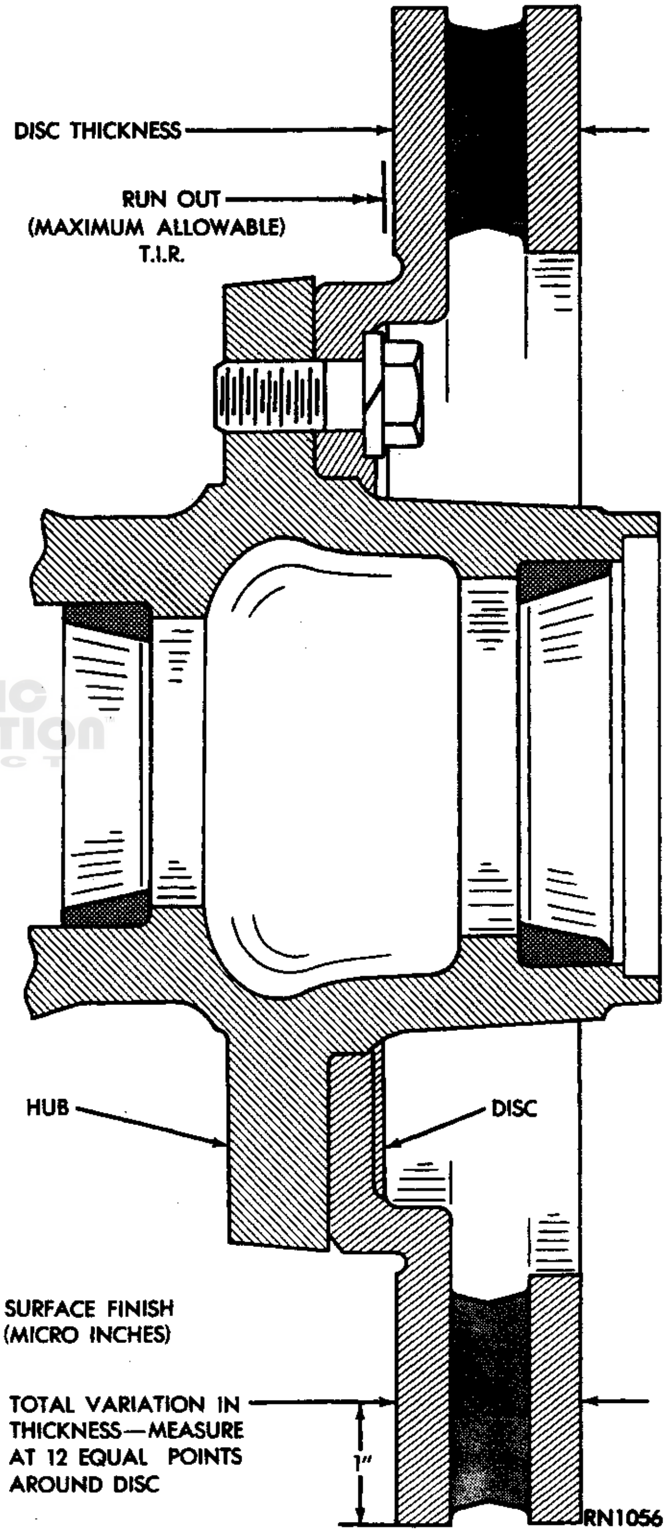

Fig. 16 Rotor Measurement Points

ROTOR RUNOUT

Check rotor lateral runout with a dial indicator C-3339 (Fig. 17). Excessive lateral runout will cause brake pedal pulsation and rapid, uneven wear of the brakeshoes. position the dial indicator plunger approximately 25.4 mm (one inch) in from the rotor edge. **Be sure wheel bearing end play is reduced to zero before checking runout.** Maximum allowable runout is .127 mm (.005 inch).

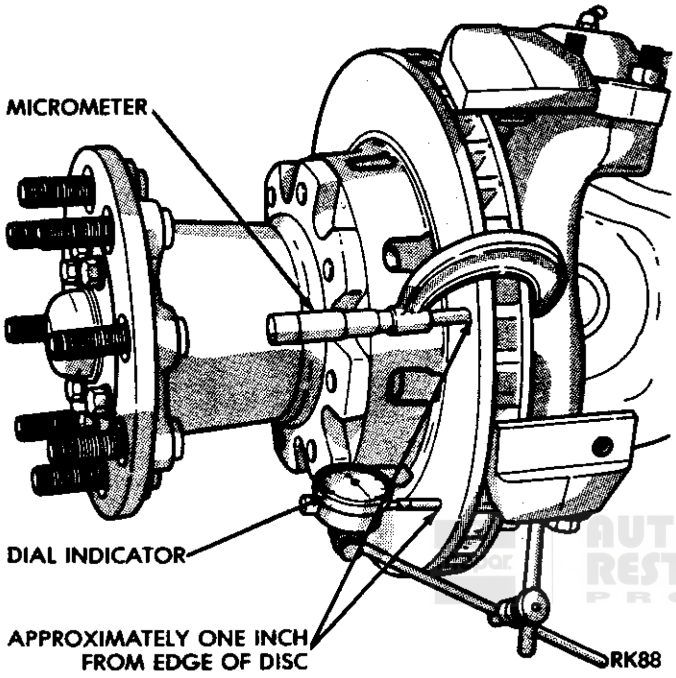

Fig. 17 Checking Rotor Runout And Thickness Variation

ROTOR REFINISHING

Rotor braking surfaces can be refinished by sanding and/or machining in a disc brake lathe. The lathe must be capable of machining both rotor surfaces simultaneously with dual cutter heads. Equipment capable of machining only one side at a time will produce a tapered rotor. The lathe should also be equipped with a grinder attachment or dual sanding discs for final cleanup or light refinishing.

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

CAUTION: Do not refinish a rotor if machining would cause the rotor to fall below minimum allowable thickness.

ROTOR REMOVAL

(1) Block brake pedal in released (up) position.

(2) Raise vehicle to a comfortable working height and support with jack stands.

(3) Remove wheel and tire assembly.

(4) Remove support key retaining screw (Fig. 6).

(5) Remove caliper support key and spring with pin punch or drift (Fig. 18).

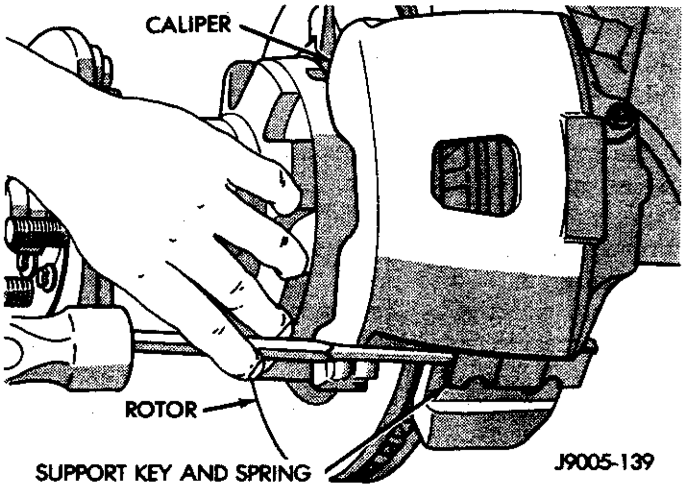

Fig. 18 Removing Caliper Support Key And Spring

(6) Remove caliper and brakeshoes from adapter. **Do not allow brake hose to support caliper weight. Support caliper on stool, or secure caliper to nearby frame or chassis component with wire.**

(7) Remove hub cap.

(8) Remove drive flange snap ring with tool C-4020 (Fig. 19).

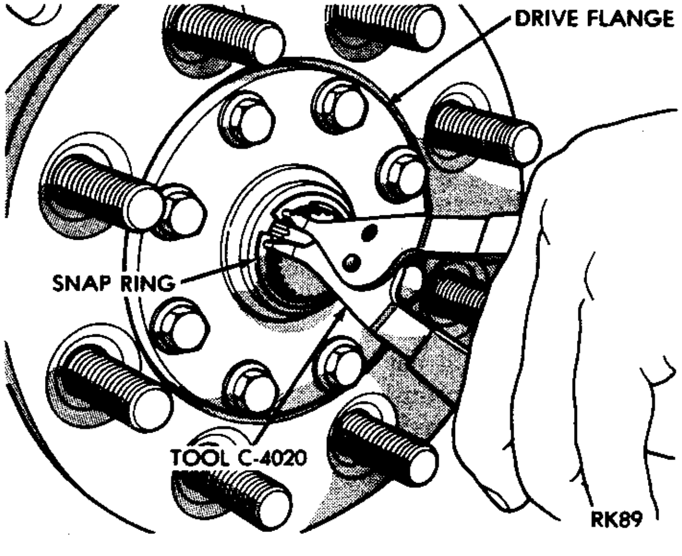

Fig. 19 Removing Drive Flange Snap Ring

(9) Remove flange nuts and lockwashers and remove drive flange. Discard the flange gasket.

(10) Straighten tang on lockring.

(11) Loosen outer locknut and adjusting nut with tool DD-1241-JD (Fig. 18). Then remove outer locknut, lock ring, inner adjusting nut and outer bearing.

(12) Remove hub and rotor from spindle.

(13) Remove seal and inner bearing from hub if bearings or seal require service.

(14) If wheel bearing races require service, remove them with suitable remover tools or with brass drift.

(15) Clean rotor and hub and wheel bearings in solvent.

ROTOR INSTALLATION

(1) Repack the wheel bearings and coat the spindle with Mopar high temperature bearing grease.

(2) Install new bearing races, bearings and seal in hub if necessary.

(3) Install hub on spindle and install outer bearing and inner adjusting nut.

(4) Tighten adjusting nut to 68 N•m (50 ft-lbs) with tools DD-1241-JD and C-3952 to seat bearings.

(5) Adjust wheel bearings as follows:

(a) Back off adjusting nut.

(b) Retighten adjusting nut to 54 N•m (40 ft-lbs) while rotating hub and rotor.

(c) Back off adjusting nut approximately 135 to 150 degrees.

(d) Install lock ring and locknut.

(6) Tighten lock nut to a minimum of 88 N•m (65 ft-lbs). Bearing end play should be .025 -.25 mm (.001-.010 inch).

(7) Bend one tang of lock ring over adjusting nut and another tang over locknut to secure them.

(8) Install new gasket on hub and install drive flange, lockwashers and nuts. Tighten nuts to 41 - 54 N•m (30 - 40 ft-lbs).

(9) Install flange snap ring with tool C-4020.

(10) Install hub cap.

(11) Install caliper and brakeshoes. Tighten support retaining screw to 20 N•m (15 ft-lbs) torque.

(12) Install wheel and tire assembly and lower vehicle.

11-INCH DRUM BRAKE

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GENERAL INFORMATION

Chrysler 11-inch rear drum brakes are used on D and W 100/150 models (Fig. 1). All applications are two-shoe, internal expanding units with a self adjuster mechanism. A single wheel cylinder is used to expand the dual brakeshoes. The lower ends of the brake shoes are connected by a star wheel adjusting screw which is part of the self adjusting mechanism.

SAFETY PRECAUTIONS

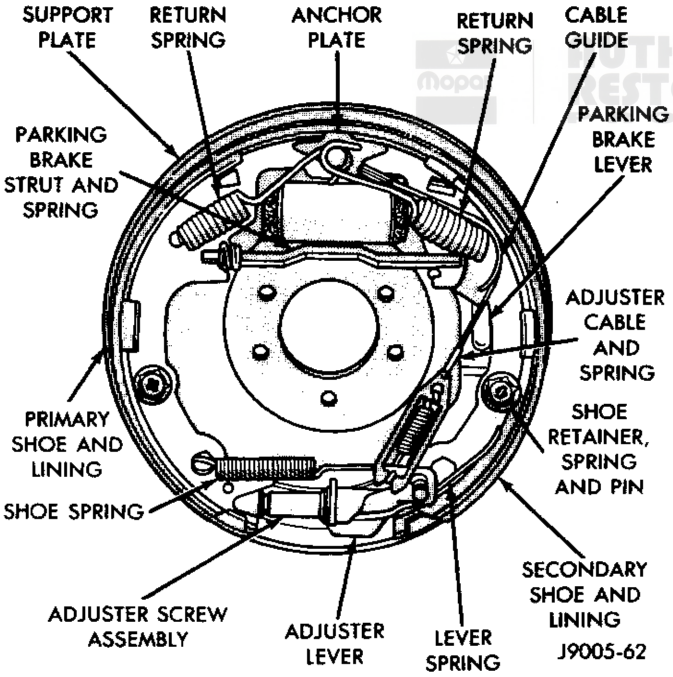

Fig. 1 11-Inch Drum Brake Assembly

WARNING: DUST AND DIRT ON BRAKE PARTS GENERATED DURING THE NORMAL USE AND WEAR OF MOTOR VEHICLE BRAKE SYSTEMS MAY CONTAIN ASBESTOS FIBERS. BREATHING EXCESSIVE CONCENTRATIONS OF ASBESTOS FIBERS CAN CAUSE SERIOUS BODILY HARM. EXTREME CARE SHOULD BE EXERCISED WHILE SERVICING BRAKE ASSEMBLIES OR COMPONENTS. DO NOT CLEAN BRAKE ASSEMBLIES OR COMPONENTS WITH COMPRESSED AIR OR BY DRY BRUSHING; USE A VACUUM CLEANER SPECIFICALLY RECOMMENDED FOR USE WITH ASBESTOS FIBERS. IF A SUITABLE VACUUM CLEANER IS NOT AVAILABLE, CLEANING SHOULD BE DONE WET USING A WATER DAMPENED CLOTH. DO NOT CREATE DUST BY SANDING, GRINDING, AND/OR SHAVING BRAKE LININGS OR PADS UNLESS SUCH OPERATION IS DONE WHILE USING PROPERLY VENTILATED EXHAUST EQUIPMENT. DISPOSE OF DUST AND DIRT SUSPECTED OF CONTAINING ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS TO MINIMIZE EXPOSURE TO YOURSELF AND OTHERS. FOLLOW ALL RECOMMENDED PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION AND THE ENVIRONMENTAL PROTECTION AGENCY FOR THE HANDLING, PROCESSING, AND DISPOSITION OF DUST OR DIRT WHICH MAY CONTAIN ASBESTOS FIBERS.

BRAKE DRUM REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire.

(3) Remove clip nuts securing brake drum to wheel studs.

(4) If drum is difficult to remove, retract brakeshoes as follows:

  (a) Remove rear plug from access hole in support plate.

  (b) Insert a thin screwdriver into access hole and push self adjusting adjusting lever away from adjuster screw star wheel.

  (c) Insert tool C-3784 into brake adjusting hole and rotate adjuster screw star wheel to retract brakeshoes.

(5) Remove brake drum.

(6) Inspect brakelining for wear, alignment, or evidence of leakage from axle or wheel cylinder.

BRAKESHOE REMOVAL

(1) Remove rear wheel and drum.

(2) Remove shoe return springs with tool C-3785 (Fig. 2).

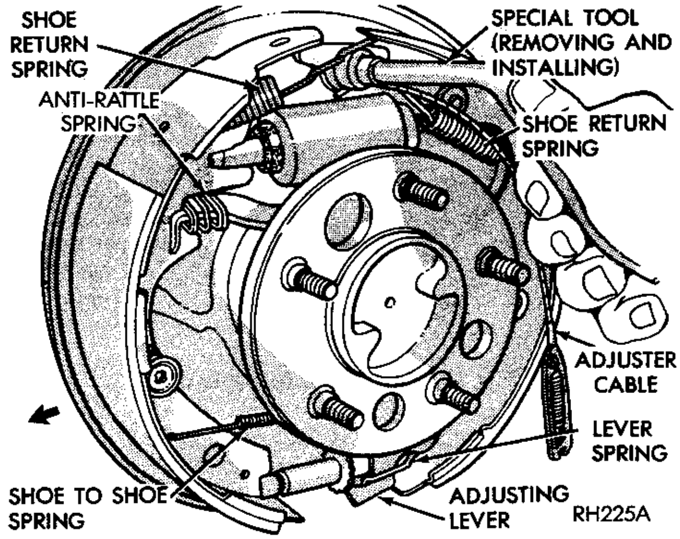

Fig. 2 Removing/Installing Shoe Return Springs

(3) Remove adjuster cable. Slide cable eye off anchor pin and remove cable from adjuster lever.

(4) Remove cable guide from secondary shoe and remove anchor plate from anchor pin.

(5) Remove adjuster lever. Disengage lever from spring by sliding lever forward to clear pivot and work lever out from under spring.

(6) Remove adjuster lever spring from pivot.

(7) Disengage and remove shoe spring from brakeshoes.

(8) Disengage and remove adjuster screw assembly from brakeshoes.

(9) Remove brake shoe retainers, springs and pins with tool C-4070, (Fig. 3).

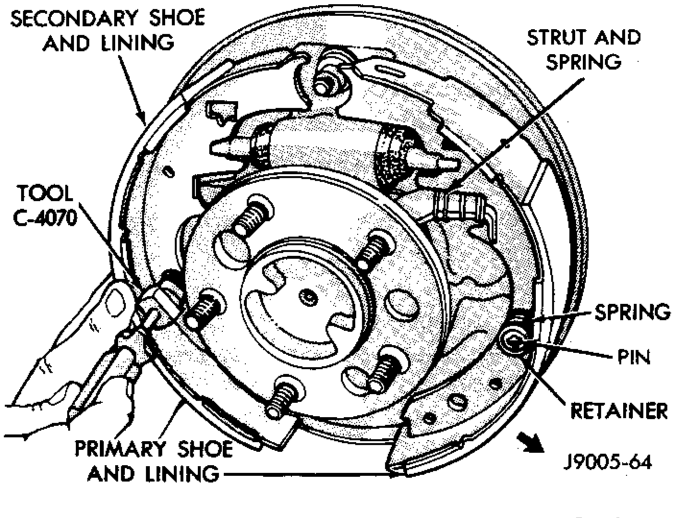

Fig. 3 Removing/Installing Shoe Retainers, Springs and Pins

(10) Remove secondary brakeshoe from support plate.

(11) Remove strut and anti rattle spring (Fig. 4).

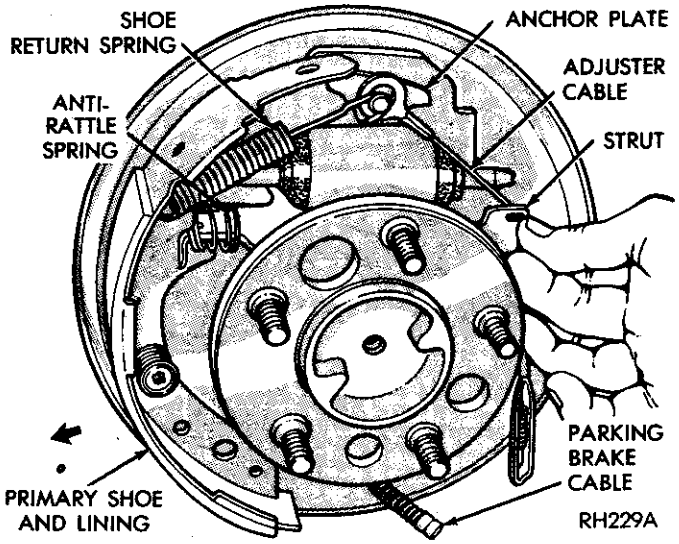

Fig. 4 Removing/Installing Strut And Spring

(12) Remove parking brake lever from secondary shoe.

(13) Remove primary shoe from support plate.

(14) Disengage parking brake lever from parking brake cable.

CLEANING AND INSPECTION

Clean the brake components, including the support plate and wheel cylinder exterior, with a water dampened cloth or with Mopar brake cleaner. Do not use any other cleaning agents.

Replace the brakeshoes if worn to within .76 mm (.030 in) of the rivet heads or if bonded lining is less than 1.57 mm (1/16 in) thick. Examine the lining contact pattern to determine if the shoes are bent or the drum is tapered. The lining should exhibit contact across the entire width. Shoes exhibiting contact only on one side should be replaced and the drum checked for runout or taper.

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

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

Inspect the brakeshoe contact pads on the support plate (Fig. 5). Remove light rust and scale from the pads with fine sandpaper. However, replace the support plate if any of the pads are worn or rusted through. Also replace the plate if it is bent or distorted.

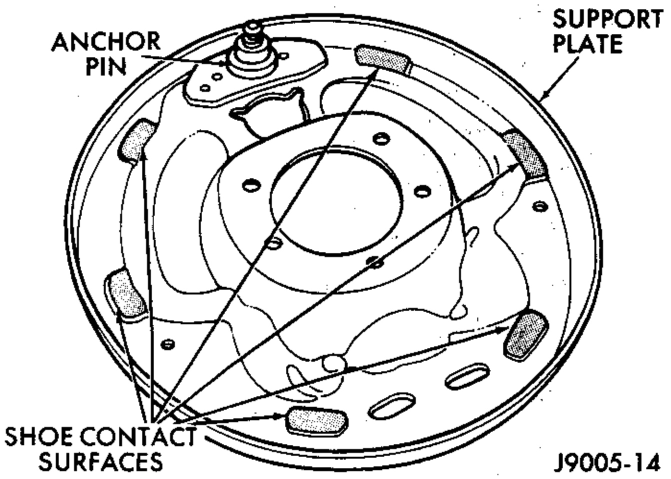

Fig. 5 Shoe Contact Surfaces

BRAKE SHOE INSTALLATION

(1) Lubricate anchor pin and brakeshoe contact pads on support plate (Fig. 5) with Mopar multi purpose grease or Lubriplate.

(2) Lubricate adjuster screw socket, nut, button and screw thread surfaces with Mopar multi purpose grease or Lubriplate.

(3) Attach parking brake cable to lever. Then connect lever to secondary shoe.

(4) Install primary shoe on support plate. Secure shoe with new spring retainers and pin (Fig. 6).

(5) Install spring on parking brake strut and engage strut in primary show (Fig. 6).

(6) Install secondary shoe on support plate (Fig. 6). Insert strut in shoe and guide shoe onto anchor pin. Temporarily secure shoe with retaining pin.

(7) Install anchor plate and adjuster cable eyelet on support plate anchor pin.

(8) Install cable guide in secondary shoe and position cable in guide.

(9) Assemble adjuster screw (Fig. 7). Then install and engage adjuster screw in brakeshoes.

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 (Fig. 8).

(10) Install adjuster lever and spring and connect adjuster cable to lever.

(11) Install secondary shoe retainers and spring.

(12) Install shoe spring. Connect spring to secondary shoe first. Then to primary shoe.

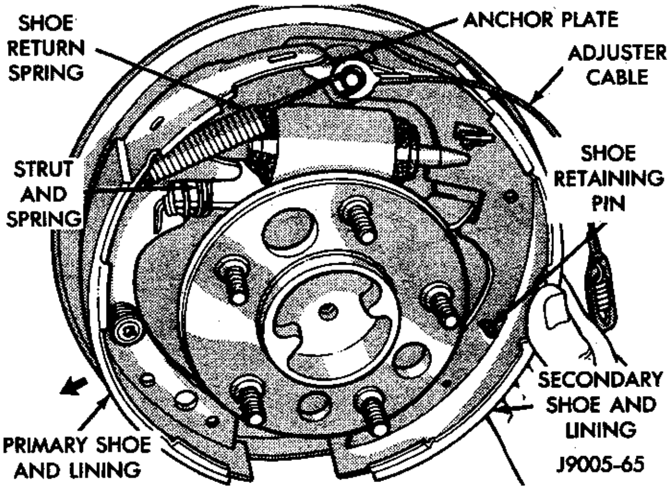

Fig. 6 Brakeshoe Installation

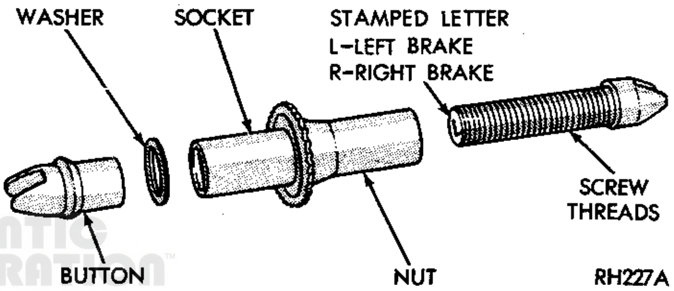

Fig. 7 Adjuster Screw Components

(13) Verify adjuster operation. Pull adjuster cable upward. Cable should lift lever and rotate start wheel. Be sure adjuster lever properly engages start wheel teeth.

(14) Adjust brakeshoes to drum with brake gauge as described in Service Adjustments section.

BRAKE DRUM INSPECTION AND REFINISHING

BRAKE DRUM REFINISHING

The brake drums can be resurfaced on a drum lathe when necessary. Initial machining cuts should be limited to .12 - .20 mm (.005 -.008 in) at a time as heavier feed rates can produce taper and surface variation. Final finish cuts of .025 to .038 mm (.001 to .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.

BRAKE DRUM REFINISH LIMITS

The maximum allowable diameter of the drum braking surface is stamped or cast into the drum outer edge (Fig. 8). Generally, a drum can be machined to a maximum of 1.52 mm (.060 in) oversize.

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

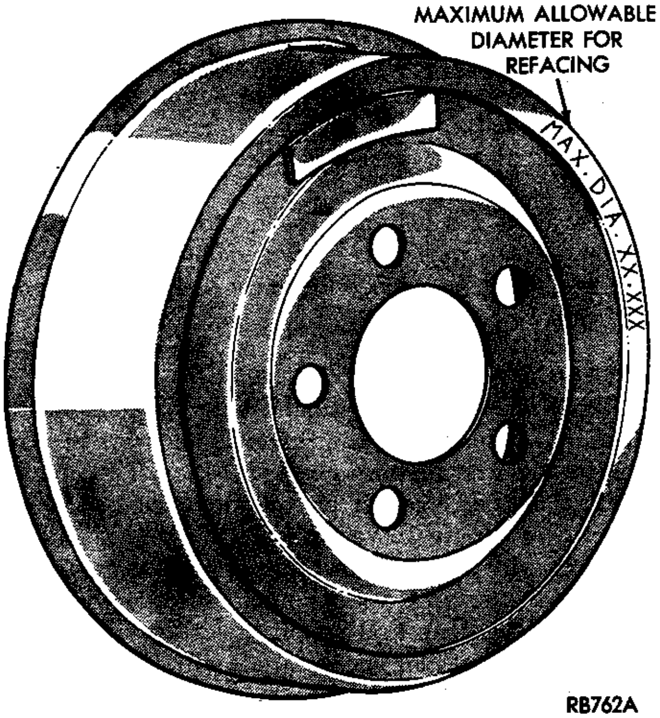

Fig. 8 Location Of Brake Drum Maximum Allowable Diameter

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 .076 mm (.003 inch). Drum runout should not exceed .20 mm (.008 in) out of round. Refinish the drum if runout or variation exceed these values.

BRAKE DRUM INSTALLATION

(1) Clean drum with Mopar brake cleaning solvent or with a soap and water solution only. Do not use any other cleaning agents.

(2) Adjust brake shoes to drum with a brake gauge.

(3) Install and secure drum to wheel studs with new retaining nuts/clips.

(4) Install rubber access plugs in support plate if removed.

(5) Install wheel and tire.

BRAKE SUPPORT PLATE REMOVAL

(1) Remove wheel and tire and brake drum.

(2) Remove axle shaft and retainer. Refer to Group 3 for procedures.

(3) Remove primary brakeshoe for access to parking brake cable if necessary.

(4) Compress parking brake cable retainer tabs with a hose clamp (Fig. 9). Then push retainer and cable through and out of support plate.

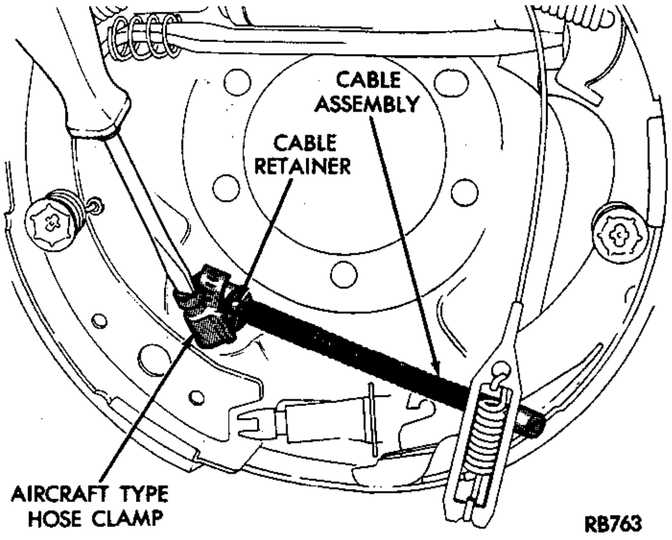

Fig. 9 Removing Parking Brake Cable From Support Plate

(5) Disconnect brake line at wheel cylinder.

(6) Remove wheel cylinder and brakeshoes from support plate.

(7) Remove bolts attaching support plate to axle and remove support plate.

BRAKE SUPPORT PLATE INSTALLATION

(1) If new support plate is being installed, apply bead of silicone sealer around wheel cylinder mounting surface. Then transfer wheel cylinder to new support plate.

(2) Apply bead of silicone sealer around axle mounting surface of support plate.

(3) Install support plate on axle flange. Tighten attaching bolts to 25-60 ft-lbs.

(4) Install parking brake cable in support plate.

(5) Install axle shaft and retainer.

(6) Start brakeline in wheel cylinder and install cylinder on support plate. Tighten brakeline fitting after cylinder installation.

(7) Connect parking brake cable to lever on secondary shoe and install brakeshoes on support plate.

(8) Adjust brakeshoes to drum with brake gauge.

(9) Install brake drum and wheel and tire.

(10) Bleed brake system.

WHEEL CYLINDER REMOVAL

(1) Raise vehicle and remove wheel and brake drum.

(2) Disconnect wheel cylinder brakeline.

(3) Remove brakeshoe return springs and move shoes out of engagement with cylinder push rods.

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

WHEEL CYLINDER OVERHAUL

WHEEL CYLINDER DISASSEMBLY

(1) Remove the push rods and boots (Fig. 10).

(2) Press the pistons, cups and spring and expander out of the cylinder bore.

(3) Remove the bleed screw.

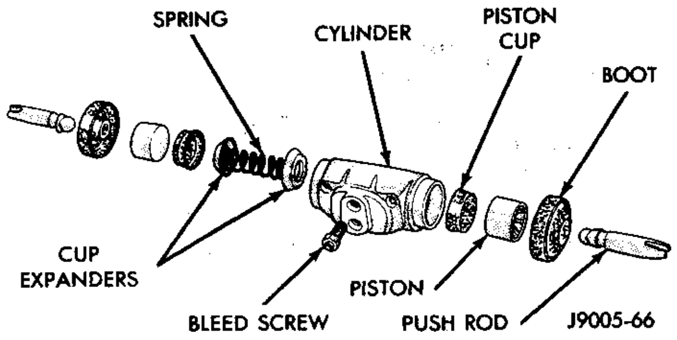

Fig. 10 Wheel Cylinder Components

CLEANING AND INSPECTION

Clean the cylinder and pistons with fresh 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 such materials can adhere to the cylinder bores and pistons.

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

ASSEMBLING WHEEL CYLINDER

(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 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 expanders 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.

WHEEL CYLINDER INSTALLATION

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

(2) Connect brake line to cylinder. Mount cylinder on support plate and install cylinder attaching bolts.

(3) Install wheel brake components.

(4) Install brake drum and wheel and bleed brakes.

12-INCH DRUM BRAKE

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GENERAL INFORMATION

Twelve inch rear drum brakes are used on D and W 250/350 models (Fig. 1). All applications are dual shoe, internal expanding units with a self adjusting mechanism. A single wheel cylinder is used to expand the dual brakeshoes. The lower ends of the brake shoes are connected by a star wheel-type adjuster screw which is part of the self adjusting mechanism (Fig. 1).

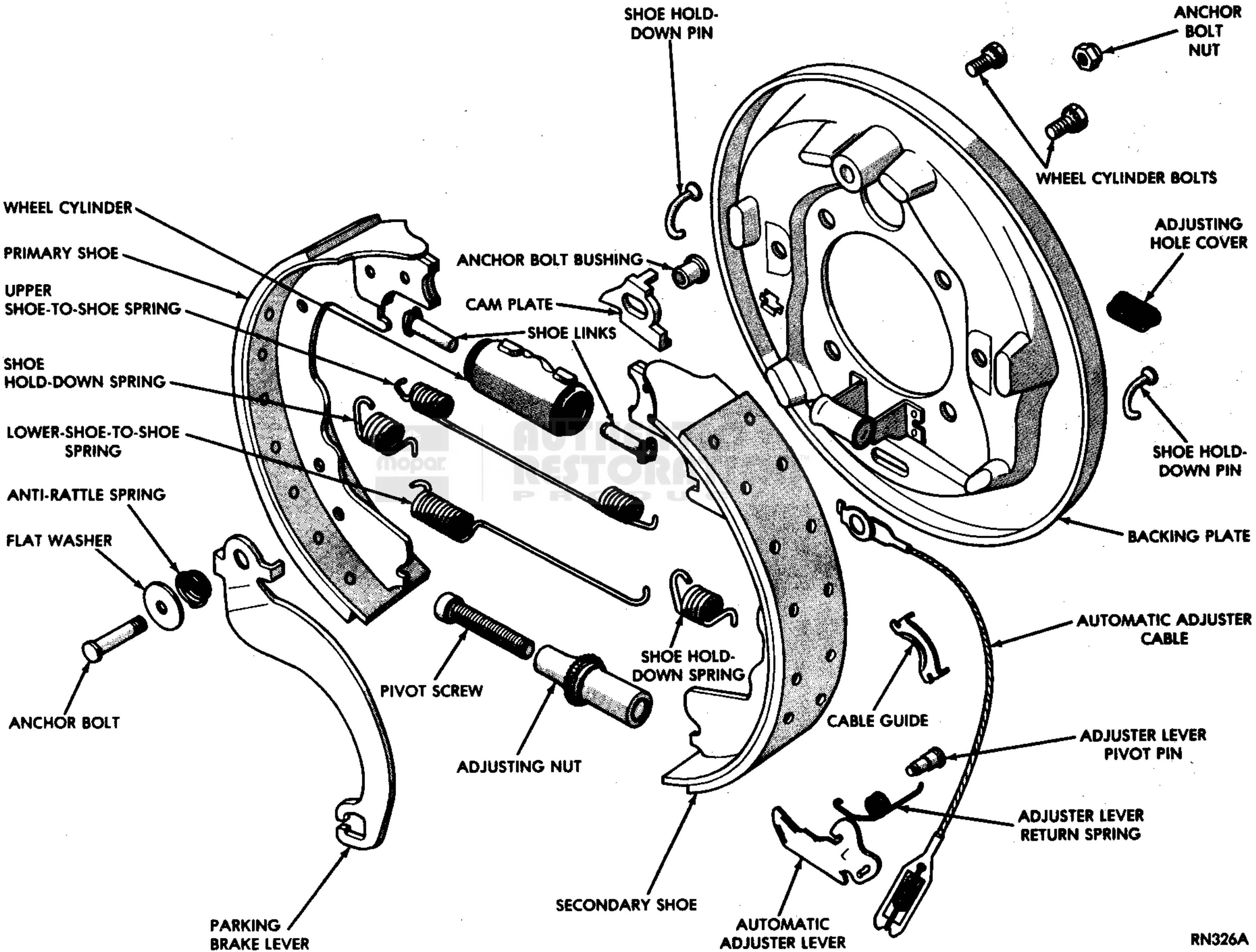

Fig. 1 12-Inch Drum Brake Assembly

SAFETY PRECAUTIONS

WARNING: DUST AND DIRT ON BRAKE PARTS GENERATED DURING THE NORMAL USE AND WEAR OF MOTOR VEHICLE BRAKE SYSTEMS MAY CONTAIN ASBESTOS FIBERS. BREATHING EXCESSIVE CONCENTRATIONS OF ASBESTOS FIBERS CAN CAUSE SERIOUS BODILY HARM. EXTREME CARE SHOULD BE EXERCISED WHILE SERVICING BRAKE ASSEMBLIES OR COMPONENTS. DO NOT CLEAN BRAKE ASSEMBLIES OR COMPONENTS WITH COMPRESSED AIR OR BY DRY BRUSHING. USE A VACUUM CLEANER SPECIFICALLY RECOMMENDED FOR USE WITH ASBESTOS FIBERS. IF A SUITABLE VACUUM CLEANER IS NOT AVAILABLE, CLEANING SHOULD BE DONE WET USING A WATER DAMPENED CLOTH. DO NOT CREATE DUST BY SANDING, GRINDING, AND/OR SHAVING BRAKE LININGS OR PADS UNLESS SUCH OPERATION IS DONE WHILE USING PROPERLY VENTED EXHAUST EQUIPMENT. DISPOSE OF ALL DUST AND DIRT SUSPECTED OF CONTAINING ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS TO MINIMIZE EXPOSURE TO YOURSELF AND OTHERS. FOLLOW ALL RECOMMENDED PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION AND THE ENVIRONMENTAL PROTECTION AGENCY FOR THE HANDLING, PROCESSING, AND DISPOSITION OF DUST OR DIRT WHICH MAY CONTAIN ASBESTOS FIBERS.

BRAKE DRUM REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove axle shaft nuts, washers and cones. Strike axle shaft in center with copper or dead blow hammer to loosen retaining cones.

(4) Remove axle shaft.

(5) Remove outer hub nut.

(6) Straighten and remove lock washer.

(7) Remove inner nut and bearing.

(8) Remove drum. However, if drum is difficult to remove, retract brakeshoes as follows:

  (a) Remove rear plug from access hole in support plate.

  (b) Insert a thin releasing tool (or screwdriver) into access hole and push self adjusting adjusting lever away from adjuster screw star wheel (Fig. 2).

  (c) Insert thin screwdriver, or tool C-3784 into access hole and rotate adjuster star wheel to retract brakeshoes (Fig. 2).

(9) Remove brake drum.

(10) Inspect brakelining for wear, alignment, or evidence of leakage from axle or wheel cylinder.

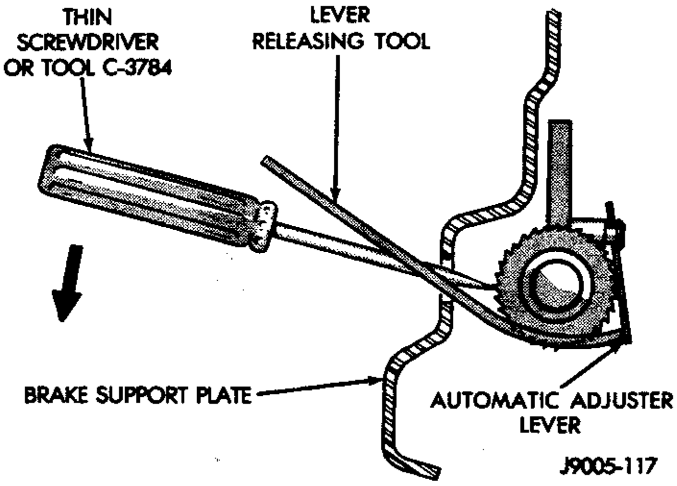

Fig. 2 Retracting Brakeshoes

BRAKESHOE REMOVAL

(1) Unhook adjuster lever return spring from lever (Fig. 1).

(2) Remove lever and return spring from lever pivot pin (Fig. 1).

(3) Unhook adjuster lever from adjuster cable assembly (Fig. 1).

(4) Remove shoe-to-shoe upper spring (Fig. 3).

(5) Remove shoe holddown springs (Fig. 4).

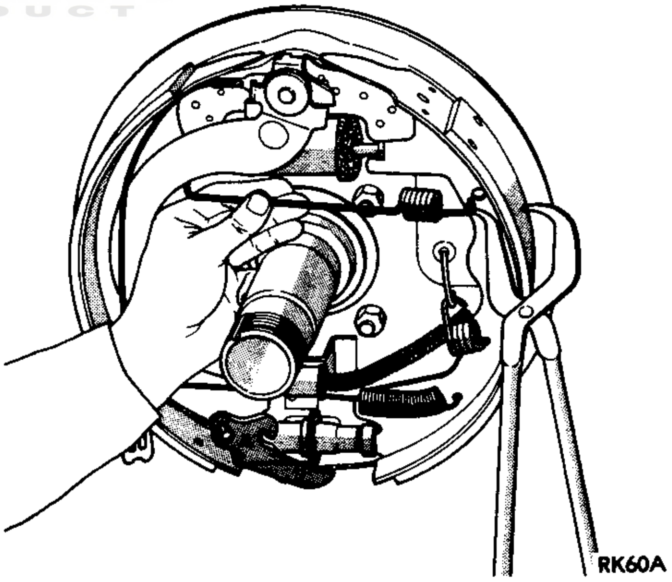

Fig. 3 Removing/Installing Shoe-To-Shoe Upper Spring

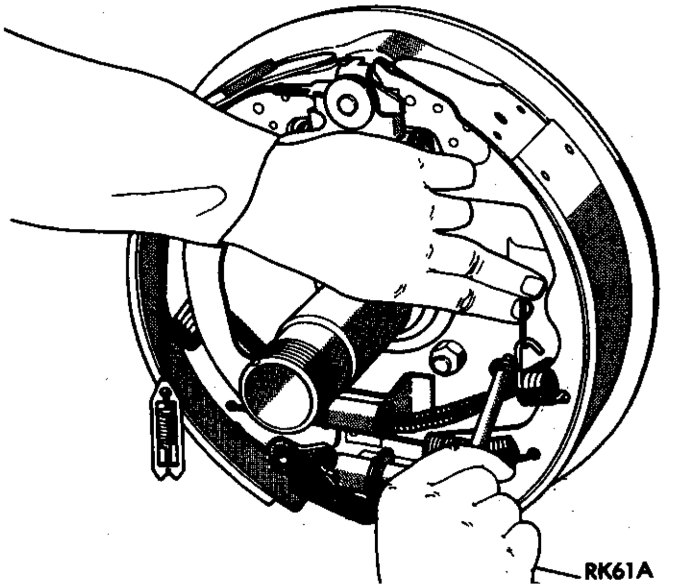

Fig. 4 Removing/Installing Shoe Holddown Springs

(6) Disconnect parking brake cable from parking brake lever.

(7) Remove both brakeshoes, shoe-to-shoe lower spring and adjuster nut as assembly (Fig. 5).

(8) If support plate or wheel cylinder are to be serviced, remove anchor bolt and nut that attaches parking brake lever to support plate. Then remove lever, washer, spring, cam plate, anchor bolt bushing and adjuster cable (Fig. 1).

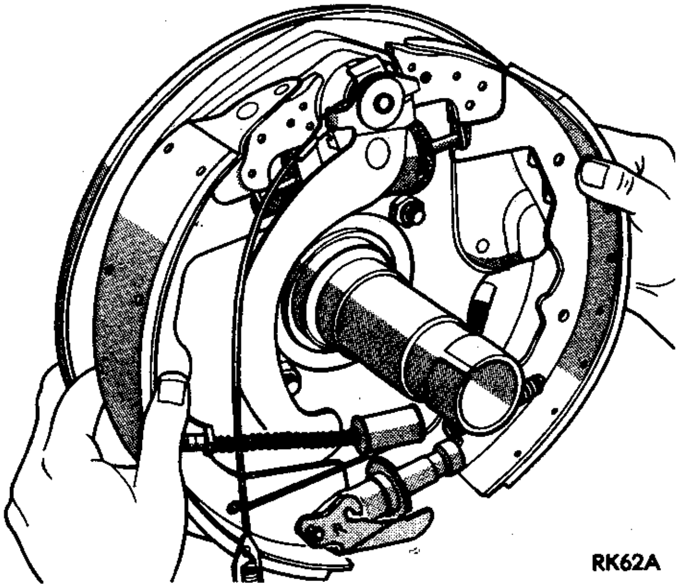

Fig. 5 Removing/Installing Brakeshoes

CLEANING AND INSPECTION

Clean the brake components, including the support plate and wheel cylinder exterior, with a water dampened cloth or with Mopar brake cleaner. Do not use compressed air.

Replace the brakeshoes if worn to within .76 mm (.030 in) of the rivet heads or if bonded lining is less than 1.57 mm (1/16 in) thick. Examine the lining contact pattern to determine if the shoes are bent or the drum is tapered. The lining should exhibit contact across the entire width. Shoes exhibiting contact only on one side should be replaced and the drum checked for runout or taper.

Clean and inspect the adjusting nut and pivot screw assembly. Replace the assembly if the star wheel threads on the nut are damaged, or the screw 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 brakeshoe contact pads on the support plate (Fig. 6). Remove light rust and scale from the pads with fine sandpaper. However, replace the support plate if any of the pads are worn or rusted through. Also replace the plate if it is bent or distorted.

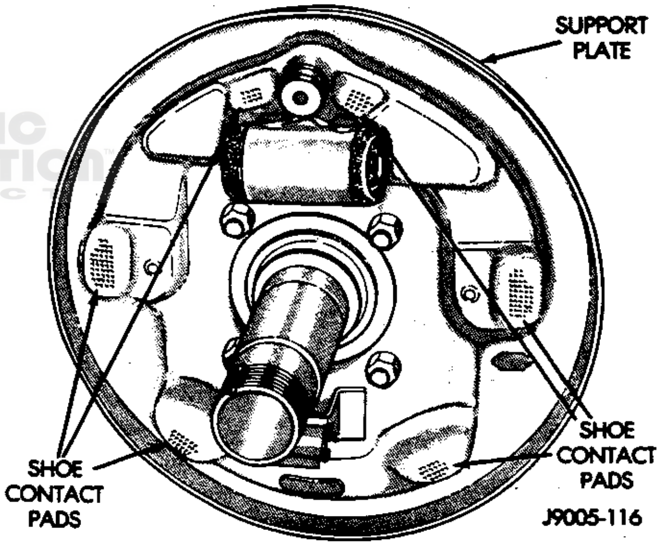

Fig. 6 Support Plate Brakeshoe Contact Pads

BRAKE SHOE INSTALLATION

(1) If parking brake lever was removed, install anchor bolt bushing, cam plate, lever, spring, washer and anchor bolt and nut (Fig. 1).

(2) Coat contact pads on support plate (Fig. 6) with Mopar high temperature grease, or equivalent.

(3) If both sets of brakeshoes were removed, verify that adjusting nuts are installed on correct side of vehicle. Pivot screw and adjusting nut have left hand threads on left side brake assembly and right hand threads on right side assembly.

(4) Lubricate and assemble adjusting nut and pivot screw.

(5) Assemble adjusting nut, shoe-to-shoe lower spring and both brakeshoes. Then position the assembled components on the support plate.

(6) Install brakeshoe holddown springs and pins (Fig. 4). Be sure holddown pins are seated in support plate and springs are connected as shown (Fig. 7).

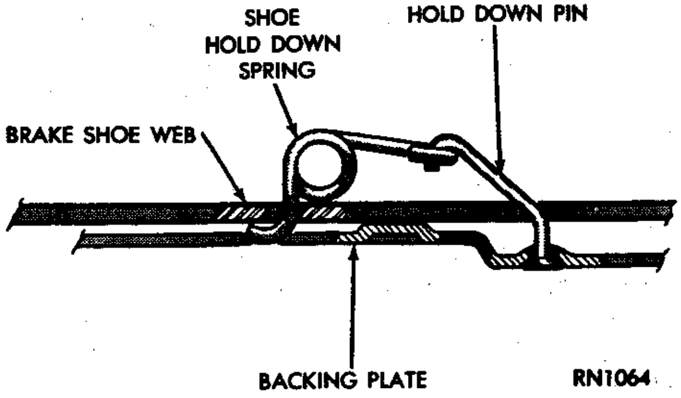

Fig. 7 Holddown Spring And Pin Attachment

(7) Connect parking brake cable to parking brake lever. Be sure cable end is properly secured in lever (Fig. 8).

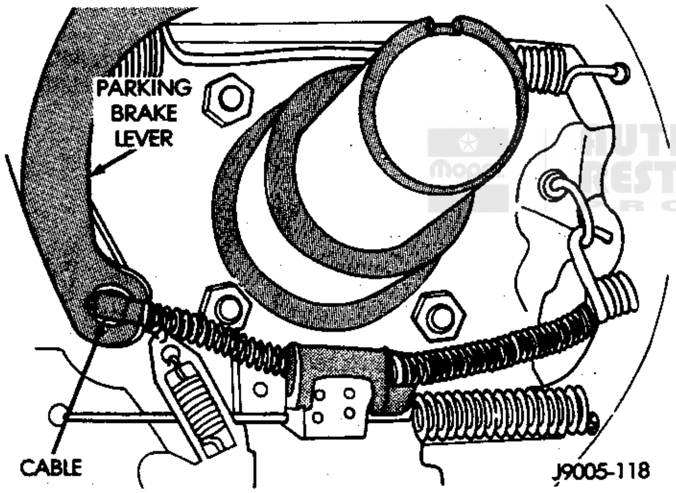

Fig. 8 Connecting Parking Brake Cable

(8) Install shoe-to-shoe upper spring (Fig. 3).

(9) Position adjuster lever return spring on pivot.

(10) Install adjuster lever.

(11) Attach adjuster cable to adjuster lever. Be sure cable is properly routed.

(12) Adjust brakeshoes to drum with brake gauge.

BRAKE DRUM INSTALLATION

(1) Position drum on axle housing.

(2) Install bearing and inner nut. Adjust bearing as described in Group 3.

(3) Install locking washer and outer nut. Bend locking washer to secure it.

(4) Place new gasket on hub and install axle shaft, cones, lock washers and nuts.

(5) Install wheel and tire assembly.

(6) Remove support stands and lower vehicle.

BRAKE DRUM SERVICE

BRAKE DRUM REFINISHING

The brake drums can be resurfaced on a drum lathe when necessary. Initial machining cuts should be limited to .12 - .20 mm (.005 -.008 in) at a time as heavier feed rates can produce taper and surface variation. Final finish cuts of .025 to .38 mm (.001 to .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.

BRAKE DRUM REFINISH LIMITS

The maximum allowable diameter of the drum braking surface is stamped or cast into the drum outer edge (Fig. 9). Generally, an 11 inch drum can be machined to a maximum of 11.060 inch. Always replace the drum if machining would cause drum diameter to exceed indicated size limit.

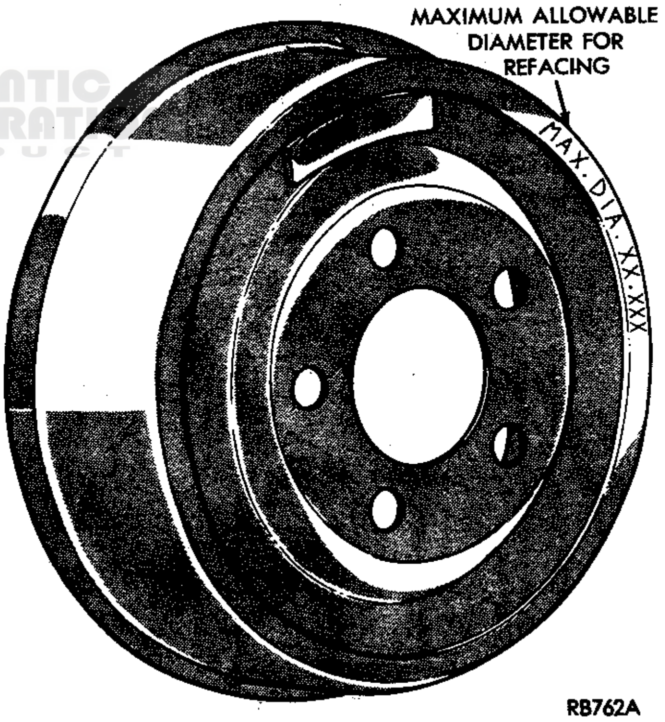

Fig. 9 Location Of Brake Drum Maximum Allowable Diameter

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 .076 mm (.003 in). Drum runout should not exceed .20 mm (.008 in) out of round. Refinish the drum if runout or variation exceed these values.

WHEEL CYLINDER REMOVAL

(1) Raise and support the vehicle.

(2) Remove the brake drum and brakeshoes as described in this section.

(3) Remove the anchor bolt and nut and remove the washer, spring, parking brake lever, adjuster cable, cam plate and anchor pin bushing.

(4) loosen the brakeline at the wheel cylinder.

(5) Remove the wheel cylinder bolts.

(6) Disconnect the brakeline and remove the wheel cylinder.

WHEEL CYLINDER OVERHAUL

WHEEL CYLINDER DISASSEMBLY

(1) Remove the push rods and boots (Fig. 10).

(2) Press the pistons, cups and spring and expander out of the cylinder bore.

(3) Remove the bleed screw.

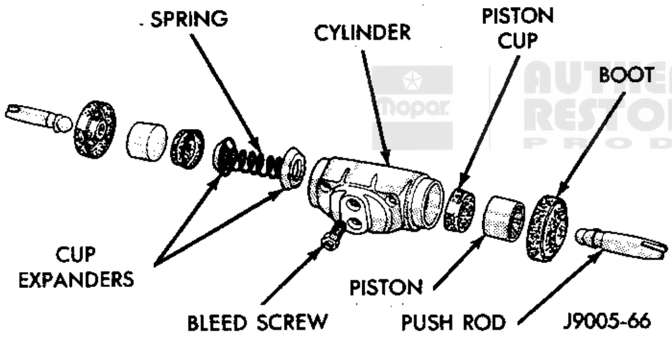

Fig. 10 Wheel Cylinder Components

CLEANING AND INSPECTION

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 such materials can adhere to the cylinder bores and pistons.

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

ASSEMBLING WHEEL CYLINDER

(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 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 expanders 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.

WHEEL CYLINDER INSTALLATION

(1) Start the brakeline in the cylinder.

(2) Position the cylinder on the support plate and install the cylinder attaching bolts.

(3) Tighten the brakeline fitting and the cylinder attaching bolts.

(4) Install the anchor pin bushing, cam plate, adjuster cable, parking brake lever, spring washer and the anchor bolt and nut.

(5) Install the brakeshoes and brake drum as described in this section.

(6) Install axle shaft.

(7) Install the wheel and tire.

(8) Remove the supports and lower the vehicle.

SUPPORT PLATE REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire.

(3) Remove axle shaft.

(4) Remove the brake drum, brake shoes and wheel cylinder as described in this section.

(5) Remove the bolts/nuts attaching the support plate to the axle and remove the support plate.

SUPPORT PLATE INSTALLATION

(1) Transfer the wheel cylinder and parking brake lever components to the replacement support plate.

(2) Position the support plate on the axle and install the attaching bolts/nuts.

(3) Install the brakeshoes. Adjust the shoes to the drum with a brake gauge.

(4) Install the brake drum.

(5) Install the axle shaft.

(6) Install the wheel and tire.

(7) Remove the supports and lower the vehicle.

PARKING BRAKES

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GENERAL INFORMATION

The parking brake mechanism on AD models is a three cable system operated by a foot pedal assembly (Figs. 1 and 2). The foot pedal is mounted on the driver side cowl panel. The front cable is attached to the pedal assembly. An intermediate cable connects the front cable to the rear cables. An equalizer and ratio lever connect the rear cables to the intermediate cable. The rear cables are connected to the secondary brakeshoes by a lever attached to each shoe.

PARKING BRAKE CABLE ADJUSTMENT

(1) Adjust the rear drum brakes before adjusting the parking brake cables.

(2) Release the parking brakes fully.

(3) Raise the vehicle.

(4) Loosen the adjusting nut on the front cable until there is slack in all the cables.

(5) Rotate the rear wheels and tighten the cable adjusting nut until a slight drag is created at the wheels.

(6) Continue rotating the rear wheels and loosen the cable adjusting nut until all drag is eliminated.

(7) Back off the cable adjusting nut an additional two full turns.

(8) Apply the parking brake several times.

(9) Release the parking brakes and and verify that the rear wheel rotates freely (no drag).

(10) Lower the vehicle.

REAR CABLE REPLACEMENT

REAR CABLE REMOVAL

(1) Release the parking brakes fully.

(2) Raise the vehicle.

(3) Remove the adjusting nut from the front cable.

(4) Remove the rear wheels.

(5) Remove the brake drums.

(6) Remove the brakeshoes and parking brake strut and spring.

(7) Disconnect the cable from the parking brake lever on the secondary brakeshoe.

(8) Compress the cable retainer tabs and remove the cable from the support plate.

(9) Remove the cable from the guides and retaining clips.

(10) Disconnect the cable from the equalizer and ratio lever.

(11) Remove the cable.

REAR CABLE INSTALLATION

(1) Insert the cable through the support plate hole and seat the cable.

(2) Connect the cable to the lever on the secondary brakeshoe.

(3) Install the brakeshoes, parking brake strut and spring, the shoe return and holdown springs and the self adjuster components.

(4) Install the cable in the cable guide and install the cable retaining clips, if equipped.

(5) Connect the cable to the ratio lever and equalizer.

(6) Adjust the rear brakes and install the brake drum and wheel.

(7) Adjust the parking brake cable.

FRONT CABLE REPLACEMENT

FRONT CABLE REMOVAL

(1) Remove the front cable adjusting nut.

(2) Remove the clip securing the cable to the anchor bracket and slide the cable out of the bracket.

(3) Remove the retainer attaching the cable to the pedal assembly frame.

(4) Disengage the cable from the pedal clevis.

(5) Remove the cable grommet (or seal) from the floor pan.

(6) Remove the front cable.

FRONT CABLE INSTALLATION

(1) Insert the cable through the floor pan.

(2) Connect the cable to the pedal clevis and install the cable retainer.

(3) Seat the cable grommet (or seal) in the floorpan.

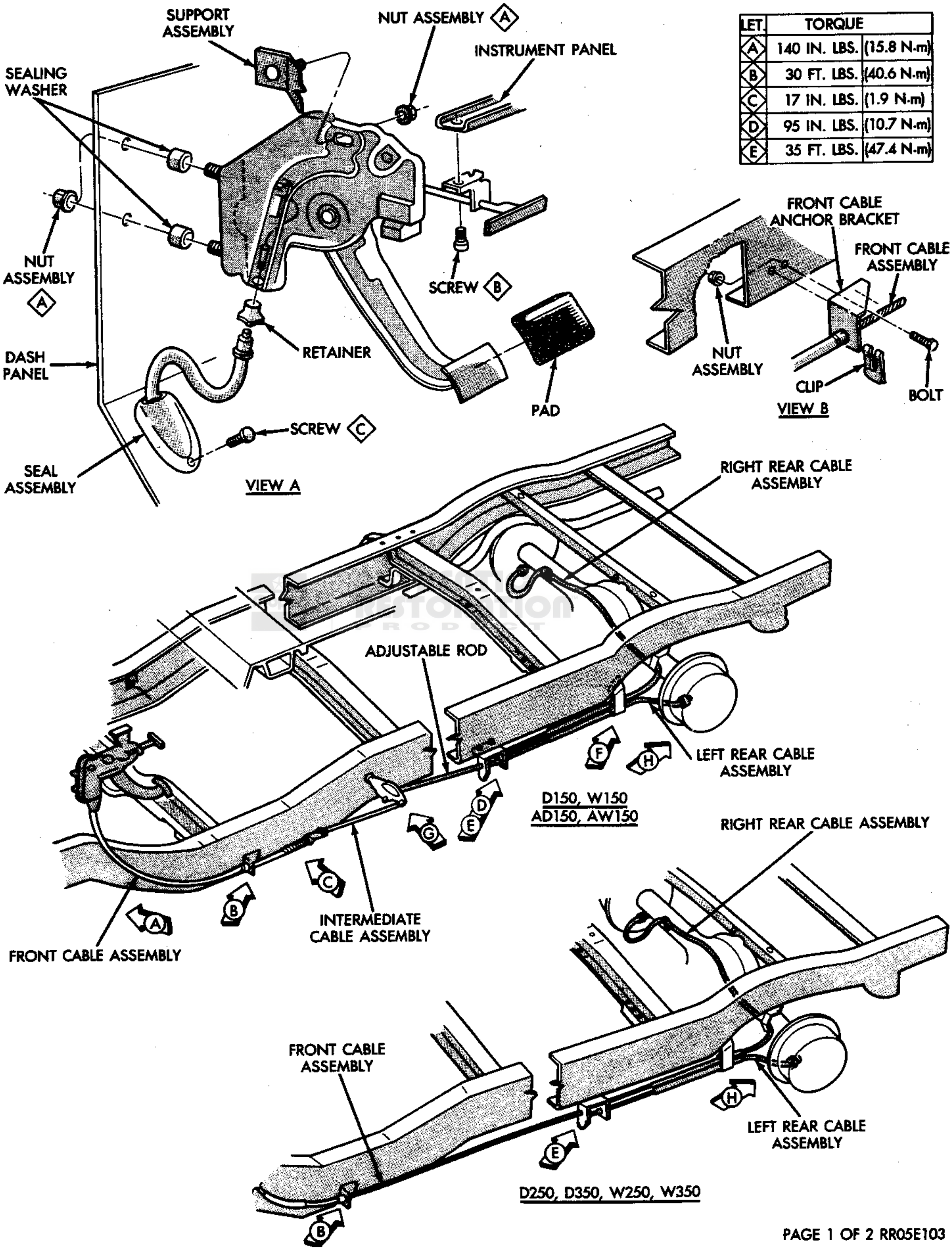
(4) Route the cable to the anchor bracket and intermediate cable.

(5) Secure the cable in the anchor bracket with the U-clip.

(6) Connect the cable to the adjusting link and install the cable adjusting nut.

(7) Adjust the rear brakeshoes, if necessary.

(8) Adjust the parking brake cable as described in this section.



LET.	TORQUE	
Ⓐ	140 IN. LBS.	(15.8 N·m)
Ⓑ	30 FT. LBS.	(40.6 N·m)
Ⓒ	17 IN. LBS.	(1.9 N·m)
Ⓓ	95 IN. LBS.	(10.7 N·m)
Ⓔ	35 FT. LBS.	(47.4 N·m)

Fig. 1 Parking Brake Cable Routing

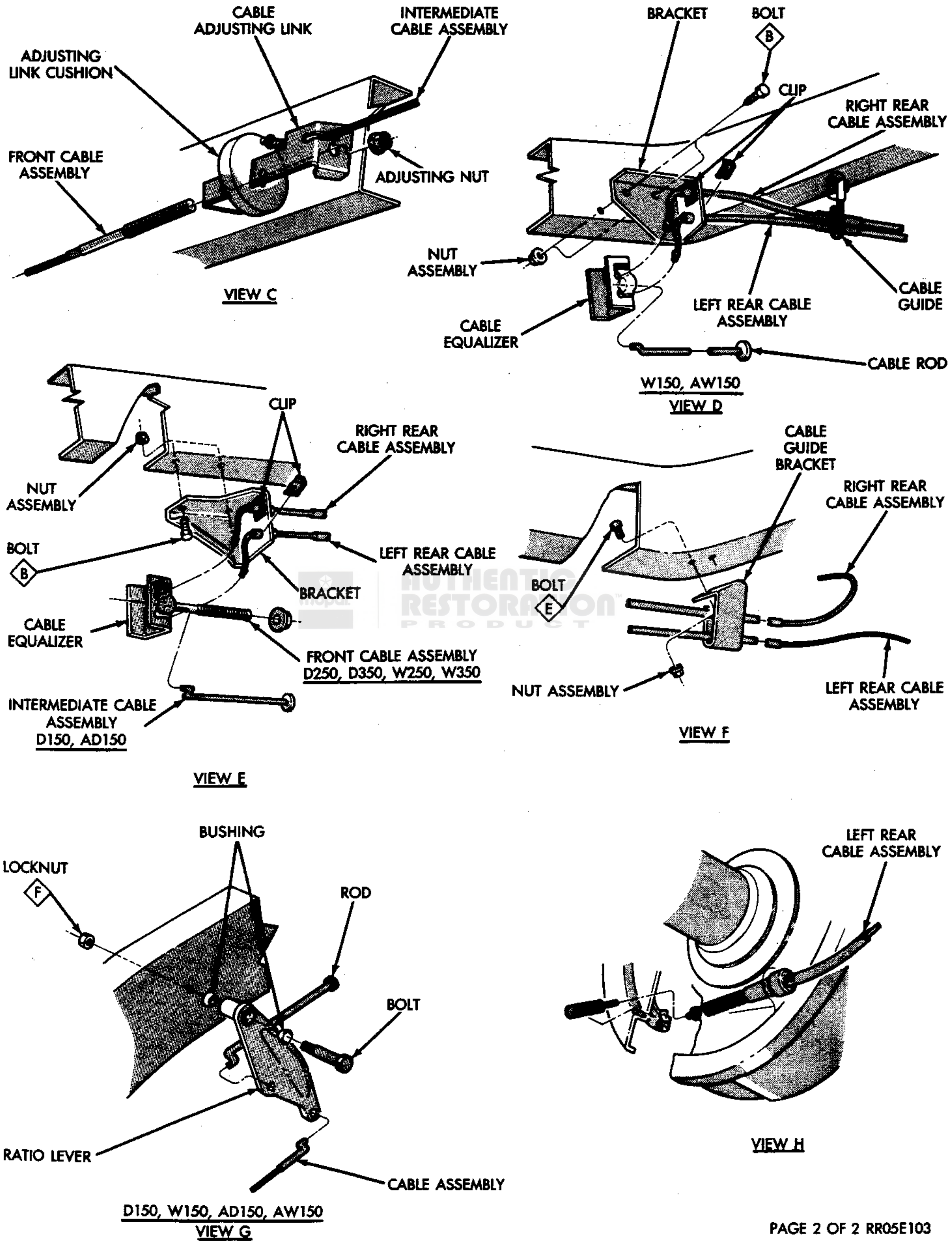


Fig. 2 Parking Brake Cable Attachment

INTERMEDIATE CABLE REPLACEMENT

(1) Remove the adjusting nut from the front cable.

(2) Disengage the intermediate cable from the ratio lever or cable equalizer.

(3) Remove the cable.

(4) Connect the new cable to the ratio lever or cable equalizer.

(5) Connect the cable to the adjusting link.

(6) Instert the front cable in the adjusting link and and install the cable adjusting nut.

(7) Adjust the brakeshoes if necessary.

(8) Adjust the parking brake cable as described in this section.

REAR WHEEL ANTI-LOCK BRAKE SYSTEM (RWAL)

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GENERAL INFORMATION

A rear wheel anti-lock brake system is standard equipment on all AD models. It is an electronically operated system designed to retard rear wheel lockup during periods of high wheel slip and deceleration. Retarding lockup is accomplished by modulating fluid pressure to the rear brake units.

Rear brake fluid apply pressure is modulated according to wheel speed, degree of wheel slip and rate of deceleration. A sensor located in the rear axle housing converts differential case rotating speed into electronic signals. The signals are transmitted to the electronic brake control module for processing. The control unit determines rate of deceleration and wheel slip from these signals.

SYSTEM COMPONENTS

Basic system components include an electronic brake control module, a hydraulic pressure control valve, a speed sensor and exiter ring and an anti-lock indicator lamp (Fig. 1).

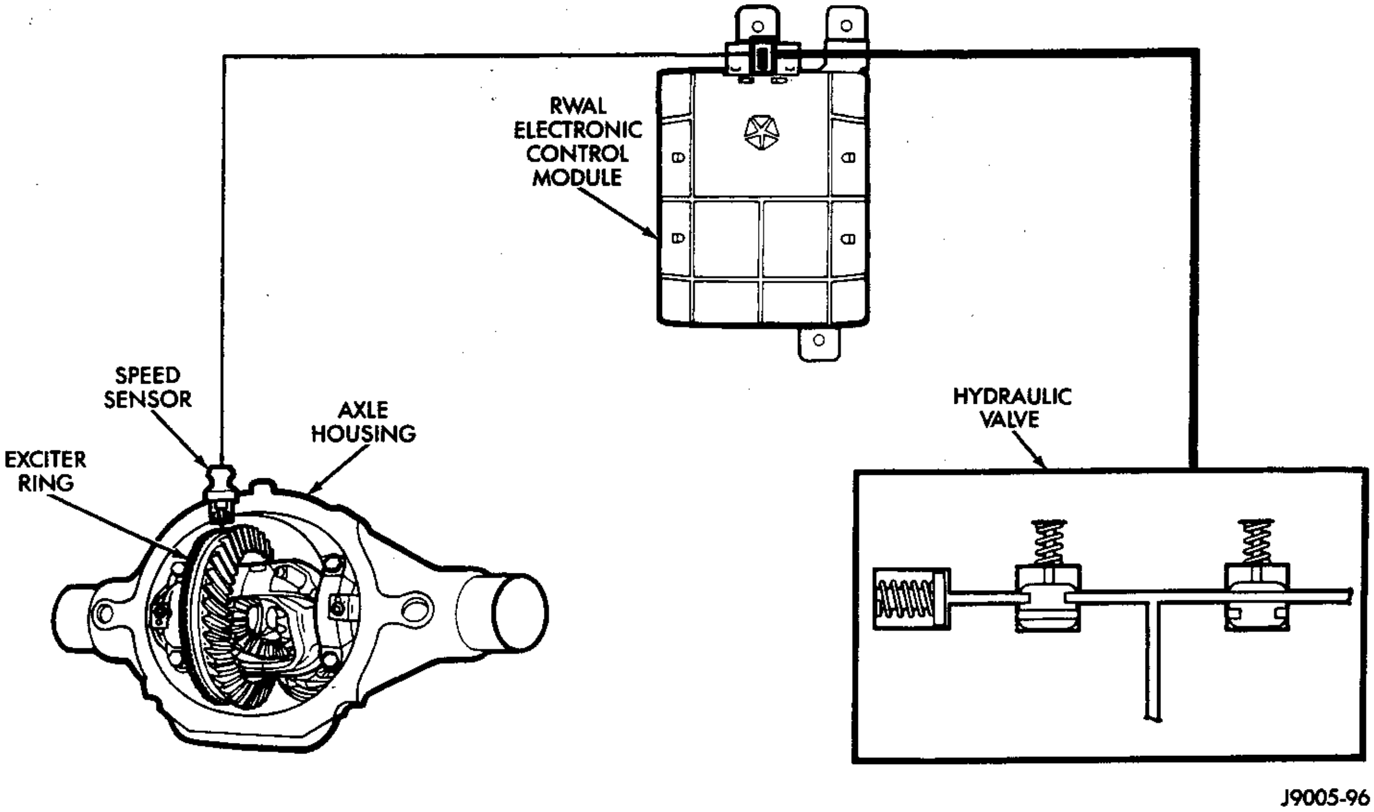

Fig. 1 Rear Wheel Anti-Lock Brake System (RWAL)

A standard master cylinder and vacuum power brake booster are used for all applications.

ANTI-LOCK ELECTRONIC CONTROL MODULE

The electronic module controls all phases of anti-lock mode brake operation. The module is separate from other electrical circuits in the vehicle and operates independently.

The module is located on the passenger side cowl panel under the dash (Fig. 2). The system hydraulic valve, speed sensor and indicator lamps are all in circuit with the module. The module contains a microprocessor that operates the system and performs system diagnostic checks.

Speed sensor inputs are continuiously monitored and interpreted by the module. The module determines wheel speed and rate of deceleration from these inputs and activates the appropriate solenoid in the hydraulic valve when necessary.

The module microprocessor also contains a self test program. The program is activated when the ignition switch is turned to the On position. In this mode, the module checks indicator light operation, the system electrical circuits and the pressure limiting valve solenoids.

The brake warning and anti-lock indicator lamps are illuminated for approximately two seconds during the system self test cycle.

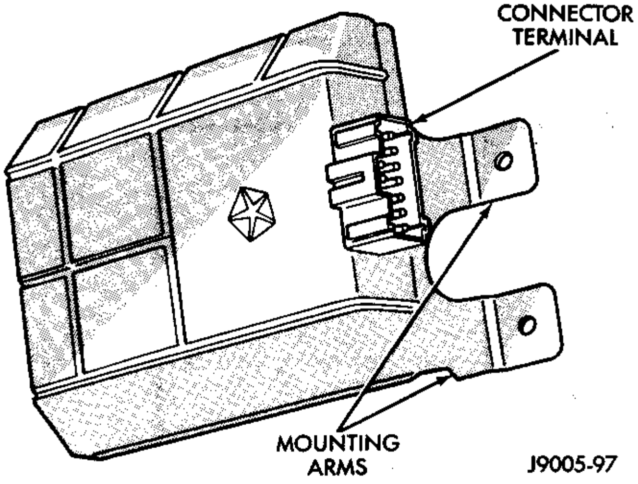

Fig. 2 Anti-Lock Electronic Control Module

RWAL HYDRAULIC VALVE

The hydraulic valve is a pressure controlling device and is operated by the electronic module. The valve controls fluid apply pressure to the rear brake units during anti-lock mode braking (Fig. 3). The valve is mounted on the driver side frame rail at the front of the vehicle.

The valve contains an accumulator, an isolation valve and a dump valve. The accumulator is operated by fluid and spring pressure. The two valves are operated by electrical solenoids. The solenoids are operated by the anti-lock control module.

The hydraulic valve components are inactive during periods of normal braking effort. The valve components are activated only when braking effort and rate of wheel slip and deceleration are high (anti-lock mode).

During normal braking the valve allows free flow of brake fluid to the rear brake units. In anti-lock mode, the valve will decrease, hold or increase fluid apply pressure as needed.

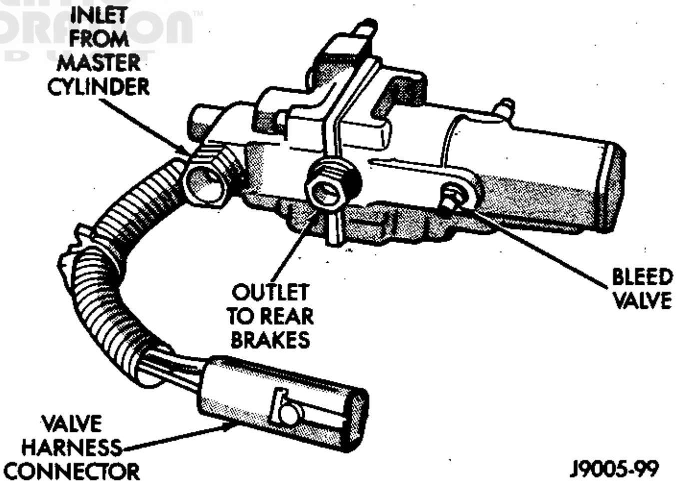

Fig. 3 RWAL Hydraulic Valve

SPEED SENSOR AND EXITER RING

A single pole, variable reluctance speed sensor is used to transmit speed and rate of deceleration inputs to the control module (Fig. 4). The sensor is actuated by an exiter ring on the differential case.

The sensor is mounted at the top of the rear axle housing directly over the gear-type exiter ring (Fig. 1). The exiter ring is pressed onto the differential case next to the ring gear.

The exiter ring is the sensor trigger mechanism. As the ring rotates, the teeth on the ring will interupt the magnetic field around the sensor pole. The rate of interruption is converted into speed signals which are transmitted to the control module.

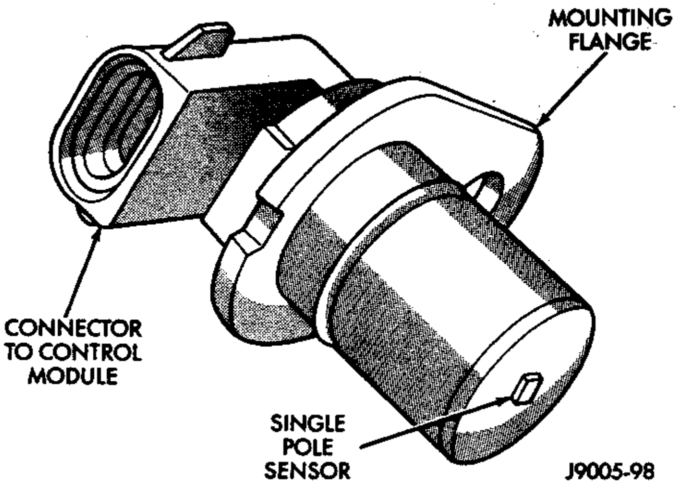

Fig. 4 RWAL Speed Sensor

ANTI-LOCK INDICATOR LAMP

The amber colored indicator lamp is located in the message center. The lamp alerts the driver if an anti-lock system fault occurs.

The anti-lock and brake warning lamps are both in circuit with the electronic module. The module will cause the two lamps to illuminate or flash to alert the driver that system operation is either normal or that a fault has occurred.

ANTI-LOCK SYSTEM OPERATION

During light brake applications, rear wheel deceleration and/or slip is not sufficient to activate the anti-lock system. Brake fluid apply pressure at the rear wheels is normal. However, when braking effort, degree of wheel slip and rate of deceleration approach programmed limits, sensor inputs will cause the module to activate the system.

Normal Braking Mode

In normal braking mode, the hydraulic valve components are inactive. The isolation valve is open and the dump valve and accumulator are closed. Fluid flows unimpeded through the isolation valve directly to the rear wheel cylinders (Fig. 5).

Start Of Anti-Lock Mode Braking

When high pedal effort braking occurs, the decrease in exiter wheel rotating speed is noted and converted into an electronic signal by the sensor. This signal is transmitted to and processed by the control module. The module determines that acceptable limits of wheel slip/deceleration are about to be exceeded. The module activates the hydraulic valve at this point.

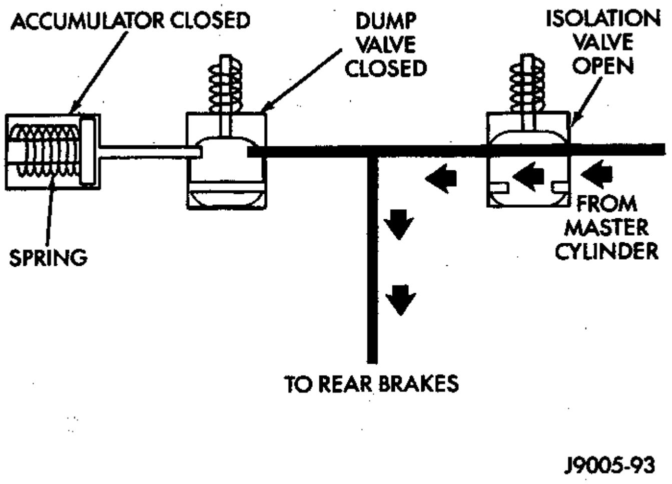

Fig. 5 Valve Position And Fluid Flow-Normal Braking

The control module transmits a signal to the isolator valve solenoid which closes the valve (Fig. 6). Closing the valve prevents further fluid flow to the rear wheel cylinders. This action isolates the rear brakes from the master cylinder. The net effect is to decrease rear brake apply pressure to the point where the wheels will continue to rotate and not lock.

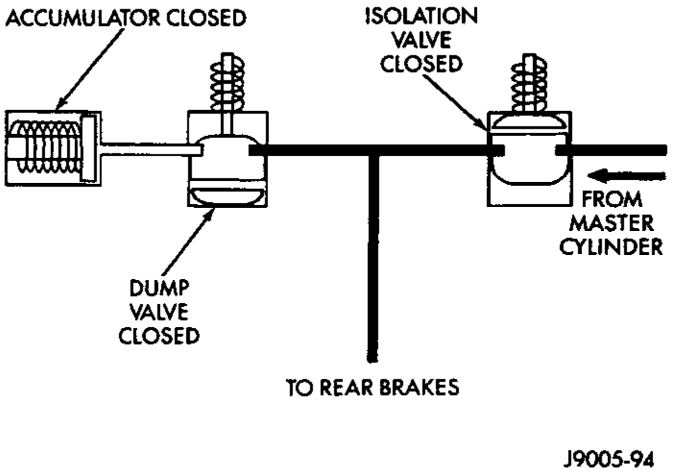

Fig. 6 Valve Position And Fluid Flow At Start Of Anti-Lock Mode Braking

Additional Pressure Relief During Anti-Lock Mode Braking

The dump valve and accumulator are hydraulically connected and serve as additional pressure limiting devices. The accumulator and dump valve remain closed during initial closing of the isolation valve. However, if pressure exerted by fluid captured in the wheel cylinders and lines is high enough to lock the wheels, the dump valve and accumulator are activated (Fig. 7).

When captured fluid pressure is high, the control module opens the dump valve (Fig. 7). Since the dump valve is connected to the accumulator, a portion of the captured fluid is diverted through the valve and into the accumulator. The amount of fluid diverted is sufficient to reduce apply pressure to anti-lock levels.

When rear brake pressure requirements return to normal levels, the accumulator spring closes the accumulator. Fluid in the accumulator is forced out and back into the hydraulic system.

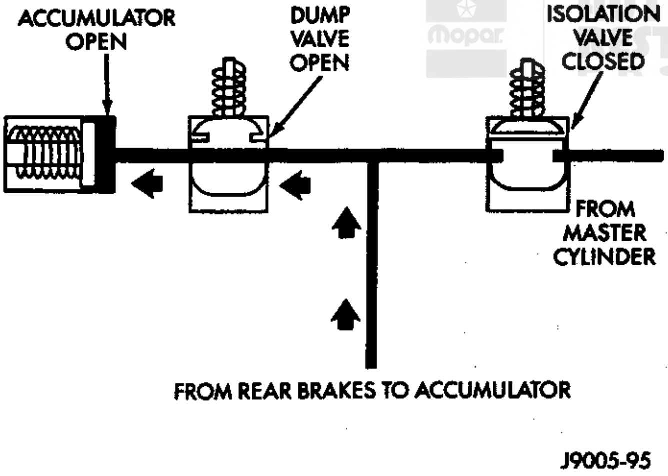

Fig. 7 Dump Valve And Accumulator Position In Pressure Relief Mode

Isolation/Dump Valve Cycle Times

Activation (opening/closing) of the isolation and dump valves is continous during anti-lock operation. The valves cycle rapidly in response to speed sensor inputs and control module signal commands. Cycle times are measured in milliseconds.

As the demand for anti-lock mode brake operation is decreased, the module deactivates the hydraulic valve components to restore normal brake operation.

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GENERAL INFORMATION

An anti-lock system malfunction will be indicated by illumination of the amber anti-lock warning lamp. In most cases, the red brake warning lamp will also illuminate at the same time.

If a problem occurs, system diagnosis should begin with a fluid level check followed by a visual examination of the system electrical and hydraulic connections. If obvious defects (low fluid, leaks, loose connections, etc.) are not evident, road test the vehicle. A road test should help determine if a malfunction is actually related to an anti-lock component.

During the road test, note if other conditions are evident such as a low pedal, pull, grab, or similar condition. Remember that brake malfunctions such as low fluid, system leaks, parking brakes partially applied, will also affect the anti-lock system. The idea is to determine if a malfunction is actually related to an anti-lock component.

If a visual inspection and road test do not indicate the problem cause, component inspection, fault code identification and testing with the DRB II will be necessary.

SYSTEM FAULT CODES

The microprocessor in the electronic control module has a self test feature. This feature is activated whenever the ignition switch is in the On and Run positions.

If a system fault is detected, the control module will illuminate the anti-lock indicator lamp and store the fault code in the microprocessor memory. If a fault code is generated, the module will retain the code after turning the ignition switch to Off position.

FAULT CODE CAPACITY

The microprocessor memory will store and display only one fault code at a time. The stored code can be displayed by grounding the RWAL diagnostic connector.

FAULT CODE IDENTIFICATION

To determine what the fault code is, momentarily ground the RWAL diagnostic connector and count the number of times the amber anti-lock indicator lamp flashes. Fault codes and typical malfunctions are outlined in Figure 8. Note that when a fault code is generated, the red brake warning lamp will also illuminate.

The initial flash will be a long flash followed by a number of short flashes. The long flash indicates the beginning of the fault number sequence and the short flashes are a continuation of that sequence. **You must count the long flash along with the short flashes for an accurate fault code count.**

CLEARING A FAULT CODE

To clear a fault code, disconnect the control module connector or disconnect the battery for a minimum of five seconds. During system retest, wait 30 seconds to be sure the fault code does not reappear.

FAULT CODE NUMBER	TYPICAL FAILURE DETECTED
1	Not used.
2	Open isolation valve wiring or bad control module.
3	Open dump valve wiring or bad control module.
4	Closed RWAL valve switch.
5	Over 16 dump pulses generated in 2WD vehicles (disabled for 4WD).
6	Erratic speed sensor reading while rolling.
7	Electronic control module fuse pellet open, isolation output missing, or valve wiring shorted to ground.
8	Dump output missing or valve wiring shorted to ground.
9	Speed sensor wiring/resistance (usually high reading).
10	Sensor wiring/resistance (usually low reading).
11	Brake switch always on. RWAL light comes on when speed exceeds 40 mph.
12	Not used.
13	Electronic control module phase lock loop failure.
14	Electronic control module program check failure.
15	Electronic control module RAM failure.

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Fig. 8 RWAL System Fault Codes

Refer to Figures 9, 10 and 11 for module connector pin identification, diagnostic connector locations and component locations. Refer to the wiring schematics in Group 8 for RWAL system electrical circuitry and wire identification.

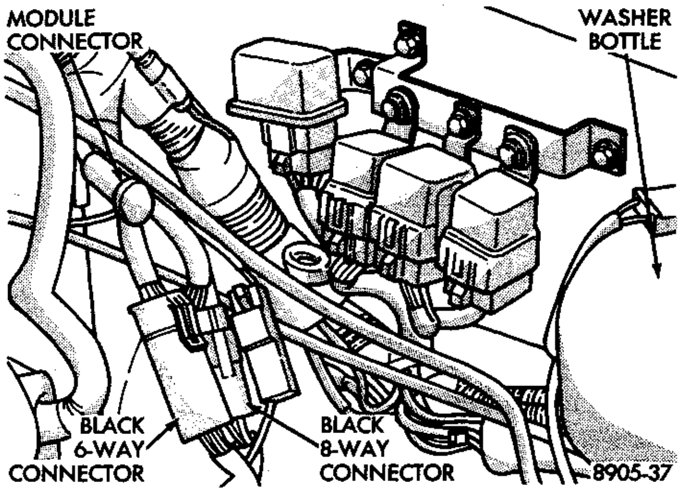

Fig. 9 Connector Locations

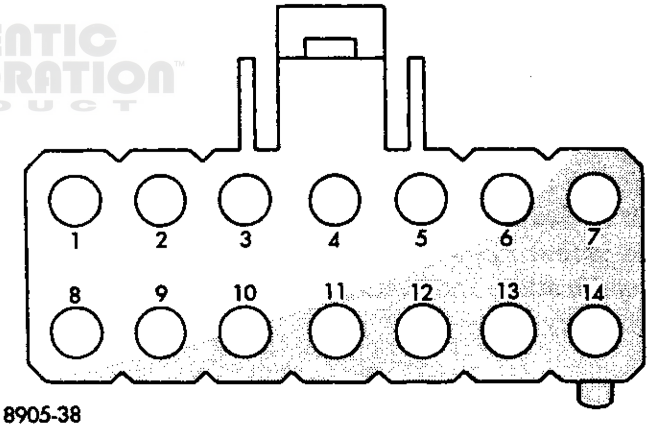

Fig. 10 Module Connector Identification

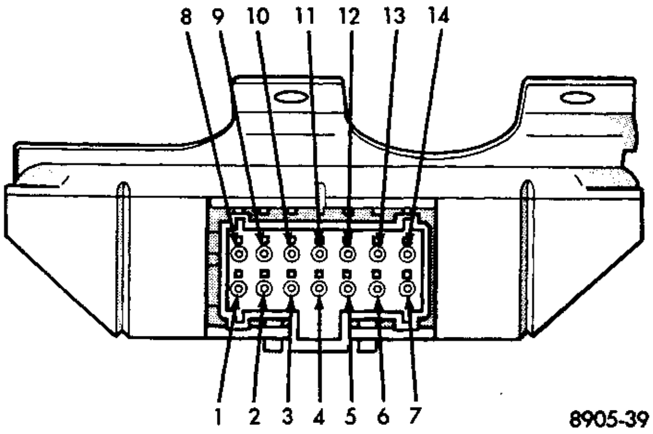

Fig. 11 Module Connector Pin Position

COMPONENT SERVICE

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GENERAL SERVICE INFORMATION

The rear wheel anti-lock (RWAL) components are serviced as assemblies only. The module, anti-lock hydraulic control valve, speed sensor and exciter ring are not repairable. These components must be replaced if diagnosis indicates a fault.

HYDRAULIC VALVE REPLACEMENT

VALVE REMOVAL

(1) Raise vehicle.

(2) Disconnect valve-to-sensor harness connector. Refer to Fig. 10, on page 5-16 for valve mounting.

(3) Disconnect brake lines connecting hydraulic valve to rear brakes and to combination valve.

(4) Remove hydraulic valve attaching screws and remove valve from frame bracket.

VALVE INSTALLATION

(1) Start brake lines in hydraulic valve.

(2) Position valve on frame bracket.

(3) Install and tighten valve attaching nuts to 22-34 N•m (16-25 ft-lbs) torque.

(4) Tighten valve brake lines.

(5) Bleed the hydraulic valve and brakes. Refer to procedure in Service Adjustments section.

(6) Lower vehicle.

CHECKING SPEED SENSOR AIR GAP

(1) Remove sensor from differential.

(2) Measure and record distance from underside of sensor flange to end of sensor pole piece (Fig. 12). Distance should be 27.17 to 27.43 mm (1.07 to 1.08 in). This measurement represents dimension B.

(3) Measure distance between sensor mounting surface of differential case and teeth at top of exciter ring (Fig. 13). distance should be 1.085 to 1.12 inch. This distance represents dimension A.

(4) Subtract dimension B from dimension A to determine sensor air gap which is dimension C (Fig. 12).

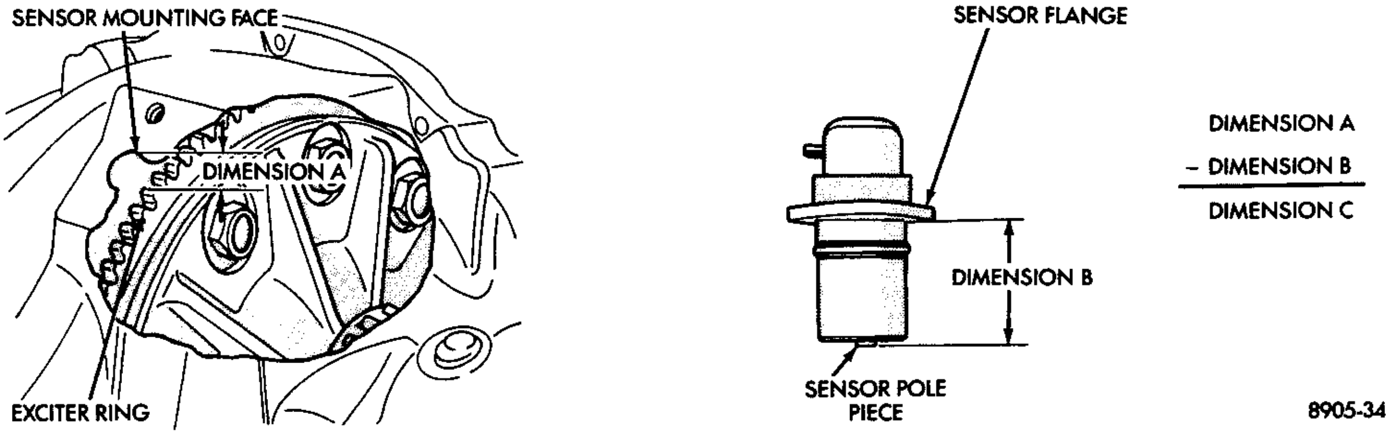

Fig. 12 Checking Sensor Air Gap

(5) Air gap should be minimum of .12 mm (.005 in) and a maximum of 1.27 mm (.050 in).

(6) If air gap is **not** within stated limits, proceed as follows:

(a) Replace sensor if dimension B is not within limits specified in step (2).

(b) Replace exciter wheel or repair differential if dimension A is not within limits specified in step (3).

(c) Replace sensor and exciter wheel if both components are out of tolerance.

SPEED SENSOR REPLACEMENT

SENSOR REMOVAL

(1) Raise vehicle on hoist.

(2) Remove bolt securing sensor to differential housing.

(3) Remove sensor shield and sensor from differential housing.

(4) Disconnect sensor wiring and remove sensor.

SENSOR INSTALLATION

(1) Connect wires 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 and tighten sensor attaching bolt to 19-29 N•m (170-230 in-lbs).

(6) Lower vehicle.

ELECTRONIC CONTROL MODULE REPLACEMENT

The RWAL control module is at the passenger side of the vehicle. On models with A/C, the module is attached to the dash panel near the defroster duct and resistor board (Fig. 13).

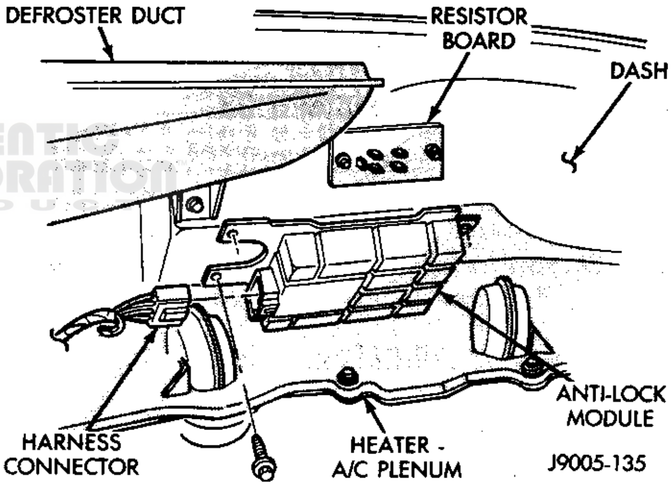

Fig. 13 Anti-Lock Control Module Mounting

To remove the module, remove the attaching screws, disconnect the module harness connector and remove the module. After installing the new module, tighten the module attaching screws to 2.3 N•m (21 in-lbs) torque.

SPECIFICATIONS

DISC BRAKE	W100/150	D100/150 AD150	W250	D250/350	W250/350 with Model 60 Frt. Axle
Caliper	Chrysler	Chrysler	Chrysler	Chrysler	Bendix
Type	Sliding	Sliding	Sliding	Sliding	Sliding
Piston Diameter	3.1 in (78.7 mm)	3.1 in (78.7 mm)	3.1 in (78.7 mm)	3.1 in (78.7 mm)	3.38 in (85.8 mm)
Rotor Diameter	11.63 in (295 mm)	11.75 in (298 mm)	12.82 in (325.6 mm)	12.88 in (327 mm)	12.88 in (327 mm)
Rotor Thickness	1.25 in (31.75 mm)	1.25 in (31.75 mm)	1.25 in (31.75 mm)	1.25 in (31.75 mm)	1.19 in (30 mm)

DRUM BRAKE	AD100/150 D100/150 W100/150	D250 - D350 W250 - W350	D350 - W350 w/4000 1B or Model 60 Frt. Axle
Size (inches)	11 x 2.5	12 x 2.5	12 x 3
Make	Chrysler	Bendix	Bendix
Drum Type	Composite	Cast Iron	Cast Iron
Wheel Cyl. Bore	.938" (23.8 mm)	1.00" (25.4 mm)	1.125" (28.57 mm)

MASTER CYLINDER:

D and W 100/150/250	Chrysler, Aluminum, Two-Section, 1.125" bore
D and W 250/350	Bendix, Integral, Cast One-Piece, 1.125" bore

POWER BOOSTER:

D and W 100/150	250 mm (9.84 in) Single Diaphragm, Vacuum.
D and W 250/350 H.D.	205 mm (8.07 in) Dual Diaphragm, Vacuum.

TOLERANCE LIMITS:

Rotor Runout (All except W250/350)	.004 in (.10 mm)
Rotor Runout (W250/350)	.005 in (.127 mm)
Rotor Thickness Variation (All except W250/350)	.0005 in (.013 mm)
Rotor Thickness Variation (W250/350)	.001 in (.025 mm)
Brake Drum Runout (Max. allowable—all)	.008 in (.20 mm)
Brake Drum Diameter Variation (Max. allowable—all)	.003 in (.076 mm)

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TIGHTENING REFERENCE

COMPONENT	FOOT LBS.	(N·m)	INCH LBS.	(N·m)
Rear Wheel Brake Support Axle Housing Bolt/Nut 7/16	75	(101)		
1/20	85	(101)		
Wheel Cylinder Bleeder Screw			95	(11)
Wheel Cylinder Mounting Bolt			15	(2)
Front Wheel Brake Hose Fitting Bolt	35	(48)		
Flexible Brake Hose To Brake Line Tubes (All)			115-175	(13-20)
POWER BRAKE				
Power Brake Booster Mounting Nuts			220	(25)
Pedal Shaft Screw Assembly			35	(4)
Master Cylinder to Booster Nuts			200 ± 30	(23)
Brake Line Tube Nuts, 3/8 or 7/16			115-175	(13-20)
1/2 or 9/16			140-200	(15-23)
Bottom attaching bolts	120	(162)		
DISC BRAKE (CHRYSLER)				
Adapter Mounting Bolts D150-D250-AD150	110	(149)		
W150, AW150, W250	150	(203)		
D250 H.D., D350	160	(216)		
Retainer and Anti-Rattle Spring			200	(25)
DISC BRAKE (BENDIX)				
Adapter Mounting Bolts W350 and W250 Extra	160	(216)		
Retainer Screw (key-lock)	15	(20)		
RWAL HYDRAULIC VALVE				
Mounting Studs	16-25	(22-34)		

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CLUTCH

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GENERAL INFORMATION

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CLUTCH COMPONENTS

MECHANICAL COMPONENTS

The clutch mechanism in AD models with manual transmission consists of a single, dry-type clutch disc and a diaphragm style clutch cover. The transmission input shaft is supported in the crankshaft by a pilot bushing. A sleeve type release bearing is used to engage and disengage the clutch pressure plate.

The release bearing is operated by a release fork in the clutch housing. The fork pivots on a ball stud attached to the housing interior. The release fork is actuated by a hydraulic slave cylinder mounted in the housing. The slave cylinder is operated by a clutch master cylinder connected to the clutch pedal.

The clutch disc has cushion springs in the disc hub. The clutch disc facing is riveted to the hub. The facing is made from a non-asbestoes material. The clutch cover pressure plate is a diaphragm type unit with a one-piece diaphragm spring and multiple release fingers. The pressure plate release fingers are preset during manufacture and are not adjustable.

A 265 mm (10 in) diameter clutch disc and clutch cover pressure plate are used in models with 3.9L engine and NP2500 transmission.

A 280 mm (11 in) diameter clutch disc and clutch cover pressure plate are used in models with a 3.9L, 5.2L, or 5.9L engine and an A435 or A833 transmission.

HYDRAULIC LINKAGE COMPONENTS

A hydraulic linkage mechanism is used for clutch actuation. The linkage consists of a remote reservoir, clutch master cylinder, slave cylinder, and interconnecting fluid lines.

The master cylinder is connected to the clutch pedal and the slave cylinder is connected to the clutch release fork. The clutch master cylinder is mounted on the drivers side of the dash panel adjacent to the brake master cylinder. The cylinder is operated by a suspended type clutch pedal.

CLUTCH LINKAGE FLUID

The clutch fluid reservoir, master cylinder, slave cylinder and fluid lines are prefilled with fluid at the factory during assembly operations.

The hydraulic system should not require additional fluid under normal circumstances. In fact, **the reservoir fluid level will actually increase as normal clutch wear occurs. For this reason, it is important to avoid overfilling, or removing fluid from the reservoir.**

If inspection or diagnosis indicates additional fluid may be needed, use Mopar brake fluid, or an equivalent meeting SAE and DOT standards J1703 and DOT 3. Do not use any other type of fluid.

CLUTCH COMPONENT LUBRICATION

Proper clutch component lubrication is important to satisfactory operation. Using the correct lubricant and avoiding overlubrication are also equally important. During service, apply recommended lubricant sparingly. Do not overlubricate as this could result in disc and pressure plate contamination.

Clutch components requiring lubrication are: the pilot bushing; release lever pivot ball; release lever contact surfaces; clutch disc hub splines and clutch pedal pivot bore and bushings. Transmission components requiring lubrication are the: input shaft splines and pilot hub and release bearing slide surface of the front bearing retainer. **Do not** apply grease to any part of the clutch cover, disc, or release bearing.

Use Mopar multi-purpose grease or a silicone grease for the clutch pedal bushings and pivot shaft. Use Mopar High Temperature Wheel Bearing Grease or equivalent for all other clutch lubrication requirements. Apply recommended amounts only and do not overlubricate. Refer to the Clutch Service section for specific information.

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GENERAL DIAGNOSIS INFORMATION

Unless the cause of a clutch problem is extremely obvious, a road test followed by component inspection will be required for accurate diagnosis. The test will help determine the type of fault and component inspection will identify the problem component.

During a road test, drive the vehicle at normal speeds. Shift the transmission through all gear ranges and observe clutch action. If chatter, grab, slip, or improper release is experienced, remove and inspect the clutch components. However, if the problem is noise or hard shifting, further diagnosis may be needed as the transmission or another driveline component may be at fault. Careful observation during the test will help narrow the problem area.

CLUTCH PROBLEM CAUSES

CONTAMINATION

Fluid contamination is one of the more common causes of clutch malfunctions. Oil, water, or clutch fluid on the clutch contact surfaces will result in faulty operation. The usual result is chatter, slip, or 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 cylinder openings. Driving through deep water puddles can force water/road splash into the housing through such openings.

Clutch fluid leaks are from a loose or damaged slave cylinder line or connection. However, clutch fluid leaks will usually be noted and corrected before severe contamination occurs.

CLUTCH MISALIGNMENT

Clutch components must be in proper alignment with the crankshaft and transmission input shaft. Misalignment caused by excessive runout or warpage of any clutch component will cause grab, chatter and improper clutch release.

Flywheel Runout

Common causes of runout are heat warpage, improper machining, mounting the flywheel on a dirty crankshaft flange, incorrect bolt tightening, or improper seating on the crankshaft flange shoulder.

Very light scratches or surface roughness on the flywheel face can be cleaned up by scuff sanding with 180 grit paper. However, if the surface is warped or severely scored, replace the flywheel. **Do not machine the flywheel. The flywheel face is manufactured with a unique surface finish. Machining would negate this feature and could result in unsatisfactory operation.**

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing 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 could distort the flywheel hub causing runout.

Clutch Cover And Disc Runout

Check the clutch disc before installation. Axial (face) runout of a **new** disc should not exceed .5 mm (.020 inch). Measure runout about .35 mm (1/4 inch) 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. To avoid warping the cover, the bolts must tightened alternately (diagonal pattern) and evenly (2-3 threads at a time) to specified torque.

Clutch Housing Misalignment And Runout

Clutch housing alignment is important to proper operation. The housing bore maintains alignment between the crankshaft and transmission input shaft. Misalignment can cause noise, incomplete clutch 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 bearing.

Housing face 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 parallel.

If housing misalignment is suspected, housing bore and face runout can be checked with a dial indicator as described in the following two procedures:

MEASURING CLUTCH HOUSING BORE RUNOUT

(1) Remove the clutch housing and strut.

(2) Remove the clutch cover and disc.

(3) Replace one of the flywheel bolts with a 7/16-20 by ten inch (25.4 cm) long threaded rod (Fig. 1). The rod will be used to mount the dial indicator.

(4) Remove the release fork from the clutch housing.

(5) Reinstall the clutch housing. Tighten the housing bolts nearest the alignment dowels first.

(6) Mount the dial indicator on the threaded rod and position the indicator plunger on the surface of the clutch housing bore (Fig. 2).

(7) Rotate the crankshaft until the indicator plunger is at the top center of the housing bore. Zero the indicator at this point.

(8) Rotate the crankshaft and record the indicator readings at eight points (45 degrees apart) around the bore (Fig. 3). Repeat the measurement at least twice for accuracy.

(9) Subtract each reading from the one 180 degrees opposite to determine magnitude and direction of runout. Refer to Figure 3 and following example.

Bore runout example:
.000 -(-.007) = .007 inch
+.002 - (-.010) = .012 inch
+.004 - (-.005) = .009 inch
-.001 - (+.001) = -.002 inch (=.002 inch)

In the above example, the largest difference is .012 inch and is called the total indicator reading (TIR). This means that the housing bore is offset from the crankshaft centerline by .006 inch (which is 1/2 of .012 inch).

The acceptable maximum TIR for the housing bore is .010 inch. However, if the TIR is more than .010 (as in the example), bore runout would have to be corrected with offset dowels. Offset dowels are available in .007, .014 and .021 inch sizes for this purpose (Fig. 4).

If housing bore runout exceeds .010 TIR, refer to Correcting Housing Bore Runout for offset dowel installation.

CORRECTING CLUTCH HOUSING BORE RUNOUT

The dial indicator reads positive when the plunger moves inward (toward indicator) and negative when it moves outward (away from indicator). As a result, the lowest or most negative reading determines the direction of housing bore offset (runout).

In the sample readings shown in Figure 3 and in step (7) above, the bore is offset toward the .010 inch reading. To correct this, remove the housing and original dowels. Then install the new offset dowels in the direction needed to center the bore with the crankshaft centerline.

In the example, TIR was .012 inch. The dowels needed to correct offset would be P/N 1736347 with an offset of .007 inch (Fig. 4).

Install the dowels with the slotted side facing out so they can be turned with a screwdriver. Then install the housing, remount the dial indicator and check bore runout again. Rotate the dowels until the TIR is less than .010 inch if necessary.

If a TIR of .053 inch or greater is encountered, it may be necessary to replace the clutch housing.

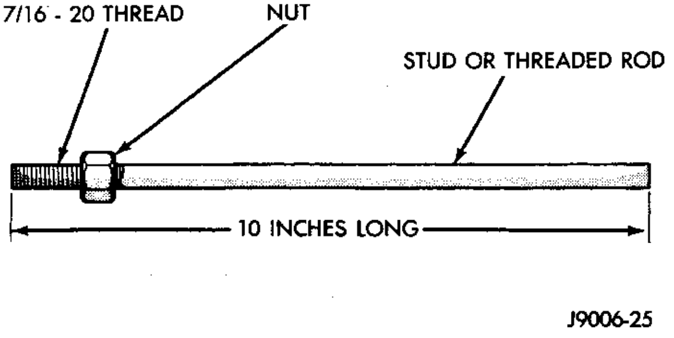


Fig. 1 Dial Indicator Mounting Stud Or Rod

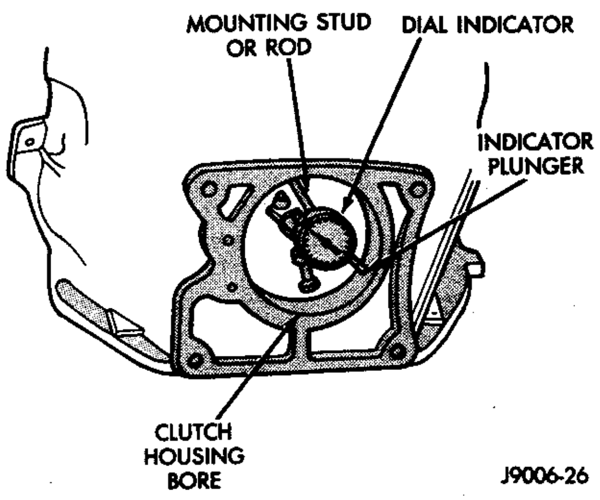


Fig. 2 Checking Clutch Housing Bore Runout

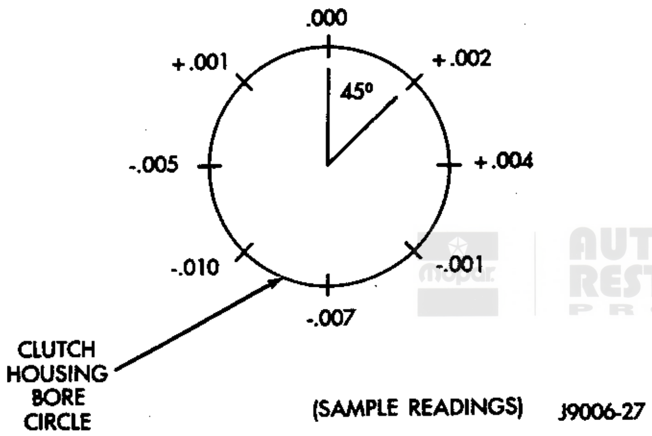
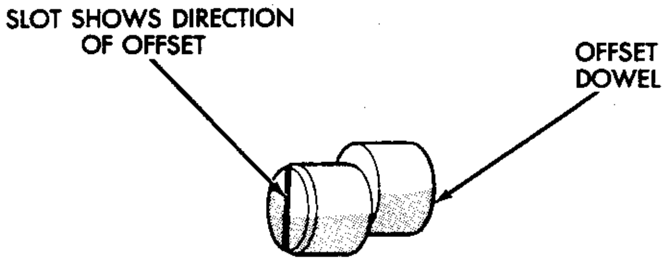


Fig. 3 Housing Bore Measurement Points And Sample Readings



DOWEL SELECTION

TIR Value	Dowel P/N	Dowel Offset
.011 – .021 inch	1736347	.007 inch
.022 – .035 inch	1736348	.014 inch
.036 – .052 inch	1736353	.021 inch

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Fig. 4 Housing Bore Alignment Dowels

MEASURING CLUTCH HOUSING FACE RUNOUT

(1) Reposition the dial indicator plunger on the housing face (Fig. 5). Place the indicator plunger at the rim of the housing bore as shown.

(2) Rotate the crankshaft until the indicator plunger is at the ten o-clock position on the bore. Then zero the dial indicator.

(3) Measure and record face runout at four points 90 degrees apart around the housing face (Fig. 6). Perform the measurement at least twice for accuracy.

(4) Subtract the lowest reading from the highest to determine total runout. As an example, refer to the sample readings shown in Figure 6. If the low reading was **minus** .004 inch and the highest reading was **plus** .009 inch, total runout is actually .013 inch.

(5) Total allowable face runout is .010 inch. If runout exceeds this figure, runout will have to be corrected. Refer to Correcting Clutch Housing Face Runout.

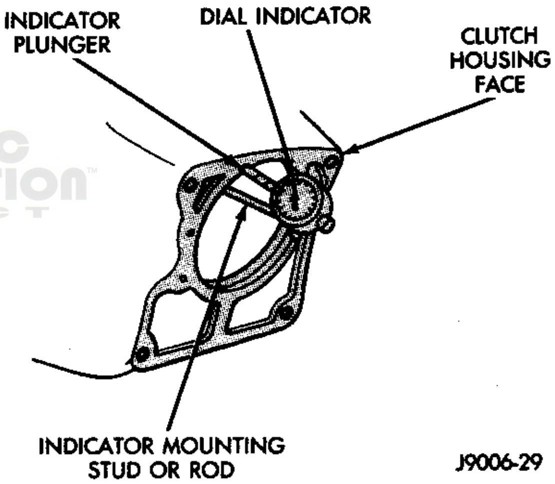


Fig. 5 Measuring Clutch Housing Face Runout

CORRECTING CLUTCH HOUSING FACE RUNOUT

Housing face runout can be corrected by installing shims between the clutch housing and transmission (Fig. 7). The shims can be made from shim stock or similiar materials of the required thickness.

As an example, assume that face runout is the same as shown in Figure 6 and in step (4) above. In this case, three shims will be needed. Shim thicknesses should be .009 (at the .000 corner), .012 (at the -.003 corner) and .013 inch (at the -.004 corner).

After installing the clutch assembly and housing, tighten the housing bolts nearest the alignment dowels first. Correct housing bolt torques are: 30 ft-lbs for 3/8 diameter bolts and 50 ft-lbs for 7/16 diameter bolts.

During final reassembly of the transmission, install the shims between the clutch housing and transmission at the appropriate bolt locations.

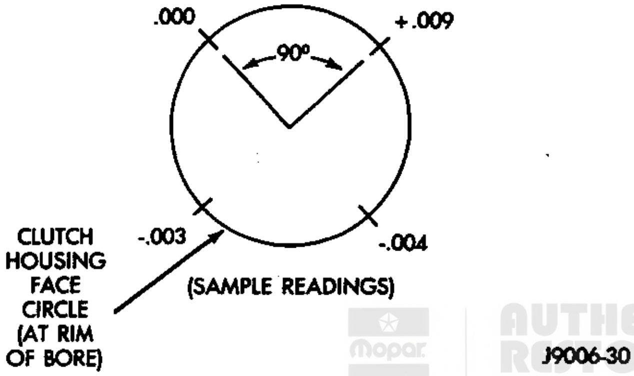


Fig. 6 Housing Face Measurement Points And Sample Readings

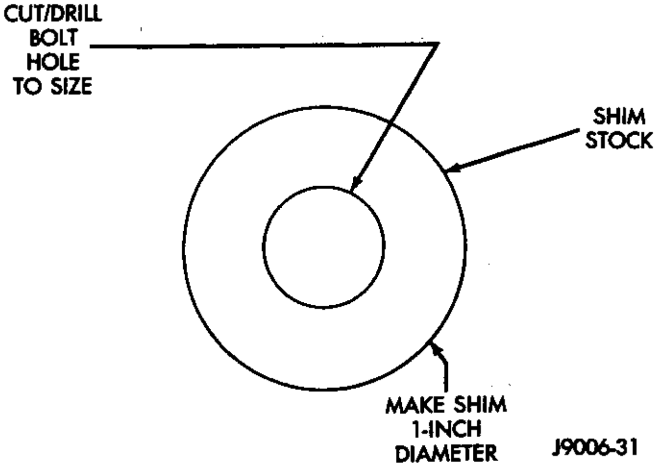


Fig. 7 Housing Face Alignment Shims

INSTALLATION METHODS AND PARTS USAGE

Distortion of clutch components during installation and the use of non-standard components are additional causes of clutch malfunction.

Improper clutch cover bolt tightening can distort the cover. The usual result is clutch grab, chatter and rapid wear. Tighten the cover bolts as described in the Clutch Service section.

Improperly seated flywheels and clutch housings are other causes of clutch failure. Improper seating will produce misalignment and subsequent clutch problems. Tighten all the clutch housing bolts to proper torque before installing any struts. Also be sure the alignment dowels are in place and seated in the block and housing beforehand.

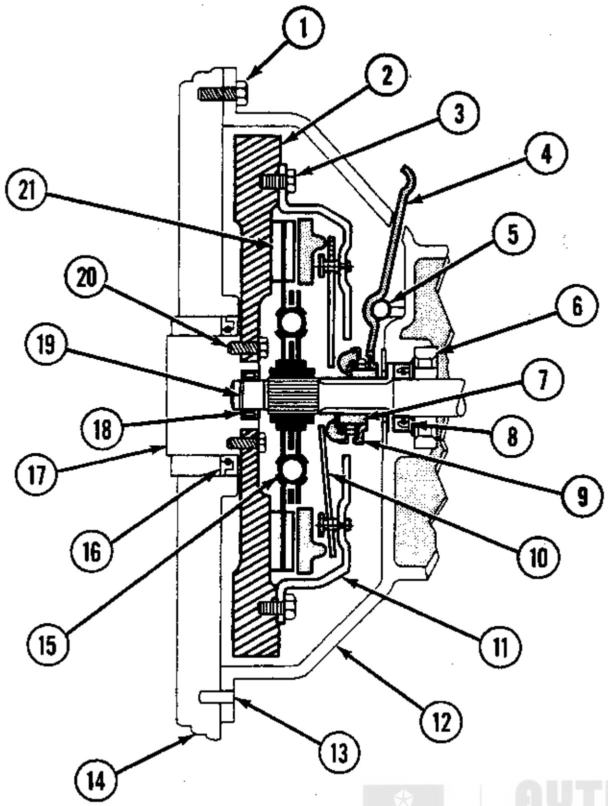
The use of non-standard or low quality parts can also lead to problems and wear. Use the recommended factory quality parts to avoid comebacks.

INSPECTION AND DIAGNOSIS CHARTS

The clutch inspection chart (Fig. 8) outlines items to be checked before and during clutch installation. Use the chart as a check list to help avoid overlooking potential problem sources during service operations.

The diagnosis charts describe common clutch problems, causes and correction. Fault conditions are listed at the top of each chart. Conditions, causes and corrective action are outlined in the indicated columns.

The charts are provided as a convenient reference when diagnosing faulty clutch operation.



1 Check clutch housing bolts. Tighten if loose. Be sure housing is fully seated on engine block.

2 Check flywheel condition. Scuff sand flywheel face to remove glaze. Clean surface with a wax and grease remover afterward. Replace flywheel if severely scored, worn or cracked. Secure flywheel with new bolts (if removed). Do not reuse old bolts. Use Lock and Seal on bolts.

3 Tighten clutch cover bolts 2-3 threads at a time, alternately and evenly (in a diagonal pattern) to specified torque. Failure to do so could warp the cover.

4 Check release fork. Replace fork if distorted or worn. Make sure ball stud and release bearing contact surfaces are lubricated.

5 Check release fork pivot. Be sure pivot is tight 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 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.

8 Check input shaft seal if clutch cover and disc were oil covered. Replace seal if worn, or cut.

9 Do not replace release bearing unless actually faulty. Replace bearing only if seized, noisy, or damaged.

10 Check clutch cover diaphragm spring and release fingers. Replace cover if spring or fingers are bent, warped, broken, cracked. Do not tamper with factory clutch spring setting. Clutch problems will result.

11 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.

12 Inspect clutch housing. Be sure alignment dowels are in position and bolts are tight. Replace housing if cracked, or damaged. If clutch problems ocurred, check runout, to be sure housing is square with flywheel and transmission input shaft.

13 Verify that housing alignment dowels are in position before installing housing.

14 Clean engine block surface before installing clutch housing. Dirt, grime can produce misalignment.

15 Make sure side of clutch disc marked "flywheel side" is toward flywheel.

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 bushing. Replace bushing if scored or seized. Lube with high temp. Grease before installation.

19 Check transmission input shaft. Clutch disc must slide freely on shaft splines. Lightly grease splines before installation. Replace shaft if splines or pilot bushing hub are damaged.

20 Check flywheel bolt torque. If bolts are loose, replace them. Use Mopar Lock and 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 .5 mm (.02 in.).

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Fig. 8 Clutch Inspection Points

CLUTCH SLIPS

Condition Found	Cause	Correction
1. Disc facing worn out.	a) Normal wear. b) Driver frequently "rides" (slips) clutch. Results in rapid wear overheating. c) Insufficient clutch cover diaphragm spring tension.	Replace clutch disc. Also replace cover if spring is weak or pressure plate surface is damaged.
2. Clutch disc facing contaminated with oil, grease, or clutch fluid.	a) Leak at rear main seal or at transmission input shaft seal. b) Excessive amount of grease applied to input shaft splines. c) Road splash, water entering housing. d) Slave cylinder leaking.	a), b), c), d) Replace leaking seals. Apply less grease to input shaft splines. Replace clutch disc (do not clean and reuse). Clean clutch cover and reuse only if cover is in good condition. Replace slave cylinder if leaking.
3. Clutch is running partially disengaged.	Release bearing sticking–binding. Does not return to normal running position.	Verify that bearing is actually binding, then replace bearing and transmission front bearing retainer if sleeve surface is damaged.
4. Flywheel height incorrect.	Flywheel surface improperly machined. Too much stock removed or surface is tapered.	Replace flywheel.
5. Wrong disc or pressure plate installed.	Incorrect parts order or model number.	Replace with correct parts. Compare old and new parts before installation.
6. Clutch disc, cover and/or diaphragm spring, warped, distorted.	a) Rough handling (impact) bent cover, spring, or disc. b) Incorrect bolt tightening sequence and method caused warped cover.	Install new disc or cover as needed. Follow installation/tightening instructions.
7. Facing on flywheel side of disc torn, gouged, worn.	Flywheel surface scored and nicked.	Reduce scores and nicks by sanding or surface grinding. Replace flywheel if scores–nicks are deeper than .002-.004 inch.
8. Clutch disc facing burnt (charred). Flywheel and cover pressure plate surfaces heavily glazed.	a) Frequent operation under high loads or hard acceleration conditions. b) Driver frequently "rides" (slips) clutch. Results in rapid wear and overheating of disc and cover.	Scuff sand flywheel. Replace clutch cover and disc. Alert driver to problem cause.

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IMPROPER CLUTCH RELEASE

Condition Found	Cause	Correction
1. Clutch disc warped.	New disc not checked for axial runout before installation.	Replace disc. Be sure runout of new disc is less than .5 mm (.020 in.).
2. Clutch disc binds on input shaft splines.	a) Clutch disc hub splines damaged during installation. b) Input shaft splines rough, damaged. c) Corrosion, rust formations on splines of disc and input shaft.	Clean, smooth and lubricate disc and shaft spines. Replace disc and/or input shaft if splines are severely damaged.
3. Clutch disc rusted to flywheel and/or pressure plate.	Occurs in vehicles stored, or not driven for extended periods of time. Also occurs after steam cleaning if vehicle is not used for extended period.	Remove clutch cover and disc. Sand rusted surfaces clean with 180 grit paper. Replace disc cover, and flywheel if corrosion is severe.
4. Clutch disc facing sticks to flywheel.	Vacuum may form in pockets over rivet heads in clutch disc. Occurs as clutch cools down after use.	Drill 1/16 inch diameter hole through rivets and scuff sand disc facing with 180 grit paper.
5. Clutch disc too thick.	Wrong disc installed.	Replace disc.
6. Pilot bushing seized or loose.	a) Bushing cocked during installation. b) Bushing defective. c) Bushing not lubricated. d) Clutch misalignment.	a), b), c), d) Lubricate and install new bushing. Check and correct any misalignment.
7. Clutch will not disengage properly.	a) Low clutch fluid level. b) Clutch cover loose. c) Wrong clutch disc. d) Disc bent, distorted during installation. e) Clutch cover diaphragm spring bent or wraped during transmission instalation. f) Clutch disc installed backwards. g) Release fork bent or fork pivot is loose or damaged. h) Clutch master or slave cylinder fault.	a) Top off reservoir and check for leaks. b) Tighten bolts. c) Install correct disc. d) Repalce disc. e) Replace cover. f) Remove and reinstall disc correctly. Be sure disc side marked "to flywheel" is actually toward flywheel. g) Replace fork and pivot if worn or damaged. h) Replace master and slave cylinder as assembly.

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CLUTCH GRAB/CHATTER

Condition Found	Cause	Correction
1. Clutch disc facing covered with oil, grease, or clutch fluid.	a) Oil leak at rear main or input shaft seal. b) Too much grease applied to splines or disc and input shaft.	a) Correct leak and replace disc (do not clean and reuse the disc). b) Apply lighter grease coating to splines and replace disc (do not clean and reuse the disc).
2. Clutch disc and/or cover warped, or disc facings exhibit unusual wear or appear to be wrong type.	Incorrect or substandard parts.	Replace disc and/or cover with correct parts.
3. Clutch master or slave cylinder plunger dragging–binding.	a) Master or slave cylinder components worn or corroded.	a) Replace both cylinders as assembly (and reservoir).
4. No fault found with clutch components.	a) Problem actually related to suspension or driveline component. b) Engine related problem.	a) Further diagnosis required. Check engine/transmission mounts, propeller shafts and U-joints, tires, suspension attaching parts and other driveline components as needed. b) Check EFI and igniton systems.
5. Partial engagement of clutch disc (one side worn–opposite side glazed and lightly worn).	a) Clutch pressure plate position setting incorrect or modified. b) Clutch cover, spring, or release fingers bent, distorted (rough handling, improper assembly). c) Clutch disc damaged or distorted. d) Clutch misalignment.	a) Replace clutch cover and disc. b) Replace clutch cover and disc. c) Replace disc. d) Check alignment and runout of flywheel, disc, or cover and/or clutch housing. Correct as necessary.

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CLUTCH NOISE

Condition Found	Cause	Correction
1. Clutch components damaged or worn out prematurely.	Incorrect or sub-standard clutch parts.	Replace with parts of correct type and quality.
2. Pilot bushing seized.	a) Bushing cocked or scored during installation. b) Bushing not lubricated prior to installation. c) Bushing defect. d) Clutch misalignment.	a), b), c) Replace bushing. Be sure it is properly seated and lubricated before installing clutch. d) Check and correct misalignment caused by excessive runout of flywheel, disc, cover or clutch housing. Replace input shaft if bearing hub is damaged.
3. Loose components.	Attaching bolts loose at flywheel, cover, or clutch housing.	Tighten bolts to specified torque. Replace any clutch bolts that are damaged.
4. Components appear overheated. Hub of disc cracked or torsion damper springs are distorted or broken.	Frequent high load, full throttle operation.	Replace parts as needed. Alert driver to condition causes.
5. Contact surface of release bearing damaged.	a) Clutch cover incorrect, or release fingers are bent or distorted causing damage. b) Release bearing defect. c) Release bearing misaligned.	a) Replace clutch cover and bearing. b) Replace bearing. c) Check and correct runout of clutch components. Check front bearing retainer sleeve surface. Replace if damaged.
6. Release bearing is noisy.	Release bearing defect.	Replace bearing.
7. Clutch pedal squeak.	a) Pivot pin loose. b) Pedal bushings worn out or cracked.	Tighten pivot pin. Replace bushings if worn or damaged. Lubricate pin and bushings with silicone base lubricator chassis grease.

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CLUTCH SERVICE

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CLUTCH COVER AND DISC REMOVAL

(1) Raise the vehicle.

(2) Remove the transmission and transfer case if equipped. Refer to Group 21 for procedures.

(3) If the clutch cover will be reused, mark position of the cover on the flywheel with small punch marks (Fig. 1).

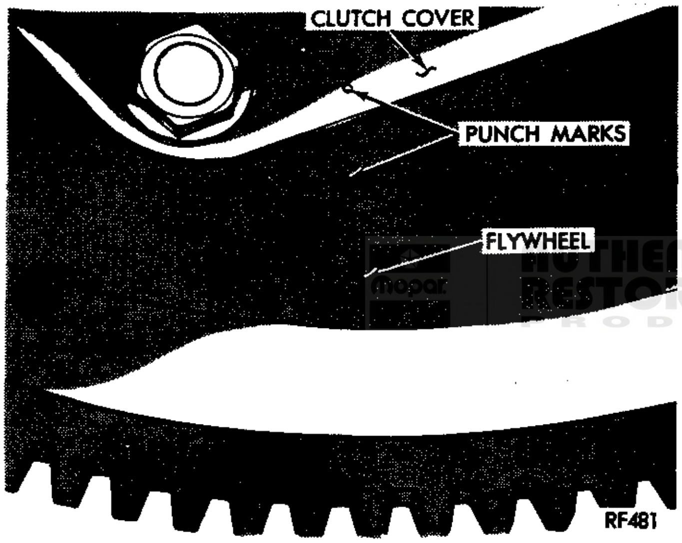


Fig. 1 Marking Cover And Flywheel Position

(4) If the clutch cover will be reused, loosen the clutch cover bolts evenly and in rotation to relieve spring tension. Loosen the bolts a few threads at a time only to avoid warping the cover.

(5) Remove the cover bolts and remove the cover and disc.

CLUTCH COVER AND DISC INSTALLATION

(1) Check runout and free operation of the new clutch disc. Install the disc on the transmission input shaft splines. The disc should slide freely on the splines. Leave the disc on the shaft and check runout with a dial indicator. Position the indicator plunger about 1/4 inch from the outer edge of the facing. Runout should not exceed .5 mm (.020 inch). Obtain another clutch disc if runout exceeds specified limit.

(2) Lubricate the crankshaft pilot bushing with Mopar High Temperature grease. The grease must be a high temperature type to be effective and remain on the bushing surface.

(3) Insert a clutch alignment tool in the clutch disc.

(4) Verify that the disc hub is positioned correctly. Side of hub marked "Flywheel Side" should face flywheel (Fig. 2).

(5) Insert the alignment tool or spare input shaft in the pilot bushing and position the disc on the flywheel (Fig. 3).

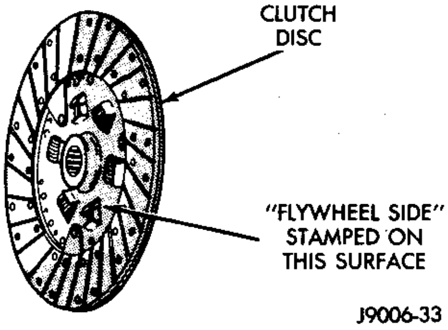


Fig. 2 Clutch Disc Position (Typical)

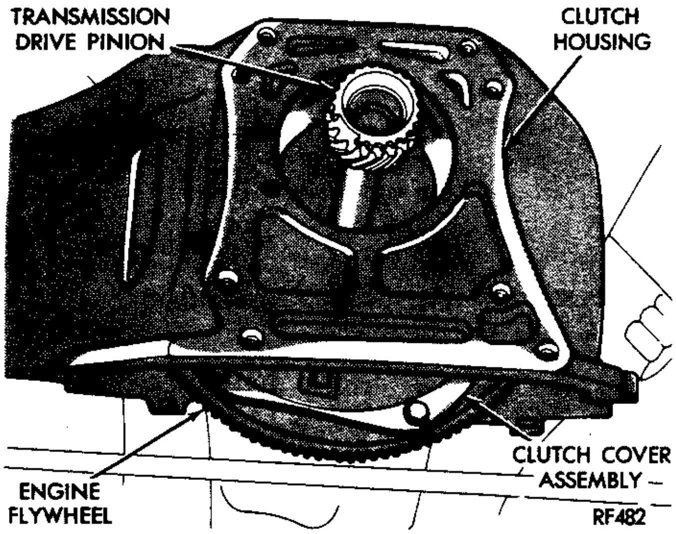


Fig. 3 Clutch Disc Alignment (Typical)

(6) Position the clutch cover over the disc and on the flywheel (Fig. 4).

(7) Install all of the clutch cover bolts finger tight.

(8) Tighten the cover bolts evenly (and in rotation) a few threads at a time. **The cover bolts must be tightened evenly and to specified torque to avoid distorting the cover. Tighten 5/16 inch diameter bolts to 23 N•m (17 ft-lbs). Tighten 3/8 inch diameter bolts to 41 N•m (30 ft-lbs).**

(9) Apply a light coating of Mopar High Temperature grease to the splines of the transmission input shaft and to the release bearing slide surface of the transmission front bearing retainer. **Do not overlubricate the shaft splines. This can result in grease contamination of the disc.**

(10) Install the transmission. See Group 21 for procedure.

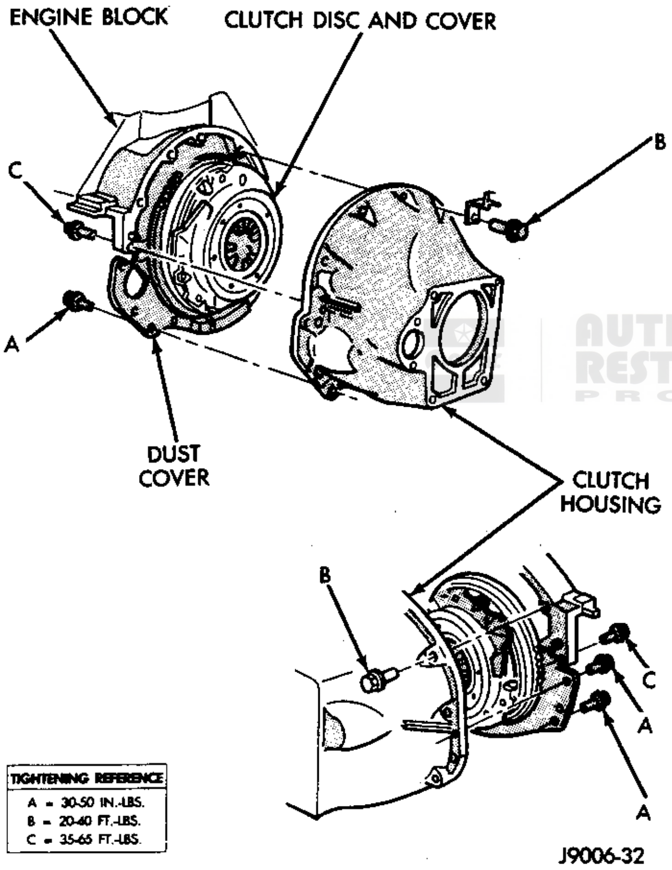


Fig. 4 Clutch Housing Installation And Tightening Reference

CLUTCH HOUSING REMOVAL/INSTALLATION

(1) Raise the vehicle and remove the transmission and transfer case if equipped.

(2) Remove the dust cover and clutch housing bolts and remove the cover and housing from the transmission (Fig. 4).

(3) Clean the housing mounting surface of the engine block with a wax and grease remover.

(4) Verify that the clutch housing alignment dowels are in good condition and properly seated.

(5) Transfer the slave cylinder, release fork and boot, fork pivot stud and wire/hose brackets to the new housing.

(6) Lubricate the release fork and pivot contact surfaces with Mopar High Temperature wheel bearing grease before installation.

(7) Align and install the clutch housing on the transmission. Tighten the housing bolts closest to the alignment dowels first and to the torque values indicated (Fig. 4).

(8) Install the transmission-to-engine strut after installing the clutch housing. Tighten the bolt attaching the strut to the clutch housing first and the strut-to-engine bolt last.

(9) Install the transmission and transfer case if equipped. Refer to the procedure in Group 21.

RELEASE BEARING REPLACEMENT

(1) Remove the transmission and clutch housing as an assembly.

(2) Disconnect the release bearing from the fork and remove the bearing (Fig. 5).

(3) Inspect the bearing slide surface on the transmission front bearing retainer. Replace the retainer if the slide surface is scored, worn or cracked.

(4) Inspect the release fork and fork ball pivot. Be sure the pivot is secure and in good condition. Be sure the fork is not distorted or worn. Also replace the release fork retainer spring if bent or damaged in any way.

(5) Lubricate the crankshaft pilot bushing, input shaft splines, bearing retainer slide surface, fork pivot and release fork pivot surface with Mopar High Temperature wheel bearing grease.

(6) Install the release fork and release bearing. Be sure the fork and bearing are properly secured.

(7) Install the transmission and clutch housing.

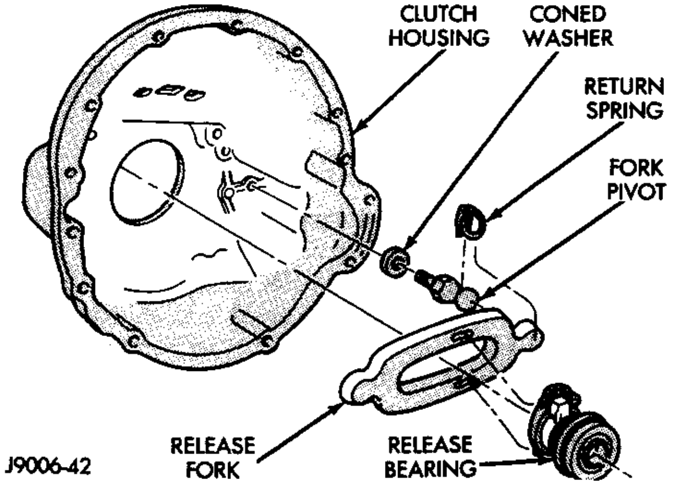


Fig. 5 Clutch Release Fork And Bearing

PILOT BUSHING REPLACEMENT

(1) Remove the transmission and clutch housing.

(2) Remove the clutch cover and disc.

(3) Remove the pilot bushing. Use an internal type puller tool or collapse the bushing with a punch and remove it.

(4) Clean the bushing bore with solvent and dry with compressed air.

(5) Install the new bushing with an alignment tool or spare input shaft. The bushing should be flush with the edge of the bushing bore. Do not recess the bushing.

(6) Lubricate the bushing with Mopar High Temperature grease, or equivalent only. Do not use any other type of lubricant on the bushing.

(7) Install the clutch cover and disc.

(8) Install the transmission and clutch housing.

CLUTCH LINKAGE SERVICE

The clutch master cylinder, remote reservoir, slave cylinder and connecting lines are all serviced as an assembly. These components cannot be serviced separately. The cylinders and connecting lines are sealed units. They are prefilled with fluid during manufacture and must not be disassembled nor disconnected.

LINKAGE REMOVAL

(1) Raise the vehicle.

(2) Remove the nuts attaching the slave cylinder to the clutch housing.

(3) Remove the slave cylinder and clip from the housing.

(4) Lower the vehicle.

(5) Carefully remove the locating clip from the clutch master cylinder mounting bracket (Fig. 6).

(6) Remove the retaining ring, flat washer and wave washer that attach the clutch master cylinder push rod to the clutch pedal (Fig. 6).

(7) Slide the clutch master cylinder push rod off the clutch pedal pin.

(8) Inspect condition of the bushing on the clutch pedal pin. Remove and replace the bushing if worn or damaged.

(9) Verify that the cap on the clutch master cylinder reservoir is tight. This is necessary to avoid undue spillage during removal.

(10) Remove the screws attaching the clutch fluid reservoir to the dash panel.

(11) If necessary, remove the reservoir mounting bracket screws and remove the bracket from the dash panel.

(12) Pull the clutch master cylinder rubber seal from the dash panel (Fig. 6).

(13) Rotate the clutch master cylinder 45 degrees counterclockwise to unlock it. Then remove the cylinder from the dash panel.

(14) Remove the clutch cylinders, reservoir and connecting lines from the vehicle.

LINKAGE INSTALLATION

(1) Tighten the cap on the clutch fluid reservoir to avoid spillage during installation.

(2) Position the cylinders, connecting lines and reservoir in the vehicle.

(3) Insert the clutch master cylinder in the dash panel. Rotate the cylinder 45 degrees clockwise to lock it in place.

(4) Lubricate the master cylinder rubber seal with liquid dish soap to ease installation. Then seat the seal in the dash and around the cylinder.

(5) Position the reservoir on the dash panel and install the reservoir screws. Tighten the screws to 5 N•m (40 in-lbs) torque.

(6) Install the reservoir mounting bracket on the dash panel, if removed.

(7) Install a replacement bushing on the clutch pedal pin if necessary.

(8) Install the clutch master cylinder push rod on the clutch pedal pin. Secure the rod with the wave washer, flat washer and retainer ring.

(9) Install the locating clip in the clutch master cylinder mounting bracket.

(10) Raise the vehicle.

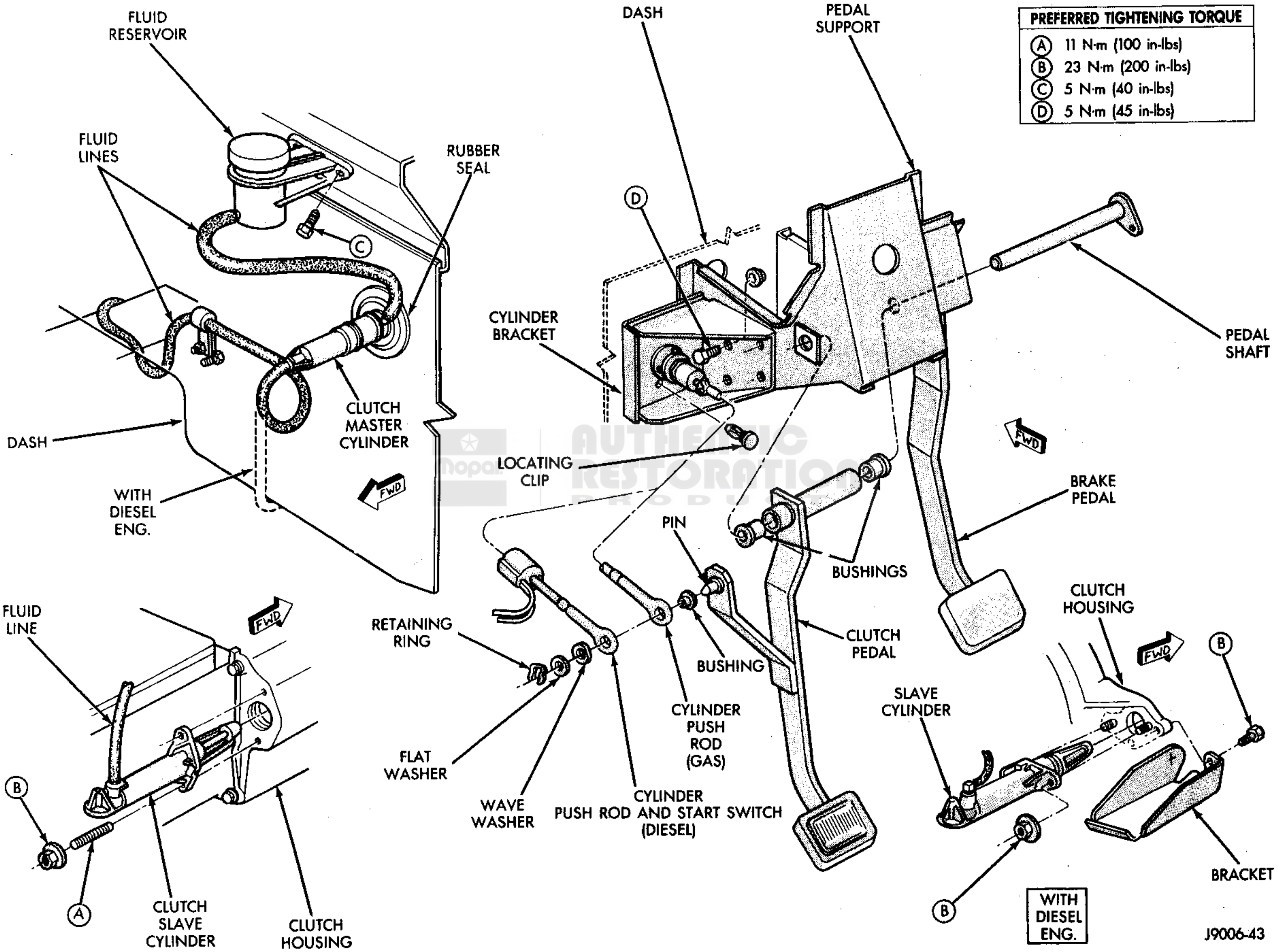
(11) Insert the slave cylinder push rod through the clutch housing opening and into the release lever. Be sure the cap on the end of the rod is securely engaged in the release lever. Check this before installing the cylinder attaching nuts.

(12) Install and tighten the slave cylinder attaching nuts to 23 N•m (200 in-lbs) torque.

(13) Lower the vehicle.

(14) If a new linkage has been installed, remove the plastic shipping stop from the master cylinder push rod—after installing the slave cylinder—and before operating the linkage.

(15) Operate the linkage a few times to verify proper operation.



PREFERRED TIGHTENING TORQUE
Ⓐ 11 N·m (100 in-lbs)
Ⓑ 23 N·m (200 in-lbs)
Ⓒ 5 N·m (40 in-lbs)
Ⓓ 5 N·m (45 in-lbs)

Fig. 6 Clutch Linkage And Pedal Components

◆

CLUTCH PEDAL REMOVAL/INSTALLATION

(1) Remove the retaining ring, flat washer and wave washer that secure the clutch master cylinder push rod to the clutch pedal pin (Fig. 6).

(2) Remove the fastener that secures the pedal shaft to the pedal support.

(3) Slide the pedal shaft out of the left side of the support and out of the clutch pedal.

(4) Slide the push rod off the clutch pedal pin and remove the clutch pedal.

(5) Remove and inspect the bushings in the clutch pedal shaft bore and on the bushing on the pedal pin. Replace any bushing that is worn or damaged.

(6) lubricate the pedal shaft, pedal shaft bore and all the bushings with Mopar multi purpose grease, or with a silicone grease.

(7) Insert the pedal pin into the cylinder push rod. Then position the clutch pedal in the support.

(8) Slide the pedal shaft through the clutch pedal bore and bushings.

(9) Install the fastener that secures the pedal shaft to the support.

(10) Secure the push rod to the pedal pin with the wave washer, flat washer and retaining ring (Fig. 6).

COOLING SYSTEM

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GENERAL INFORMATION

Throughout this group, references may be made to a particular vehicle by letter or number designation. A chart showing the breakdown of these designations is included in the Introduction Section at the front of this service manual.

COOLING SYSTEM

The cooling system regulates the engine operating temperature by; allowing the engine to reach normal operating temperature as quickly as possible, maintaining normal operating temperature, and preventing 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.

As coolant temperature reaches approximately 220°F the engine idle speed is increased by the engine controller to provide increased cooling system performance.

COOLING SYSTEM COMPONENTS

The cooling system consists of: a down-flow radiator, engine driven cooling fan, fan spacer (without air conditioning), fluid fan drive (with air conditioning), fan shroud, radiator pressure cap, thermostat, coolant reserve system, transmission oil cooler (if equipped with an automatic transmission), coolant, water pump (to circulate coolant), hoses and hose clamps.

SYSTEM COOLANT ROUTING

Coolant flow circuits for 3.9L, 5.2L and 5.9L engines with water cooled intake manifolds are shown in figure 1.

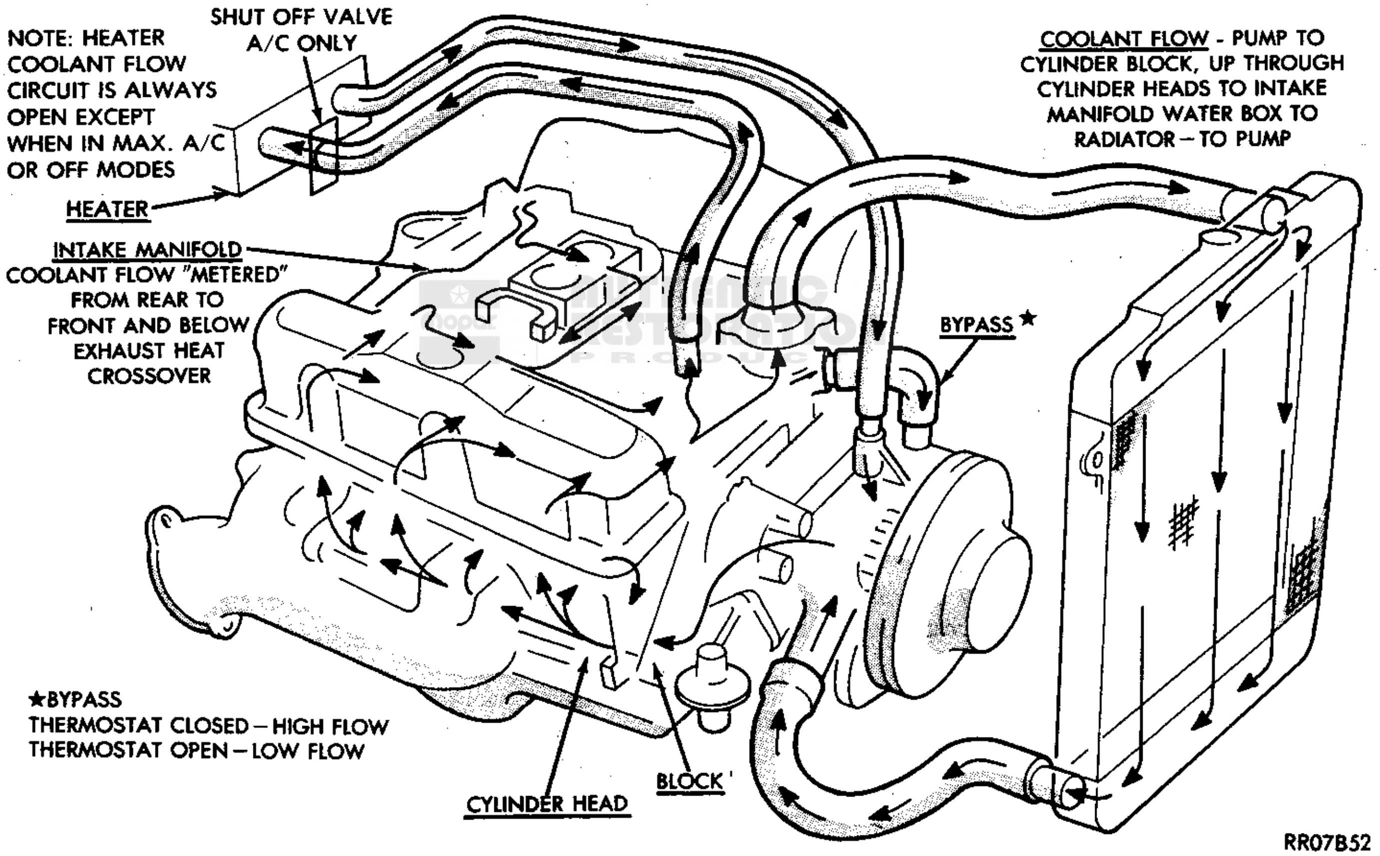

Fig. 1 Cooling System Routing

DIAGNOSIS

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PRELIMINARY DIAGNOSIS

ENGINE COOLING SYSTEM OVERHEAT DIAGNOSIS

Establish what "driving" conditions caused the complaint. Any of the following abnormal loads on the cooling system may be the cause.

1. PROLONGED IDLE, VERY HIGH AMBIENT TEMPERATURE, SLIGHT TAIL WIND AT IDLE, SLOW TRAFFIC, TRAFFIC JAMS, HIGH SPEED, STEEP GRADES:

Driving techniques that avoid overheating are:

(a) Idle with A/C off when temperature gauge is at end of normal range.

(b) Increase engine speed for more air flow.

2. TRAILER TOWING:

Consult the "Trailer Towing" section of the owners manual. Do not exceed limits.

3. AIR CONDITIONING; ADD-ON OR AFTER MARKET:

A maximum cooling package should have been ordered with the vehicle if add-on or after market A/C is installed. If not, maximum cooling system components should be installed for the model involved according to manufacturer's specifications.

4. RECENT SERVICE OR ACCIDENT REPAIR:

Determine if any recent service has been performed on the vehicle that may affect the cooling system such as: engine adjustments (incorrect timing), slipping accessory drive belt(s), brakes (possibly dragging), changed parts (possibly wrong), recored radiator or cooling system refilling (possibly under filled or trapped air).

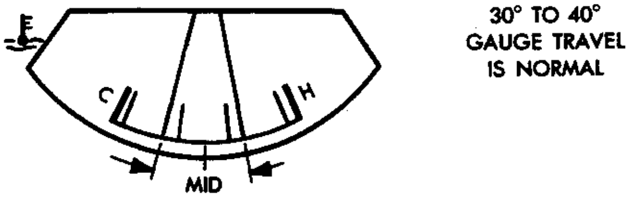
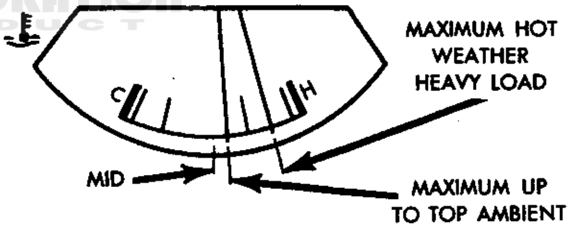
If investigation reveals none of the above as a cause for engine overheating complaint refer to the following symptom and action chart.

SYMPTOM and ACTION

(See Preliminary FIRST)

Symptom	Action
Blinking Engine Temperature Warning Light Or High Gauge Indication-Without Coolant Loss	Normal during temporary operation with heavy load, towing a trailer, high outdoor temperatures, and/or on a steep grade.
Coolant Loss	Improper refilling procedures can result in trapped air in the system. Subsequent operation of the pressure cap and coolant reserve system will deaereate the cooling system. A low coolant level will then result in the Coolant Reserve Tank. Add coolant. If condition persists refer to System Diagnosis.
Hot Vehicle (Not Engine) Heat Damage, Hot Carpet, Seat, Hot Catalytic Converter, Smoke, Burnt Odor	Check heat shielding, exhaust system, engine emission controls, ignition timing, engine misfiring.
Hot Engine Crackling Noise Hot Smell Severe Local Hot Spots	A moderate amount of sound from heating metal can be expected with any vehicle. However, a crackling sound from the thermostat housing, a hot smell and/or severe local hot spots on an engine can indicate blocked coolant passages, bad casting, core sand deposits and subsequent blockage, cracked cylinder block or head, or blown cylinder head gasket. Usually accompanied with coolant loss.
Coolant Color	Coolant color is not necessarily an indication of adequate temperature or corrosion protection.
Coolant Reserve Bottle Level Changes	Level changes are to be expected as coolant volume fluctuates with engine temperature. If the level in the bottle is between the Maximum and Minimum marks at normal engine operating temperature, the level should return to within that range after operation at elevated temperatures.
Coolant Not Returning To Radiator	Coolant will not return to the radiator if the radiator cap vent valve does not function, if an air leak destroys vacuum, or if the overflow passage is blocked or restricted. Inspect all portions of the overflow passage, pressure cap, filler neck nipple, hose, and passages within the bottle for vacuum leak only. Coolant return failure will be evident by a low level in the radiator. Reserve bottle level should increase during heat-up.

COOLING SYSTEM DIAGNOSIS

CONDITION AND CHECK	DIAGNOSIS
OPTIONAL 60°F GAUGE READS LOW	
	Normal Gauge Travel
(1) Verify gauge reading. Is a low temperature indicated?	(1) Inspect temperature gauge sending unit. Refer to Group 8, Electrical. Repair or replace sending unit as necessary.
(2) Is code 17 recorded in On Board Diagnostics memory?	(2) If code 17 is recorded, replace the thermostat. If not, the thermostat is not the cause of the low gauge reading.
(3) Is the gauge reading in the cold range?	(3) Inspect for disconnected sending unit electrical connector or incorrect sending unit. Ensure that gauge sending unit is installed and not an indicator light switch.
(4) Low coolant level during cold ambient temperatures (accompanied with poor heater performance).	(4) **WARNING: DO NOT REMOVE THE RADIATOR CAP OF A HOT, PRESSURIZED ENGINE. SERIOUS INJURY CAN RESULT FROM SCALDING COOLANT.** Inspect coolant level in the coolant reserve tank and radiator. Inspect system for leaks.
(5) Coolant level is correct.	(5) Inspect heater door controls. Refer to Group 24, Heating and Air Conditioning.
GAUGE READING HIGH. NO PRESSURE BLOW OFF FROM RADIATOR PRESSURE CAP OR STEAM FROM COOLANT RESERVE TANK.	
	High Gauge Reading — Hot Weather — Heavy Load
(1) Verify gauge reading. Is a high temperature reading indicated?	(1) Compare gauge reading to High Gauge Reading Illustration above.
(2) Gauge reading at "H" without signs of boiling.	(2) Inspect for grounded gauge, sending unit or circuit. Refer to Group 8, Electrical.
(3) Low coolant level in radiator and coolant reserve tank.	(3) a — Fill to full. b — Inspect for leaks in system and repair as necessary. c — Ensure radiator pressure cap was shut tight. Verify proper operation of the radiator cap upper and lower seals.
(4) Coolant level in radiator is low. But not low in coolant reserve tank.	(4) a — Fill to full. b — Inspect for leaks in the system and repair as necessary. c — Inspect for leaks in the coolant reserve tank to radiator hose. d — Verify proper operation of the radiator cap upper and lower seals.
(5) Test coolant freeze point.	(5) a — Adjust coolant solution to 50/50 mixture of anti-freeze and water. Refer to Coolant in this group. b — If a reading is not recorded or below −50, the mixture is too rich. Clean system and fill with a 50/50 mixture of anti-freeze and water. Refer to Coolant in this group.
(6) Ensure proper coolant flow.	(6) a — With the thermostat open and a slight amount of coolant removed, inspect for coolant flow through the radiator at the filler neck opening. b — Determine reason for lack of coolant flow and repair as necessary.

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COOLING SYSTEM DIAGNOSIS—CONTINUED

Condition and Checks	Diagnosis
(7) Other possible causes.	(7) a — If symptom occurs during high speed operation inspect for plugged air inlet side of the radiator or condenser, plugged radiator core tubes, add on A/C package without proper radiator, engine not operating within specifications, dragging brakes, trailer towing or hill climbing, or an insect screen. b — If symptom occurs during high or low speed operation inspect for: thermostat being stuck partially open if ambient temperature is below 70°F and the vehicle has high mileage, plugged air inlet side of the radiator or condenser, add on A/C with incorrect radiator. c — If symptom occurs during low speed operation only, inspect the radiator fan drive. Repair as necessary.
TEMPERATURE GAUGE READS HOT. PRESSURE CAP VENTS RESULTING IN STEAM AND COOLANT TRANSFER TO COOLANT RESERVE TANK.	
(1) Coolant level low in radiator and coolant reserve tank.	(1) a — Fill cooling system and vent trapped air. b — Inspect for leaks. Repair as necessary. c — Ensure that pressure cap is completely shut and seals. d — If level is low in radiator but normal in the coolant reserve tank, check the filler cap to coolant reserve bottle connection and pressure cap seal.
(2) Test coolant freeze point.	(2) Adjust coolant to 50/50 mix of anti-freeze and water. Refer to Coolant section in this group.
(3) Ensure coolant is flowing through system.	(3) a — With the coolant level low and the thermostat open, check for coolant flow through the radiator at the filler neck. b — If a metal cracking sound is heard, inspect for core sand restricting coolant flow through the water jacket and/or a faulty cylinder head casting.
(4) Thermostat stuck in the closed position (prevalent in cold ambient temperatures).	(4) Replace thermostat if found to be stuck in closed position. Refer to the Thermostat Testing section in this group.
(5) Cylinder head gasket leak.	(5) Inspect for leaking cylinder head gasket with a commercially available Block Leak Tester.

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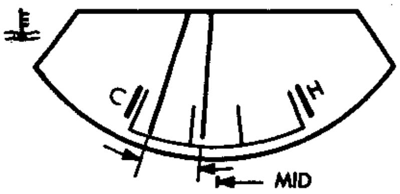
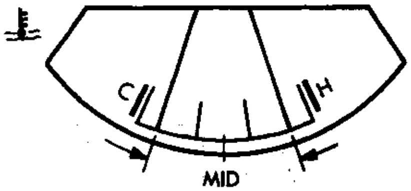
COOLING SYSTEM DIAGNOSIS—CONTINUED

CONDITION AND CHECKS	DIAGNOSIS
TEMPERATURE GAUGE IS INCONSISTENT, CYCLES AND/OR IS ERRATIC.	
(1) Is cycle normal.	 **(a) Normal Gauge Reaction to Thermostat Cycle.**  **(b) Normal Gauge Reaction at Stop After Heavy Use.** **(c) Hot Water Build-Up is Normal at Stop after Heavy Use.**
(2) Is coolant in radiator low (air will build up in the cooling system and cause the thermostat to open late).	(2) Fill system, vent trapped air and check for leaks.
(3) Is a cylinder head gasket leak allowing exhaust gas to enter cooling system (exhaust gas building up in the cooling system will cause the thermostat to open late).	(3) a — Test for leaking cylinder head gasket leak with a commercially available Block Leak Tester. b — Check for coolant in engine oil. c — Inspect for white steam from exhaust system.
(4) Water pump impeller loose on shaft. Loose accessory drive belt.	(4) Repair or replace as necessary.
(5) Air leak on the suction side of the water pump (allows air to build up in cooling system causing thermostat to open late).	(5) Find leak and repair.
WARNING LIGHT GLOWS ALL THE TIME (VEHICLE NOT EQUIPPED WITH GAUGE).	
(1) Inspect temperature gauge sending unit. The warning light sending unit has a screwdriver slot in the electrode (used for calibration). Gauge sending units do not have a slot in the electrode.	(1) Ensure that a warning light sending unit is installed.
NO GAUGE READING INITIALLY THEN HOT INDICATION (VEHICLE EQUIPPED WITH GAUGE).	
(1) Gauge stationary until very hot, then moves immediately to "H".	(1) Vehicle is equipped with sending unit for light not gauge.

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COOLING SYSTEM DIAGNOSIS—CONTINUED

Condition and Check	Diagnosis
PRESSURE CAP VENTS TO ATMOSPHERE AND COOLANT RESERVE TANK. TEMPERATURE GAUGE READING ABOVE NORMAL BUT NOT HIGH.	
(1) Test radiator pressure cap relief pressure. Refer to Radiator Pressure cap section in this group.	(1) Replace cap if relief pressure is lower than 14 psi.
COOLANT LOSS VISIBLE ON GROUND BELOW VEHICLE, BUT NO PRESSURE CAP BLOW OFF.	
(1) Inspect system for leaks.	(1) Repair as necessary.
COOLANT LOSS PAST PRESSURE CAP TOP SEAL, VISIBLE ON RADIATOR FILLER NECK.	
(1) With normal gauge reading.	(1) a — Pressure cap not installed tightly. b — Pressure cap top seal leaks. c — Pressure cap diaphragm bowed. d — Damaged radiator filler neck. e — Pressure cap top seal out of position.
(2) With high or low gauge reading on new vehicle.	(2) a — Kinked coolant reserve system hose. b — Coolant reserve system tank plastic tube plugged. c — Pressure cap seal out of position.
DETONATION OR PREIGNITION. NOT CAUSED BY IGNITION OR ENGINE CONDITIONS.	
(1) Check engine coolant freeze point. If the tester does not register a reading or if the reading is below 50°F, inspect ethylene-glycol/water ratio. A 100 percent solution of ethylene-glycol in the system causes the engine to run hotter and possibly overheat.	(1) a — Adjust coolant solution to 50/50 water ethylene-glycol mixture. b — If 100 percent ethylene-glycol solution is found in system, clean and flush system before replacing with 50/50 mixture of ethylene-glycol and water.
COOLING SYSTEM HOSES COLLAPSE ON COOLDOWN.	
(1) Inspect pressure cap vent valve.	(1) a — Gasket swell can prevent valve from opening. b — Replace pressure cap.
(2) Coolant reserve tank hose plugged or kinked.	(2) Repair as necessary.
(3) Inside of pressure cap plugged.	(3) Clean cap or replace if necessary.
COOLING SYSTEM SUSPECTED AS CAUSE OF INADEQUATE AIR CONDITIONING SYSTEM PERFORMANCE.	
(1) Inspect for plugged radiator and/or condenser.	(1) Clean with low pressure water from fan side.
(2) Inspect for missing air seals in the recirculating air path.	(2) Repair as necessary.
EXCESSIVE FAN NOISE	
(1) Inspect for loose or bent fan blades.	(1) Replace fan.
(2) Inspect clearance between fan and adjacent part.	(2) Repair or replace as necessary.
(3) Inspect radiator and condenser for incoming air obstructions.	(3) Clean air path with low pressure water from fan side.
(4) Inspect viscous fan drive.	(4) Replace if viscous drive does not operate properly.
HEAT ODOR	
(1) Was temperature gauge reading high?	(1) If YES, refer to GAUGE READING HIGH. If NO, refer to steps 2, 3, and 4.
(2) Are all heat shields in place?	(2) If YES, refer to steps 3 and 4. If NO, repair as required.
(3) If the air side of the heat exchanger plugged?	(3) Clean as necessary.
(4) Engine running rich causing catalytic converter to overheat.	(4) Repair as necessary.
POOR DRIVEABILITY. SUSPECT THERMOSTAT FAILED IN OPEN POSITION.	
(1) Check On-Board Diagnostics. Is code 17 set in memory?	(1) If YES, replace thermostat. If NO, refer to the appropriate Driveability Manual.

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COOLING SYSTEM DIAGNOSIS—CONTINUED

Condition and Check	Diagnosis
POOR HEATER PERFORMANCE. SUSPECT THERMOSTAT FAILED IN OPEN POSITION.	
(1) Does gauge read low?	**(1) If YES, replace thermostat. If NO, inspect the auxiliary heater vacuum water valve. The valve should be open except when the climate controls are OFF or in the MAX A/C mode.**
(2) Is coolant level low?	**(2) Fill cooling system and inspect for leaks. Repair as necessary.**
(3) Check On-Board Diagnostics. Is code 17 set in memory?	**(3) If YES, replace thermostat. If NO, inspect the auxiliary heater vacuum water valve. The valve should be open except when the climate controls are OFF or in the MAX A/C mode.**

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SERVICE PROCEDURES

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WATER PUMPS

A centrifugal water pump circulates the 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 "V" drive belt.

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 to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary.

A quick test to tell whether or not the pump is working is to check if the heater warms properly. A defective water pump will not be able to circulate heated coolant through the long heater hose to the heater core.

The water pump on all models can be removed without discharging the air conditioning system.

WATER PUMP REMOVAL—ALL ENGINES

If the water pump is replaced because of bearing or shaft damage, the mechanical cooling fan should be inspected for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace the fan if any of these conditions are found.

The water pump can be removed and installed without discharging the air conditioning system.

(1) Drain cooling system.

(2) If equipped with air-conditioning, remove the radiator. Refer to Radiator Removal in this section.

CAUTION: Do not place viscous fan in upright position. The silicone fluid in the viscous drive could drain into the bearing assembly and contaminate the lubricant.

(3) Remove fan blade, spacer or viscous drive unit, pulley and bolts as an assembly (Fig. 1).

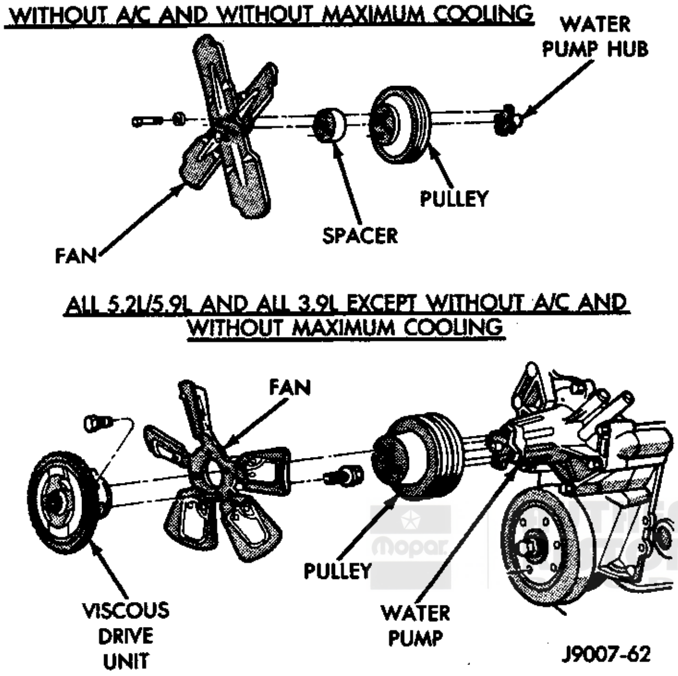


Fig. 1 Radiator Fan Removal/Installation

(4) Loosen alternator adjusting strap bolt, lock nut and pivot bolt (Fig. 2 or 3). Loosen adjusting screw to release belt tension.

(5) Remove front bracket that supports the alternator and air conditioning compressor (if equipped) or idler pulley (not equipped with air conditioning). The compressor or idler pulley will be supported by the rear mounting bracket.

(6) Loosen air pump pivot and adjusting bolt. Remove drive belt.

(7) Remove air pump.

(8) Loosen power steering pump pivot and adjusting bolt if equipped. Remove drive belt.

(9) Remove power steering pump front mounting bracket if equipped. Support power steering pump with mechanics wire. Do not let pump hang supported by hoses.

(10) Disconnect heater and by-pass hoses.

(11) Remove water pump mounting bolts and water pump assembly. Discard gasket and clean mating surfaces.

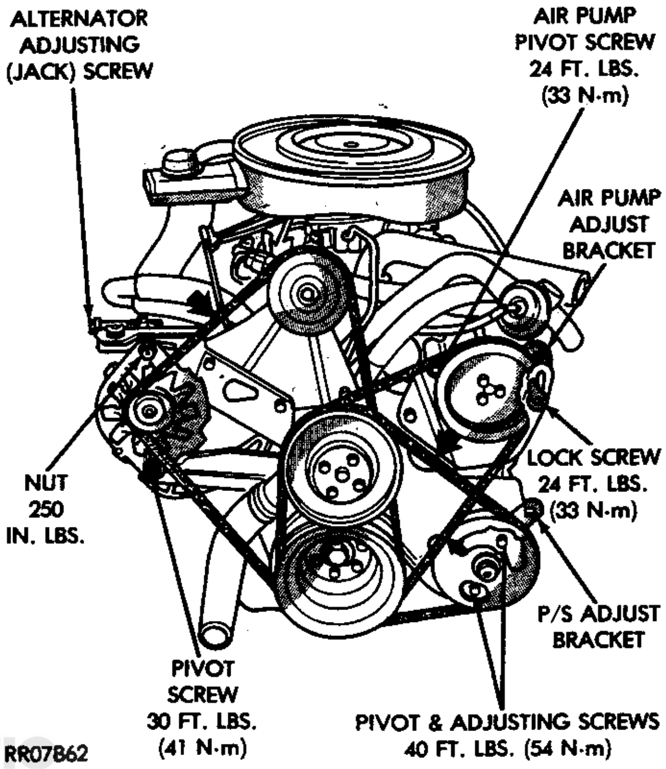


Fig. 2 Water Pump Removal/Installation—3.9L, 5.2L Engines and 5.9L Engine Low Duty Cycle

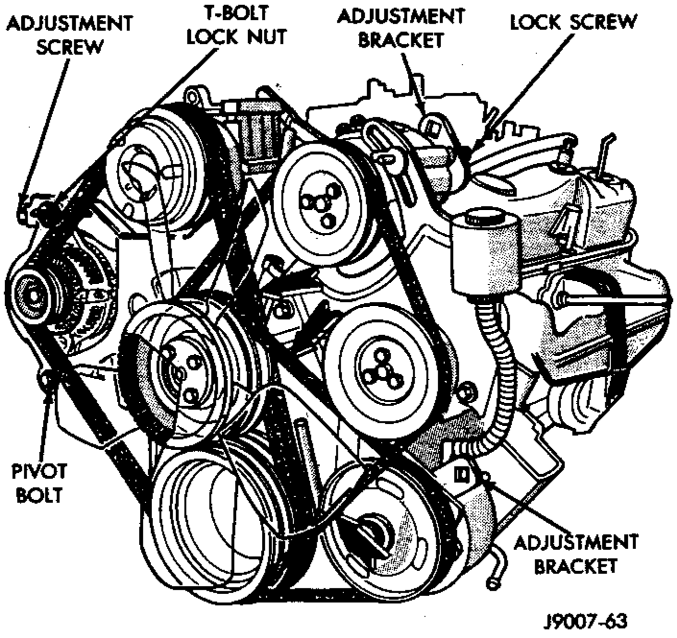


Fig. 3 Water Pump Removal/Installation—5.9L Heavy Duty Cycle

WATER PUMP INSTALLATION

(1) Using a new gasket, install the water pump. Tighten mounting bolts to 41 N•m (30 ft-lbs) torque.

(2) Spin the water pump to ensure that the impeller does not rub against the chain case cover.

(3) Connect radiator lower hose, bypass hose and heater return hose to water pump.

(4) Install power steering pump and bracket.

(5) Install air pump and bracket.

(6) Install alternator.

(7) Install front bracket to alternator and air conditioning compressor or idler pulley. Tighten bracket mounting bolts to 68 N•m (50 ft. lbs.) torque. Tighten the bolts that mount the bracket and water pump to 41 N•m (30 ft. lbs.) torque.

(8) Install water pump pulley, viscous fan assembly or spacer and fan shroud.

(9) Install accessory drive belts. Refer to "Accessory Drive Belt" section of this manual.

(10) Fill cooling system. Refer to "Refilling Cooling System" section in this group.

ENGINE THERMOSTAT

The thermostat is located beneath the thermostat housing at the front of the intake manifold (Fig. 4). The thermostat has an air bleed notch.

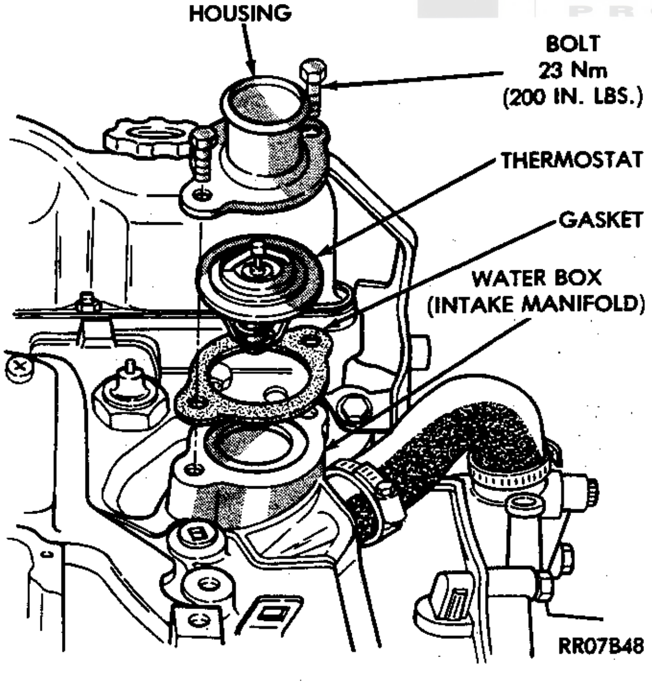


Fig. 4 Thermostat—All Engines

DESCRIPTION AND OPERATION

The thermostat is a wax pellet driven, reverse poppet choke type. 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. 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 thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. The thermostat is closed below 88°C (192°F). When the coolant reaches this temperature, the thermostat begins to open allowing coolant flow to the radiator. This provides quick engine warm-up and overall temperature control. The thermostat is designed to provide a minimum engine operating temperature range of from 88 to 93°C (192 to 199°F) and to be fully open for maximum coolant flow during operation in hot ambient temperatures of approximately 104°C (220°F). Above 104°C (220°F) coolant temperature is controlled by the radiator, fan and ambient temperature.

An arrow plus the word **UP** stamped on the front flange next to the air bleed and the words **TO RAD** stamped on one arm of the thermostat, indicate the proper installed position.

The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes longer engine warmup time, unreliable warmup performance, increased exhaust emissions, and crankcase condensation that can result in sludge formation.

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

TESTING

The on-board diagnostics include a mode for a thermostat open too soon failure condition. The check engine light will not be lit by an open too soon condition, but if it has failed open, code 17 will be set. Do not change a thermostat for lack of heat by gauge or heater performance unless code 17 is present. Refer to "Diagnosis" for other probable causes.

The more common type of thermostat failure, usually found on high milage vehicles, is a thermostat failed in the shut position. The temperature gauge (if equipped) will give an indication of this condition. Depending upon length of time that the vehicle is operated, the pressure cap may vent, expelling steam and coolant to the coolant reserve bottle and to the surface below the vehicle. Refer to the "Diagnosis" section of this group.

The thermostat opening and full open conditions can also be tested.

Remove the thermostat. Refer to "Thermostat Removal" section in this group. Insert a 0.076mm (0.003-in) feeler gauge, with a wire or string attached, between the thermostat valve and seat (Fig. 5).

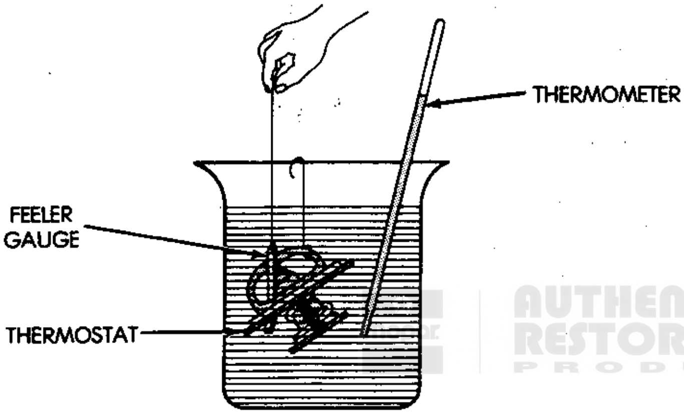
WARNING: ANTIFREEZE IS POISONOUS. KEEP OUT OF THE REACH OF CHILDREN.

Submerge the thermostat in a container of pure antifreeze and suspend it so that it does not touch the sides or the bottom of the container.

Suspend a thermometer in the antifreeze so that it does not contact the container or thermostat.

WARNING: DO NOT BREATHE THE VAPOR. ENSURE THE TEST AREA IS PROPERLY VENTILATED.

Heat the antifreeze. Apply a slight tension on the feeler gauge while the antifreeze is heated. When the valve opens the feeler gauge will slip free from the valve. Note the temperature (Fig. 5). If defective, replace the thermostat.



Must Be Open 0.076 mm (0.003 inch)	88-93°C (192°-199°F)
Must Be Fully Open	104°C (220°F)

Fig. 5 Thermostat Calibrations

Install the thermostat. Refer to "Thermostat Removal" section in this group.

THERMOSTAT REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED BECAUSE SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

Do not waste reusable coolant. If the solution is clean and being drained only to service the cooling system, drain the coolant into a clean container for reuse.

(1) Disconnect battery negative cable from battery negative terminal.

(2) Drain cooling system until coolant level is below thermostat. Refer to "Draining Cooling System" in this section.

(3) Remove radiator hose from thermostat housing.

(4) Remove thermostat housing mounting bolts, thermostat housing, gasket, and thermostat (Fig. 4). Discard old gasket.

(5) Clean gasket mating surfaces.

THERMOSTAT INSTALLATION

If the thermostat is being replaced, ensure that the replacement is the specified thermostat for the vehicle model and engine type.

(1) Dip the replacement gasket in water and install on intake manifold (Fig. 4).

(2) Insert thermostat (spring side down) through gasket into opening in intake manifold. Center thermostat in manifold.

CAUTION: Tightening the housing unevenly or without thermostat centered in recess in thermostat housing may result in a cracked housing.

(3) Install housing over thermostat. Ensure that thermostat is positioned into recess in housing. Tighten mounting bolts to 23 N•m (200 in-lbs).

(4) Connect battery negative cable to battery.

(5) Fill cooling system. Refer to "Refilling Cooling System" in this group.

COOLANT

The cooling system is designed around the coolant. Coolant flows through the engine water jacket absorbing heat produced during engine operation. The coolant carries the heat to radiator and heater core where it is transferred to the ambient air passing through the radiator and heater core fins. The coolant also removes heat from the automatic transmission fluid in vehicles equipped with an automatic transmission.

COOLANT PERFORMANCE

The required ethylene-glycol (anti-freeze) and water mixture depends upon climate and vehicle operating conditions. The coolant performance of various mixtures follows.

Pure Water- For the purpose of heat transfer only, water is able to absorb more heat than a mixture of water and ethylene-glycol. But, water freezes at a higher temperature and allows corrosion.

100%Ethylene-Glycol- The corrosion inhibiting additives in ethylene-glycol need the presence of water to dissolve, without water they form deposits in the system which act as insulation causing the temperature to rise to as high as 149°C (300°F) which 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 (-35°F). The antifreeze concentration **MUST ALWAYS** be a minimum of 44 percent, year-round in all climates. If the percentage is lower, engine parts may be eroded by cavitation.

Where required, a 56 percent ethylene-glycol and 44 percent water mixture will provide a freeze-point of -50°F.

CAUTION: Richer mixtures cannot be measured with normal field equipment and can cause problems associated with 100%ethylene-glycol.

COOLANT SELECTION-ADDITIVES

The presence of aluminum components in the cooling system requires strict corrosion protection. Maintain the coolant at the specified level with a mixture of ethylene glycol- based antifreeze and water. Only use an anti-freeze containing ALUGARD 340-2 ™ such as Mopar Anti-freeze, Prestone, Peak or an equivalent. If the coolant becomes contaminated or looses color, drain and flush the cooling system and fill with correctly mixed solution.

A .25% emulsifiable oil is added to the radiator at the factory to prevent solder corrosion.

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

COOLANT SERVICE

It is recommended that the cooling system be drained and flushed at 84,000 kilometers (52,500 miles) or 3 years whichever occurs first. Then every two years or 48,000 kilometers (30,000 miles) or 2 years whichever comes first.

COOLANT LEVEL CHECK-ROUTINE

Do not remove radiator cap for routine coolant level inspections. The coolant level can be checked at the coolant reserve bottle.

The coolant reserve system provides a quick visual method for determining the coolant level without removing the radiator pressure cap. With the engine idling and at normal operating temperature, observe the coolant level in the reserve tank. The coolant level should be between the minimum and maximum marks.

ADDING ADDITIONAL COOLANT-ROUTINE

Do not remove the radiator cap to add coolant to the system.

When adding coolant to maintain the correct level, do so at the coolant reserve bottle with a 50/50 mixture of ethylene-glycol antifreeze (containing Alugard 340-2) and water. Remove the radiator cap only for testing or when refilling the system after service. Removing the cap unnecessarily can cause loss of coolant and allow air to enter the system, which produces corrosion.

COOLANT LEVEL CHECK—SERVICE

The cooling system is closed and designed to maintain coolant level to the top of the radiator.

When vehicle servicing requires a coolant level check in the radiator, **with engine off and the cooling system not under pressure (cold),**

drain several ounces of coolant from the radiator drain cock while observing the coolant reserve system (CRS) tank. The coolant level in the reserve tank should drop slightly. If not, inspect for a leak between the radiator and coolant reserve system connection. Remove the radiator cap. The coolant level should be to the top of the radiator. If not, and if the coolant level in the reserve tank is at the “MIN” mark, an air leak exists in the coolant reserve tank or radiator filler neck, or the pressure cap seal to the radiator filler neck leaks.

LOW COOLANT LEVEL-AERATION

If the coolant level in the radiator drops below the top of the radiator core tubes air will enter the system.

Low coolant level can cause the thermostat pellet to be suspended in air instead of coolant. This will cause the thermostat to open later which in turn causes higher coolant temperature. Air trapped in cooling system also reduces the amount of coolant circulating in the heater core resulting in low heat output.

DEAERATION

As the engine operates, air trapped in the cooling system gathers under the radiator cap. The next time engine is operated thermal expansion of coolant will push trapped air past radiator cap into coolant reserve tank where it escapes to atmosphere in the bottle. When engine cools down coolant will be drawn from reserve bottle into radiator to replace removed air.

DRAINING COOLING SYSTEM

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.

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.

(1) Start the engine and place the heater control temperature selector in the "Full On" position (engine vacuum is needed to actuate the heater controls).

(2) Turn the ignition off.

(3) Do not remove the radiator cap when draining the coolant from the reserve tank. Open the radiator draincock and when the tank is empty, remove the radiator cap. If the coolant reserve tank does not drain, refer to "Testing Cooling System for Leaks" section in this group. The coolant need not be removed from the tank unless the system is being refilled with a fresh mixture.

(4) Remove the cylinder block drain plugs located on the sides of the block towards the front of engine just above the oil pan.

(5) Remove radiator pressure cap.

REFILLING THE COOLING SYSTEM

Clean cooling system prior to refilling. Refer to "Cooling System Cleaning" section of this group.

(1) Install the cylinder block drain plugs.

(2) Close radiator drain plug.

(3) Fill the cooling system with a 50/50 mixture of water and anti-freeze.

(4) Fill coolant reserve tank to the "MAX" mark.

(5) Start and operate engine until thermostat opens (upper radiator hose warm to touch).

(6) If necessary, add 50/50 water and anti-freeze mixture to the coolant reserve tank to maintain coolant level between the "MAX" and "MIN" marks. The level in the reserve tank may drop below the "MIN" mark after three or four warm-up and cool down cycles.

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.

REVERSE FLUSHING

Reverse flushing of the cooling system is the forcing of water through the cooling system, using air pressure, in the opposite direction of normal coolant flow. This is usually only necessary with very dirty systems with evidence of partial plugging.

REVERSE FLUSHING RADIATOR

Disconnect the radiator hoses from the radiator inlet and outlet. Attach a section of radiator hose to the radiator bottom outlet fitting and insert the flushing gun. Connect a water supply hose and air supply hose to the flushing gun.

CAUTION: Internal radiator pressure must not exceed 138 kPa (20 psi) as damage to radiator may result.

Allow the radiator to fill with water. When the radiator is filled, apply air in short blasts, allowing the radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear the radiator cooling tube passages, have the radiator cleaned more extensively by a radiator repair shop.

REVERSE FLUSHING ENGINE

Drain the cooling system. Remove the thermostat housing and thermostat. Install the thermostat housing. Disconnect the radiator upper hose from the radiator and attach the flushing gun to the hose. Disconnect the radiator lower hose from the water pump and attach a lead away hose to the water pump inlet fitting.

CAUTION: Ensure the heater control valve is closed (heat off). This will prevent coolant flow with scale and other deposits from entering the heater core.

Connect the water supply hose and air supply hose to the flushing gun. Allow the engine to fill with water. When the engine is filled, apply air in short blasts, allowing the system to fill between air blasts. Continue until clean water flows through the lead away hose.

Remove the lead away hose, flushing gun, water supply hose and air supply hose. Remove the thermostat housing and install the thermostat. Install the thermostat housing with a replacement gasket. Refer to Thermostat Replacement. Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture. Refer to "Refilling the cooling System"

CHEMICAL CLEANING

In some instances, the use of a radiator cleaner (Mopar Radiator Kleen, or equivalent) before flushing will soften scale and other deposits and aid the flushing operation.

CAUTION: Follow manufacturers instructions when using these products.

TESTING COOLING SYSTEM FOR LEAKS

ULTRAVIOLET LIGHT METHOD

A leak detection additive is available through the parts department that can be added to the cooling system. The additive is highly visible under ultraviolet light (black light). Poor one ounce of additive into the cooling system. Place the heater control unit in "HEAT" position. Start and operate the engine until the radiator upper hose is warm to the touch. Aim the black light, tool 7138 or an equivalent, at the components to be checked. If leaks are present, the black light will cause the additive to glow a bright green color.

The black light can be used in conjunction with a pressure tester to determine if any external leaks exist (Fig. 6).

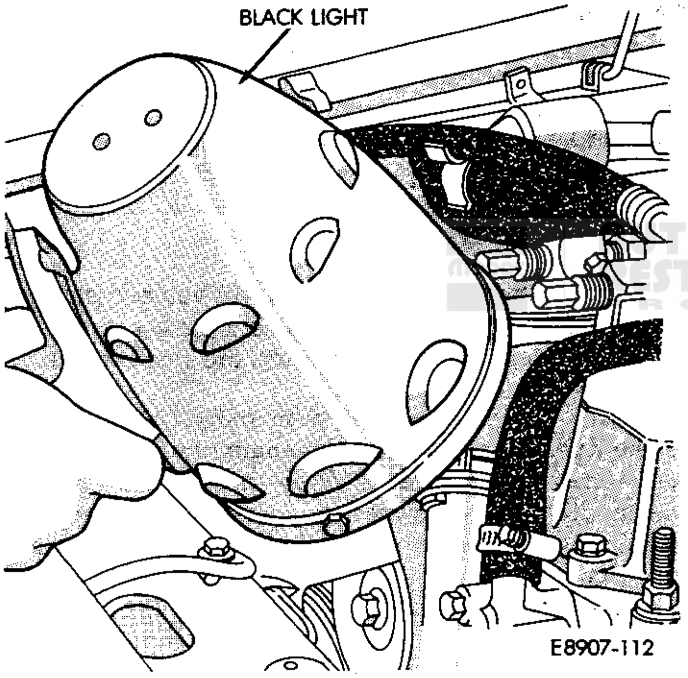


Fig. 6 Leak Detection Using Black Light—Typical

PRESSURE TESTER METHOD

The engine should be at the normal operating temperature. Recheck the system cold if the cause of coolant loss is not located during warm engine examination.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING.

Carefully remove the radiator pressure cap from the filler neck and check the coolant level. Push down on the cap to disengage it from the stop tabs. Wipe the inside of the filler neck and examine the lower inside sealing seat for nicks, cracks, paint, dirt and solder residue. Inspect the radiator to reserve tank tube for internal obstructions. Insert a wire through the tube to ensure it is not obstructed.

Inspect the cams on the outside of the filler neck. If the cams are bent, seating of pressure cap valve and tester seal will be affected. Bent cams can be reformed if done carefully. Attach pressure tester 7700-A or an equivalent to the radiator filler neck (Fig. 7).

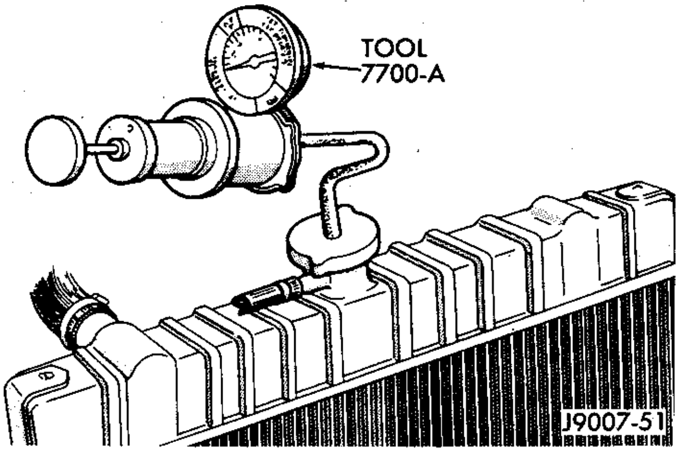


Fig. 7 Pressure Testing Cooling System

Operate the tester pump to apply 103.4 kPa (15 psi) pressure to the system. If the hoses enlarge excessively or bulge while testing, replace as necessary. Observe the gauge pointer and determine the condition of the cooling system according to following criteria.

Holds Steady: If the pointer remains steady for two minutes, there are no serious coolant leaks in the system. However, there could be an internal leak that does not appear with normal system test pressure. If it is certain that coolant is being lost and no leaks can be detected, inspect for interior leakage or perform the Combustion Leakage Test.

Drops Slowly: Indicates a small leak or seepage is occurring. Examine all connections for seepage or slight leakage with a flashlight. Inspect the radiator, hoses, gasket edges and heater. Seal small leak holes with a Sealer Lubricant, or equivalent. Repair leak holes and reinspect the system with pressure applied.

Drops Quickly: Indicates that serious leakage is occurring. Examine the system for external leakage. If no leaks are visible, inspect for internal leakage. Large radiator leak holes should be repaired by a reputable radiator repair shop.

INTERNAL LEAKAGE INSPECTION

Remove the engine oil pan drain plug and drain a small amount of engine oil. If coolant is present in the pan it will drain first because it is heavier than oil. An alternative method is to operate the engine for a short period to churn the oil, then remove the engine dipstick and inspect for water globules. Also inspect the transmission dipstick for water globules and the transmission fluid cooler for leakage.

WARNING: WITH PRESSURE TESTER TOOL 7700-A INSTALLED ON RADIATOR DO NOT ALLOW PRESSURE TO EXCEED 110 KPA (20 PSI). PRESSURE WILL BUILD UP QUICKLY IF A COMBUSTION LEAK IS PRESENT. TO RELEASE THE PRESSURE, ROCK THE TESTER FROM SIDE TO SIDE. WHEN REMOVING THE TESTER, DO NOT TURN THE TESTER MORE THAN 1/2 TURN IF THE SYSTEM IS UNDER PRESSURE.

Operate the engine without the pressure cap on the radiator until the thermostat opens. Attach a Pressure Tester to the filler neck. If the pressure builds up quickly it indicates a combustion leak exists usually the result of cylinder head gasket leak or crack in the engine. Repair as necessary.

If there is no immediate pressure increase, pump the Pressure Tester until the indicated pressure is within the system range of 110 kPa (16 psi). Fluctuation of the gauge pointer indicates compression or combustion leakage into the cooling system.

Because the vehicle is equipped with a catalytic converter, **do not remove spark plug wires or short out cylinders** to isolate the compression leak.

If the needle on the dial of the pressure tester does not fluctuate, race the engine a few times to check for an abnormal amount of coolant or steam emitting from the exhaust pipe. Coolant or steam from the exhaust pipe may indicate a faulty cylinder head gasket, cracked engine cylinder block or cylinder head.

A convenient check for exhaust gas leakage into the 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 the solution is clean and is being drained only to service the cooling system, drain the coolant into a clean container for reuse.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.

Drain sufficient coolant to allow thermostat removal. Refer to Thermostat Replacement. Disconnect the water pump drive belt.

Add coolant to the radiator to bring the level to within 6.3 mm (1/4 in) of the top of the thermostat housing.

CAUTION: Avoid overheating. Do not operate the engine for an excessive period of time. Open the draincock immediately after the test to eliminate boil over.

Start the engine and accelerate rapidly three times, to approximately 3000 rpm while observing the coolant. If internal engine combustion gases are leaking into the cooling system, bubbles will appear in the coolant. If bubbles do not appear, there is no internal combustion gas leakage.

COOLANT RESERVE SYSTEM (CRS)

The Coolant Reserve System (CRS) works in conjunction with the radiator pressure cap to utilize thermal expansion and contraction of the coolant to keep the coolant free of trapped air. It provides a volume for expansion and contraction, provides a convenient and safe method for checking coolant level and adjusting level at atmospheric pressure without removing the radiator pressure cap. It also provides some reserve coolant to cover minor leaks and evaporation or boiling losses (Fig. 8).

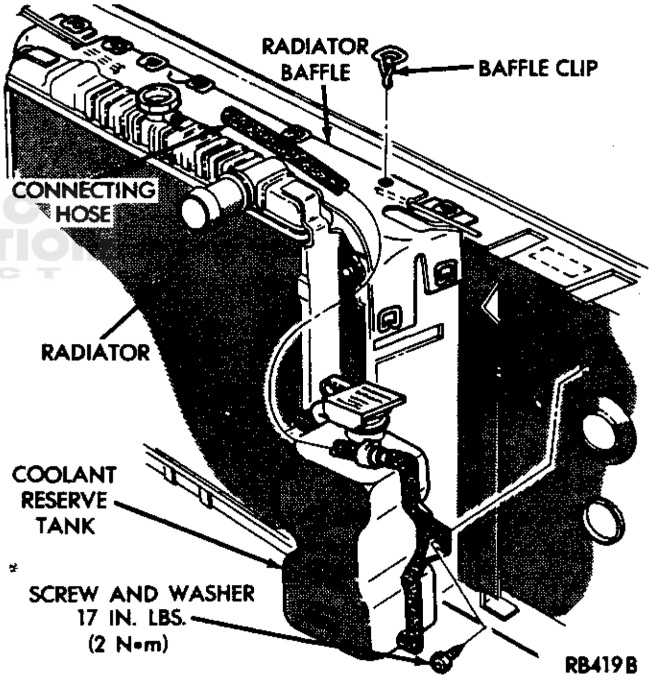


Fig. 8 Coolant Reserve System

Refer to “Coolant Level Check—Service”, “Deaeration”, and “Radiator Pressure Cap” sections in this group for CRS system operation and service. Vehicles equipped with an electronic monitor system use a level sensor in the CRS tank, refer to Group 8, Electrical, for service.

Should the CRS tank become coated with corrosion or emulsifiable oil it can be cleaned with detergent and water. Rinse the tank thoroughly before refilling the cooling system as described in the “Coolant” section of this group.

RADIATOR PRESSURE CAP

Radiators are equipped with a pressure cap which releases pressure at some point within a range of 97-124 kPa (14-18 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 (Fig. 9) contains a spring-loaded pressure relief valve that opens when system pressure reaches the release range of 97-124 kPa (14-18 psi).

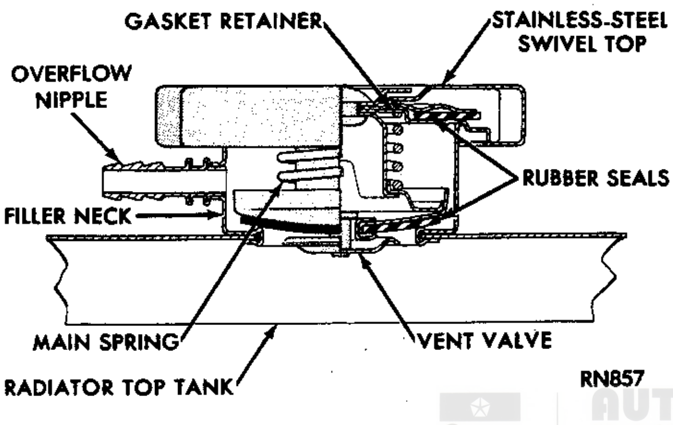


Fig. 9 Radiator Pressure Cap and Filler Neck

A vent valve in the center of the cap allows a small coolant flow through the cap when coolant is below boiling temperature. The valve is completely closed when boiling point is reached. As coolant cools it contracts and creates a vacuum in the cooling system. This causes the vacuum valve to open and coolant in reserve bottle to be drawn through connecting hose into radiator. If the vacuum valve is stuck shut radiator hoses will collapse on cool down. Clean the vent valve (Fig. 11) to ensure proper sealing.

A rubber gasket seals the radiator filler neck to prevent leakage when system is under pressure and to maintain vacuum during coolant cool down allowing coolant to return from the reserve tank.

RADIATOR CAP TO FILLER NECK SEAL, PRESSURE RELIEF CHECK

The pressure cap upper gasket (seal) pressure relief can be tested by removing the overflow hose from the radiator filler neck nipple and attaching the hose of pressure tester tool 7700-A to the nipple. It will be necessary to disconnect the hose from it's adapter for the filler neck. Pump air into the radiator. The pressure cap upper gasket should relieve at 69- 124 kPa (10-18 psi) and hold pressure at a minimum of 55 kPa (8 psi).

WARNING: THE WARNING WORDS "DO NOT OPEN HOT" ON THE RADIATOR PRESSURE CAP ARE A SAFETY PRECAUTION. WHEN HOT, PRESSURE BUILDS UP IN COOLING SYSTEM. TO PREVENT SCALDING OR INJURY, THE RADIATOR CAP SHOULD NOT BE REMOVED WHILE THE SYSTEM IS HOT AND/OR UNDER PRESSURE.

There is no need to remove the radiator cap at any time **except** for the following purposes:

(1) Check and adjust anti-freeze freeze point.
(2) Refill system with new anti-freeze.
(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 THE CAP AND WITHOUT PUSHING CAP DOWN ROTATE IT COUNTER-CLOCKWISE TO THE FIRST STOP. ALLOW FLUID TO ESCAPE THROUGH OVERFLOW HOSE INTO COOLANT RESERVE BOTTLE. SQUEEZE RADIATOR UPPER HOSE TO DETERMINE WHEN PRESSURE HAS BEEN RELEASED. WHEN COOLANT AND STEAM STOP BEING PUSHED INTO BOTTLE AND SYSTEM PRESSURE DROPS REMOVE RADIATOR CAP COMPLETELY.

PRESSURE TESTING RADIATOR CAPS

Remove cap from radiator. Ensure that sealing surfaces are clean. Moisten rubber gasket with water and install the cap on pressure tester 7700-A or an equivalent (Fig. 10).

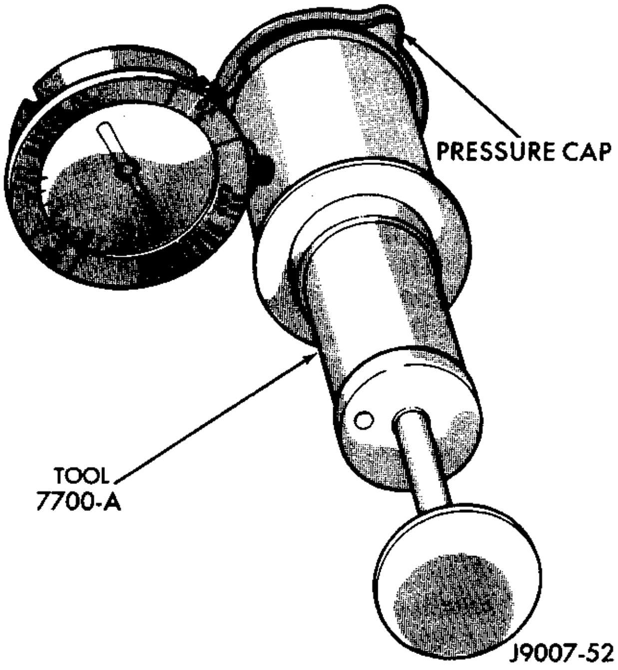


Fig. 10 Pressure Testing Radiator Cap

Operate the tester pump to bring pressure to 104 kPa (15 psi) on the gauge. If the pressure cap fails to hold pressure of at least 97 kPa (14 psi) replace cap. Refer to **CAUTION** below.

If the pressure cap tests properly while positioned on tool 7700-A, but will not hold pressure or vacuum when installed on the radiator, inspect the radiator filler neck and cap top gasket for damage, dirt or distortion that may prevent the cap from sealing properly.

CAUTION: Tool 7700-A is 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 the tool. Turn the tool upside down and recheck the pressure cap to confirm that cap needs replacement.

INSPECTION

Hold cap at eye level, right side up. The vent valve (Fig. 9) at the bottom of the cap should open. If the rubber gasket has swollen and prevents the vent valve from opening, replace the 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 the vent shut.**

A replacement cap must be the type designed for a coolant reserve system with a completely sealed diaphragm spring and a rubber gasket to seal to the radiator filler neck top surface. Use of the proper cap ensures coolant return to the radiator.

RADIATOR

The radiator is a down-flow type (vertical tubes). The radiator supplies sufficient heat transfer to cool the engine and automatic transmission (if equipped).

RADIATOR COOLANT FLOW CHECK

Use the following procedure to determine if coolant is flowing through the cooling system.

(1) Idle engine until operating temperature is reached. If the upper radiator hose is warm to the touch, the thermostat is opening and coolant is flowing to the radiator.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. USING A RAG TO COVER THE RADIATOR PRESSURE CAP, OPEN RADIATOR CAP SLOWLY TO THE FIRST STOP, ALLOWING ANY BUILT-UP PRESSURE TO VENT TO THE RESERVE TANK. AFTER PRESSURE BUILD-UP HAS BEEN RELEASED, REMOVE CAP FROM FILLER NECK.

(2) Drain a small amount of coolant from the radiator until the ends of the radiator tubes are visible through the filler neck. Idle the engine at normal operating temperature. If coolant is flowing past the exposed tubes the coolant is circulating.

RADIATOR REMOVAL

(1) Disconnect battery negative cable from battery.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.

(2) Drain the cooling system. Refer to "Draining Cooling System".

(3) Remove hose clamps and hoses from radiator. Remove coolant reserve tank hose from radiator filler neck nipple.

(4) If equipped with an automatic transmission, disconnect oil cooler hoses at radiator lower tank.

(5) Remove fan shroud mounting screws and position shroud rearward on engine (Fig. 11).

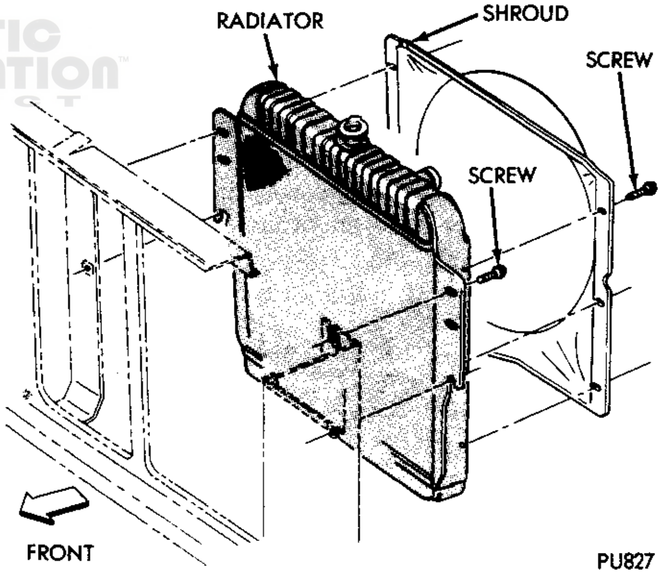


Fig. 11 Radiator and Fan Shroud

(6) Loosen radiator lower mounting screws then remove the upper mounting screws. Lift radiator straight up out of engine compartment taking care not to damage radiator cooling fins or tubes.

INSTALLATION

(1) Position shroud rearward on engine.

(2) Slide radiator into position place behind the radiator support with lower mounting holes (slots) resting on loosened bottom mounting screws (Fig. 11). Install upper mounting screws. Tighten all mounting screws to 11 N•m (95 in. lbs.) torque.

(3) Connect radiator hoses. Tighten hose clamps to 4 N•m (35 in. lbs.) torque.

(4) Connect transmission oil cooler lines to bottom tank. Tighten hose clamps to 4 N•m (35 in. lbs.) torque.

(5) Position fan shroud on radiator flange. Tighten mounting nuts to 11 N•m (95 in. lbs.) torque.

(6) Open heater valve.

(7) Fill cooling system with coolant. Refer to Filling Cooling System in this group.

(8) Operate engine until it reaches normal temperature. Check cooling system and automatic transmission fluid levels.

RADIATOR DRAINCOCK SERVICE

The radiator draincock is replaceable. Unscrew the draincock in a clockwise direction and remove from radiator. Install replacement draincock.

COOLING SYSTEM HOSES

Rubber hoses route coolant to and from the radiator, intake manifold, and heater core (Fig. 12). Radiator lower hoses are spring-reinforced to prevent collapse from water pump suction at moderate and high engine speeds.

Inspect the hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed or swell excessively when the system is pressurized. The use of molded replacement hoses is recommended. When performing a hose inspection, inspect the radiator lower hose for proper position and condition of the spring.

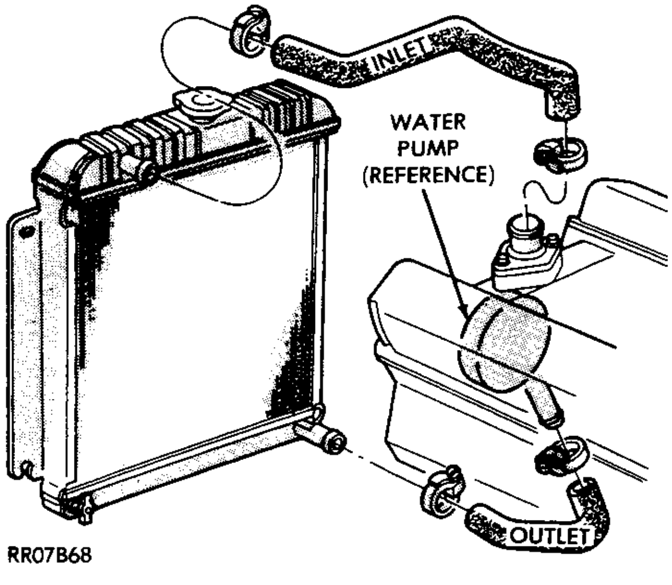


Fig. 12 Radiator Hoses

HOSE CLAMPS

Constant tension hose clamps are used on some cooling system hoses. The clamp size is identified by a letter stamped on the tongue. Special pliers for removing and installing the clamps are available from most automotive jobbers.

Ordinary worm gear type hose clamps can be removed with a straight screwdriver or a hex socket. **To prevent damage to hoses or clamps, these hose clamps should be tightened to 4.1 N•m (34 in-lbs) torque. Do not over tighten hose clamps.**

TRANSMISSION OIL COOLER

The automatic transmission oil is cooled when it passes through a cooler in the radiator lower tank (Fig. 13 and 14).

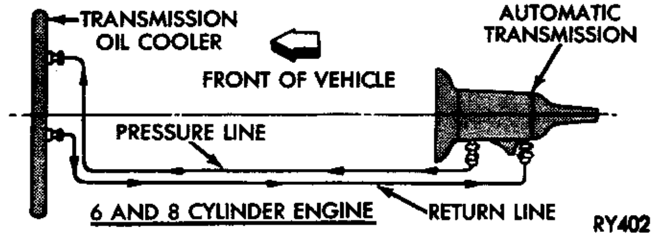


Fig. 13 Top View of Transmission Oil Cooling Circuit

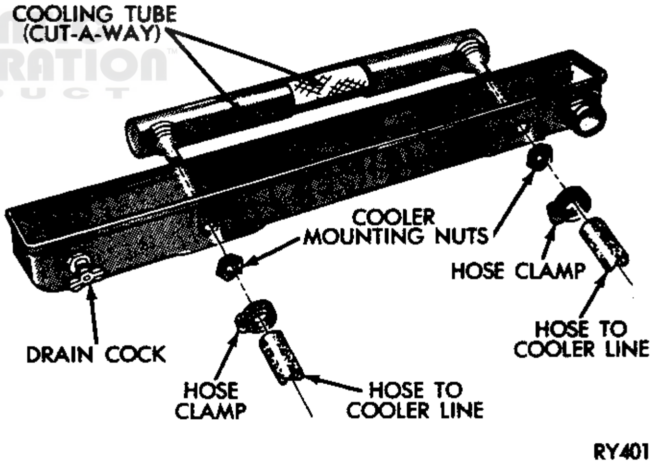


Fig. 14 Automatic Transmission Oil Cooler

In case of a leak in the transmission oil cooler, engine coolant may become mixed with transmission fluid, or transmission fluid may enter the engine cooling system. Both cooling system and transmission should be drained and inspected in the event cooler is leaking.

REPLACING OIL COOLER IN BOTTOM TANK

Remove radiator. Refer to Radiator Removal in this group. The servicing should be performed by a qualified repair facility.

Once the repaired or replacement radiator has been installed, fill the cooling system and inspect for leaks. Refer to “Refilling Cooling System” and “Testing Cooling System For Leaks” sections in this group. If the transmission operates properly after repairing the leak, drain the transmission and torque converter while hot. Remove the transmission oil pan and inspect sludge and/or rust. Inspect for a dirty or plugged inlet filter. If none of these conditions are found, the transmission may not require reconditioning. Refer to Group 21 for automatic transmission servicing.

TRANSMISSION OIL-TO-AIR COOLER

Oil to air transmission coolers are mounted ahead of the radiator and operate in conjunction with the main cooler located in the radiator lower tank (Fig. 15). The transmission oil is routed through the main cooler in the radiator lower tank first, then the auxiliary cooler before returning to the transmission.

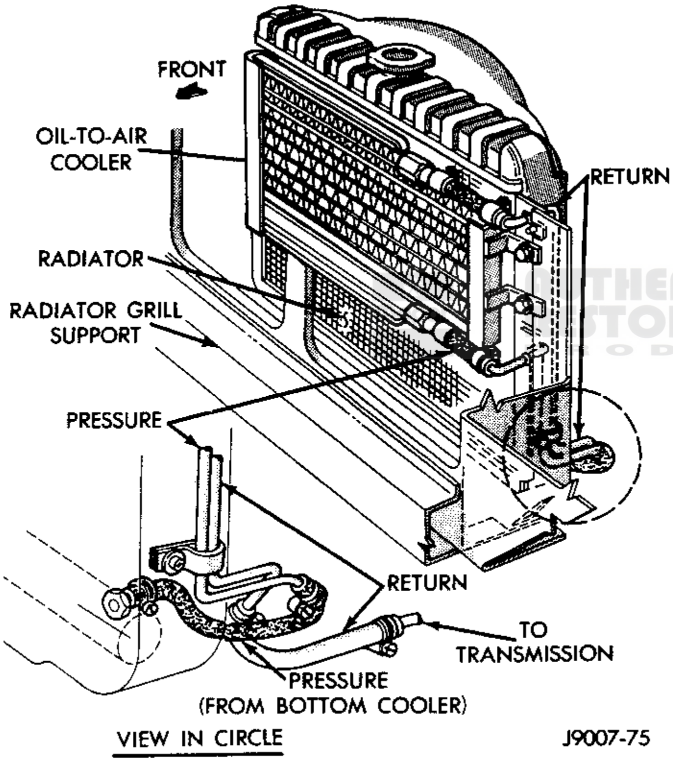


Fig. 15 Transmission Oil-to-Air Cooler

COOLING SYSTEM FAN

Removal

(1) Disconnect battery negative cable from battery.

(2) Loosen accessory drive belts. Refer to "Accessory Drive Belt" section in this group.

(3) Remove fan/viscous drive assembly to water pump hub mounting bolts.

(4) Remove fan shroud mounting screws (Fig. 13).

(5) Remove fan/viscous drive assembly and shroud from engine compartment.

(6) Remove fan to viscous drive unit mounting screws.

Inspection

The fan cannot be repaired if it is damaged. It must be replaced. Inspect the fan as follows.

(1) Remove fan and viscous drive assembly from engine. Refer to Removal procedure.

(2) Disconnect fan from viscous drive unit.

(3) Lay fan on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0mm (.090 inch). Rocking motion of oppósite blades should not exceed 2.0mm (.090 inch). Test all blades in this manner.

WARNING: IF FAN IS NOT WITHIN SPECIFICATIONS, DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN.

(2) Inspect dan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

CAUTION: If the water pump is replaced because of bearing or shaft damage, the mechanical cooling fan should be inspected for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace the fan if any of these conditions are found.

Thermal Control Fan Drive

The thermal control fan drive consists of the viscous fan drive clutch and a thermostatic spring coil mounted on it's front face. The viscous fan drive clutch is essentially a silicone-fluid-filled coupling connecting the fan assembly to the fan/water pump pulley (Fig. 16). The coupling allows the fan to be driven in a normal manner at low engine speeds while limiting the top speed of the fan to a predetermined maximum level at higher engine speeds.

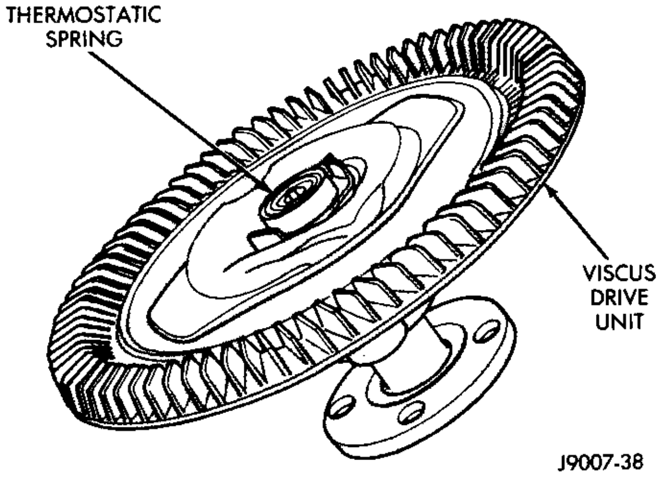


Fig. 16 Thermal Control Fan Drive

The thermostatic spring coil reacts to the temperature of the radiator discharge air and engages the drive clutch for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced RPM regardless of engine speed. Only when sufficient heat is present in the air flowing through the radiator core to cause a reaction from the thermostatic spring coil will the viscous drive clutch engage and increase fan speed to provide the necessary additional engine cooling.

Regardless of increased engine speed, once the fan has reached its maximum operating speed it will not rotate any faster. When the necessary engine cooling has been accomplished causing a reduction in the temperature of the radiator discharge air, the spring coil again reacts and the fan speed is reduced to the previous disengaged speed.

Fan Installation

(1) Install fan to viscous drive unit. Tighten mounting screws to 23 N•m (17 ft-lbs) torque.

(2) Install fan/viscous drive assembly and shroud. Tighten fan/viscous drive assembly to water pump hub mounting screws to 23 N•m (17 ft-lbs) torque. Tighten shroud mounting screws to 11 N•m (95 in-lbs) torque.

(3) Install and tension accessory drive belts. Refer to "Accessory Drive Belt" section in this group.

(4) Connect battery negative cable to negative terminal of battery.

ACCESSORY DRIVE BELTS

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GENERAL INFORMATION

Vehicles are available with either a 3.9L V-6 engine or a 5.2L or 5.9L V-8 engine. The accessory drive systems of all engines are operated by crankshaft driven V-belt accessory drive belts. The alternator is driven by a dual belt system that also drives the air conditioning compressor (if equipped).

PROPER BELT TENSION

Correct accessory drive belt tension is required to ensure optimum performance of the belt driven engine accessories. If the specified tension is not maintained, belt slippage may cause; engine overheating, lack of power steering assist, loss of air conditioning capacity, reduced alternator output rate, and greatly reduced belt life.

BELT TENSION TESTING—USING GAUGE

There are different gauges for checking Poly "V" serpentine (multi-ribbed) belts and conventional "V" belts. Use the correct gauge when checking belt tension. Place gauge in the middle of the section of belt being used to check tension. The gauge can only contact the belt or a false reading may result. Refer to the Belt Tension Chart for tension specifications. **A belt is considered a used belt after 15 minutes of use.**

DIAGNOSIS

V-Belt Diagnosis

Condition	Possible Cause	Correction
INSUFFICIENT ACCESSORY OUTPUT DUE TO BELT SLIPPAGE	(a) Belt too loose. (b) Belt excessively glazed or worn.	(a) Adjust belt tension (b) Replace and tighten as specified.
BELT SQUEAL WHEN ACCELERATING	(a) Belt too loose. (b) Belt glazed.	(a) Adjust belt tension. (b) Replace belt.
BELT SQUEAK AT IDLE	(a) Belt too loose. (b) Dirt and/or paint imbedded in belt. (c) Non-uniform belt. (d) Misaligned pulleys. (e) Non-uniform groove or eccentric pulley.	(a) Adjust belt tension. (b) Replace belt. (c) Replace belt. (d) Align accessory drive pulleys. (e) Replace pulley.
BELT ROLLED OVER IN GROOVE OR BELT JUMPS OFF	(a) Broken cord in belt. (b) Belt too loose or too tight. (c) Misaligned pulley. (d) Non-uniform groove or eccentric pulley.	(a) Replace belt. (b) Adjust belt tension. (c) Adjust belt tension. (d) Replace pulley.

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ACCESSORY DRIVE BELT SCHEMATICS

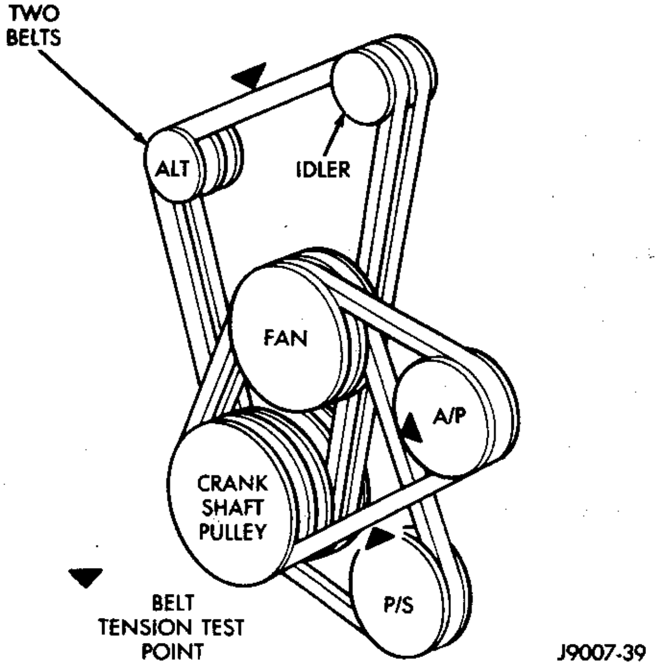

Fig. 1 Alternator, Air Pump and Power Steering—3.9L, 5.2L and 5.9L Engines

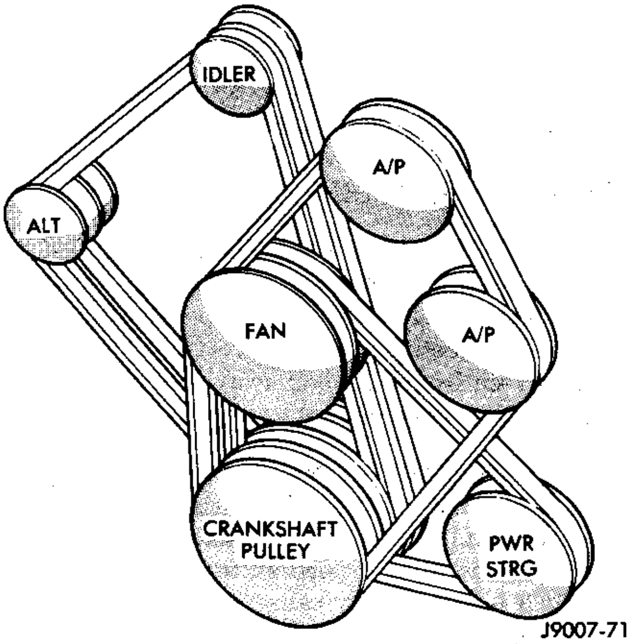

Fig. 3 Alternator, Air Pumps, and Power Steering—Heavy Duty Cycle 5.9L Engine

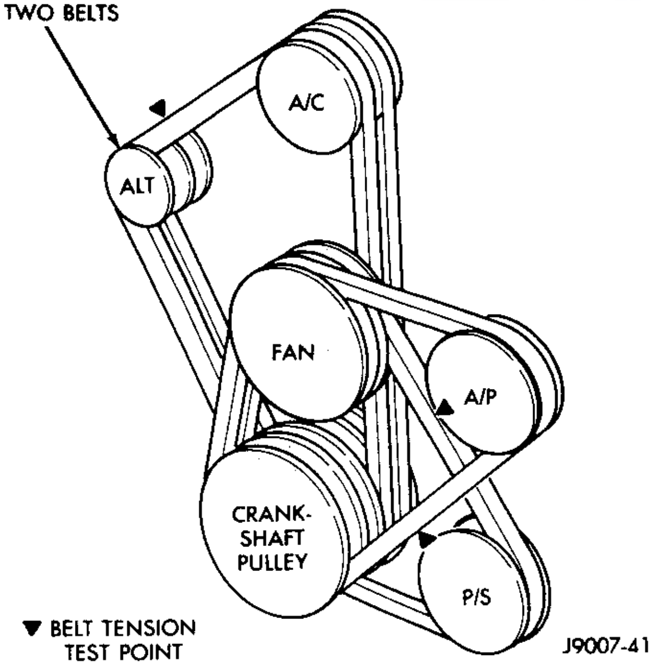

Fig. 2 Alternator, Air Pump, A/C, and Power Steering—3.9L, 5.2L and 5.9L Engines

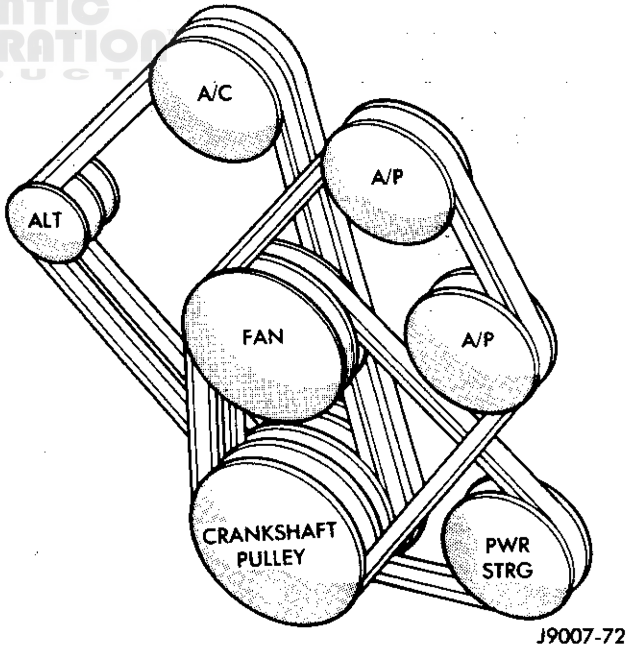

Fig. 4 Alternator, Air Pumps, A/C, and Power Steering—Heavy Duty Cycle 5.9L Engine

ALTERNATOR AND AIR CONDITIONING BELTS

The alternator has a matched two belt system. Both belts are tightened to the correct tension at the same time by the adjusting screw.

(1) Disconnect battery negative cable from battery.

(2) Loosen alternator pivot bolt (Fig. 5 or 6).

(3) Loosen alternator locknut.

(4) Loosen adjusting bolt to remove or replace belt.

(5) Install belts. **The belts are a matched set.**

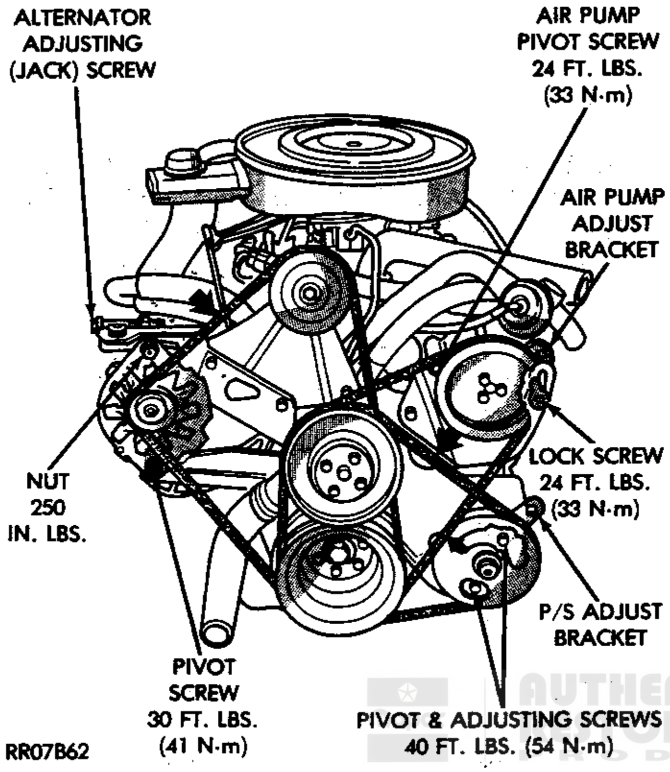

Fig. 5 Accessory Drive System—3.9L, 5.2L Engines and 5.9L Engines Low Duty Cycle

Both belts must be replaced at the same time. Tension belts by tightening the adjusting bolt. Refer to “Belt Tension Chart” in the “Specifications” section for tension specifications.

(6) Tighten locknut to 27 N•m (20 ft-lbs) torque.

(7) Tighten pivot bolt and nut to 40 N•m (30 ft-lbs) torque.

(8) Connect battery negative cable to battery. Tighten cable terminal bolt to 12 N•m (100 in-lbs) torque.

AIR PUMP BELT

(1) Disconnect battery negative cable from battery.

(2) Loosen air pump lock screw (Fig. 5 or 6).

(3) Loosen air pump pivot screw and remove or replace belt.

(4) Insert a 1/2 inch breaker bar into the square hole in the adjustment bracket at the rear of the pump and adjust belt tension. Refer to the “Belt Tension Chart” in the “Specifications” section for tension specifications.

(5) Tighten the lock screw and pivot screw to 33 N•m (24 ft-lbs) torque.

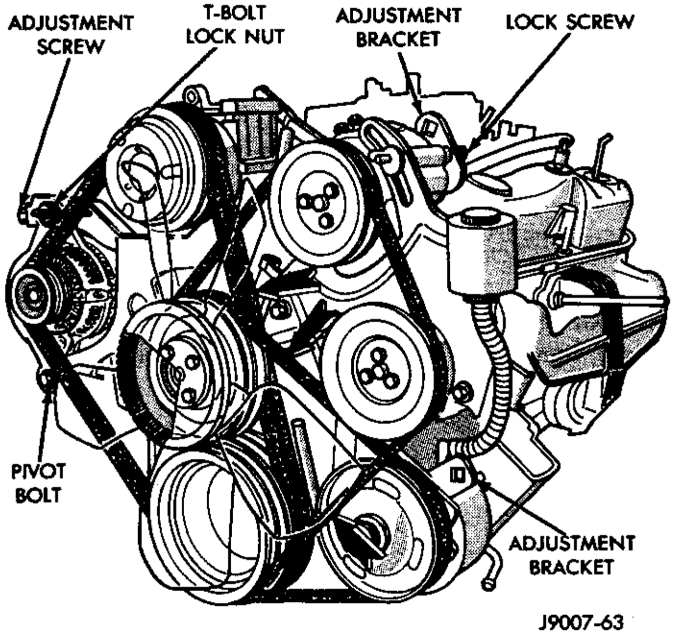

Fig. 6 Accessory Drive System—Heavy Duty Cycle 5.9L Engine

(6) Connect battery negative cable to battery. Tighten cable terminal bolt to 12 N•m (100 in-lbs) torque.

POWER STEERING PUMP BELT

(1) Disconnect battery negative cable from battery.

(2) Loosen power steering pump adjusting screw and pivot screw (Fig. 5).

(3) Remove or replace the belt.

(4) Insert a 1/2 inch breaker bar into the square hole in the adjusting bracket at the front of the pump and adjust belt tension. Refer to the “Belt Tension Chart” in the “Specifications” section for tension specifications.

ENGINE BLOCK HEATERS

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GENERAL INFORMATION

DESCRIPTION AND OPERATION

An optional engine block heater is available with for all models. The heater is equipped with a power cord that is located behind the grille. 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 welsh plug) with the heating element immersed in engine coolant. The power cord is located behind the radiator grille. Connect the power cord to a grounded 110-120 volt AC electrical outlet with a grounded, three wire extension cord.

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE. THE POWER CORD MUST BE SECURED IN ITS RETAINING CLIPS AND ROUTED AWAY FROM EXHAUST MANIFOLDS AND MOVING PARTS.

REMOVAL

(1) Disconnect battery negative cable from battery.

(2) Drain coolant from radiator and cylinder block.

(3) Remove power cord from heater (Fig. 1).

(4) Loosen screw at center of heater. Remove heater assembly.

INSTALLATION

(1) Thoroughly clean cylinder block core hole and heater seat.

(2) Insert heater assembly with element loop pointing down.

(3) With heater fully seated, tighten center screw securely.

(4) Fill cooling system with recommended coolant. Refer to "Filling Cooling System" section in this group.

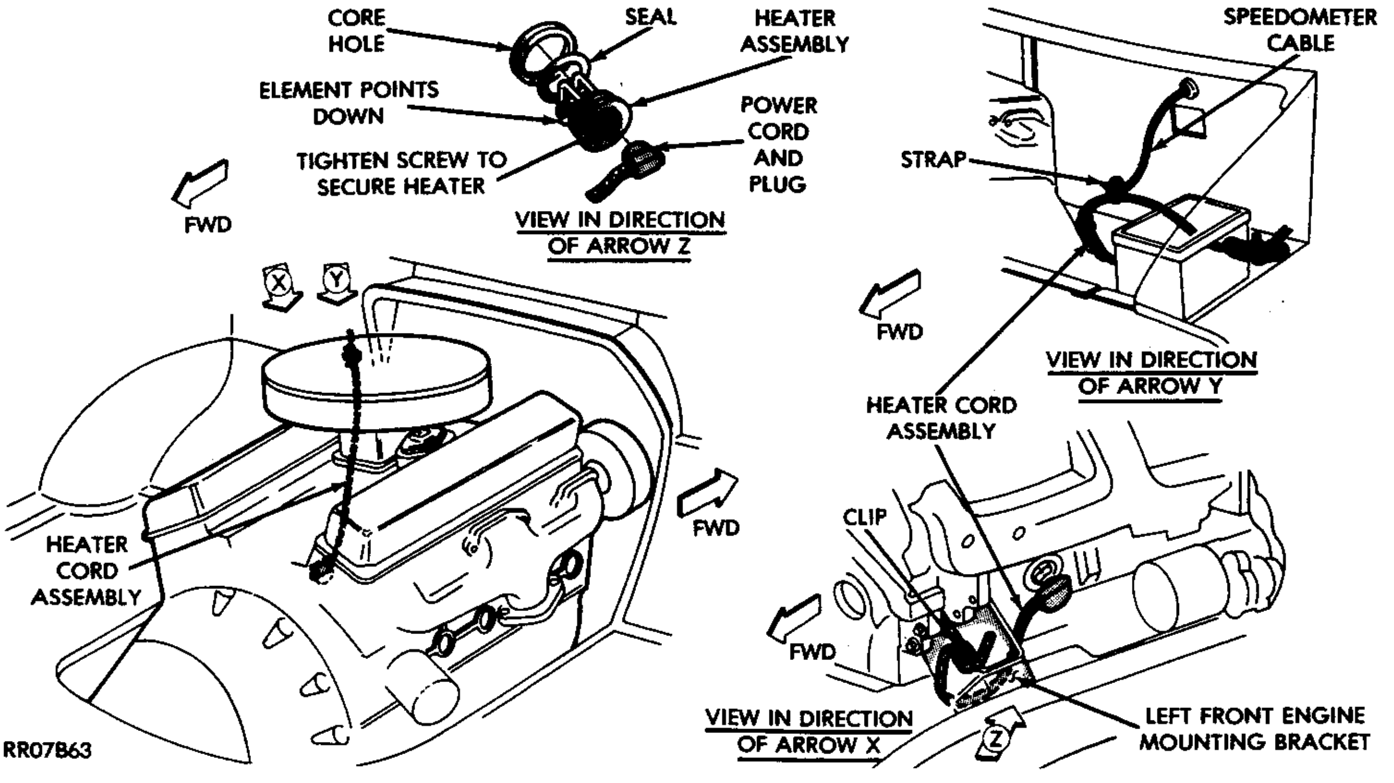

Fig. 1 Engine Block Heater

SPECIFICATIONS

COOLING SYSTEM SPECIFICATIONS

ENGINE *C.U.-LITER	MODEL	DRIVE	RADIATOR WIDTH (INCHES)	CAPACITY QUARTS-LITER
238-3.9	D150, 250	2-Wheel	26	15.1-14.0
318-5.2	D150, 250, 350	2-Wheel	26	17.0-16.0
360-5.9	D150, 250, 350 and Ramcharger	2-Wheel	26	15.5-14.5
318-5.2	Ramcharger	4-Wheel	26	16.5-15.50
360-5.9	Ramcharger	4-Wheel	26	15.0-14.0
318-5.2	W150, 250, 350	4-Wheel	26	17.0-16.0
360-5.9	W150, 250, 350	4-Wheel	26	15.5-14.5

*Cubic Inch Displacement

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Engine	Models	Thermostat Calibration	Water Pump Impeller	Remarks
3.9L - 5.2L - 5.9L	All	195°F (91°C)	3.85 Dia. 6 Blades	W/O A/C & W/ A/C

W/O A/C — Without Air Conditioning
W/ A/C — With Air Conditioning

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CONVERSION CHART

U.S. Quart	13	14	15	15-1/2	16	16-1/2	17	17-1/2	18	18-1/2
Litre	12L	13L	14L	14.6L	15L	15.6L	16L	16.5L	17L	17.5L

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TIGHTENING REFERENCE

COMPONENT	INCH POUNDS	FOOT POUNDS	THREAD SIZE
Water Pump Bolts	—	30 (41 N•m)	3/8-16
Viscous Fan Drive Attaching Bolts	—	20 (27 N•m)	5/16-18
Fan Attaching Bolts	200 (23 N•m)	—	5/16-18
Thermostat Housing Bolts	200 (23 N•m)	—	3/8-18
Shroud Mounting Screws	95 (11 N•m)	—	1/4-20
Radiator Mounting Screws	95 (11 N•m)	—	1/4-20
Drain Cock	150 (17 N•m)	—	—
Drain Cock Handle	22-32 (2-4 N•m)	—	—
Radiator Hose Clamps	35 (4 N•m)	—	—
Lines to Connector (at Transmission)	50 (6 N•m)	—	—
Transmission Cooler Hose Clamps	15 (2 N•m)	—	—

N•m — Newton Meters

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ACCESSORY DRIVE BELT TENSION

Accessory Drive Belt Tension	New Belt	Used Belt
Alternator (dual belt drive)	100-140 lbs 444-622 N	60-90 lbs 266-400 N
Air Pump	100-140 lbs 444-622 N	60-90 lbs 266-400 N
Power Steering Pump	100-140 lbs 444-622 N	60-90 lbs 266-400 N

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ELECTRICAL

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Throughout these groups, references may be made to a particular vehicle by letter or number designation. A chart showing the breakdown of these designations is included in the Introduction Section at front of this service manual.

BATTERY/STARTING/CHARGING SYSTEMS DIAGNOSTICS

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DIAGNOSTIC INFORMATION

INTRODUCTION TO STARTING AND CHARGING SYSTEM DIAGNOSTICS

The Battery, Starting, and Charging Systems operate in conjunction with one another, and therefore, must be thoroughly tested as a complete system. In order for the vehicle to start and charge properly, it must have a battery that will perform to specifications. The starter motor, alternator, wiring, and electronics also must perform within specifications. Group 8A will cover Starting (Fig. 1) and Charging (Fig. 2) System diagnostic procedures from the most basic conventional methods to "On Board Diagnostics" (OBD) built into the vehicle's electronics (except diesel). The need for conventional testing equipment has not been eliminated by the introduction of OBD.

Use of an ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12 volt test light will be required.

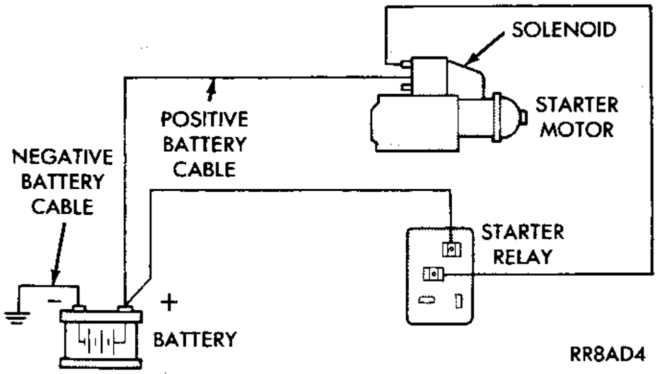

Fig. 1 Starting System Components (Typical)

All vehicles are equipped with OBD (except diesel). All OBD sensing systems are monitored by the Single Board Engine Controller. The Engine Controller will store in electronic memory any detectable failure within the monitored circuits. Refer to USING ON-BOARD DIAGNOSTIC SYSTEM in this group for more information.

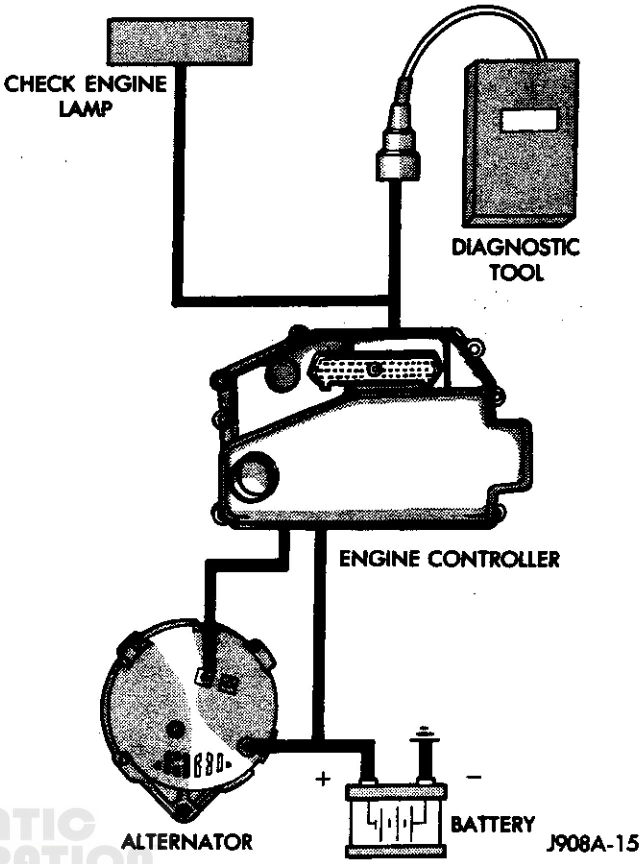

Fig. 2 Charging System Components (Typical)

BATTERY TEST PROCEDURES ON VEHICLE

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GENERAL INFORMATION

The battery stores, stabilizes, and produces electrical current to operate various electrical systems in the vehicle. The determination of whether a battery is good or bad is made by the batteries ability to accept a charge and produce high-amperage current output over an extended period. The capability of the battery to store electrical current comes from a chemical reaction between the sulfuric acid solution (electrolyte) and the lead +/-plates in each cell of the battery. As the battery discharges, the plates collect the acid from the electrolyte. When the charging system charges the battery, the acid is forced out of the plates into the electrolyte. The amount of acid (specific gravity) in the electrolyte can be measured with a hydrometer. A factory installed battery is equipped with a built-in hydrometer (test indicator) to assist in determining the batteries state-of-charge. The factory installed battery is also nonrefillable, water cannot be added. The battery is vented to release gases that are created when the battery is being charged. The battery top, posts, and terminals should be cleaned when other underhood maintenance is performed (Fig. 3).

WARNING: DO NOT ATTEMPT TO ASSIST BOOST, CHARGE, OR TEST BATTERY WHEN ELECTROLYTE LEVEL IS BELOW THE TOP OF THE PLATES (YELLOW OR BRIGHT COLOR DOT IS VISIBLE). PERSONAL INJURY MAY OCCUR.

When the electrolyte level is below the top of the plates (yellow or bright color indicator dot), the battery must be replaced. The battery must be com-

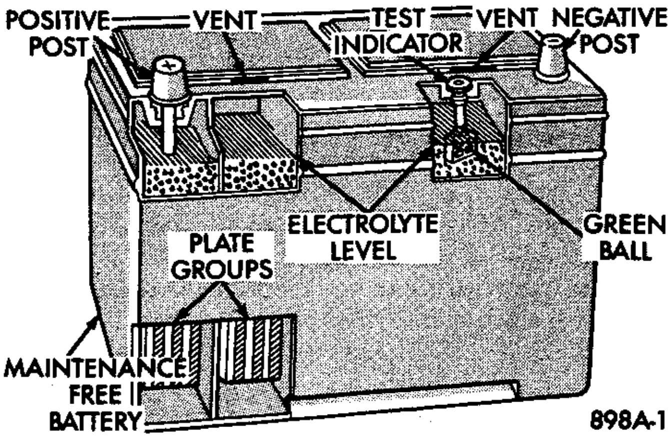

Fig. 3 Battery Construction and Test Indicator

pletely charged (green dot) and the top, posts, and terminals should be properly cleaned before diagnostic procedures are performed, see Group 8B - Battery/ Starter Service, for additional information.

TEST INDICATOR

A test indicator (hydrometer) built into the top of battery case, provides visual information for battery testing (Fig. 4). The test indicator is to be used with diagnostic procedures described in this group. It is important when using the test indicator that the battery is relatively level and has a clean top to see correct indications. A light may be required to view indicator.

WARNING: DO NOT USE OPEN FLAME. EXPLOSIVE GASES FORM ABOVE BATTERY.

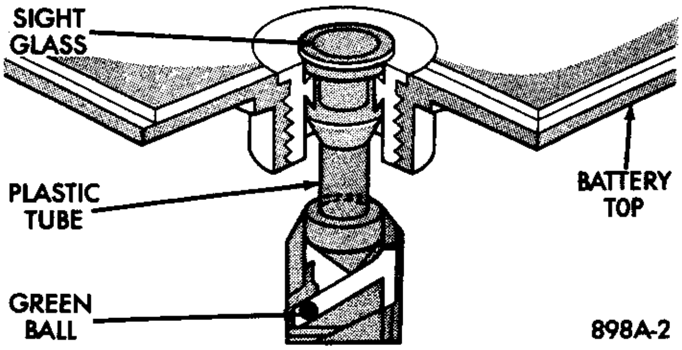

Fig. 4 Built in Test Indicator

STATE OF CHARGE TEST

USING TEST INDICATOR

The built-in test indicator (hydrometer) measures the specific gravity of the electrolyte. Specific gravity (SG) of the electrolyte will indicate state-of-charge (voltage); although, the test indicator will not indicate cranking capacity of the battery. Refer to Battery Load Test for more information. Look into the sight glass and note the color of the indicator (Fig. 5), refer to the following description as color indicates:

GREEN—75 to 100% state-of-charge

The battery is adequately charged for further testing or return to use. If the vehicle will not crank for a maximum 15 seconds, refer to Battery Load Test for more information.

BLACK OR DARK—0 to 75% state-of-charge

The battery is inadequately charged and must be charged until green dot is visible (12.4 volts or greater) before the battery is tested or returned to use, refer to Causes of Battery Discharging for more information.

YELLOW OR BRIGHT COLOR

WARNING: DO NOT ATTEMPT TO CHARGE, TEST, OR ASSIST BOOST BATTERY WHEN YELLOW OR BRIGHT COLOR DOT IS VISIBLE. PERSONAL INJURY MAY OCCUR.

A yellow or bright color dot indicates water (electrolyte) level in battery is below the test indicator (Fig. 5). Water can not be added to a maintenance free battery. The battery must be replaced. A low electrolyte level may be caused by an over charging condition. Refer to Alternator Test Procedures On Vehicle in this group.

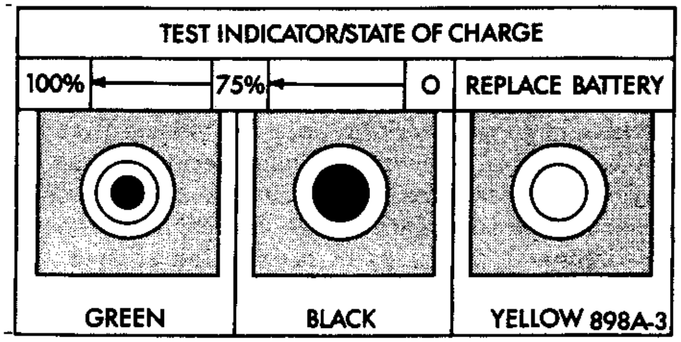

Fig. 5 Test Indicator Sight Glass

CAUSES OF BATTERY DISCHARGING

It is normal for a vehicle to have a small (5 to 30 milliamperes) continuous electrical draw from the battery with the ignition in the OFF position, and the courtesy, dome, storage compartments, and engine compartment lights OFF. The continuous draw is due to various electronic features or accessories that require electrical current with the ignition OFF to function properly. When a vehicle is not used over an extended period (20 days) the main fusible link connector (Fig. 6), located behind the battery on the engine wiring harness, should be disconnected. This will prevent battery discharging.

ABNORMAL BATTERY DISCHARGING

(1) Corroded battery posts and terminals.

(2) Loose or worn alternator drive belt.

(3) Electrical loads that exceed the output of the charging system due to equipment or accessories installed after delivery.

(4) Slow driving speeds (heavy traffic conditions) or prolonged idling with high-amperage electrical systems in use.

(5) Defective electrical circuit or component causing excess Ignition Off Draw (IOD).

(6) Defective charging system.

(7) Defective battery.

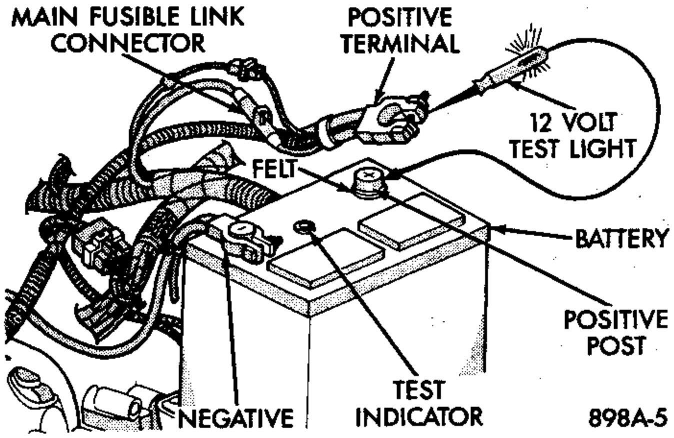

Fig. 6 High Amperage IOD Test

IGNITION OFF DRAW (IOD)

A normal vehicle electrical system will draw 5 to 30 milliamperes from the battery, with the ignition in the OFF position and all nonignition controlled circuits in proper working order. A vehicle that has not been operated for an extended period of time (20 days) may discharge the battery to an inadequate level. In this case, main fusible link connector should be disconnected. The main fusible link connector is located rearward of the battery on the engine wiring harness (Fig. 6). If the IOD is excessive (over 30 milliamperes), the defect must be found and corrected.

IGNITION OFF DRAW TESTS

To test for excessive IOD, verify that all electrical accessories are OFF. Turn off all lights, remove ignition key, and close all doors and decklid. If the vehicle is equipped with electronic accessories (illuminated entry, automatic load leveler, body computer, or high line radio), allow the systems to automatically shut off (time out), up to 3 minutes.

(1) Raise the hood and disconnect both battery cables, negative first.

(2) Connect the negative cable and connect a typical 12-volt test light (low wattage bulb) between the positive cable clamp and the battery positive post (Fig. 6). Remove the engine compartment lamp bulb. If the test light does not light, proceed to step 3. If the test light does light, proceed to step 4. The test light will indicate IOD greater than 3 amps.

CAUTION: IOD greater than 3 amps may damage milliampmeter.

(3) With 12-volt test light still connected (not lit, see step 2), connect an ammeter (milliampere scale) between the positive cable clamp and the battery positive post (Fig. 7), disconnect test light, refer to instructions provided with ammeter being used. A reading of 30 milliamperes or less indicates normal electrical draw. If ammeter reads more than 30 milliamperes, excessive IOD must be corrected.

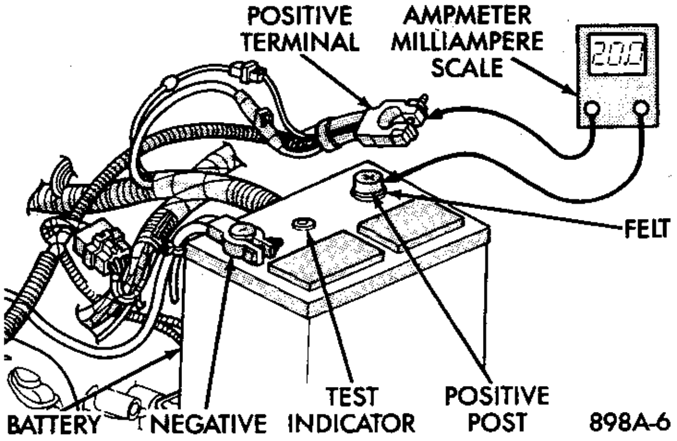

Fig. 7 Low Amperage IOD Test

(4) Locate the fuse panel and remove fuses or circuit breakers one at a time, if test light goes out and the reading drops below 30 milliamperes when a certain fuse or circuit breaker is removed, that circuit may have a defect. Refer to Group 8W - Wiring Diagrams, for component and splice locations.

(5) If IOD is detected after all fuses and circuit breakers have been removed, disconnect the 60-way connector at the Single Board Engine Control (SBEC), located outboard of the battery, see Group 8D - Ignition, for more information.

(6) If excessive IOD is detected after all fused circuits and SBEC have been verified, disconnect the B+ terminal from the alternator. If reading drops below 30 milliamperes, reinstall all fuses and circuit breakers, reconnect B+ terminal at alternator, reconnect battery, and perform alternator diagnostics as outlined in this group.

(7) Install engine compartment lamp bulb.

OPEN CIRCUIT VOLTAGE TEST

An open circuit voltage (no load) test will indicate the state of charge in a battery that will endure (pass) a load test of 50%cold crank rating, see Battery Load Test in this section. If a battery has an open circuit voltage reading of 12.4 volts or greater and will not endure a load test, it is defective and replacement would be required, see Group 8B - Battery/Starter Service for instructions. To test open circuit voltage, perform the following operation:

(1) Remove both battery cables, negative first. If the battery has been boosted, charged, or loaded just prior to this operation, allow the battery time to stabilize.

(2) Using a voltmeter connected to the battery posts, see instructions provided with voltmeter being used, measure open circuit voltage (Fig. 8).

This voltage reading will indicate state of charge, but will not reveal cranking capacity. Refer to Battery Open Circuit Voltage chart.

BATTERY OPEN CIRCUIT VOLTAGE	
Open Circuit Volts	**Percent Charge**
11.7 volts or less	0%
12.0	25%
12.2	50%
12.4	75%
12.6 or more	100%

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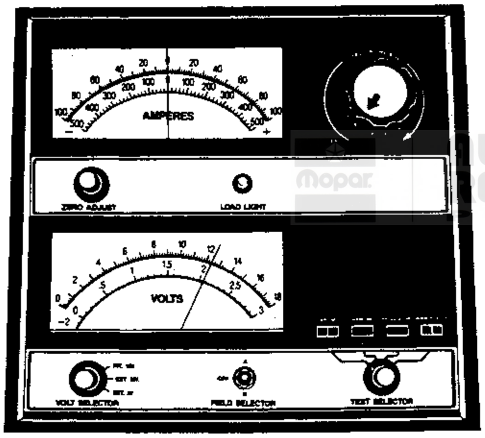

Fig. 8 Testing Open Circuit Voltage

BATTERY LOAD TEST

A battery must have the cranking capacity to supply the starter motor and ignition system enough power to start the engine over a broad range of ambient temperatures. A battery load test will verify the actual cranking performance based on the cold crank rating of the battery.

WARNING: IF BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR EXCESSIVELY LOW ELECTROLYTE LEVEL, DO NOT TEST. ACID BURNS OR EXPLOSIVE CONDITION MAY RESULT.

(1) Remove both battery cables, negative first. Battery top and posts should be clean. If green dot is not visible in indicator, charge the battery, see Battery Charging Procedures in this section.

(2) Using a suitable Volt-Ammeter-Load tester (Fig. 9) connected to the battery posts (Fig. 10), refer to operating instructions provided with the tester being used, check the open circuit voltage (no load) of the battery. Voltage should be equal to or greater than 12.4 volts (Fig. 9) with green dot visible in test indicator.

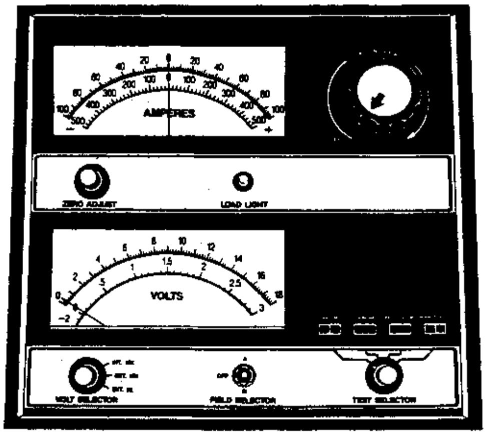

Fig. 9 Volt-Amps-Load Tester (Typical)

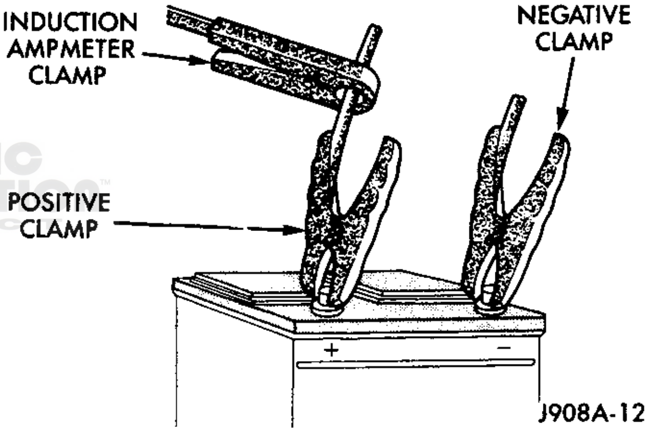

Fig. 10 Volt-Ammeter-Load Tester Connections

(3) Rotate the load control knob (Carbon pile rheostat) to apply a 300 amp load for 15 seconds to remove the surface charge from the battery and return the control knob to off (Fig. 11).

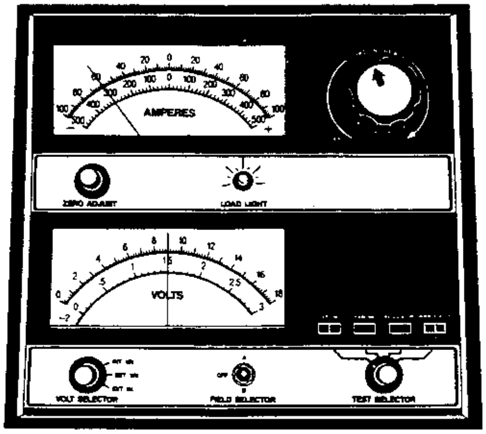

Fig. 11 Remove Surface Charge from Battery

(4) Allow the battery to stabilize for 15 seconds, verify open circuit voltage.

(5) Rotate the load control knob to maintain a load (50% of cold crank rating—see specifications) for a minimum 15 seconds (Fig. 12). After 15 seconds, record the (loaded) voltage reading and return the load control to off.

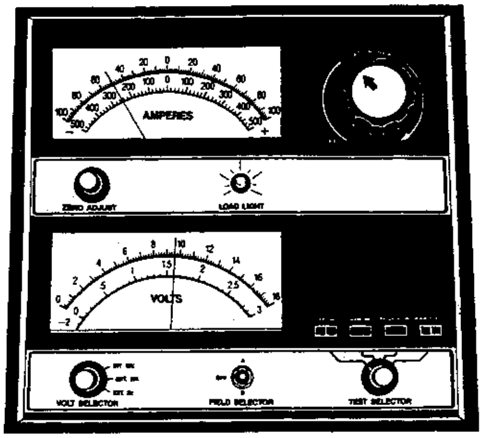

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Fig. 12 Load 50% Cold Crank Rating Note Voltage

(6) Voltage drop will vary according to battery temperature at the time of the load test. Battery temperature can be estimated by the temperature of exposure over the preceding several hours. If the battery has been charged, boosted, or loaded a few minutes prior to test, the battery would be somewhat warmer. Refer to Load Test Temperature chart for proper loaded voltage reading.

(7) If battery passes load test, it is in good condition. No further tests are necessary. If it fails load test, it should be replaced.

LOAD TEST TEMPERATURE		
Minimum Voltage	Temperature	
	F°	C°
9.6	70 and above	21 and above
9.5	60	16
9.4	50	10
9.3	40	4
9.1	30	-1
8.9	20	-7
8.7	10	-12
8.5	0	-18

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CHARGING BATTERY

A battery charged to 12.4 volts or greater, with sufficient cranking capacity (minimum 9.6 volts when loaded for 15 seconds to 50% of cold cranking amperage rating at 21°C/70°F), is completely charged. A green dot, visible in the test indicator built-in to the top of the battery, indicates it is charged enough for further testing and possibly returned to use. A black dot indicates the battery voltage is below 12.4 volts and probably will accept a charge. A yellow or bright color dot indicates the battery has excessively low electrolyte level. The battery cannot be refilled or charged, it must be replaced.

WARNING: DO NOT CHARGE A BATTERY THAT HAS EXCESSIVELY LOW ELECTROLYTE LEVEL. BATTERY MAY ARC INTERNALLY AND EXPLODE.

WARNING: EXPLOSIVE GASES FORM OVER BATTERY, DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR BATTERY.

WARNING: DO NOT ASSIST BOOST OR CHARGE A FROZEN BATTERY, CASING MAY FRACTURE.

WARNING: POISON, CAUSES SEVERE BURNS. BATTERY CONTAINS SULFURIC ACID, AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. IN EVENT OF CONTACT, FLUSH WITH WATER AND CALL PHYSICIAN IMMEDIATELY. KEEP OUT OF REACH OF CHILDREN.

CAUTION: Disconnect the vehicle's battery negative cable before charging battery to avoid damage to electrical systems. Do not exceed 16.0 volts while charging battery.

Battery electrolyte will bubble inside of case while being charged properly. If the electrolyte boils violently or is discharged from the vent holes while charging, immediately reduce charging rate or turn off charger and evaluate battery condition.

Some battery chargers are equipped with polarity (+ to +/- to -) sensing devices to protect the charger or battery from being damaged if improperly connected. If the battery state of charge is too low for the polarity sensor to detect, the sensor must be bypassed for charger to operate. Refer to operating instructions provided with battery charger being used.

CAUTION: Charge battery until test indicator appears green. Do not overcharge.

It may be necessary to jostle the battery or vehicle to bring the green dot into view in the test indicator when the state-of-charge has reached 12.4 volts.

After the battery has been charged to 12.4 volts or greater, perform a load test to determine cranking capacity. If the battery will endure a load test, return the battery to use. If battery will not endure a load test, it must be replaced. Properly clean and in-

BATTERY CHARGING TIME TABLE				
Charging Amperage	5 Amps	10 Amps	20 Amps	30 Amps
Open Circuit Voltage	Hours Charging at 21°C (70°F)			
12.25 to 12.39	6 Hrs	3 Hrs.	1.5 Hrs.	1 Hr.
12.00 to 12.24	8 Hrs.	4 Hrs.	2 Hrs.	1.5 Hrs.
11.95 to 12.09	12 Hrs.	6 Hrs.	3 Hrs.	2 Hrs.
10.00 to 11.95	14 Hrs.	4 Hrs.	3.5 Hrs.	2.5 Hrs.
10.00 to 0	See Charging Completely Discharged Battery			

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spect battery hold downs, tray, terminals, posts, and top before completing service, see Group 8B, Battery/Starter Service.

CHARGING TIME REQUIRED

The time required to charge a battery will vary depending upon the following factors:

(1) **Size of Battery**— A completely discharged large heavy-duty battery requires more than twice the recharging time as a completely discharged small capacity battery.

WARNING: NEVER EXCEED 20 AMPS WHEN CHARGING A COLD (-1°C/30°F) BATTERY, PERSONAL INJURY MAY RESULT.

(2) **Temperature**— A longer time will be needed to charge a battery at -18°C (0°F) than at 27°C (80°F). When a fast charger is connected to a cold battery, current accepted by battery will be very low at first. Then, in time, the battery will accept a higher rate as battery warms.

(3) **Charger Capacity**— A charger, which can supply only 5 amperes, will require a much longer period of charging than a charger that can supply 30 amperes or more.

(4) **State Of Charge**— A completely discharged battery requires more charging time than a partially charged battery. Electrolyte is nearly pure water in a completely discharged battery. At first the charging current amperage will be low. As acid is forced from the plates, inside the battery, the current amperate will rise. Also, the specific gravity of the electrolyte will rise, bringing the green dot into view.

CHARGING COMPLETELY DISCHARGED BATTERY

The following procedure should be used to recharge a completely discharged battery. Unless procedure is properly followed, a good battery may be needlessly replaced.

(1) Measure voltage at battery posts with a voltmeter, accurate to 1/10 volt (Fig. 13). If below 10 volts, then charge current will be low and it could take some time before it accepts a current in excess of a few milliamperes. Such low current may not be detectable on amperemeters built into many chargers.

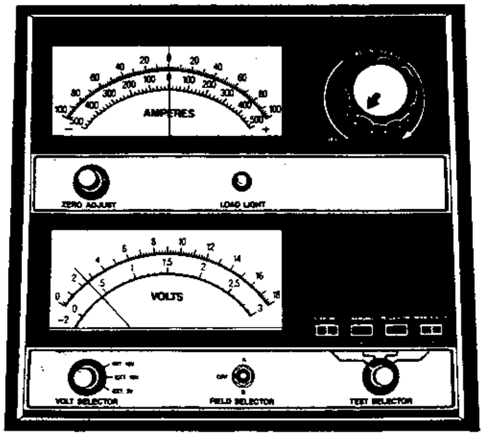

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Fig. 13 Voltmeter Accurate to 1/10 Volt Connected

(2) Connect charger leads. Some chargers feature polarity protection circuitry which prevents operation unless charger is connected to battery posts correctly. A completely discharged battery may not have enough voltage to activate this circuitry, even though leads are connected properly, making it appear that battery will not accept charging current. Refer to instructions provided with battery charger being used.

(3) Battery chargers vary in the amount of voltage and current they provide. For time required for battery to accept measurable charger current at various voltages, refer to Charge Rate chart. If charge current is still not measurable at end of charging times, the battery should be replaced. If charge current is measurable during charging time, the battery may be good and charging should be completed in the normal manner.

CHARGE RATE	
Voltage	Hours
16.0 volts or more	up to 4 hrs.
14.0 to 15.9 volts	up to 8 hrs.
13.9 volts or less	up to 16 hrs.

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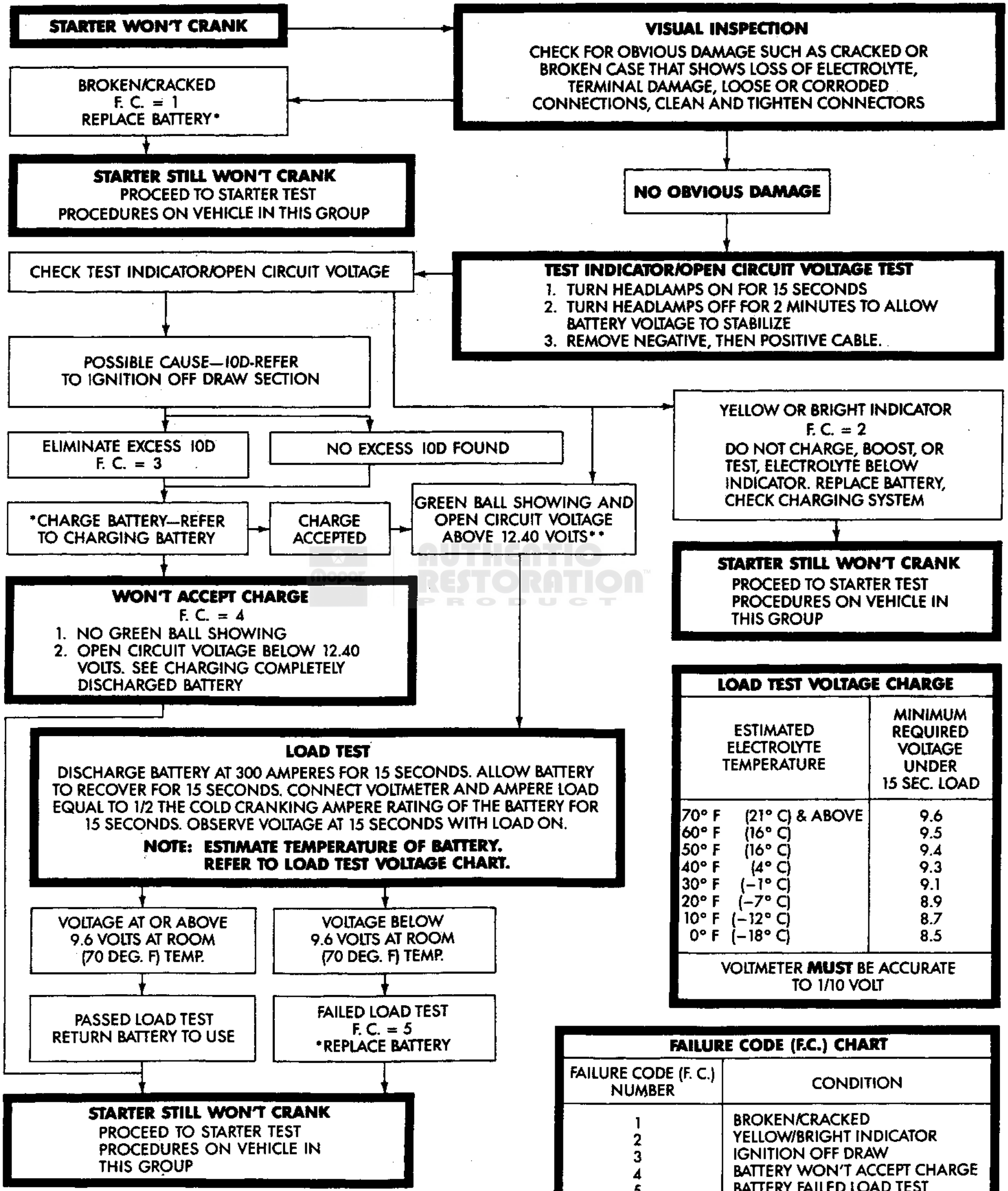
BATTERY DIAGNOSTICS CHART



LOAD TEST VOLTAGE CHARGE

ESTIMATED ELECTROLYTE TEMPERATURE	MINIMUM REQUIRED VOLTAGE UNDER 15 SEC. LOAD
70° F (21° C) & ABOVE	9.6
60° F (16° C)	9.5
50° F (16° C)	9.4
40° F (4° C)	9.3
30° F (−1° C)	9.1
20° F (−7° C)	8.9
10° F (−12° C)	8.7
0° F (−18° C)	8.5

VOLTMETER **MUST** BE ACCURATE TO 1/10 VOLT

FAILURE CODE (F.C.) CHART

FAILURE CODE (F. C.) NUMBER	CONDITION
1	BROKEN/CRACKED
2	YELLOW/BRIGHT INDICATOR
3	IGNITION OFF DRAW
4	BATTERY WON'T ACCEPT CHARGE
5	BATTERY FAILED LOAD TEST

NOTES: *AFTER CHARGING OR REPLACING A BATTERY, CHECK THE VEHICLE'S CHARGING SYSTEM, AND CLEAN AND TIGHTEN BATTERY CONNECTORS (REFER TO APPLICABLE SECTIONS OF THIS SERVICE MANUAL).

****CHECKING OPEN CIRCUIT VOLTAGE WILL MONITOR "GREEN BALL" INDICATION FOR ALL 6 CELLS.**

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STARTER TEST PROCEDURES ON VEHICLE

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Diagnostic Preparation	9
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Starter Control Circuit Tests	12
Starter Feed Circuit Tests	9

GENERAL INFORMATION

The starting system on Dodge Trucks consists of an ignition switch, starter relay, neutral safety switch (automatic transmission), wiring harness, battery, and starter motor with an integral solenoid. These components form 2 separate circuits. A high amperage circuit that feeds the starter motor up to 300+ amps, and a control circuit that operates on less than 20 amps (Fig. 1).

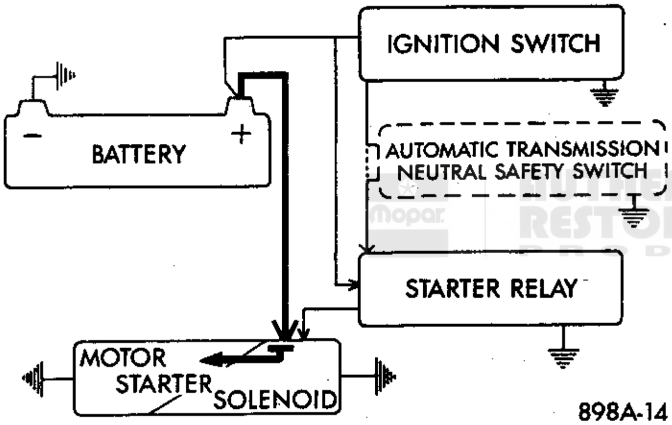

Fig. 1 Starting System Components

DIAGNOSTIC PREPARATION

Before proceeding with starting system diagnostics, verify the following conditions:

(1) Battery top, posts, and terminals are clean.

(2) Alternator drive belt tension and condition.

(3) Battery state-of charge.

(4) Battery will endure load test.

(5) Battery cable (+/-) connections at the starter motor and engine block and their condition.

(6) Wiring harness connector and terminal condition.

(7) Properly grounded.

STARTER FEED CIRCUIT TESTS

The following procedure will require a suitable volt-ampere tester (Fig. 2) and a jumper wire.

(1) Connect a suitable volt-ampere tester (Fig. 2) to the battery terminals (Fig. 3), refer to the operating instructions provided with the tester being used.

(2) Disconnect the distributor connector.

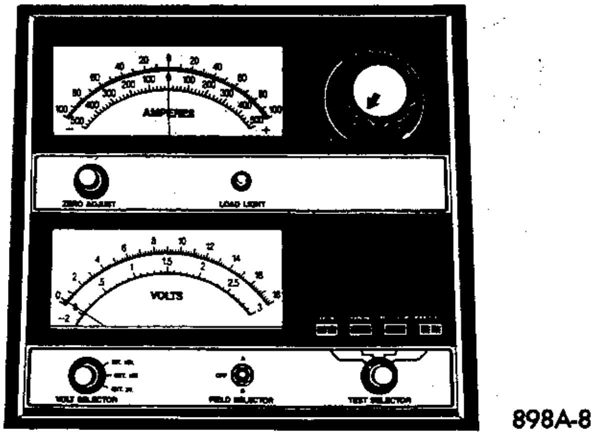

Fig. 2 Volt-Amps Tester (Typical)

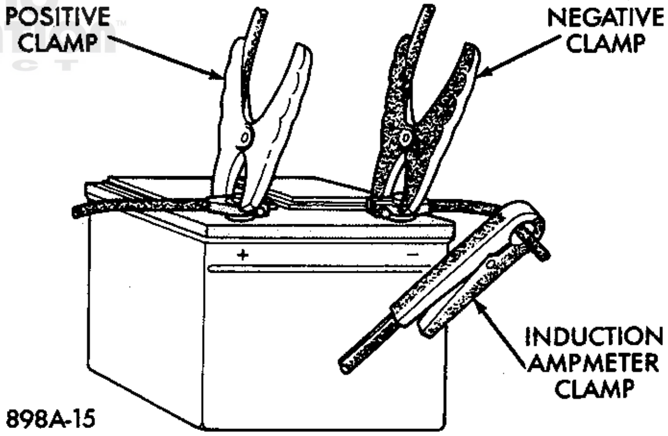

Fig. 3 Volt-Amps Tester Connections (Typical)

(3) Verify that all lights and accessories are OFF and the transmission shift selector is in PARK (automatic) or NEUTRAL (manual) and set parking brake or equivalent.

(4) Rotate and hold the ignition switch (key) in the START position. Observe the volt-amps tester (Fig. 4).

(a) If voltage reads above 9.6 volts and amperage draw reads above 250 amps, proceed to starter feed circuit resistance test.

(b) If voltage reads 12.4 volts or greater and amperage reads 0 to 10 amps, proceed to starter control circuit test.

CAUTION: Do not overheat the starter motor or draw the battery voltage below 9.6 volts during cranking operations.

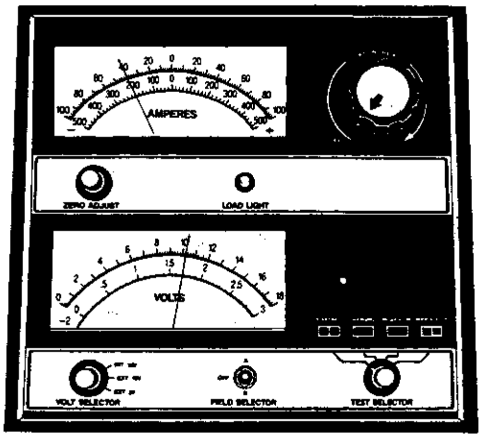

Fig. 4 Starter Draw Tests

(c) If the starter motor cranks the engine freely at times, but a problem with the starting system is still suspected, engage the starter several times while observing the volt-ampere tester. A starting system that has a problem should fail while performing this procedure.

(5) After starting system problems have been corrected, verify the battery state-of-charge (charge battery if necessary). Disconnect all testing equipment and jumper wires and connect distributor. Start the vehicle several times to assure the problem has been corrected.

STARTER FEED CIRCUIT RESISTANCE TEST

Before proceeding with this operation, review Diagnostic Preparation and Starter Feed Circuit Tests. The following operation will require a voltmeter, accurate to 1/10 of a volt.

(1) Disconnect the distributor cap and connector.

(2) With all wiring harness and components connected properly, perform the following:

(a) Connect positive lead of the voltmeter to the battery negative post, and negative lead to the battery negative cable clamp (Fig. 5). Rotate and hold the ignition switch (key) in the START position. Observe the voltmeter. If voltage is detected, correct poor contact between the cable clamp and post.

(b) Connect positive lead of voltmeter to the battery positive post, and negative lead to the battery cable positive clamp (Fig. 5). Rotate and hold the ignition switch (key) in the START position. Observe the voltmeter. If voltage is detected, correct poor contact between the cable clamp and post.

(c) Connect positive lead of voltmeter to battery negative terminal, and negative lead to engine block near the battery cable attaching point (Fig. 6).

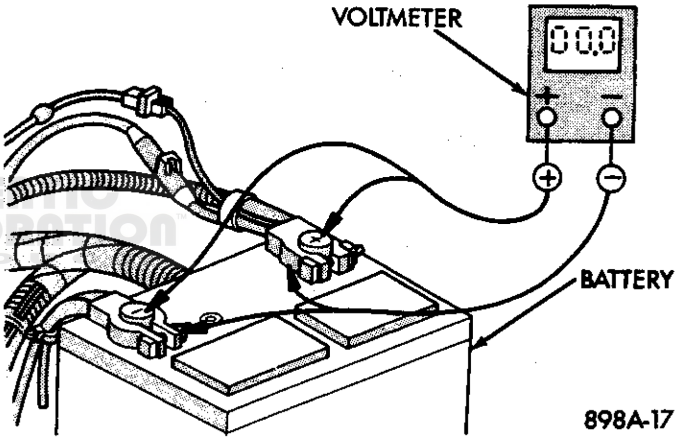

Fig. 5 Test Battery Connection Resistance

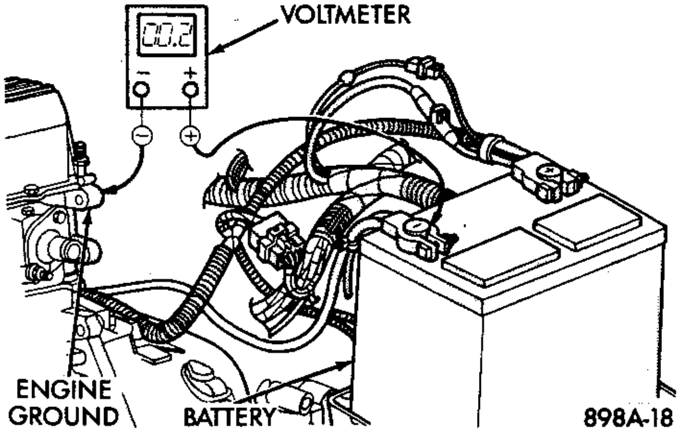

Fig. 6 Test Ground Circuit Resistance

STARTING SYSTEM DIAGNOSTICS

TEST CONDITIONS

- PLACE GEAR SELECTOR IN PARK OR NEUTRAL AND SET PARK BRAKE OR EQUIVALENT.
- VARIFY BATTERY STATE-OF-CHARGE AND CRANKING CAPACITY, SEE BATTERY SECTION.
- CLEAN BATTERY TOP, POSTS, AND TERMINALS.
- VARIFY ALTERNATOR DRIVE BELT TENSION.
- DISCONNECT AND GROUND COIL CABLE.

SYMPTOM	**SYMPTOM**	**SYMPTOM**	**SYMPTOM**	**SYMPTOM**
STARTER FAILS TO ENGAGE. NO SOUNDS	STARTER FAILS TO ENGAGE. SOLENOID OR RELAY CLICKS	STARTER ENGAGES, FAILS TO TURN ENGINE. DOME LIGHT DIMS	STARTER ENGAGES DRIVE CLUTCH SPINS OUT	STARTER DOES NOT DISENGAGE AFTER ENGINE STARTS
POSSIBLE CAUSE	**POSSIBLE CAUSE**	**POSSIBLE CAUSE**	**POSSIBLE CAUSE**	**POSSIBLE CAUSE**
STARTER CONTROL CIRCUIT FAULTY. SEE GROUP 8W, WIRING DIAGRAMS IGNITION SWITCH MISADJUSTED OR FAULTY NEUTRAL SAFETY SWITCH (AUTO TRANS.) FAULTY OR MISADJUSTED GEAR SELECTOR PRNDL SWITCH (A-604 TRANS.) FAULTY STARTER RELAY FAULTY STARTER ASSEMBLY FAULTY	RESISTANCE TO HIGH IN STARTER FEED CIRCUIT STARTER CONTROL CIRCUIT FAULTY SEE GROUP 8W, WIRING DIAGRAMS STARTER RELAY FAULTY STARTER ASSEMBLY FAULTY	RESISTANCE TO HIGH IN STARTER FEED CIRCUIT STARTER RELAY FAULTY STARTER ASSEMBLY FAULTY	DRIVE CLUTCH FAULTY BROKEN TEETH ON RING GEAR STARTER ASSEMBLY FAULTY	IGNITION SWITCH MISADJUSTED IGNITION SWITCH FAULTY STARTER RELAY FAULTY STARTER ASSEMBLY FAULTY

- CONNECT COIL CABLE
- REFER TO APPROPRIATE GROUP AND SECTION OF THIS MANUAL FOR PROPER SERVICE AND TEST PROCEDURES FOR THE COMPONENTS INVOLVED

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(3) Rotate and hold the ignition switch (key) in the START position. If voltage reads above 0.2 volt, correct poor contact at ground cable attaching point. Voltage reading still above 0.2 volt, replace ground cable.

(4) Remove starter heat shield (if equipped) to gain access to the starter motor and solenoid connections, perform the following:

(a) Connect positive voltmeter lead to the starter motor housing and the negative lead to the battery negative terminal (Fig. 7). Rotate and hold the ignition switch (key) in the START position. If voltage reads above 0.2 volt, correct poor starter to engine ground.

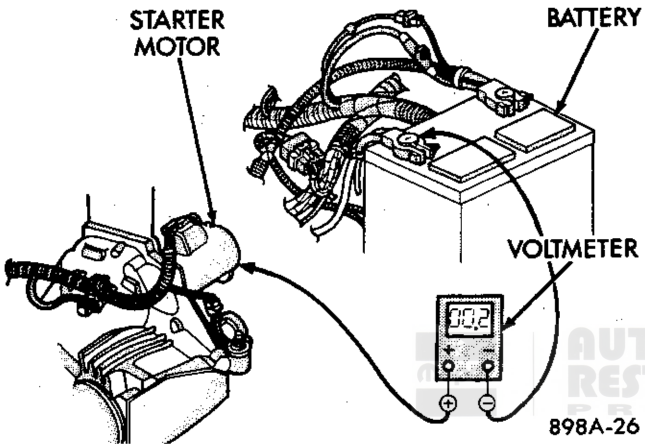

Fig. 7 Test Starter Motor Ground (Typical)

(b) Connect positive voltmeter lead to positive battery terminal and negative lead to battery cable terminal on starter solenoid (Fig. 8). Rotate and hold the ignition switch (key) in the START position. If voltage reads above 0.2 volt, correct poor contact at battery cable to solenoid connection. If reading is still above 0.2 volt, replace positive battery cable.

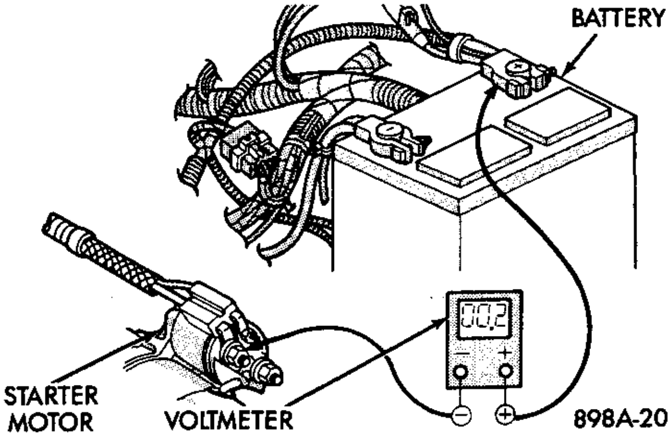

Fig. 8 Test Positive Battery Cable Resistance (Typical)

If resistance tests detect no feed circuit failures, remove the starter motor and proceed to Bench Testing Starter Solenoid.

STARTER CONTROL CIRCUIT TESTS

The starter control circuit consists of a starter solenoid, starter relay, ignition switch, safety neutral switch (automatic transmission), and all their wiring and connections.

Testing procedures for these components are as follows and should be followed in order as described.

CAUTION: Before performing any test disconnect distributor connector to prevent engine from starting.

STARTER SOLENOID TEST

Connect a heavy jumper wire on starter relay between battery (1) and solenoid (3) terminals (Fig. 9). If engine cranks starter solenoid is good. Proceed to starter relay test.

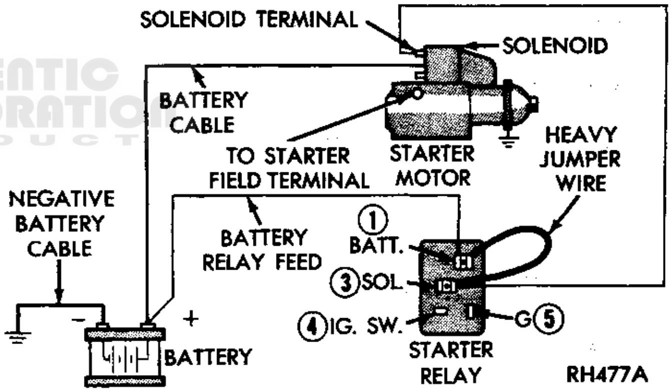

Fig. 9 Starter Solenoid Test

If the engine does not crank or the solenoid chatters, check wiring and connectors from relay to starter for loose or corroded connections, particularly at starter terminals. Repeat test and if engine still fails to crank properly trouble is within starter and it must be removed for repairs.

STARTER RELAY TEST

(1) Position gear selector in neutral (manual) or park (automatic) position.

(2) Set park brake.

(3) Do not remove relay connector.

(4) Check for battery voltage between starter relay battery (1) terminal and ground with a test lamp.

(5) Connect a jumper wire on the starter relay between battery and (1) ignition (4) terminals (Fig. 10). If engine cranks starter relay is good.

(6) If engine does not crank connect a second jumper wire to starter relay between ground terminal and to a good ground (5) (Fig. 11). Repeat test

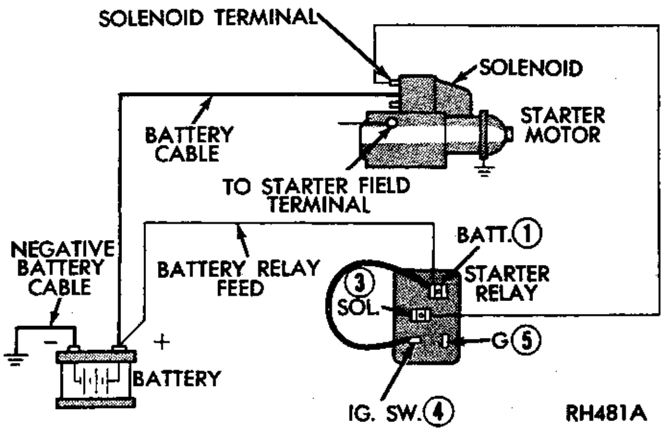

Fig. 10 Relay Test with One Jumper Wire

and if engine cranks starter relay is good, however, transmission linkage is out of adjustment or safety neutral switch is defective. If engine does not crank starter relay is defective and must be replaced.

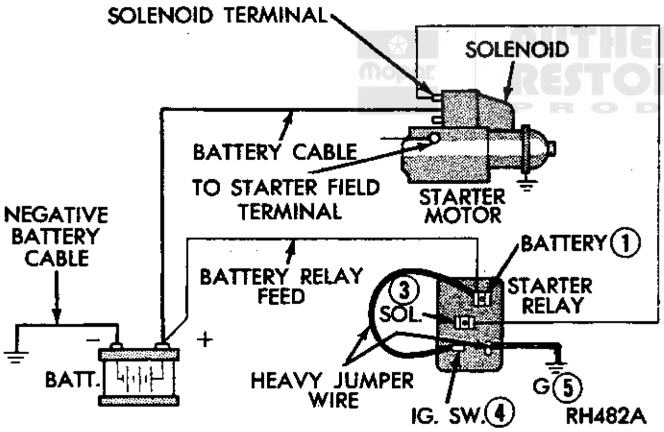

Fig. 11 Relay Test with Two Jumper Wires

IGNITION SWITCH TEST

After testing starter solenoid and relay and they check out okay, trouble is probably with ignition switch or its wiring.

Check all wiring for opens and shorts and connections for being loose or corroded.

BENCH TESTING STARTER SOLENOID

Refer to Group 8B - Battery Starter Service for starter removal procedures.

(1) Disconnect field coil wire from field coil terminal (Fig. 12).

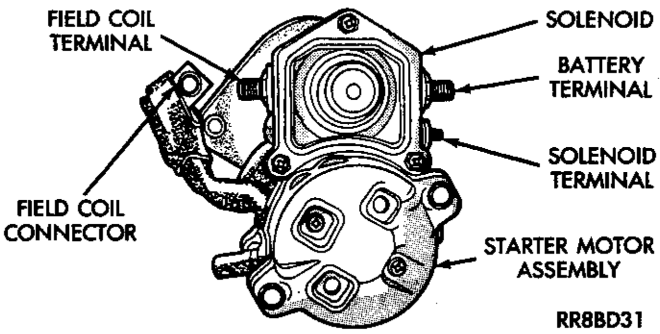

Fig. 12 Field Coil Wire Terminal

(2) Check for continuity between solenoid terminal and field coil terminal with a continuity tester. There should be continuity (Fig. 13).

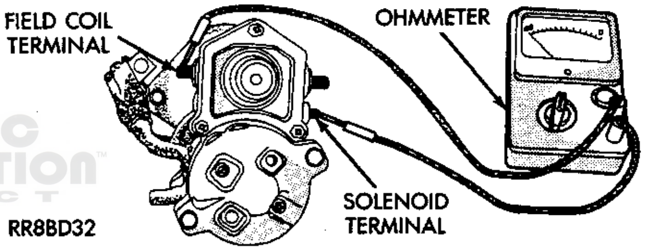

Fig. 13 Continuity Test Between Solenoid Terminal and Field Coil Terminal

(3) Check for continuity between solenoid terminal and solenoid housing. There should be continuity (Fig. 14).

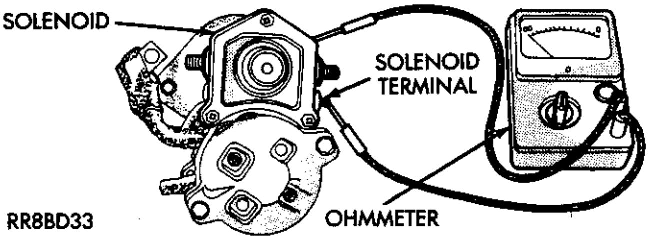

Fig. 14 Continuity Test Between Solenoid Terminal and Solenoid Case

(4) If there is continuity solenoid is good. If there is no continuity in either test solenoid has an open circuit and is defective. Replace solenoid assembly.

(5) Install starter as described in Group 8B - Battery Starter Service.

(6) Connect field coil wire to field coil terminal (Fig. 12).

ALTERNATOR TEST PROCEDURES ON VEHICLE

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Current Output Test 15
Page
How To Use Check Engine Lamp For Fault Codes 18
Using On-Board Diagnostic System 16

ALTERNATOR OUTPUT WIRE RESISTANCE TEST (FIG. 1)

Alternator output wire resistance test will show amount of Voltage Drop across alternator output wire between alternator BAT terminal and battery positive post.

PREPARATION

(1) Before starting test make sure vehicle has a fully charged battery. Test and procedures on how to check for a fully charged battery are shown in Battery section of this Group.

(2) Turn OFF ignition switch.

(3) Disconnect battery negative cable.

(4) Disconnect alternator output wire from alternator output Battery terminal.

(5) Connect a 0-150 ampere scale D.C. ammeter in series between alternator BAT terminal and disconnected alternator output wire. Connect Positive lead to alternator BAT terminal and Negative lead to disconnected alternator output wire.

(6) Connect Positive lead of a test voltmeter (Range 0-18 volts minimum) to disconnected alternator output wire. Connect negative lead of test voltmeter to battery positive cable at positive post.

(7) Remove air hose between Engine Controller and air cleaner.

(8) Connect one end of a Jumper Wire to ground and with other end probe green R3 lead wire at back of alternator (Fig. 1). (This will generate a fault code).

CAUTION: Do not connect blue J2 lead of wiring to ground. Refer to Group 8W - Wiring Diagrams for more information.

(9) Connect an engine tachometer and connect battery negative cable.

(10) Connect a variable carbon pile rheostat (C3950) between battery terminals. Be sure carbon pile is in "Open" or "Off" position before connecting leads. See Battery Section, Load Testing for instructions.

TEST

(1) Start engine. Immediately after starting, reduce engine speed to idle.

(2) Adjust engine speed and carbon pile to maintain 20 amperes flowing in circuit. Observe voltmeter reading. Voltmeter reading should not exceed 0.5 volts.

RESULTS

If a higher voltage drop is indicated, inspect, clean and tighten all connections between alternator BAT terminal and battery Positive post. A voltage drop test may be performed at each connection to locate connection with excessive resistance. If resistance tested satisfactorily, reduce engine speed, turn off carbon pile and turn off ignition switch.

(1) Disconnect battery negative cable.

(2) Remove test ammeter, voltmeter, carbon pile, and tachometer.

(3) Remove "Jumper Wire".

(4) Connect alternator output wire to alternator BAT terminal post. Tighten to 5 to 6 N•m (45 to 75 in. lbs.).

(5) Connect battery negative cable.

(6) Connect hose between Engine Controller and air cleaner.

(7) Use DRB II to erase fault code.

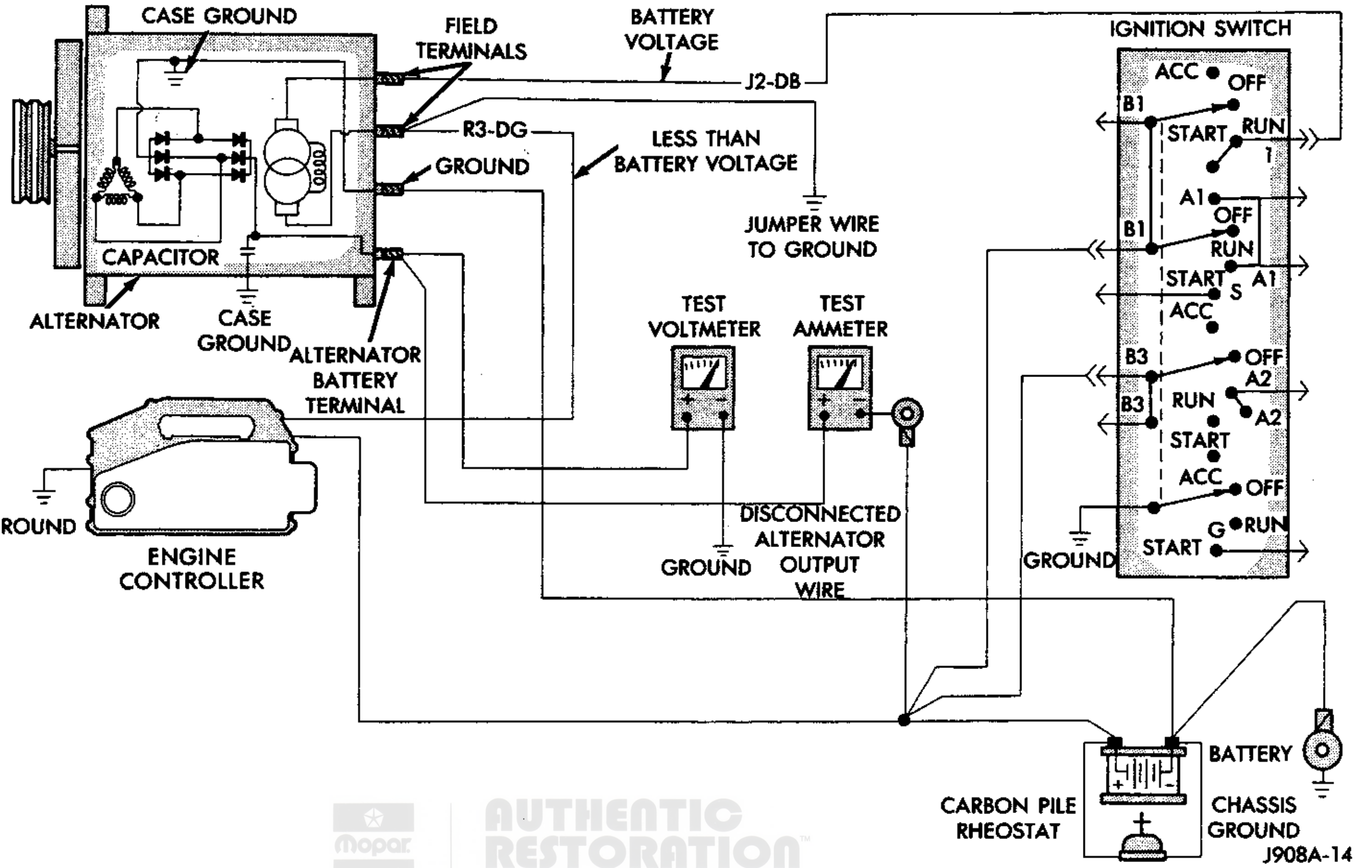


Fig. 1 Alternator Output Wire Resistance Test (Typical)

CURRENT OUTPUT TEST

Current output test determines whether or not alternator is capable of delivering its rated current output.

PREPARATION

(1) Before starting any tests make sure vehicle has a fully charged battery. Test and procedures on how to check for a fully charged battery are shown in Battery section of this Group.

(2) Disconnect battery negative cable.

(3) Disconnect alternator output wire at the alternator battery terminal.

(4) Connect a 0-150 ampere scale D.C. ammeter in series between alternator BAT terminal and disconnected alternator output wire (Fig. 2). Connect Positive lead to alternator BAT terminal and negative lead to disconnected alternator output wire.

(5) Connect positive lead of a test voltmeter (range 0-18 volts minimum) to alternator BAT terminal.

(6) Connect negative lead of test voltmeter to a good ground.

(7) Connect an engine tachometer and reconnect battery negative cable.

(8) Connect a variable carbon pile rheostat (C3950) between battery terminals. Be sure carbon pile is in Open or Off position before connecting leads. See Battery section, Load Testing for instructions.

(9) Remove air hose between Engine Controller and air cleaner.

(10) Connect one end of a Jumper Wire to ground and with other and probe green R3 lead wire at back of alternator (Fig. 2). (This will generate a fault code).

CAUTION: Do not connect blue J2 lead of wiring to ground. Refer to Group 8W - Wiring Diagrams for more information.

TEST

(1) Start engine. Immediately after starting reduce engine speed to idle.

(2) Adjust carbon pile and engine speed in increments until a speed of 1250 rpm and voltmeter reading of 15 volts is obtained.

CAUTION: Do not allow voltage meter to read above 16 volts.

(3) The ammeter reading must be within limits shown in alternator specifications in back of this group for that size of alternator being tested.

RESULTS

(1) If reading is less than specified and alternator output wire resistance is not excessive, the alternator should be replaced see, Group 8C - Alternator Service for information.

(2) After current output test is completed reduce engine speed, turn off carbon pile and turn off ignition switch.

(3) Disconnect battery negative cable.

(4) Remove test ammeter, voltmeter, tachometer and carbon pile.

(5) Remove Jumper Wire (Fig. 2).

(6) Connect alternator output wire to alternator BAT terminal post. Tighten nut to 5-6 N•m (45-75 in. lbs.).

(7) Connect battery negative cable.

(8) Connect air hose between Engine Controller and air cleaner.

(9) Use DRB II to erase fault code.

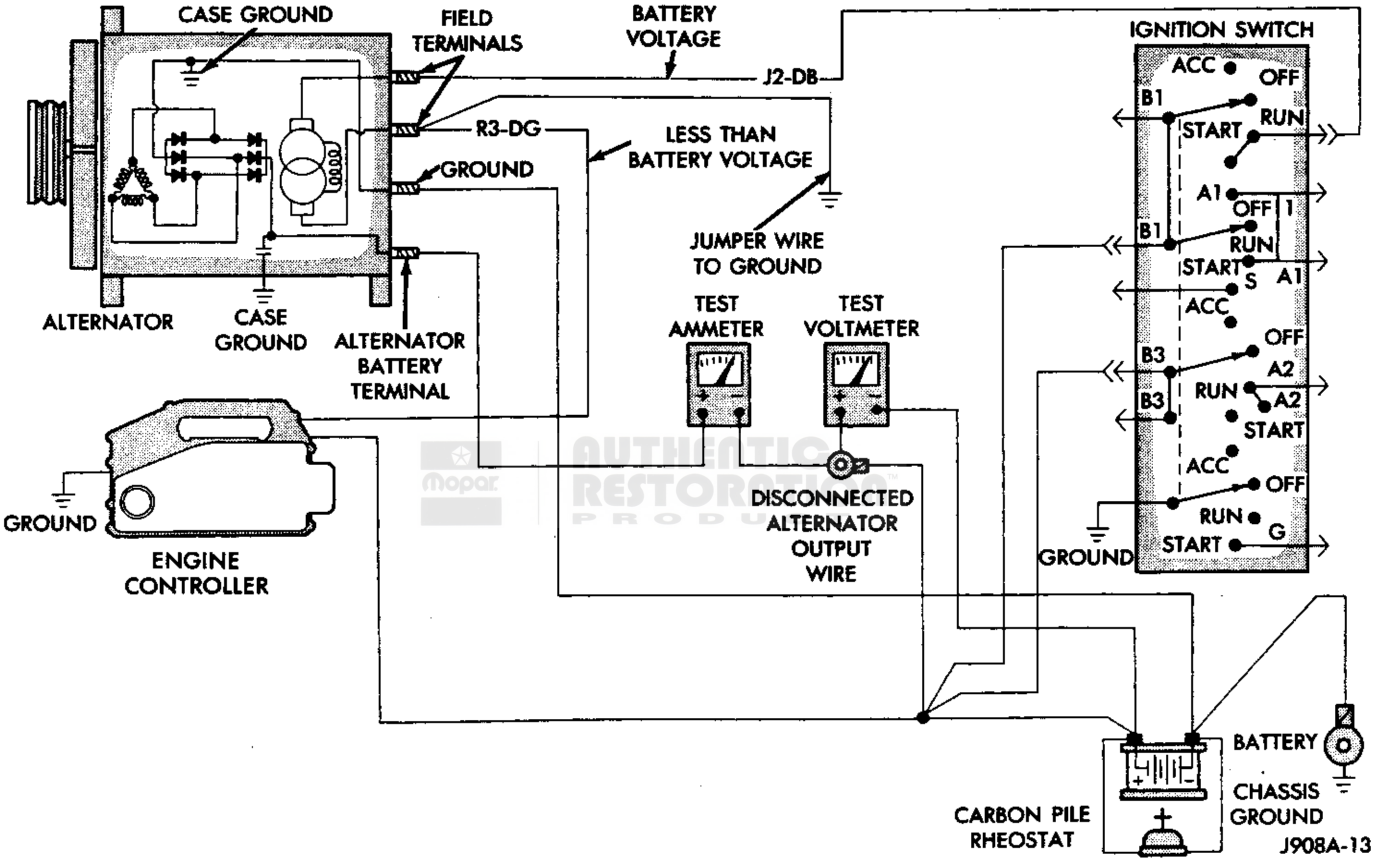


Fig. 2 Alternator Current Output Test (Typical)

USING ON-BOARD DIAGNOSTIC SYSTEM

OPERATION OF ON-BOARD DIAGNOSTIC SYSTEM

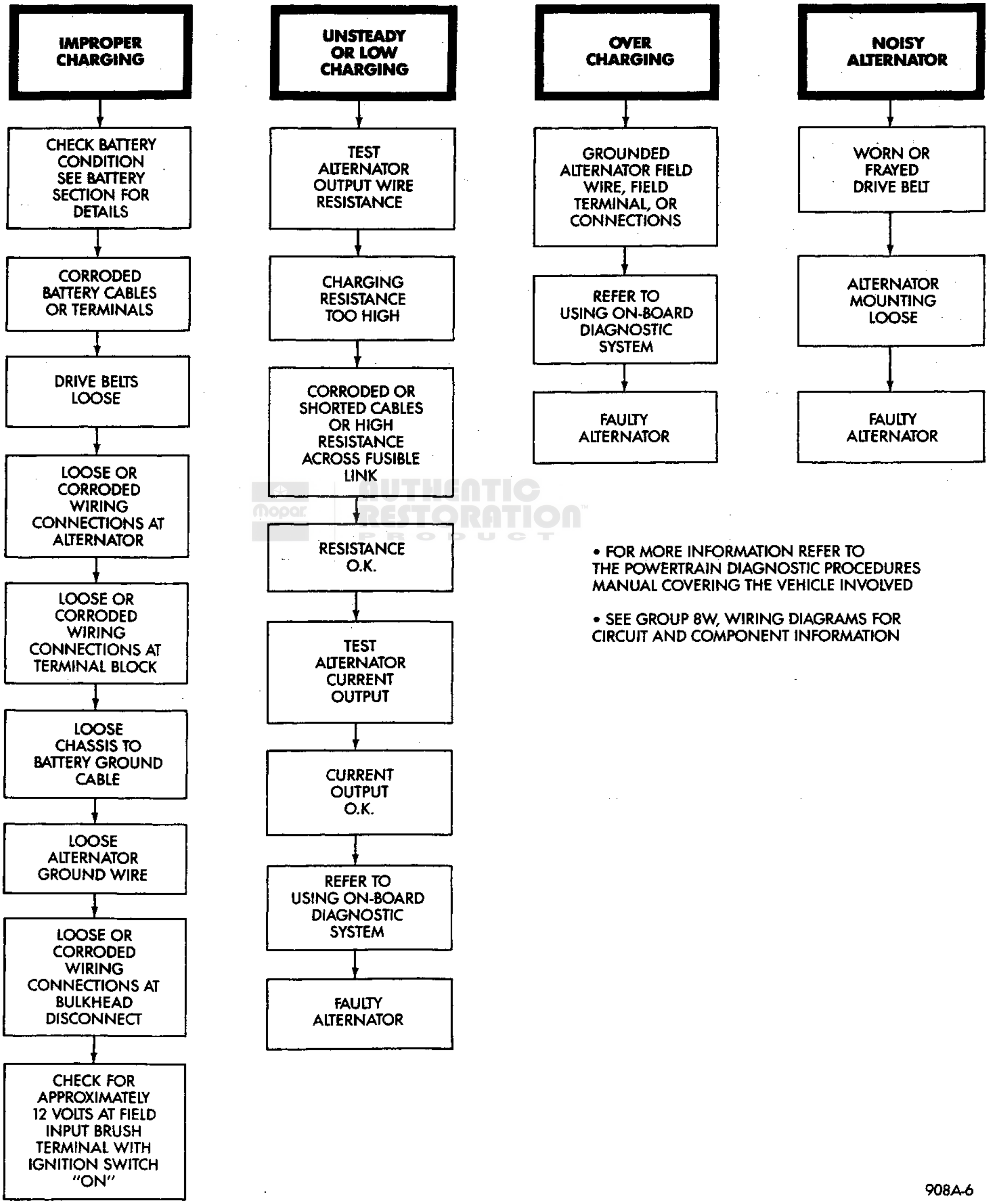
The Engine Controller monitors critical input and output circuits of the charging system making sure they are okay. Some are checked continuously and some are only checked under certain conditions.

If the on-board diagnostic system senses that one of the critical circuits is bad during a predetermined amount of time during the monitoring cycle, it will consider this a real problem and puts a fault code into memory. Each input and output circuit monitored by the on-board diagnostic system has its own fault code. The fault code will stay in memory as long as the circuit continues to be bad. However, if the problem does not happen again after the fault code is put into memory, the engine controller is programmed to clear the memory after 50 to 100 engine starts.

FAULT CODES

Fault codes are two-digit numbers flashed on Check Engine lamp that identify which circuit is bad. In most cases they do not identify which component in a circuit is bad. A fault description can be read using the DRB II. Refer to Group 14 - Fuel Systems for more information. Therefore, a fault code is only a result, not necessarily the reason for the prob-

CHARGING SYSTEM DIAGNOSTICS



- FOR MORE INFORMATION REFER TO THE POWERTRAIN DIAGNOSTIC PROCEDURES MANUAL COVERING THE VEHICLE INVOLVED
- SEE GROUP 8W, WIRING DIAGRAMS FOR CIRCUIT AND COMPONENT INFORMATION

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lem. However, in some cases, as a result of the design of the driveability test procedure, a fault code can be the reason for the problem. It is important that the test procedure be followed in order to understand what the fault codes of the on-board diagnostic system are trying to tell.

HOW TO USE CHECK ENGINE LAMP FOR FAULT CODES

To activate this function cycle the ignition switch on-off-on-off-on within five seconds and any fault stored in the engine controller will be displayed. The Check Engine lamp will display a fault code by flashing on and off. There is a short pause between flashes and a longer pause between digits. All codes displayed are two digit numbers with a four second pause between codes.

An example of a code is as follows:

(1) Lamp on for two seconds, then turns off.

(2) Lamp flashes four (4) times pauses and then flashes once (1).

(3) Lamp pauses for four seconds, flashes four (4) times, pauses and then flashes seven (7) times.

The two codes are 41 and 47. Any number of codes can be displayed (maximum of 8 faults can be stored) as long as they are in memory. The lamp will flash until all of them (including 55) are displayed (55 = End of test).

CHARGING SYSTEM FAULT CODES

See Alternator Fault Code Chart for fault codes which apply to the charging system. Refer to the Powertrain Diagnostic Procedures Manual to diagnose an On-Board Diagnostic System, Fault Code.

ALTERNATOR FAULT CODE CHART

Fault Code	Type	Check Engine Lamp	Circuit	When Monitored By the Logic Module	When Put into Memory	Actuator Test	Sensor Read Test
41	Fault	Yes	Alternator Field Control (Charging System)	All the time when the ignition switch is on.	If the field control fails to switch properly or excessive alt. field current detected.	Yes	None
46	Fault	Yes	Charging System Voltage	All the time when the engine is running.	If the battery sense voltage is more than 1 volt above the desired control voltage for more than 20 seconds.	None	Yes
47	Fault	Yes	Charging System Voltage	Engine rpm above 1,500 rpm	Battery voltage sense input below desired charging voltage during engine operation and no change in voltage during internal SBEC test performed on alternator field.	None	Yes

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SPECIFICATIONS

BATTERY SPECIFICATIONS		
Load Test (Amps)	**Cold Cranking Rating @ 0°F**	**Reserve Capacity**
200 Amp	400 Amp	100 Minutes
250 Amp	500 Amp	110 Minutes
315 Amp	625 Amp	120 Minutes
350 Amp	700 Amp	120 Minutes

CRANKING RATING is the current a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2 volts or greater at specified temperature.
RESERVE CAPACITY RATING is the length of time a battery can deliver 25 amps and maintain a minimum terminal voltage of 10.5 volts at 27°C (80°F).

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REDUCTION GEAR STARTER	
Manufacturer	**Nippondenso**
Engine Application	5.9L, 5.2L & 3.9L
Part Number and Power Rating	4379160 1.4 Kw
Voltage	12
No. of Fields	4
No. of Poles	4
Brushes	4
Drive	Conventional Gear Train
Free Running Test Voltage . . . . Amperage Draw . . . . Minimum Speed rpm	 11 82 Amps 3625 rpm
Solenoid Closing Voltage	7.5 Volts
Cranking Amperage Draw Test . . .	150-220 Amps*

*Engine should be up to operating temperature. Extremely heavy oil or tight engine will increase starter amperage draw.

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ALTERNATOR SPECIFICATIONS				
TYPE	**PART NUMBER**	**PULLEY GROOVES**	**ENGINE**	**RATING**
NIPPONDENSO	5234026	2	ALL	35/75 AMPS
NIPPONDENSO	5234199	2	ALL	50/120 AMPS
NIPPONDENSO	5234028	2	ALL	40/90 AMPS
BOSCH	5235028	2	ALL	40/90 AMPS

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BATTERY/STARTER SERVICE

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BATTERY SERVICE PROCEDURES

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GENERAL INFORMATION

This section will cover the Battery service, removal, and installation procedures only. For diagnostic procedures, see Group 8A - Battery/Starting/Charging Systems Diagnostics.

A battery is the heart of a vehicle's electrical system (Fig. 1). It functions in three ways, first it supplies electrical energy to the starter motor and ignition system while the engine is starting, it also acts as power supply to operate lamps, radio, and accessories with engine off. Second it intermittently supplies energy for electrical loads when the engine is running and load demands are more than output of alternator. Third it acts as a voltage stabilizer in the electrical system. The battery evens out temporarily high voltages that would otherwise damage electrical system parts. To do this the battery converts chemical energy into electrical energy by a chemical reaction.

If a battery is not up to specifications it will not deliver necessary electricity, will not accept electricity and will not act as a capacitor. Consequently, the vehicle's entire electrical system will be effected when this happens.

Standard equipment maintenance-free batteries (Fig. 1) have no removable battery cell caps. Water can not be added to the maintenance-free battery. The battery is completely sealed, except for small vent holes in the cover. These vent holes allow what small amount of gasses are produced in the battery to escape. Special chemical composition inside the battery reduces production of gas to an extremely small amount at normal charging voltages. The battery contains a visual test indicator which signals when an adequate charge level exists (green indicator), when charging is required (black indicator), or when replacement is required (yellow indicator).

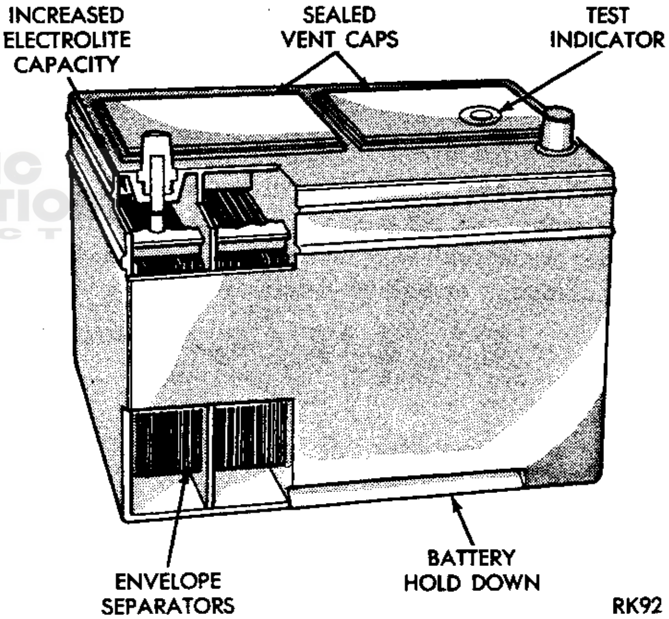

Fig. 1 Maintenance Free Battery

BATTERY VISUAL INSPECTION AND SERVICE

(1) Make sure ignition switch is on OFF position and all battery feed accessories are OFF.

(2) Disconnect both battery cables starting with the Negative cable.

WARNING: CARE SHOULD BE TAKEN, IN THE EVENT BATTERY CASE IS CRACKED OR LEAKING. TO PROTECT HANDS FROM ELECTROLYTE, A SUITABLE PAIR OF RUBBER GLOVES (NOT THE HOUSEHOLD TYPE) SHOULD BE WORN WHEN REMOVING BATTERY BY HAND.

(3) Remove battery hold down (Fig. 2) and remove battery from vehicle.

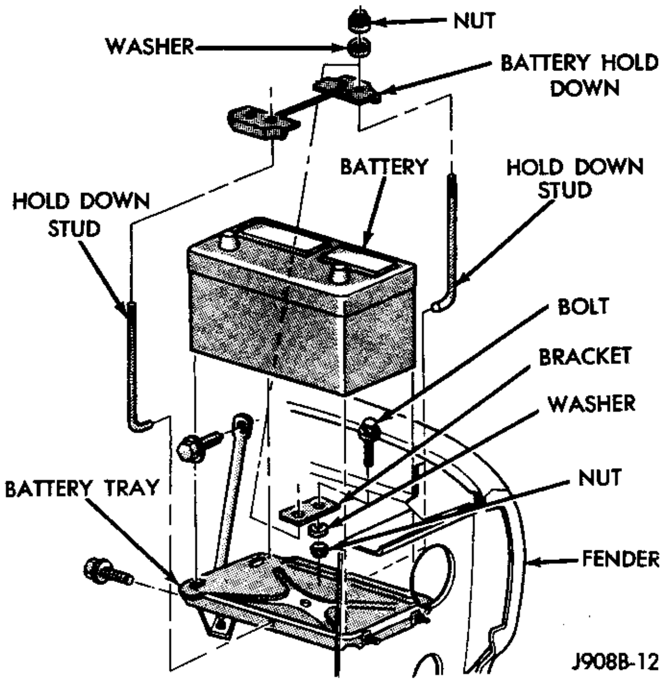

Fig. 2 Battery Holddown

(4) Clean top of battery with a solution of clean warm water and baking soda. Scrub area with a stiff bristle brush and wipe off with a cloth moistened with ammonia or baking soda in water (Fig. 3).

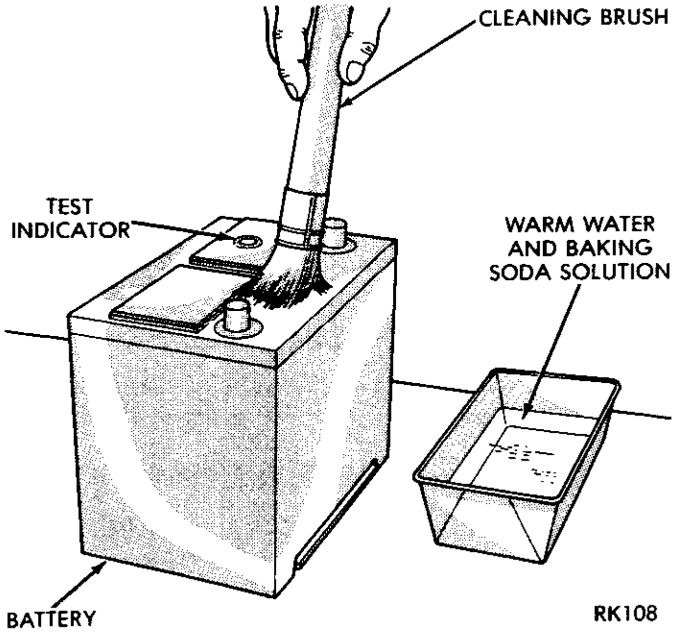

Fig. 3 Cleaning Battery

CAUTION: Care should be taken to ensure that solution does not enter vent holes.

(5) Inspect battery case and cover for cracks or leakage. If cracks or leakage is present, battery must be replaced.

(6) Inspect battery tray for damage caused by loss of acid from battery. If acid damage is present it will be necessary to clean area with same solution described in Step (4) (Fig. 4).

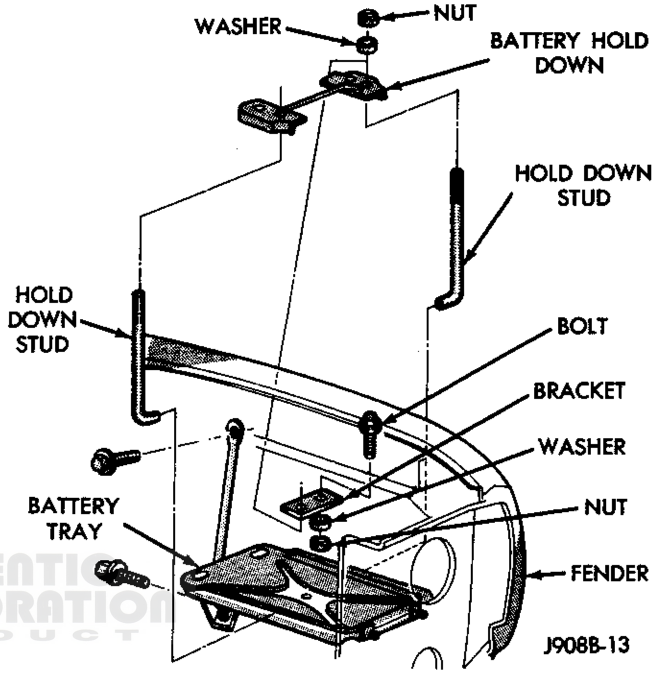

Fig. 4 Battery Tray

(7) Clean battery post with a suitable battery post cleaning tool (Fig. 5).

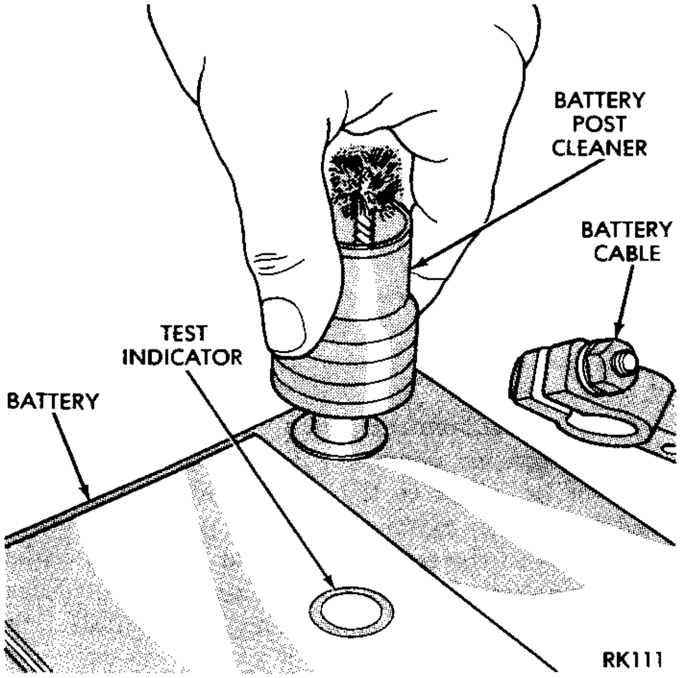

Fig. 5 Cleaning Battery Post

(8) Clean inside surfaces of terminal clamps with a suitable battery terminal cleaning tool (Fig. 6). Replace damaged or frayed cables and broken terminal clamps.

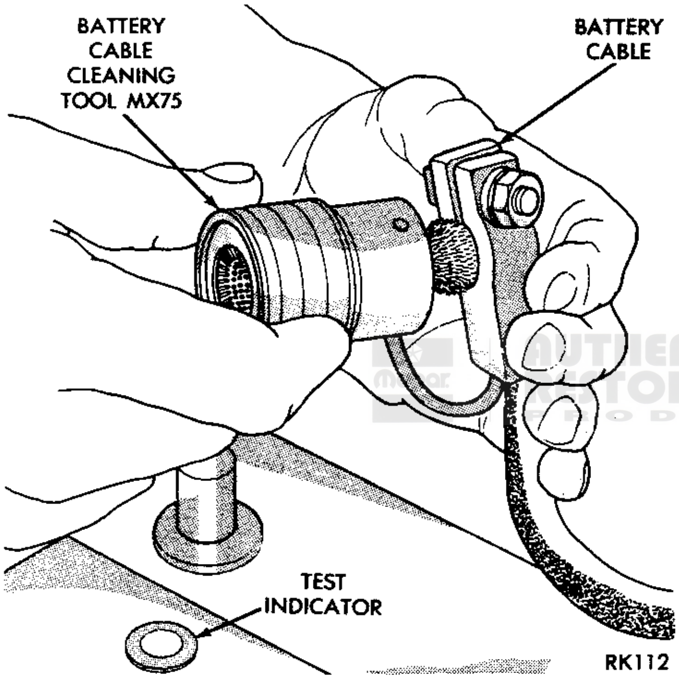

Fig. 6 Cleaning Battery Cable Terminal

(9) Inspect battery for proper or damaged hold down ledge.

(10) Install battery in vehicle making sure that battery is properly positioned on battery tray (Fig. 2).

(11) Install battery hold down clamp, making sure that it is properly positioned on battery, and tighten bolt to 12 N•m (100 in. lbs.).

(12) Place felt grease washer onto Positive (+) battery post.

(13) Connect cable clamps to battery post making sure top of clamp is flush with top of post (Fig. 7).

(14) Tighten clamp nut securely.

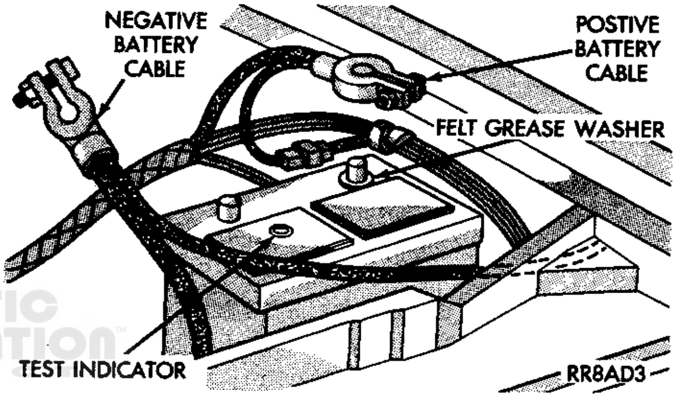

Fig. 7 Battery Cables Disconnected

STARTER SERVICE PROCEDURES

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GENERAL INFORMATION

This section will cover the Starter removal and installation. For diagnostic procedures, see Group 8A - Battery/Starting/Charging Systems Diagnostics.

STARTING SYSTEM DESCRIPTION

The starter system circuits consists of a battery, starter motor, starter relay switch, solenoid, switch, ignition switch, connecting wires and battery cables.

In starter system circuits turning ignition switch to start position closes starter relay points allowing current to energize starter solenoid windings, this causes solenoid plunger and clutch shift lever to move engaging clutch pinion gear into ring gear, and also at this time closing solenoid contacts causing starter motor to crank. As soon as engine starts running clutch pinion gear overruns to protect starter armature from damage due to excessive speed. Once the engine starts running, the ignition key switch should be immediately returned to the run position to prevent excessive starter motor damage.

WARNING: ALWAYS DISCONNECT THE BATTERY NEGATIVE CABLE BEFORE SERVICING THE STARTER.

STARTER MOTOR REMOVAL AND INSTALLATION

(1) Disconnect the battery negative cable.

(2) Remove wire terminal connector from the starter motor (Fig. 1).

(3) Remove mounting bolt and nut securing the starter to the bellhousing (Fig. 2).

(4) Move the starter forward to clear lower mounting stud and starter gear housing nose and allow the starter to come down past the exhaust pipe (Fig. 3).

To install, reverse the removal procedures.

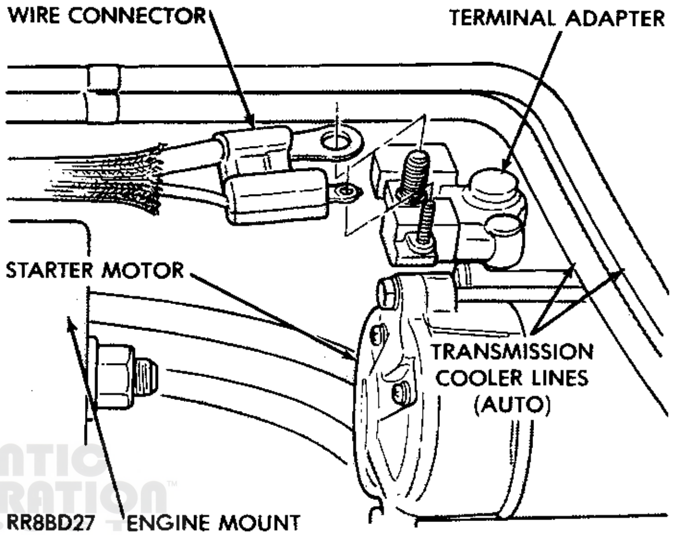

Fig. 1 Remove or Install Starter Wire Connector

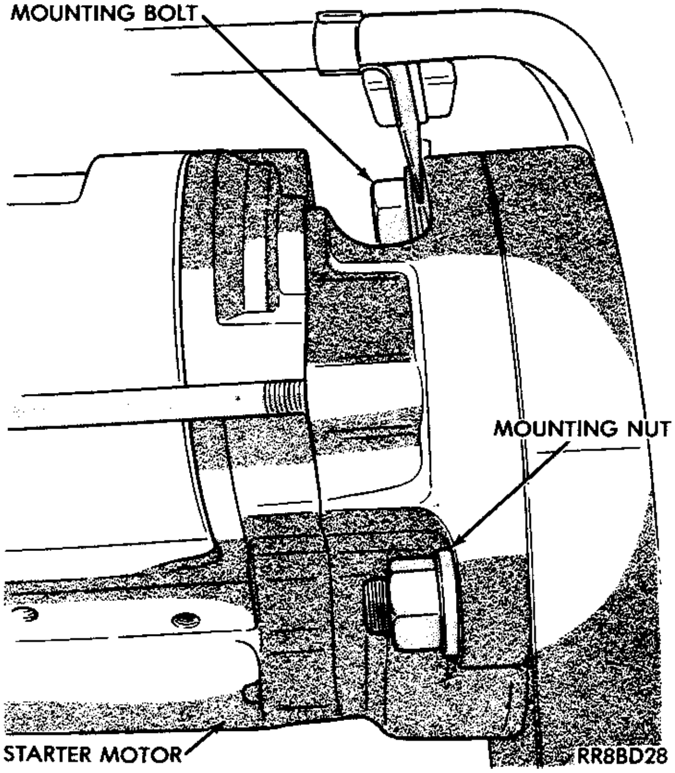

Fig. 2 Remove or Install Starter Mounting Bolt and Nut

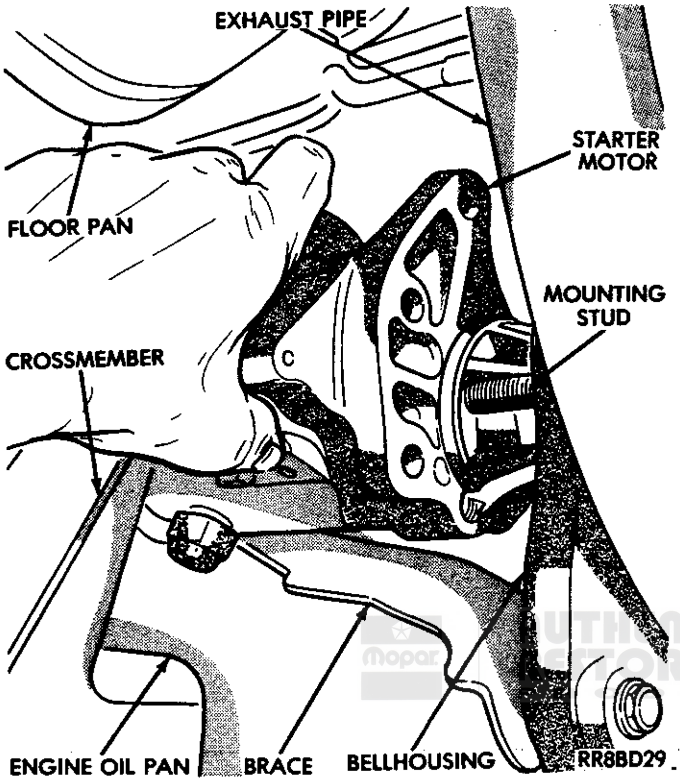

Fig. 3 Remove or Install Starter Motor

SPECIFICATIONS

REDUCTION GEAR STARTER	
Manufacturer	**Nippondenso**
Engine Application	5.9L, 5.2L & 3.9L
Part Number and Power Rating	4379160 1.4 Kw
Voltage	12
No. of Fields	4
No. of Poles	4
Brushes	4
Drive	Conventional Gear Train
Free Running Test Voltage Amperage Draw Minimum Speed rpm	 11 82 Amps 3625 rpm
Solenoid Closing Voltage	7.5 Volts
Cranking Amperage Draw Test	150-220 Amps*

*Engine should be up to operating temperature. Extremely heavy oil or tight engine will increase starter amperage draw.

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BATTERY SPECIFICATIONS		
Load Test (Amps)	**Cold Cranking Rating @ 0°F**	**Reserve Capacity**
200 Amp	400 Amp	100 Minutes
250 Amp	500 Amp	110 Minutes
315 Amp	625 Amp	120 Minutes
350 Amp	700 Amp	120 Minutes

CRANKING RATING is the current a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2 volts or greater at specified temperature.

RESERVE CAPACITY RATING is the length of time a battery can deliver 25 amps and maintain a minimum terminal voltage of 10.5 volts at 27°C (80°F).

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ALTERNATOR SERVICE

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SPECIFICATIONS 2

GENERAL INFORMATION

This section will cover alternator removal and installation. The alternator is not serviceable. Information covering on-vehicle testing can be found in Group 8A - Battery/Starting/Charging/System Diagnostics.

The standard equipment alternator on the D & W bodies is the 75 amp alternator. The Ramcharger is equipped with the 90 amp alternator. When a vehicle is equipped with a heavy duty package, a 120 amp alternator is used.

ALTERNATOR REMOVAL AND INSTALLATION

(1) Remove the battery negative cable.

(2) Remove alternator drive belt. See Group 7 - Cooling System, for instructions.

(3) Remove the alternator mounting nut (top) and bolt (bottom) and separate the alternator from the mounting plate (Fig. 1).

(4) Remove the B+ terminal nut, 2 field terminal nuts, ground, and harness hold down nuts (Fig. 2). Remove wire connectors.

(5) Remove the alternator from the vehicle.

(6) To install the alternator, reverse the removal procedures.

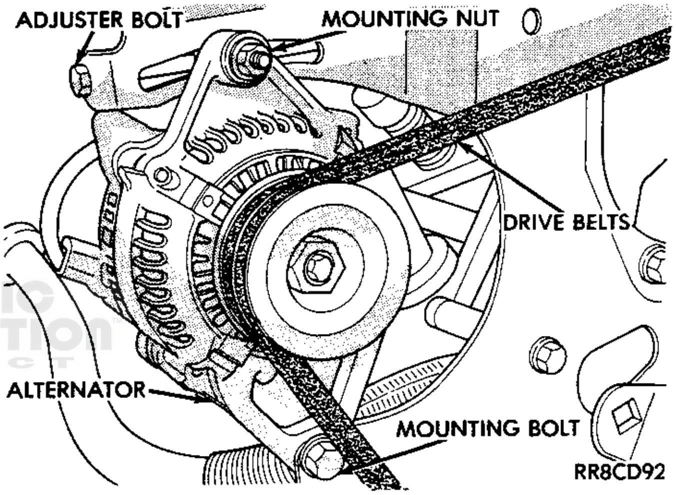

Fig. 1 Remove or Install Alternator Mounting Bolts

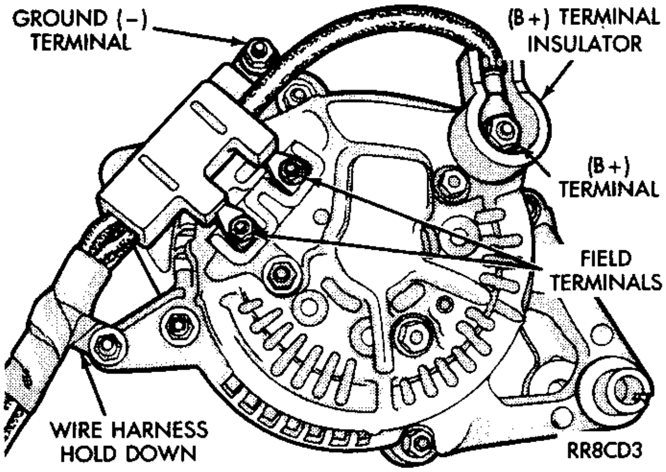

Fig. 2 Remove or Install Wire Connector Assembly

SPECIFICATIONS

ALTERNATOR SPECIFICATIONS

TYPE	PART NUMBER	PULLEY GROOVES	ENGINE	RATING
NIPPONDENSO	5234026	2	ALL	35/75 AMPS
NIPPONDENSO	5234199	2	ALL	50/120 AMPS
NIPPONDENSO	5234028	2	ALL	40/90 AMPS
BOSCH	5235028	2	ALL	40/90 AMPS

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IGNITION SYSTEMS

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COMPONENT IDENTIFICATION

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GENERAL INFORMATION

This section contains basic diagnostic procedures for the ignition systems of 3.9L V-6 engines and 5.2L and 5.9L V-8 engines. Information regarding "On Board Diagnostics" can be found in the Single Point Fuel Injection and Dual Point Fuel Injection sections of Group 14—Fuel Systems. A specifications section is included at the end of this group. General maintenance information for ignition related items can be found in Group 0, Lubrication and Maintenance, and the Operating Instructions and Product Information Manual.

DISTRIBUTOR CAP

INSPECTION

Remove the distributor cap and wipe it clean with a dry lint free cloth. Visually inspect the cap for cracks, carbon paths, broken towers, white deposits on the inside (caused by condensation entering the cap through cracks), and damaged rotor button (Fig. 1). The machined surface of a terminal end (faces toward rotor) will indicate some evidence of erosion from normal operation. The residue can be removed with a sharp knife. Examine the terminal ends for evidence of mechanical interference with the rotor tip.

A cap that is greasy or dirty or has a powder-like substance on the inside should be cleaned with a solution of warm water and a mild detergent. Scrub with a soft brush, thoroughly rinse, and dry with a clean soft cloth.

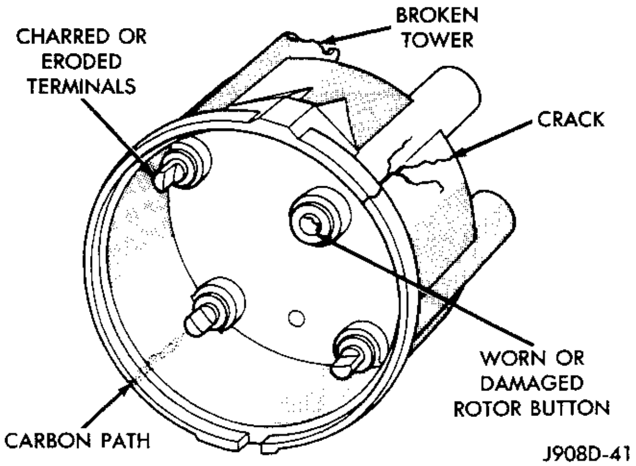

Fig. 1 Distributor Cap Inspection—Typical

If replacement of the distributor cap is necessary, **transfer sparkplug wires from the original cap to the new cap one at a time. Ensure that each wire is installed into the tower of the new cap that corresponds to its tower position in the original cap. Fully seat the wires into the towers.**

If necessary, refer to the appropriate engine firing diagram (Fig. 2 or Fig. 3).

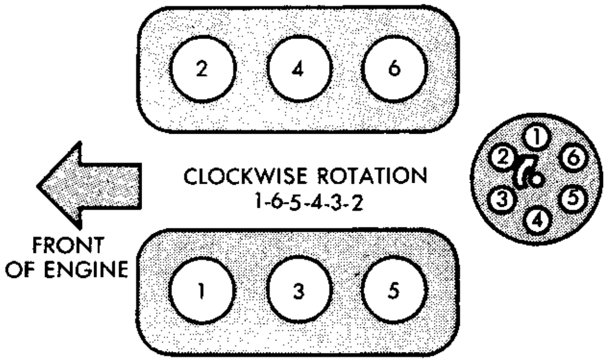

Fig. 2 Engine Firing Order—3.9L

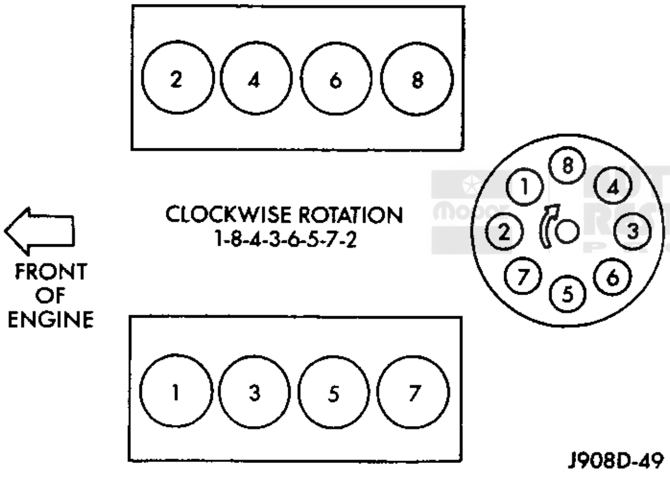

Fig. 3 Engine Firing Order—5.2L and 5.9L

DISTRIBUTOR ROTOR

Replace the rotor if it is cracked or if the spring terminal does not have proper tension (Fig. 4).

A black silicone varnish covers the tip of the rotor electrode (in previous years silicone grease was used). The coating is used to suppress electromagnetic radiation. The coating will darken with age and have an ash like appearance. The ash formation is normal and does affect engine performance.

SPARK PLUG CABLES

Spark Plug cables are sometimes referred to as secondary ignition wires. The wires transfer electrical current from the distributor to individual spark plugs at each cylinder. The spark plug cables are of nonmetallic construction and have a built in resistance. The cables provide suppression of radio frequency emissions from the ignition system.

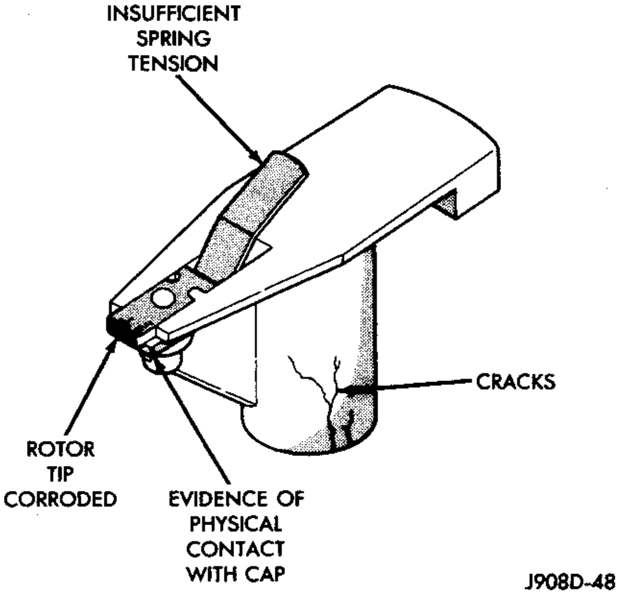

Fig. 4 Distributor Rotor Inspection—Typical

Check the high-tension cable connections for good contact at the ignition coil, distributor cap towers and spark plugs. Terminals should be fully seated. The terminals and covers should be in good condition. Terminals should fit tightly to the ignition coil, distributor cap, and spark plugs. The cover (boot) of the cable should fit tight around the coil tower, distributor tower and spark plug insulator. Loose cable connections can cause corrosion and increase resistance resulting in shorter cable service life. To maintain proper sealing at the terminal connections, the connections should not be broken unless they are damaged or testing indicates that high resistance, an open circuit, or other damage.

Clean high tension cables with a cloth moistened with a nonflammable solvent and wipe dry. Check for brittle or cracked insulation.

When testing secondary cables for damage with an oscilloscope, follow the instructions of the equipment manufacturer.

If an oscilloscope is not available, spark plug cables may be tested as follows:

With the engine running, remove spark plug cable from spark plug (one at a time) and hold next to engine ground. If the cable and spark plug are in good condition, the engine RPM will drop and engine performance will decrease. If engine RPM does not drop the cable and/or spark plug is not operating properly and should be replaced.

CAUTION: Do not leave any one spark plug cable disconnected for longer than necessary during testing or possible heat damage to the catalytic converter may occur. Total test time must not exceed ten minutes.

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 coil to the distributor cap can be checked in the same manner. Cracked, damaged or faulty cables should be replaced with resistance type cable which can be identified by the words “Electronic Suppression” printed on the cable jacket.

Use an Ohmmeter (tool C-4845 or an equivalent) to test for open circuits, excessive resistance or loose terminals. Remove the distributor cap from the distributor—Do not remove cables from cap. Remove cable from spark plug. Connect ohmmeter to spark plug terminal of cable and to corresponding electrode in distributor cap. Resistance should be within specifications shown in the resistance chart. If not, remove cable from distributor cap tower and connect ohmmeter to the terminal ends of cable. If resistance is still not within specifications, 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

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To test coil to distributor cap cable, do not remove the cable from the cap. Connect the ohmmeter to the rotor button (center contact) and the terminal at the coil end of the cable. If resistance is not within specifications in the resistance chart, remove the cable from the distributor cap and connect the ohmmeter to the terminal ends of the cable. If resistance is still not within specifications, replace the cable. Inspect the coil tower for cracks, corrosion or oil leaks.

Replace cables one at a time to ensure that the correct firing order is maintained. Route the new cables in the same manner as the original cables keeping them away from accessory drive pulleys and exhaust manifolds securing them in the proper retainers.

To remove cables from spark plugs, twist the rubber protector boot approximately 1/2-turn to break the seal. Grasp the boot and pull it from the plug with a straight and steady pull. Do not pull on the wire itself because this will damage the conductor and terminal connection. Do not use pliers to remove the cable.

To remove cables from the distributor cap or ignition coil tower, loosen the boot first, then grasp the upper part of the boot and the cable and gently pull straight up.

When installing new cables, pinch the protective nipple to release any air trapped between the tower and the nipple (Fig. 5 and 6).

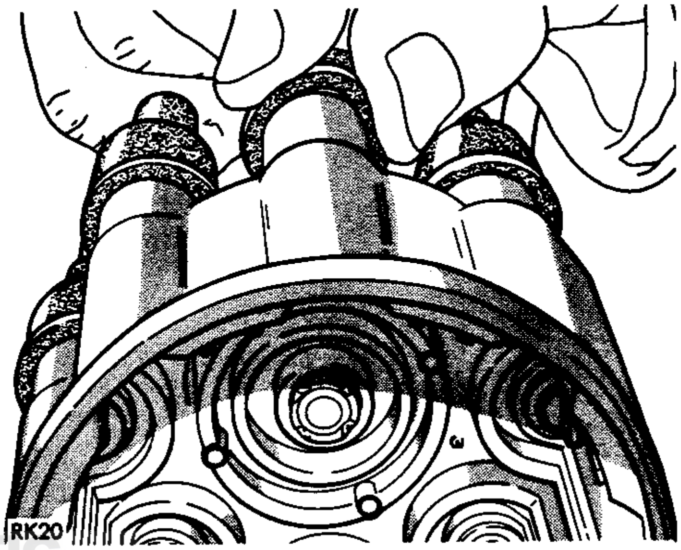

Fig. 5 Spark Plug Cable to Distributor Cap Installation

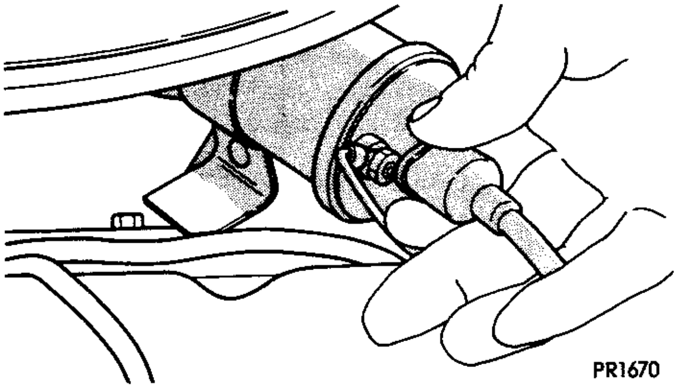

Fig. 6 Coil Cable to Coil Installation

SPARK PLUGS

Remove the spark plugs and examine them for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order in which they were removed from the engine. An isolated plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in the maintenance chart in Group 0.

Spark plugs that have low milage may be cleaned and reused if not otherwise defective. Refer to the Spark Plug Condition section of this group. After cleaning, file the center electrode flat with a small point file or jewelers file. Adjust the gap between the electrodes to the specified dimension (Fig. 7). The gap for 2.5L and 3.9L engines is .88mm (.035 in).

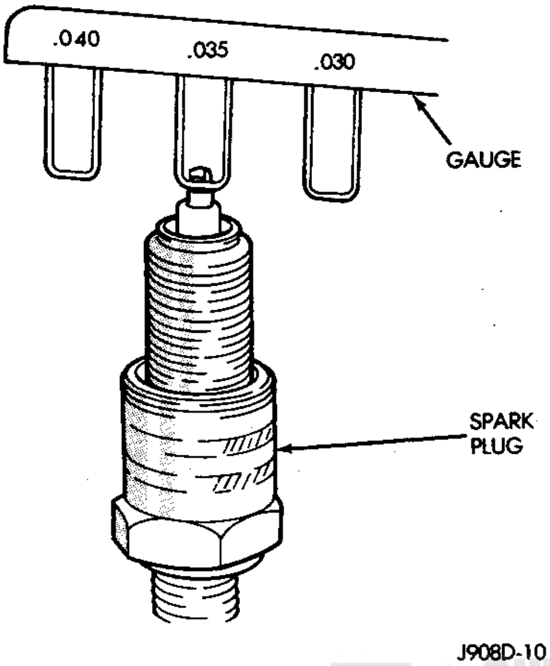

Fig. 7 Setting Spark Plug Gap - Typical

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap. Tighten all spark plugs to 41 N•m (30 ft-lbs) torque.

SPARK PLUG CONDITION

Normal Operating Conditions

The few deposits present will probably be light tan or slightly gray in color with most grades of commercial gasoline (Fig. 8). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 1600 km (1000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have its electrodes filed and regapped, and then reinstalled.

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT causes the entire tip of the spark plug to be coated with a rust colored deposit. This rust color can be misdiagnosed as being caused by coolant in the combustion chamber. Spark plug performance is not affected by MMT deposits.

Cold Fouling (Carbon Fouling)

Cold fouling is sometimes referred to as carbon fouling because the deposits that cause cold fouling are basically carbon (Fig. 8). 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 may be caused by a clogged air cleaner.

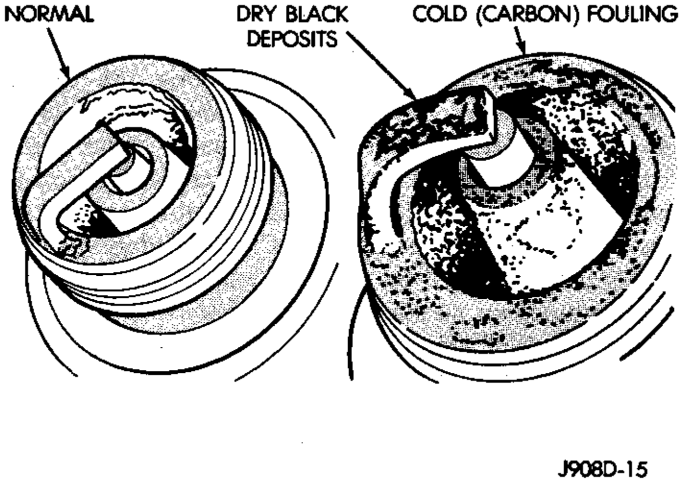

Fig. 8 Normal Operation and Cold (Carbon) Fouling

Cold fouling is normal after short operating periods. The spark plugs do not reach a high enough operating temperature during short operating periods to burn the carbon deposits off.

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, the deposits partially liquefy and bridge the gap between the electrodes (Fig. 9). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

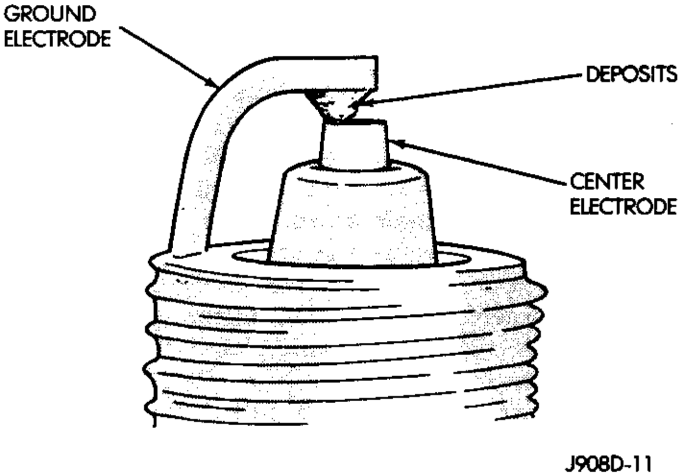

Fig. 9 Electrode Gap Bridging

Scavenger Deposits

Fuel scavenger deposits may be either white or yellow (Fig. 10). 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 be cleaned using standard procedures.

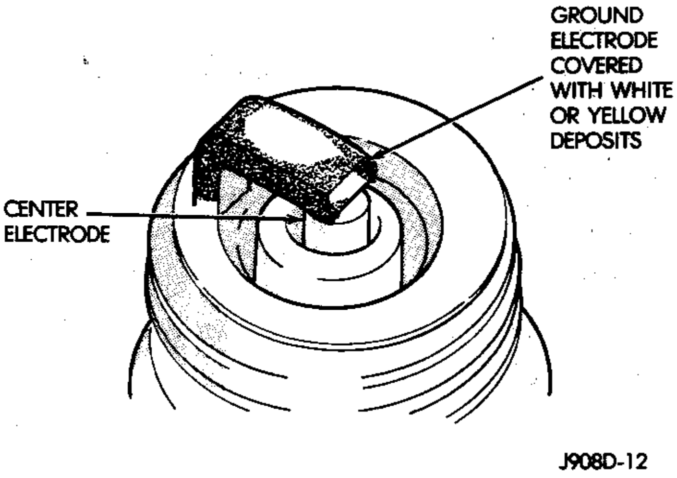

Fig. 10 Scavenger Deposits

Chipped Electrode Insulator

A chipped electrode insulator usually results from bending the center electrode while adjusting the spark plug electrode gap. Under certain conditions, severe detonation can also separate the insulator from the center electrode (Fig. 11). Spark plugs with this condition must be replaced.

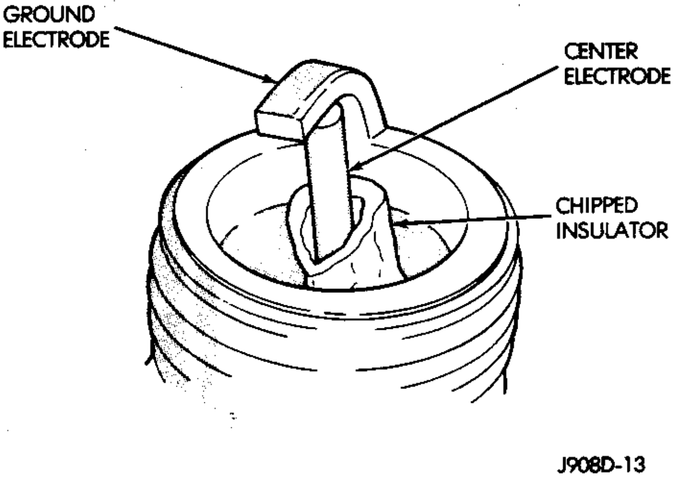

Fig. 11 Chipped Electrode Insulator

Preignition Damage

Preignition damage is caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dissolves somewhat later (Fig. 12). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine, 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 depending upon the thickness and length of the center electrodes porcelain insulator.)

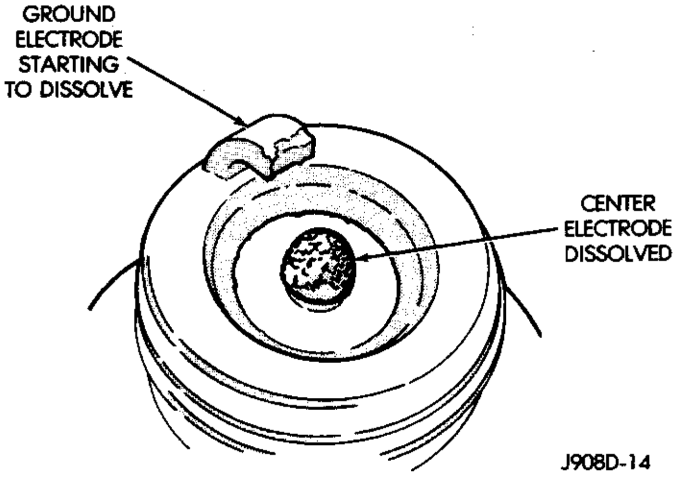

Fig. 12 Preignition Damage

Spark Plug Overheating

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 13). The increase in electrode gap will be considerably in excess of 0.001 inch per 1000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions can also cause spark plug overheating.

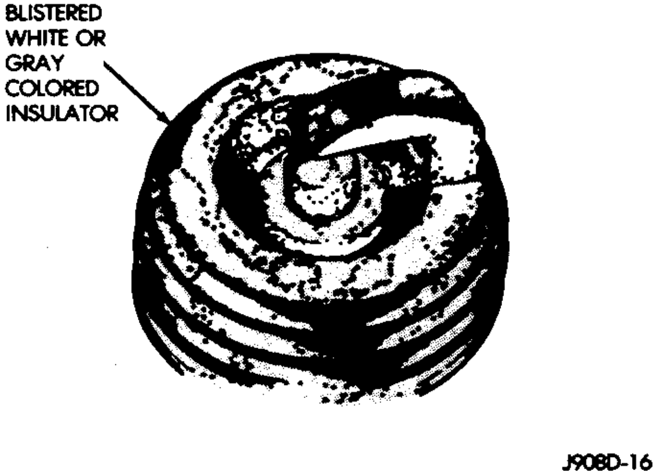

Fig. 13 Spark Plug Overheating

SPARK PLUG SERVICE

Use care when disconnecting the spark plug and coil cable boots and cables. Twist the boot 1/2 turn and pull on the boot only to disconnect the cable.

When replacing the spark plug and 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, cross ignition of the spark plugs or short circuit the cables to ground.

Spark Plug Removal

Remove the spark plug cable by grasping at the spark plug boot turning the boot 1/2 turn and pulling straight back in a steady motion.

(1) Prior to removing the spark plug spray compressed air around the spark plug hole and the area around the spark plug.

(2) Remove the spark plug using a quality socket with a rubber or foam insert.

(3) Inspect the spark plug condition. Refer to Spark Plug Condition in this section.

Spark Plug Gap Adjustment

(1) Check the spark plug gap with a gap gauge. If the gap is not correct, adjust it by bending the ground electrode (Fig. 7).

Spark Plug Installation

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten the spark plugs to 41 N•m (30 ft-lbs) torque.

(3) Install spark plug cables over spark plugs.

SINGLE BOARD ENGINE CONTROLLER (SBEC)

The Single Board Engine Controller (SBEC) is a digital computer containing a microprocessor. The SBEC controls the ignition system, fuel injection, speed control, alternator output, and other vehicle operations based upon inputs it receives from various sensors and switches.

The SBEC controls the ground path for the ignition coil and fuel injectors. The SBEC (Fig. 14) supplies battery power to the ignition coil, fuel injectors, fuel pump, and oxygen sensor heating element through the auto shutdown (ASD) relay. Refer to "Auto Shutdown (ASD) Relay" in this section for relay operation.

By switching the ground path for the ignition coil on and off the SBEC adjusts ignition timing to meet changing engine conditions.

The amount of electronic spark advance provided by the SBEC is determined by four input factors, coolant temperature, engine rpm, throttle position and available manifold vacuum. During engine cranking/start-up, the SBEC advances the ignition timing a set amount.

Based on inputs that it receives, the SBEC also controls idle speed and evaporative canister purge operation. The SBEC adjusts the alternator charge rate through control of the alternator field.

Refer to Group 14, Fuel Systems, for further information on the SBEC and fuel injection systems.

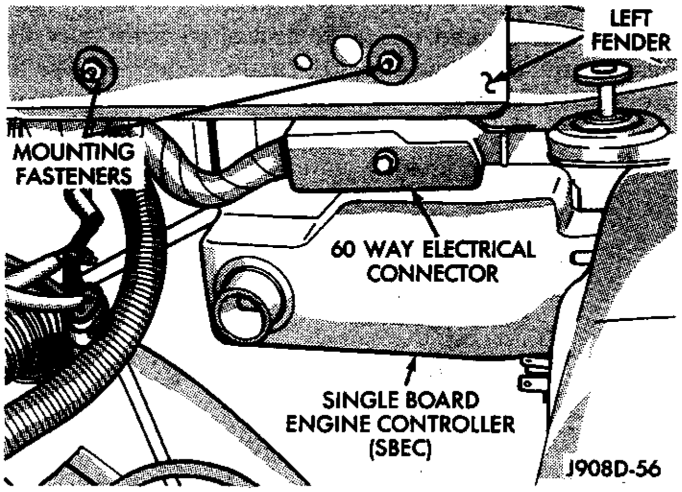

Fig. 14 Single Module Engine Controller (SBEC)

HALL EFFECT PICK-UP ASSEMBLY

The distributor pick-up is a Hall Effect device (Fig. 15). The pick-up supplies engine position and rpm information to the SBEC.

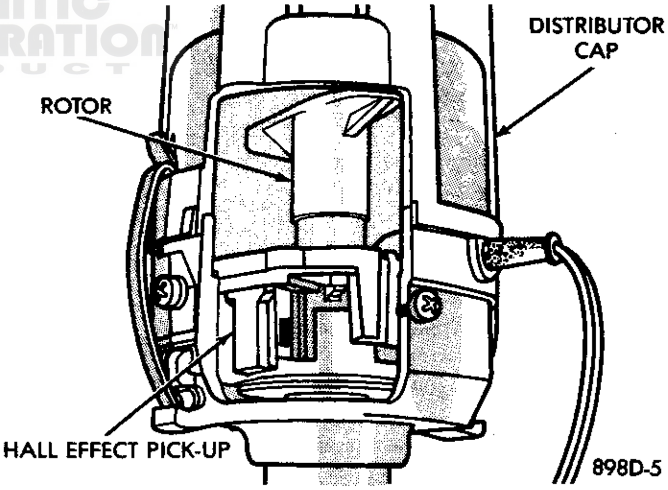

Fig. 15 Hall Effect Distributor 3.9L Engine

A shutter (sometimes referred to as an interrupter) is attached to the distributor shaft (Fig. 16). The shutter contains one blade per engine cylinder. A switch plate is mounted to the distributor housing above the shutter. The switch plate contains the distributor pick-up (a Hall Effect device and magnet) through which the shutter blades rotate. As the shutter blades pass through the pick-up, they interrupt the magnetic field. The Hall effect device in the pick-up senses the change in the magnetic field and switches on and off (which creates pulses), generating the input signal to the SBEC. The SBEC calculates engine speed through the number of pulses generated.

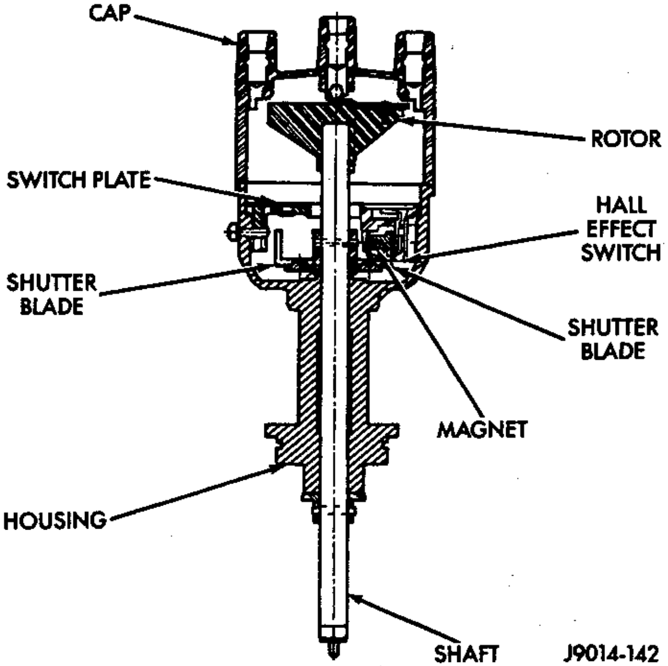

Fig. 16 Distributor Pick-Up—Typical

COOLANT TEMPERATURE SENSOR

The SBEC receives information regarding engine operating temperature from the Coolant Temperature Sensor (engine coolant temperature is the same as engine operating temperature). The sensor is located near the thermostat housing (Fig. 17).

The sensor is a variable resistor with a range of 5° to 129°C (40°F to 265°F). As coolant temperature varies the coolant temperature sensors resistance changes resulting in a different input voltage to the SBEC.

The SBEC contains different spark advance curves for different engine operating conditions. There are unique spark advance schedules for cold and warm engine operation that have been added to reduce engine emission and improve driveability. The SBEC will supply slightly richer air-fuel mixtures and higher idle speeds until normal operating temperatures are reached.

All spark advance testing should be done with the engine fully warmed.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

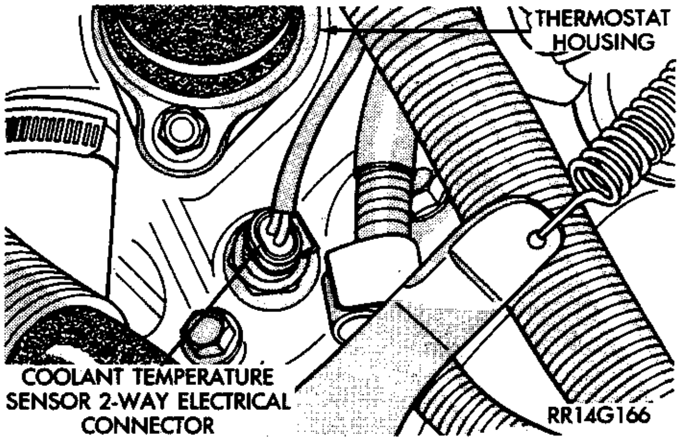

Fig. 17 Coolant Temperature Sensor—3.9L Engine

The MAP sensor reacts to absolute pressure in the intake manifold and provides an input voltage to the Single Board Engine Controller (SBEC). As engine load changes manifold pressure varies, causing the MAP sensor output voltage to change resulting in a different input voltage to the SBEC. The input voltage level supplies the SBEC with information relating to ambient barometric pressure during engine start-up (cranking) and to engine load while the engine is running. The SBEC uses this input along with inputs from other sensors to adjust air-fuel mixture and ignition timing.

The MAP sensor is located on the throttle body (Fig. 18).

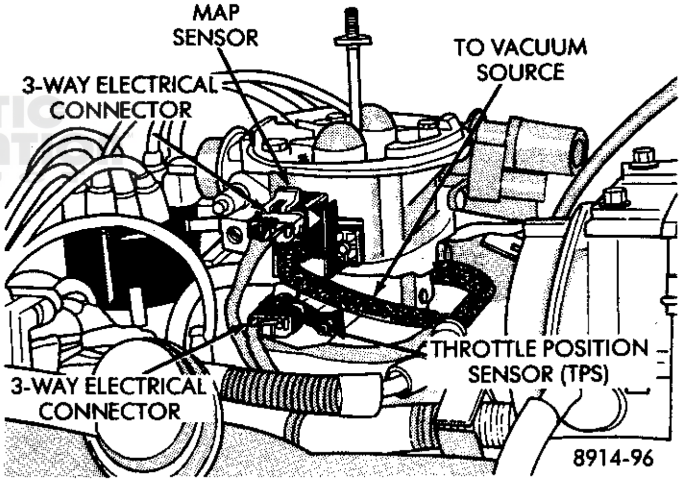

Fig. 18 MAP Sensor—3.9L Engine

AUTO SHUTDOWN (ASD) RELAY

The Auto Shutdown Relay (ASD) supplies battery voltage to the fuel pump, fuel injector, ignition coil, and O_2 sensor heating element. The ground circuit for the ASD relay is controlled by the Single Board Engine Controller (SBEC). The SBEC controls the relay operation by switching the ground circuit on and off.

The SBEC monitors the distributor pick-up signal to determine engine speed and compute injector synchronization. If the SBEC does not receive a distributor signal when the ignition switch is in the "Run" position it will not energize (not provide a ground) the ASD relay, stopping the battery voltage supply to the fuel pump, fuel injectors, ignition coil, and 0_2 sensor heater element.

The ASD relay is located in the engine compartment near the 50-way bulkhead connector (Fig. 19).

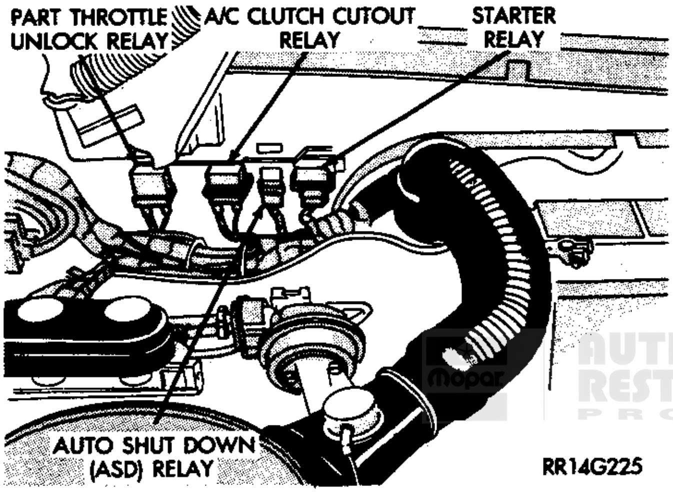

Fig. 19 ASD Relay Location

IGNITION COIL

The SBEC controls ignition coil firing through the auto shutdown (ASD) relay. When the relay is energized by the SBEC, battery voltage is supplied to the ignition coil positive terminal. The SBEC will not energize the ASD relay until it receives input from the distributor pick-up. Refer to "Auto Shutdown (ASD) Relay" in this section for relay operation.

The ignition coil is designed to operate without an external ignition resistor. Inspect the coil for external leaks and arcing.

Test coil according to coil tester manufacturer's instructions. Test coil primary resistance. Test coil secondary resistance. Replace any coil that does not meet specifications.

If the ignition coil is replaced because of a burned tower, carbon tracking, or arcing at either the tower, nipple or boot at the coil end of the secondary cable, replace cable. Any arcing at the tower will carbonize the nipple. Installing the cable on a new coil will cause the coil to fail.

If secondary cables shows any signs of damage, they should be replaced with new cables. Damaged cables can cause arcing and failure of a new coil.

The ignition coil is mounted to the dash panel at the rear of the right side valve cover (Fig. 20).

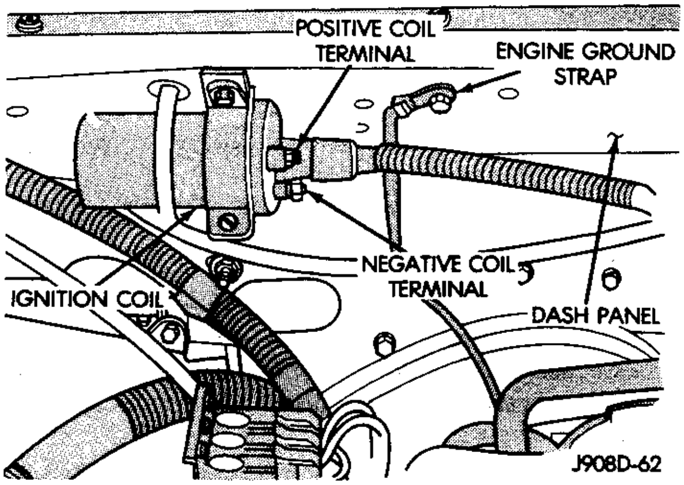

Fig. 20 Ignition Coil Connections

DIAGNOSTIC PROCEDURES

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GENERAL INFORMATION

For more information refer to “On Board Diagnostics” in the General Diagnosis sections of Group 14, Fuel System.

TESTING FOR SPARK AT COIL

Remove coil secondary cable from distributor cap. Hold end of cable about 6mm (1/4-inch) away from a good engine ground (Fig. 1). Crank the engine and check for a spark at coil secondary cable.

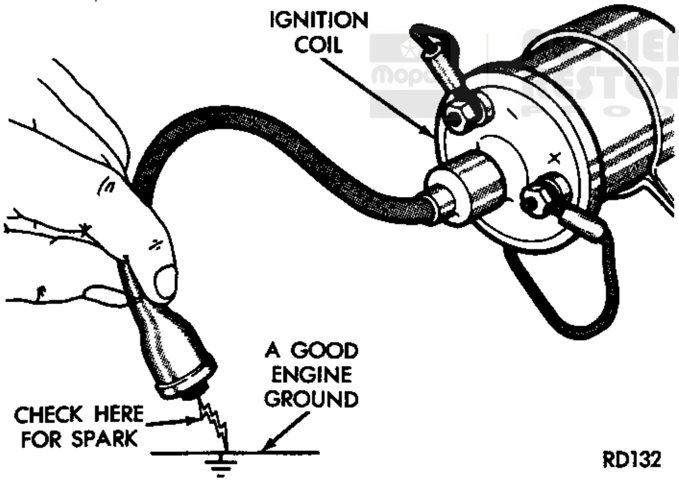

Fig. 1 Checking for Spark

If a spark occurs, it must be constant. If it is, continue to crank engine and while slowly moving the coil secondary cable away from ground, check for arcing at the coil tower. If arcing occurs replace coil. If spark is not constant or spark is not present, proceed to the failure to start test.

If a good spark is produced the ignition coil is producing high secondary voltage. Inspect the distributor rotor, cap, spark plug cables, and spark plugs. If they are okay, the ignition system is not the reason why the engine will not start. It will be necessary to check the fuel system and engine mechanical items.

FAILURE TO START TEST

To prevent unnecessary diagnostic time and wrong test results, the “Checking for Spark Test” should be performed prior to this test.

WARNING: SET PARKING BRAKE OR BLOCK THE DRIVE WHEELS BEFORE PROCEEDING WITH THIS TEST.

(1) Determine that sufficient battery voltage (12.4 volts) is present for the starting and ignition systems.

(2) Crank the engine for 5 seconds while monitoring the voltage at the coil positive terminal (Fig. 2).

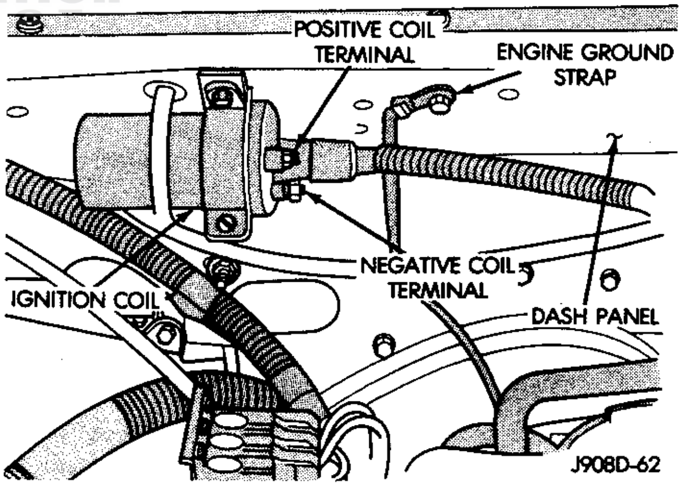

Fig. 2 Coil Terminals

- If the voltage remains near zero during the entire period of cranking, refer to “On-Board Diagnostics” in the Fuel Injection section of Group 14 to check the single board engine controller (SBEC) and auto shutdown relay.
- If voltage is at “near-battery” voltage and drops to zero after 1-2 seconds of cranking, refer to “On-Board Diagnostics” in the Fuel Injection section of Group 14 to check the distributor reference pickup to SBEC circuit.

- If voltage remains at "near battery" voltage during the entire 5 seconds, turn the key off and remove the 60-way connector (Fig. 3) from the SBEC. Check 60-way connector for any spread terminals.

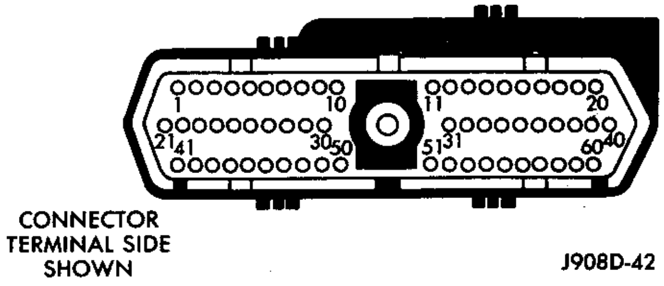

Fig. 3 SBEC 60-Way Connector

(3) Remove test lead from the coil positive terminal and connect an 18 gauge jumper wire between the battery positive terminal and the coil positive terminal.

(4) Make the special jumper shown in Figure 4. Using the jumper, momentarily ground terminal number 19 of the 60-way connector. A spark should be generated at the coil cable when the ground is removed.

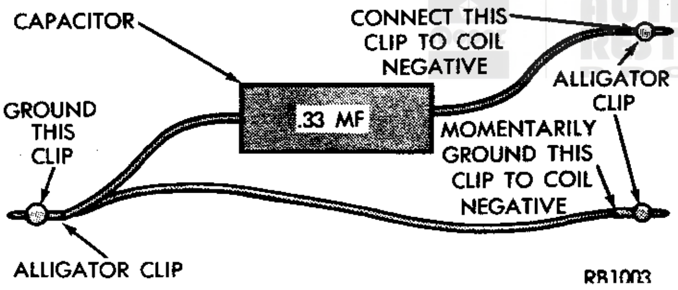

Fig. 4 Special Jumper—Ground to Coil Negative Terminal

(5) If spark is generated, replace the SBEC.

(6) If no spark is seen, use the special jumper to ground the coil negative terminal directly.

(7) If spark is produced, repair wiring harness for an open condition.

(8) If no spark is produced, replace the ignition coil.

POOR PERFORMANCE TEST

To prevent unnecessary diagnostic time and wrong test results, the "Testing For Spark At Coil" should be performed prior to this test.

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING IDLE CHECK/ADJUSTMENT, OR ANY TEST WITH AN OPERATING ENGINE.

Check and adjust basic timing. Refer to the Specification and Service Procedure sections. Refer to On Board Diagnostics in the Fuel Injection General Diagnosis sections of Group 14.

COOLANT TEMPERATURE SENSOR TEST

(1) Turn the ignition key to the off position. Disconnect wire connector from coolant temperature sensor.

(2) Connect one lead of ohmmeter to one terminal of coolant temperature sensor (Fig. 5).

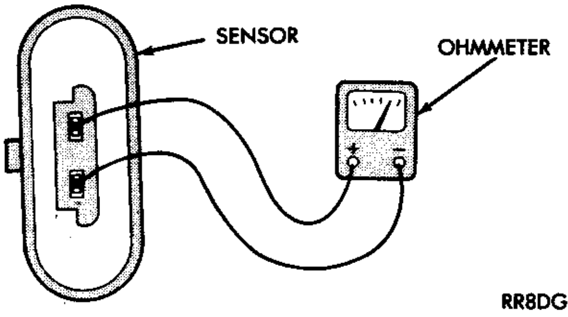

Fig. 5 Coolant Temperature Sensor Test

(3) Connect the other lead of ohmmeter to remaining terminal of coolant temperature sensor.

- With the engine/sensor at normal operating temperature, about 93°C (200°F), the sensor impedance should be approximately 700 to 1,100 ohms.
- With the engine/sensor at room temperature, about 21°C (70°F), the sensor impedance should be approximately 7,000to 14,000 ohms.

Refer to "On Board Diagnostics" in the Fuel Injection General Diagnosis sections of Group 14 for further test procedures.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

Refer to "On Board Diagnostics" in the Fuel Injection General Diagnosis sections of Group 14 for MAP sensor testing.

SPARK ADVANCE (SBEC CONTROLLED) TEST

(1) Set basic timing. (Refer to Ignition Timing Procedure in the Service Procedures Section of this group).

(2) Engine at operating temperature. The temperature sensor must be connected and working properly.

(3) Raise and maintain engine speed to 2000 rpm, wait one minute and check advance (the DRBII diagnostic tool "SET ENGINE RPM" test in "SPECIAL FUNCTIONS" mode can be used to raise and maintain engine speed). Refer to Specifications at the rear of this group. Advance specifications are in addition to basic advance.

WARNING: WHILE PERFORMING THESE TESTS, IT IS NECESSARY TO USE A METAL EXHAUST EVACUATION TUBE. THE USE OF A RUBBER HOSE MAY RESULT IN A FIRE DUE TO HIGH TEMPERATURES AND LONG TEST PERIOD.

Replace the SBEC if the ignition timing fails to reach specified settings.

SERVICE PROCEDURES

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SINGLE BOARD ENGINE CONTROLLER (SBEC)

REMOVAL

CAUTION: Do not remove the grease from the SBEC 60-way connector. The grease is used to prevent moisture from contacting the connector terminals. Ensure that at least a 1/8 inch thick coating of grease covers the bottom of connector cavities. If not, apply a liberal coating of Mopar Multi-Purpose Grease to the connector prior to connecting it to the SBEC.

The Single Board Engine Controller (SBEC) is located on the dash panel.

(1) Remove air cleaner duct from SBEC.

(2) Remove (3) module mounting screws (Fig. 1).

(3) Remove 60-way electrical connector from the SBEC. Remove SBEC (Fig. 1).

INSTALLATION

(1) Connect 60-Way electrical connector to SBEC (Fig. 1).

(2) Mount SBEC to inside right front fender (Fig. 1). Install and tighten mounting screws.

(3) Install air cleaner duct to SBEC.

COOLANT TEMPERATURE SENSOR

(1) Disconnect electrical connector from sensor. Remove sensor and immediately plug hole in water jacket (Fig. 2). Some engine coolant may be lost.

(2) Install sensor and tighten to 27 N•m (20 ft. lbs.) torque. Connect electrical connector to sensor (Fig. 2).

(3) Replace any lost engine coolant. Refer to Group 7, Cooling System.

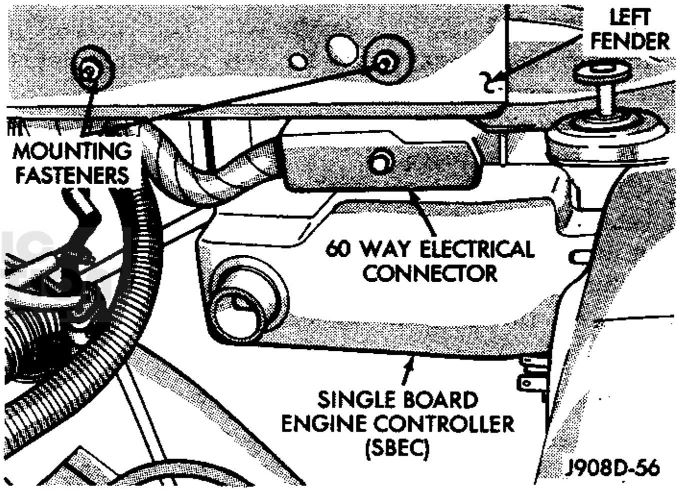

Fig. 1 Servicing the Single Board Engine Controller (SBEC)

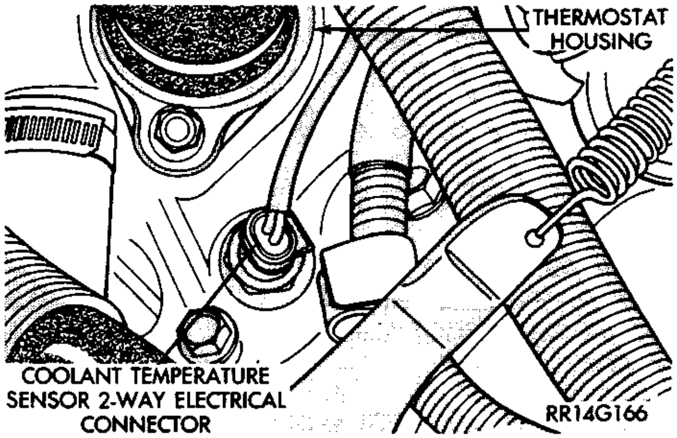

Fig. 2 Coolant Temperature Sensor

SPARK PLUG SERVICE

SPARK PLUG REMOVAL

Remove the spark plug cable by grasping at the spark plug boot turning the boot 1/2 turn and pulling straight back in a steady motion.

(1) Prior to removing the spark plug spray compressed air around the spark plug hole and the area around the spark plug.

(2) Remove the spark plug using a quality socket with a rubber or foam insert.

(3) Inspect the spark plug condition. Refer to Spark Plug Condition in the Component Identification section of this group.

INSPECTION

Inspect the spark plugs for the following items. Clean or replace if necessary.

(1) Cracked or damaged threads or insulator.

(2) Worn electrodes.

(3) Damaged or worn gasket.

(4) Condition of burnt electrode and amount of carbon deposit.

Refer to the General Information section of this group for information regarding spark plug condition.

SPARK PLUG GAP ADJUSTMENT

(1) Check the spark plug gap with a gap gauge. If the gap is not correct, adjust it by bending the ground electrode.

SPARK PLUG INSTALLATION

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten the spark plugs to 41 N•m (30 ft-lbs) torque.

(3) Install spark plug cables over spark plugs.

IDLE RPM TEST

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING IDLE CHECK OR ADJUSTMENT, OR ANY TESTS WITH A RUNNING ENGINE.

Engine idle set RPM should be tested and recorded when the vehicle is first brought into shop for testing. This will assist in diagnosing complaints of engine stalling, creeping, and hard shifting on vehicles equipped with automatic transmissions.

Test procedures are as follows:

(1) Connect red lead of test tachometer unit to negative primary terminal of coil and black lead to a good ground.

(2) Turn selector switch to the appropriate cylinder position of engine being tested.

(3) Turn tachometer rpm switch to 1,000 rpm position.

(4) With engine at normal operating temperature, momentarily open the throttle and release it to ensure there is no bind in the linkage and that the throttle lever is against its stop.

(5) Note engine rpm. Refer to Vehicle Emission Control Information (VECI) label for correct engine idle rpm. If not within specification, Refer to "On Board Diagnostics" section of Group 14, Fuel System for throttle body minimum air-flow check procedure.

IGNITION TIMING PROCEDURE

Proper ignition timing is required to obtain optimum engine performance. The distributor must be correctly indexed to provide correct initial ignition timing.

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE CHECKING IGNITION TIMING.

(1) Set the gearshift selector in park or neutral and apply the parking brake. All lights and accessories must be off.

(2) Using a magnetic timing unit, insert the pickup probe into the open receptacle in front of the timing scale (Fig. 3). If a magnetic timing unit is not available, use a conventional power timing light connected to the number one cylinder spark plug wire.

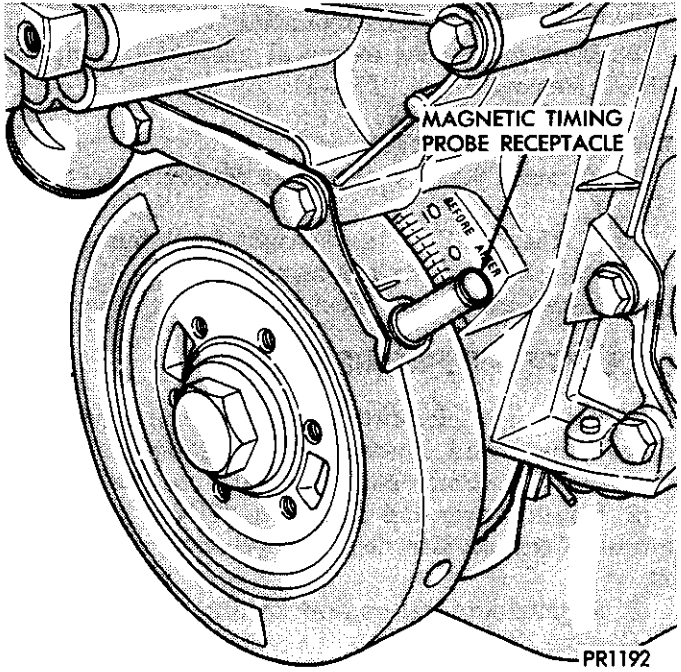

Fig. 3 Timing Marks

Do not puncture cables, boots or nipples with test probes. Always use proper adapters. Puncturing the spark plug cables with a probe will

damage the cables. The probe can separate the conductor and cause high resistance. Breaking the rubber insulation may permit secondary current to arc to ground.

(3) Turn selector switch to the appropriate cylinder position.

(4) Start engine and run until operating temperature is obtained.

(5) With engine at normal operating temperature, connect the DRBII diagnostic tool and access "BASIC TIMING MODE" in "SPECIAL FUNCTIONS" section (or disconnect coolant temperature sensor—Fig. 2). Instrument Panel lamp should come on if the coolant temperature sensor is disconnected.

(6) Aim Timing Light at timing scale (Fig. 3) or read magnetic timing unit.

- If flash occurs when timing mark is before specified degree mark, timing is advanced. To adjust, turn distributor housing in direction of rotor rotation.
- If flash occurs when timing mark is after specified degree mark, timing is retarded. To adjust, turn distributor housing against direction of rotor rotation. Refer to Vehicle Emission Control Information (VECI) label for correct timing specification. If timing is within ±2° of value specified on the label, proceed to step (8). If outside specified tolerance, proceed to next step.

(7) Loosen distributor hold-down arm screw just enough so the distributor housing can be rotated (Fig. 4). Turn distributor housing until specified label value is reached. Tighten the hold-down arm screw and recheck timing.

(8) Turn the engine off. Remove timing light or magnetic timing unit and tachometer. If the coolant temperature sensor was disconnected, connect the sensor and **erase fault codes using the Erase Fault Code Mode on the DRBII.** Refer to Group 14 General Diagnosis "On Board Diagnostics".

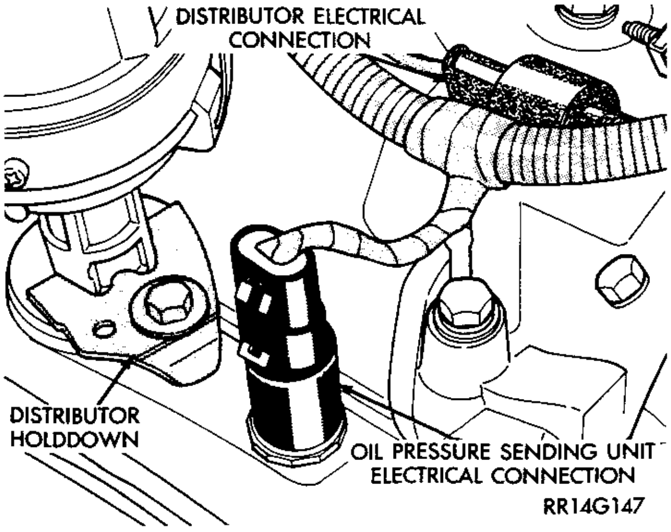

Fig. 4 Distributor Hold-Down

DISTRIBUTOR

REMOVAL

(1) Disconnect distributor pickup lead wire at wiring harness connectors.

(2) Unfasten distributor cap retaining clips and lift off distributor cap.

(3) Scribe a mark on the edge of distributor housing to indicate position of rotor as reference when reinstalling distributor.

(4) Remove distributor hold down clamp screw and clamp.

(5) Carefully lift distributor from engine.

INSTALLATION

(1) Position distributor in engine. Ensure rubber O-ring seal is in groove of distributor housing. Align rotor with marks previously made on distributor housing. Clean top of cylinder block to ensure a good seal between distributor base and block.

(2) Engage tongue of distributor shaft with slot in distributor oil pump drive gear. **If engine has been cranked while distributor is removed, it will be necessary to establish the proper relationship between distributor shaft and No. 1 piston position as follows:**

(a) Rotate crankshaft until number one piston is at top of compression stroke. Mark on crankshaft vibration damper should be in line with **"0" TDC** mark on timing chain case cover.

(b) Rotate rotor to position of number one distributor cap terminal.

(c) Lower distributor into opening, connect pickup coil leads and install distributor cap. Ensure all high-tension wires snap firmly in cap towers. Install distributor hold-down clamp screw. Tighten screw finger tight.

(3) Connect distributor pick-up lead wire(s) at wiring harness connectors.

(4) Adjust engine timing to Specification (refer to Ignition Timing).

HALL EFFECT PICK-UP ASSEMBLY REPLACEMENT

Removal

(1) Remove distributor cap. Refer to "Distributor Removal and Installation".

(2) Remove ignition rotor from distributor shaft (Fig. 5).

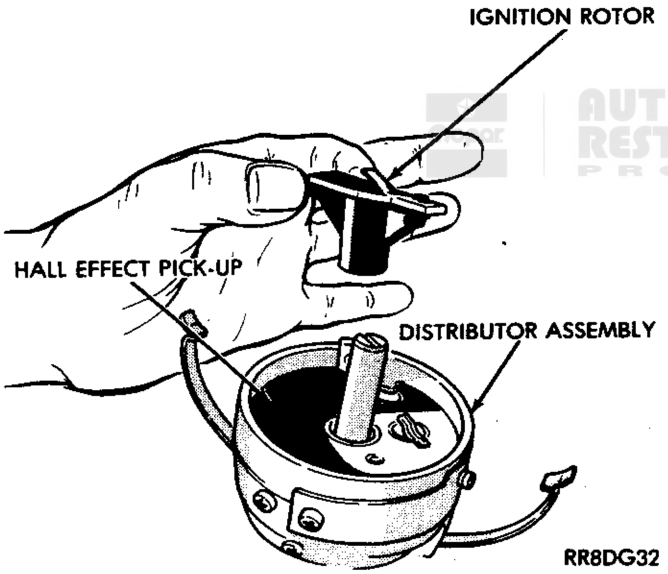

Fig. 5 Ignition Rotor Removal and Installation

(3) Remove hall effect pick-up attaching screws on opposite sides of the distributor housing and carefully lift the hall effect pick-up assembly from the distributor housing (Fig. 6).

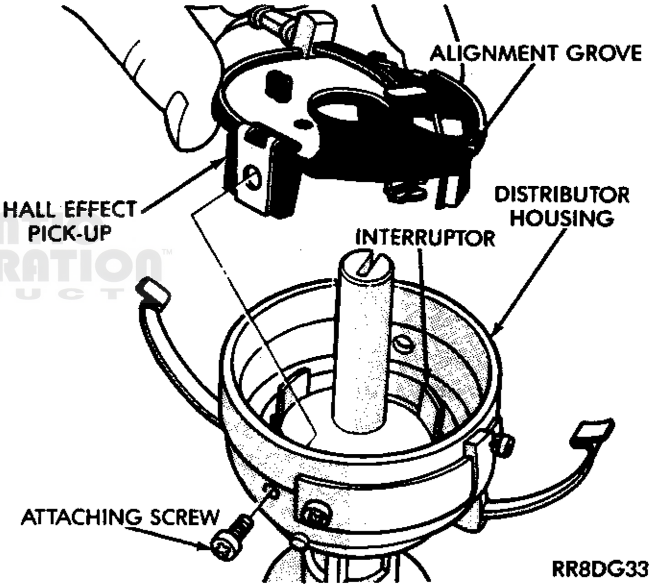

Fig. 6 Hall Effect Pick-Up Removal and Installation

Installation

To reinstall hall effect pick-up assembly follow the preceding procedure in reverse order.

SPECIFICATIONS

GENERAL INFORMATION

The following specifications are published from the latest information available at the time of publication. If anything differs from the specifications on the Vehicle Emission Control Information label, use the specifications on the label.

DISTRIBUTOR SPECIFICATIONS

Engine Application	**3.9L Engine**	**5.2L/5.9L Engine**
Application	Fed.–Cal.–Can.–Alt.	Fed.–Cal.–Can.–Alt.
Transmission	Manual & Automatic	Manual & Automatic
Duty Cycle	All	All
Spark System	SBEC-TBI	SBEC-TBI
Rotation	Clockwise	Clockwise
Firing Order	1-6-5-4-3-2	1-8-4-3-6-5-7-2
Basic Timing ± 2	10° BTDC	10° BTDC
Shaft Side Play	Not to Exceed 0.1mm (0.004″)	Not to Exceed 0.1mm (0.004″)
Shaft End Play	0.08 to 0.43mm (0.003″ to 0.017″)	0.08 to 0.43mm (0.003″ to 0.017″)

SBEC—Single Board Engine Controller TBI—Throttle Body Injection
Fed.—Federal Cal.—California Can.—Canada

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IGNITION COIL

Coil	**Chrysler Prestolite**	**Chrysler UTC**	**Diamond**
Primary Resistance at 70–80°F	1.34–1.55	1.34–1.55	1.34–1.55
Sec. Resistance at 70–80°C	9,400–11,700	9,000–12,200	15,000–19,000

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SPARK PLUGS

Engine	**Spark Plug**		**Application**	**Gap**	**Tightening Torque**	**Size**
	Original Equipment	**Replacement**				
3.9L	RN12YC	RN12YC	All	.035″ (0.9mm)	41 N•m (30 ft. lbs.)	14mm 3/4″ Reach
5.2L/5.9L	RN12YC	RN12YC	All			

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SENSOR SPECIFICATIONS

Component	No. of Terminals	Resistance at °F	Thread Compound	Thread Size and Torque Reference
Coolant Temperature Sensor	2	7,000–13,000 Ohms at 21°C (70°F)*	Preapplied	3/8–18 NPTF 27 N·m (20 ft. lbs.)
		700–1,000 Ohms at 93°C (200°F)		
Throttle Body Temperature Sensor	2	5,600–14,600 Ohms at 12°C (70°F)*	Mopar Silicone Heat Transfer Compound	M12 × 1.5 11 N·m (100 in. lbs.)
		400–1,500 Ohms at 93°C (200°F) *		

*Temperature ratings are nominal values and will vary slightly.

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INSTRUMENT PANEL AND GAUGES

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INSTRUMENT CLUSTER (Fig. 1)

D-body trucks have an instrument cluster which includes gauges for fuel level, coolant temperature, oil pressure, and charging system voltage (Fig. 1). There is also a warning lamp for low oil pressure. When the ignition switch is in the OFF position all the gauges will show a reading except the voltage gauge. However, the readings are only accurate when the ignition switch is in the ON position.

The cluster also includes warning lamps for seat belt warning, and liftgate open (Ramcharger only).

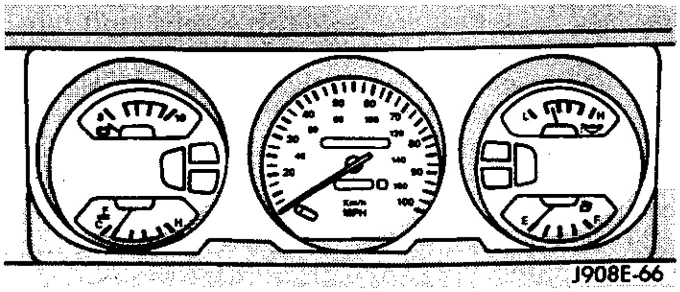

Fig. 1 Instrument Cluster

MESSAGE CENTER—GAS ENGINE

The message center (Fig. 2), which is located above the Heater-A/C controls, includes warning lamps for the brake systems (parking and service) anti-lock brakes, the check engine system and maintenance required.

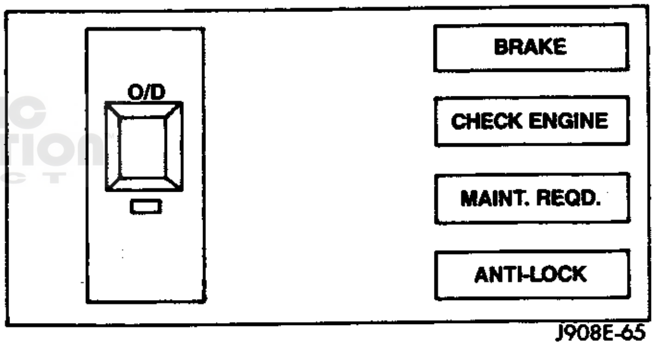

Fig. 2 Message Center—Gas Engine

CHECK ENGINE

If the input from one of the following sensors fails an internal SBEC self check, the controller turns on the Check Engine Lamp and substitutes a modified signal in place of the one that failed until a repair is made:

- Manifold Absolute Pressure (MAP) Sensor
- Throttle Position Sensor
- Coolant Temperature Sensor
- Battery Voltage Sense
- Battery Voltage Too High

Refer to the approriate Powertrain Diagnostic Test Procedures manual for further information.

EMISSIONS MAINTENANCE REMINDER

This system is designed to act as a reminder that scheduled vehicle emissions maintenance should be performed. **It is not intended to indicate a warning or that a state of emergency exists which must be corrected to insure safe vehicle operation.** The components covered by the system include the EGR system, PCV valve, and oxygen sensor.

Refer to Group 25 - Emissions, for further information.

ANTI-LOCK WARNING LIGHT

This light monitors the Anti-Lock Brake System. This light will come on when the ignition key is turned to the ON position and may stay on for as long as thirty seconds. If the Anti-Lock light remains on or comes on during driving, it indicates that the Anti-Lock portion of the brake system is not functioning. Refer to Group 5 - Brakes for further information.

BRAKE SYSTEM WARNING LIGHT

The dual brake system provides a reserve braking capability in the event of a failure to a portion of the hydraulic system. Failure of either of the dual system is indicated by the brake warning light which will glow when the service brake pedal is depressed. The light will remain on until the cause is corrected.

The light will also come on when the parking brake is applied with the ignition in the ON position. Refer to Group 5 - Brakes for further information.

MESSAGE CENTER—DIESEL ENGINE

The message center (Fig. 3), which is located above the Heater-A/C controls, includes warning lamps for the brake systems (parking, service brakes) anti-lock brakes, water in fuel, wait to start (controlled by Air Heater Control Module) and Low Fuel.

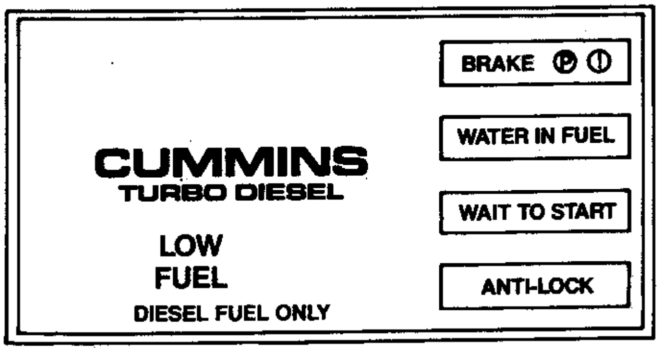

Fig. 3 Message Center—Diesel Engine

ANTI-LOCK WARNING LIGHT

This light monitors the Anti-Lock Brake System. This light will come on when the ignition key is turned to the ON position and may stay on for as long as thirty seconds. If the Anti-Lock light remains on or comes on during driving, it indicates that the Anti-Lock portion of the brake system is not functioning. Refer to Group 5 - Brakes for further information.

BRAKE SYSTEM WARNING LIGHT

The Brake light is connected to a sensor that monitors vacuum in the brake booster system. The Brake light when lit indicates LOW VACUUM.

The dual brake system provides a reserve braking capability in the event of a failure to a portion of the hydraulic system. Failure of either of the dual system is indicated by the brake warning light which will glow when the service brake pedal is depressed. The light will remain on until the cause is corrected.

The light will also come on when the parking brake is applied with the ignition in the ON position. Refer to Group 5 - Brakes for further information.

WATER IN FUEL

The Water In Fuel light is connected to a sensor located in the fuel filter. If water collects in the fuel/ water separator filter, the Water In Fuel indicator will light.

WAIT TO START

The Wait To Start light is connected to a sensor that monitors the intake air temperature in the intake manifold. When the engine air temperature is low and the ignition switch is in the ON position, the control module sends current to the intake manifold air heaters and the Wait To Start light. This intake manifold preheat cycle is controlled by an electronic Air Heater Control Module.

LOW FUEL

The Low Fuel light is connected to a sensor in the fuel tank. When the fuel level reaches approximately 1/6 of a tank, the words LOW FUEL will illuminate and remain on until fuel is added.

ELECTRONIC DIGITAL CLOCK

The electronic digital clock is in the radio. The clock and radio each use the display panel built into the radio. A digital readout indicates the time in hours and minutes whenever the ignition switch is in the ON or ACC position.

When the ignition switch is in the OFF position or when the radio frequency is being displayed, time keeping is accurately maintained.

The procedure for setting the clock varies slightly with each radio. The correct procedure is described under the individual radio operating instructions referred to in the Owner Manual supplied with the vehicle.

FUEL LEVEL INDICATING SYSTEM (FIG. 4)

A hinged float arm in the fuel tank raises or lowers depending on the fuel level. The float arm contacts a variable resistor in the gauge sending unit that provides a change of resistance in the fuel gauge circuit with any up or down movement of the float. This sender resistance is shown as fuel level on the gauge.

When the fuel level in the tank is low, the float arm drops, resistance of the fuel level sender is increased, current flow decreases and positions the instrument cluster gauge pointer to empty.

When the tank is full of fuel, the float arm rises, resistance of the fuel level sender decreases, current flow increases and positions the instrument cluster gauge to full.

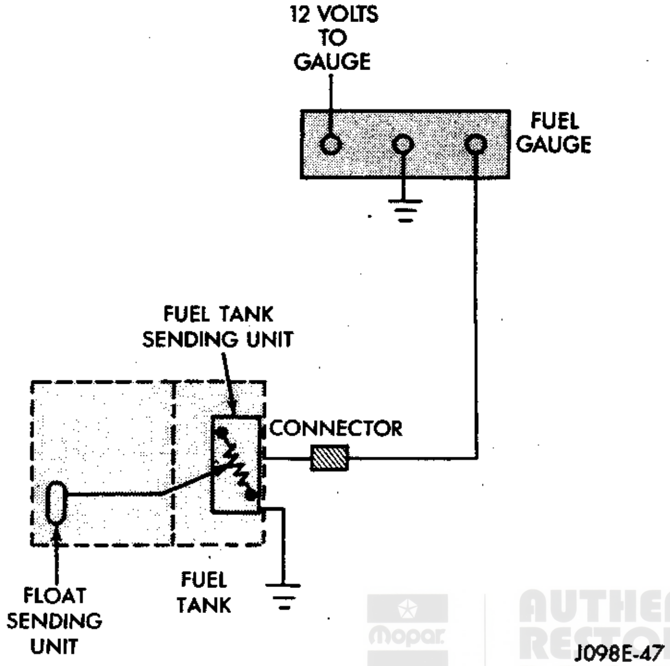

Fig. 4 Fuel Level Indicating System

TEMPERATURE AND OIL INDICATING SYSTEM (FIG. 5)

The operation of the temperature and oil pressure indicating systems are identical. In the temperature system the sending unit resistance varies in direct relationship to the temperature of the coolant.

When the engine is cold, the resistance of the temperature sending unit is high and a cold temperature will be indicated on the gauge.

When the engine is hot, the resistance of the temperature sending unit is low and a hot temperature will be indicated on the gauge.

In the oil pressure indicating system the sending unit resistance is actuated by a diaphragm as the oil pressure increases or decreases. Low oil pressure causes high resistance. High pressure causes low resistance.

OIL PRESSURE WARNING LAMP

The oil pressure warning switch, mounted on the engine, is controlled by engine oil pressure.

When engine oil pressure is normal, the switch is held in the OFF or OPEN position allowing no current to flow to the oil pressure warning lamp on instrument panel.

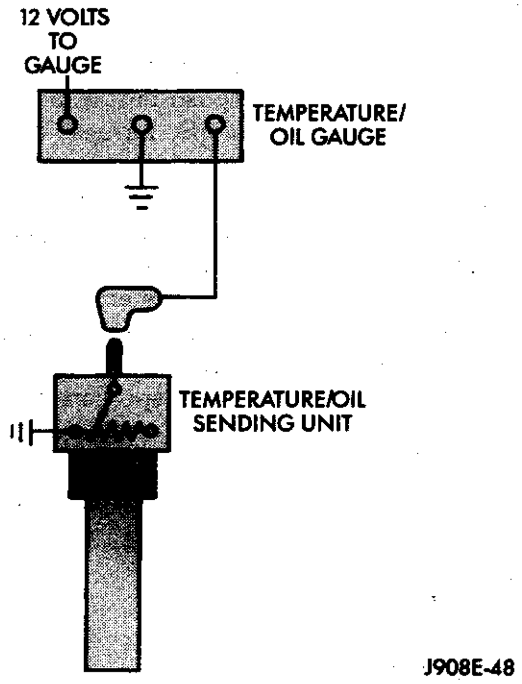

Fig. 5 Temperature/Oil Indicating System

When the engine oil pressure is low, the switch is in the ON or CLOSED position allowing current to flow to the oil pressure warning lamp on the instrument cluster causing the warning lamp to be illuminated.

ALTERNATOR INDICATING SYSTEM (FIG. 6)

The voltmeter gauge senses the voltage of the electrical system.

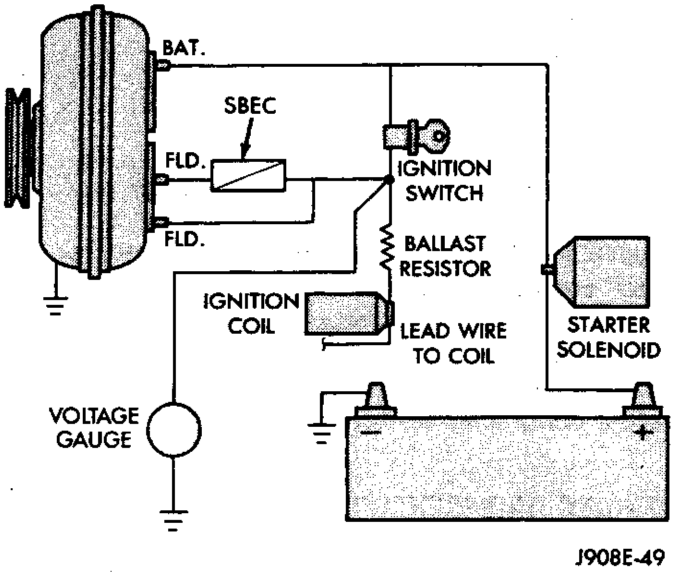

Fig. 6 Alternator Indicating System

SPEEDOMETER/ODOMETER SYSTEM

The speedometer/odometer system consists of an electric speedometer and push button reset odometer, mounted in the cluster, a wire harness from the cluster to the distance sensor at the transmission, and the adapter and pinion in the transmission. The speedometer/odometer has the same appearance as a conventional speedometer/odometer but it eliminates the cable-driven mechanical system. A signal is sent from a transmission mounted distance sensor to the speedometer/odometer circuitry through the wiring harness. By eliminating the speedometer cable, instrument cluster service and removal is improved. Refer to Group 21 - Transmission for selecting the proper pinion, and selecting and indexing the proper adapter.

DISTANCE SENSOR

DISTANCE SENSOR TEST

For testing of the distance sensor and related components refer to the Vehicle Diagnostics Test Procedure Manual.

DISTANCE SENSOR REMOVAL AND INSTALLATION

(1) Remove harness connector from sensor. Be sure weather seal stays on harness connector.

(2) Remove sensor by loosening sensor coupling nut from the pinion gear adapter until sensor is free (Fig. 7).

(3) To install the sensor, reverse the removal procedures. Tighten coupling nut to 17 N•m (150 in. lbs.)

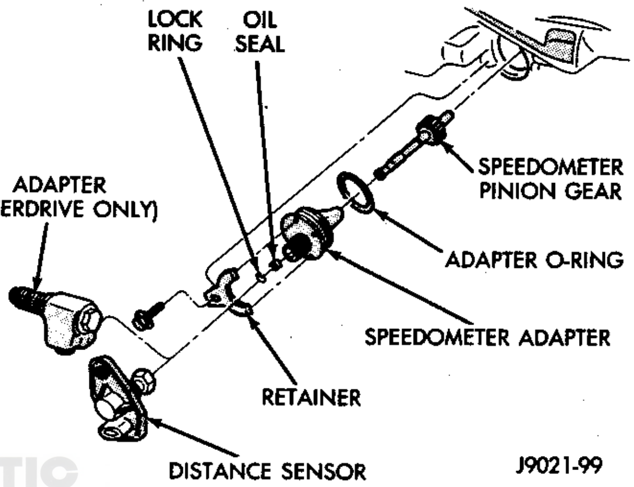

Fig. 7 Distance Sensor

CLUSTER AND GAUGE SERVICE AND TESTING

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CAUTION: Disconnect battery negative cable, in engine compartment, before servicing instrument panel. When power is required for test purposes, connect battery cable (for test only).

Disconnect battery negative cable after test and before continuing service procedures.

SENDING UNIT (SENSOR) TEST

When a problem occurs with a cluster gauge, before disassembling the cluster to check the gauge, check for a defective sending unit (sensor) or wiring.

(1) Sending units and wiring can be checked by grounding the connector leads, at the sending unit, in the vehicle.

CAUTION: When connecting an input terminal to ground, Do Not leave the connection grounded for more than a few seconds.

(2) With the ignition in the ON position; a grounded input will cause the oil, fuel or temperature gauge to read at or above maximum.

FUEL TANK SENDING UNIT TEST

(1) Disconnect wire from terminal on fuel tank sending unit (Fig. 1).

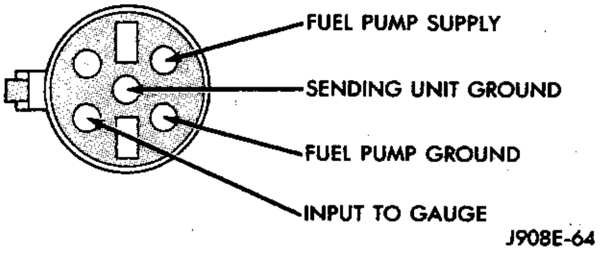


Fig. 1 Fuel Tank Sending Connector Terminals

(2) Connect wire to a known good sending unit.

(3) Connect a jumper wire between sending unit fuel pick up tube and a good ground.

(4) Check fuel gauge as described in following steps. Allow at least three minutes at each test point for gauge to settle. Lightly tapping instrument cluster may help position pointer.

(5) Clip float arm of sending unit to its empty stop (Fig. 2) and turn ignition key to ON position. The gauge should read Empty, plus one pointer width, or minus two pointer widths.

(6) Move and clip sending unit float arm to full stop. The gauge should read Full, or above.

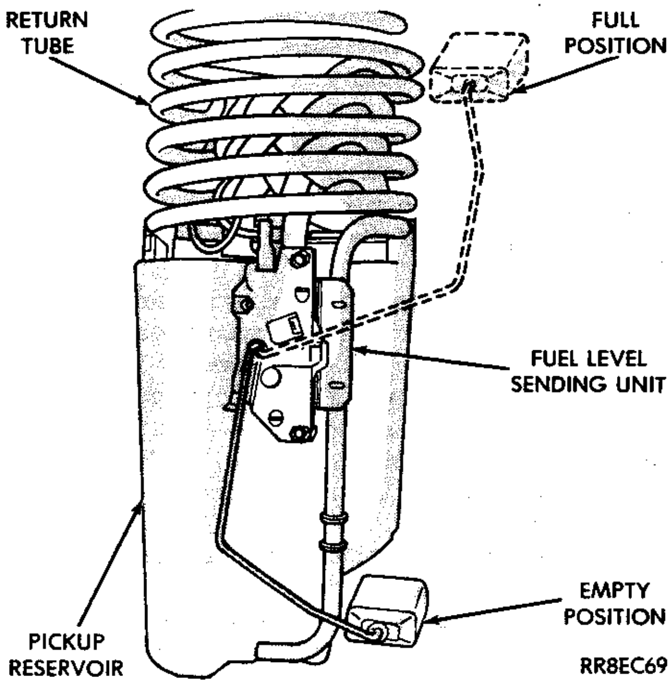


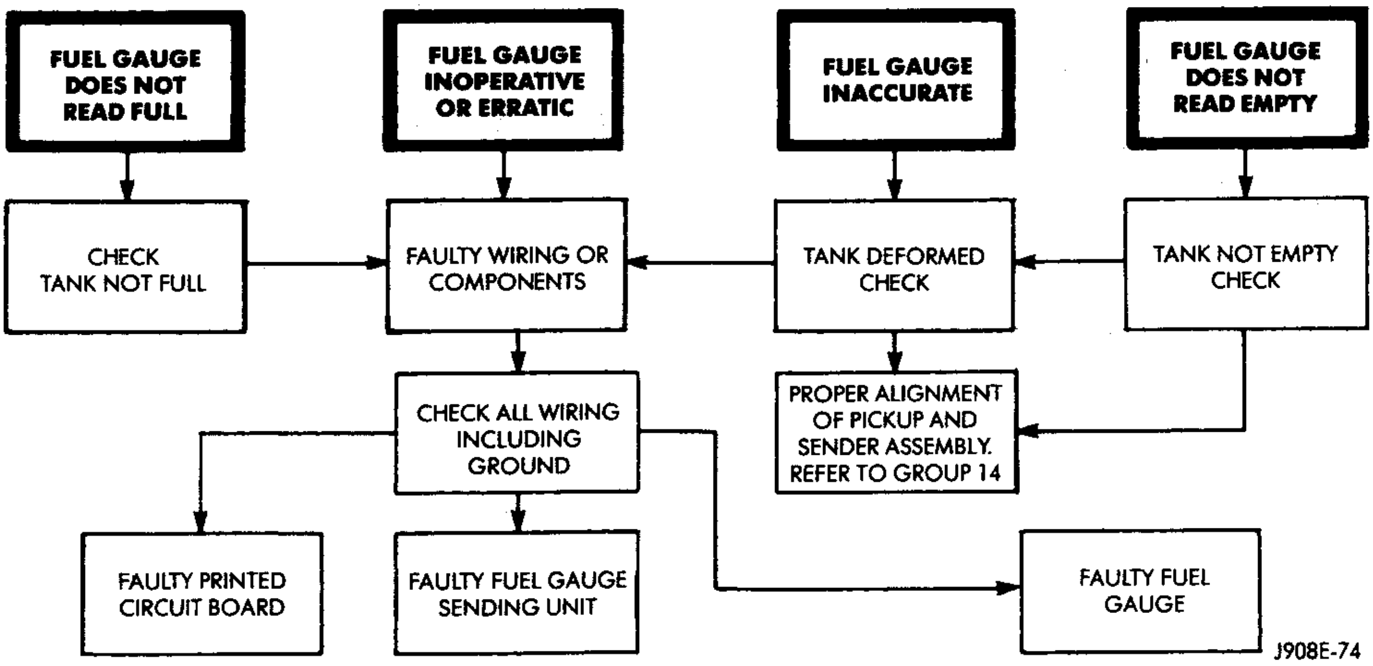
Fig. 2 Fuel Tank Sending Unit Test

RESULTS

(1) If fuel gauge does not meet specifications, check following items as possible causes;

(a) Wiring and connections between the gauge sending unit and multiple connector.

FUEL GAUGE SYSTEM DIAGNOSIS



(b) Wiring and connections between multiple connector and printed circuit board terminals.

(c) Circuit continuity between printed circuit board terminals and gauge terminals.

If these items check okay, fuel gauge is defective and must be replaced.

(2) If the fuel gauge meets specifications check fuel tank and original installed fuel tank sending unit as follows:

(a) Carefully remove fuel tank sending unit from tank. Connect sending unit wire and jumper wire as described in the procedure.

(3) If fuel gauge now checks within specifications, originally installed sending unit is electrically okay, check following as possible cause:

(a) Ground strap from sending unit to fuel line for continuity.

(b) Sending unit deformed. Make sure sending unit float arm moves freely, pick up tube is not bent upwards so that there is not an interference fit with bottom of tank and inspect float.

(c) Sending unit improperly installed. Install properly.

(d) Mounting flange on fuel tank for sending unit deformed. Feel for interference fit of sending unit to bottom of tank. It is permissible to bend pick up tube down a little near mounting flange to gain interference fit.

(e) Fuel tank bottom deformed causing improper positioning of sending unit pick up tube. Replace or repair tank and recheck sending unit. Refer to Fuel Tank Section of Group 14 - Fuel System.

WARNING LAMP SYSTEM TESTS

LOW OIL PRESSURE WARNING LAMP CIRCUIT TEST

The low oil pressure warning lamp will illuminate when the ignition key is turned to the ON position. The lamp also illuminates if the engine oil pressure drops below a safe oil pressure level.

To test the system turn ignition key to the ON position.

If the lamp fails to light, inspect for a broken or disconnected wire at the oil pressure combination unit, which is located at the rear of the engine (Fig. 3). If the wire at the connector checks good, pull connector loose from the switch and with a jumper wire ground the light switch terminal to the engine (Fig. 4). With the ignition key turned to the ON position check the warning lamp. If lamp still fails to light, inspect for a burned out bulb or disconnected socket in the cluster.

If light comes on, proceed and start engine. If the lamp remains on, immediately turn engine off and check engine oil pressure according to procedures as outlined in Group 9 - Engine of this manual. If it is determined that oil pressure is according to specifications, check for a grounded wire and/or replace the oil pressure sending unit (refer to combination oil unit test).

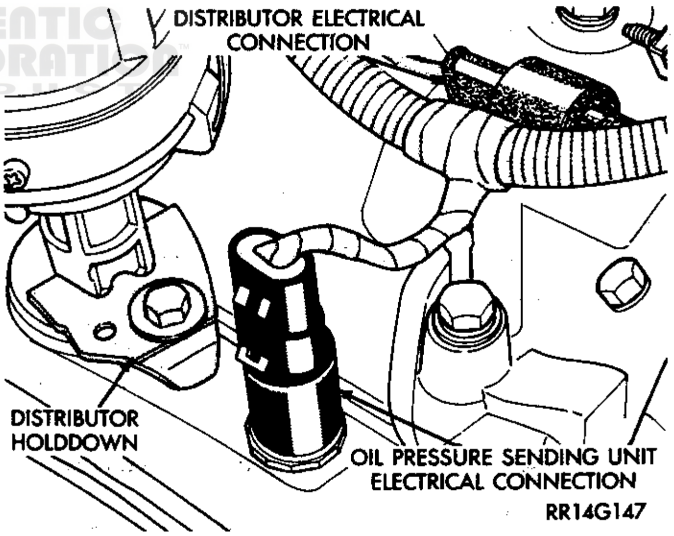
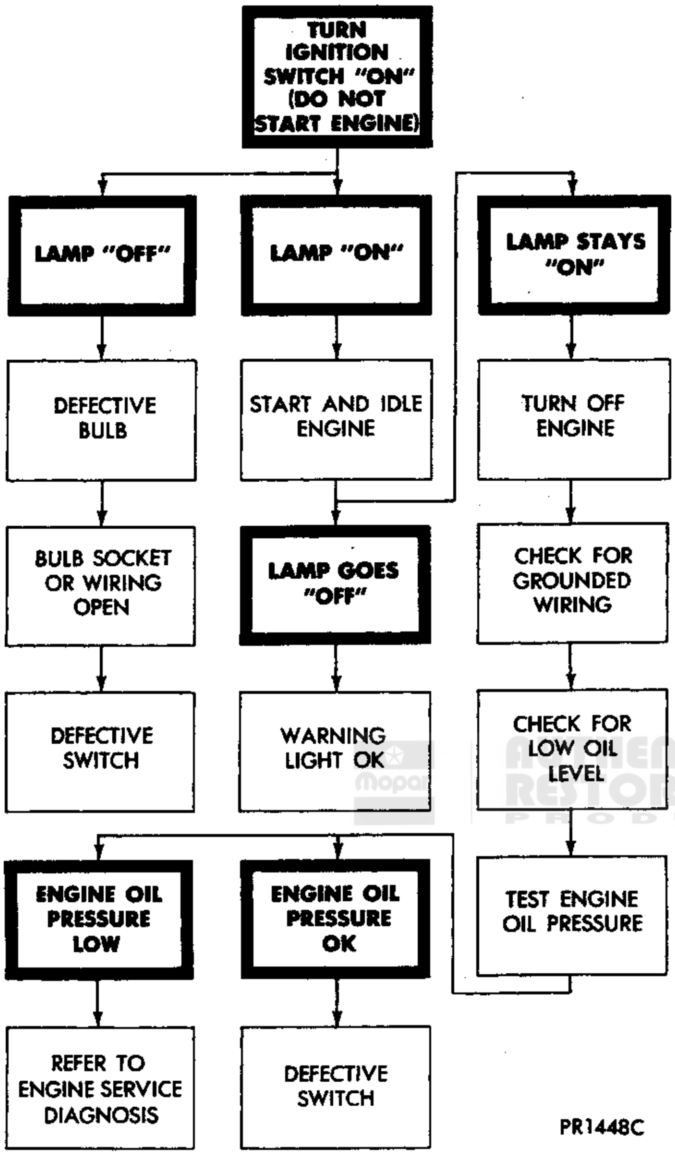


Fig. 3 Combination Oil Switch and Connection

ENGINE WARNING LAMP DIAGNOSIS OIL PRESSURE FUNCTION



COMBINATION OIL UNIT TEST (FIG. 4)

The combination oil unit has 2 functions:

(1) The normal closed circuit keeps the oil pressure warning lamp on until there is oil pressure.

(2) The sending provides a resistance that varies with oil pressure.

To test the normally closed oil lamp switch, disconnect the locking connector and measure the resistance between the switch terminal and the metal housing. The ohmmeter should read 0 ohms. Start the engine.

If there is oil pressure, the ohmmeter should read an open circuit.

To test the sending unit, measure the resistance between the sending unit terminal and the metal housing. The ohmmeter should read open. Start the engine.

The ohmmeter should read between 30 to 55 ohms, depending on engine speed, oil temperature, and oil viscosity.

If the above results are not obtained, replace the switch.

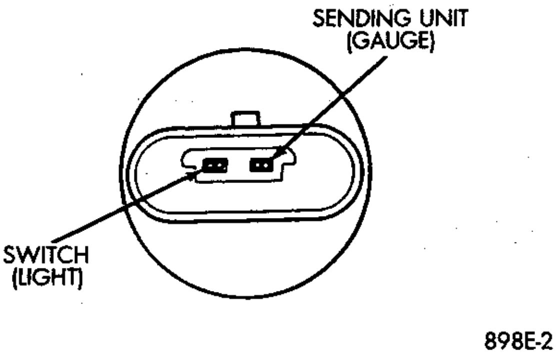


Fig. 4 Combination Oil Unit Terminals

SEAT BELT WARNING SYSTEM

For testing of this system refer to Section 8M - Seat Belt Warning Systems.

BRAKE SYSTEM WARNING LAMP (FIG. 5)

The brake warning lamp illuminates when the parking brake is applied with the ignition key turned ON. The same lamp will also illuminate should one of the two service brake systems fail when the brake pedal is applied. To test the system turn the ignition key ON, and apply the parking brake. If the lamp fails to light, inspect for a burned out bulb, disconnected socket, a broken or disconnected wire at the switch. The lamp also lights when the ignition switch is turned to the START position.

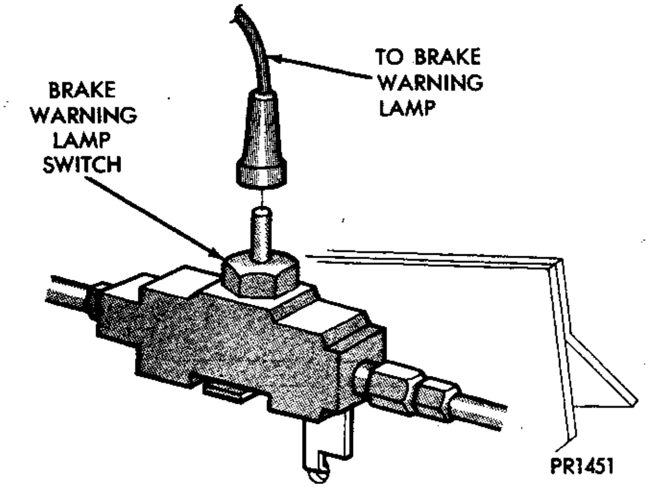
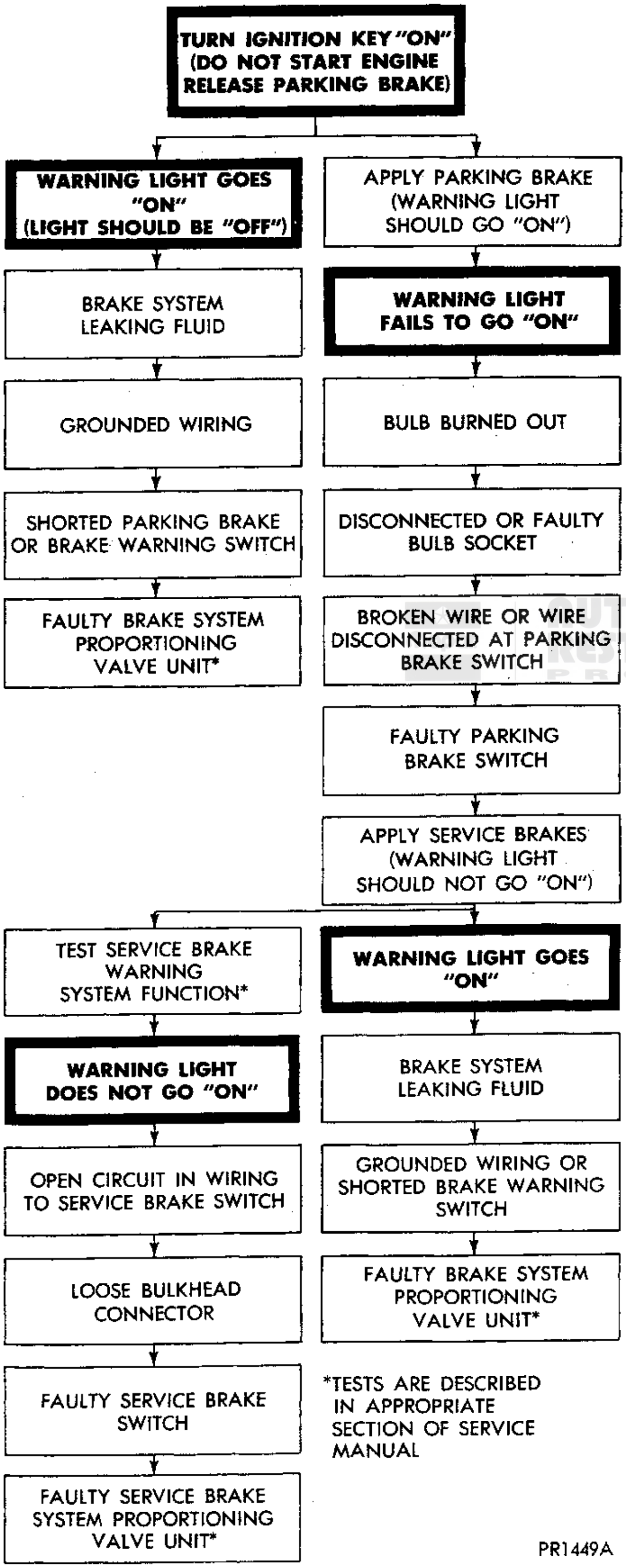


Fig. 5 Brake Warning Lamp Switch

To test the service brake warning system, raise the vehicle on a hoist and open a wheel cylinder bleeder while a helper depresses the brake pedal and observes the warning lamp. If the lamp fails to light, inspect for a burned out bulb, disconnected socket, a broken or disconnected wire at the switch. If the bulb is not burned out and the wire continuity is proven, replace the brake warning switch in the brake line Tee fitting mounted on the frame rail in the engine compartment below the master cylinder.



CAUTION: If wheel cylinder bleeder was opened check master cylinder fluid level.

Diesel The Brake light is also connected to a sensor that monitors vacuum in the brake booster system. The Brake light when lit indicates LOW VACUUM. Refer to the Diesel supplement for more information.

CLUSTER BEZEL

REMOVAL

(1) Disconnect battery negative cable.

(2) Tape or cover steering column to prevent damage to paint.

(3) Remove 2 screws and remove map lamp.

(4) Remove 6 screws which attach cluster bezel to base panel (Fig. 6). Make sure the screw below the Heater-/C control is removed.

(5) Place column shift lever in Position "1".

(6) Remove bezel by pulling top edge rearward to clear brow. Disengage attaching clips around bottom of bezel and complete removal of bezel.

(7) If bezel is equipped with a four wheel drive indicator, remove bulb socket as bezel is removed.

(8) Disconnect message center wires.

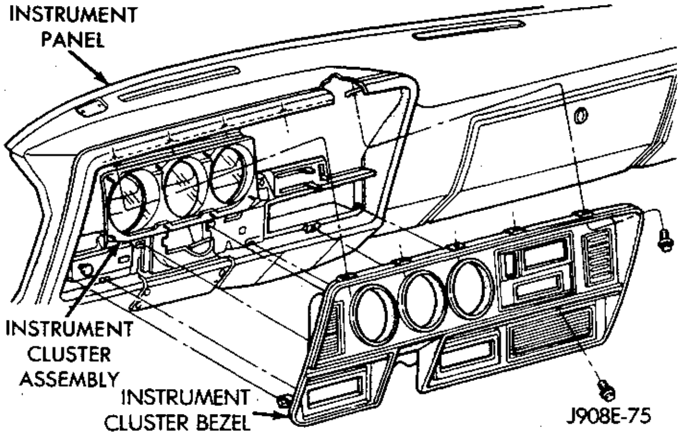


Fig. 6 Instrument Cluster Bezel

INSTALLATION

(1) Connect bulb socket for four wheel drive indicator if equipped.

(2) Connect message center wires.

(3) Engage attaching clips around bottom of bezel, roll bezel into position.

(4) Install 6 mounting screws.

(5) Install map lamp.

(6) Remove tape from steering column.

(7) Connect battery cable.

CLUSTER MASK AND LENS

REMOVAL

(1) Disconnect battery negative cable.
(2) Remove bezel.
(3) Remove 8 screws.
(4) Remove mask and lens.

INSTALLATION

(1) Position mask and lens.
(2) Install 8 screws.
(3) Install bezel.
(4) Connect battery cable.

INSTRUMENT CLUSTER ASSEMBLY (Fig. 7)

REMOVAL

(1) Disconnect battery negative cable.

(2) Tape or cover steering column to prevent damage to paint.

(3) Remove bezel.

(4) Remove lower steering column cover 4 screws.

(5) Spread upper steering column cover out of the locking tangs and slide downward.

(6) Disconnect PRND21 actuator cable from steering column if equipped.

(7) Loosen heater and A/C control. Pull rearward to clear forward mount on cluster housing.

(8) Remove 6 screws that retain cluster. Pull cluster rearward and disconnect 2 large connectors.

(9) Remove cluster.

INSTALLATION

(1) Connect 2 large connectors to cluster.

(2) Position cluster to instrument panel and install 6 retaining screws.

(3) Install heater A/C control.

(4) Connect PRND21 actuator to steering column if equipped.

(5) Position upper steering column cover and slide upward until tangs snap into place.

(6) Position lower steering cover and install 4 screws.

(7) Install bezel.

(8) Remove protective cover from steering column.

(9) Connect battery cable.

(10) Check to see that all instruments are functioning properly.

PRINTED CIRCUIT BOARD

A visual inspection of the conductors should be made for cracks or damaged circuits. If no visual damage is evident, each circuit should be tested for

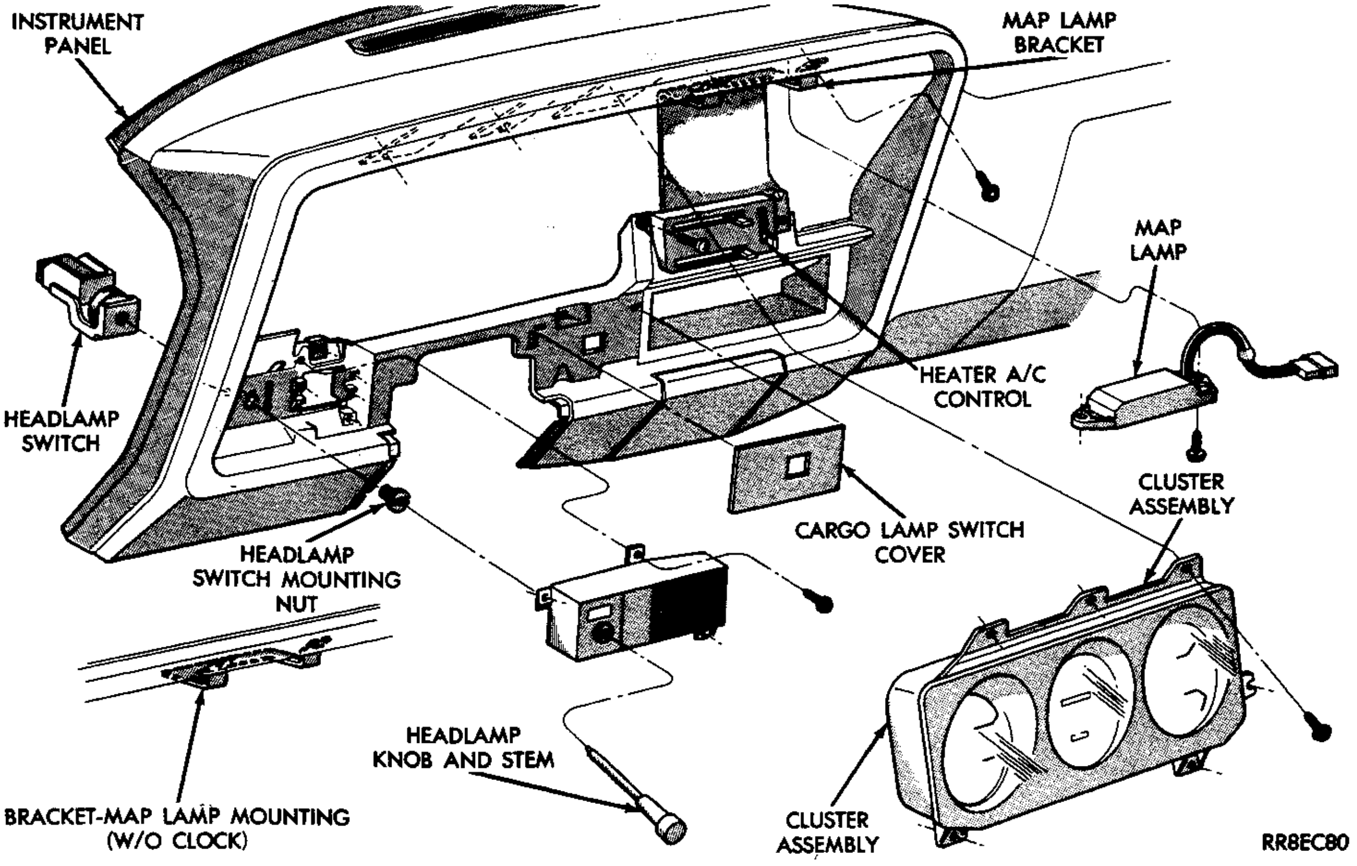


Fig. 7 Instrument Panel Cluster and Switches

continuity with an ohmmeter or a test light. Should an open circuit be detected, the printed circuit board should be replaced.

REMOVAL (FIG. 8)

(1) Remove instrument cluster. See cluster removal.
(2) Remove lamp socket assemblies.
(3) Remove gauge mounting screws and remove gauges.
(4) Remove printed circuit board mounting screws.
(5) Remove printed circuit board from cluster housing.

INSTALLATION

CAUTION: Do not overtighten mounting screws or damage to circuit board and/or cluster housing will occur.

(1) Position printed circuit board on cluster housing, install mounting screws and tighten.
(2) Install gauges.
(3) Install lamp socket assemblies. Be sure illumination lamp diffusers are installed.
(4) Install instrument cluster.

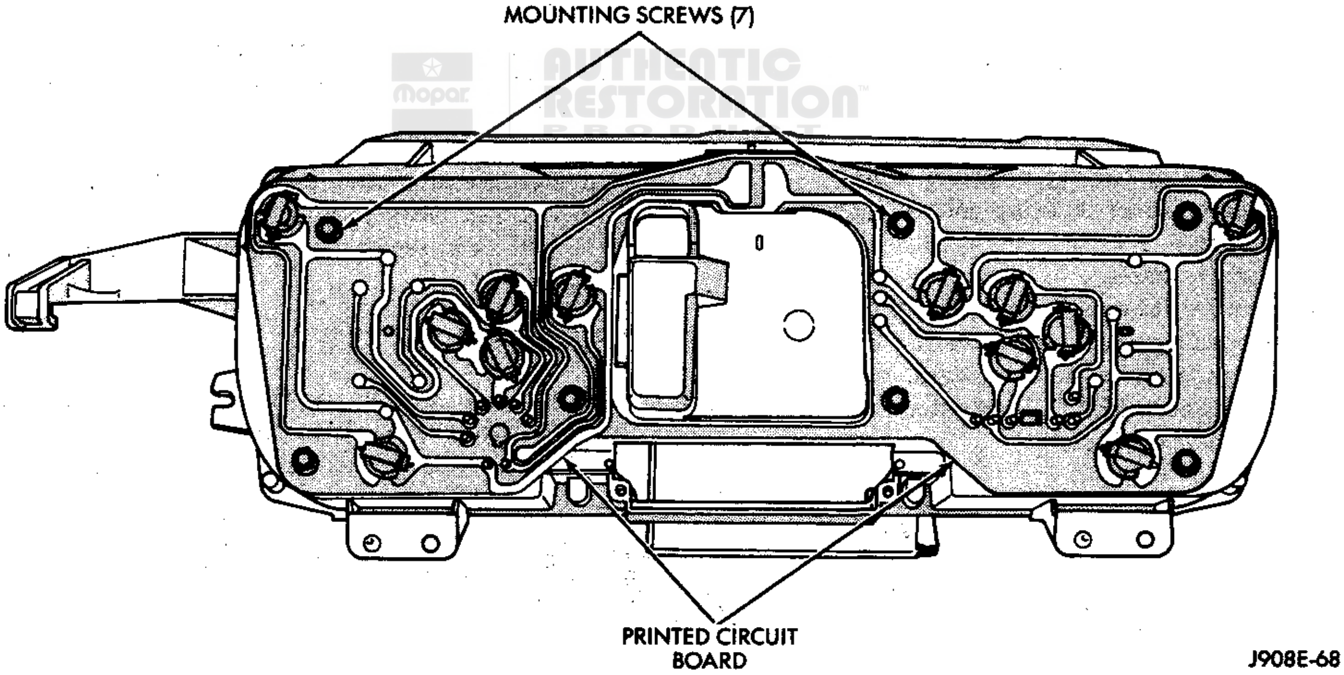


Fig. 8 Printed Circuit Board

GAUGE REPLACEMENT

It is not necessary to remove instrument cluster from vehicle for gauge replacement.

When removing gauge assemblies (Fig. 9) from cluster, gauge must be pulled straight out, not twisted, or damage to gauge pin and/or printed circuit board may result.

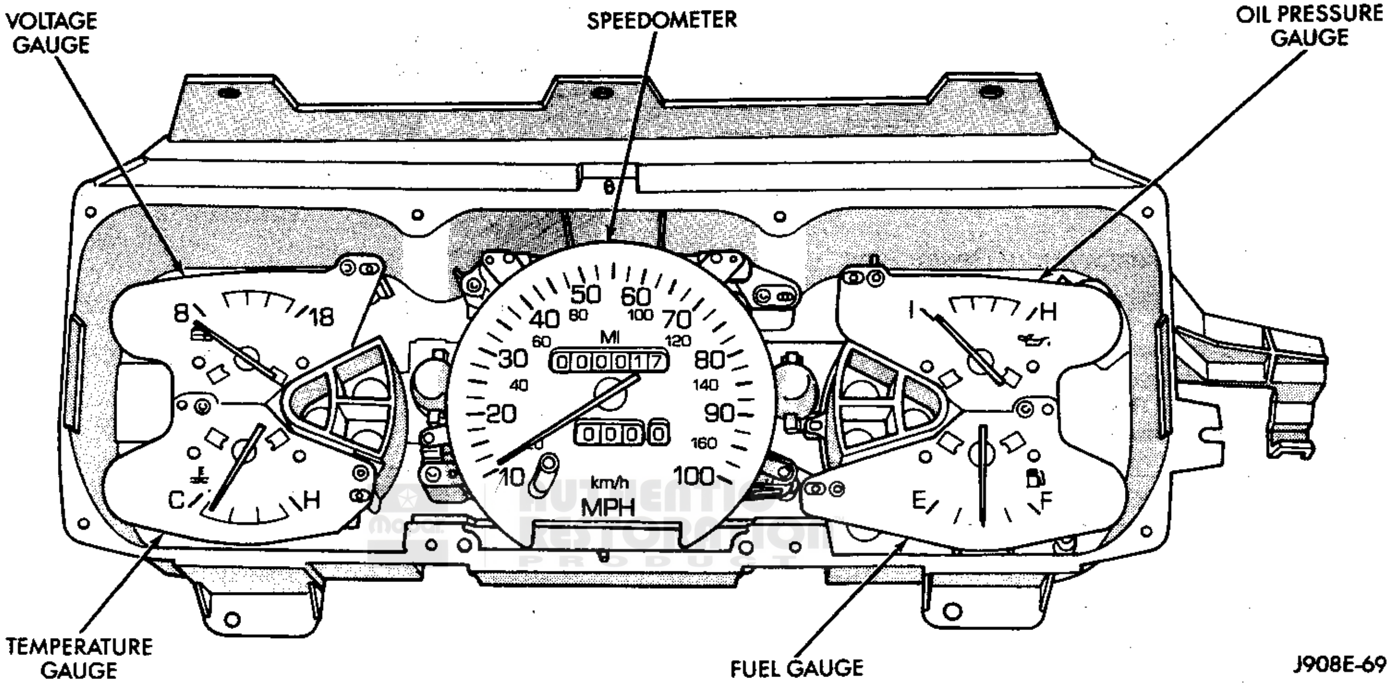


Fig. 9 Cluster With Mask Removed

FUEL GAUGE

Temperature Gauge
Voltage Gauge
Oil Pressure Gauge

(1) Disconnect battery negative cable.

(2) Remove bezel. Refer to Cluster Bezel Removal.

(3) Remove cluster mask and lens. Refer to Cluster Mask and Lens Removal.

(4) Remove gauge mounting screws.

(5) Pull gauge rearward to remove.

For Installation, reverse Removal procedures.

SPEEDOMETER/ODOMETER

(1) Disconnect battery negative cable.

(2) Remove bezel. Refer to Cluster Bezel Removal.

(3) Remove cluster mask and lens. Refer to Cluster Mask and Lens Removal.

(4) Remove mounting screws retaining speedometer/odometer to housing.

(5) Pull speedometer/odometer rearward to remove.

For Installation, reverse Removal procedures.

GAUGE AND GAUGE CIRCUIT TESTING

TEMPERATURE GAUGE CIRCUIT TEST

(1) Remove temperature gauge. Refer to Gauge Replacement.

(2) Check continuity in the wire between the temperature sensor and the temperature gauge (sensor input pin) (Figs. 10 and 11).

(3) With the ignition switch in the ON position, check for battery voltage across the B+ pin and the Ground pin.

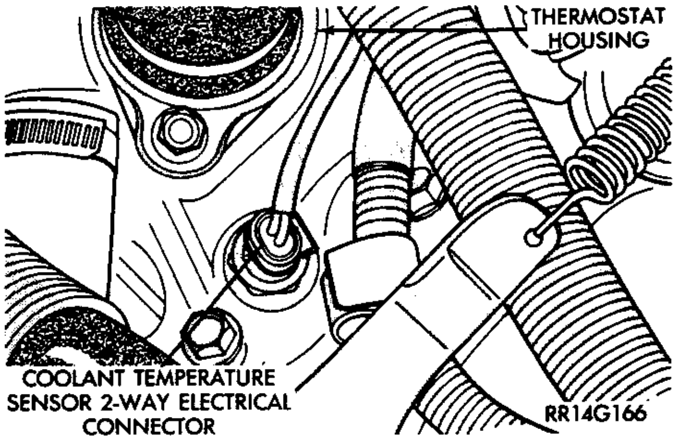


Fig. 10 Coolant Temperature Sensor

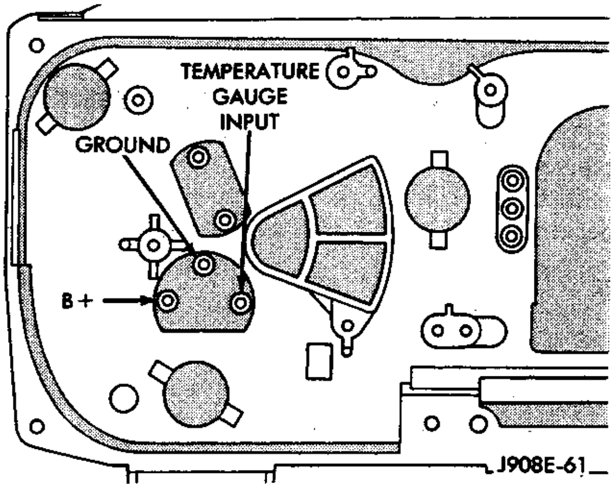
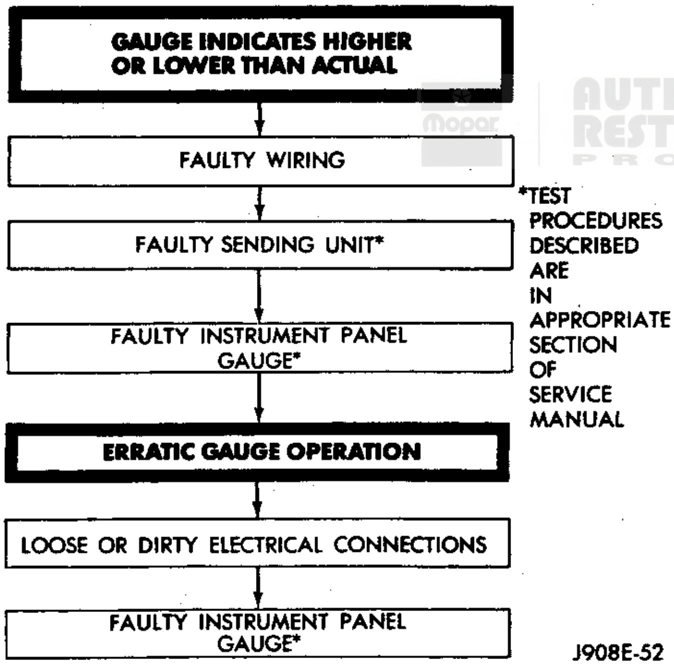


Fig. 11 Temperature Gauge Pins

TEMPERATURE/OIL/FUEL GAUGE DIAGNOSIS



OIL PRESSURE GAUGE CIRCUIT TEST

(1) Remove oil pressure gauge. Refer to Gauge Replacement.

(2) Check for continuity in the wire between the oil pressure sensor and the oil pressure gauge (sensor input pin) (Figs. 12, 13 and 14).

(3) With the ignition switch in the ON position, check for battery voltage across the B+ pin and the Ground pin.

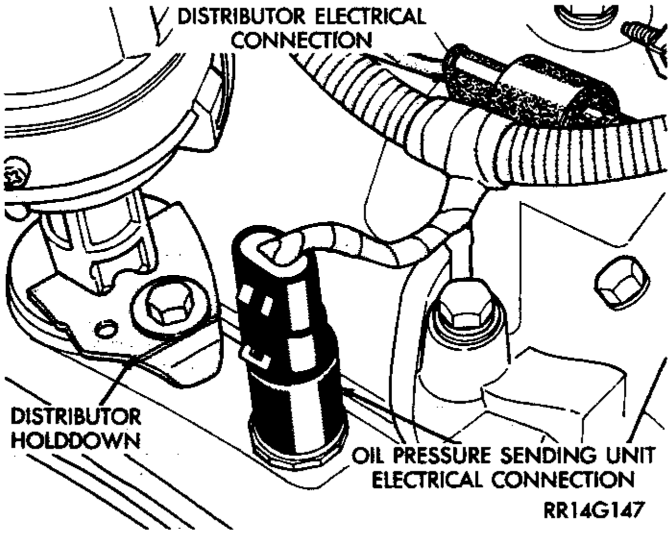


Fig. 12 Combination Oil Switch and Connection

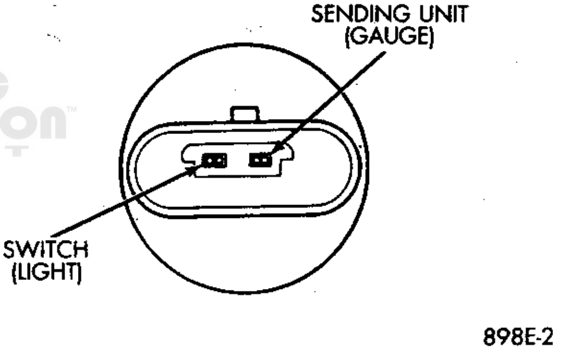


Fig. 13 Combination Oil Unit Terminals

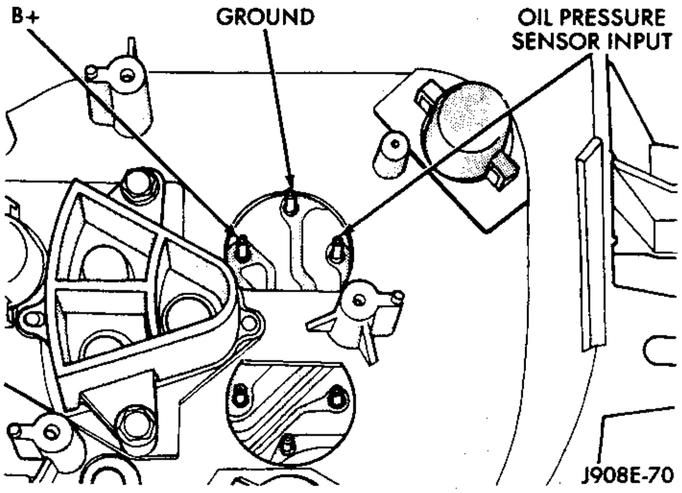


Fig. 14 Oil Pressure Gauge Pins

FUEL GAUGE CIRCUIT TEST

(1) Remove fuel gauge assembly. Refer to Gauge Replacement.

(2) Check for continuity in the wire between the fuel tank sending unit and the gauge (fuel level input pin) (Figs. 15 and 16).

(3) With the ignition switch in the ON position, check for battery voltage across the B+ pin and the Ground pin.

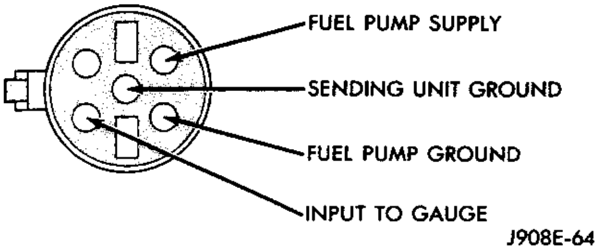


Fig. 15 Fuel Tank Sending Connector Terminals

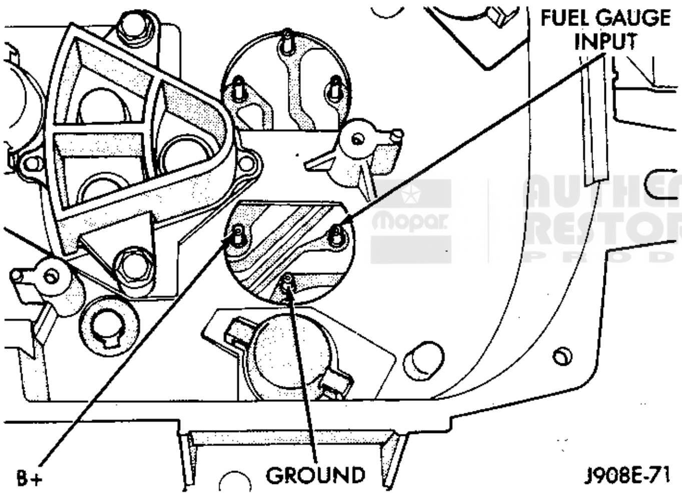


Fig. 16 Fuel Gauge Pins

VOLTAGE GAUGE CIRCUIT TEST

(1) Remove voltage gauge. Refer to Gauge Replacement.

(2) With the ignition switch in the ON position, check for battery voltage across the B+ pin and the Ground pin (Fig. 17).

The instrument panel voltmeter indicates electrical system battery voltage.

SPEEDOMETER

(1) Remove speedometer assembly. Refer to Gauge Replacement.

(2) Check for continuity in the wire between the distance sensor connector and the speedometer (distance sensor input pin) (Fig. 18).

(3) With the ignition switch in the ON position, check for battery voltage across the B+ pin and the Ground pin.

(4) Perform distance sensor test. Refer to General Information - Distance Sensor in this section.

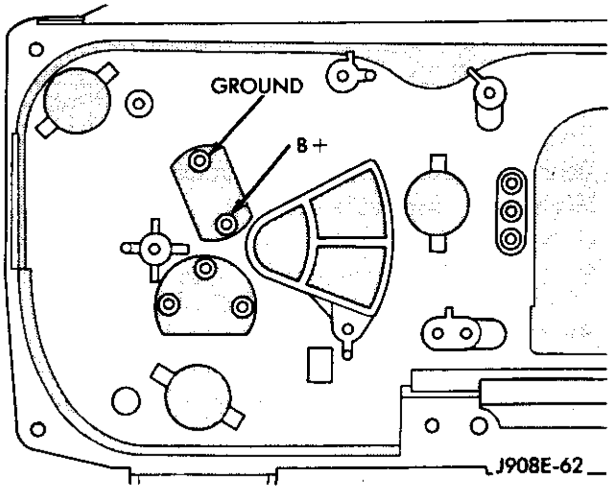


Fig. 17 Voltmeter Pins

(5) If all of above tests prove good, replace speedometer.

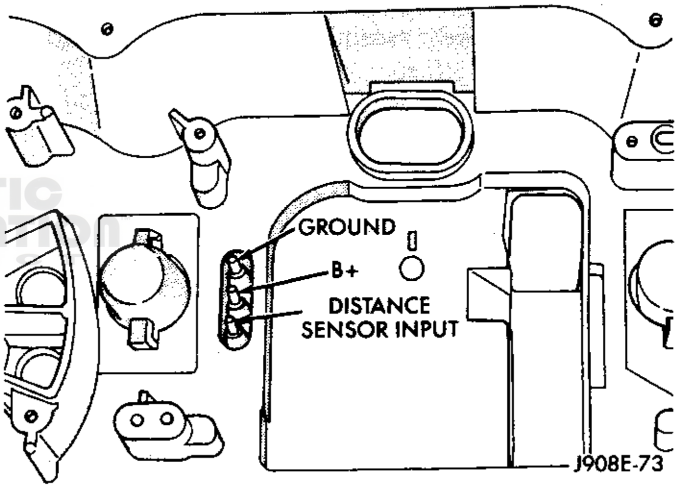


Fig. 18 Speedometer Pins

PRND21 INDICATOR

REMOVAL

(1) Remove bezel. Refer to Cluster Bezel Removal.

(2) Remove cluster mask and lens. Refer to Cluster Mask and Lens Removal.

(3) Remove cluster assembly. Refer to Instrument Cluster Removal.

(4) Remove screws attaching PRND21 mechanism to cluster housing.

(5) Remove PRND21 mechanism.

INSTALLATION

(1) Position PRND21 mechanism to cluster housing.

(2) Install mounting screws.

(3) Install cluster assembly.

(4) Install mask-lens.

(5) Install bezel.

LAMP BULBS

CLUSTER LLUMINATION LAMPS

Turn Signal Indicator Lamps
Low Oil Pressure Indicator Lamp
High Beam Indicator Lamp
Gate Open Lamp
Seat Belt Warning Lamp

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove instrument cluster. See cluster removal.

(3) Twist lamp socket assembly and remove from printed circuit board.

(4) Remove bulb from socket.

INSTALLATION

(1) Install bulb into socket.

(2) Install socket assembly into printed circuit board.

(3) Position cluster into place in panel. See cluster installation.

(4) Connect battery negative cable.

LAMP BULB REPLACEMENT—MESSAGE CENTER

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove instrument cluster bezel assembly. Refer to Instrument Cluster removal.

(3) Twist lamp socket assembly and remove from printed circuit board.

(4) Remove bulb from socket.

INSTALLATION

(1) Install bulb into socket assembly.

(2) Install lamp socket assembly into printed circuit board.

(3) Install Instrument Cluster bezel assembly to instrument panel. Refer to Instrument Cluster installation.

(4) Connect battery negative cable.

FOUR WHEEL DRIVE INDICATOR LAMP

(1) Pull bulb and socket assembly from rear of housing.

(2) Remove bulb from socket.

(3) Reverse removal procedures to install.

SPECIFICATIONS

Fuel Gauge Calibration

Pointer Position	Resistance
Empty Graduation	90 ohms ± 3 ohms
Empty Stop	Greater than 96.5 ohms
Full Graduation	12 ohm ± 3 ohms
Full Stop	Less than 8 ohms
1/2	45.3 ohms ± 3 ohms

Temperature Gauge Calibration

Pointer Position	Resistance
Cold Graduation	655 ohms
Hot Graduation	64 ohms

Oil Pressure Gauge Calibration

Pointer Position	Resistance
Low Graduation	100 ohms
High Graduation	12 ohms

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SWITCH AND PANEL COMPONENT SERVICE

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DISCONNECT BATTERY NEGATIVE CABLE IN ENGINE COMPARTMENT BEFORE SERVICING INSTRUMENT PANEL.

STEERING COLUMN LOWERING AND RAISING

When servicing the instrument panel and the Lowering and Raising of the steering column is required, the following is the procedure for doing so:

This procedure is not for removing and replacing the steering column. Refer to Group - 19 Steering of this manual for the removal and replacement procedures.

LOWERING STEERING COLUMN

(1) Disconnect battery negative cable.

(2) Remove three toe plate nuts and washers (Fig. 1).

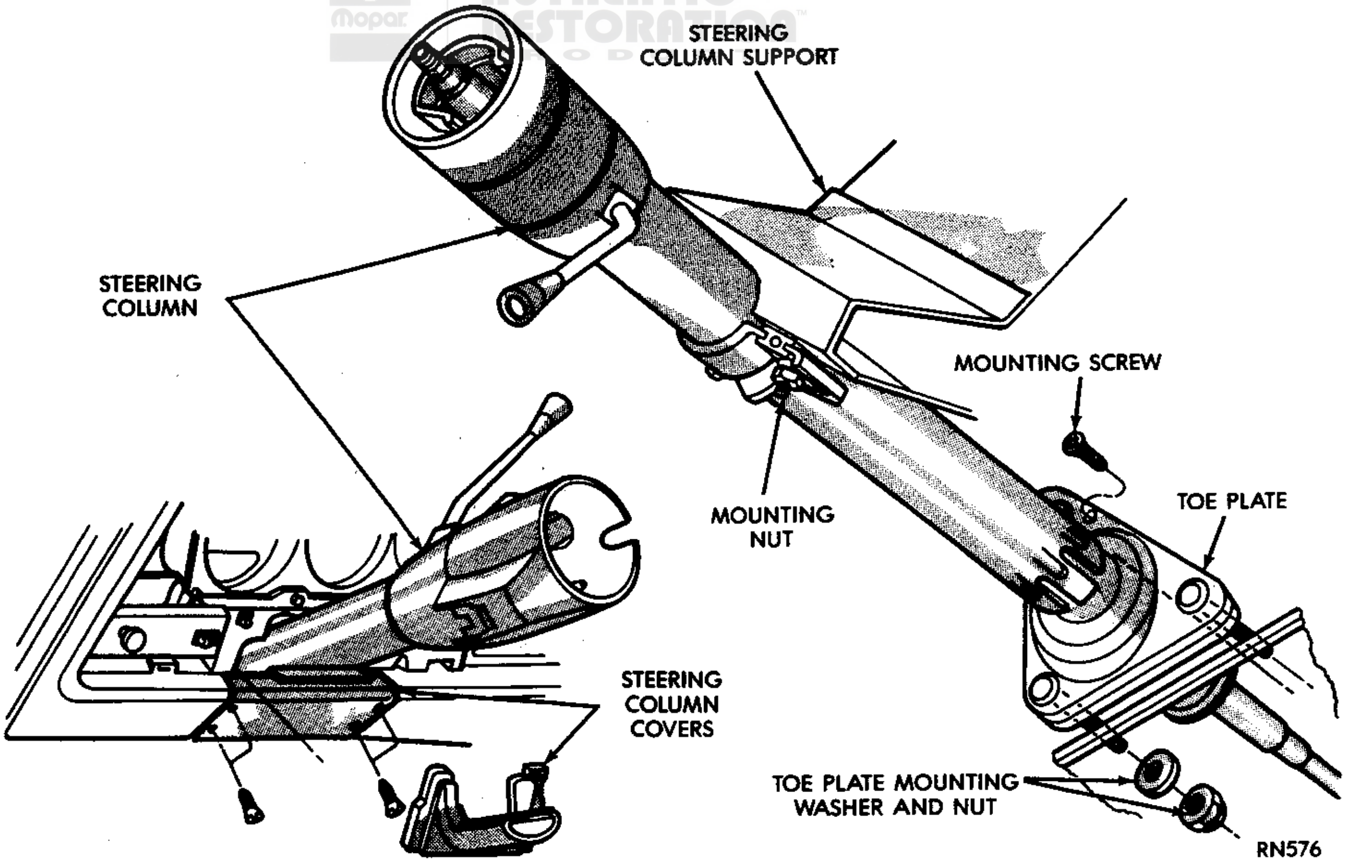

Fig. 1 Steering Column Mounting

(3) Remove one toe plate screw.

(4) Remove four screws attaching lower steering column cover and remove cover. The fuse block is attached to this cover and should be supported when cover is removed.

(5) Spread upper steering column cover out of locking tangs and slide
downward.

(6) Disconnect cable from shift indicator bracket.

(7) Remove two nuts and washers attaching steering column bracket to instrument panel steering column support bracket.

(8) Allow column to lower and rest on seat.

RAISING STEERING COLUMN

(1) Raise steering column assembly against the instrument panel support bracket.

(2) Install two steering column bracket washers and nuts (Finger Tighten Only).

CAUTION: Check that all wiring is clear and not pinched.

(3) Tighten the two bracket nuts to 12 N•m (110 in. lbs.) torque.

(4) Slide toe plate into position, install attaching screw, tighten to 4 N•m (35 in. lbs.).

(5) Install toe plate nuts and washers and tighten to 23 N•m (200 in. lbs.).

(6) Connect cable to shift indicator bracket.

(7) Position upper steering column cover and slide upward until tangs snap into place.

(8) Install fuse block to cover.

(9) Position lower steering column cover and install four attaching screws.

HEATER CONTROL

REMOVAL

(1) Remove map lamp.

(2) Remove cluster bezel (refer to Cluster Bezel Removal).

(3) Remove two control attaching screws.

(4) Pull control rearward.

(5) Disconnect illumination lamp, and wire connections.

(6) Disconnect control cables.

(7) Remove control.

INSTALLATION

(1) Position control near panel.

(2) Connect control cables to control (see Heater A/C Section).

(3) Connect illumination lamp, and wire connectors.

(4) Push control into panel.

(5) Install two control mounting screws.

(6) Install bezel.

(7) Install map lamp.

HEATER A/C CONTROL

REMOVAL

(1) Remove map lamp.

(2) Remove cluster bezel (refer to Cluster Bezel Removal).

(3) Remove two control attaching screws.

(4) Pull control rearward.

(5) Disconnect blower switch wiring.

(6) Disconnect wires to pushbutton switch (three connectors).

(7) Disconnect illumination lamp.

(8) Disconnect vacuum harness.

(9) Disconnect temperature cable.

(10) Remove control.

INSTALLATION

(1) Position control near panel.

(2) Connect temperature cable (see Group 24 - Heating and Air Conditioning).

(3) Connect vacuum harness.

(4) Connect illumination lamp.

(5) Attach three wire connectors to pushbutton switch.

(6) Connect wires to blower motor switch.

(7) Push control into panel.

(8) Install two control mounting screws.

(9) Install cluster bezel.

(10) Install map lamp.

SWITCHES

HEADLAMP SWITCH (FIG. 2)

Removal

(1) Remove cluster bezel (refer to Cluster Bezel Removal).

(2) Reaching under instrument panel, depress knob and stem release button located on bottom of switch housing and at same time pull knob and stem assembly out of switch housing located on front of panel.

(3) Remove power mirror switch knob by pulling straight off.

(4) Remove bezel.

(5) From front of panel remove spanner nut, mounting switch to panel.

(6) Reaching under instrument panel, lower switch down far enough to disconnect electrical leads.

(7) Remove switch.

(4) Pull rearward, disconnect wire from headlamp switch.

(5) Remove auxiliary headlamp switch by snapping out of bezel.

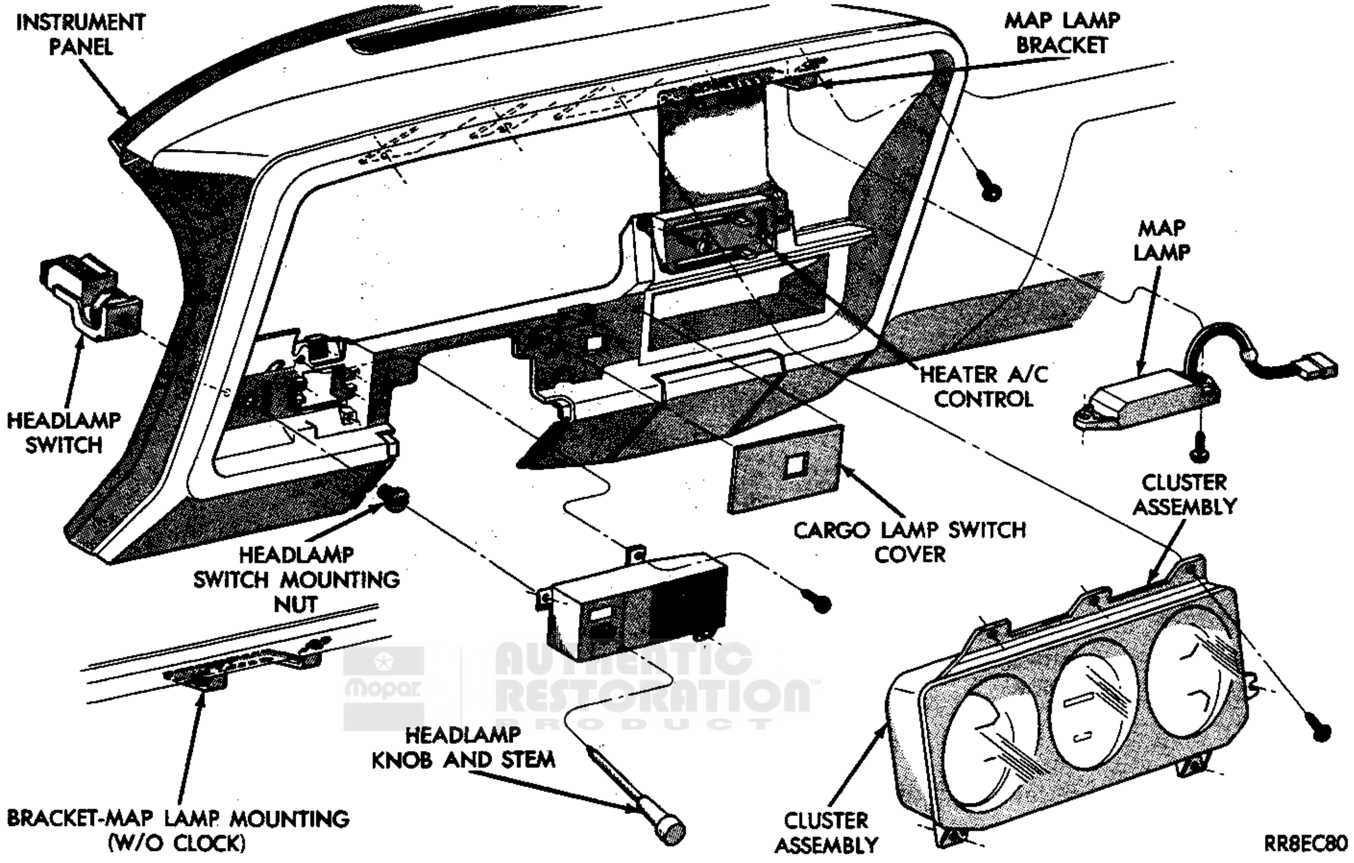

Fig. 2 Instrument Panel Switches

Installation

(1) Connect all electrical leads to switch.

(2) Guide switch into position in panel, install spanner nut and tighten securely.

(3) Install bezel.

(4) Install power mirror switch knob.

(5) Insert knob and stem assembly into switch.

(6) Install cluster bezel.

(7) Check operation of switch.

POWER MIRROR SWITCH

Refer to Group 8T - Power Mirrors

AUXILIARY HEADLAMP SWITCH (FIG. 3) (USED WITH SNOW PLOW OPTION)

Removal

(1) Remove two screws on right side of snow plow control housing.

(2) Loosen two screws on left side of housing and slide housing to the right and pull away from instrument panel.

(3) Remove four screws holding bezel to housing.

Installation

(1) Snap auxiliary headlamp switch into bezel.

(2) Connect wires to switch.

(3) Position bezel to housing and install four mounting screws.

(4) Check operation of switch.

(5) Position housing onto two left side screws, install two right side screws and secure housing to instrument panel.

SNOW PLOW TOGGLE SWITCH (FIG. 3)

Removal

(1) Remove two screws on right side of snow plow control housing.

(2) Loosen two screws on left side of housing and slide housing to the right and pull away from instrument panel.

(3) Remove four screws holding bezel to housing.

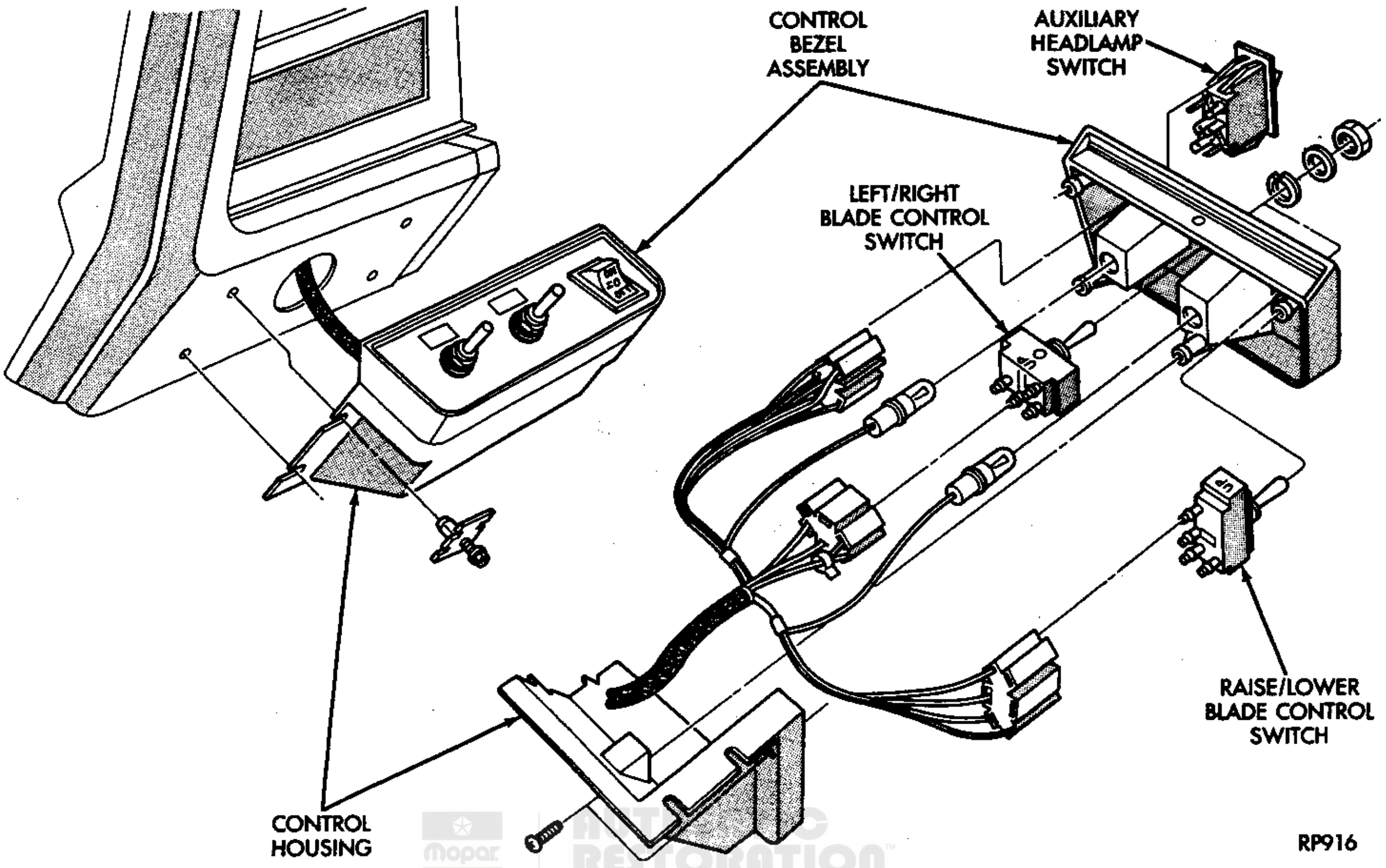

Fig. 3 Snow Plow Control Assembly

(4) Pull rearward, disconnect wire from toggle switch.

(5) Remove toggle switch by unscrewing nut from front of bezel.

Installation

(1) Position toggle switch to bezel and install nut.

(2) Connect wires to toggle switch.

(3) Position bezel to housing and install four mounting screws.

(4) Check operation of switch.

(5) Position housing onto two left side screws, install two right side screws and secure housing to instrument panel.

CARGO LAMP SWITCH

Removal

(1) Locate chime module. Grasp chime module and twist it to remove it from the bracket.

(2) Remove wiring connector from cargo lamp switch.

(3) Depress lock tabs on switch and push it out of the instrument panel.

Installation

(1) Hold wiring connector in switch opening.

(2) Push switch on to wiring connector.

(3) Continue to push until switch snaps into place.

(4) Install chime module on to bracket.

MAP LAMP SWITCH

Removal

(1) Remove 2 attaching screws.

(2) Drop assembly down and remove wiring connector, then remove map lamp assembly.

Installation

(1) Connect wiring connector to lamp assembly.

(2) Position map lamp assembly to panel and install 2 mounting screws.

GLOVE BOX LAMP SWITCH

Removal

(1) Open glovebox until stops in bin rest against instrument panel, depress stops to clear instrument panel and continue pivoting glovebox assembly downward.

(2) Disconnect wire to switch.

(3) Snap switch out of panel.

Installation

(1) Snap switch into panel.

(2) Connect wire to switch.

(3) Depress stops and close glove box door.

OVERDRIVE LOCKOUT SWITCH (FIG. 4)

Removal

(1) Remove map lamp.

(2) Remove cluster bezel (refer to Cluster Bezel Removal).

(3) Reach behind bezel and disconnect lockout switch connector.

(4) Depress retaining tabs on top and bottom of switch and pull switch out of module.

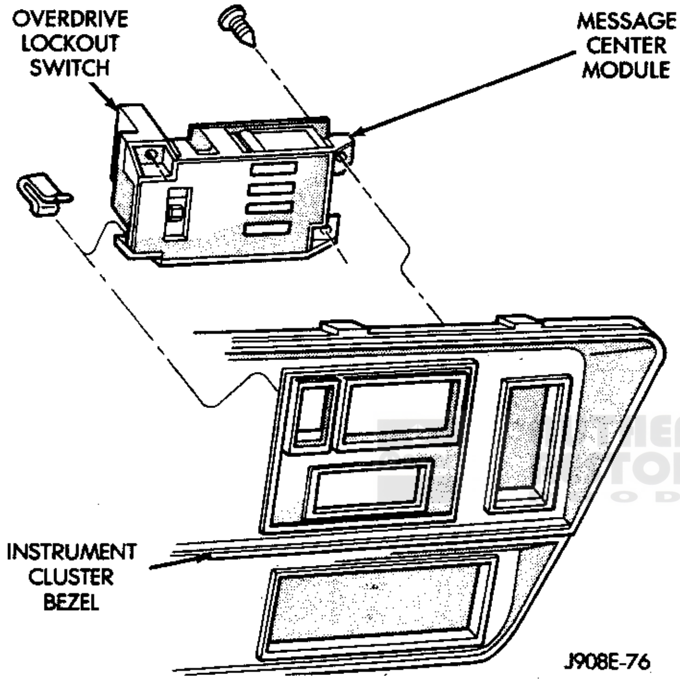

Fig. 4 Overdrive Lockout Switch and Message Center Module

Installation

(1) Position lockout switch into module and push until retaining tabs lock into place.

(2) Connect switch connector.

(3) Install instrument cluster bezel to panel.

MESSAGE CENTER MODULE (Fig. 4)

REMOVAL

(1) Remove map lamp.

(2) Remove cluster bezel (refer to Cluster Bezel Removal).

(3) Reach behind bezel and disconnect lockout switch and message center connectors.

(4) Remove three module retaining screws and one clip and pull module from bezel.

(5) Remove overdrive lockout switch from module.

INSTALLATION

(1) Install overdrive lockout switch into module.

(2) Position module on bezel and install screws and clip.

(3) Connect lockout switch and message center connectors.

(4) Install instrument cluster bezel to panel.

(5) Install map lamp.

FUSEBLOCK AND FLASHERS

FUSEBLOCK

The fuseblock is located directly below the steering column, on the lower steering column cover.

Removal

(1) Push fuseblock locking tab on column cover downward and lower fuseblock. The following components plug into the fuseblock.

(1) Fuses.

(2) 30 amp circuit breakers.

(3) Turn signal flasher.

(4) Horn relay.

(5) Hazard Warning Flasher.

Installation

(1) Position fuseblock to steering column cover.

(2) Push locking tab to lock fuseblock in position.

HOOD RELEASE

REMOVAL

(1) Disengage cable from hood latch in engine compartment.

(2) Remove four screws holding handle assembly to instrument panel.

(3) Remove assembly by pulling cable rearward through dash panel grommet.

INSTALLATION

(1) Feed cable assembly forward through dash panel grommet.

(2) Mount handle assembly to instrument panel with four screws.

(3) Connect cable to hood latch.

FOUR WHEEL DRIVE INDICATOR

REMOVAL

(1) Remove map lamp.

(2) Remove cluster bezel (refer to Cluster Bezel Removal).

(3) Remove two screws and remove indicator from bezel.

INSTALLATION

(1) Position indicator to bezel and attach with two screws.

(2) Install cluster bezel.

(3) Install map lamp.

CIGAR LIGHTER (Fig. 5)

REMOVAL

(1) Open ash receiver.
(2) Remove lighter element from shell.
(3) Disconnect wiring.
(4) Turn clamp counterclockwise and remove.
(5) Remove shell through front of housing.

Installation

(1) Install ash tray bin.
(2) Push ash tray inwards to closed position.

HOUSING

Removal

(1) Remove ash tray bin.
(2) Disconnect electrical leads from cigar lighter.
(3) Remove six screws retaining housing to panel.

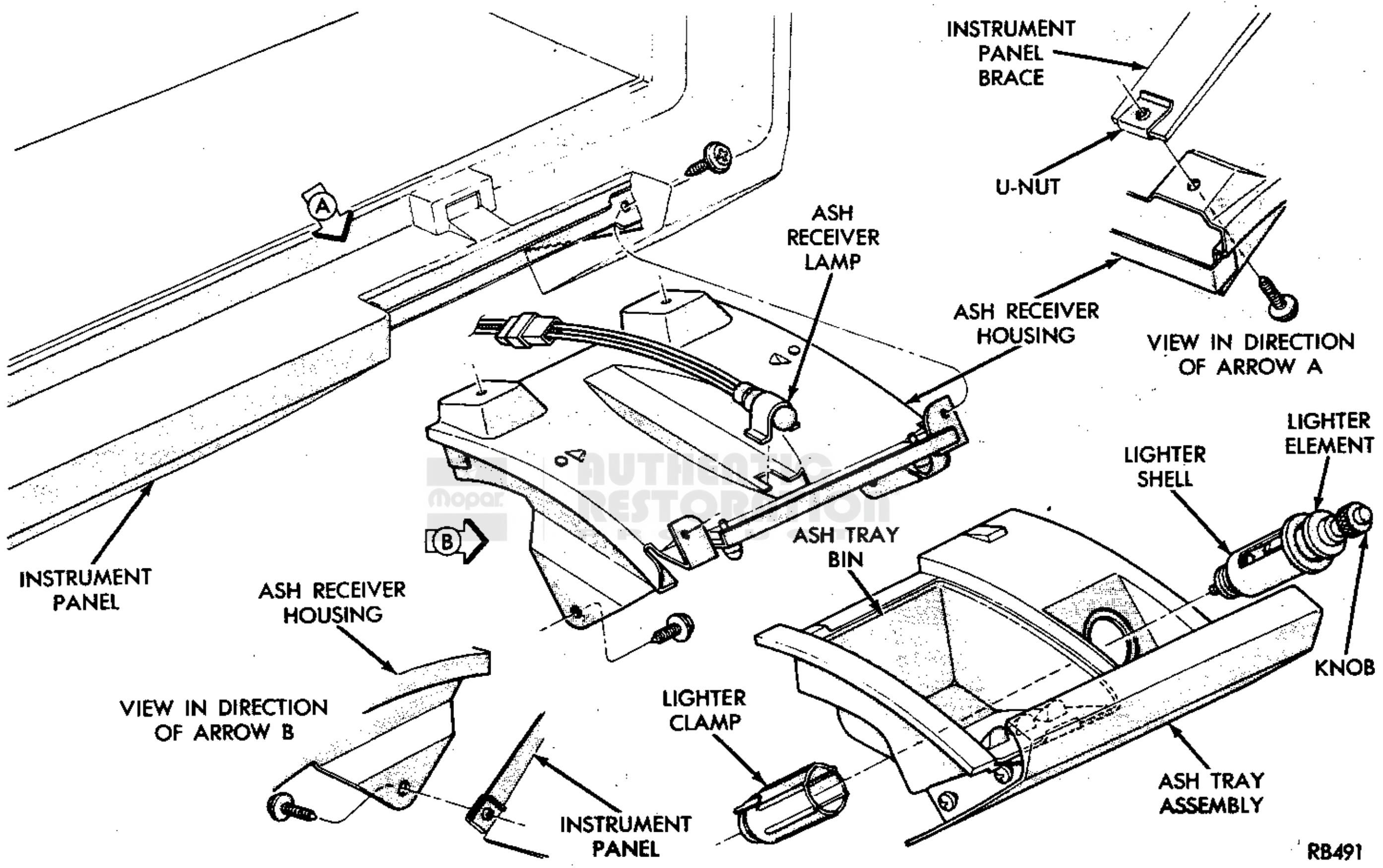

Fig. 5 Cigar Lighter and Ash Tray

INSTALLATION

(1) Insert shell through front of housing.
(2) Install clamp on shell, turn clockwise and tighten securely.
(3) Connect wiring to shell.
(4) Install lighter element.
(5) Install wires and close ash receiver.

ASH TRAY (Fig. 5)

TRAY

Removal

(1) Open ash tray.
(2) Remove ash tray bin.

(4) Remove cigar lighter from housing.

Installation

(1) Install cigar lighter in housing.
(2) Connect electrical leads to cigar lighter.
(3) Position housing to panel and install six mounting screws.
(4) Install ash tray bin.

GLOVE BOX (Fig. 6)

DOOR AND BIN ASSEMBLY

Removal

(1) Remove four screws that retain glovebox to lower reinforcement.

(2) The bin is removed by unsnapping bin from door assembly.

(4) Push lock cylinder into latch assembly, and remove key.

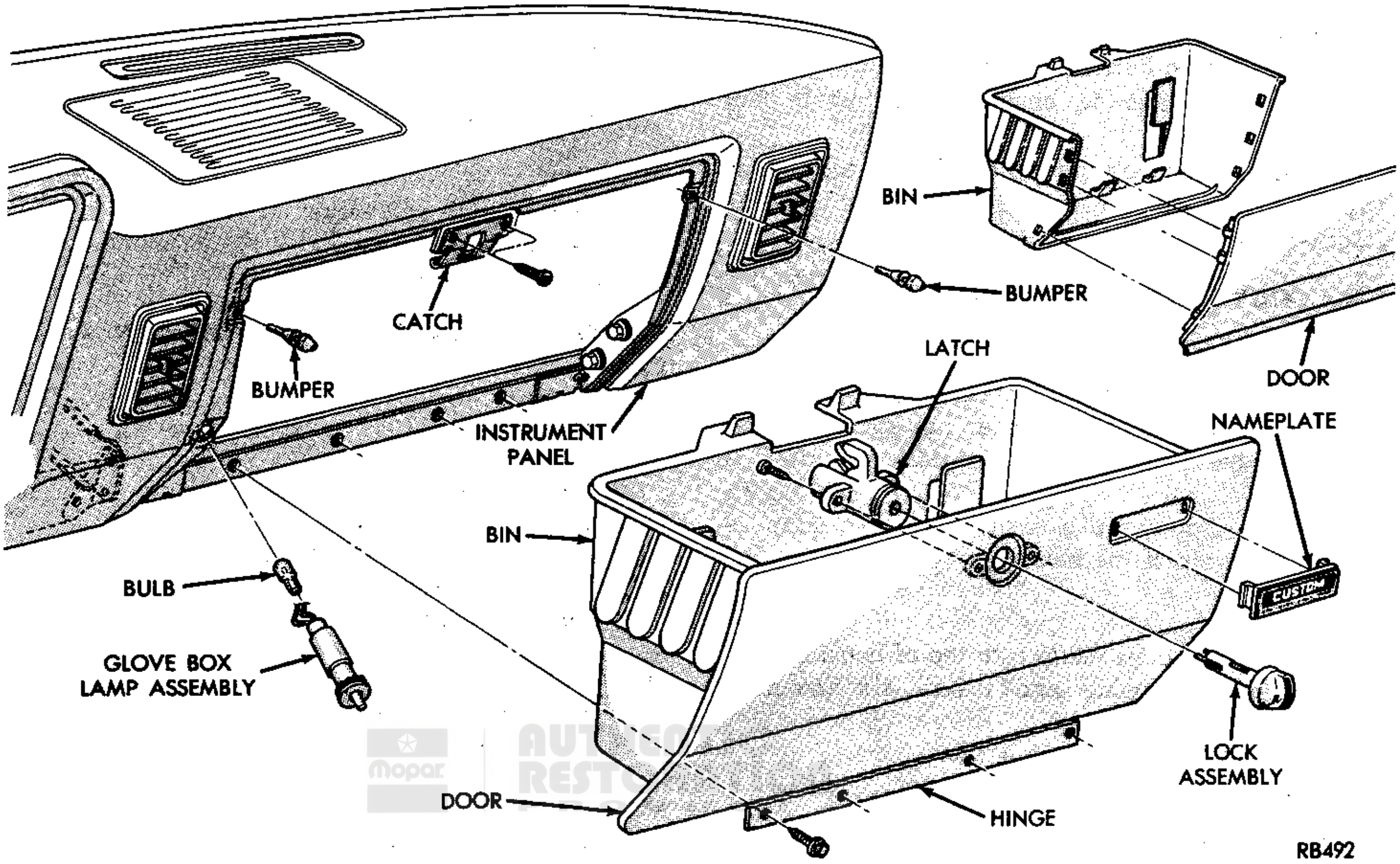

Fig. 6 Glove Box and Bin

Installation

(1) Snap bin onto door.

(2) Mount assembly to lower reinforcement with four mounting screws.

GLOVE BOX LOCK

Removal

(1) Open glove box door.

(2) Turn lock into locked position and remove key.

(3) Insert a stiff wire in rear slot of lock mechanism and depress retaining tumbler into cylinder.

(4) While holding tumbler down with wire in lock cylinder, insert key.

(5) Remove wire and pull out lock cylinder.

(6) Remove latch mounting screws and remove assembly.

Installation

(1) Position latch assembly into place on glove box door, install mounting screws and tighten securely.

(2) Depress retaining tumbler into lock cylinder and insert key.

(3) Position assembly so that it will be in the closed position when installed.

CATCH

Removal

(1) Open glove box door.

(2) Remove catch mounting screws.

(3) Remove catch.

Installation

(1) Position catch and spring nut into place, install mounting screws and tighten securely.

(2) Close glove box door.

ILLUMINATION BULB REPLACEMENT

SNOW PLOW CONTROLS ILLUMINATION LAMP

Removal

(1) Remove two screws on right side of snow plow control housing.

(2) Loosen two screws on left side of housing and slide housing to the right and pull away from instrument panel.

(3) Remove four screws holding bezel to housing.

(4) Pull rearward and remove lamp bulb and socket.

Installation

(1) Install lamp bulb and socket.

(2) Position bezel to housing and install four screws.

(3) Position housing onto two left side screws, install two right side screws and secure housing to instrument panel.

ASH TRAY ILLUMINATION LAMP

Removal

(1) Open ash receiver and remove bin.

(2) Disconnect wires from cigar lighter.

(3) Remove six screws that retain assembly to panel.

(4) While dropping ash receiver, remove lamp assembly from top of the housing.

Installation

(1) Install lamp assembly into top of housing.

(2) Position housing and install six mounting screws.

(3) Connect wires to cigar lighter.

(4) Install bin and close ash receiver.

MAP LAMP BULB

To replace bulb, snap lens out, replace bulb.

FOUR WHEEL DRIVE INDICATOR

Removal

(1) Remove map lamp.

(2) Remove cluster bezel (refer to Cluster Bezel Removal).

(3) Remove bulb and socket.

Installation

(1) Snap in bulb and socket.

(2) Replace cluster bezel.

(3) Install map lamp.

HEATER OR HEATER A/C ILLUMINATION LAMP

Removal

(1) Remove map lamp.

(2) Remove cluster bezel (refer to Cluster Bezel Removal).

(3) Remove two control attaching screws.

(4) Pull control rearward.

(5) Snap out illumination lamp.

Installation

(1) Install bulb into socket.

(2) Snap socket into control.

(3) Push control forward and install two attaching screws.

(4) Install cluster bezel.

(5) Install map lamp.

RADIO, ANTENNA AND SPEAKERS

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GENERAL INFORMATION

For operation of the factory installed standard and optional radios available, refer to the Owner Manual supplied with the vehicle.

RADIO SCHEMATICS

Radio repair service and schematic wiring diagrams are available through Technical Service, Chrysler Huntsville Division, 102 Wynn Dr., Huntsville, AL 35805.

INTERFERENCE ELIMINATION

A number of components are utilized on vehicles equipped with a radio to suppress radio frequency interference (static).

A capacitor is mounted inside the alternator. Ground straps are utilized from cab to box, from radio chassis to instrument panel bracket and from engine to cowl. All ground straps should be securely mounted to a clean ground surface to work effectively.

Radio resistance spark plug wires complete the interference suppression system. Faulty or deteriorated spark plug wires should be replaced (Fig. 1).

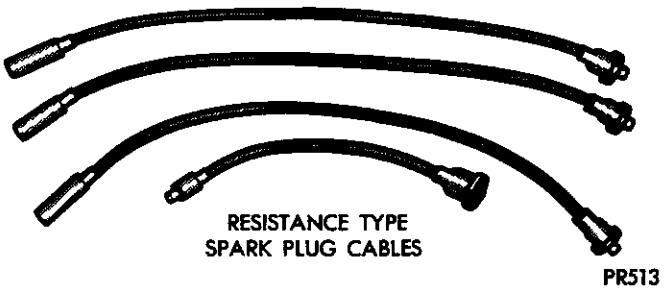

Fig. 1 Resistance Type Spark Plug Cables

RADIO RECEPTION MODE

In some instances a radio may be changed from North American to European reception mode. When the radio is in this mode, poor frequency reception will result in both AM and FM modes. To verify this condition, turn the radio on and observe the display window at its highest and lowest frequencies. If the readout compares to the following chart, the radio is in the European mode.

Band Type	**Lowest Frequency**	**Highest Frequency**
AM	531 KHZ	1602 KHZ
FM	87.5 MHZ	108.0 MHZ

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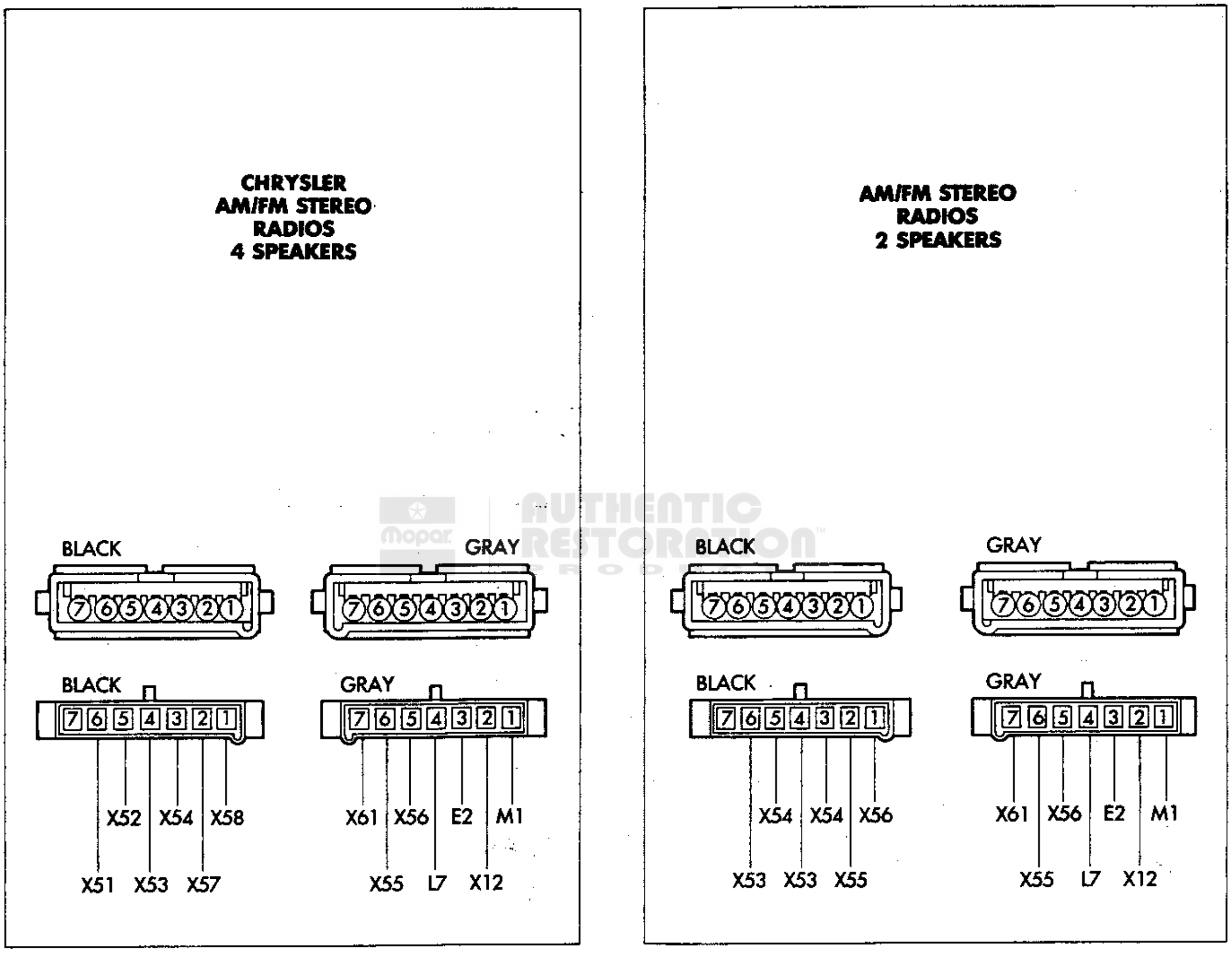
CHANGING RECEPTION MODE

(1) Turn radio on.
(2) Radio in FM mode.
(3) Press "set".
(4) Press "sel".
(5) Press station memory set button one, 5 times. Radio will reset to lowest AM frequency.

RADIO CONNECTOR PINS



LEGEND:

E2- ILLUMINATION
L7- PARK LAMPS
M1- BATTERY
X12-ACC/RUN

X51-LEFT REAR
X52-RIGHT REAR
X53-LEFT PNL/DR
X54-RIGHT PNL/DR

X55-LEFT PNL/DR
X56-RIGHT PNL/DR
X57-LEFT REAR
X58-RIGHT REAR

X60-FEED (RADIO SWITCHED)
X61-MUTE

NOTE: FOR WIRE COLORS REFER TO SECTION 8W-WIRING DIAGRAMS

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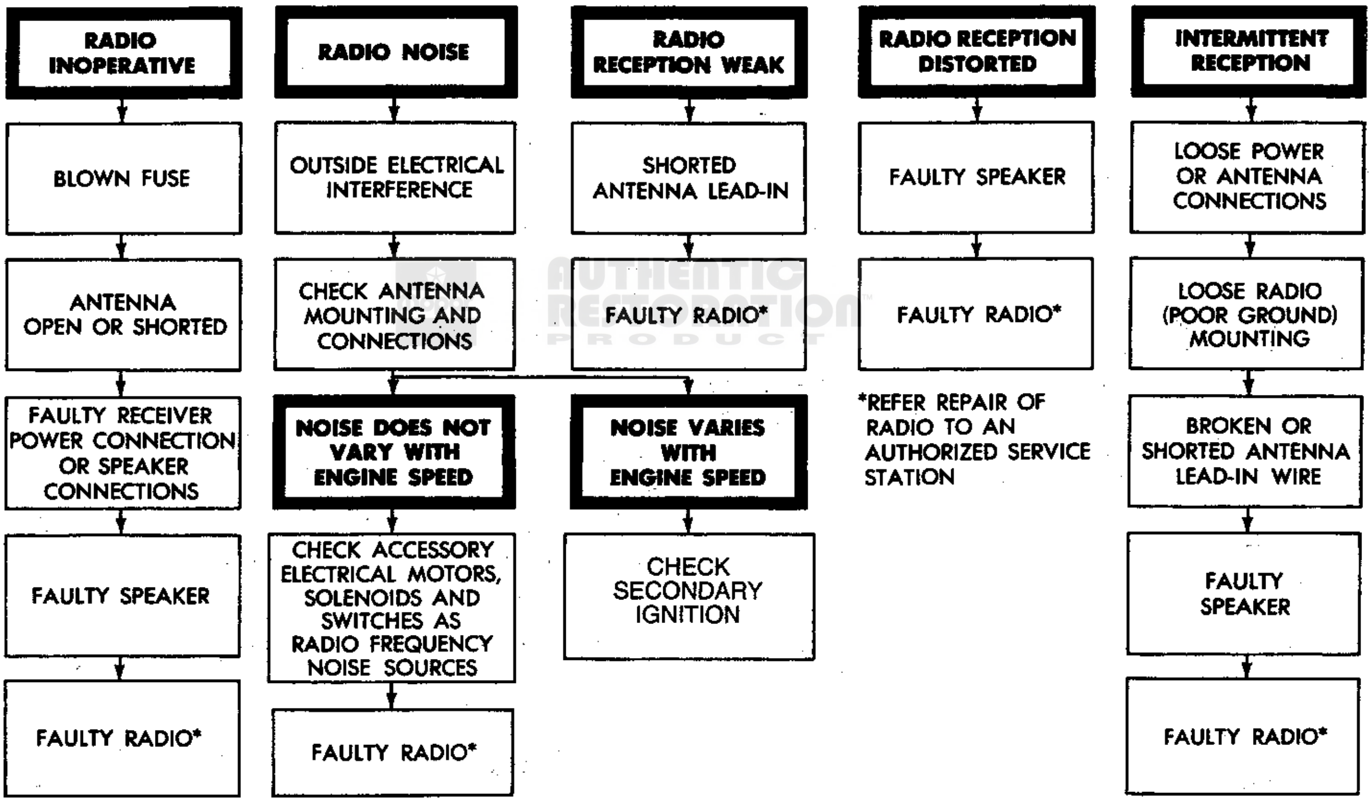
RADIO DIAGNOSIS



*REFER REPAIR OF RADIO TO AN AUTHORIZED SERVICE STATION

TEST PROCEDURES

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ANTENNA

TESTING (FIG. 2)

Antenna performance may be tested by substituting a known good antenna. It is also possible to check short or open circuits with an ohmmeter or continuity light once the antenna cable is disconnected from the radio as follows:

(1) Continuity should be observed between the tip of the mast and radio end pin.

(2) No continuity or a very high resistance of several megohms should be observed between the ground shell of the connector and radio end pin.

(3) Continuity should be observed between the ground shell of the connector and the mounting hardware on the fender.

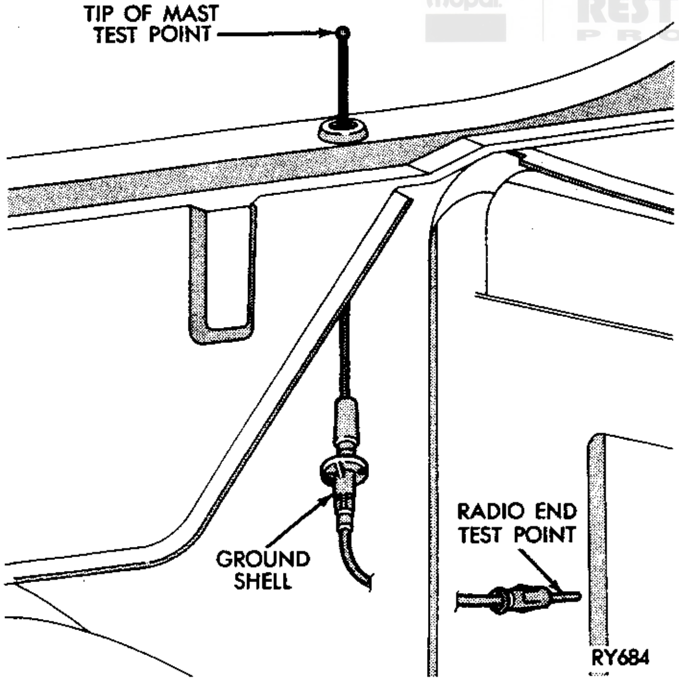

Fig. 2 Antenna Test Points

BENCH TEST FOR ANTENNA MALFUNCTION (FIG. 3)

(1) With test lamp and battery in circuit attach one test lead to concentric pin on "lead-in" connector and other test lead to tip of mast. The lamp should "light" indicating Continuity.

(2) Keeping one lead on connector pin, clip other lead on antenna body assembly. The lamp should NOT light. If it does, look for a short circuit in the body or in the cable probably at the connector.

(3) Remove clip lead from connector pin and clip on outer shell of connector. Connect other clip lead to antenna body assembly. The lamp should LIGHT again. If it does not Light, antenna shielding has an open circuit.

Wiggle cable over its entire length to reveal intermittent short or open circuits during steps 1, 2 and 3.

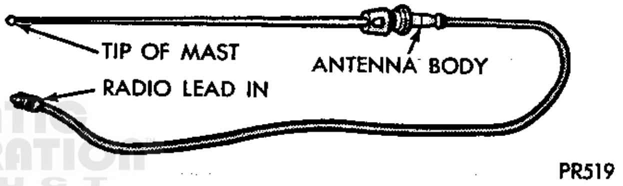

Fig. 3 Antenna Bench Test Points

REMOVAL

(1) Disconnect fusible link in engine compartment.

(2) Remove glove box.

(3) Reach behind instrument panel and unplug antenna cable from radio (Fig. 4).

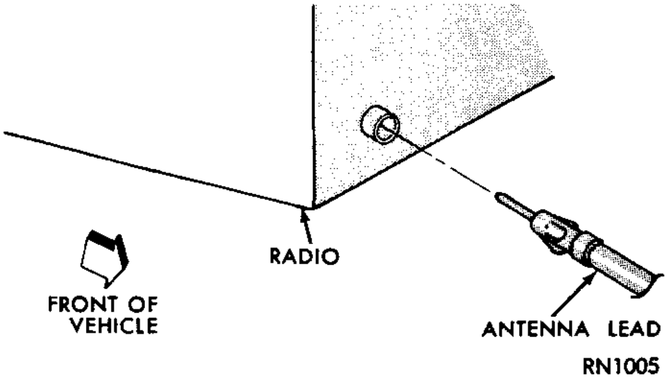

Fig. 4 Unplugging Antenna Lead from Radio

(4) Working through the glove box opening, pull antenna cable from retainer clip (Fig. 5).

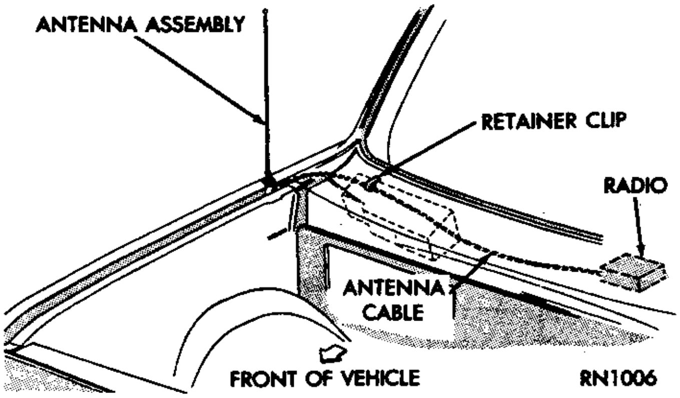

Fig. 5 Removing Antenna Cable

(5) Open right door and remove cable grommet from A pillar (Fig. 6).

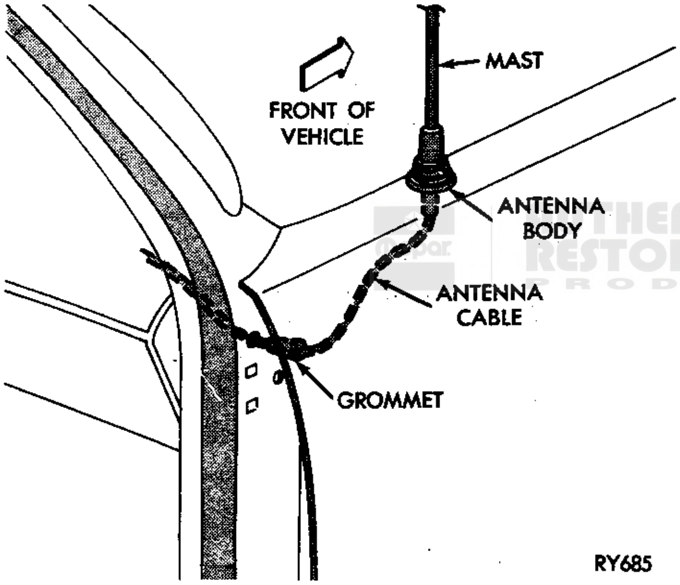

Fig. 6 Removing Grommet

(6) Pull cable from A pillar.

(7) Loosen antenna mast from antenna body. **Do not remove at this time.**

(8) Loosen cap nut using tool C4816 (Fig. 7).

(9) While holding antenna mast with one hand, remove cap nut with other hand.

(10) Lower antenna assembly down far enough to gain access to antenna body (Fig. 8).

(11) While holding body remove antenna mast.

(12) Pull antenna body and cable assembly from fender area and remove.

(13) Remove adapter on fender.

INSTALLATION

(1) Route anteanna cable between fender and dash panel to A pillar area.

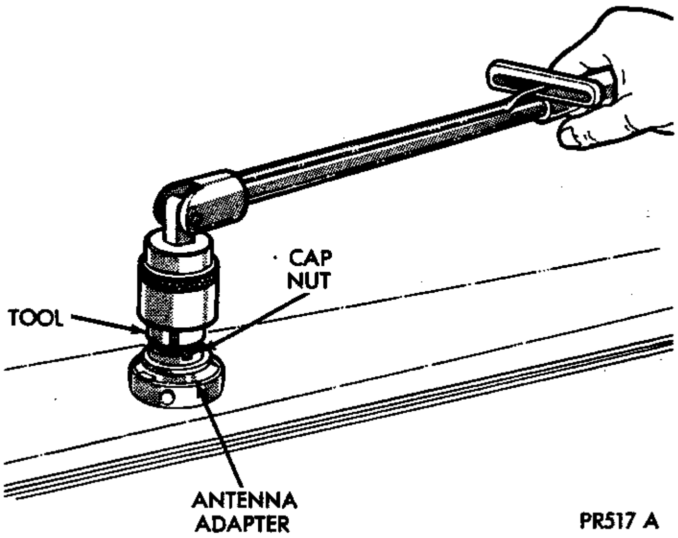

Fig. 7 Cap Nut and Adapter

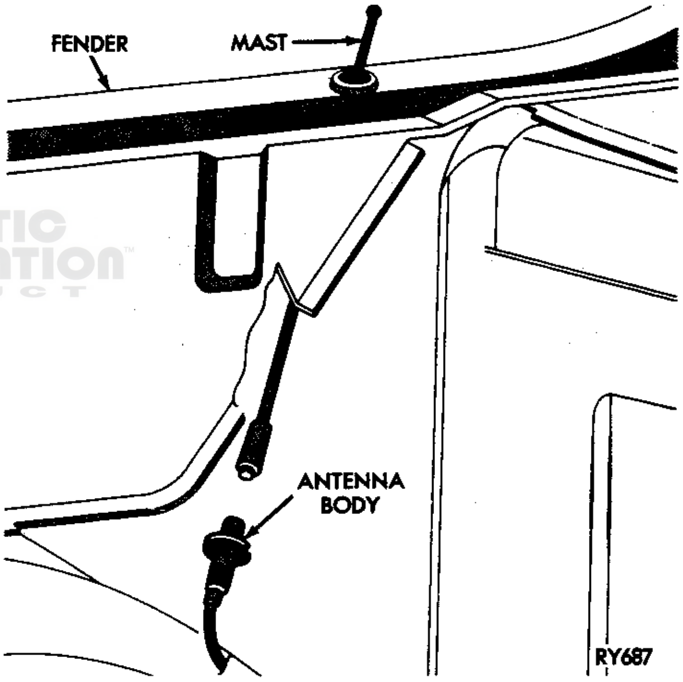

Fig. 8 Removing or Installing Antenna Body

(2) Insert antenna mast through hole in fender and screw into antenna body.

(3) Pull assembly up and position into place and hold.

(4) Install adapter making sure tab indexes with opening in fender and antenna body.

(5) Install cap nut and tighten securely with tool C-4816.

(6) Insert cable through opening in A pillar and from inside glove box opening pull in far enough to snap grommet into place.

(7) Route cable through retainer clip, over to radio, and plug into back of radio.

(8) Install glove box.

(9) Connect fusible link.

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RADIO REPLACEMENT

REMOVAL

(1) Disconnect fusible link in engine compartment.

(2) Remove 2 screws and the map lamp (if equipped) (Fig. 9).

(3) Remove 6 screws attaching faceplate to the instrument panel. Be sure the screw below the Heater/C control is removed.

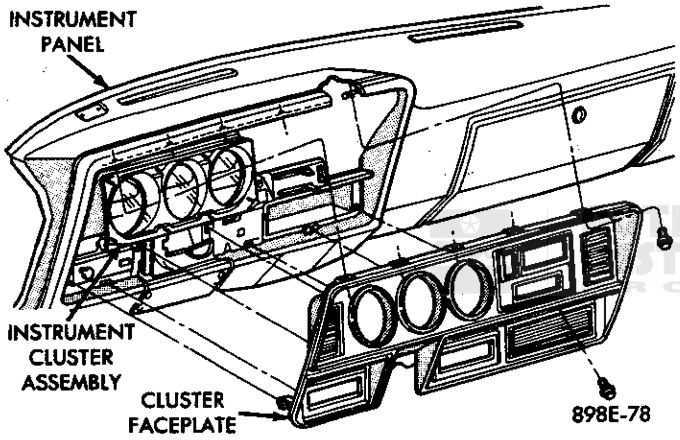

Fig. 9 Instrument Cluster Faceplate

(4) Remove two mounting screws from front of radio (Fig. 10).

(5) Pull radio out of instrument panel and disconnect wiring and antenna.

(6) Remove screw from ground strap.

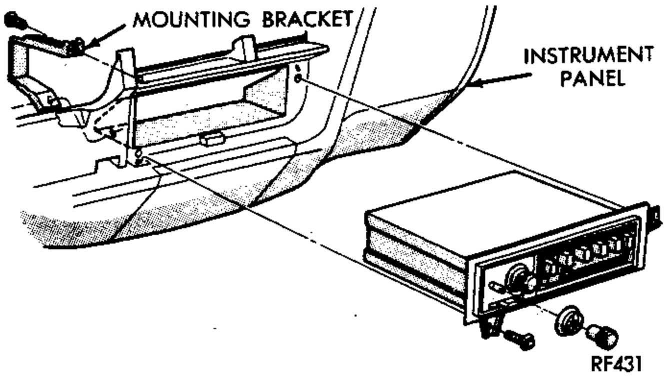

Fig. 10 Radio to Instrument Panel Mounting

INSTALLATION

(1) Install ground strap.

(2) Install wiring and antenna.

(3) Insert radio into panel and install mounting screws.

(4) Install instrument cluster bezel.

(5) Install map lamp, if equipped.

(6) Connect fusible link.

DOOR MOUNTED SPEAKER

REMOVAL

(1) Remove remote control handle.

(2) Remove window regulator handle, if equipped.

(3) Remove pull strap if equipped.

(4) Remove screw at top of armrest.

(5) Using a trim stick or other suitable flat tool, gently pry trim panel away from door.

(6) Remove screws holding speaker (Fig. 11).

(7) Disconnect speaker leads.

(8) Remove speaker.

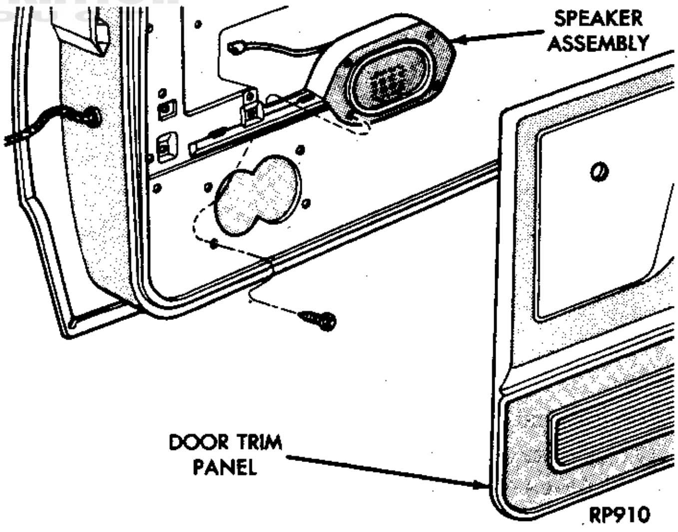

Fig. 11 Door Mounted Speaker

INSTALLATION

(1) Connect leads to speaker.

(2) Position speaker into place, install mounting screws and tighten securely.

(3) Install door trim panel.

REAR SPEAKER - STANDARD CAB PICKUP

REMOVAL

(1) Remove grille and speaker assembly to pillar mounting screws (Fig. 12).

(2) Pull speaker and grille away from pillar and disconnect wiring.

(3) Remove speaker to grille retaining nuts (2).

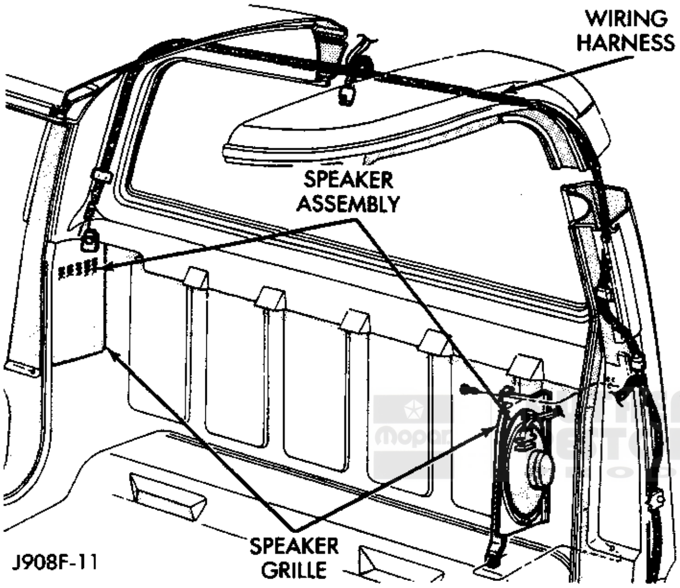

Fig. 12 Rear Speakers

INSTALLATION

(1) Position speaker onto studs of speaker grille and install nuts.

(2) Install wiring harness connector on speaker.

(3) Position speaker and grille on pillar and install mounting screws.

REAR SPEAKER - CLUB CAB PICKUP

REMOVAL

(1) Remove two screws from bottom of speaker housing (Fig. 13).

(2) Lower speaker housing and pull bottom out, allowing retaining tab on top of housing to clear slot.

(3) Disconnect speaker connector and remove speaker.

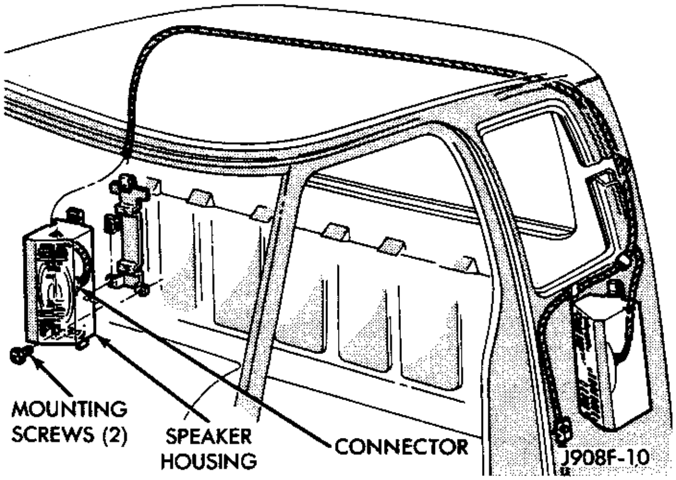

Fig. 13 Club Cap Speaker Installation

INSTALLATION

(1) Install wiring harness connector on speaker.

(2) Install retaining tab into clip.

(3) Install screws on the bottom of the speaker housing.

REAR SPEAKER - RAMCHARGER

(1) Remove screws holding the speaker and grille assembly to the mounting plate (Fig. 14).

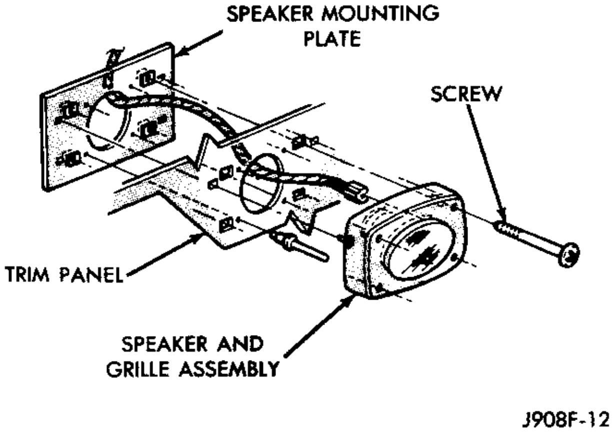

Fig. 14 Ramcharger Rear Speaker

(2) Disconnect speaker connector and remove speaker.

(3) Remove screws holding speaker to grille and remove speaker.

(4) To install the speaker and grille assembly, reverse the removal procedures.

HORNS

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GENERAL INFORMATION

The horn system (Fig. 1) consists of a horn switch, horn relay (located on the fuse block), horns, and all their wiring and connections. The circuit is fed from the fuse block and grounded in the horn switch. When the horn switch on the steering column is pressed, the ground circuit is completed, energizing the relay, and supplying power to the horns.

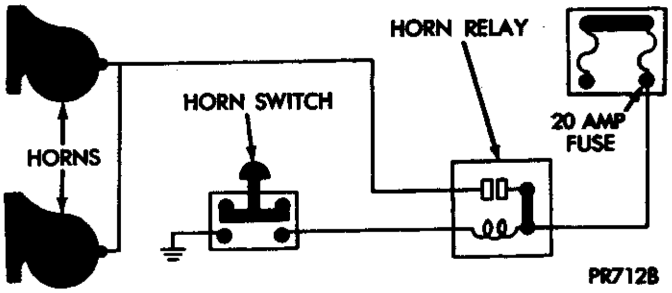

Fig. 1 Horn System

TEST PROCEDURES

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Horns Will Not Sound 1

HORNS WILL NOT SOUND

If the horns do not sound, check for a blown horn fuse in cavity number 6 of the fuse block. If the fuse is blown, replace it with the same type fuse. In case the horns fail to sound and the newly replaced fuse blows when depressing the horn switch, a short circuit in the horn or the horn wiring between the fuse terminal and the horn is responsible.

If the fuse is intact, disconnect wire connector at horn and connect one lead of a test lamp to the wire connector and the other lead to a good body ground (Fig. 2). Depress the horn switch. Should test lamp illuminate the horn is ungrounded or faulty. Grounding can be verified by making a temporary jumper wire connection between horn bracket (scratch through paint) and the negative battery terminal. With the ground jumper wire still intact and the horn reconnected, if the horn still fails to sound when horn button or rim is depressed, replace the horn.

If the lamp fails to illuminate, check for a defective horn relay by substituting a known good horn relay in the circuit. If the lamp illuminates when depressing the horn switch, the original relay is defective. If the lamp fails to illuminate with a known good relay, unplug that relay and connect a jumper wire from the battery terminal to the horn terminal on the relay terminal board. If the lamp, which is connected in place of the horns, fails to illuminate, inspect for an open circuit between the horn fuse and the horn terminal on the relay terminal board and between relay terminal board and the horn terminals. Should the lamp illuminate, a defective horn switch or an open circuit in the wiring between the relay terminal and the horn switch is at fault.

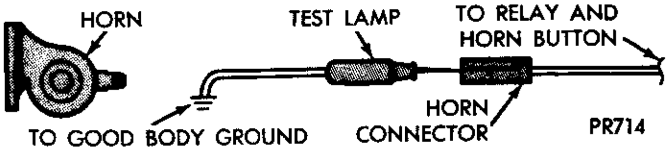

Fig. 2 Testing for Voltage

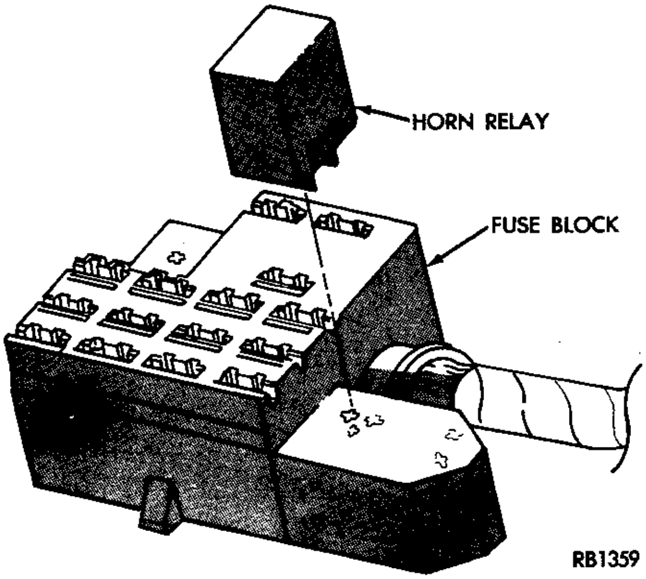

Fig. 3 Horn Relay

HORNS SOUND CONTINUOUSLY

Should the horns sound continuously, unplug the horn relay from the relay connector inside the passenger compartment (Fig. 3). Plug in a known good relay. If the horns stop blowing, relay is defective and must be replaced. Should the horns still sound, proceed with Horn Diagnosis Chart.

Remove steering wheel pad and disconnect wire from horn switch. Repeat the above test and if the test lamp still illuminates, wire is shorted and should be repaired. If test lamp does not illuminate, horn switch is defective and must be replaced.

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HORN SWITCH (HORN PAD ASSEMBLY) REPLACEMENT

REMOVAL

(1) From underside of steering wheel, remove horn pad mounting screws (Figs. 4 and 5).

(2) Pull pad up from wheel and disconnect electrical leads.

(3) Remove pad.

INSTALLATION

(1) Connect electrical leads to switch terminal on horn pad.

(2) Position pad into place on steering wheel, install mounting screws and tighten to 1.5 N•m (15 in. lbs.).

HORN REPLACEMENT - GAS ENGINE

The horns are located on either side of the radiator support (Fig. 6).

(1) Raise the hood.

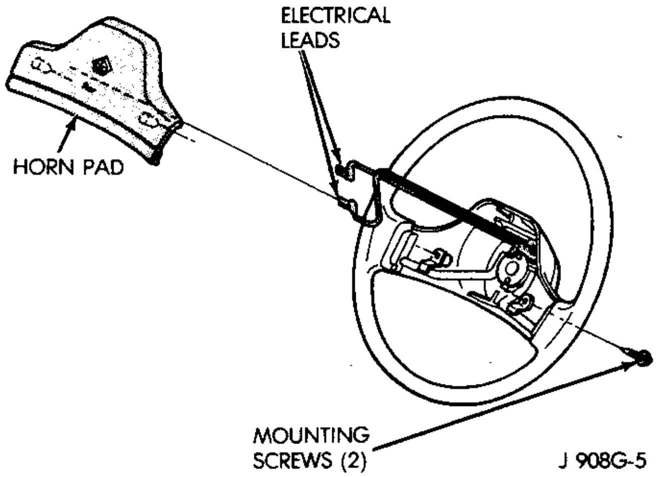
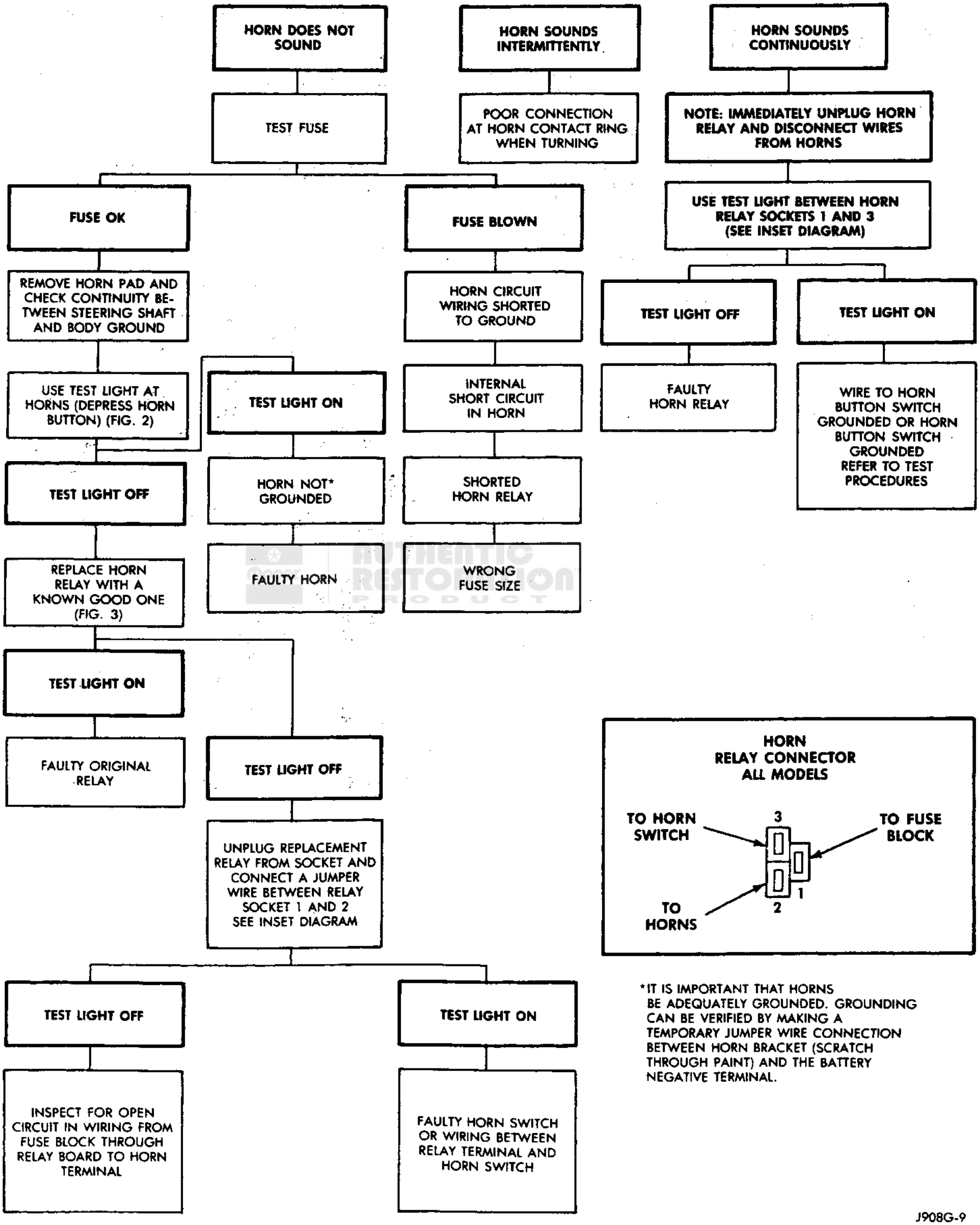


Fig. 4 Standard Steering Wheel

(2) Disconnect the horn electrical connector.

(3) Remove bolt holding the horn bracket to the radiator support and remove the horn.

(4) To install the horns reverse the removal procedures. Tighten the bolts to 200 in. lbs.



*IT IS IMPORTANT THAT HORNS BE ADEQUATELY GROUNDED. GROUNDING CAN BE VERIFIED BY MAKING A TEMPORARY JUMPER WIRE CONNECTION BETWEEN HORN BRACKET (SCRATCH THROUGH PAINT) AND THE BATTERY NEGATIVE TERMINAL.

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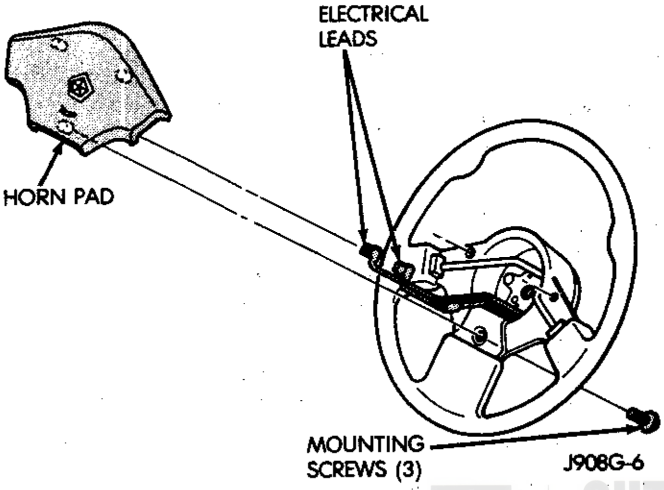

Fig. 5 Optional Steering Wheel

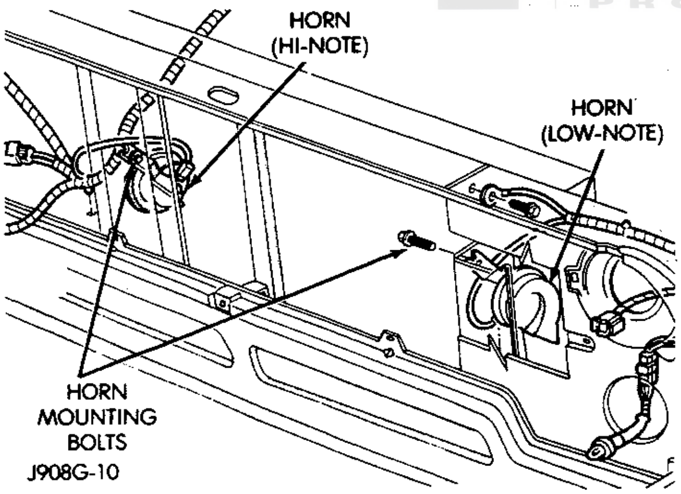

Fig. 6 Horn Removal and Installation—Gas Engine

HORN REPLACEMENT - DIESEL ENGINE

The horns are located on the inside of the left front fender behind the battery (Fig. 7).

(1) Raise the hood.

(2) Remove screw and washer holding the horn bracket to the fender.

(3) Lower the horn and bracket toward the rear of the battery.

(4) Disconnect the horn electrical connector.

(5) Remove the horn and bracket assembly by working it under the battery tray brace (Fig. 7).

(6) To install the horns reverse the removal procedures.

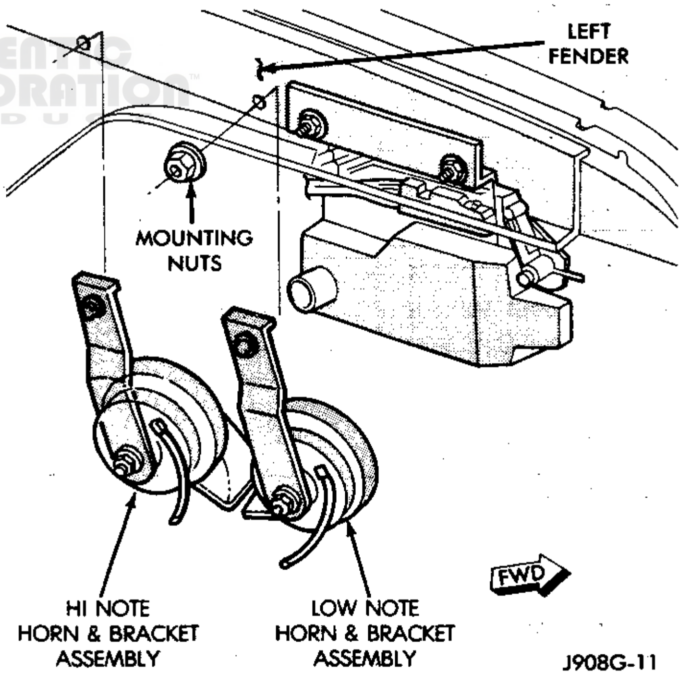

Fig. 7 Horn Removal and Installation—Diesel Engine

SPEED CONTROL SYSTEM

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GENERAL INFORMATION

The speed control system is electrically actuated and vacuum operated. The multifunction control lever on the steering column incorporates a slide switch which has three positions OFF, ON, and RESUME. The SET button is located at the end of the three position slide switch. This system is designed to operate at speeds above approximately 35 mph (58km/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.

To engage: When the desired speed is achieved, push and release the SET button to turn on and engage the system. Remove foot from accelerator. Speed will be maintained at this level. Moving the slide switch from OFF to ON while the vehicle is in motion establishes memory without system engagement.

To disengage: Normal brake application or a soft tap on the brake pedal will disengage control unit without erasing speed memory. Moving the slide switch to the OFF position or turning the ignition OFF also disengages the system and in addition erases the speed memory.

To resume after breaking: Momentarily move slide switch to RESUME. Vehicle will resume to the previously memorized speed.

To vary speed setting: To increase speed, depress accelerator to desired speed and momentarily push and release SET button.

When speed control system is engaged, tapping SET button will increase speed setting by approximately 2 mph.

To decrease speed, tap brake pedal lightly disengaging system. When desired speed has been obtained push and release SET button. Decrease in speed can also be attained by holding SET button against stop until desired speed is attained. Releasing the button engages the system at that speed.

To accelerate for passing: Depress accelerator as needed. When passing is completed, release accelerator and vehicle will return to previous speed setting. There may be a slight (3-7 mph) speed loss before the vehicle recovers to the set speed.

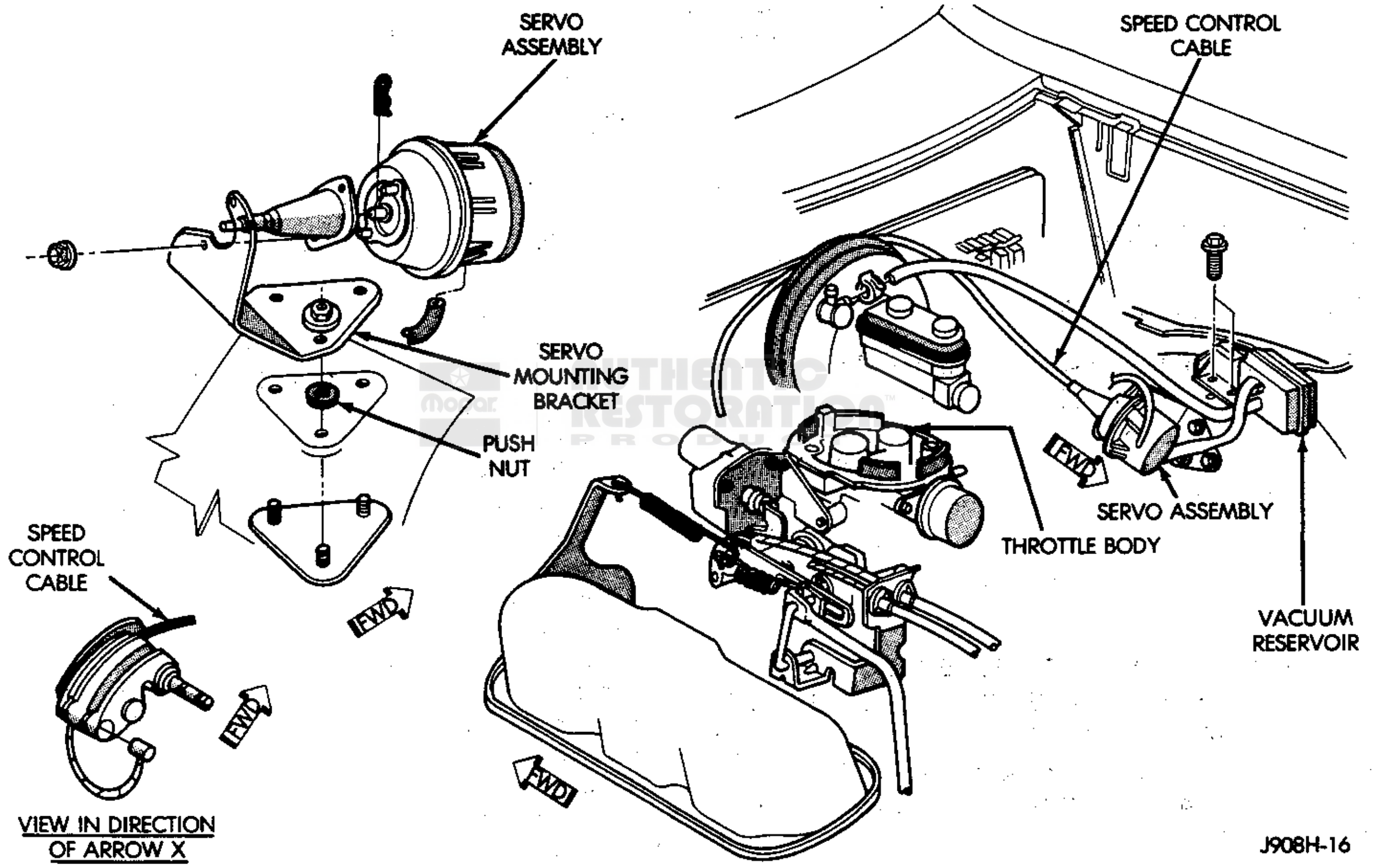
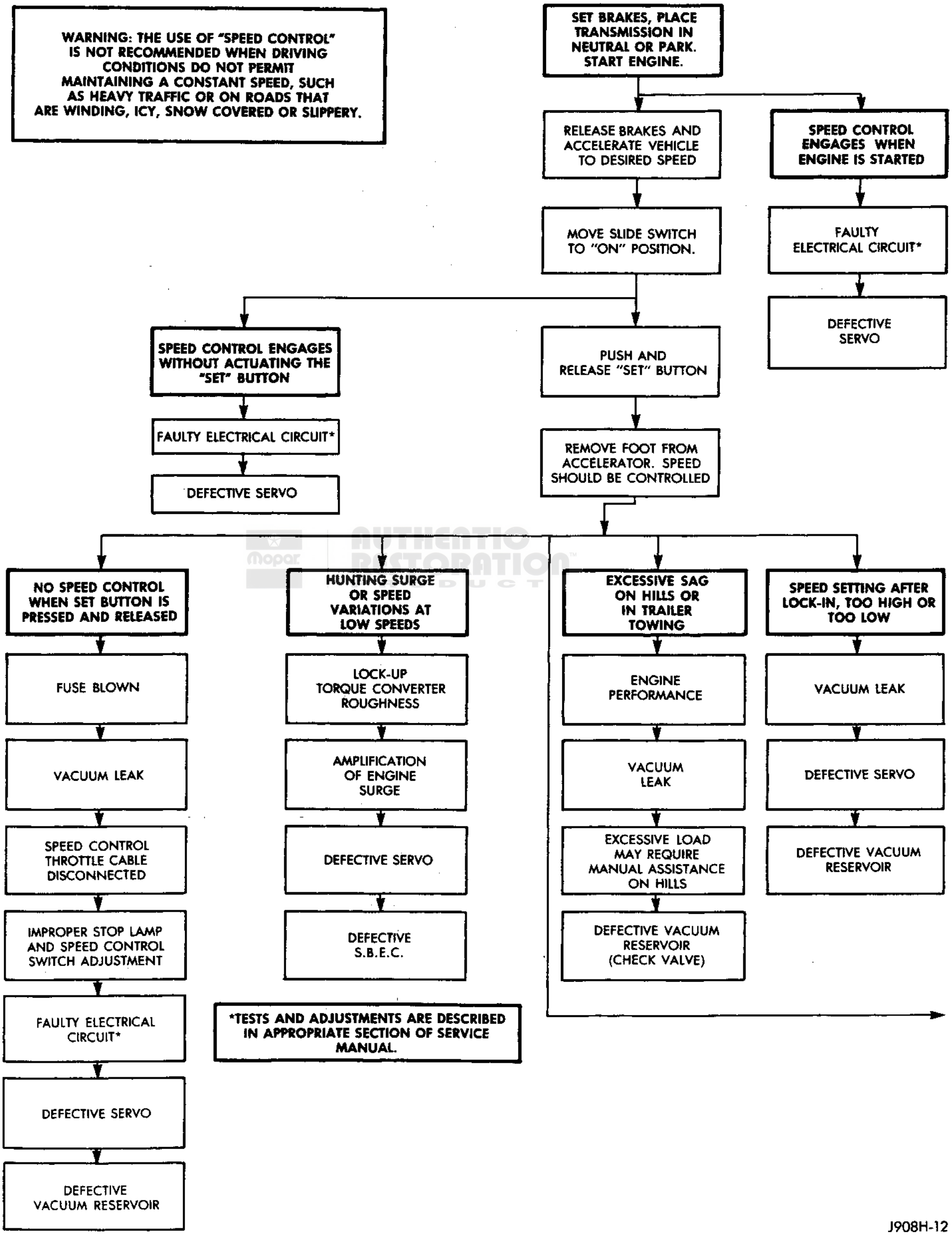


Fig. 1 Speed Control System

WARNING: THE USE OF "SPEED CONTROL" IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED OR SLIPPERY.



***TESTS AND ADJUSTMENTS ARE DESCRIBED IN APPROPRIATE SECTION OF SERVICE MANUAL.**

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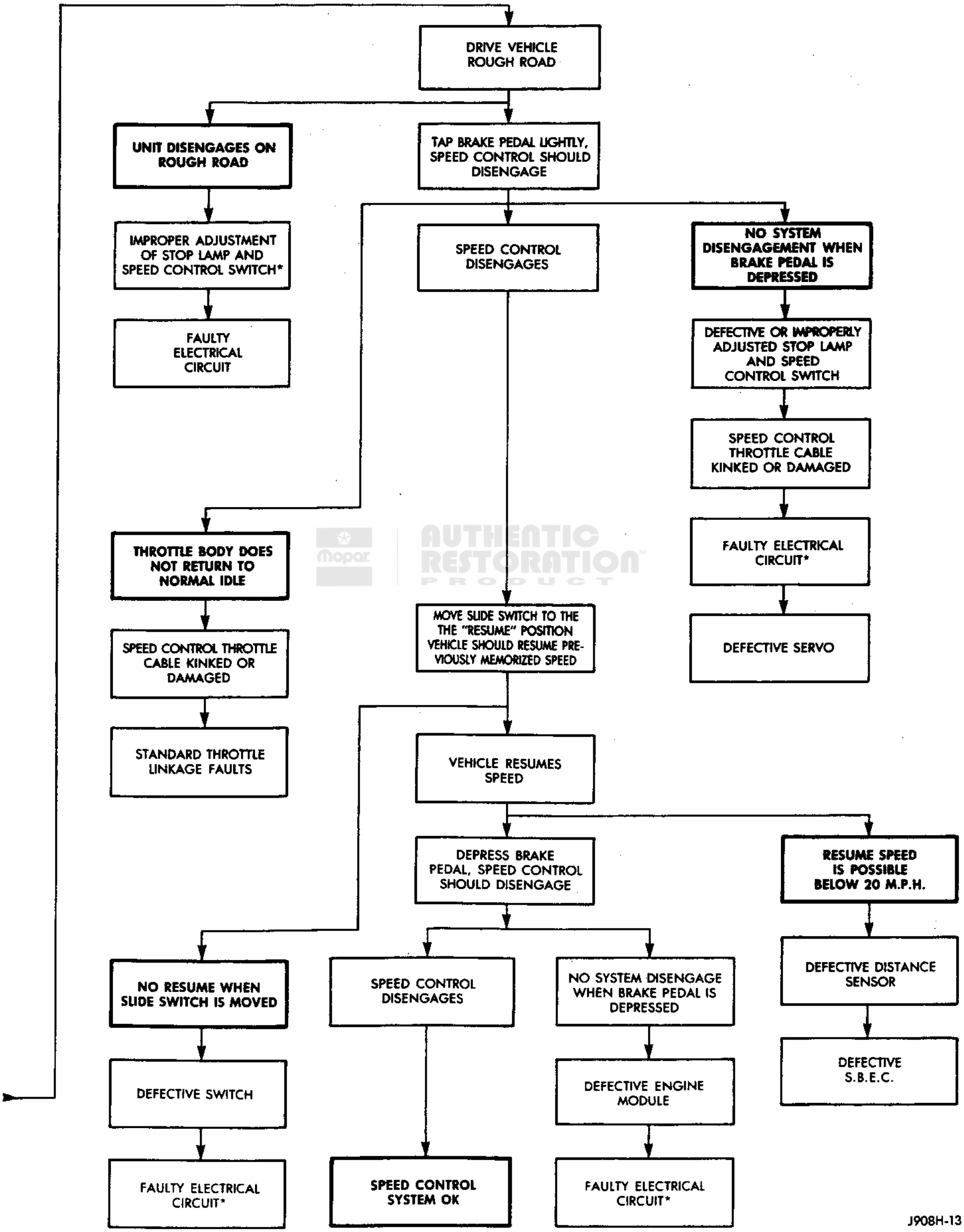
DRIVE VEHICLE ROUGH ROAD
UNIT DISENGAGES ON ROUGH ROAD
IMPROPER ADJUSTMENT OF STOP LAMP AND SPEED CONTROL SWITCH*
FAULTY ELECTRICAL CIRCUIT
TAP BRAKE PEDAL LIGHTLY, SPEED CONTROL SHOULD DISENGAGE
SPEED CONTROL DISENGAGES
NO SYSTEM DISENGAGEMENT WHEN BRAKE PEDAL IS DEPRESSED
DEFECTIVE OR IMPROPERLY ADJUSTED STOP LAMP AND SPEED CONTROL SWITCH
SPEED CONTROL THROTTLE CABLE KINKED OR DAMAGED
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
THROTTLE BODY DOES NOT RETURN TO NORMAL IDLE
SPEED CONTROL THROTTLE CABLE KINKED OR DAMAGED
STANDARD THROTTLE LINKAGE FAULTS
MOVE SLIDE SWITCH TO THE THE "RESUME" POSITION VEHICLE SHOULD RESUME PREVIOUSLY MEMORIZED SPEED
VEHICLE RESUMES SPEED
DEPRESS BRAKE PEDAL, SPEED CONTROL SHOULD DISENGAGE
RESUME SPEED IS POSSIBLE BELOW 20 M.P.H.
DEFECTIVE DISTANCE SENSOR
DEFECTIVE S.B.E.C.
NO RESUME WHEN SLIDE SWITCH IS MOVED
DEFECTIVE SWITCH
FAULTY ELECTRICAL CIRCUIT*
SPEED CONTROL DISENGAGES
SPEED CONTROL SYSTEM OK
NO SYSTEM DISENGAGE WHEN BRAKE PEDAL IS DEPRESSED
DEFECTIVE ENGINE MODULE
FAULTY ELECTRICAL CIRCUIT*

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TEST PROCEDURES

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ROAD TEST

Road test vehicle 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 deficiencies should be corrected before proceeding.

INOPERATIVE SYSTEM

If road test verifies a report on an inoperative system and of satisfactory speedometer operation, an inspection should be made for loose electrical and vacuum connections at the servo.

Check for correct installation of the vacuum check valve in the hose from servo to vacuum source. The word VAC on the valve must point toward the vacuum source.

Corrosion should be removed from electrical terminals and a light coating of Mopar Multi-Purpose Grease, or equivalent, applied.

Inspection should also be made to verify that both ends of the speed control cable are securely attached.

CHECKING FOR FAULT CODE

(1) When trying to verify a speed control system electronic malfunction, one of two similar methods may be used. If a DRBII is available, plug into the diagnostic connector in the engine compartment and verify that either a Fault Code 34 (S/C SERVO SOLENOIDS) or Fault Code 15 (VEHICLE SPEED SIGNAL) is indicated.

You can also refer to the appropriate Powertrain Diagnostic Procedures Manual.

If the DRBII is not available, the Fault Code may be determined with the following method:

(a) With key inserted in ignition switch, cycle switch to ON position three times. On third cycle, leave switch in ON position.

(b) After switch has been cycled three times, observe CHECK ENGINE indicator on instrument cluster. If a Fault Code is present, indicator will flash (blink) in a series which will show which Fault Code is the problem (i.e. three flashes in rapid succession, a slight pause, then four flashes in rapid succession would indicate Fault Code 34).

(2) If a Fault Code 34 is observed, determine the source of the problem by performing the tests in the sections Electrical Tests at Servo and Electrical Tests at Engine Controller.

If a fault code 15 is observed, perform the test for a faulty distance sensor.

(3) Correct any problems found when performing these tests and recheck for Fault Code if changes were made.

DISTANCE SENSOR TEST

For testing of the distance sensor and related components refer to the Vehicle Diagnostics Test Procedure Manual.

SPEED CONTROL SYSTEM ELECTRICAL TESTS

Electronic speed control systems may be tested using two different methods. One involves use of a DRBII. If this test method is desired, please refer to the Vehicle Diagnostic Test Procedures booklet.

The other test method uses a voltmeter. The voltmeter method is described in the following tests.

If any information is needed concerning wiring, refer to Group 8W - Wiring Diagrams.

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.

ELECTRICAL TESTS AT SERVO

(1) Turn ignition switch to the ON position. With the speed control switch in the ON position, set up a voltmeter to read battery voltage and connect the negative lead to a good chassis ground.

(2) Disconnect the 4-way connector going to the servo. The blue wire with the red tracer of the main harness 4-way connector should read approximately battery voltage. If not, check for loose connections, brake switch adjustment or, repair the main harness as necessary.

(3) Connect a jumper wire between the male and female terminals of the blue wire with red tracer. The other three male terminals from the servo should show battery voltage. If not, replace the servo.

(4) Using an ohmmeter, connect one lead to a good body ground and with the other lead touch the black (BK) wire terminal in the 4-way connector of the main harness. The meter should show continuity. If not, repair the ground circuit as necessary.

ELECTRICAL TESTS AT ENGINE CONTROLLER

(1) Unplug 60-way connector from the engine controller, located on dash panel (Fig. 1).

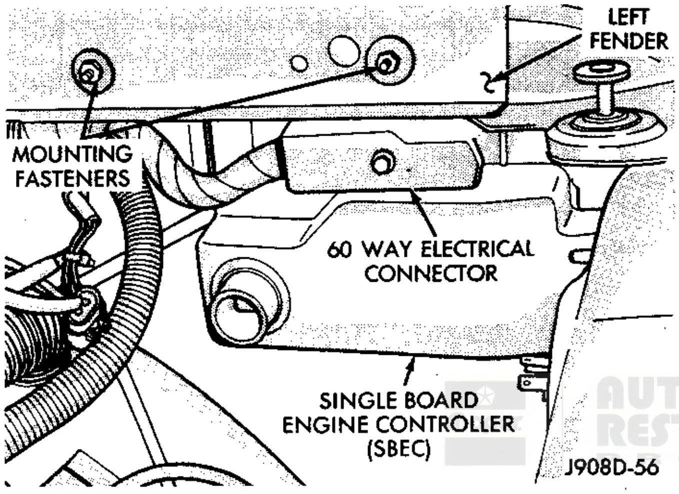

Fig. 1 Engine Controller and Connector Location

(2) Connect negative lead of voltmeter to a good body ground near the module.

(3) For the following tests, the ignition switch must be in the ON position. Refer to Fig. 2 for controller terminal locations. Touch the positive lead of the voltmeter to the terminal in cavity number 33. With the speed control switch in the OFF position, the voltmeter should read 0 volts. With the speed control switch in the ON position, the voltmeter should read battery voltage. If not, repair the main harness as necessary.

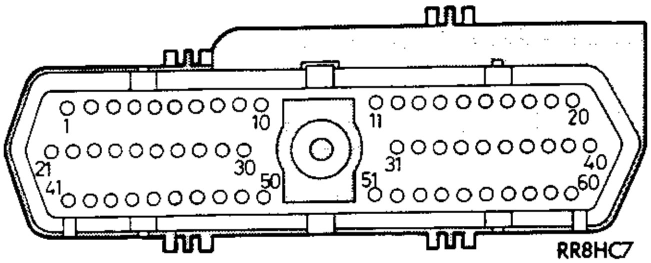

Fig. 2 Engine Controller 60-Way Connector Shown from Terminal End

(4) Touch the positive lead of the voltmeter to the terminal in cavity number 53. As in step (3), the voltmeter should read 0 volts with the switch in the OFF position and battery voltage with the switch in the ON position.

(5) Touch the positive lead of the voltmeter to the terminal in cavity number 48. With the speed control switch in the OFF position, the voltmeter should read 0 volts. With the switch in the ON position, the voltmeter should read battery voltage. Pressing the SET button should cause the voltmeter to change from battery voltage to 0 volts for as long as the switch is held. If not, perform the speed control switch test. If the switch is not at fault, then check the main harness and repair as necessary.

(6) Touch the positive lead of the voltmeter to the terminal in cavity number 50. The voltmeter should read 0 volts with the speed control switch in either the OFF or ON position. With switch in either RESUME or SET position, the voltmeter should read battery voltage. If not, perform the speed control switch test. If the switch is not at fault, then check the main harness and repair as necessary.

(7) Touch the positive lead of the voltmeter to the terminal in cavity number 49. The voltmeter should read 0 volts with the switch in the OFF position. With the switch in the ON position, the voltmeter should read battery voltage. The voltmeter will continue to read battery voltage when either the SET or RESUME switch is pressed. If not, perform the speed control switch test. If the switch is not at fault, then check the main harness and repair as necessary .

(8) Using an ohmmeter, connect one lead to a good body ground and touch the other lead to the terminal in cavity number 29. With the brake pedal released, the meter should show continuity. When the pedal is depressed, the meter should show open circuit.

STOP LAMP SPEED CONTROL SWITCH TEST

(1) Disconnect the connector at the stop lamp switch. Using an ohmmeter, continuity may be checked at the switch side of the connector as follows (Fig. 3):

(a) With brake pedal released, there should be continuity (no resistance) between the black (BK) and white with pink tracer (WT/PK*) wires, and between the yellow with red tracer (YL/RD*) and dark blue with red tracer (DB/RD*) wires. There should be no continuity between the pink (PK) and white (WT) wires.

(b) With brake pedal depressed, there should be continuity between pink (PK) and white (WT) wires. There should be no continuity between black (BK) and white with pink tracer (WT/PK*) wires, or between the yellow with red tracer (YL/RD*) and dark blue with red tracer (DB/RD*) wires.

(2) If the above results are not obtained, the stop lamp switch is defective or out of adjustment.

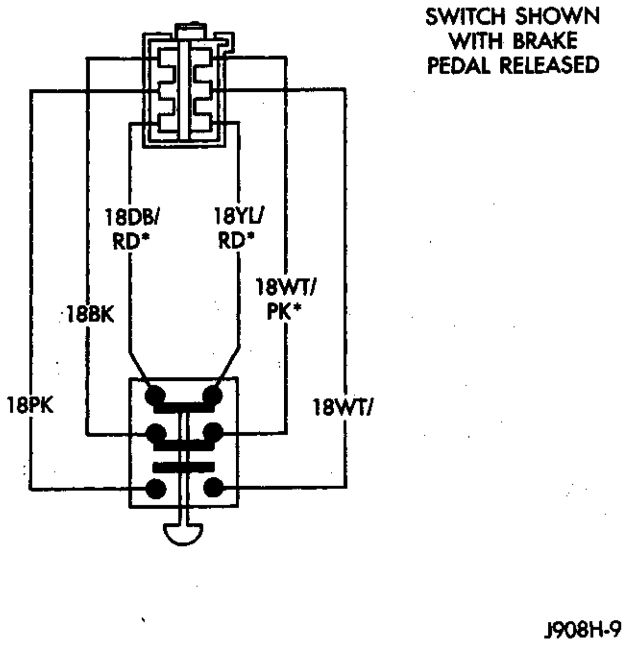

Fig. 3 Stop Lamp and Speed Control Switch Wiring

Stop lamp switch adjustment is detailed in Group 5 - Brakes.

SPEED CONTROL SWITCH (TURN SIGNAL LEVER) TEST (Fig. 4)

(1) Disconnect the blade-type four wire electrical connector at base of steering column.

(2) Using a continuity tester or an ohmmeter (do not use a test light), check for continuity at the connector wires. Results should be obtained according to the following chart.

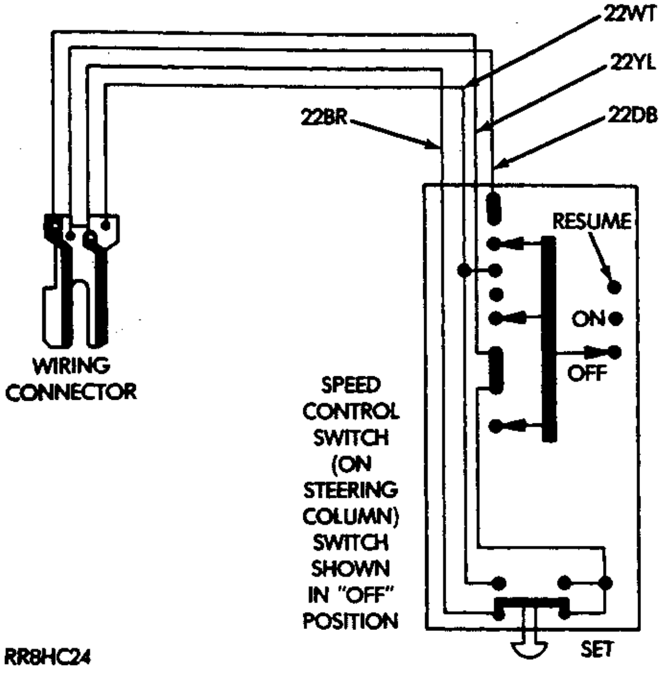

Fig. 4 Speed Control Steering Column Switch and Wiring

VACUUM SUPPLY TEST

(1) Disconnect vacuum hose at the servo and install a vacuum gauge in the hose (Fig. 5).

(2) Start engine and observe gauge at idle. Vacuum gauge should read at least ten inches of mercury.

(3) Connect vacuum supply hose.

SPEED CONTROL SWITCH CONTINUITY CHART

SWITCH POSITION	CONTINUITY BETWEEN
OFF	BR and YL
ON	BR and YL BR and DB YL and DB
SET	YL and WT DB and WT YL and DB/WT
RESUME	DB and WT DB and YL BR and YL BR and DB BR and WT

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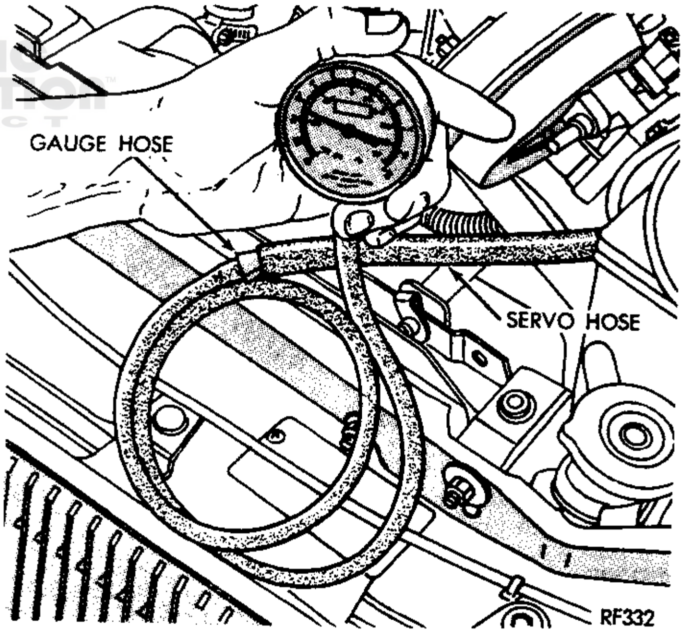

Fig. 5 Vacuum Gauge Test

(4) If vacuum does not meet this requirement, check for vacuum leaks or poor engine performance.

SPEED CONTROL CABLE ATTACHMENT

SPEED CONTROL CABLE ATTACHMENT—THROTTLE BODY

(1) The clevis of the speed control cable is retained on the throttle body with a specially shaped retaining clip. Visual inspection will verify that the cable is securely attached. If the cable is not attached, the speed control system will be inoperative.

The speed control cable on D-body trucks is snapped into a T-shaped slot in the cable mounting bracket (Fig. 6).

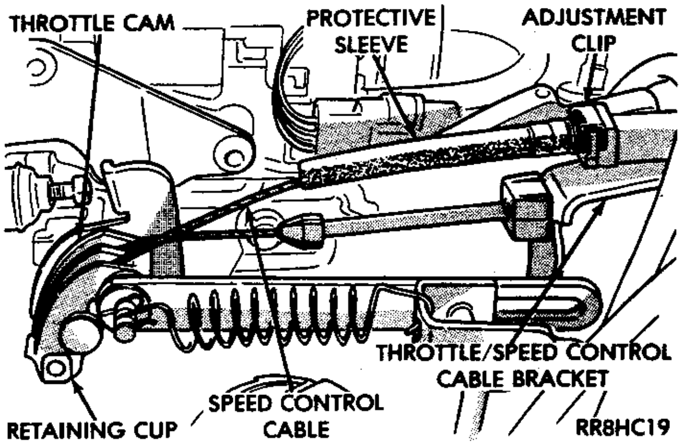

Fig. 6 Speed Control Cable and Mounting Bracket

(1) Grip cable core wire and lightly push toward servo.

(2) While lightly holding toward servo, mark core wire next to protective sleeve (Fig. 7).

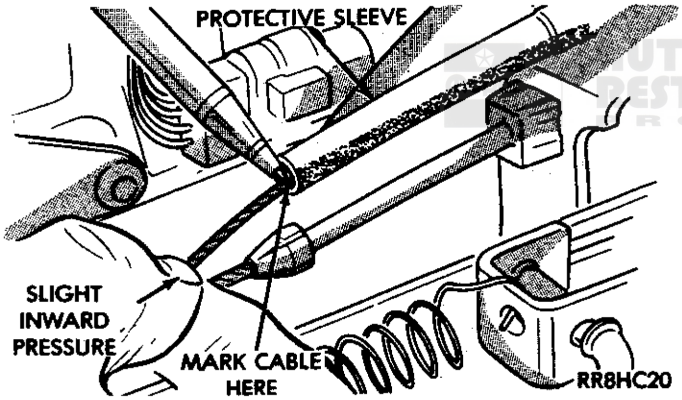

Fig. 7 Push Cable In and Mark at Protective Sleeve

(3) Pull core wire away from servo. There should be a 6mm (.24 in.) gap between the mark on the core wire and the protective sleeve (Fig. 8).

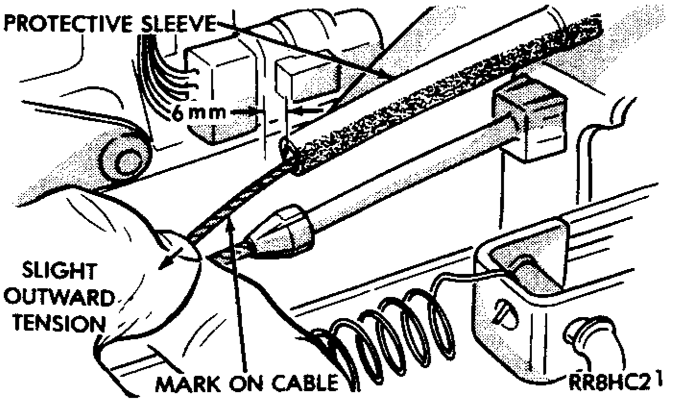

Fig. 8 Pull Cable Out and Measure from Mark to Protective Sleeve

(4) If gap is not correct, remove adjustment clip and push protective sleeve into housing to decrease gap or pull sleeve out of housing to increase gap (Fig. 9).

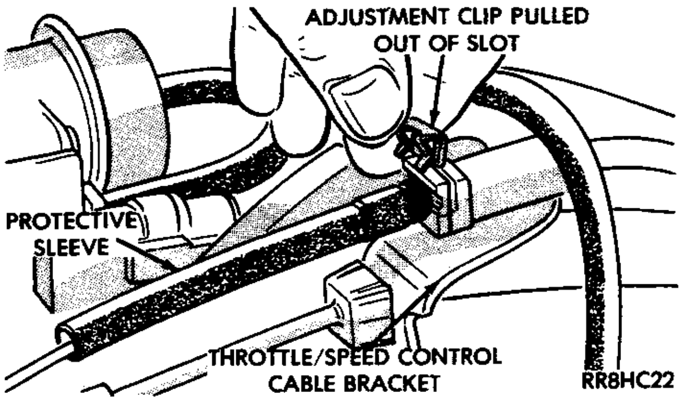

Fig. 9 Adjustment Clip Pulled Out of Slot to Move Sleeve

(5) Install adjustment clip.

SPEED CONTROL CABLE ATTACHMENT—SERVO

(1) The speed control cable is attached to the servo with a wire clip (Fig. 10). A check should be made to verify that the clip is in place. If the clip is missing the speed control system will be inoperative.

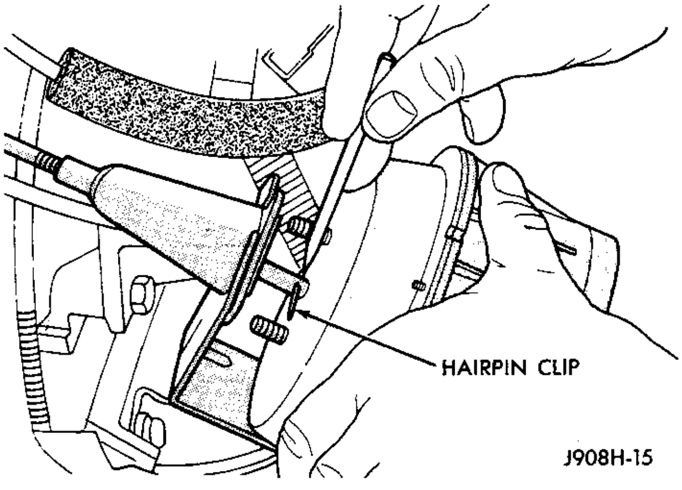

Fig. 10 Speed Control Cable Attachment at Servo

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SPEED CONTROL SERVO

REMOVAL

(1) Remove two nuts attaching throttle cable and mounting bracket to servo.

(2) Remove two screws attaching servo mounting bracket to U-Nuts on battery tray.

(3) Remove servo mounting bracket.

(4) Disconnect electrical connector and vacuum hose.

(5) Pull cable away from servo to expose retaining clip and remove clip attaching cable to servo.

INSTALLATION

(1) With throttle in full open position align hole in throttle cable sleeve with hole in servo pin and install retaining clip.

(2) Connect vacuum hose to servo.

(3) Connect electrical connector.

(4) Position mounting bracket and install two screws attaching bracket to battery tray, tighten to 12 N•m (105 in. lbs.).

(5) Insert servo studs through holes in throttle cable and mounting bracket.

(6) Install nuts, tighten to 9 N•m (80 in. lbs.).

SERVO THROTTLE CABLE ASSEMBLY

REMOVAL

(1) Remove air cleaner.

(2) Disconnect cable at retaining clamp and at carburetor (throttle body), removing snap ring (retaining clip).

(3) Disconnect cable at servo and remove cable assembly.

INSTALLATION

(1) Locate cable through servo mounting bracket.

(2) Connect cable sleeve to servo stud, align holes, and install hairpin clip.

(3) Insert servo studs through holes in cable and holes in bracket, install nut-washers, and tighten to 9 N•m (80 in. lbs.).

(4) Route cable from servo, through cable support bracket and clip, and install cable end on stud of throttle body.

(5) Adjust cable as described under speed control cable adjustment.

(6) Replace air cleaner.

SPEED CONTROL SWITCH (Turn Signal Lever)

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove four screws attaching lower steering column cover and remove cover (Fig. 1). The fuse block is attached to this cover and should be supported when cover is removed.

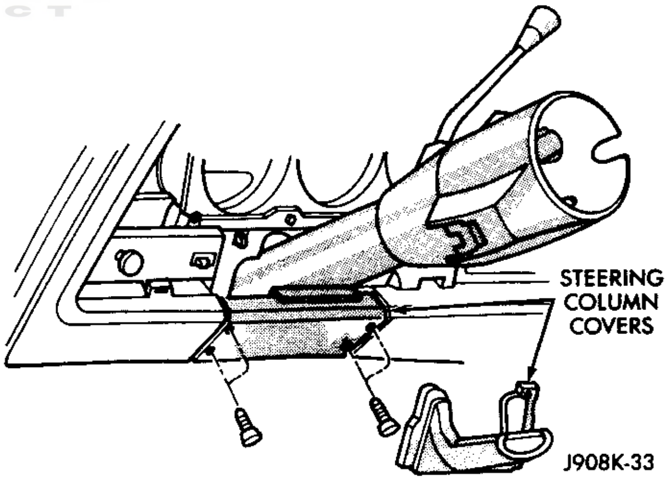

Fig. 1 Steering Column Cover

(3) Remove wiring trough after unsnapping four plastic retaining clips (Fig. 2).

(4) Disconnect speed control switch electrical connector from instrument panel harness connector.

(5) Pull wiper control knob from end of turn signal lever.

(6) Remove silencer from lever.

(7) Remove two screws attaching speed control switch to column.

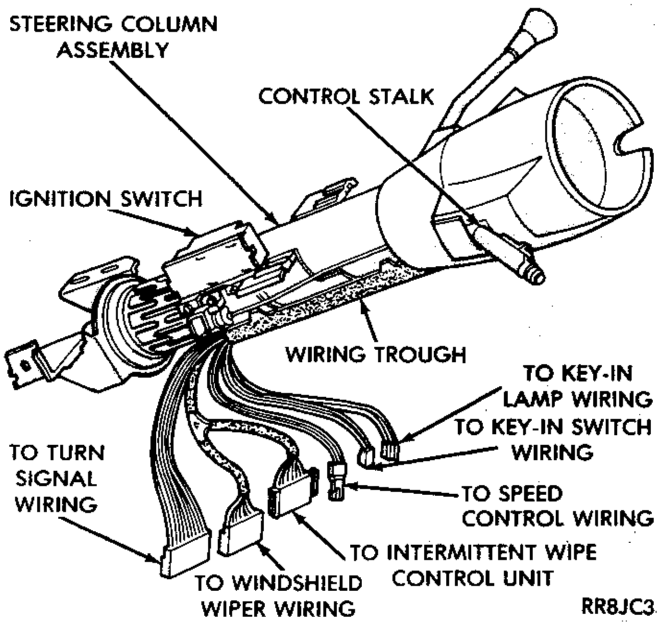

Fig. 2 Steering Column Connectors

(8) On tilt columns remove steering wheel with puller C3428B (Fig. 3).

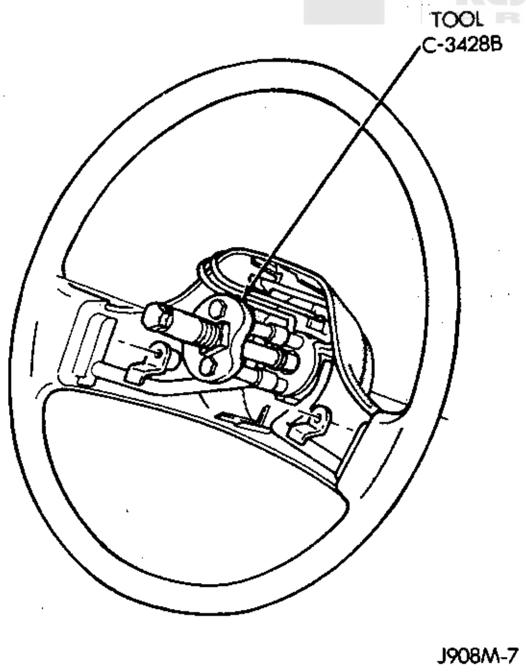

Fig. 3 Removing Steering Wheel (Typical)

(9) On tilt columns attach a flexible guide wire to lower end of speed control switch harness.

(10) On standard columns, remove upper steering column lock housing cover which is retained by two screws.

(11) Remove switch and harness from column. On tilt columns pull wires through lock housing between lock-plate and side of housing. Then disconnect guide wire from harness.

INSTALLATION

(1) On standard columns, insert harness and connector through turn signal lever opening in column and pull down and out lower end.

(2) On tilt columns, insert harness connector through turn signal lever opening in column and pull upward through upper housing. Attach guide wire to switch wiring harness and gently pull downward through column opening, between lockplate and side of housing, taking care to avoid damaging wires.

(3) Remove all slack from wires.

(4) On tilt columns, remove guide wire.

(5) Install wiring trough with plastic clips.

(6) Connect speed control switch electrical connector to instrument panel harness connector.

(7) Secure speed control switch to column with two screws.

(8) Position silencer on lever.

(9) Push wiper control knob in place on end of lever.

(10) On tilt columns replace steering wheel.

(11) On standard columns install upper steering column lock housing cover.

(12) Install fuse block to cover.

(13) Position lower steering column cover and install four attaching screws.

(14) Connect battery negative cable and test operation of speed control.

SPEED CONTROL VACUUM RESERVOIR REPLACEMENT

REMOVAL

(1) Disconnect vacuum supply hose and servo hose (Fig. 4).

(2) Remove reservoir mounting bolts.

(3) Remove reservoir from left side splash shield.

INSTALLATION

(1) Install reservoir to the left side splash shield. Torque screws to 6 N•m (50 in. lbs.).

(2) Connect vacuum supply hose to large nipple. Connect servo hose to shielded small nipple.

TURN SIGNALS AND HAZARD WARNING FLASHER

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GENERAL INFORMATION

TURN SIGNALS

The turn signals are actuated with a lever on the left side of the steering column just below the steering wheel. When the driver wishes to signal his intentions to change direction of travel, he moves the lever upward to cause the right signals to flash and downward to cause the left signals to flash. (Fig. 1).

After completion of a turn the system is deactivated automatically. As the steering wheel returns to the straight ahead position, a canceling cam in the turn signal switch (with standard column-rotated by steering wheel; with tilt column-rotated by column lock plate) comes in contact with one of two canceling fingers of the turn signal switch. The cam pushing on the switch canceling finger returns the switch to the OFF position.

If only momentary signaling such as indication of a lane change is desired, the switch is actuated to a left or right intermediate detent position. In this position the signal lamps flash as described above, but the switch returns to the OFF position as soon as the lever is released (Fig. 1)

When the system is activated, one of two indicator lamps mounted in the instrument cluster flashes in unison with the turn signal lamps, indicating to the driver that the system is operating.

HAZARD WARNING SYSTEM

The hazard warning system is actuated by a switch knob (Fig. 2) on the right side of the steering column just below the steering wheel. On standard columns the knob is pulled out (away from the column) to operate the hazard warning system, and on the Tilt column it is pushed in. When the switch is actuated all turn signal lamps and turn signal indicators flash simultaneously.

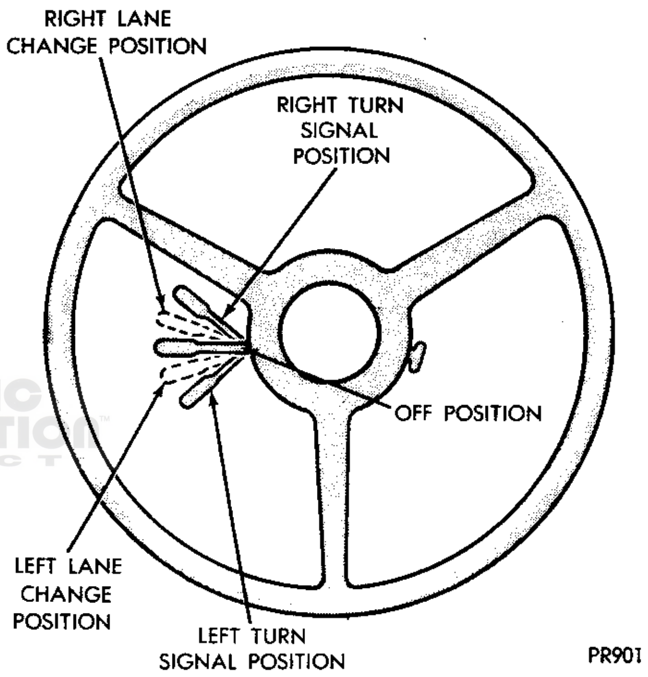

Fig. 1 Turn Signal Lever Positions

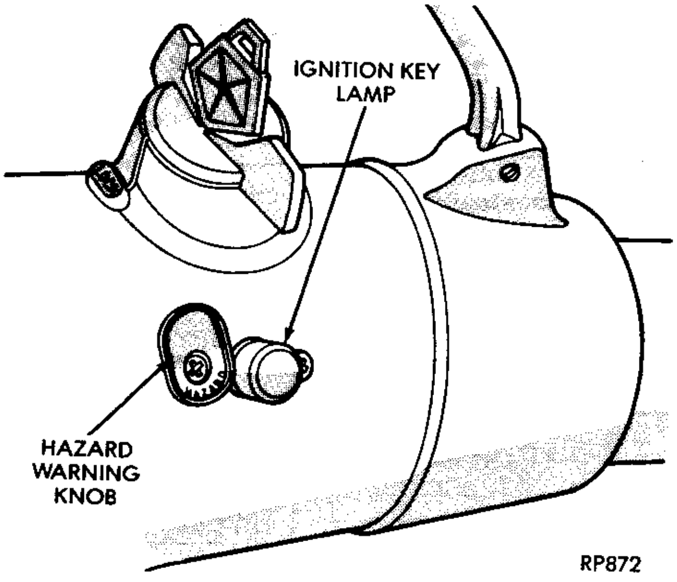

Fig. 2 Hazard Warning Knob

When the hazard warning switch is actuated, the turn signal switch should be in the OFF position to avoid a characteristic feed back through the accessory circuit which might cause intermittent operation of any accessories left with switches turned on.

When the hazard warning switch is actuated and the brakes applied, the hazard warning lamps will continue to flash.

TURN SIGNAL AND HAZARD WARNING FLASHER LOCATION

The turn signal and hazard warning flashers are located on the fuse block, which is on the lower instrument panel cover under the steering column (Fig. 3).

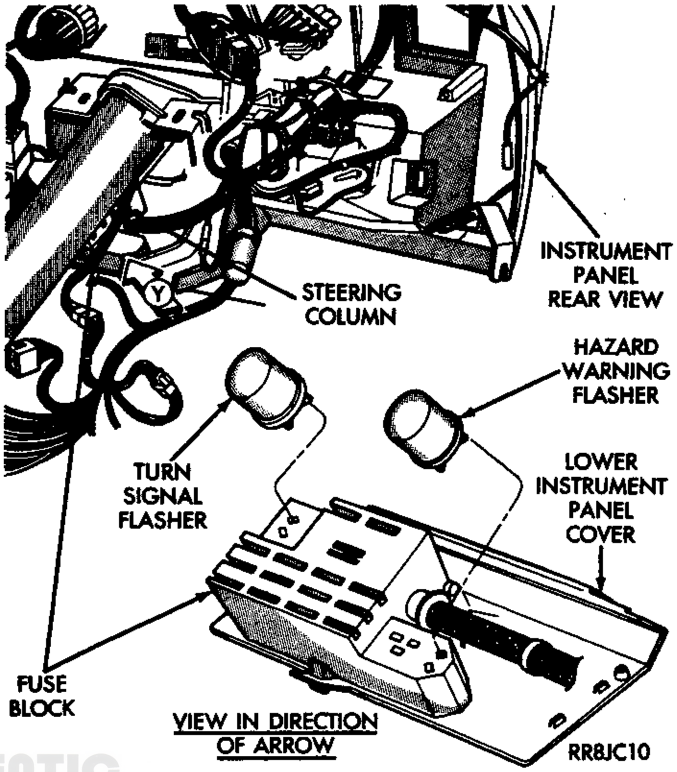

Fig. 3 Turn Signal and Hazard Warning Flashers

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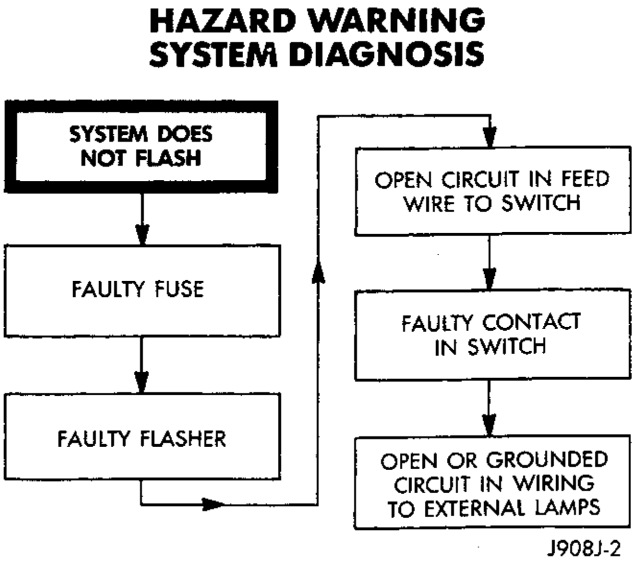
HAZARD WARNING SYSTEM DIAGNOSIS

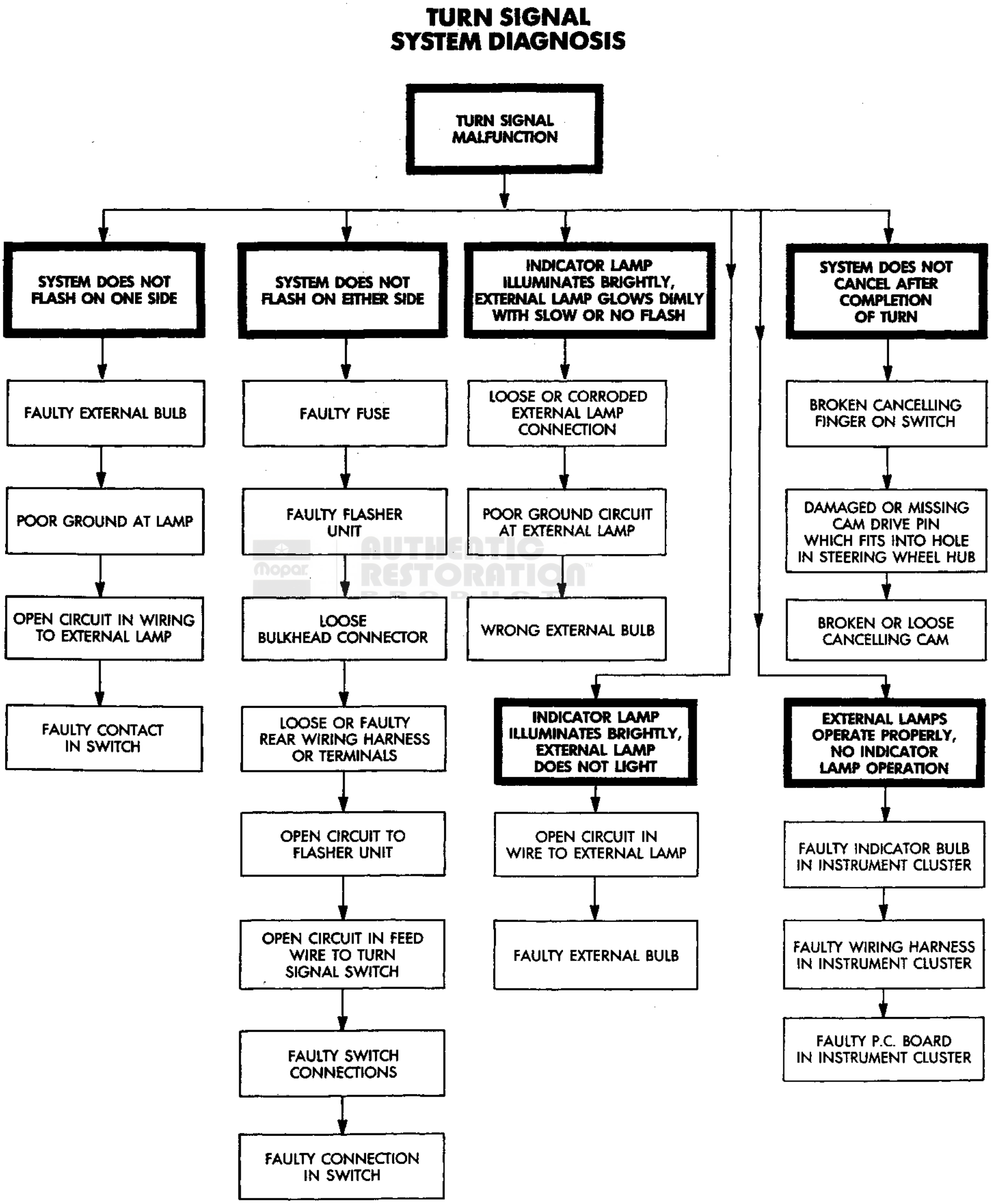


TURN SIGNAL AND HAZARD WARNING SWITCH TESTS

The turn signal switch and hazard warning switch operate the same lamps, and therefore, have much common wiring. Analyzing both systems when there is a fault can often lead to more rapid identification of the fault.

Since the stop lamp circuitry feeds through both the turn signal switch and the hazard warning switch, these switches should be given consideration when there is a failure in the stop lamp circuit. To test the switch, first disconnect the battery negative cable then the switch wires from the body wiring at the connector (Fig. 4).

TURN SIGNAL SYSTEM DIAGNOSIS



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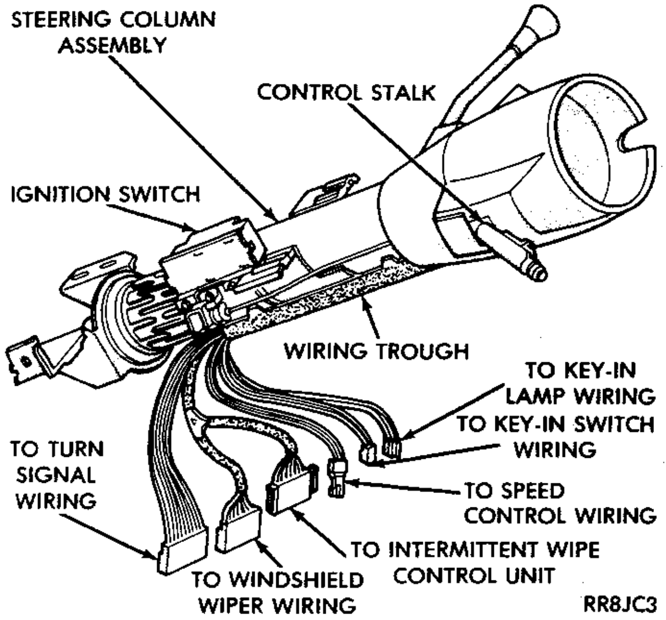
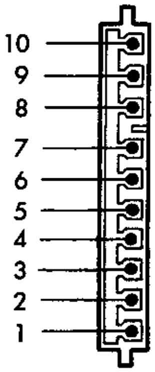


Fig. 4 Steering Column Wiring Connectors

Using a continuity tester or an ohmmeter, test for continuity (no resistance) between the terminals of the switch as shown in the following continuity chart. The identity of each terminal is shown in the Switch Continuity Chart.

WIRE CAVITY	WIRE COLOR	APPLICATION
10	WHITE/TAN	STOP LIGHT SWITCH
9	BR/RED	RIGHT REAR
8	DK GRN/RED	LEFT REAR
7	RED/BK	TURN SIGNAL FLASHER
6	PINK	HAZARD WARNING FLASHER
5	TAN	RIGHT FRONT
4	LIGHT GRN	LEFT FRONT
3	BLACK/RED	HORN
2	BLACK	HORN GROUND
1		



Turn Signal Switch

Switch Position:	Left	Neutral	Right
Continuity Between:	7 and 4	10 and 9	7 and 5
Continuity Between:	7 and 8	10 and 8	7 and 9
Continuity Between:	10 and 9	—	10 and 8

Hazard Warning Switch

Switch Position:	Off	On
Continuity Between:	10 and 9	6 and 4
Continuity Between:	10 and 8	6 and 5
Continuity Between:	—	6 and 8
Continuity Between:	—	6 and 9

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SWITCH CONTINUITY CHART

SERVICE PROCEDURES

TURN SIGNAL/HAZARD WARNING SWITCH

REMOVAL

(1) Disconnect battery negative cable.

(2) On the standard and optional steering wheels (Figs. 5 and 6) remove two horn pad mounting screws from underside of steering wheel.

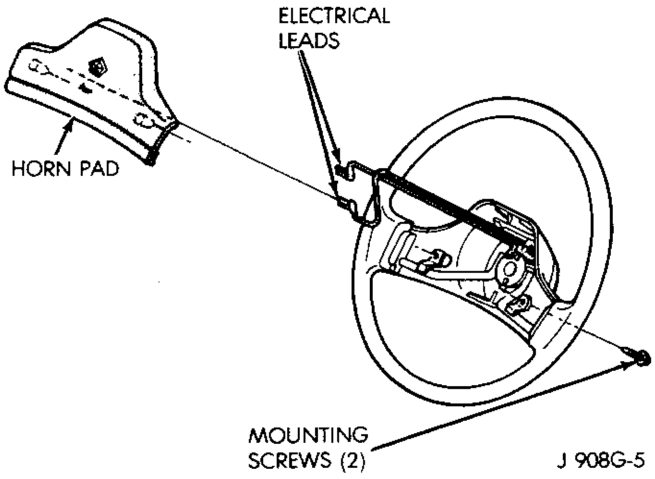

Fig. 5 Standard Steering Wheel

(3) Pull pad up from wheel and disconnect electrical leads.

(4) Remove pad.

(5) Remove steering wheel with puller C-3428B (Fig. 7).

(6) Remove wiring trough by prying out plastic retainer buttons.

(7) Position gearshift lever to its full clockwise position (standard column). If equipped with tilt column position at mid-point.

(8) Disconnect turn signal wiring (Figs. 8 and 9).

(9) Disassemble steering column for switch removal.

(a) Standard Column: Remove screw holding wiper-washer switch to turn signal switch pivot. Leave the entire turn signal lever (control stalk) in its installed position.

Remove three screws attaching turn signal switch to upper bearing housing (Fig. 10).

(b) Tilt Column: Depress lock plate with Tool C-4156 and pry retaining ring out of groove with screwdriver (Fig. 11). The full load of the upper bearing spring should not be relieved; if it is, the retaining ring will turn too easily making removal more difficult. Remove lock plate, canceling cam, and upper bearing spring.

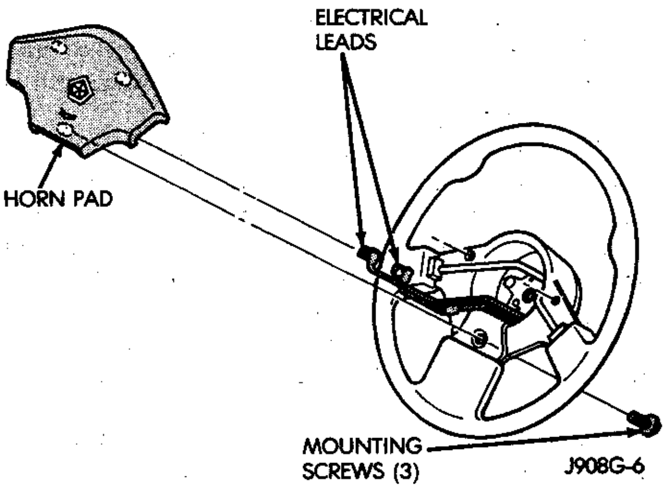

Fig. 6 Optional Steering Wheel

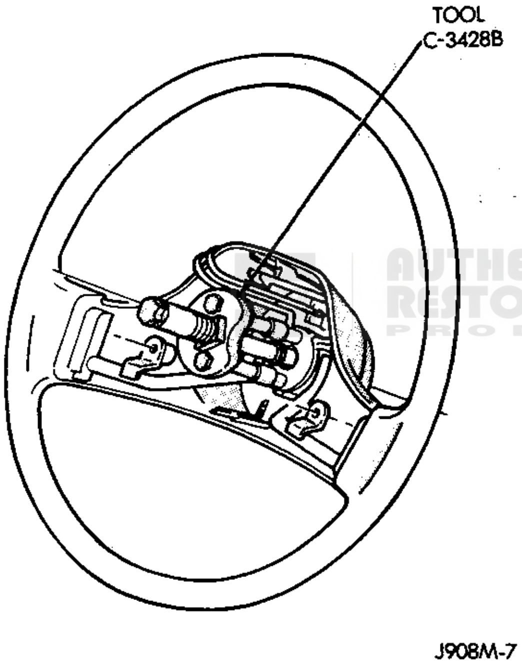

Fig. 7 Removing Steering Wheel (Typical)

Place turn signal switch in right turn position. Remove screw which attaches link between turn signal switch and wiper-washer switch pivot. Remove screw which attaches hazard warning switch knob. Remove three screws attaching turn signal switch to steering column.

(10) Wrap a piece of tape around the turn signal switch wiring and connector to prevent snagging when removing the switch.

(11) Remove turn signal and hazard warning switch assembly by gently pulling switch up from column while straightening and guiding wires up through column opening.

INSTALLATION

(1) On standard columns, lubricate turn signal switch pivot (entire 360° around depth of column hole through which it installs). Use a film of Lubriplate or a light lubricant equivalent.

(2) Maneuver connector through opening in steering column, then carefully guide wires down through column.

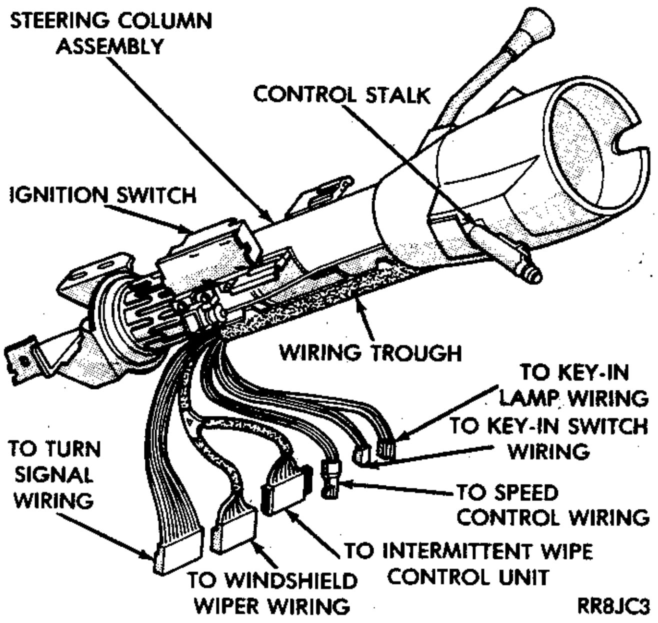

Fig. 8 Steering Column Wiring Connectors

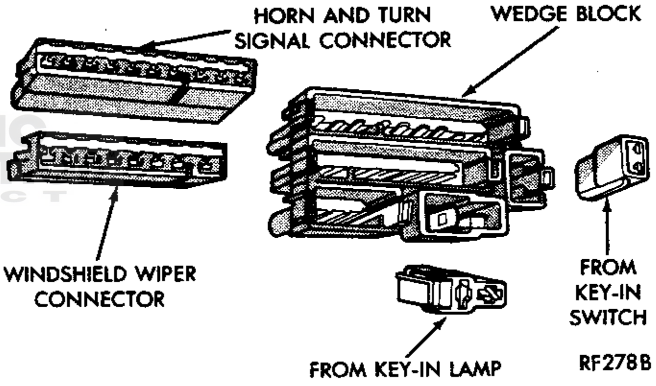

Fig. 9 Disconnecting Wires

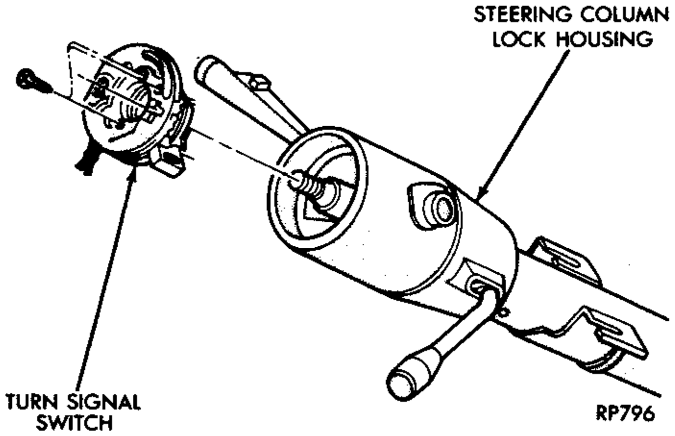

Fig. 10 Turn Signal Switch

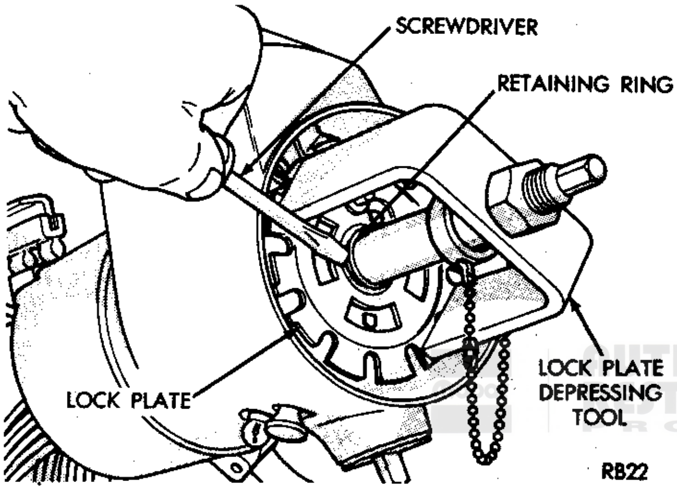

Fig. 11 Removing Lock Plate Retaining Ring Using Tool C-4156

(3) On column shift, place gear shift lever into PARK position.

(4) Assemble upper part of steering column.

(a) Standard Column: Position turn signal switch into place on upper bearing housing. Install three mounting screws and tighten securely. Position turn signal lever (control stalk) to turn signal switch pivot, then put screw through pivot and tighten securely. Be sure that dimmer switch rod is in control stalk pocket.

(b) Tilt Column: Position turn signal switch in upper column housing. Place switch in right turn position. Install three mounting screws and tighten. Pull link in position between turn signal switch and wiper-washer switch pivot, and secure with screw. Using Tool C-4156 install upper bearing spring, canceling cam, and lock plate, with new retaining ring. Install hazard warning knob with screw.

(5) Connect wiring harness connector. Install wiring trough to column with 4 plastic buttons.

(6) Install lower bezel to instrument panel.

(7) Install steering wheel, being sure that it is properly indexed to column shaft. Torque wheel nut to 61 N•m (45 ft. lbs.).

(8) Connect horn switch leads and install horn switch pad.

(9) Connect battery negative cable.

(10) Test operation of turn signals, hazard warning flashers, and horn.

WINDSHIELD WIPER AND WASHER SYSTEMS

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WINDSHIELD WASHERS 15
WINDSHIELD WIPER SYSTEM SERVICE PROCEDURES 7

GENERAL INFORMATION

The windshield wipers can be operated with the windshield wiper switch only when the ignition switch is in the ACCESSORY or IGNITION position. A fuse located in the fuse block protects the circuitry of the wiper system and the vehicle.

The same motor is used for standard and intermittent wipe systems.

The wiper motor has permanent magnet fields. The speeds are determined by current flow to the appropriate set of brushes.

The intermittent wipe system in addition to low and high speed, has a delay mode. The delay mode has a range of 2 to 15 seconds. This is accomplished by a variable resistor in the wiper switch and is controlled electrically by a relay.

The wiper system completes the wipe cycle when the switch is turned OFF. The blades park in the lowest portion of the wipe pattern.

If the washer knob is depressed while the system is in the OFF position, the wiper control module will turn the wiper motor on and allow it to operate through 3-4 wipe cycles and then turn OFF.

TWO SPEED WINDSHIELD WIPER MOTOR AND SWITCH TESTING PROCEDURES

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STANDARD TWO SPEED WIPER MOTOR SYSTEM TEST

The following is a list of general wiper motor system problems, the tests that are to be performed to locate the faulty part, and the corrective action to be taken. The same motor is used for standard and optional systems. If the malfunction involves only the Delay mode, switch, or wiring, refer to the Intermittent Windshield Wiper Motor and Switch Service Procedures.

CONDITION

Motor will not run in any switch position.

PROCEDURE

(1) Check for a blown fuse in the fuse block.

(a) If fuse is good, proceed to step No. 2.

(b) If fuse is defective, replace and check motor operation in all switch positions.

(c) If motor is still inoperative and the fuse does not blow, proceed to step No. 2.

(d) If replacement fuse blows, proceed to step No. 5.

(2) Place switch in low speed position.

(3) Listen to motor. If you cannot hear it running, proceed to step No. 4. If you hear it running, check motor output shaft. If output shaft is not turning, replace motor assembly. If it is turning, crank arm or drive link is not properly connected. Replace worn parts and/or properly connect drive link to the motor output shaft.

(4) Connect a voltmeter between motor terminal “L” and ground strap (Fig. 1). If there is no voltage or very little voltage (less than one volt) present, move negative test lead from the ground strap to battery negative terminal.

(a) If an increase in voltage is noticed, the problem is a bad ground circuit. Make sure the motor mounting is free of paint and that nuts or bolts are tight.

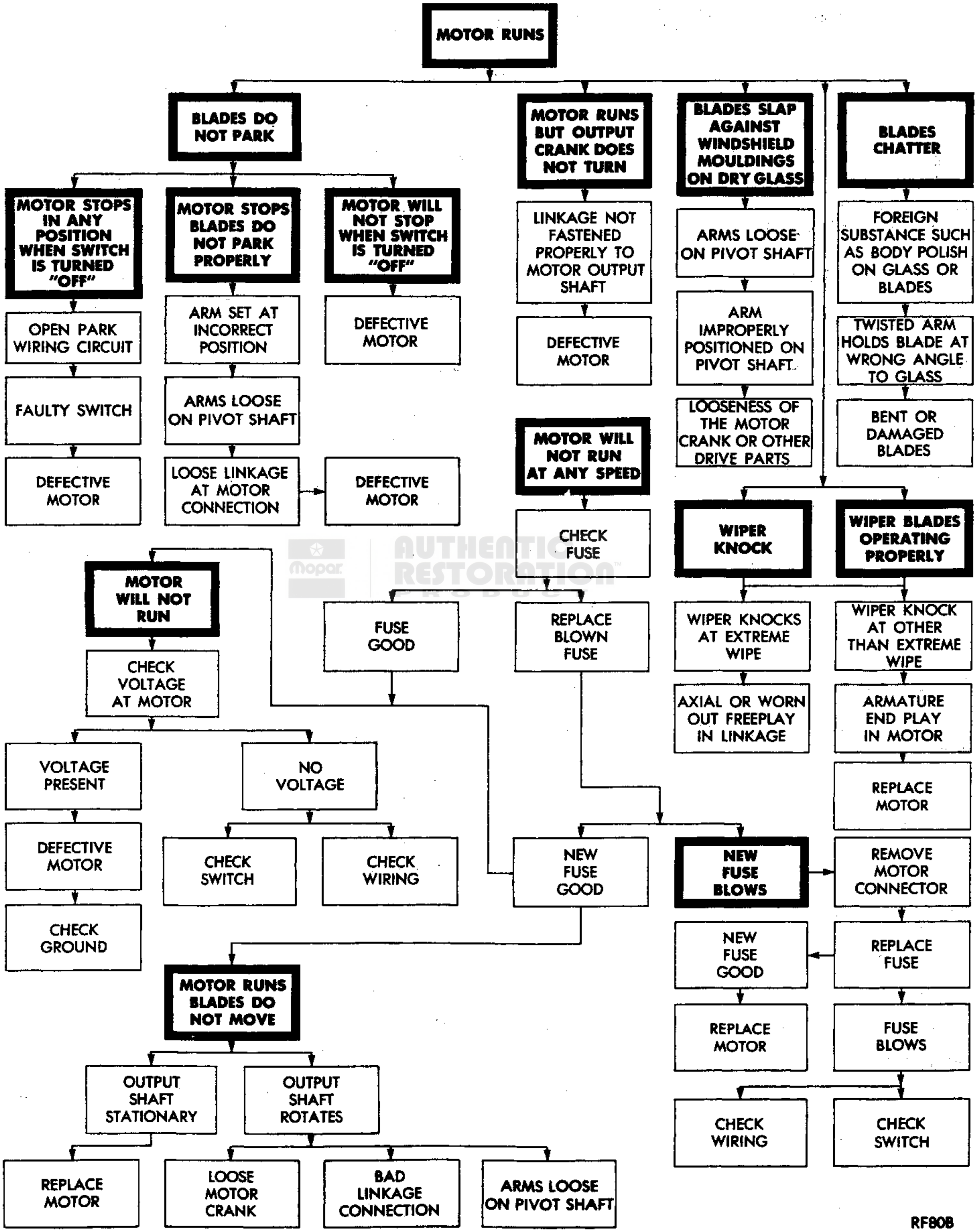
(b) If there is still no indication of voltage, the problem is an open circuit in the wiring harness or wiper switch.

(c) If no noticeable increase (greater than 3 volts) in voltage is observed, the problem is a faulty motor assembly.

(5) Disconnect motor wiring connector and replace fuse.

(a) If fuse does not blow, motor is defective.

(b) If fuse blows, switch or wiring is at fault.


MOTOR RUNS
BLADES DO NOT PARK
MOTOR STOPS IN ANY POSITION WHEN SWITCH IS TURNED "OFF"
OPEN PARK WIRING CIRCUIT
FAULTY SWITCH
DEFECTIVE MOTOR
MOTOR STOPS BLADES DO NOT PARK PROPERLY
ARM SET AT INCORRECT POSITION
ARMS LOOSE ON PIVOT SHAFT
LOOSE LINKAGE AT MOTOR CONNECTION
DEFECTIVE MOTOR
MOTOR WILL NOT STOP WHEN SWITCH IS TURNED "OFF"
DEFECTIVE MOTOR
MOTOR RUNS BUT OUTPUT CRANK DOES NOT TURN
LINKAGE NOT FASTENED PROPERLY TO MOTOR OUTPUT SHAFT
DEFECTIVE MOTOR
BLADES SLAP AGAINST WINDSHIELD MOULDINGS ON DRY GLASS
ARMS LOOSE ON PIVOT SHAFT
ARM IMPROPERLY POSITIONED ON PIVOT SHAFT
LOOSENESS OF THE MOTOR CRANK OR OTHER DRIVE PARTS
BLADES CHATTER
FOREIGN SUBSTANCE SUCH AS BODY POLISH ON GLASS OR BLADES
TWISTED ARM HOLDS BLADE AT WRONG ANGLE TO GLASS
BENT OR DAMAGED BLADES
MOTOR WILL NOT RUN AT ANY SPEED
CHECK FUSE
FUSE GOOD
REPLACE BLOWN FUSE
WIPER KNOCK
WIPER KNOCKS AT EXTREME WIPE
AXIAL OR WORN OUT FREEPLAY IN LINKAGE
WIPER BLADES OPERATING PROPERLY
WIPER KNOCK AT OTHER THAN EXTREME WIPE
ARMATURE END PLAY IN MOTOR
REPLACE MOTOR
MOTOR WILL NOT RUN
CHECK VOLTAGE AT MOTOR
VOLTAGE PRESENT
DEFECTIVE MOTOR
CHECK GROUND
NO VOLTAGE
CHECK SWITCH
CHECK WIRING
NEW FUSE GOOD
NEW FUSE BLOWS
REMOVE MOTOR CONNECTOR
REPLACE FUSE
NEW FUSE GOOD
REPLACE MOTOR
FUSE BLOWS
CHECK WIRING
CHECK SWITCH
MOTOR RUNS BLADES DO NOT MOVE
OUTPUT SHAFT STATIONARY
REPLACE MOTOR
OUTPUT SHAFT ROTATES
LOOSE MOTOR CRANK
BAD LINKAGE CONNECTION
ARMS LOOSE ON PIVOT SHAFT
RF80B

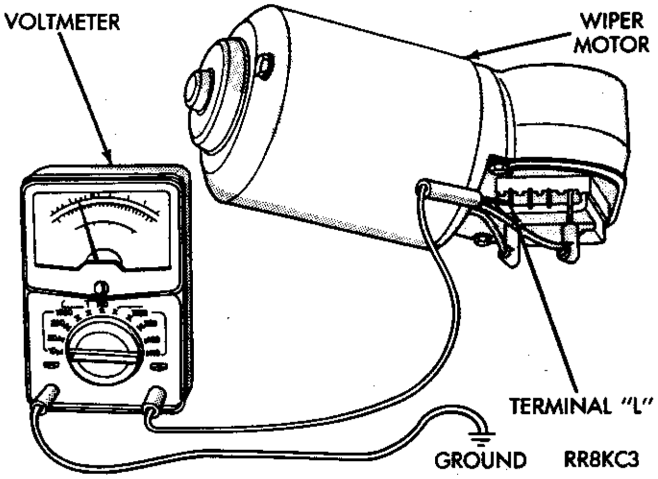


Fig. 1 Voltmeter Between Terminal "L" and Ground

CONDITION

Motor runs slowly at all speeds.

PROCEDURE

(1) Disconnect wiring harness connector at motor. Remove wiper arms and blades. Connect an ammeter between battery and terminal "L" on motor (Fig. 2).

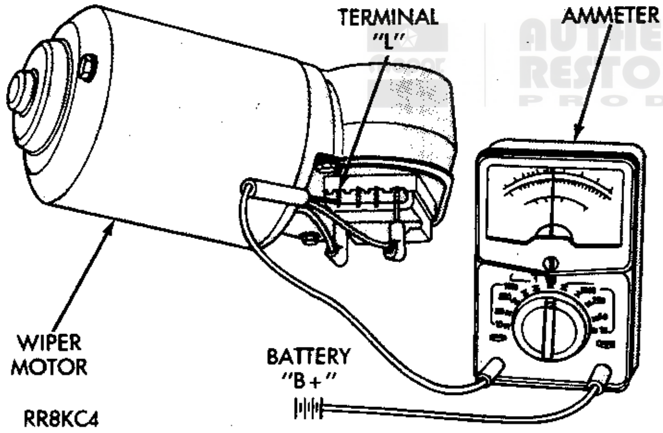


Fig. 2 Ammeter Between Terminal "L" and Battery

(a) If motor runs and average ammeter reading is more than 6 amps, proceed to step 2.

(b) If motor runs and average ammeter reading is less than 6 amps, proceed to step 3.

(2) Check to see if wiper linkage or pivots are binding or caught. Disconnect drive link from motor.

(a) If motor now runs and draws less than 3 amps, repair linkage system.

(b) If motor continues to draw more than 3 amps, replace motor assembly.

(3) Check motor wiring harness for shorting between high and low speed wires as follows:

(a) Connect a voltmeter or test lamp to motor ground strap.

(b) Set wiper switch to LOW position.

(c) Connect other lead of voltmeter (test lamp) to terminal "H" of the wiring harness.

(d) If voltage is present, there is a short in the wiring or wiper switch. If no voltage is present proceed to step (e).

(e) Set wiper switch to HIGH position.

(f) Move voltmeter (test lamp) lead from terminal "H" to terminal "L" of the wiring harness.

(g) If voltage is present, there is a short in the wiring or wiper switch.

CONDITION

Motor will run at high speed, but not at low speed. Motor will run at low speed, but not at high speed.

PROCEDURE

(1) If motor will not run on high speed, put switch in HIGH position and connect a test lamp between motor terminal "H" and ground (Fig. 3).

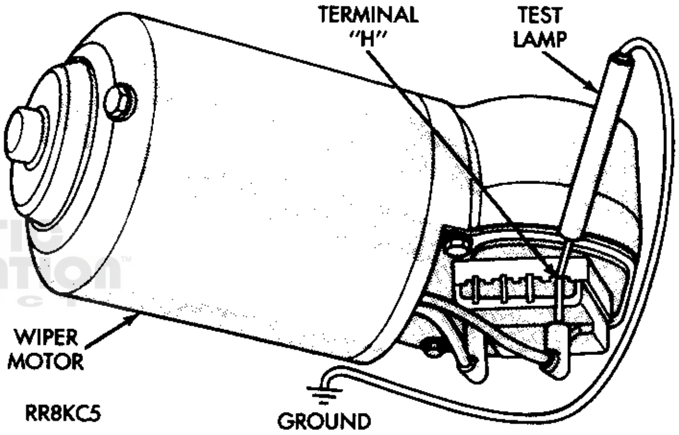


Fig. 3 Test Lamp Between Terminal "H" and Ground

If motor will not run on low speed, put switch in LOW position and connect a test lamp between motor terminal "L" and ground.

(2) If test lamp does not light at motor terminal, there is an open in wiring or switch. If test lamp lights at motor terminal, replace motor assembly.

CONDITION

Motor will keep running with switch in OFF position.

PROCEDURE

(1) Remove wiring harness. Connect jumper from Terminal P2 to terminal L of wiper motor (Fig. 4).

(2) Connect second jumper from terminal P1 to battery. If motor runs to PARK position and stops, wiper switch is faulty. If motor keeps running and does not park, replace motor assembly.

CONDITION

Motor will stop wherever it is, when column switch is put in OFF position. (Wipers do not continue running to PARK position).

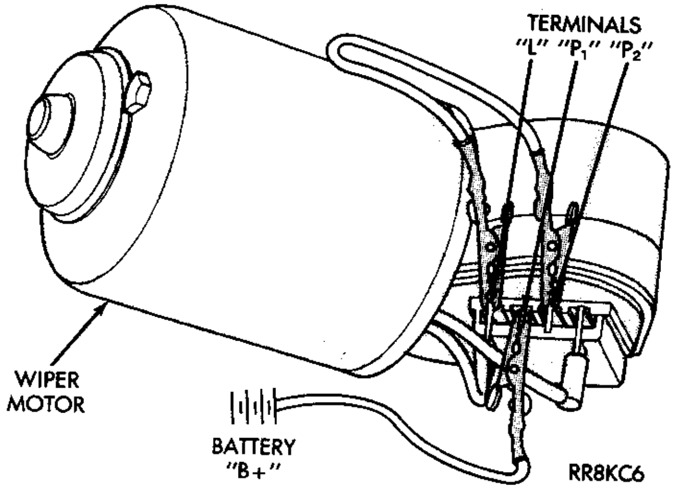


Fig. 4 One Jumper Wire Between Terminal "P2" and "L". One Jumper Wire Between Terminal "P1 and "B+"

PROCEDURE

(1) Remove motor wiring connector and clean terminals. Reconnect connector and test motor. If problem persists, proceed to step No. 2.

(2) Put wiper switch to OFF position. Disconnect motor wiring connector. Connect a voltmeter or test lamp to the motor ground strap. Connect the other lead to terminal "P1" of wiring connector.

(a) If voltage is not present, check for an open circuit in the wiring harness or wiper control switch.

(b) If voltage is present, proceed to step (3).

(3) Connect an ohmmeter or continuity tester between terminals "L" and "P2" (Fig. 5).

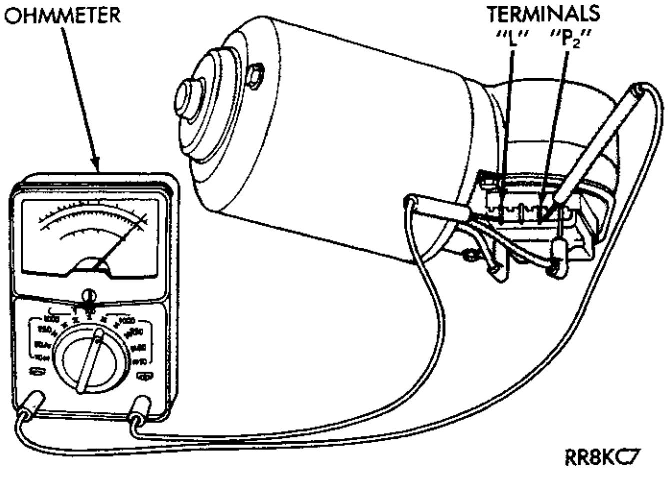


Fig. 5 Ohmmeter Between Terminal "L" and "P2"

(a) If there is continuity between these terminals, the problem is a defective motor.

(b) If there is no continuity, the problem is an open circuit in the wiper control switch or wiring harness.

SWITCH TEST

To test the switch, first disconnect the switch wires from the body wiring at the connector. Then, using a continuity tester or an ohmmeter, test for continuity (no resistance) between the terminals of the switch as shown in the following continuity chart. The identity of each terminal is shown in (Fig. 6).

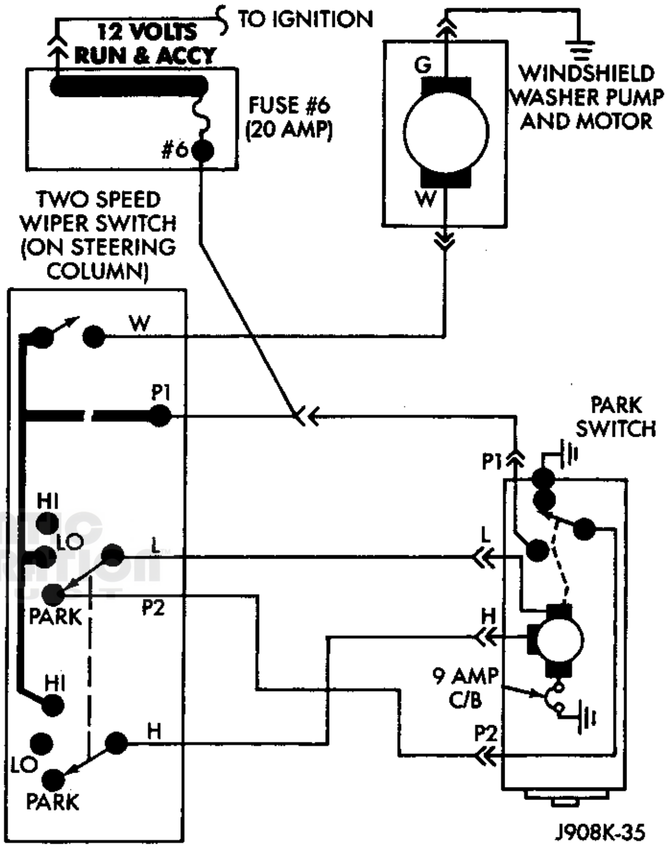


Fig. 6 Two Speed Wiper Motor Wiring Schematic

For test purposes, the first (or clockwise) position is the OFF position, with LOW being the next detent position and HIGH being the last (counterclockwise) detent position. In any wiper mode, if the knob is pushed all the way in, the washer circuit will be completed.

TWO SPEED WIPER SWITCH CONTINUITY CHART

Off	Low	High
B + to P_1	B + to P_1	B + to P_1
L to P_2	B + to L	B + to H
H—Open	P_2—Open	P_2—Open
	H—Open	L—Open
B + to W (In Wash)	B + to W (In Wash)	B + to W (In Wash)

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INTERMITTENT WINDSHIELD WIPER FUNCTION AND SWITCH TESTING PROCEDURES

INDEX

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Intermittent Windshield Wiper Function Tests	5
Intermittent Wipe Module Location	5
Intermittent Wipe Switch Test	5

INTERMITTENT WINDSHIELD WIPER FUNCTION TESTS

Since the intermittent wipe and standard two speed motors are identical. Refer to previous sections for diagnosis of system problems which do not involve the DELAY function. If problem occurs only in the DELAY mode, the following tests are to be performed. These tests involve disconnecting the intermittent wipe control unit which can be found on the steering column support bracket (refer to Intermittent Wipe Module Location).

CONDITION

Excessive delay (more than 30 seconds) or inadequate variation in delay.

PROCEDURE

Variations in delay should be as follows:

(1) Minimum delay (delay control to extreme counterclockwise position before first detent) one half to two seconds.

(2) Maximum delay (delay control to extreme clockwise position before off detent) ten to thirty seconds.

(3) If there is excessive delay or no variations in delay proceed to intermittent wipe switch test.

CONDITION

In DELAY mode wipers run continually when wash is operated but do not provide an extra wipe when the wash control is released.

PROCEDURE

Replace the control unit.

CONDITION

Wipers start erratically during DELAY mode.

PROCEDURE

(1) Verify that the ground connection at the instrument panel is making good connection (free from paint) and is tight.

(2) Verify that the motor ground strap is making good contact and that the motor mounting bolts are tight.

(3) Verify that the wiring ground connections for the intermittent wipe control unit and the wiper switch are tight.

(4) If condition is not corrected, replace control unit.

INTERMITTENT WIPE SWITCH TEST

To test the switch, first disconnect the switch wires from the body wiring at the connector. Then, using a continuity tester or an ohmmeter, test for continuity (no resistance) between the terminals of the harness side of the switch connector as shown in the continuity chart.

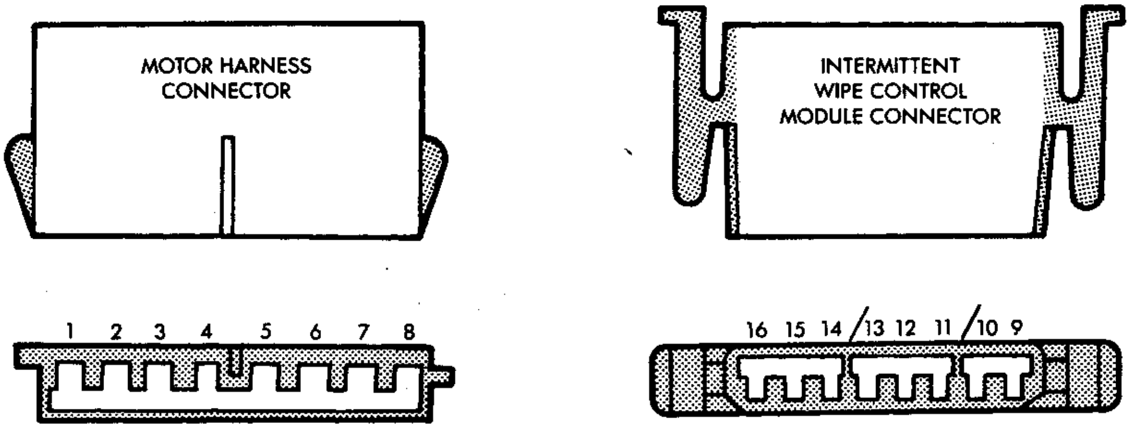
For test purposes, the first (or clockwise) position is the OFF position, next is the slide for the DELAY wipe, with counterclockwise rotation, reducing the delay. Low is the next detent position and HIGH is the full counterclockwise detent position.

In any wiper mode, if the knob is pushed all the way in, the washer circuit will be completed.

INTERMITTENT WIPE MODULE LOCATION

The intermittent wipe module is located to the right of the steering column on the back side of the instrument panel (Fig. 2).

INTERMITTENT WIPE SWITCH CONTINUITY CHART



VIEW FROM TERMINAL SIDE

SWITCH POSITION	CONTINUITY BETWEEN
OFF	PIN 1-13, PIN 3-10, PIN 4-11, PIN 5-12
DELAY	PIN 1-13, PIN 3-10, PIN 4-16, PIN 4-11, PIN 4-7, PIN 5-12, PIN 8-15, PIN 9-16, PIN 11-16, PIN 9-11
LOW	PIN 1-13, PIN 3-10, PIN 4-7, PIN 4-11, PIN 5-12, PIN 7-11
HIGH	PIN 1-13, PIN 3-10, PIN 4-6, PIN 4-11, PIN 5-12, PIN 6-11

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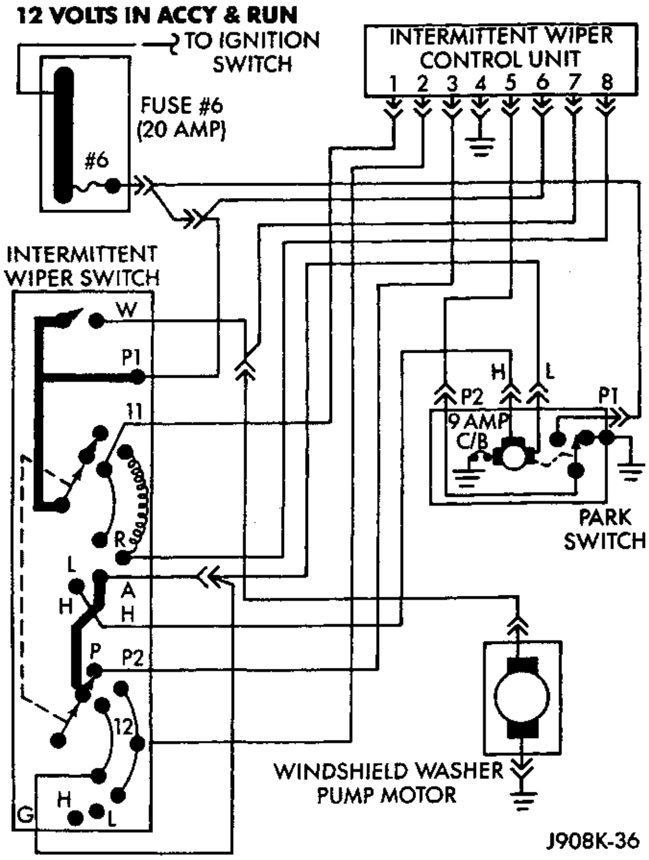

Fig. 1 Intermittent Wipe Wiring Schematic

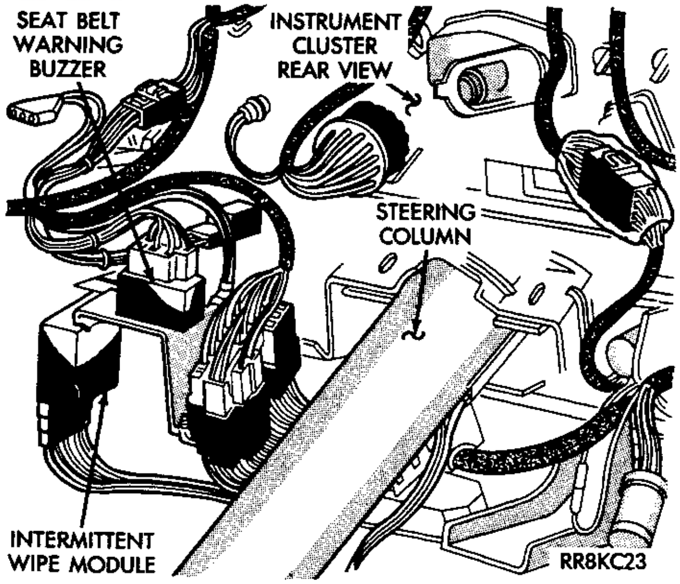

Fig. 2 Intermittent Wipe Module Location

WINDSHIELD WIPER SYSTEM SERVICE PROCEDURES

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WIPER BLADES

Wiper blades exposed to the weather for a long period of time tend to lose their wiping effectiveness. Periodic cleaning of the wiper blade is suggested to remove the accumulation of salt and road film. The wiper blades, arms and windshield should be cleaned with a sponge or cloth and a mild detergent or nonabrasive cleaner. If the blades continue to streak or smear, they should be replaced.

WIPER BLADE ELEMENT CHANGE

There are two types of wiper blade assemblies. The assemblies are identified as “Type A” (Fig. 1) and “Type B” (Figs. 2 and 3).

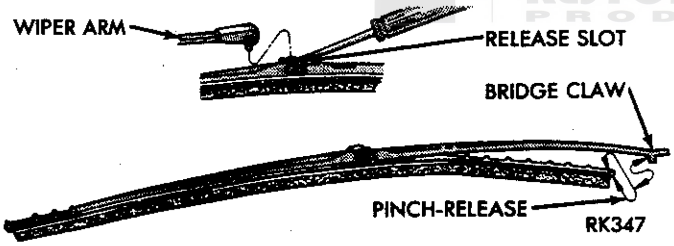


Fig. 1 Removing Blade and Wiping Element from Blade Assembly Type“A”

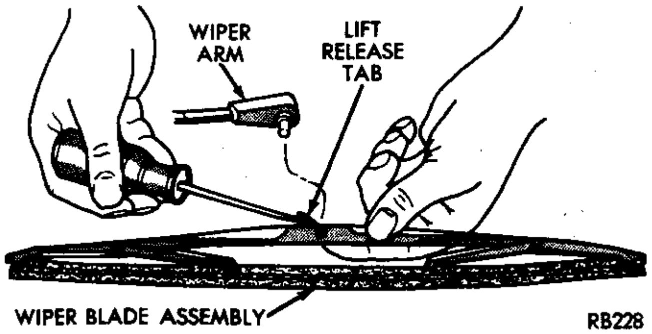


Fig. 2 Removing Blade from Arm Type “B”

(1) Turn wiper switch ON, position blades to a convenient place by turning the ignition switch ON and OFF.

(2) Lift wiper arm to raise blade off glass.

(3) Remove blade assembly from arm and wiping element from blade, depending on type, as follows:

TYPE A— To remove blade assembly from arm, insert a small screwdriver blade into release slot of wiper blade and pry slightly upward (Fig. 1).

To remove wiping element from blade assembly, pinch lock on end of blade assembly and withdraw wiping element (blade) out of claws.

Check each release point for positive locking when installing blade element and blade assembly.

Type B—To remove blade, lift up on release tab on center bridge pivot (Fig. 2).

Lift lock tab on one of end links and squeeze link to remove from center bridge. Slide end link off element and slide element from claws of other link (Fig. 3).

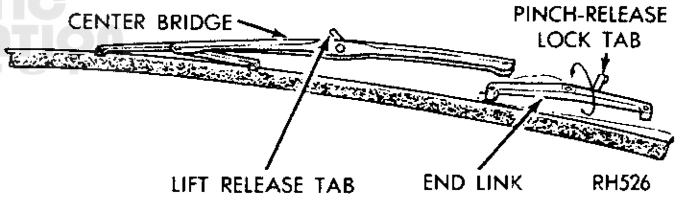


Fig. 3 Removing Wiping Element From Blade Assembly Type “B”

Check each release point for positive locking when installing blade element and blade assembly.

WIPER ARM REPLACEMENT

REMOVAL

(1) Lift the arm to permit the latch (Fig. 4) to be pulled out to the holding position and remove the arm from the pivot using a rocking motion.

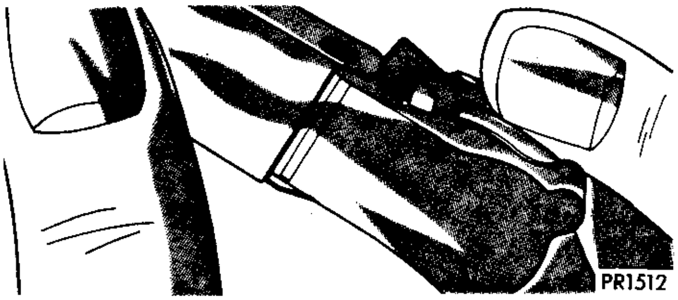
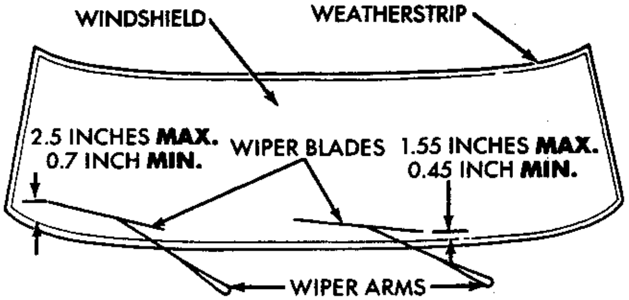


Fig. 4 Removing Wiper Arm

CAUTION: The use of a screwdriver or other prying tool to remove an arm may distort it in a manner that will allow it to come off the pivot shaft in the future, regardless of how carefully it is installed.

INSTALLATION

With wiper motor in park position, mount arms on pivot shafts, choosing a serration engagement which locates blades so that distance between the intersection of arm and the blade and the weatherstrip is as shown in Fig. 5.



ADJUST WIPER ARM SO TIP OF BLADE IS ABOVE THE WEATHERSTRIP IN PARK POSITION AS SHOWN

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Fig. 5 Adjusting Wiper Arms

WIPER MOTOR REPLACEMENT

REMOVAL

(1) Disconnect battery negative cable.

(2) Disconnect wires from wiper motor.

(3) Remove motor mounting screws.

(4) Lower motor down far enough to gain access to crank arm to drive link retainer bushing.

(5) Remove crank arm from drive link by prying retainer bushing from crank arm pin with a suitable size screwdriver.

(6) Remove motor.

(7) Remove nut attaching crank arm to motor drive shaft.

(8) Remove crank arm.

INSTALLATION

(1) Position crank arm on motor drive shaft, making sure slot is indexed properly, install mounting nut and tighten to 11 N•m (95 in. lbs.) torque.

(2) Install crank arm pin in drive link retainer bushing by snapping together with channel lock pliers.

(3) Position motor into place, install mounting screws, and tighten to 6 N•m (55 in. lbs.) torque.

(4) Connect wires to wiper motor.

(5) Connect battery cable.

LINKAGE REPLACEMENT (Fig. 6)

CRANK ARM

REMOVAL

(1) Remove wiper motor as previously described.

(2) Remove nut attaching crank arm to motor drive shaft.

(3) Remove crank arm.

INSTALLATION

(1) Position crank arm on motor drive shaft, making sure slot is indexed properly, install mounting nut and tighten to 11 N•m (95 in. lbs.) torque.

(2) Install wiper motor.

DRIVE LINK ASSEMBLY LEFT PIVOT ASSEMBLY

REMOVAL

(1) Remove wiper arms.

(2) Remove screws attaching louvered cowl cover to cowl panel.

(3) Remove cowl cover by pulling forward with a slight upward movement.

(4) Reach through access hole and remove drive link from right pivot by prying retainer bushing from pivot pin with a suitable size screwdriver.

(5) Remove crank arm from drive link by prying retainer bushing from crank arm pin with a suitable size screwdriver.

(6) Remove left pivot mounting screws and let pivot hang loose.

(7) Working through access holes remove drive links and left pivot as an assembly.

(8) Remove drive link from left pivot by prying retainer busing from pivot pin with a suitable size screwdriver.

INSTALLATION

(1) Install left pivot pin in drive link retainer bushing by snapping together with channel lock pliers.

(2) Maneuver drive links and pivot assembly through access hole and position into place.

(3) Position left pivot into place, install mounting screws and tighten to 11 N•m (95 in. lbs.) torque.

(4) Install crank arm pin in drive link retainer bushing by snapping together with channel lock pliers.

(5) Install right pivot pin in drive link retainer bushing by snapping together with channel lock pliers.

(6) Position cowl cover into place, install mounting screws and tighten securely.

(7) Install wiper arms, refer to wiper arm adjustment procedure.

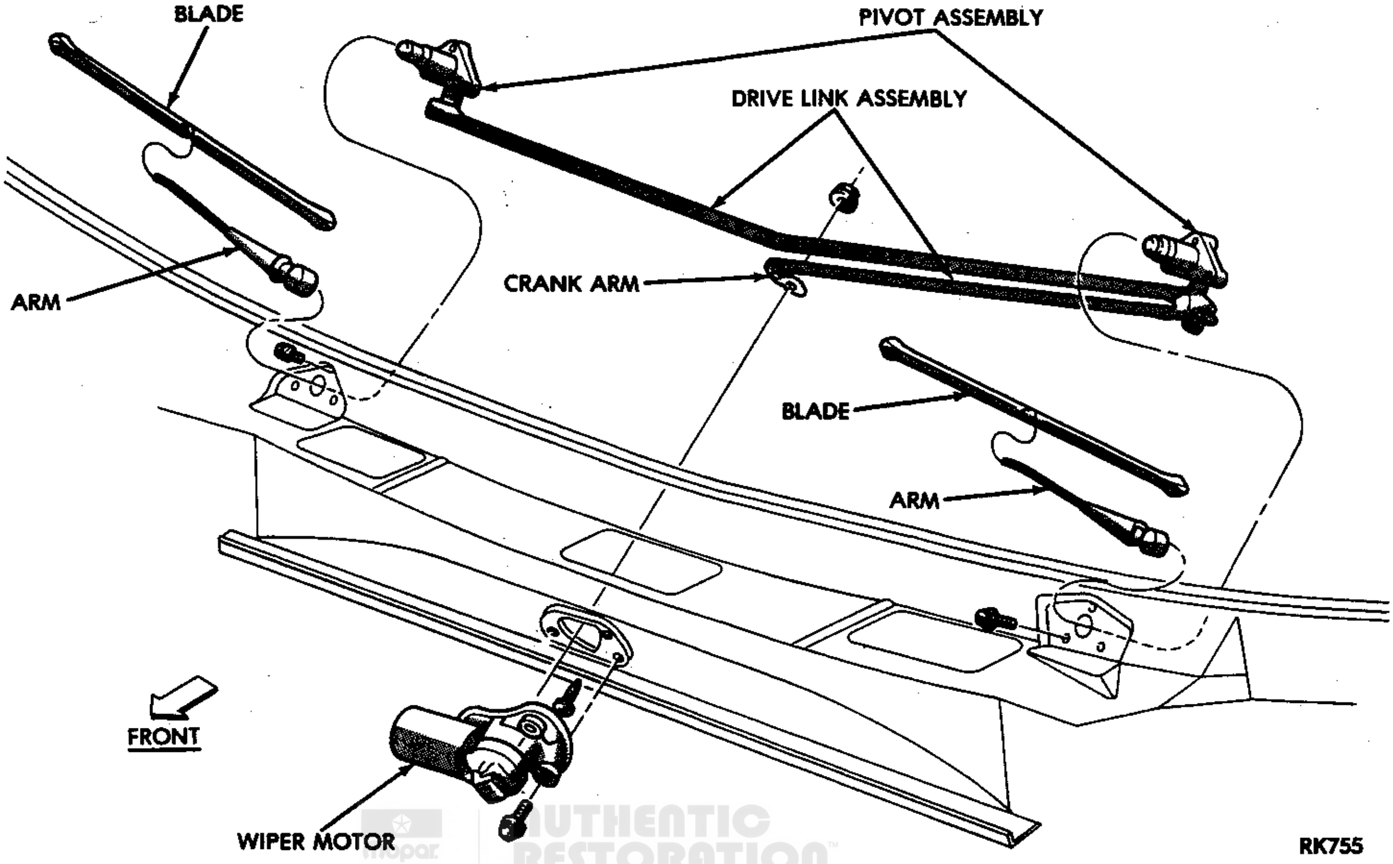

Fig. 6 Wiper Linkage

RIGHT PIVOT ASSEMBLY

REMOVAL

(1) Remove wiper arms.

(2) Remove screws attaching louvered cowl cover to firewall.

(3) Remove cowl cover by pulling forward with a slight upward movement.

(4) Reach through access hole and remove drive link from right pivot by prying retainer bushing from pivot pin with a suitable size screwdriver.

(5) Remove right pivot mounting screws.

(6) Remove pivot through access hole.

INSTALLATION

(1) Position pivot into place, install mounting screws, and tighten to 11 N•m (95 in. lbs.) torque.

(2) Install right pivot pin in drive link retainer bushing by snapping together with channel lock pliers.

(3) Position cowl cover into place, install mounting screws and tighten securely.

(4) Install wiper arms.

WIPER SWITCH REPLACEMENT—STANDARD COLUMN

(1) Disconnect battery negative cable.

(2) Remove 4 screws attaching the lower steering column cover (Fig. 7). The fuse block is attached to this cover and should be supported when cover is removed.

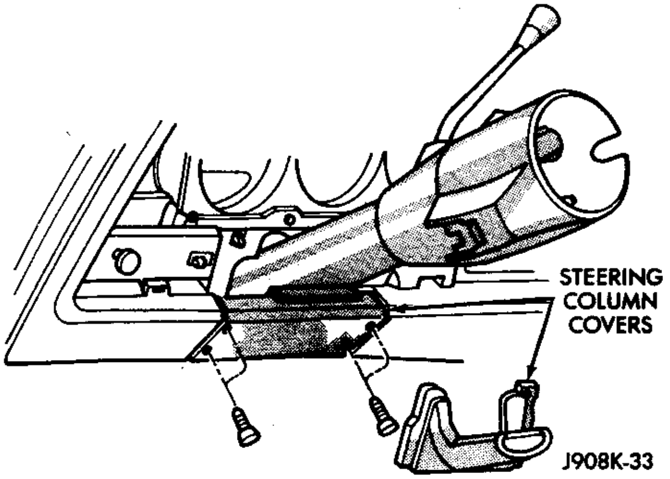

Fig. 7 Steering Column Cover

(3) On the standard and optional steering wheels (Figs. 8 and 9) remove two horn pad mounting screws from underside of steering wheel.

(4) Pull pad up from wheel and disconnect electrical leads.

(5) Remove pad.

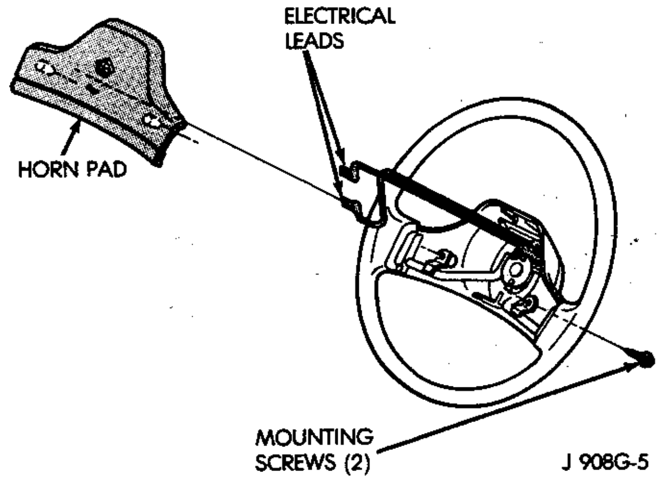

Fig. 8 Standard Steering Wheel

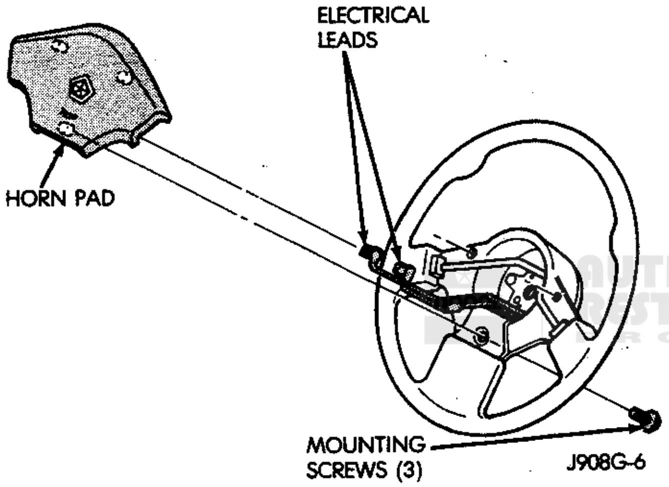

Fig. 9 Optional Steering Wheel

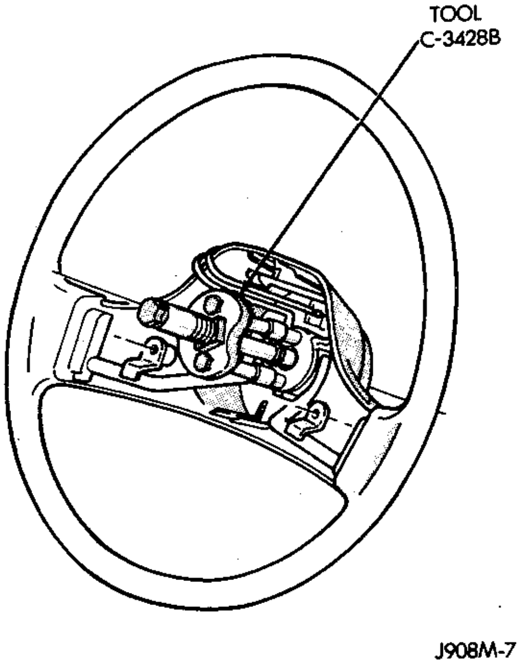

Fig. 10 Removing Steering Wheel (Typical)

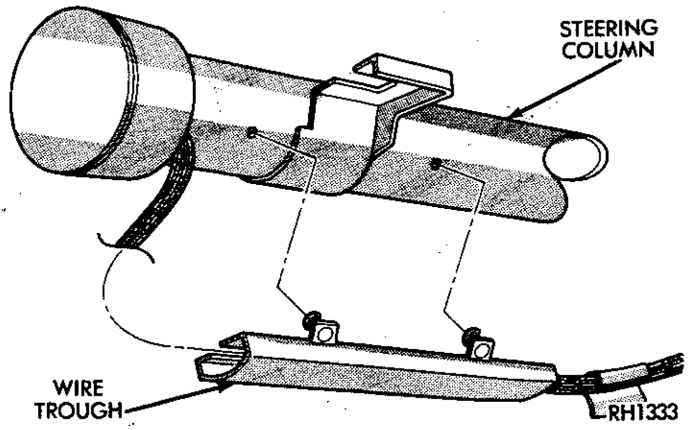

Fig. 11 Wire Trough Cover

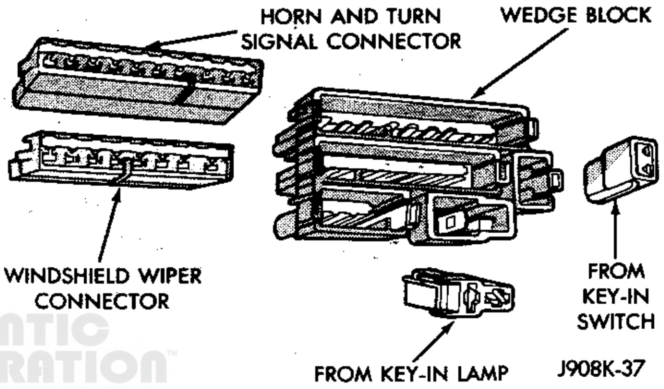

Fig. 12 Disconnecting Wires

(6) Remove steering wheel nut and remove steering wheel with puller C-3428B (Fig. 10).

(7) Pry out wiring trough retainers and lift off wiring trough. New retainers may be required for reassembly (Fig. 11).

(8) Disconnect wash/wipe switch connector and, if equipped, intermittent wipe module connector and speed control connector (Figs. 12 and 13).

(9) Remove two screws that attach the lock housing to the lock housing and remove the lock housing cover.

(10) Remove the wipe/wash switch assembly (Fig. 14)

(11) Pull the hider up the control stalk and remove the two screws that attach the control stalk sleeve to the wipe/wash switch (Figs. 14 and 15).

(12) Remove wash/wipe switch control knob from end of multifunction control stalk (Fig. 15).

(13) Rotate the control stalk shaft to the full clockwise position and remove the shaft from the switch by pulling straight out of the switch (Fig. 16).

For installation, reverse the removal procedures. Tighten steering wheel nut to 61 N•m (45 ft. lbs.).

WIPER SWITCH REPLACEMENT—TILT COLUMN

(1) Disconnect battery negative cable.

(2) Remove steering column cover (Fig. 17).

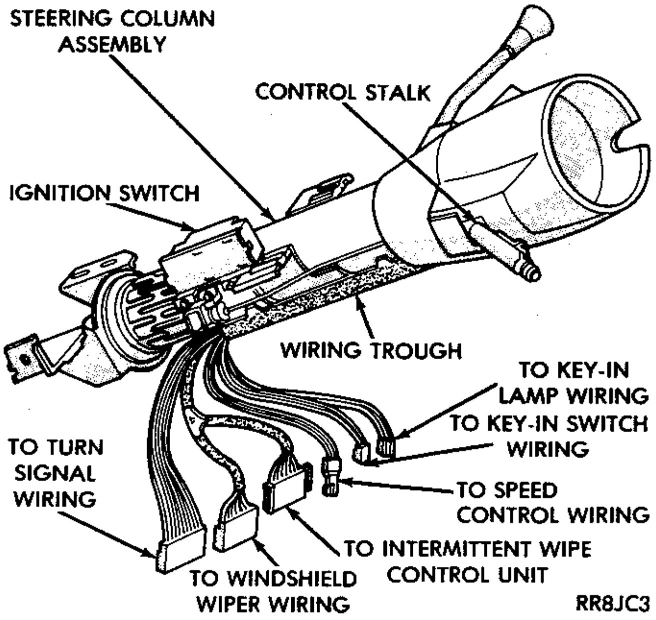

Fig. 13 Steering Column Wiring Connectors

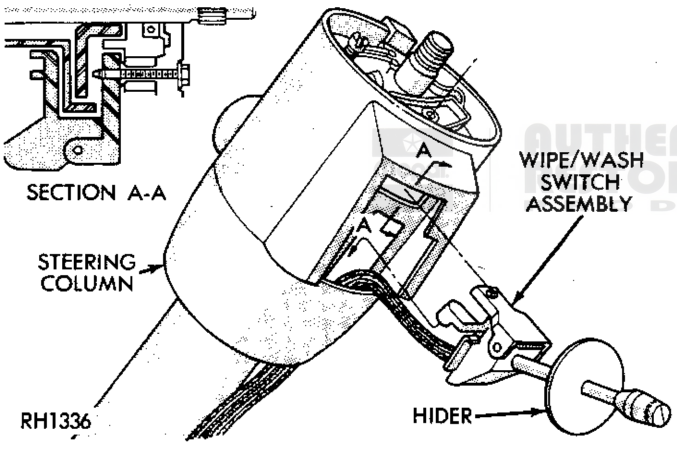

Fig. 14 Wipe/Wash Switch Assembly

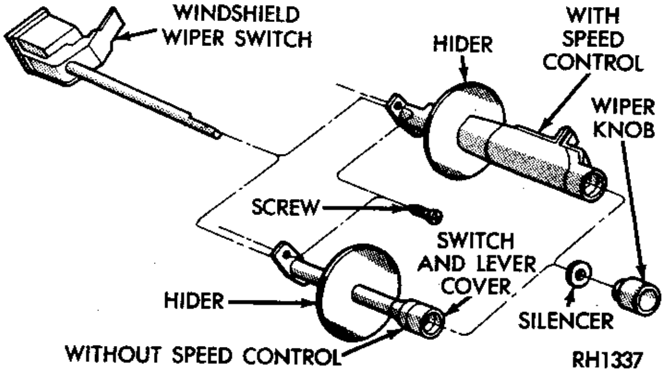

Fig. 15 Multifunction Control Stalk

(a) Remove one screw from left side of cover.

(b) Remove two screws, one on each side of steering column.

(c) Remove one screw from brace on right side of cover and pull down to remove.

(3) On the standard and optional steering wheels (Figs. 18 and 19) remove two horn pad mounting screws from underside of steering wheel.

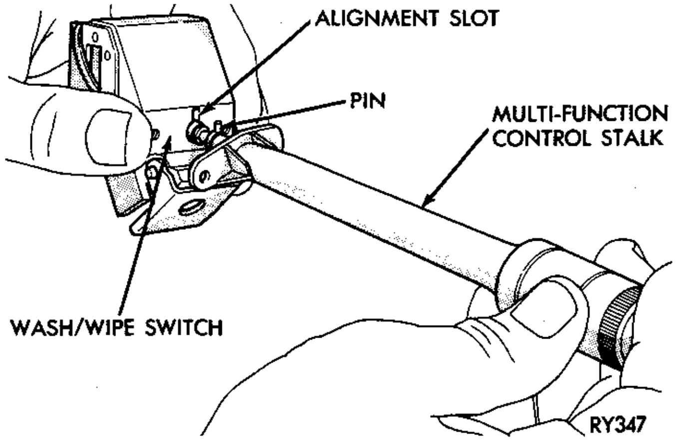

Fig. 16 Remove or Install Control Stalk

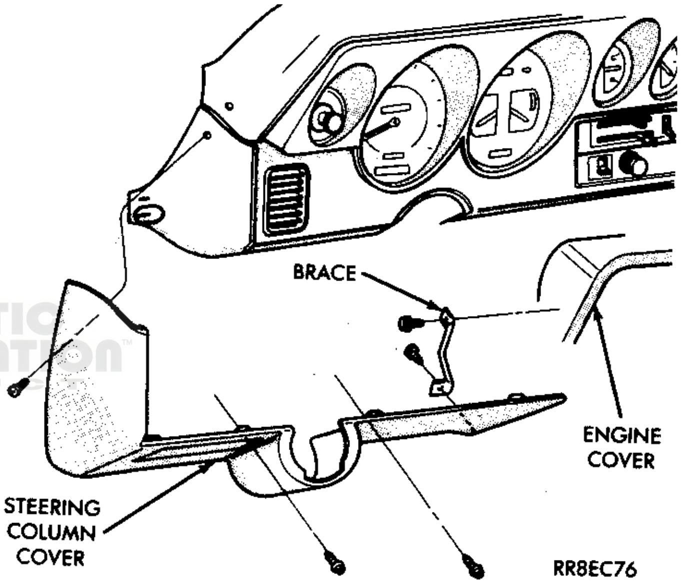

Fig. 17 Steering Column Cover

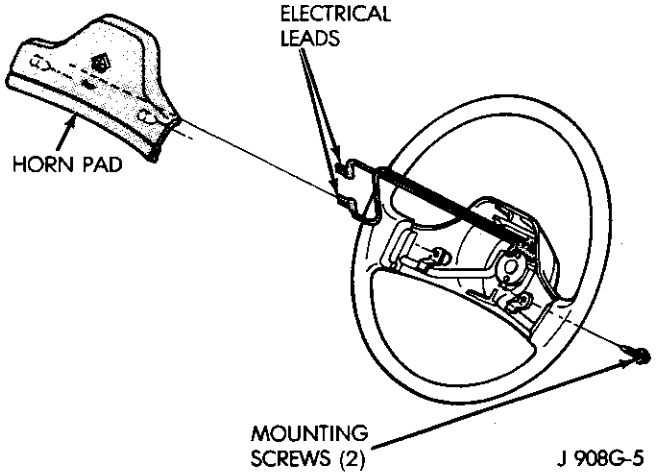

Fig. 18 Standard Steering Wheel

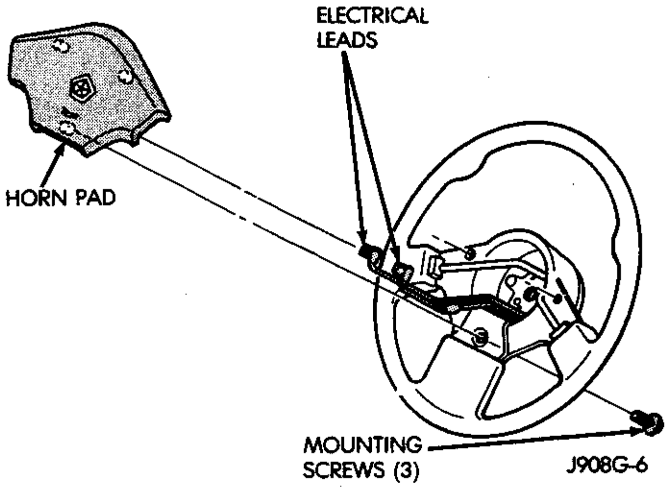

Fig. 19 Optional Steering Wheel

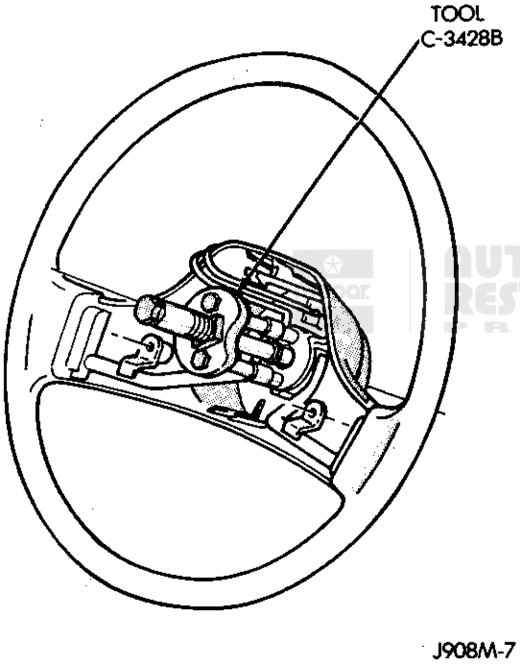

Fig. 20 Removing Steering Wheel (Typical)

(4) Pull pad up from wheel and disconnect electrical leads.

(5) Remove pad.

(6) Remove steering wheel nut and remove steering wheel with puller C-3428B (Fig. 20).

(7) Pry out wiring trough retainers and lift off wiring trough. New retainers may be required for reassembly (Fig. 21).

(8) Depress lock plate with Tool C-4156 and pry retaining ring out of groove with screwdriver (Fig. 22). The full load of the upper bearing spring should not be relieved as the retaining ring will turn too easily making removal more difficult. Remove lock plate, canceling cam, and upper bearing spring.

(9) Remove switch stalk actuator screw and arm.

(10) Push hazard warning knob in and unscrew to remove.

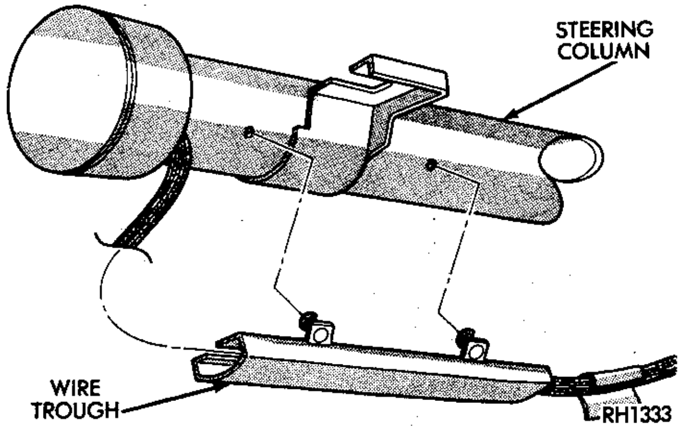

Fig. 21 Wire Trough Cover

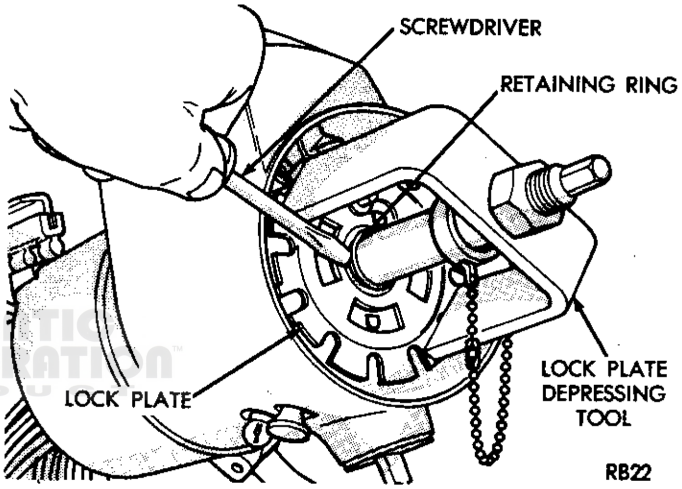

Fig. 22 Removing Lock Plate Retaining Ring Using Tool C-4156

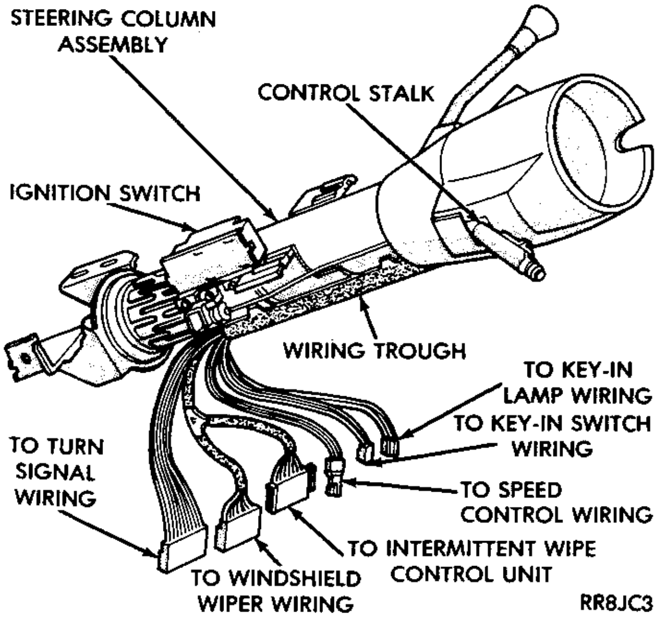

Fig. 23 Steering Column Wiring Connectors

(11) Disconnect turn signal wiring, wipe/wash switch connector, and if so equipped, intermittent

wipe and speed control connectors (Figs. 23 and 24).

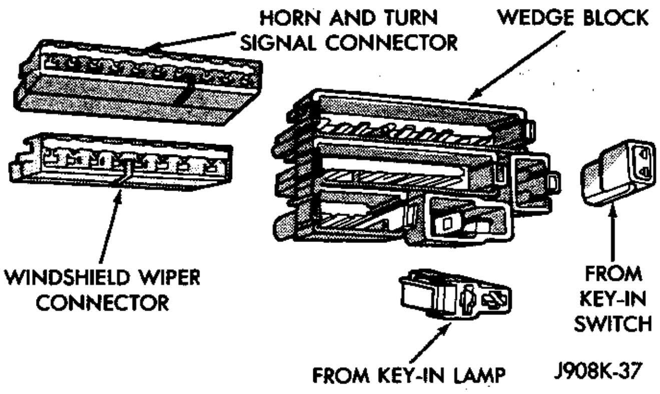

Fig. 24 Disconnecting Wires

(12) Remove 3 turn signal switch attaching screws. Place shift lever in low (1) position. Wrap a piece of tape around the connector and wires to prevent snagging when removing the switch (Fig. 25). Remove turn signal switch and wiring.

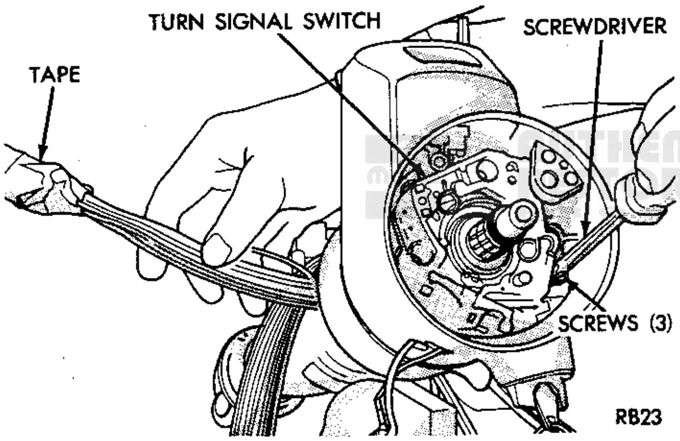

Fig. 25 Tape Connector and Wires

(13) Remove ignition key lamp (Fig. 26).

(14) The lock cylinder may be removed in any position from ACCESSORY to ON. The lock position is recommended because of its positive location.

Insert a thin tool (small screwdriver or shim stock) into the slot next to the switch mounting screw boss (right hand slot) and depress spring latch at bottom of slot, which releases lock. Remove lock (Fig. 27).

The buzzer switch can be pulled straight out of the housing (Fig. 28). A straightened paper clip or similar piece of stiff wire with a hook bent on one end should be inserted in the exposed loop of the wedge spring, then a straight pull on the wire will remove both spring and switch (if the lock cylinder is not removed before the switch, it must be in the ON position).

CAUTION: If wedge spring is dropped on removal, it could fall into the column, requiring complete disassembly to retrieve spring.

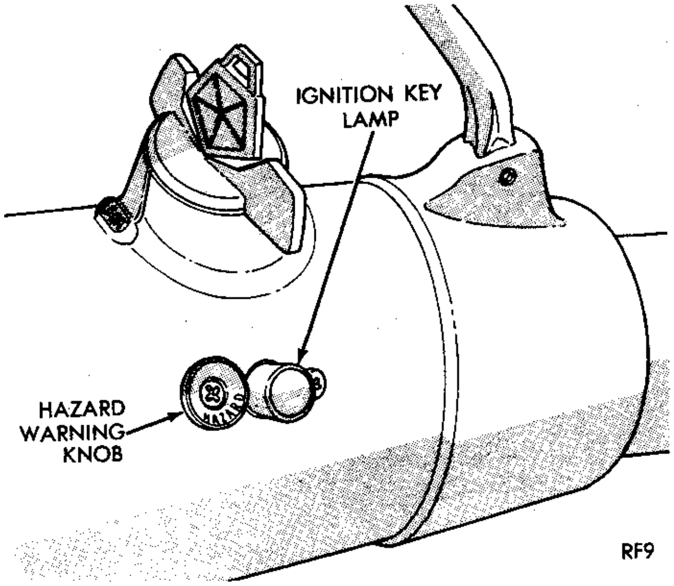

Fig. 26 Ignition Key Lamp and Hazard Warning Knob.

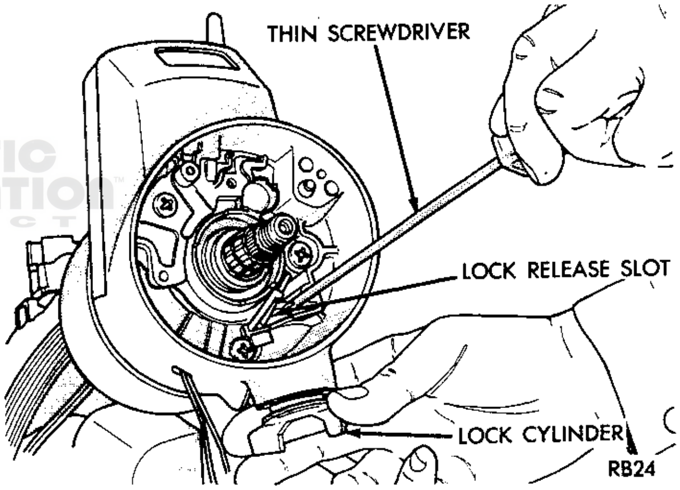

Fig. 27 Removing Lock Cylinder

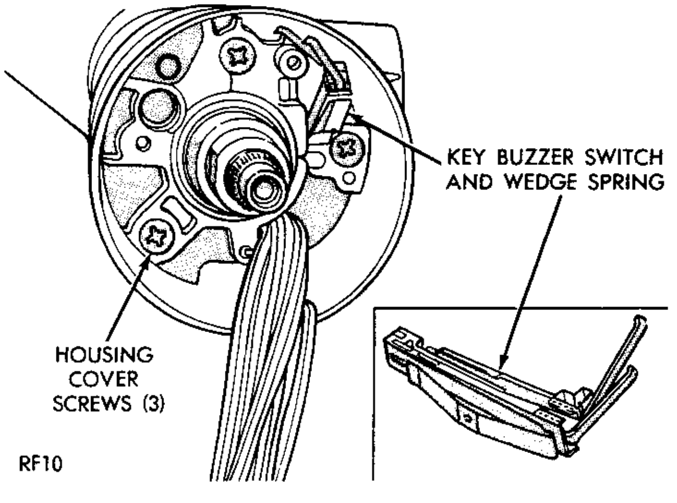

Fig. 28 Key Buzzer Switch and Wedge Spring

(15) Remove 3 housing cover screws and remove

housing cover (Fig. 31). With the housing cover removed, the wash/wipe switch may be removed.

(16) Press out wash/wipe switch pivot pin with a punch (Fig. 29).

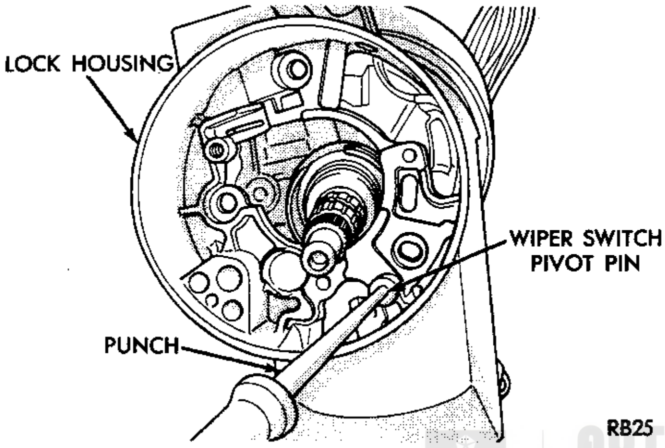

Fig. 29 Wiper Switch Pivot Pin

(17) Remove the wash/wipe switch assembly (Fig. 30).

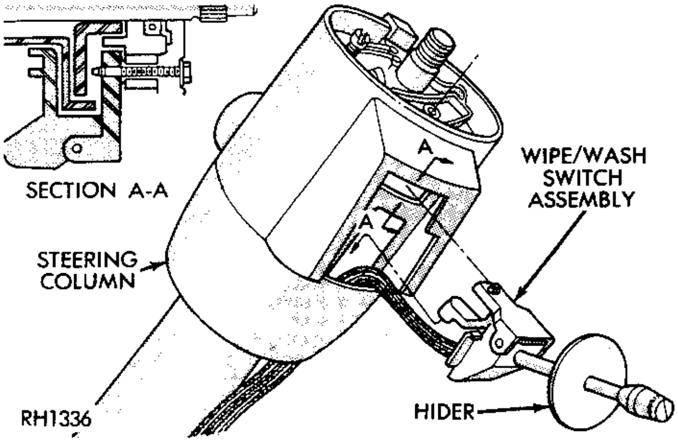

Fig. 30 Wipe/Wash Switch Assembly

(18) Pull the hider up the control stalk and remove the two screws that attach the control stalk sleeve to the wash/wipe switch (Figs. 30 and 31).

CAUTION: Use tape to hold dimmer switch rod in place.

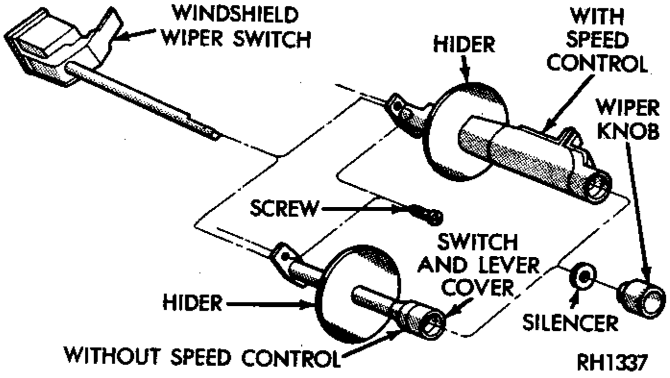

Fig. 31 Multifunction Control Stalk

(19) Remove wash/wipe switch control knob from end of multifunction control stalk (Fig. 31).

(20) Rotate the control stalk shaft to the full clockwise position and remove the shaft form the switch by pulling straight out of the switch (Fig. 32).

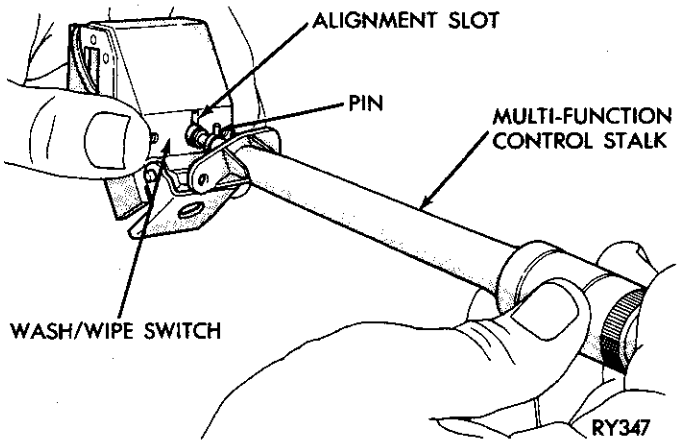

Fig. 32 Remove or Install Control Stalk

For Installation, reverse the removal procedures. Tighten steering wheel nut to 61 N•m (45 ft. lbs.).

WINDSHIELD WASHERS

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GENERAL INFORMATION

All models are equipped with electric operated windshield washer pumps.

The electric pump assembly is mounted directly to the reservoir. A permanently lubricated sealed motor is coupled to a rotor type pump. Fluid, gravity fed from the reservoir, is forced by the pump through rubber hoses to the nozzles which direct the streams to the windshield.

These vehicles are equipped with special plastic washer nozzles (Fig. 1). Because they are inserted directly into the cowl panel, there is no adjustment required.

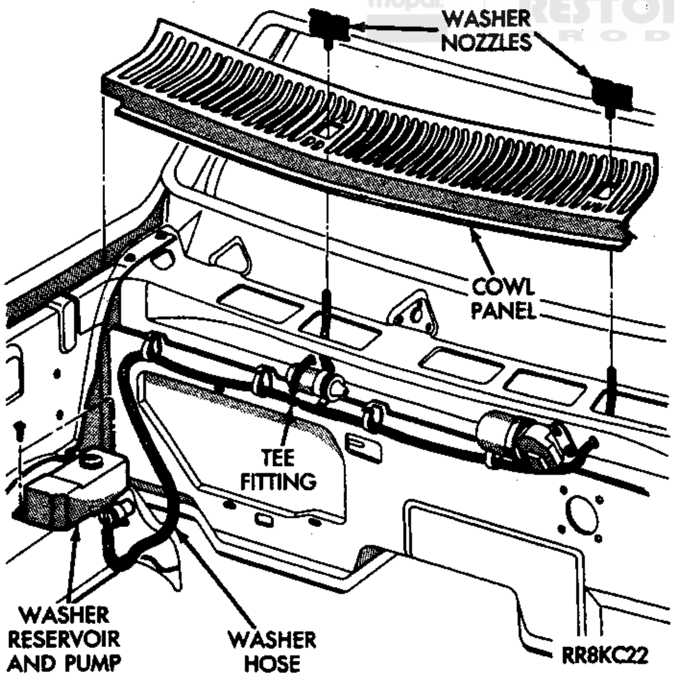


Fig. 1 Windshield Washer System

WINDSHIELD WASHER PUMP REPLACEMENT (Fig. 2)

REMOVAL

(1) Remove liquid from reservoir.

(2) Remove reservoir mounting screws and remove reservoir and pump assembly.

(3) Disconnect electrical lead and rubber hose from bottom of pump.

(4) Using an extension and deep well socket, reach through reservoir filler neck, and remove pump mounting nut and plastic washer.

(5) Remove pump from bottom reservoir.

(6) Remove rubber grommet from reservoir and throw away.

INSTALLATION

(1) Install new rubber grommet into place in bottom of reservoir.

(2) Position pump into place in reservoir. Install plastic washer then mounting nut, and tighten to 3 N•m (25 in. lbs.) torque. Do not overtighten.

(3) Connect electrical leads and hose to pump.

(4) Position reservoir into place, install mounting screws and tighten securely.

(5) Fill reservoir with water and/or washer fluid, inspect for leaks and test system.

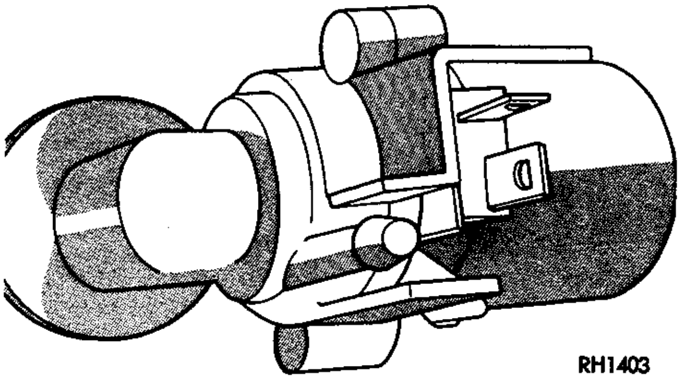
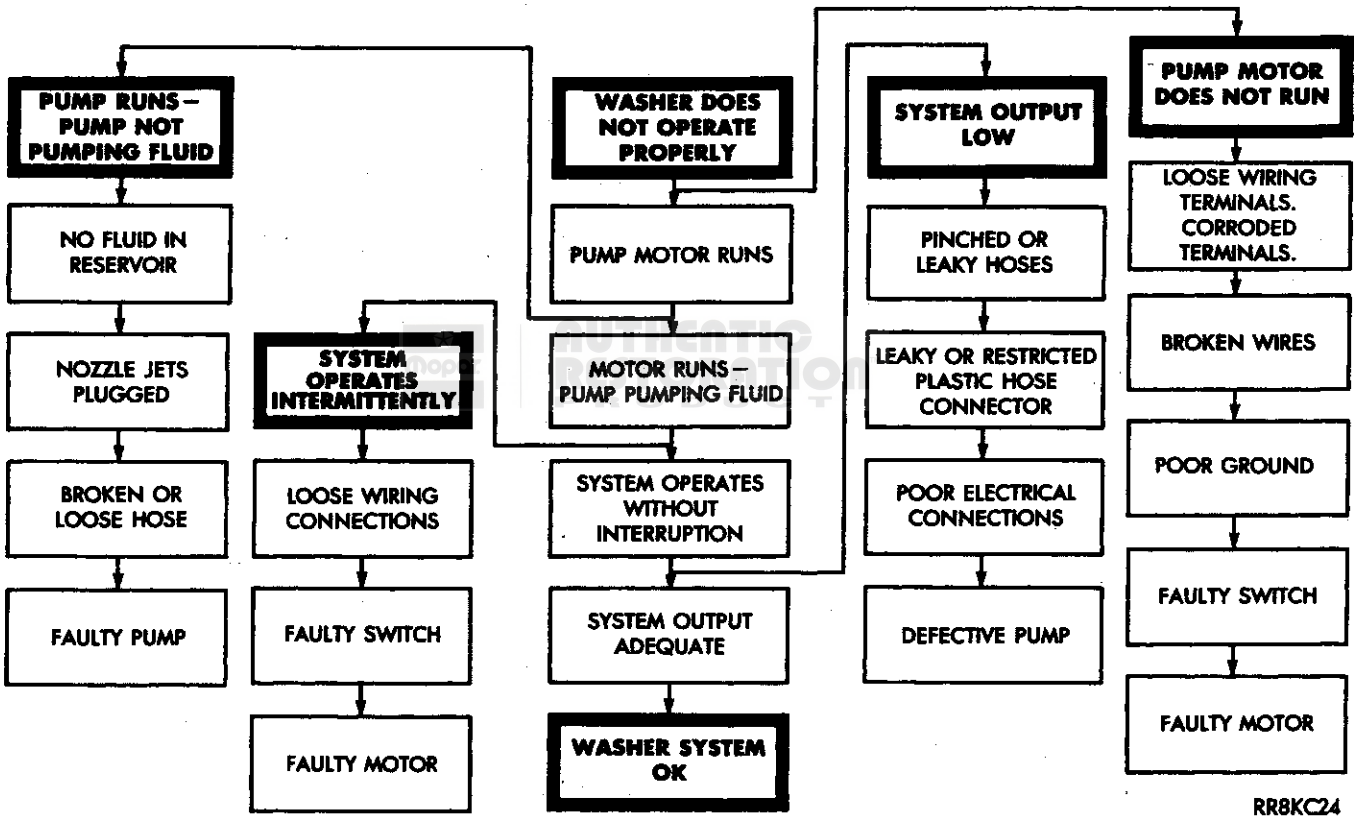


Fig. 2 Washer Pump

WINDSHIELD WASHER DIAGNOSIS



LAMPS

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EXTERIOR LAMPS

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GENERAL INFORMATION

Each vehicle is equipped with various lamp assemblies which are used for illuminating and/or indicating purposes. A good ground is mandatory for proper lighting circuit operation. Circuit grounding is provided by the lamp socket when it comes in contact with the metal body, or through a separate ground wire linking the lamp socket to the body on plastic lamp assemblies.

When changing lamp bulbs, check the socket for corrosion. If corrosion is present, clean it with a wire brush and coat the inside of the socket lightly with any good multipurpose grease or petroleum jelly.

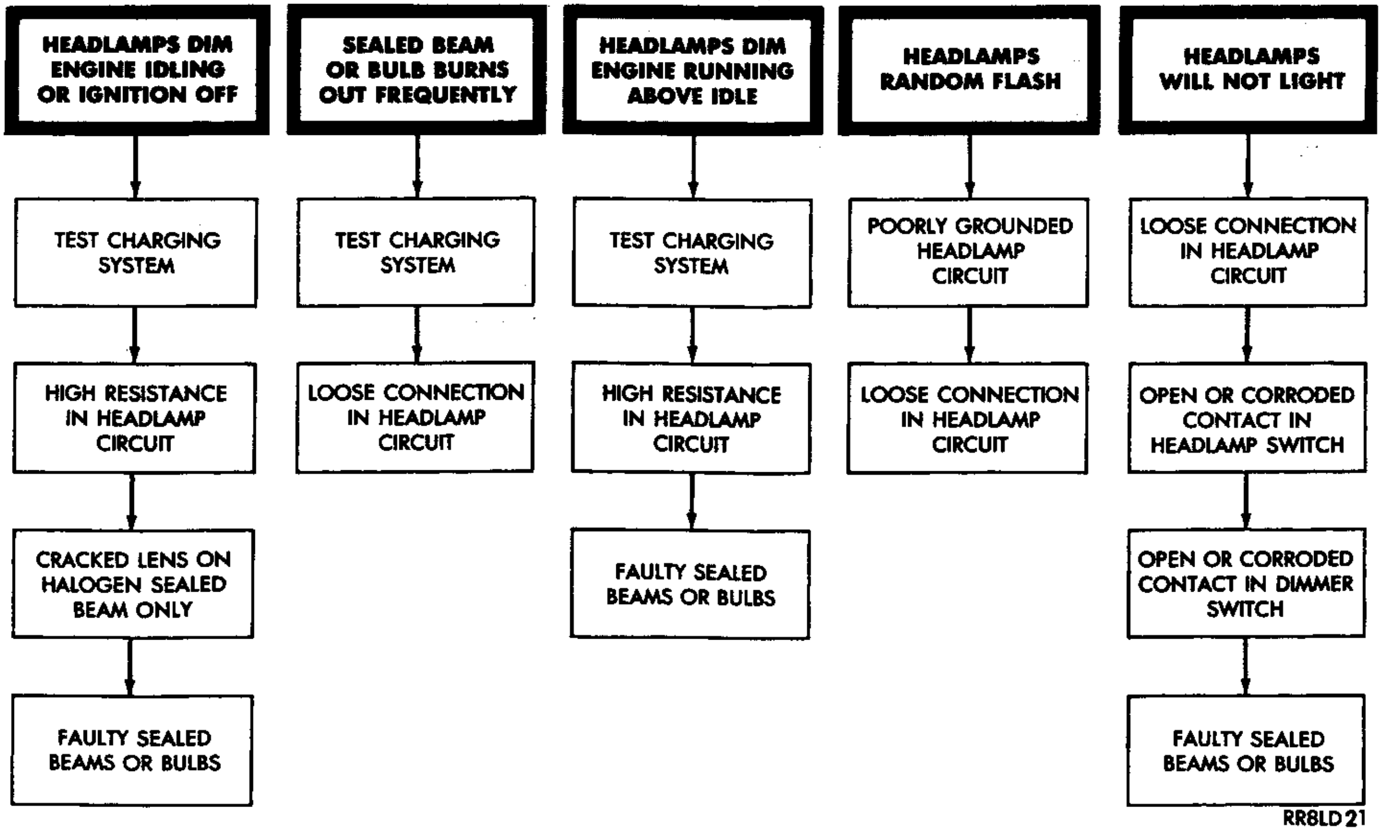
Bulb identification and application for exterior and interior lamps can be found in Specifications.

DIAGNOSTIC PROCEDURES

Always begin any electrical system failure diagnosis by testing all of the related fuses and circuit breakers in the fuse block and engine compartment (see Group 8W - Wiring Diagrams).

Conventional and halogen headlamp sealed beam units are physically and electrically interchangeable, but it is recommended that they not be intermixed on a given vehicle.

HEADLAMP DIAGNOSIS



HEADLAMP DIMMER SWITCH TEST

(1) Remove 4 screws attaching the lower steering column cover (Fig. 1). The fuse block is attached to this cover and should be supported when cover is removed.

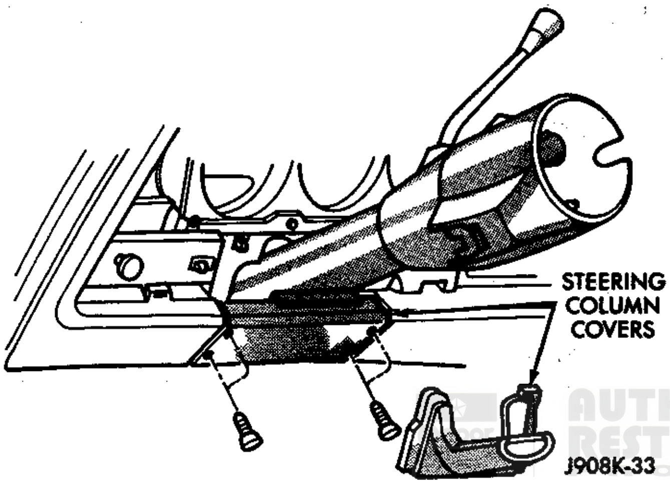


Fig. 1 Steering Column Cover

(2) To test the switch, leave the harness connected to the dimmer switch and with a 12 volt test light check for 12 volts at the terminals of the switch (Figs. 2 and 3).

With the headlamp switch in the OFF or Park position, there should be 12 volts at terminal B ONLY.

With the headlamp switch ON and the dimmer switch in HIGH BEAM position, there should be 12 volts at terminals A, B, and D.

With the headlamp switch in the LOW BEAM position there should be 12 volts at terminals A, B, and C.

With the dimmer switch held in the Flash to Pass position, there should be 12 volts on all four terminals.

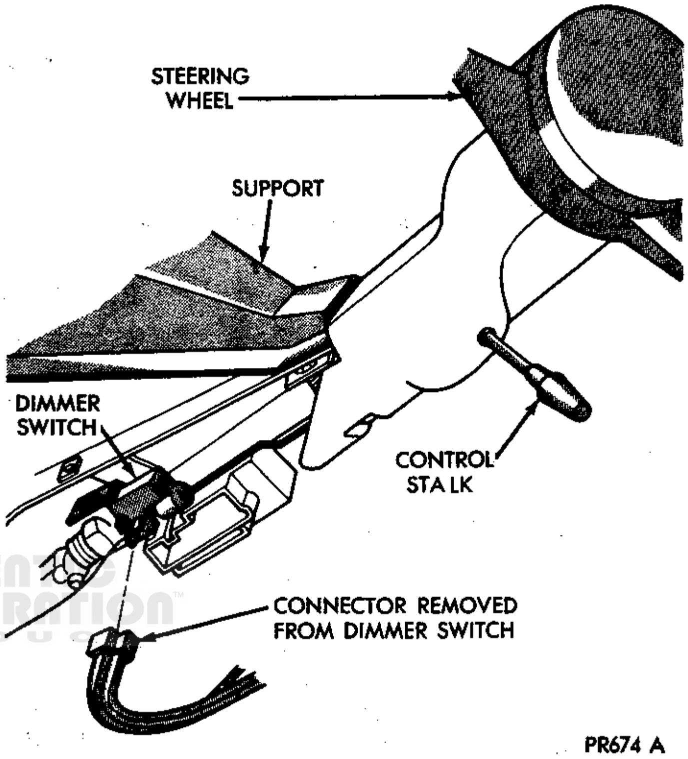


Fig. 2 Dimmer Switch Wiring Harness

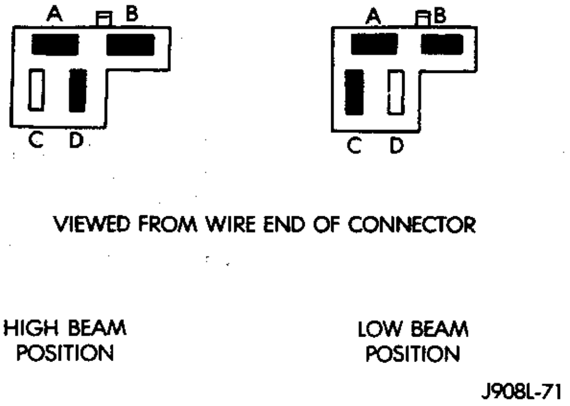


Fig. 3 Dimmer Switch Test Points

EXTERIOR LAMPS SERVICE PROCEDURES

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SEALED BEAM REPLACEMENT

(1) Remove screws from headlamp bezel (Fig. 1).

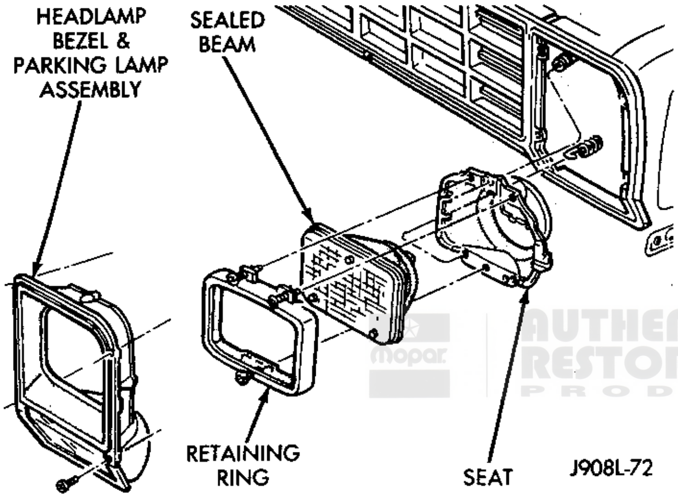

Fig. 1 Sealed Beam Replacement

(2) Twist out park and turn signal lamp socket from back of lamp housing. Set Headlamp bezel aside.

(3) Remove screws from retaining ring, and remove ring (Fig. 2). **Do not disturb headlamp aiming screws.**

(4) Pull out sealed beam unit and unplug connector, by pulling it straight off.

(5) Position new sealed beam unit and install connector.

(6) Install retaining ring.

(7) Install headlamp bezel.

(8) Aim Headlamp as described in Headlamp Aiming Procedures.

FRONT PARK AND TURN SIGNAL LAMP BULB

(1) Remove screws from headlamp bezel (Fig. 1).

(2) Twist out park and turn signal lamp socket from back of lamp housing.

(3) Replace bulb.

To install, reverse removal procedures.

SIDE MARKER LAMP AND BULB

(1) Twist out socket from back of housing.

(2) Remove nuts attaching lamp assembly to fender.

(3) Lift lamp assembly away from outside of fender.

To install, reverse the removal procedures.

TAIL, STOP, TURN SIGNAL, REAR SIDE MARKER AND BACK-UP LAMPS

SWEPTLINE MODELS (FIG. 2)

To replace bulbs, remove lamp.

REMOVAL

(1) Remove assembly attachment screws and remove lamp assembly.

(2) Twist out socket.

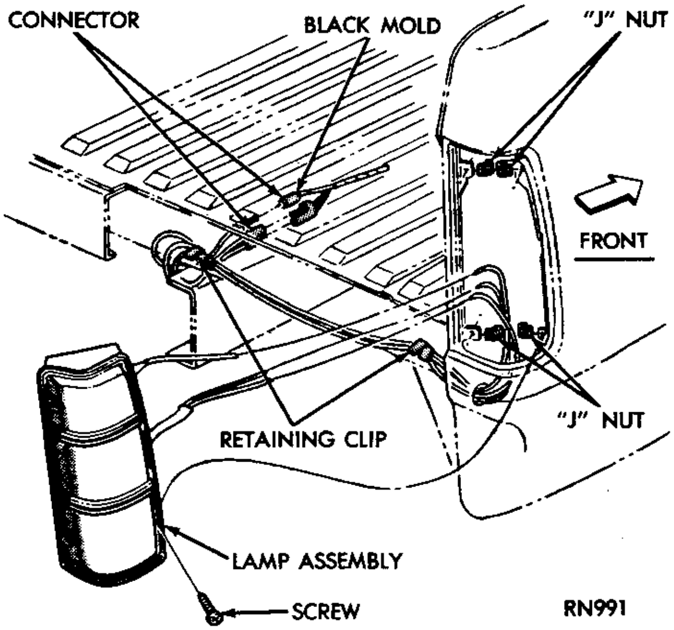

Fig. 2 Tail, Stop, Turn Signal, Rear Side Marker and Back-Up Lamp

INSTALLATION

(1) Twist in socket.

(2) Position the lamp and install assembly mounting screws.

CAB CHASSIS MODELS (FIG. 3)

REMOVAL

(1) Disconnect wiring harness.

(2) Remove lamp mounting nuts and remove assembly.

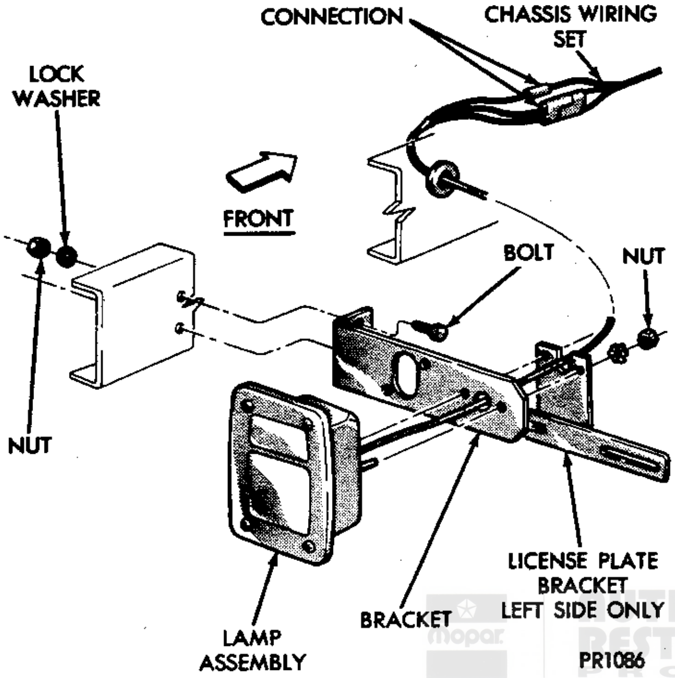

Fig. 3 Tail, Stop, Turn Signal, and Back-Up Lamp

INSTALLATION

(1) Position lamp to bracket and install two attaching screws.

(2) Connect wiring harness.

SPORT UTILITY MODELS (FIG. 4)

REMOVAL

(1) Remove assembly attachment screws and remove lamp assembly.

(2) Twist out socket.

INSTALLATION

(1) Twist in socket.

(2) Position the lamp and install assembly mounting screws.

I.D. AND CLEARANCE LAMPS FOR DUAL WHEEL MODEL

To change bulb, remove lamp.

WHEEL FLARE MOUNTED AND REAR CLEARANCE LAMPS

(1) Pry out retaining clamps.

(2) Pull lens away from mounting plate.

(3) Disconnect electrical connector from bulb and lens assembly (Figs. 5 and 6).

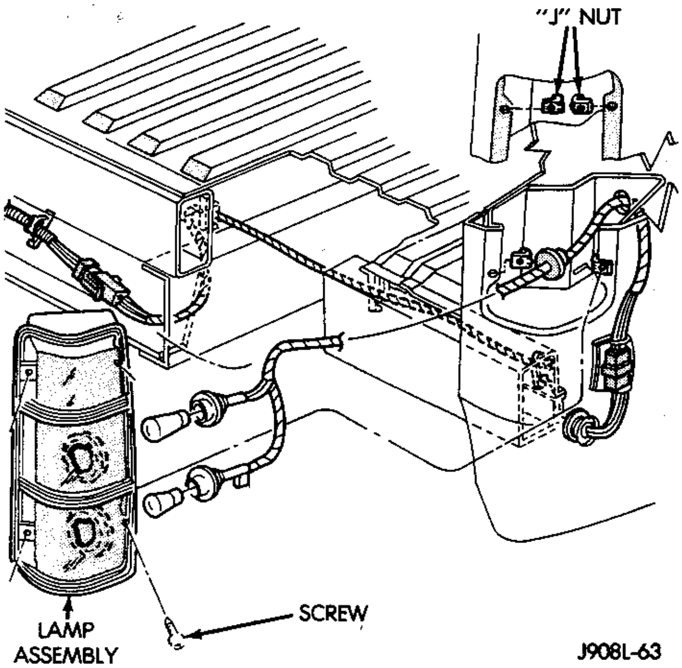

Fig. 4 Tail, Stop, Turn Signal, Rear Side Marker and Back-Up Lamp

CAB LAMPS

(1) Remove mounting screws (Fig. 7).

(2) Pull lens away from mounting plate.

(3) Lift lamp up and disconnect wires and twist out socket.

To install, reverse the removal procedures.

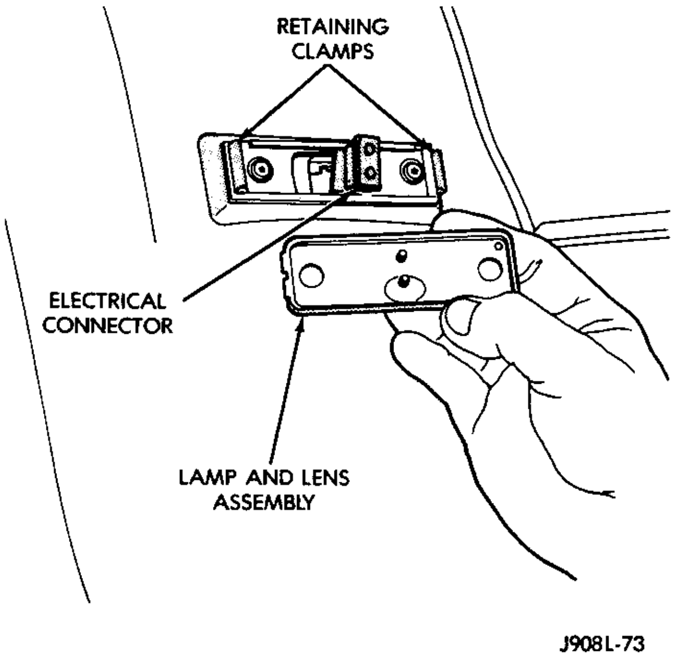

Fig. 5 Rear Wheel Flare Mounted Clearance Lamp

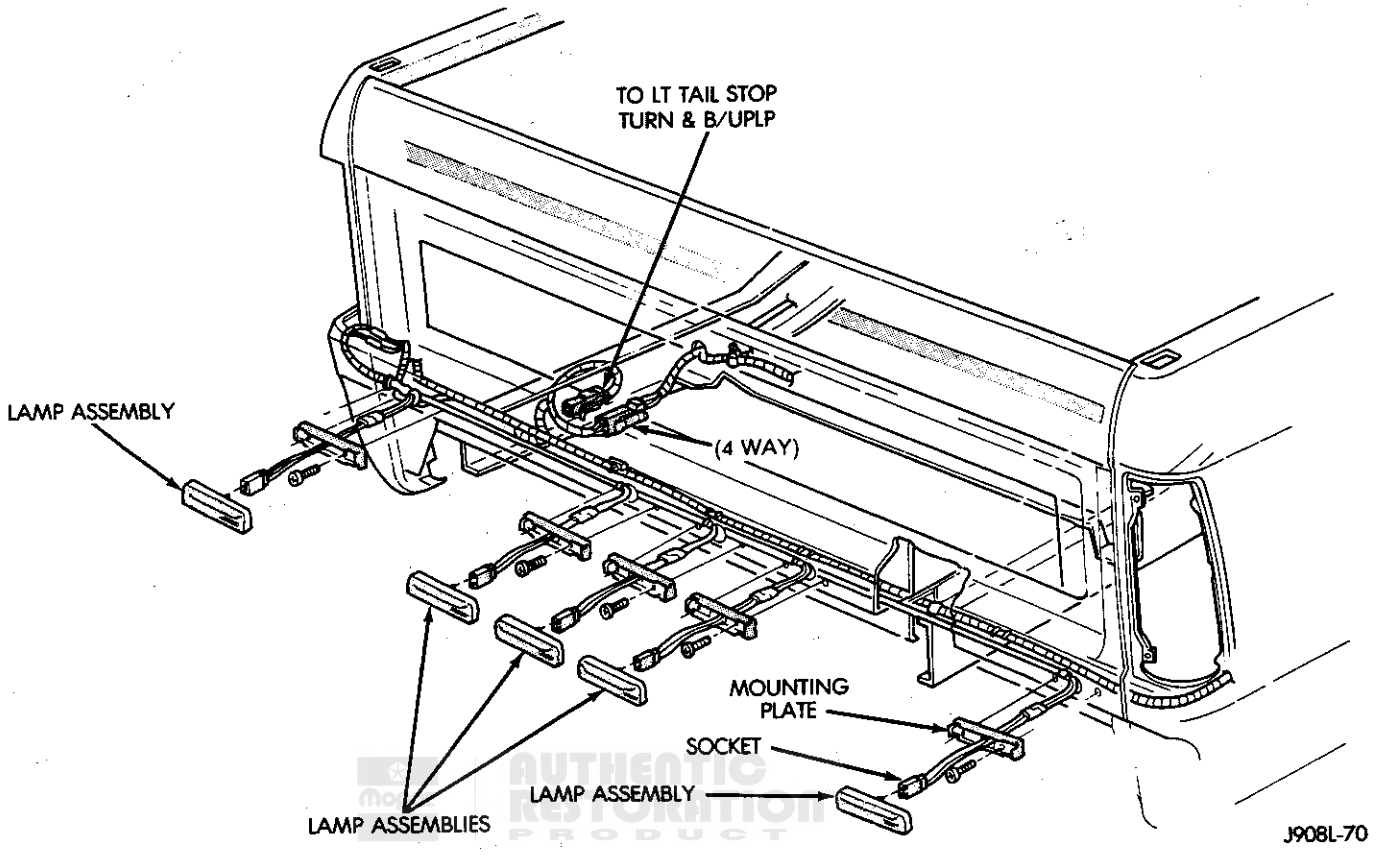

Fig. 6 Rear Clearance Lamps—Sweptline with Dual Wheels

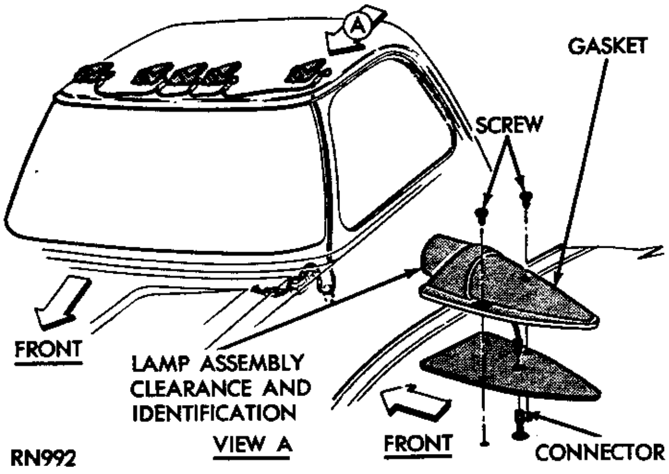

Fig. 7 Clearance and Identification Lamps

CARGO LAMP BULB

STANDARD CAB

(1) Remove two mounting screws (Fig. 8).

(2) Pull assembly out and disconnect wiring connector.

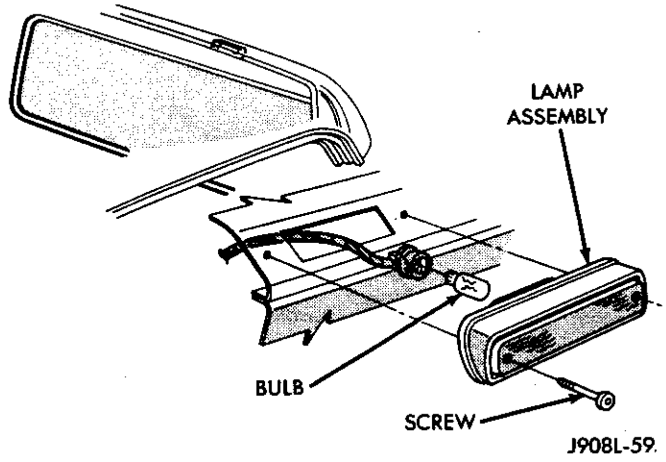

Fig. 8 Cargo Lamp—Standard Cab

(3) To install, reverse the procedures.

CLUB CAB

(1) Remove two mounting screws (Fig. 9).

(2) Pull assembly out and disconnect wiring connectors.

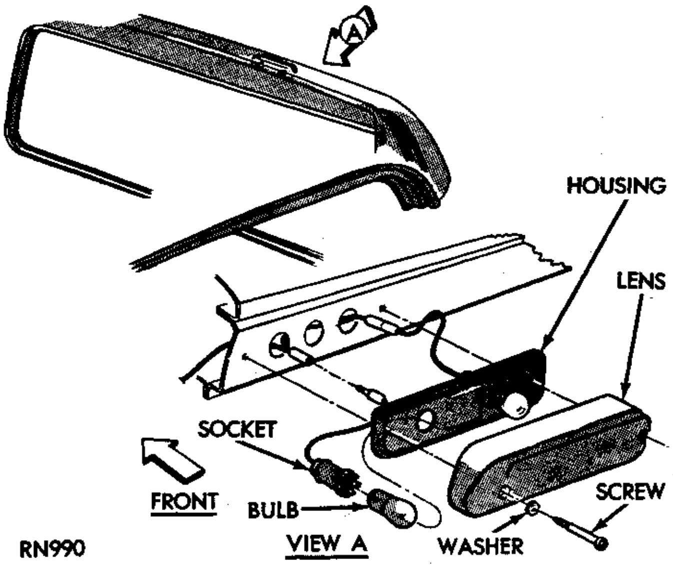

Fig. 9 Cargo Lamp—Club Cab (3) To install, reverse the procedures.

LICENSE LAMP

STANDARD BUMPER (FIG. 10)

(1) Remove rear license plate.

(2) Remove 2 lamp assembly hex head mounting screws.

(3) Remove lamp assembly.

(4) Remove 2 screws attaching lamp lens to housing.

(5) Twist out bulb.

To install, reverse the removal procedures.

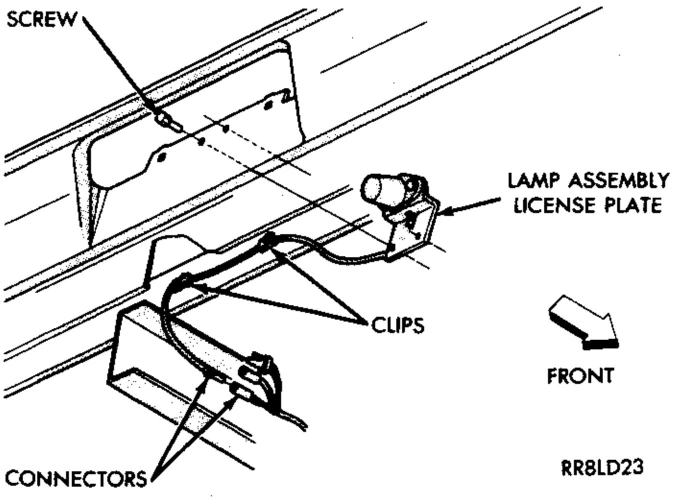

Fig. 10 License Plate Lamp - Standard Rear Bumper

STEP BUMPER (FIG. 11)

To remove bulbs, remove license plate lamp assembly from step bumper and separate lens from lamp, twist out bulb.

(1) Remove 2 lamp assembly mounting screws.

(2) Remove lamp from bumper.

(3) Disconnect wire connector.

To install, reverse the removal procedures.

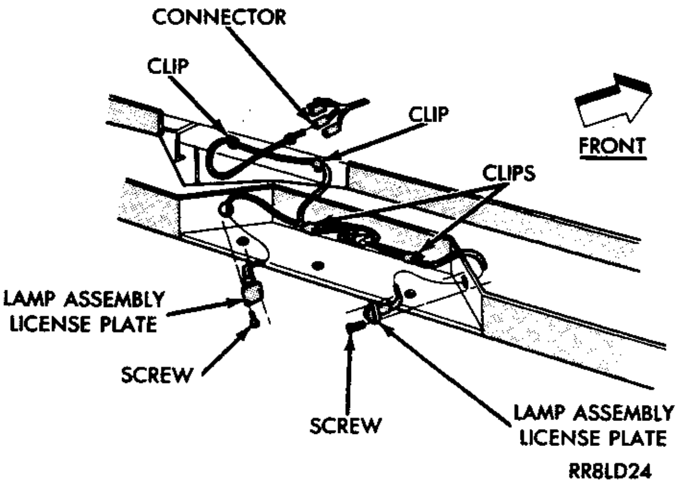

Fig. 11 License Plate Lamps - Step Bumper

WITHOUT REAR BUMPER

(1) Remove screws holding lamp assembly to license bracket (Fig. 12).

(2) Disconnect electrical connector and remove lamp assembly.

(3) Install new lamp assembly with screws and connect electrical connector.

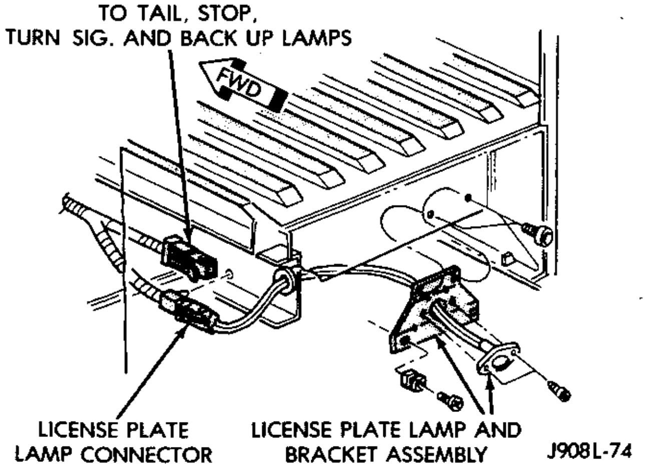

Fig. 12 License Plate Lamp Without Rear Bumper

HEADLAMP SWITCH

To remove or replace the headlamp switch see instructions in Group 8E - Instrument Panel and Gauges.

HEADLAMP DIMMER SWITCH

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove 4 screws attaching the lower steering column cover (Fig. 13). The fuse block is attached to this cover and should be supported when cover is removed.

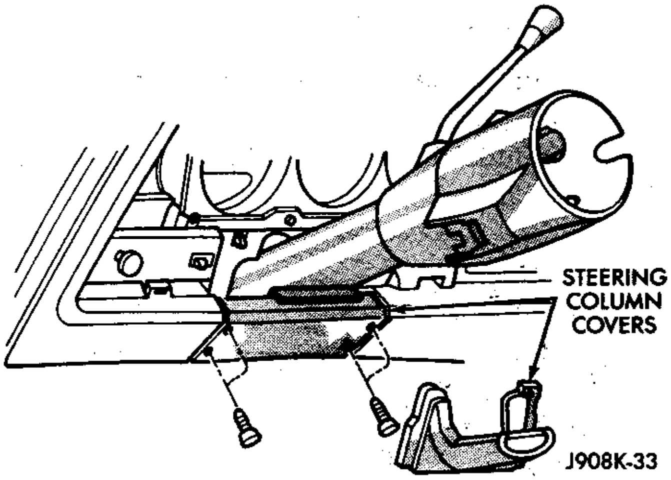

Fig. 13 Steering Column Cover

(3) Disconnect electrical connector.

(4) Remove two screws on dimmer switch mounting plate to replace. switch (Fig. 14).

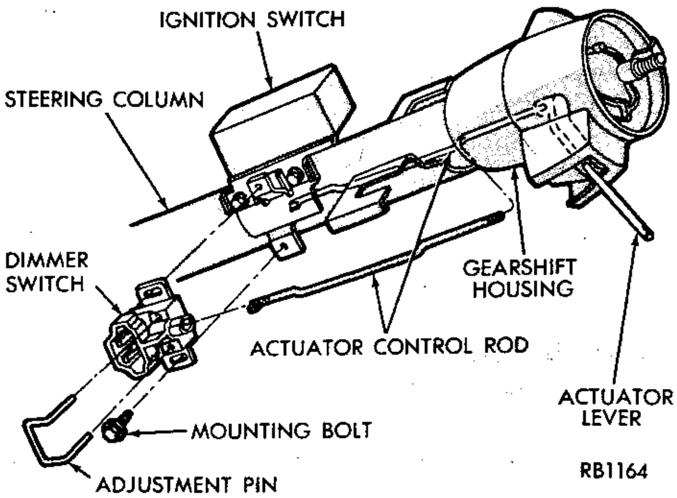

Fig. 14 Dimmer Switch

INSTALLATION AND ADJUSTMENT

(1) Position new switch. Install two screws, do not tighten.

(2) Insert pin in switch hole to lock switch in adjustment position.

(3) Adjust switch by pushing gently up on switch to take up the rod slack.

(4) Tighten screws and remove pin.

(5) Connect electrical connector.

(6) Install steering column cover.

HEADLAMP AIMING PROCEDURES

PRE-AIMING INSTRUCTIONS

(1) Test dimmer switch operation.

(2) Observe operation of high beam indicator light mounted in instrument cluster.

(3) Inspect for badly rusted or faulty headlamp assemblies. These conditions must be corrected before a satisfactory adjustment can be made.

(4) Place vehicle on a level floor.

(5) Jounce front suspension through 3 oscillations by applying body weight to hood or bumper.

(6) Inspect tire inflation.

(7) Rock vehicle sideways to allow vehicle to assume its normal position.

(8) If gasoline tank is not full, place a weight in trunk of vehicle to simulate weight of a full tank (6-1/2 pounds per gallon).

(9) Thoroughly clean headlight lenses.

COMPENSATING THE AIMERS (C-4466) FOR FLOOR SLOPE

The floor level offset dial must coincide with the floor slope for accurate aiming. Calibration fixtures are included with the aimers.

(1) Attach one calibration fixture to each aimer. Fixtures will easily snap into position on aimer when properly positioned (Fig. 1).

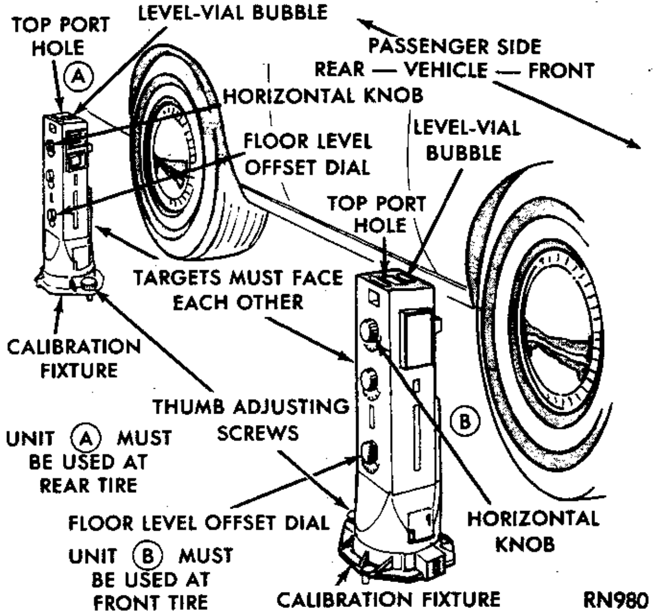

Fig. 1 Determining Floor Slope

(2) Place aimers at center line of each wheel on one side of vehicle (Fig. 1). Unit A must be placed at rear wheel with target facing forward.

(3) Unit B must be placed at front wheel with target facing rearward.

(4) Adjust thumb adjusting screw on each calibration fixture by turning either clockwise or counterclockwise until level vial bubble registers in a centered, level position (Fig. 1).

(5) Look into top port hole of Unit A. Turn horizontal knob until split image is aligned (Figs. 2 and 3).

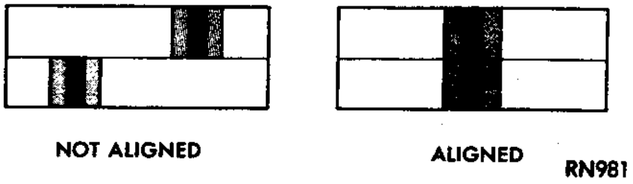

Fig. 2 Split Image Alignment

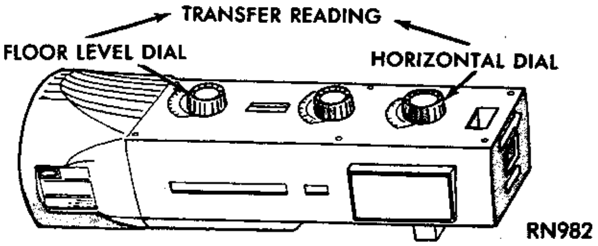

Fig. 3 Floor Level Compensating Adjustment

(6) Transfer plus or minus reading indicated on horizontal dial to floor level offset dial on each aimer. Press floor level dial inward to set reading (Fig. 3).

(7) Remove calibration fixtures from both units.

TESTING AIMER CALIBRATION

Calibration of the aimers may be lost due to extended use. Calibration fixtures used in conjunction with aimers can be used to check and adjust aimers.

(1) Turn thumb adjusting screw on each calibration fixture until it is approximately the same distance as the supporting posts (Fig. 4).

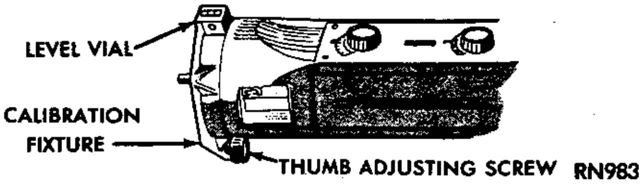

Fig. 4 Calibration Fixture

(2) Attach calibration fixtures to each unit with level vials on top (Fig. 4).

(3) Locate a true vertical plate glass window or smooth surface and secure aimers three to five feet apart so split image targets can be located in viewing ports (Fig. 5).

(4) Set floor level dial at zero (Fig. 1).

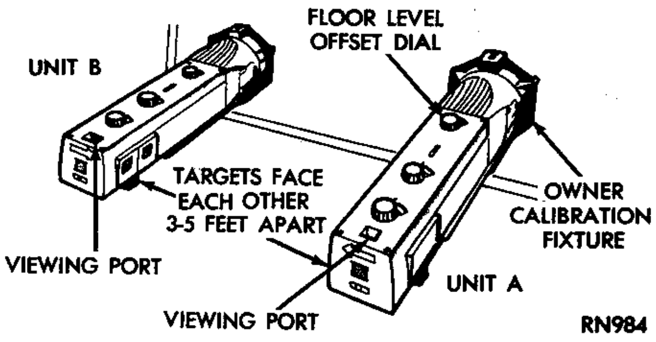

Fig. 5 Checking Aimer Calibration

(5) Rotate thumb adjusting screws on each calibration fixture until level vials on fixtures are centered (Fig. 6).

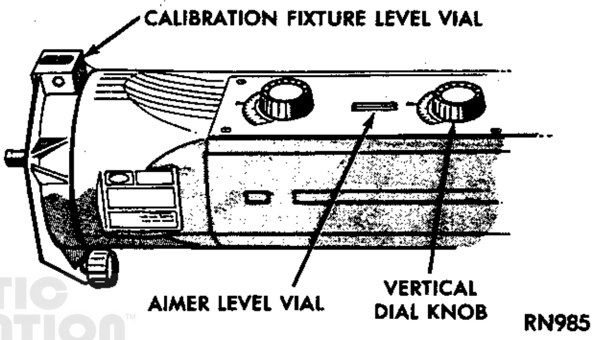

Fig. 6 Checking Vertical Aim Calibration

(6) With both calibration level vials centered turn vertical dial knobs on each aimer until aimer level vials are centered. If aimer vertical dial pointers read between 1/2 up and 1/2 down, aimers are within allowable vertical tolerance. Calibrate units if beyond these limits (Fig. 6).

(7) Adjust horizontal dial knob on each aimer until split image targets align. If aimer horizontal dial pointers read between 1 left and 1 right, the aimers are within allowable tolerance limits. Calibrate units if beyond these limits (Fig. 3).

MOUNTING AIMERS

(1) Snap adaptor into position on each aimer (Fig. 7).

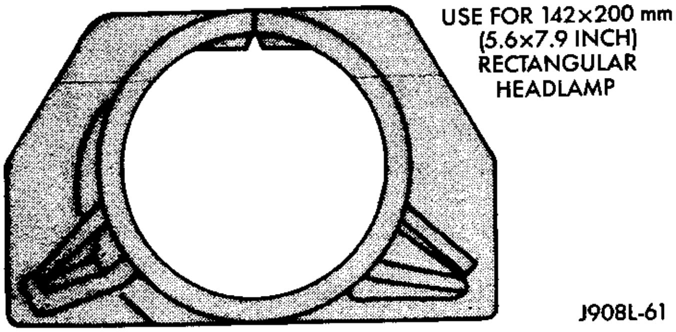

Fig. 7 Headlamp Adaptor

(2) Position aimers on headlamps by pushing piston handle forward, engaging rubber suction cup. Immediately pull back piston handle until it locks in place (Fig. 8).

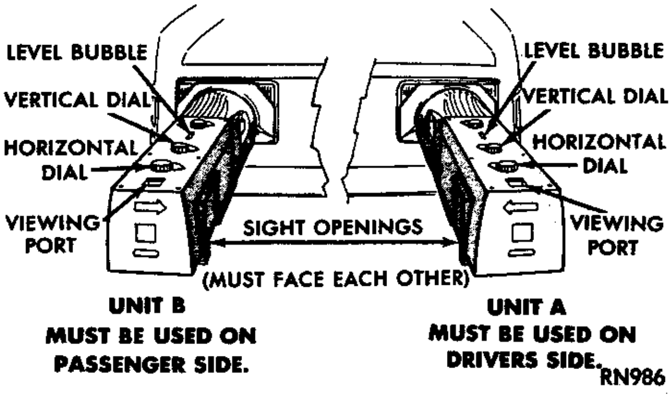

Fig. 8 Headlamp Aimers in Position

Steel inserts are molded into position on all adapters to insure accuracy. These inserts must be in contact with the three guide points on the lamps when the aimers are properly positioned.

HORIZONTAL ADJUSTMENT

(1) Set horizontal dial to zero (Fig. 3).

(2) Check to see that the split image target lines are visible in the viewing port. If necessary, rotate each aimer slightly to locate the target (Fig. 9).

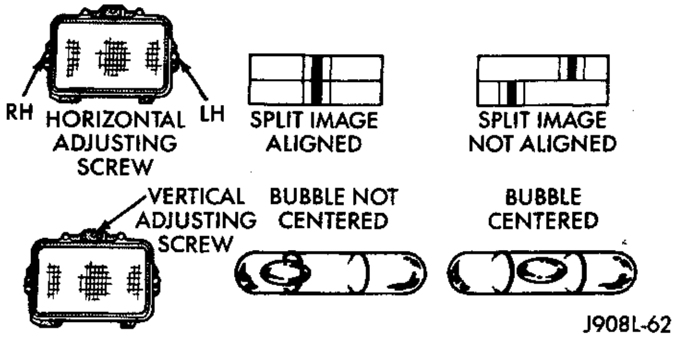

Fig. 9 Split Image, Bubble Alignment, and Headlamp Adjusting Points

(3) Turn horizontal screw on side of headlamp until split image of target line appears in mirrors as one solid line (Fig. 9). To remove "backlash," make final adjustment by turning adjusting screw in a clockwise direction.

(4) Repeat the last three steps on opposite headlamp.

VERTICAL ADJUSTMENT

(1) The vertical dial should be set at zero. (For passenger vehicles, a "0" setting is generally required. For special setting, consult local state laws.).

(2) Turn vertical adjusting screw (Fig. 6) until the level bubble is centered between the lines (Fig. 9).

(3) Repeat the last two steps on the opposite headlamp.

(4) Recheck target alignment on both aimers and readjust horizontal aim if necessary.

(5) Repeat aiming process for a four headlamp system on the second pair of lamps.

(6) Remove aimers by pressing "vacuum release" button located on piston handle.

HEADLAMP ADJUSTMENT USING AIMING SCREEN METHOD

Place vehicle on a known level floor 7.62 m (25 ft.) from aiming screen or other light colored area. Prepare aiming screen as follows:

(1) Position a vertical tape so that it is aligned with the vehicle centerline.

(2) Position a horizontal tape with reference to centerline of headlamp.

(3) Position a vertical tape on the screen with reference to the centerline of each headlamp. A two headlamp system will have two vertical tapes plus the vehicle centerline tape.

(4) Adjust top adjusting screw for vertical adjustment, adjust side screw for horizontal adjustment.

(5) A properly aimed low beam will appear on screen similar to the pattern shown (Fig. 10).

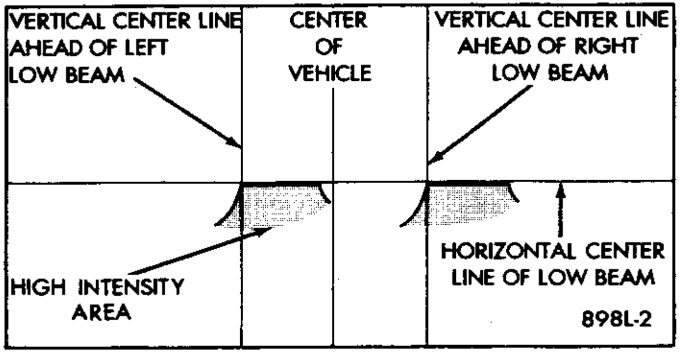

Fig. 10 Low Beam Adjusting Pattern

DAYTIME RUNNING LIGHTS (Canada Only)

The headlamps on vehicles sold in Canada will illuminate when the vehicle is started and the speed sensor recognizes forward motion. This provides a constant Lights On condition until the engine is turned OFF. The lamps illuminate at less than 50% of normal intensity.

The Daytime Running Light Module is located on the right inner fender forward of the windshield washer reservoir (Fig. 11).

(1) Remove the bolt holding the module and bracket to the vehicle.

(2) Disconnect the electrical connector.

(3) To install the module, reverse the removal procedures.

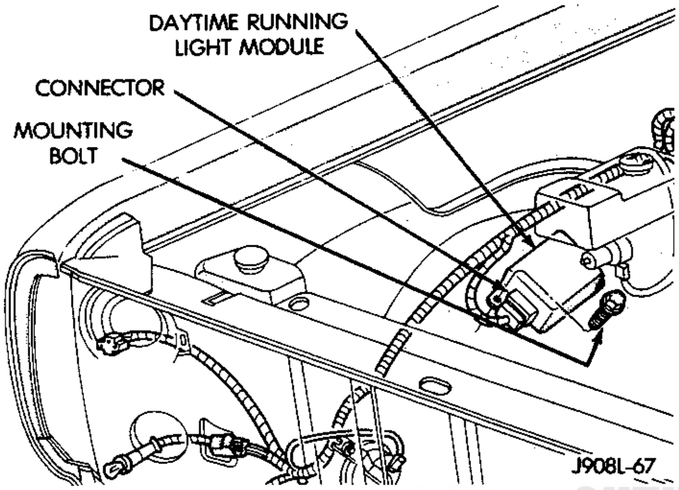

Fig. 11 Daytime Running Light Module

UNDERHOOD RETRACTABLE LAMP

REPLACEMENT

(1) Remove the lamp assembly attaching screws and the ground wire connection (Fig. 12).

(2) Disconnect the lamp connector.

(3) To install the lamp assembly, reverse the removal procedures.

BULB REPLACEMENT

(1) Remove the lens cover and remove the bulb.

(2) Install the replacement bulb and install the lens cover.

The replacement bulb is trade # 105.

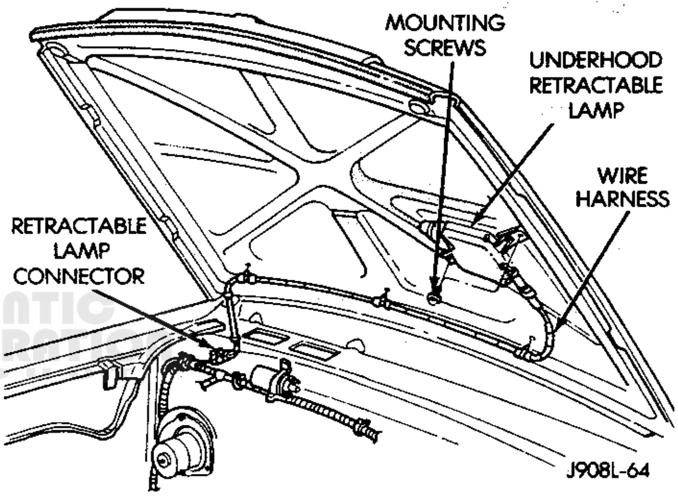

Fig. 12 Underhood Lamp Removal/Installation

INTERIOR LAMPS

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DOME LAMP

WITHOUT HEADLINER

(1) Remove two screws and lens (Fig. 1).

(2) Twist bulb to remove.

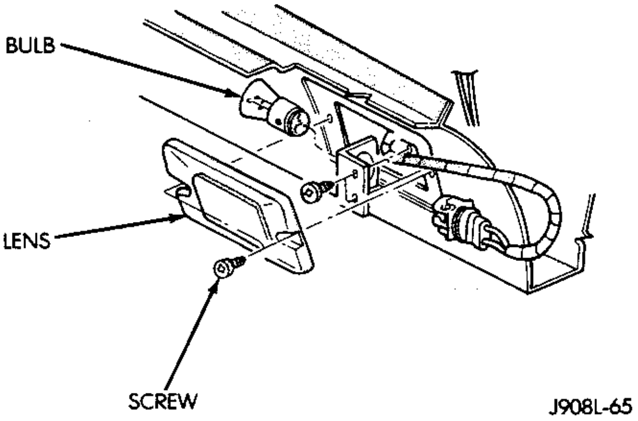

Fig. 1 Dome Lamp

WITH HEADLINER

(1) Gently squeeze the front and rear of the lens together and pull down to remove (Fig. 2).

(2) Pull bulb down to remove from socket.

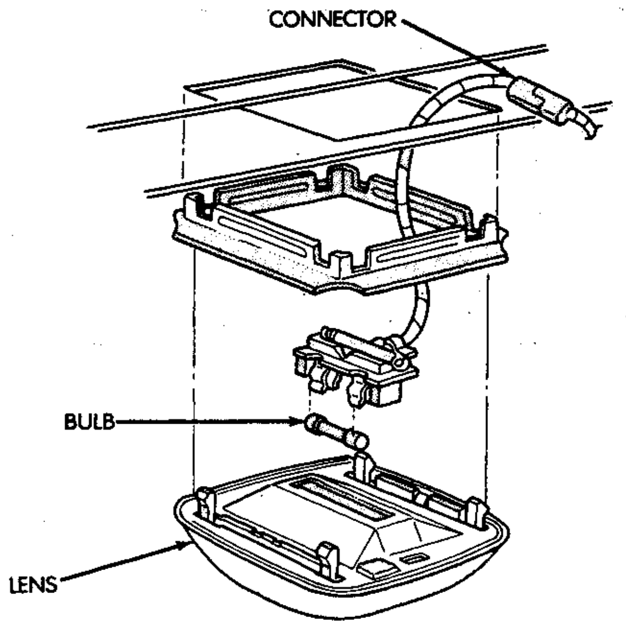

Fig. 2 Dome With Headliner

SPECIFICATIONS

INTERIOR LAMP BULBS

Headlight Switch Rheostat Dimming	
Air Conditioning Control Illumination	# 158
Ash Tray Illumination	# 158
Clock Electronic	(Note A)
Gear Shift Selector (Note B)	# 194
Heater Control Illumination	# 158
Instrument Cluster Illumination	# 194
Radio	(Note C)
Snow Plow Control Illumination	# 158

Non-Dimming	
Anti Lock Brake Indicator	# 194
Brake Indicator Lamp	# 194
Check Engine Lamp	# 194
Dome Lamp	#1004
Fasten Seat Belt Indicator Lamp	# 194
Four Wheel Drive Indicator	# 158
Gate Ajar Indicator Lamp	# 158
Glove Compartment Lamp	#1891
High Beam Indicator Lamp	# 194
Ignition Key Lamp	# 53
Low Fuel Indicator Lamp.	# 194
Low Voltage Indicator Lamp.	# 194
Map Lamp	# 562
Oil Pressure Indicator Lamp	# 158
Rear Cargo Lamp	# 211-2
Temperature Indicator Lamp	# 194
Turn Signal Indicator Lamp	# 194
Under Hood Lamp	# 105

NOTE: (A) Included in Radio. (B) Included in instrument cluster lighting. (C) Warranty service by authorized service dealer only.

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EXTERIOR LIGHT BULBS	
Auxiliary Headlamps (Snow Plow)	#6054
Back-Up Lamps	#1156
Cargo Lamp	# 922
Clearance Lamps	# 194
Front Lamp	#2057
Front Side Marker Lamp	# 168
Headlamps, Rectangular	#6052
Park and Turn Signal (Snow Plow) Lamp	#2057
Rear Bumper License Plate Lamp	
Standard Chrome Bumper	#1155
Sill Mounted (No Bumper)	# 168
Step Bumper	# 168
Side Marker Lamps	# 168
Tail, Stop and Turn Lamp Note A	#2057
Tail, Stop and Turn Lamp Note B	#1157

NOTES: (A) Tail Lamp Bulb Also Serves As Side Marker Lamp. (B) Cab and Chassis.

J908L-69

CIRCUIT BREAKER	
Circuit	Headlamps
Amp	20
Location	Integral with Switch

J908L-57

WARNING BUZZER/CHIME MODULE

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GENERAL INFORMATION

The seat belt warning system uses a lamp on the instrument panel and a buzzer for both visual and audible warning signals. The buzzer is a combined "seat belt not fastened," "key in ignition" and "headlamps ON" signal.

The seat belt portion of the buzzer includes a timer. The system will always illuminate the seat belt warning lamp for 4 to 8 seconds after the ignition switch is turned to the ON position. Also, if the driver does not fasten his seat belt, the buzzer will sound during the same interval. Only the driver's seat belt buckle has a switch that is connected to this system. Passenger seat belts are not connected to this system.

The seat belt warning buzzer is located near the bulkhead disconnect taped to the wiring harness (Fig. 1).

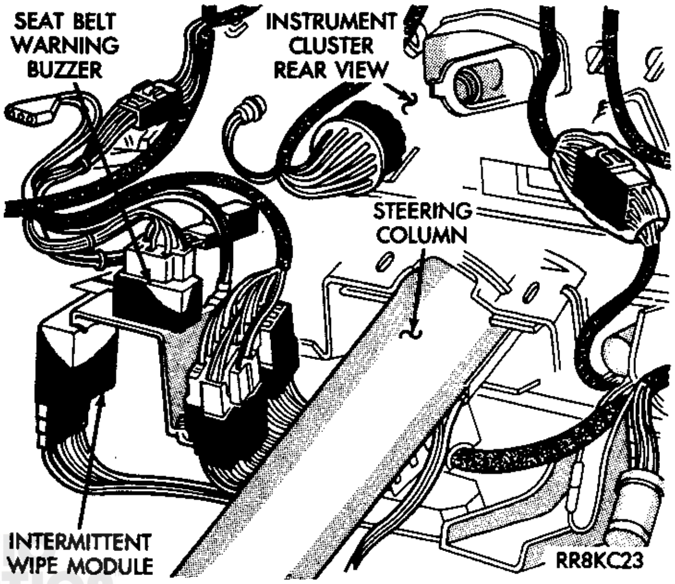

Fig. 1 Seat Belt Warning Buzzer Location

TEST PROCEDURES

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Seat Belt Buckle Switch Test	2	Timed Buzzer-Relay Test	1

TIMED BUZZER-RELAY TEST (Fig. 2)

PREPARATION

(1) Remove timed buzzer-relay.

(2) Connect one end of a jumper wire to a 12 volt supply.

(3) Connect a test lamp between terminal number 3 of buzzer and ground (Fig. 2).

(4) Ground terminals 2 and 5 of buzzer.

TEST PROCEDURE

Connect 12 volt jumper wire to terminal number 4 of buzzer module, look at test lamp and listen for buzzer.

RESULTS

(1) Light should come on and buzzer should sound for 4 to 8 seconds and then both should go off; if not, replace buzzer module.

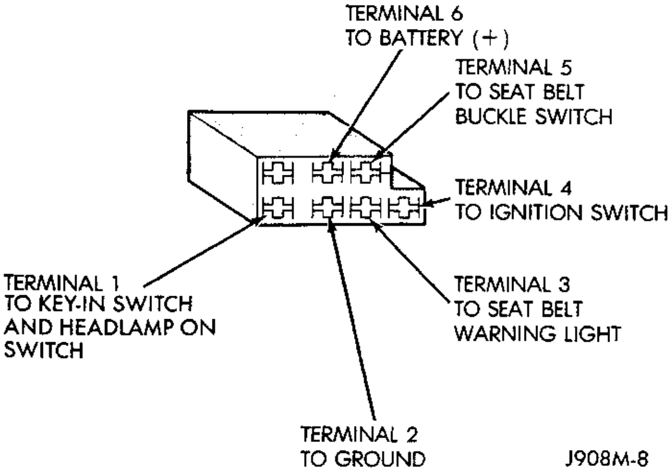

Fig. 2 Buzzer Module Connector (Front View) Terminal Identification

(2) If operation is okay, check wiring for opens, shorts, or poor connections.

SEAT BELT BUCKLE SWITCH TEST (Fig. 3)

If buzzer checks out okay, check wiring from terminal number 5 to the seat belt switch and the wire from the seat belt switch to terminal number 2 (ground). If they check out okay, replace the seat belt buckle and switch assembly.

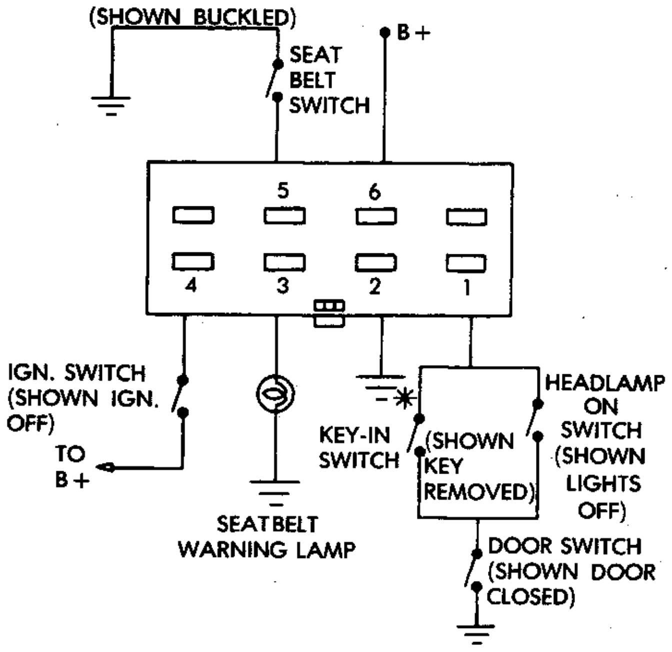

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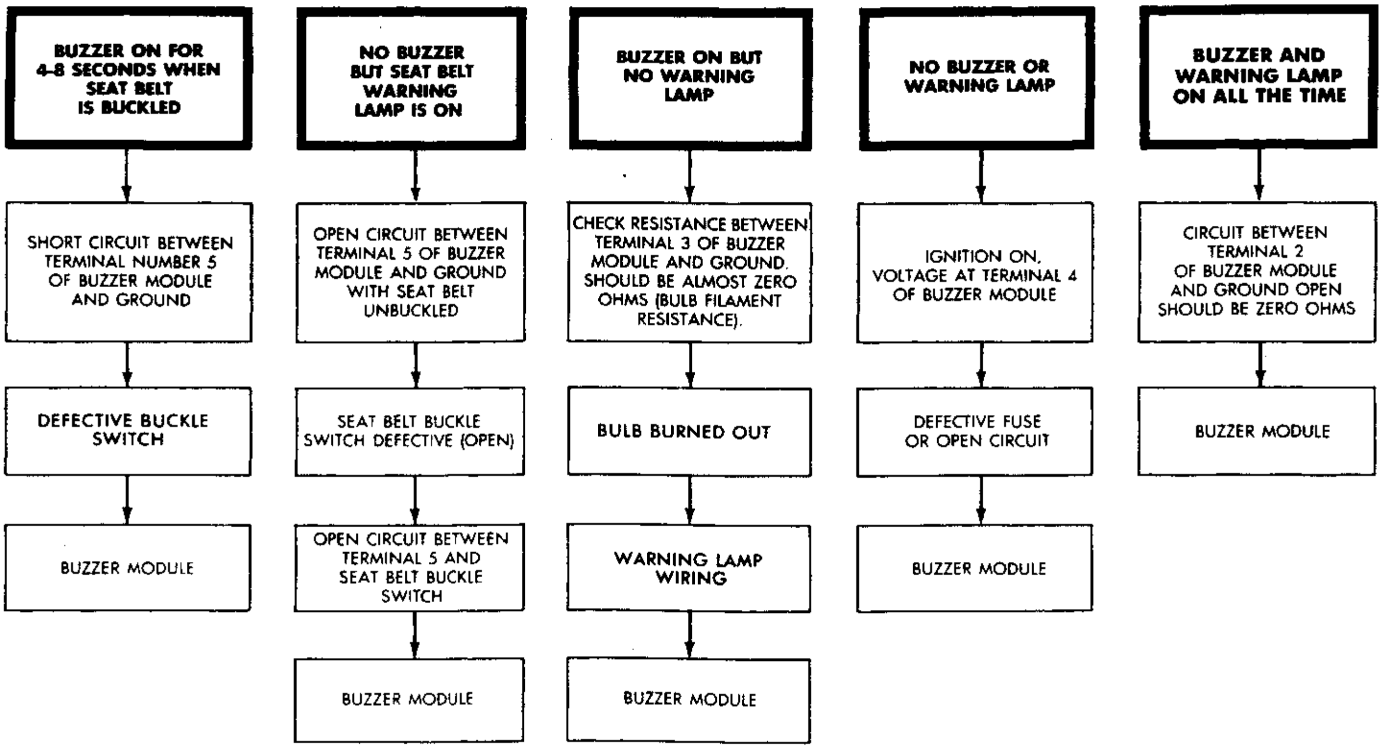
Fig. 3 Warning Buzzer System Schematic



J908M-4

SERVICE PROCEDURES

KEY-IN SWITCH

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove horn pad assembly and steering wheel nut (Figs. 4, 5).

(3) Remove steering wheel with puller C-3428B (Fig. 6).

(4) Remove 3 screws along bottom edge of steering column cover.

(5) Pull cover down to disengage slide tabs and remove cover.

(6) Pry out wiring trough retainers and lift off wiring trough (Fig. 7). New retainers may be required for assembly.

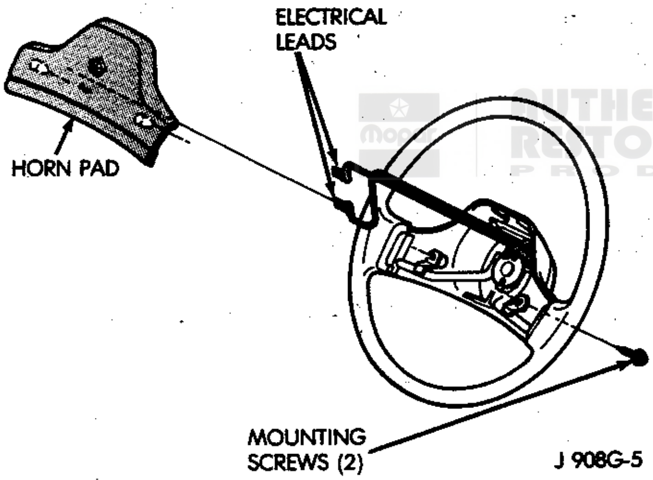


Fig. 4 Standard Steering Wheel Horn Pad Removal

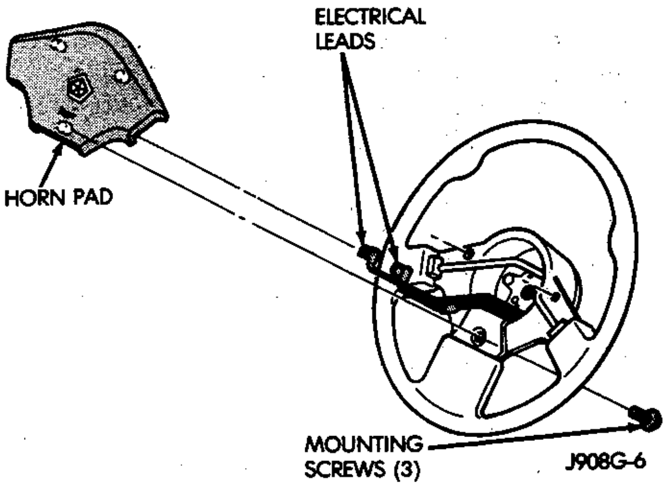


Fig. 5 Optional Steering Wheel Horn Pad Removal

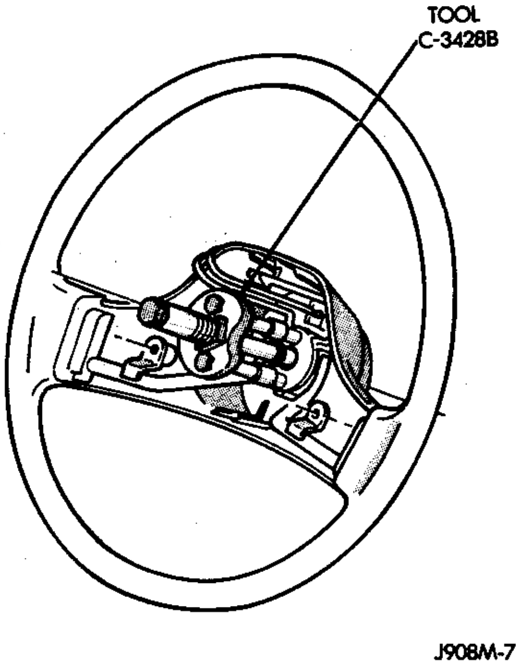


Fig. 6 Remove Steering Wheel With Tool C-3428B

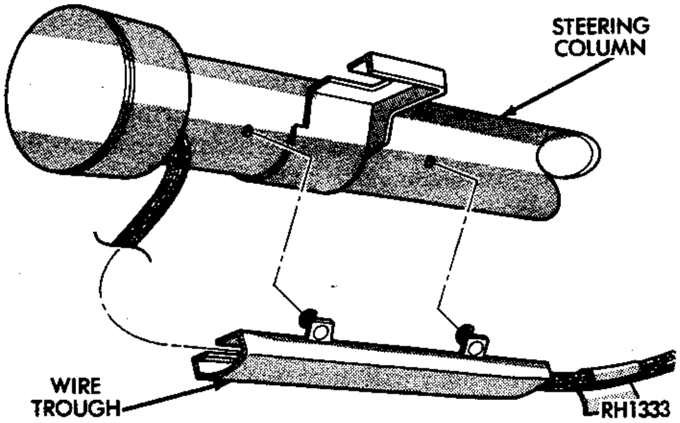


Fig. 7 Wire Trough Cover

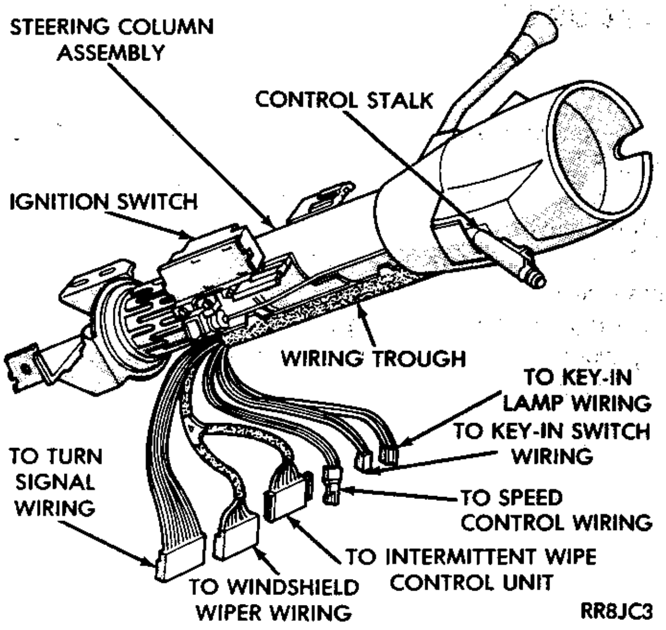


Fig. 8 Steering Column Wiring Connectors

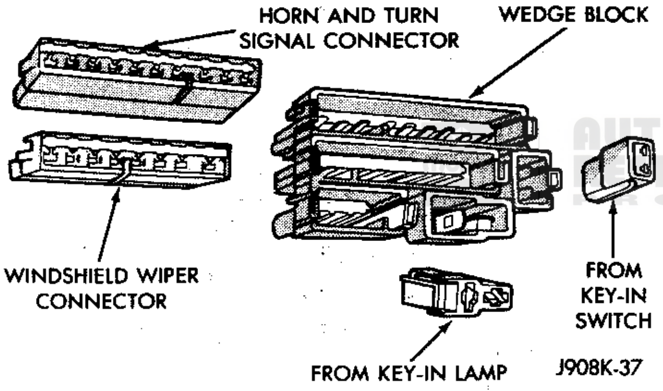


Fig. 9 Disconnecting Wires

(7) Disconnect turn signal and key-in switch wiring connectors. (Figs. 8, 9).

(8) Disassemble steering column for switch removal as follows:

(a) **Standard Column:** Remove screw holding wiper-washer switch to turn signal switch pivot. Leave the entire turn signal lever (control stalk) in its installed position.

Remove 3 screws attaching bearing retainer and turn signal switch to upper bearing housing (Fig. 10). Pull turn signal switch out of column far enough to set aside. DO NOT completely remove switch and wiring assembly.

(b) **Tilt Column:** Depress lock plate with Tool C-4156 and pry retaining ring out of groove with screwdriver (Fig. 11). **The full load of the upper bearing spring should not be relieved;** if it is, the retaining ring will turn too easily making removal more difficult. Remove lock plate, cancelling cam, and upper bearing spring.

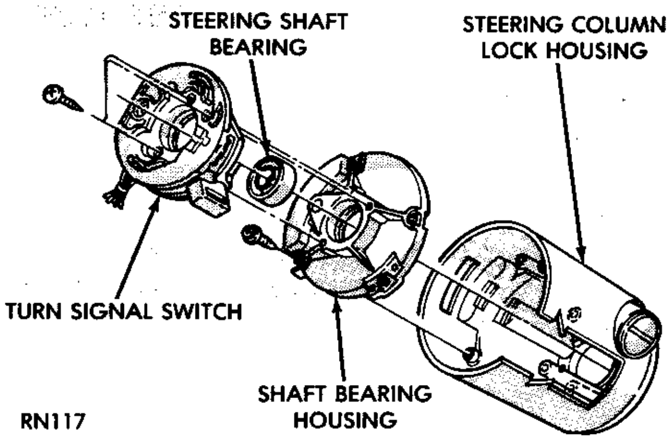


Fig. 10 Turn Signal Switch

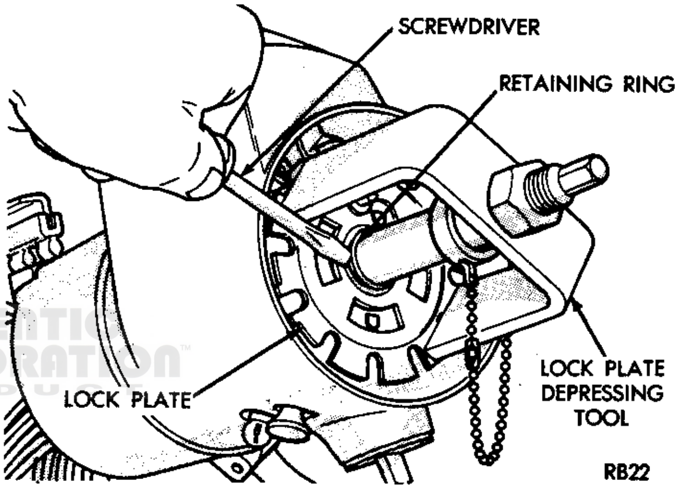


Fig. 11 Remove Lock Plate Retaining Ring Using Tool C-4156

Place turn signal switch in right turn position. Remove screw which attaches link between turn signal switch and wiper-washer switch pivot. Remove screw which attaches hazard warning switch knob (Fig. 12). Remove 3 screws attaching turn signal switch to steering column.

(8) Pull turn signal and hazard warning switch out of column far enough to set aside (Fig. 10). DO NOT completely remove switch and wiring assembly.

(9) Remove screw mounting key-in switch (Fig. 13).

(10) Gently pull the key-in switch up from column while straightening and guiding wires and wire connector up through column opening.

INSTALLATION

(1) Guide key-in switch wiring and connector down through column opening.

(2) Secure key-in switch to column (Fig. 13).

(3) Assemble upper part of steering column.

(a) **Standard Column:** Position turn signal switch and bearing retainer into place on upper bearing housing. Install 3 mounting screws and tighten securely. Position turn signal lever (control

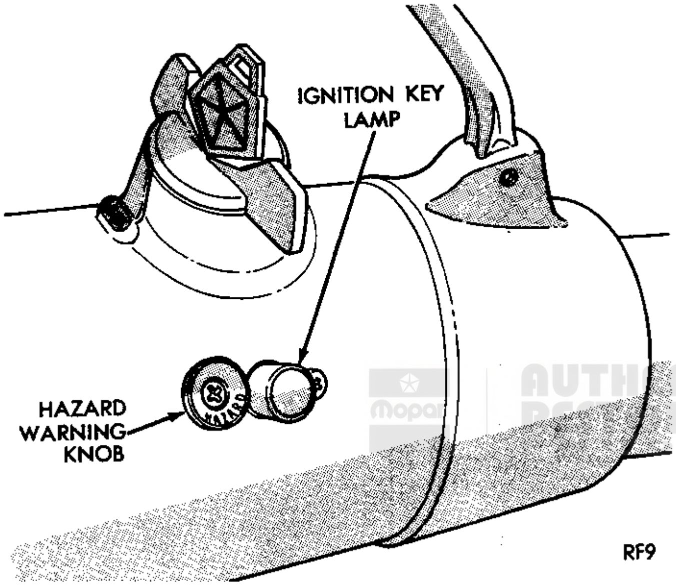


Fig. 12 Hazard Warning Switch Knob

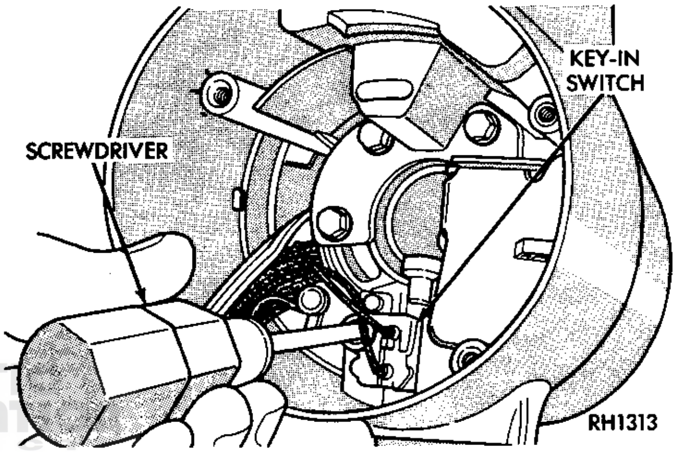


Fig. 13 Key-In Switch

stalk) to turn signal switch pivot, then put screw through pivot and tighten securely. Be sure that dimmer switch rod is in control stalk pocket.

(b) **Tilt Column:** Position turn signal switch in upper column housing. Place switch in right turn position. Install three mounting screws and tighten. Pull link in position between turn signal switch and wiper-washer switch pivot, and secure with screw. Using Tool C-4156, install upper bearing spring, cancelling cam and lock plate with **new retainer spring.** Install hazard warning knob with screw.

(4) Connect wiring harness connectors (Figs. 8, 9).

(5) Install wiring trough to column with four plastic buttons.

(6) Position steering wheel master serration over missing tooth on steering shaft.

(7) Install horn switch and steering wheel nut. Tighten steering wheel nut to 61 N•m (45 ft. lbs.).

(8) Place gearshift lever in Park position, connect battery negative cable and test operation of turn signal, hazard warning, horn and dimmer switch.

REAR WINDOW DEFOGGER

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GENERAL INFORMATION

The electrically heated rear window defogger is available on Ramcharger with sunscreen glass only.

The system consists of a rear window with two vertical bus bars and a series of electrically connected grid lines baked on the inside surface.

Circuit protection for the heated grid circuit is provided by a 18 gauge fusible link wire located in the engine compartment. The relay circuit is protected by a 20 amp fuse, located in the fuse block.

When the rear window defogger switch is placed in the ON position, current is directed to rear window grid lines. The heated grid lines in turn heat the rear window to clear the surface of fog or snow.

CAUTION: Grid lines can be damaged or scraped off with sharp instruments. Care should be taken in cleaning the glass or removing foreign materials, decals or stickers. Normal glass cleaning solvents or hot water used with rags or toweling is recommended.

SYSTEM DESCRIPTION

CONTROL SWITCH/TIMER RELAY MODULE

The control switch and timer relay are integrated into a single panel mounted assembly. Actuating the switch energizes the electronic timing circuit which allows current to flow through the grid system for approximately 10 minutes, or until either the control switch or ignition is turned off. An indicating lamp illuminates a lens inlaid in the control switch.

TEST PROCEDURES

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Rear Window Grid Lines Test 2
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System Test 1

SYSTEM TEST

Electrically heated rear window defogger operation can be checked in-vehicle in the following manner:

(1) Turn the ignition ON.

(2) Turn rear window defogger control switch ON.

(3) Monitor vehicle voltmeter. With the control switch ON, a distinct needle deflection should be noted.

(4) The rear window defogger operation can be checked by feeling the glass. A distinct difference in temperature between the grid lines and adjacent clear glass can be detected in 3 to 4 minutes of operation.

(5) Using a DC voltmeter (Fig. 1), contact terminal "B" with the negative lead (passenger side), and terminal "A" with the positive lead (driver side). The voltmeter should read 10-14 volts.

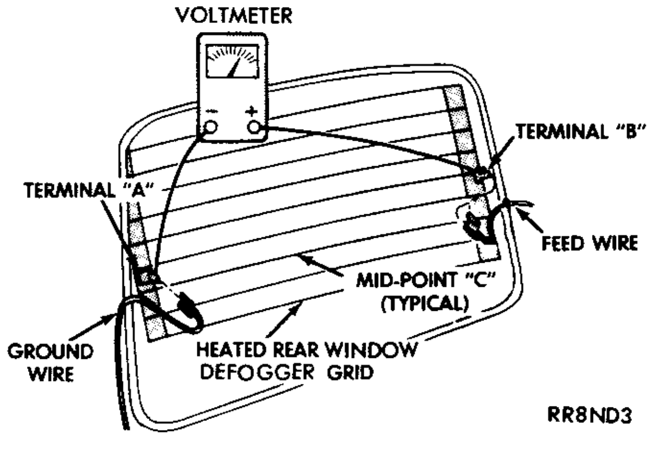

Fig. 1 Grid Line Test

Only steps (3) and (4) or (5) above will confirm system operation. Indicator light illumination means that there is power available at the output of the relay only, and does not necessarily verify system operation.

If the rear window defogger does not operate, the problem should be isolated in the following manner:

(1) Confirm that ignition switch is ON.

(2) Ensure that the heated rear window feed wire is connected to the terminal or pigtail and that the ground wire is in fact grounded.

(3) Ensure that the fuse is operational and all electrical connections are secure.

When the above steps have been completed and the system is still inoperative, one or more of the following is defective:

(a) Control switch/timer relay module.

(b) Rear window grid lines (all grid lines would have to be broken) or one of the feed wires are not connected for the system to be inoperative.

The following paragraphs outline component check-out procedures.

If turning the switch ON produces severe voltmeter deflection, the circuit should be closely checked for a shorting condition.

If system operation has been verified but indicator bulb does not light, check and replace bulb.

For detailed wiring information, refer to Group 8W - Wiring Diagrams.

REAR WINDOW GRID LINES TEST

The horizontal grid lines and vertical bus bar lines printed and baked on inside surface of rear window glass (Fig. 1) comprise an electrical parallel circuit. The electrically conductive lines are composed of a silver-ceramic material which when baked on glass becomes bonded to the glass and is highly resistant to abrasion. It is possible, however, that a break may exist or occur in an individual grid line resulting in no current flow through the line. To detect breaks in grid lines, the following procedure is required:

(1) Turn ignition on and push control switch to ON. The indicator light should come on.

(2) Using a DC voltmeter with 0-15 volt range, contact vertical bus bar connecting grid lines on passenger side of vehicle (point A of Fig. 1) with negative lead of voltmeter. With positive lead of voltmeter, contact vertical bus bar on driver side of vehicle (point B of Fig. 1). The voltmeter should read 10-14 volts.

(3) With negative lead of voltmeter, contact a good body ground point. The voltage reading should not change. A different reading indicates a poor ground connection.

(4) Connect negative lead of voltmeter to Point A on passenger side bus bar and touch each grid line at Mid-Point with positive lead. A reading of approximately 6 volts indicates a line is good. A reading of 0 volts indicates a break in line between Mid-Point C and Point B. A reading of 10-14 volts indicates a break between Mid-Point C and ground Point A. Move toward break and voltage will change as soon as break is crossed.

CONTROL SWITCH/TIMER MODULE TEST

Control switch/timer relay module may be tested in-vehicle or bench tested. In vehicle testing is accomplished in the following manner:

(1) Remove the switch from the instrument panel (refer to Control Switch Replacement) and leave the switch connector plugged in.

(2) Turn ignition ON.

(3) Using a DC voltmeter with 0-15 range, check voltage at terminals B, I and L (Figs. 2 and 3). Terminals B and I should confirm a voltage of 10 to 14 volts to ground. Terminal L should confirm 0 volts to ground. When terminals B and I show no voltage, trace circuit upstream of switch/relay module for problem (wiring cut, fusible link or circuit breaker inoperative, bulkhead connector not operative, etc.). If terminal L indicates voltage, place switch in OFF position. If voltage at L is still indicated or indicator lamp remains on, the switch/relay module should be replaced.

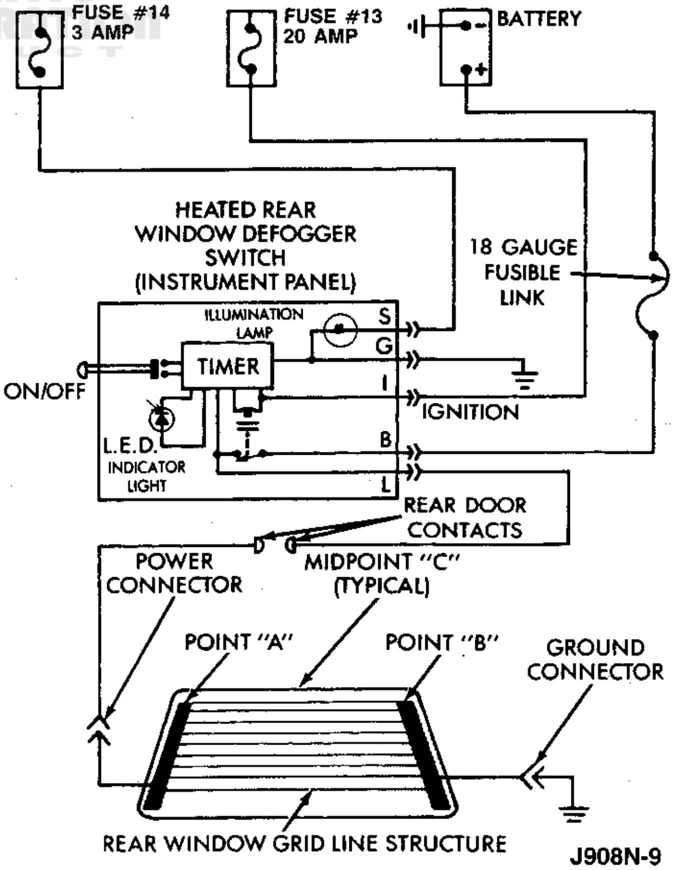

Fig. 2 Systems Electrical Circuit

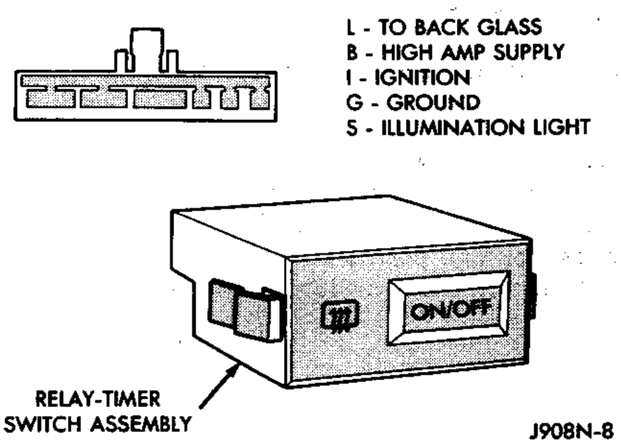

Fig. 3 Rear Window Defogger Switch, Timer, Relay Connector

(4) If the relay checks out to this point, momentarily operate switch to ON position. The indicator lamp should come on and remain on for approximately 10 minutes. Terminal L should confirm voltage. If the indicator lamp fails to light or voltage at terminal L is not confirmed the switch/relay module should be replaced.

Bench checking of the relay may be accomplished in the following manner. By following the in-vehicle procedure except Step 2: With a DC power supply, apply 12 volts to terminal B and I and ground terminal G.

REPAIR PROCEDURES (GRID LINES, TERMINALS, AND PIGTAILS)

The repair of grid lines or the terminal is possible using the MOPAR Repair Kit No. 4267922 or equivalent.

WARNING: REPAIR KIT MAY CAUSE SKIN OR EYE IRRITATION.

CONTAINS EPOXY RESIN AND AMINE TYPE HARDENER, HARMFUL IF SWALLOWED. AVOID CONTACT WITH SKIN AND EYES. FOR SKIN, WASH AFFECTED AREAS WITH SOAP AND WATER. DO NOT TAKE INTERNALLY. IF TAKEN INTERNALLY, INDUCE VOMITING; CALL A PHYSICIAN IMMEDIATELY. IF IN CONTACT WITH EYES, FLUSH WITH PLENTY OF WATER. USE WITH ADEQUATE VENTILATION. DO NOT USE NEAR FIRE OR FLAME. CONTENTS CONTAIN 3%FLAMMABLE SOLVENTS. KEEP OUT OF REACH OF CHILDREN.

(1) Mask repair area so conductive epoxy can be extended onto the line or the bus bar (Fig. 4).

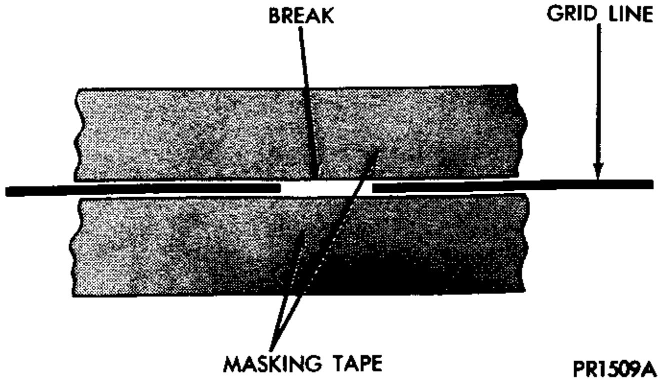

Fig. 4 Grid Line Repair (Typical)

(2) Follow instructions in repair kit for preparing damaged area.

(3) Remove package separator clamp and mix plastic conductive epoxy thoroughly. Fold in half and cut center corner to dispense epoxy.

(4) For grid line, mark off area to be repaired with masking tape or a template (Fig. 4).

(5) Apply epoxy through slit in masking tape. Overlap both ends of the break by at least 19mm (.75 in).

(6) For a terminal or pigtail replacement, mask adjacent areas so epoxy can be extended onto line as well as bus bar. Apply a thin layer of epoxy to area where terminal was fastened and to adjacent line.

(7) Apply a thin layer of conductive epoxy on terminal and place terminal on desired location. To prevent terminal from moving while the epoxy is curing, it must be wedged or clamped.

(8) Carefully remove masking tape from grid line.

CAUTION: Do not allow the glass surface to exceed 400°F, glass may fracture.

(9) Allow epoxy to cure 24 hours at room temperature or use heat gun with a 260°-371°C (500°-700°F) range for 15 minutes. Hold gun approximately 254mm (10 inches) from repaired area.

(10) After conductive epoxy is properly cured remove wedge from terminal and check out operation of rear window defogger. Do not attach connectors until curing is complete.

SERVICE PROCEDURES

HEATED REAR WINDOW CONTROL SWITCH REPLACEMENT

REMOVAL

(1) Locate chime module. Grasp chime module and twist it to remove it from the bracket.

(2) Squeeze rear window defogger switch retaining tangs and pull switch from rear of bezel.

(3) Remove connector from switch.

INSTALLATION

(1) Connect electrical connector to switch.

(2) Insert switch into bezel making sure retaining tangs lock into position.

(3) Install chime module on to bracket.

POWER LOCKS

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GENERAL INFORMATION

Both doors, when electrically equipped, can be locked or unlocked electrically by operating the switch on a door panel.

Both doors can be locked or unlocked mechanically with the locking knob regardless of electrical locking and unlocking actuation.

The right and left front door on all vehicles can be locked or unlocked mechanically from the outside with the key or electrically as described above. The left door can also be unlocked by actuation of the inside remote door handle.

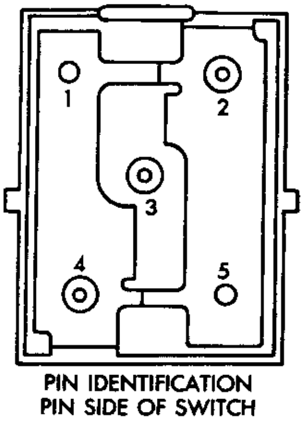
TEST PROCEDURES

CIRCUIT BREAKER TEST

Locate the circuit breaker in fuse cavity number 10 on the fuse block. Pull circuit breaker out slightly but be sure that circuit breaker terminals still contact terminals in fuse block. Connect ground wire of voltmeter to a good ground. With probe of voltmeter positive wire, check both terminals of circuit breaker for battery voltage. If only one terminal checks at battery voltage, circuit breaker is defective and must be replaced. If neither terminal shows battery voltage, check for open or shorted circuit to circuit breaker.

SWITCH TEST

For switch testing, remove the switch from its mounting location. Using an ohmmeter, refer to (Fig. 1) to determine if continuity is correct in the Lock and Unlock switch positions. If these results are not obtained, replace the switch.



SWITCH POSITION	CONTINUITY BETWEEN
OFF	PINS 1 & 4 PINS 2 & 5
LOCK	PINS 2 & 3 PINS 1 & 4
UNLOCK	PINS 3 & 4 PINS 2 & 5

898P-5

Fig. 1 Door Lock Switch Continuity

VOLTAGE TEST

The following wiring test sequence determines whether or not voltage is continuous through the body harness to switch.

After removing switch from trim panel for testing purposes, carefully separate multiple terminal block on wiring harness from switch body. Connect one lead of test light to black wire terminal and touch other test light lead to red wire terminal. If the test light comes on, the wiring circuit between the battery and switch is functional. If light does not come on, check 30 amp circuit breaker or for a broken wire.

ELECTRIC MOTOR TEST

Make certain battery is in normal condition before circuits are tested.

To determine which motor is defective, check each individual door for electrical lock and unlock or disconnect the motor connections one at a time, while operating door lock switch. In the event that none of the motors work, the problem may be caused by a shorted motor. Disconnecting the defective motor will allow the other to work.

Should the motor defect be a result of a broken pigtail wire, it should have no effect on the operation of other motors.

SERVICE PROCEDURES

DOOR LOCK MOTOR REPLACEMENT

REMOVAL

(1) Remove remote control handle (Fig. 2).

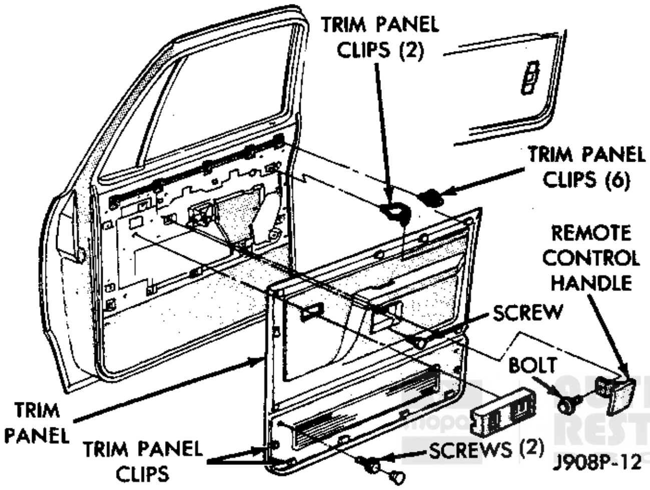


Fig. 2 Door Trim Panel

(2) Remove power window/lock switch by inserting a standard blade screwdriver into notch on forward end of switch housing and push to depress locking tab. Pull out and forward to remove switch bezel from door panel.

(3) Remove 2 screws at bottom front and rear of trim panel.

(4) Remove screw behind remote handle.

(5) Using a device such as a trim stick, pry trim panel away from door around perimeter.

(6) Roll door watershield away from lower rear corner of door to reveal inside panel access opening.

(7) Remove motor link at motor (Fig. 3).

(8) Disconnect motor lead wires.

(9) Remove 2 motor mounting bracket screws and remove motor assembly from mounting.

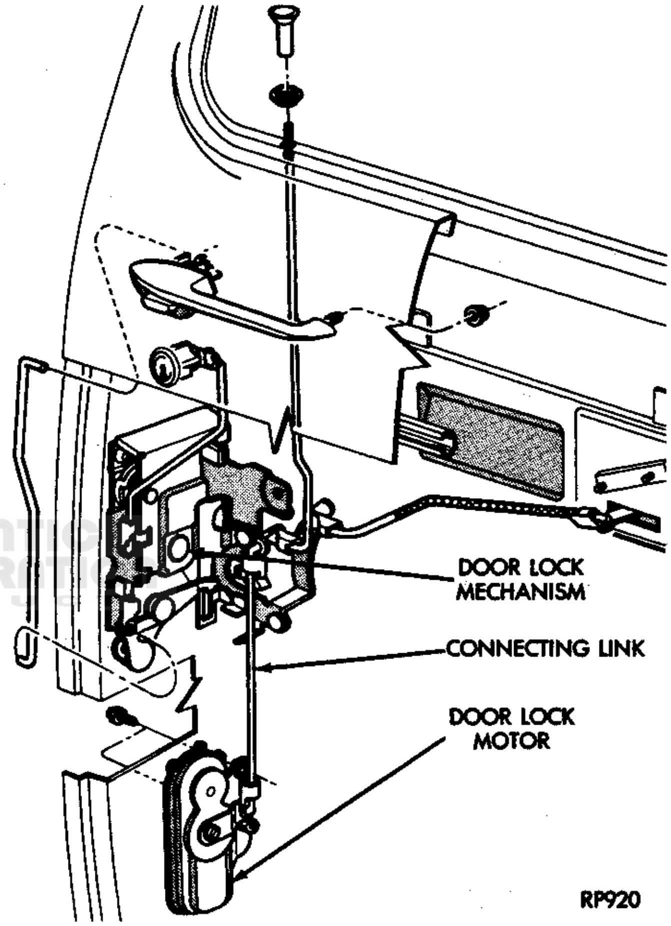


Fig. 3 Door Lock Motor Replacement

INSTALLATION

(1) Attach motor mounting bracket to door inside panel and install 2 screws.

(2) Connect link to motor rod and connect wires.

(3) Reset watershield at lower rear corner of door.

(4) Install door trim panel.

(5) Install door panel attaching screws.

(6) Install remote control handle.

(7) Install power window/lock switch.

POWER WINDOWS

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GENERAL INFORMATION

Power window motors are of the permanent magnet type. A positive and negative battery connection to either of the two motor terminals will cause the motor to rotate in one direction. Reversing current through these same two connections will cause the motor to rotate in the opposite direction.

Both motors are grounded through the master switch by a black wire attached to the ground stud which is located on the back of the instrument panel, on the right side of the steering column.

It is necessary that the window be free to slide up and down in the glass channels or tubes and tracks. If the window is not free to move up and down, the window motor will not be able to move the glass.

The most positive way to determine if the glass is free is to disconnect the electric window regulator lift arm sliders from the glass lift channels and then slide the window up and down by hand.

A less positive method is to shake the glass in the door, (with glass positioned between the up and down stop positions). If the glass will move slightly from side to side, front to rear, and up and down, then there is a good chance that the window is not bound tight in the tracks.

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SWITCH VOLTAGE TEST

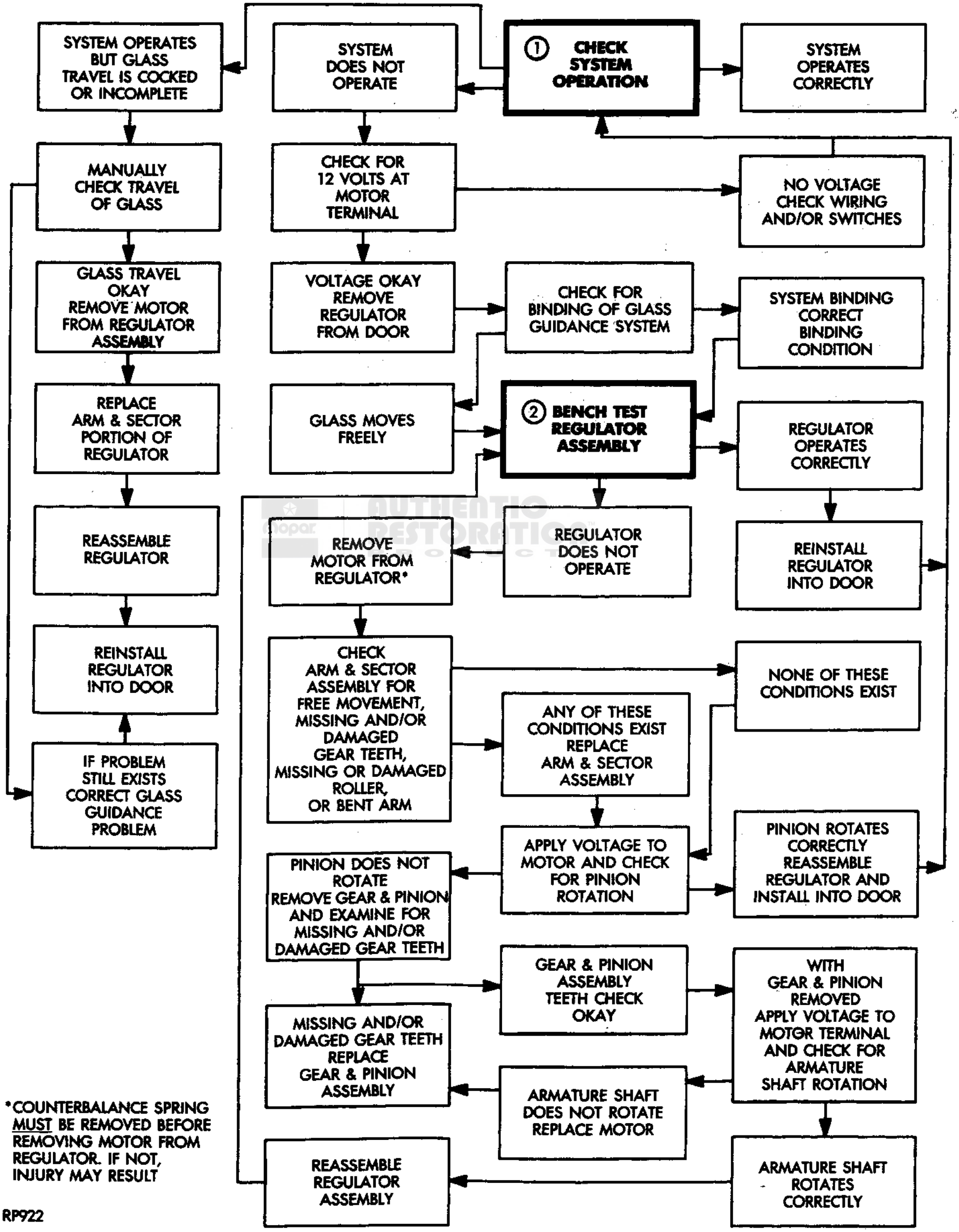
The following wiring test sequence determines whether or not voltage is continuous through the body harness to switch.

After removing left door switch from trim panel for testing purposes, carefully separate multiple terminal block on wiring harness from switch body. Connect one lead of test light to black (BK) wire terminal and touch other test light lead to tan (TN) wire terminal. If the test light comes on, the wiring circuit between the battery and switch is functional. If light does not come on, check 30 amp circuit breaker, or for a broken wire or poor ground.

CIRCUIT BREAKER TEST

Locate the circuit breaker in fuse cavity number 2 on fuse block. Pull out slightly but be sure that circuit breaker terminals still contact terminals in fuse block. Connect ground wire of voltmeter to a good ground. With probe of voltmeter positive wire, check both terminals of circuit breaker for battery voltage. If only one terminal checks at battery voltage, circuit breaker is defective and must be replaced. If neither terminal shows battery voltage, check for open or shorted circuit to circuit breaker.

POWER WINDOW SYSTEM DIAGNOSIS

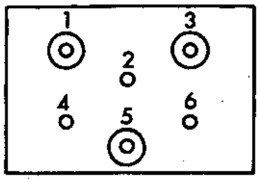


*COUNTERBALANCE SPRING MUST BE REMOVED BEFORE REMOVING MOTOR FROM REGULATOR. IF NOT, INJURY MAY RESULT

RP922

SWITCH TEST

For switch testing, remove the switch from its mounting location. Using an ohmmeter, refer to (Figs. 1 and 2) to determine if continuity is correct in the UP and DOWN switch positions. If continuity is correct perform window lift motor test.



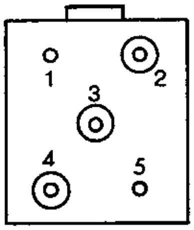
PIN IDENTIFICATION SHOWN FROM PIN SIDE OF SWITCH

MASTER WINDOW LIFT SWITCH

SWITCH POSITION		CONTINUITY BETWEEN
OFF		PINS 1 & 2 PINS 2 & 3 PINS 2 & 4 PINS 2 & 6
UP	DRIVER'S	PINS 3 & 5 PINS 2 & 6
	PASSENGER'S	PINS 1 & 5 PINS 2 & 4
DOWN	DRIVER'S	PINS 5 & 6 PINS 2 & 3
	PASSENGER'S	PINS 1 & 2 PINS 4 & 5

898S-11

Fig. 1 Master Window Lift Switch Continuity



PIN IDENTIFICATION SHOWN FROM PIN SIDE OF SWITCH

SWITCH POSITION	CONTINUITY BETWEEN
OFF	PINS 1 & 4 PINS 2 & 5
UP	PINS 3 & 4 PINS 2 & 5
DOWN	PINS 2 & 3 PINS 1 & 4

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Fig. 2 Passenger's Door Mounted Switch Continuity

WINDOW MOTOR TEST

(1) Connect positive lead (from a test battery) to either of the two motor terminals.

(2) Connect negative lead (from test battery) to remaining motor terminal.

(3) The motor should now rotate in one direction to either move window up or down.

(a) If window happens to already be in full UP position and motor is connected so as to rotate in UP direction no movement will be observed.

(b) Likewise, motor connected to DOWN direction rotation, no movement will be observed if window is already in full down position.

(4) Reverse battery leads (opposite to steps 1 and 2) and window should now move. If window does not move, remove motor. Refer to Service Procedures for motor removal from vehicle for bench test.

If window moved completely up or down, motor should be reversed one more time (reverse leads from step 4) to complete a full window travel inspection.

SERVICE PROCEDURES

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Gear And Pinion Replacement And Lubrication 4
Page
Regulator And Motor Assembly 4

GEAR AND PINION REPLACEMENT AND LUBRICATION

When gear and pinion assembly is replaced in gear box, lubrication of gear box, gear pinion and seal is necessary if these parts have been disassembled.

In the event there is no lubricant in gear box, fill with MOPAR, multi-mileage lubricant or equivalent. Apply a liberal amount of lubricant to inside area of seal and sealing surface at center area of gear and pinion coupling. Also lubricate center housing shaft and worm gear.

REGULATOR AND MOTOR ASSEMBLY

REMOVAL

To repair or inspect the entire electric window regulator, remove from door as follows:

(1) Remove remote control handle (Fig. 3).

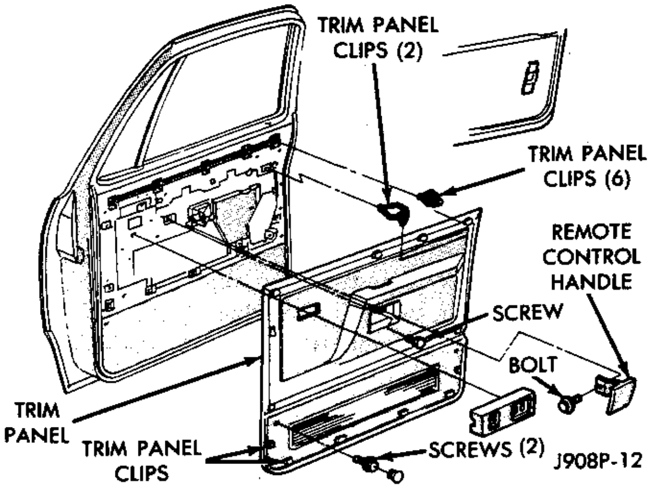

Fig. 3 Door Trim Panel

(2) Remove power window/lock switch by inserting a standard blade screwdriver into notch on forward end of switch housing and push to depress locking tab. Pull out and forward to remove switch bezel from door panel.

(3) Remove screws at bottom front and rear of trim panel.

(4) Remove screw behind remote handle.

(5) Using a device such as a trim stick, pry trim panel away from door around perimeter and remove trim panel.

(6) Roll door watershield away from bottom of door to reveal inside panel access opening.

(7) Disconnect wiring connectors from motor and if equipped, the speaker.

(8) Remove speaker if equipped.

(9) Connect switch and lower glass to full down position.

(10) Remove inner weatherstrip being careful not to scratch the beltline paint.

(11) Free the clip on the inner section of the weatherstrip with a wire hook or suitable tool.

(12) Pull back upper glass run 8 to 20-25 cm (10 inches).

(13) Remove upper and lower vent wing attaching screws.

(14) Remove vent wing, being careful to avoid paint damage from glass lower pivot adjusting screws.

(15) Remove down stop bumper bracket (Fig. 4).

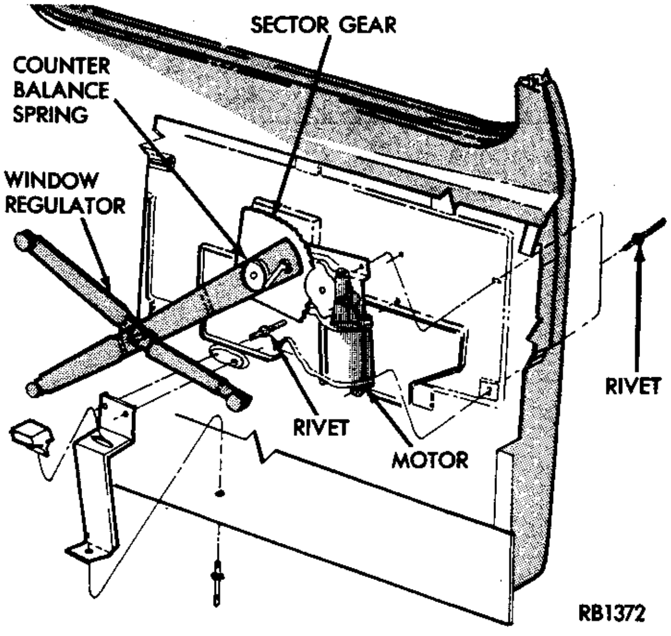

Fig. 4 Electric Window Regulator Mounting

(16) Disengage glass from regulator arms and lower to door bottom.

(17) Drill out regulator mounting rivets.

(18) Remove regulator through large access hole.

BENCH REPAIR

If entire regulator is not being replaced, repair as follows:

(1) Remove regulator as previously described.

STEPS (2) AND (3) ARE VERY IMPORTANT. IF NOT DONE BEFORE MOTOR REMOVAL INJURY MAY RESULT.

(2) Secure regulator in vise to prevent sector gear from rotating.

(3) Remove counter balance spring. (Must be done for safety before removing motor).

(4) Remove 3 motor attaching screws and remove motor.

(5) Inspect regulator for:

- (a) Sector gear teeth must not be broken or severely worn.
- (b) All rivets and sliders must be securely attached.
- (c) Parts must not be bent or cracked.
- (d) Sector gear must rotate freely.
- (e) Perform window lift motor test as described above.

(6) Install motor and attach with three motor attaching screws.

(7) Install counter balance spring.

INSTALLATION

(1) Insert upper regulator arm into door mounted channel.

(2) Mount regulator to door panel with 1/4-20 screws and nuts torqued to 10 N•m (90 in. lbs.).

(3) Slide glass onto regulator arms and into rear glass run.

(4) Connect motor electrical connector.

(5) Install plastic nut and "U" nut on vent wing assembly.

(6) Install vent wing assembly into door.

(7) Install upper and lower vent wing attachment screws.

(8) Move glass run back to vent wing by placing run adjacent to door channel and press into channel using wide blade screwdriver or similar tool. Press in both inside corners to ensure hidden lip engages in channel.

(9) Install belt weatherstrip by aligning clips to holes in door and press in.

(10) Raise or lower vent to maintain a 1.6mm (.06 in.) fore-aft glass freeplay then with glass up, tighten upper screws.

(11) Hold vent against glass (glass down) and tighten lower screws.

(12) Raise glass to full up position.

(13) Install speaker if equipped.

(14) Install down stop bumper.

(15) Install watershield and trim panel.

POWER MIRRORS

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SERVICE PROCEDURES	2	**TEST PROCEDURES**	1

GENERAL INFORMATION

Electrically-operated remote control mirrors are available as an option on D-body vehicles. The mirrors are controlled by a single switch assembly located on the instrument panel to the right of the headlamp switch (Fig. 1).

D-body vehicles use a toggle-type switch which is rotated clockwise (Right mirror) or counterclockwise (Left mirror) for mirror selection, and moved UP, DOWN, RIGHT, or LEFT for mirror movement direction.

The motors which operate the mirrors are part of the mirror assembly and cannot be serviced separately.

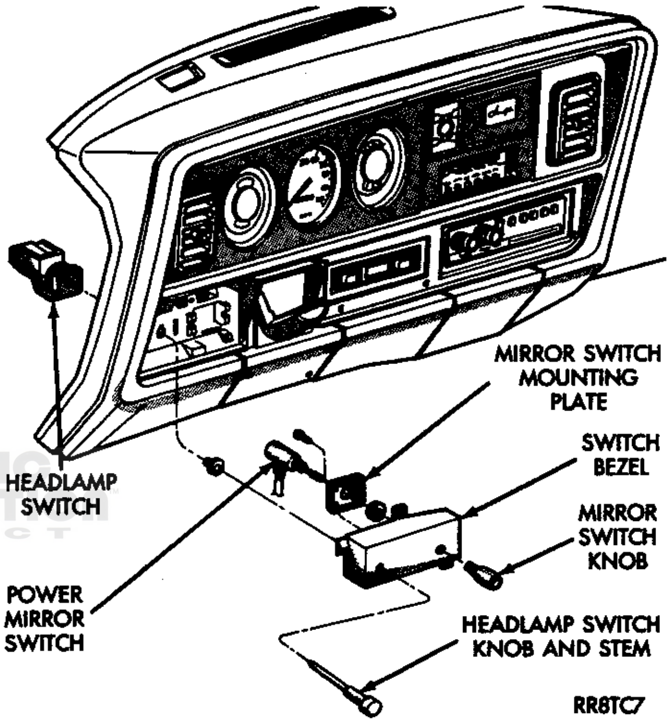

Fig. 1 Power Mirror and Headlamp Switches

TEST PROCEDURES

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Mirror Motor Test Procedure	1	Mirror Switch Test Procedure	2

MIRROR MOTOR TEST PROCEDURE

(1) Remove power mirror switch from mounting position (refer to Service Procedures).

(2) Disconnect wiring harness at switch connector.

(3) Using 2 jumper wires, one connected to a 12-volt source, and the other connected to a good body ground, refer to the MIRROR TEST CHART for wire hookups at the switch connector (harness side, not switch side).

(4) If results shown in chart are not obtained, check for broken or shorted circuit, or replace mirror assembly as necessary.

MIRROR TEST CHART

		MIRROR REACTION	
12 Volts	**Ground**	**Right**	**Left**
YL/BK	WT/BK	UP	
YL	WT		UP
WT/BK	YL/BK	DOWN	
WT	YL		DOWN
WT/BK	DB/WT	RIGHT	
WT	DB		RIGHT
DB/WT	WT/BK	LEFT	
DB	WT		LEFT

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MIRROR SWITCH TEST PROCEDURE

(1) Remove power mirror switch from mounting position (refer to Service Procedures).

(2) Disconnect wiring harness at switch connector.

(3) Using a continuity tester or ohmmeter, test for continuity (no resistance) between the terminals of the switch as shown in the MIRROR SWITCH CONTINUITY CHART.

(4) If results shown in the chart are not obtained, replace the switch.

MIRROR SWITCH CONTINUITY CHART	
Mirror Selector Knob In "L" Position	
MOVE LEVER	CONTINUITY BETWEEN
▲	WT and BK YL and PK and YL/BK and PK
▶	WT and PK, DB/WT and BK and DB & BK
▼	YL/BK and BK, YL and BK DB and PK
◀	WT and BK, DB/WT and PK DB and PK
Mirror Selector Knob In "R" Position	
MOVE LEVER	CONTINUITY BETWEEN
▲	WT/BK and BK, YL and PK YL/BK and PK
▶	WT/BK and PK, DB and BK DB/WT and BK
▼	WT/BK and PK, YL and BK YL/BK and BK
◀	WT/BK and BK, DB and PK DB/WT and PK

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SERVICE PROCEDURES

MIRROR SWITCH REPLACEMENT

REMOVAL

(1) Remove 2 screws holding map lamp and remove map lamp.

(2) Remove 6 screws which attach instrument cluster bezel to instrument panel (Fig. 2). Make sure the screw below the Heater\A/C control is removed.

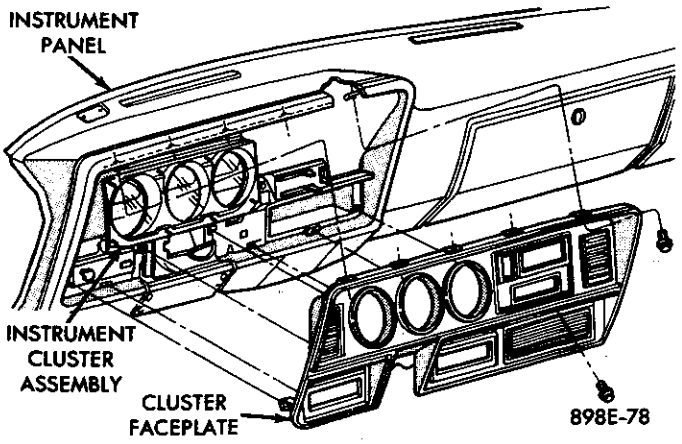

Fig. 2 Instrument Cluster Bezel

(3) Place column shift lever in Position 1.

(4) Remove bezel by pulling top edge rearward to clear brow. Disengage attaching clips around bottom of bezel and complete removal of bezel.

(5) If the bezel has a four wheel drive indicator, remove bulb socket as bezel is removed.

(6) Disconnect message center wires.

(7) Remove instrument cluster bezel assembly.

(8) Remove headlamp switch knob and stem by reaching under instrument panel and depressing button on side of switch while pulling stem out.

(9) Remove switch bezel retaining screws and pull bezel out of instrument panel (Fig. 1).

(10) Pull harness out through opening in instrument panel and disconnect mirror switch connector.

(11) Remove 2 switch mounting-plate-to-bezel retaining screws.

(12) Remove switch-to-mounting-plate nut.

For Installation, reverse removal procedures.

MIRROR ASSEMBLY REPLACEMENT

REMOVAL

(1) Remove remote control handle (Fig. 3).

(2) Remove power window/lock switch by inserting a standard blade screwdriver into notch on forward

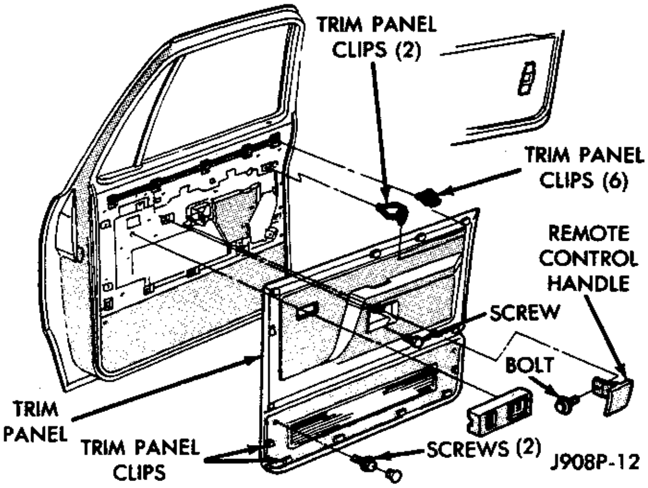

Fig. 3 Door Trim Panel

end of switch housing and push to depress locking tab. Pull out and forward to remove switch bezel from door panel.

(3) Remove 2 screws at bottom front and rear of trim panel.

(4) Remove screw behind remote handle.

(5) Using a device such as a trim stick, pry trim panel away from door around perimeter.

(6) Roll door watershield away from lower rear corner of door to reveal inside panel access opening.

(7) Reach inside door and disconnect mirror wiring at connector.

Spray grommet on mounting bracket cover with silicone to avoid grommet coming off when cover is moved up on mirror stem.

(8) Remove mirror mounting bracket cover (1 screw) and slide up on mirror stem (Fig. 4).

(9) Remove 3 mirror mounting bracket nuts.

(10) Pull mirror loose from door, and feed wiring harness out through hole in outer door panel.

For Installation, reverse Removal procedure.

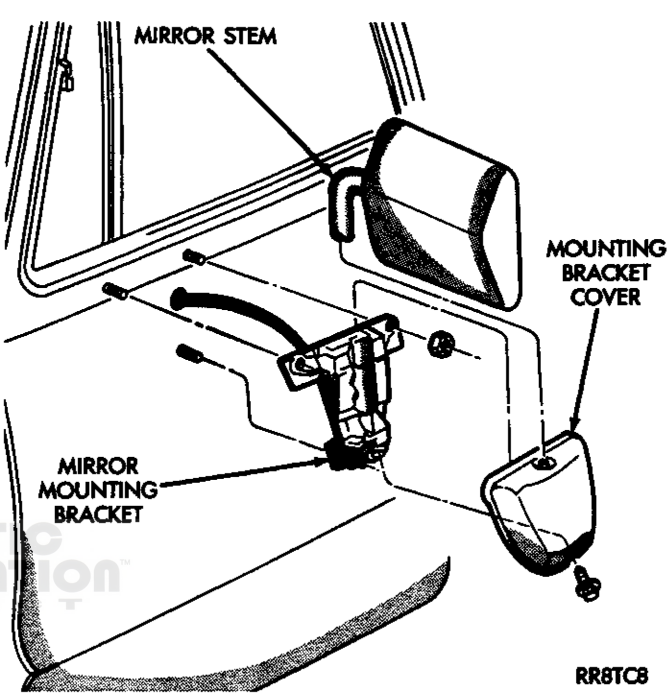

Fig. 4 Power Mirror Replacement

ELECTRICAL WIRING DIAGRAMS

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- Fusible Link Chart 3
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Locating a System or Component 3
Main Circuit Identification Codes 2
Splice Locations 3
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WIRING DIAGRAMS

GENERAL INFORMATION

Master wiring diagrams contain the latest information available at time of publication. These diagrams contain various wires, wire routing, wire color codes, switches components, fuses, splices, connectors, connector cavities and other information except distributor secondary wiring. This is shown in (Figs. 1 and 2).

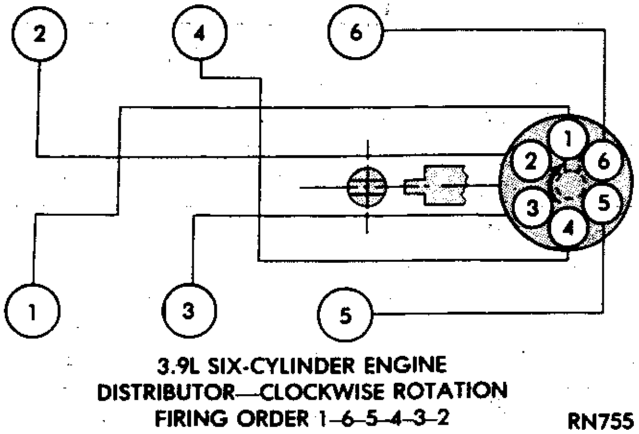

Fig. 1—Distributor Secondary Wiring 6-Cylinder 3.9L Engine

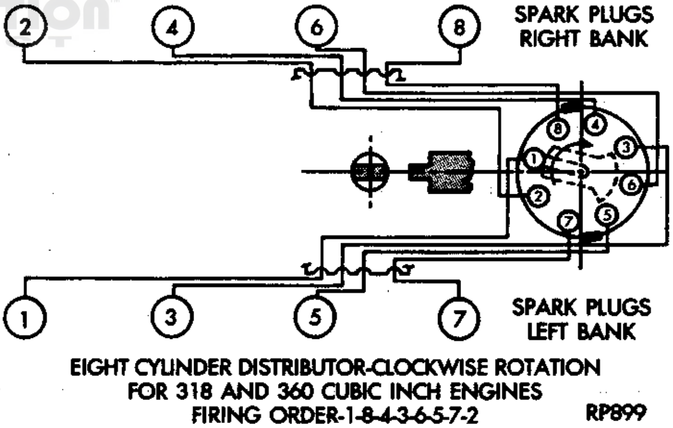

Fig. 2—Distributor Secondary Wiring 8-Cylinder 5.2L and 5.9L Engine

MAIN CIRCUIT IDENTIFICATION CODES

A1	Battery Positive Circuit.
A9	Battery Negative Circuit.
B	Back Up Lamp Circuit.
C	Air Conditioning and Heater Circuits, Heated Rear Window.
D	Emergency, Stop Lamp and Turn Signal Circuits, Diagnostic Connector.
E	Instrument Panel Cluster, Switches and Illumination Circuits.
G	Gauges, Warning Lamp Circuits.
H	Horn Circuit.
J1	Ignition Switch Feed Circuit.
J2	Ignition System Run Circuit.
J3	Starter Relay to Ballast Resistor.
J10	Ignition Switch Accessory Feed.
K	Single Board Engine Controller.
L	Lighting Circuit Feed (Exterior Lamps).
M1	Lighting Circuit Feed (Interior Lamps).
M2	Lighting Circuit Ground (Interior Lamps).
P	Brake Checking Circuit.
Q2	Accessory Buss Bar Feed (Fuse Block).
Q3	Battery Buss Bar Feed (Feed).
R3	Alternator Circuit to Electronic Regulator (Field).
R6	Alternator Circuit Feed.
S	Starter Motor and Starter Relay Circuit.
T	Tachometer.
V	Windshield Wiper and Washer Circuit.
W	Power Window Circuit, Power Lock Circuit.
X	Grounds For Radio Speakers, Cigar Lighter, Lamps, Clock, Speed Control, Power Antenna, Power Amplifier, Power Windows, Power Mirrors, Door Locks.
Y	Injectors.
Z	Fuel Injection System Grounds.

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Each wire shown in the diagrams contains a code (Fig. 3) which identifies the wires circuit, gage, and color. The color is shown as a two letter code which can be identified by referring to the Wire Color Code Chart. If the wire has a tracer and its a standard color an asterisk will follow the main wire color, if the tracer color is non-standard the main wire code will have a slash (/) after it followed by the tracer color.

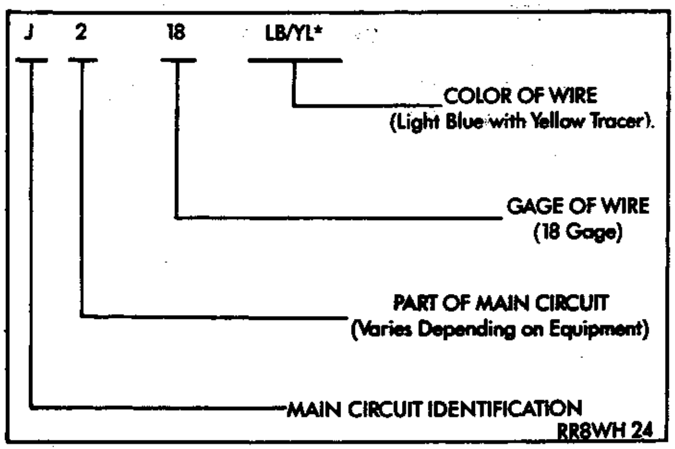

Fig. 3—Wire Color Code Identification

To identify which main circuit code applies to a system, refer to the Main Circuit Identification Code Chart.

WIRE COLOR CODE CHART

COLOR CODE	COLOR	STANDARD TRACER COLOR	COLOR CODE	COLOR	STANDARD TRACER CODE
BK	BLACK	WT	PK	PINK	BK OR WH
BR	BROWN	WT	RD	RED	WT
DB	DARK BLUE	WT	TN	TAN	WT
DG	DARK GREEN	WT	VT	VIOLET	WT
GY	GRAY	BK	WT	WHITE	BK
LB	LIGHT BLUE	BK	YL	YELLOW	BK
LG	LIGHT GREEN	BK	*	WITH TRACER	
OR	ORANGE	BK			

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Wiring harnesses that have substitute wires of a different color then called out on wiring diagrams should have an identifying tape with specified wire color code (Fig. 4).

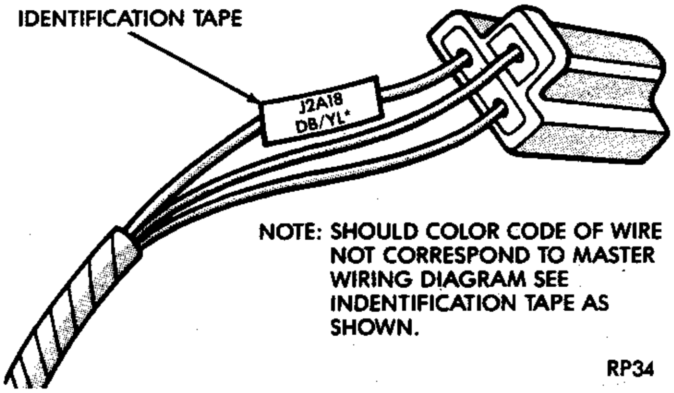

Fig. 4—Identification of Substitute Wiring Codes

LOCATING A SYSTEM OR COMPONENT

In order to locate a system or component use alphabetical index to determine **diagram sheet number** and turn to that sheet for wiring diagram.

Sheet numbers for each wiring diagram are located at lower right or left hand corner of each sheet. **Page numbers at top of page do not apply to diagram sheets.**

SPLICE LOCATIONS

Splice locations are indicated on master wiring diagrams by a diamond with splice circuit code within it (Fig. 5). If there is more than one splice per circuit splice code a small box will be connected to the diamond with the splice number in it (example 2) (Fig. 5).

Fig. 5—Wiring Splice Examples

In order to locate a particular splice determine splice number from the wiring diagram. Refer to pictorial splice index to find figure number then turn to that figure to determine splice location within a wiring harness (Fig. 6).

All connectors are viewed from terminal end unless otherwise specified.

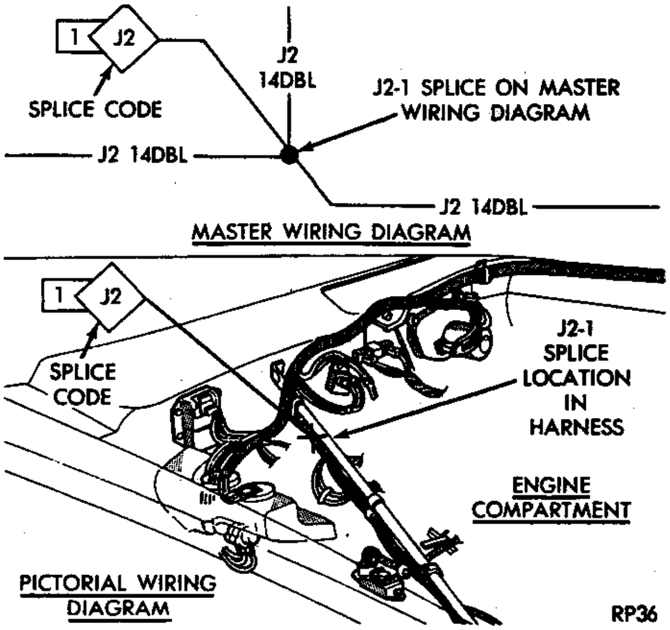

Fig. 6—Locating a Wiring Harness Splice

FUSIBLE LINKS

Vehicle wiring harnesses are equipped with fusible links to protect against harness damage in event of a short in electrical system.

Fusible links are color coded as to wire gauge size. See fusible link chart.

FUSIBLE LINK CHART		
Wire and Gauge	**Color Code**	**Color**
12 Ga.	BK	Black
14 Ga.	RD	Red
16 Ga.	DB	Dark Blue
18 Ga.	GY	Gray
20 Ga.	OR	Orange
22 Ga.	WT	White

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FUSIBLE LINK REPLACEMENT

CAUTION: Do not replace blown fusible links with standard wire. Only fusible type wire with hypalon insulation can be used or damage to the electrical system will occur. Also make sure correct gauge of wiring is used. Refer to Master Wiring Diagrams for proper gauge size.

(1) When a fusible link blows it is very important to find out why it blew. They are placed in vehicle electrical systems for protection against dead shorts to ground which can be caused by electrical component failure or various wiring failures. **Do not just replace fusible link to correct problem.**

(2) When replacing fusible links that are connected

to the battery terminal of starter relay, they are to be serviced with the same type of pre-fabricated fusible link.

All other fusible links are replaced with a piece of fusible link wire cut from bulk reels. Care must be taken that the same gauge and color wire as the original fusible link be used (see Fusible Link Chart).

Multiple Fusible Link Replacement

(1) Disconnect negative battery cable.

(2) Cut off any remaining portion of blown fusible link flush with multiple connection insulator, taking care not to cut into other fusible links.

(3) Remove 1 inch of insulation from main harness wire about 1 inch from multiple connection insulator.

(4) Remove 1 inch of insulation from one end of new fusible link and wrap it around main harness wire that was stripped.

(5) Heat splice with a high temperature soldering gun, apply rosin type solder until it flows freely, and remove soldering gun. **Do not use acid core solder** (Fig. 7).

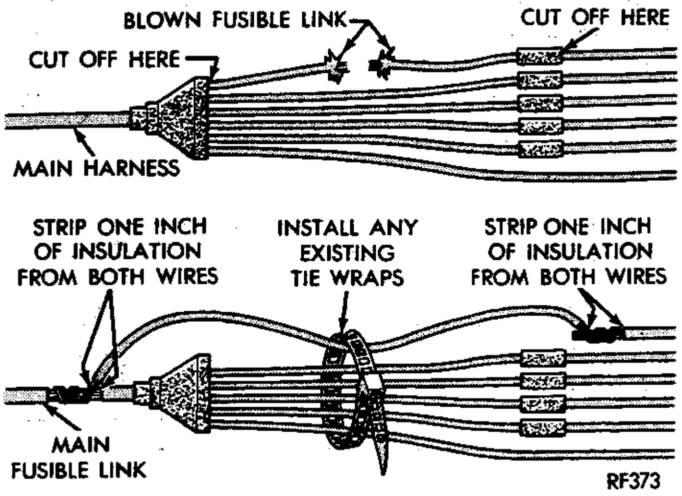


Fig. 7—Fusible Link Repair

(6) Allow to cool and wrap new splice with a minimum of 3 layers of suitable electrical tape.

Single Fusible Link Replacement

(1) Disconnect negative battery cable.

(2) Cut fusible link including connection insulator from main harness wire.

(3) Remove 1 inch of insulation from both new fusible link and main harness wire and wrap together.

(4) Heat splice with a high temperature soldering gun, apply rosin type solder until it flows freely and remove soldering gun. **Do not use acid core solder** (Fig. 7).

(5) Allow to cool and wrap new splice with a minimum of 3 layers of suitable electrical tape.

SYMBOLS, FUSES AND CONNECTORS

Various symbols are used on wiring diagrams. These symbols can be identified by referring to symbol identification (Fig. 8)

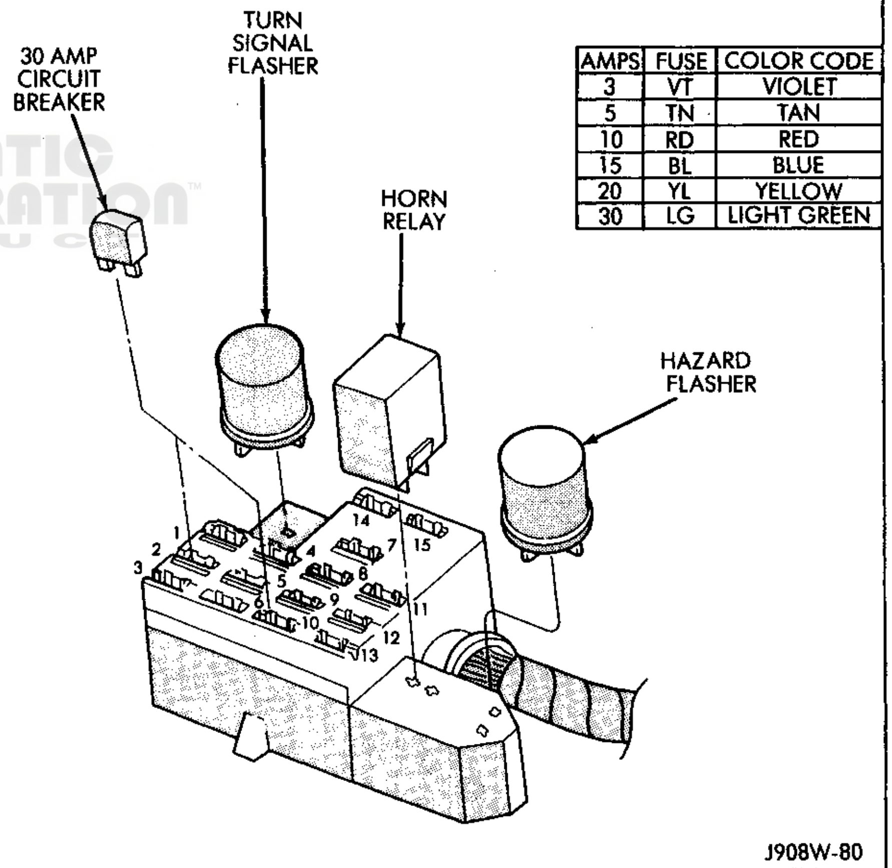
For fuse identification refer to the fuse chart.

CAUTION: When replacing a blown fuse, it is important to replace it with a fuse having the correct amperage rating. The use of a fuse with a rating other than indicated may result in a dangerous electrical overload. If a proper rated fuse continues to blow, it indicates a problem that should be corrected.

	LEGEND OF SYMBOLS USED ON WIRING DIAGRAMS		
+	POSITIVE		CONNECTOR
−	NEGATIVE		MALE CONNECTOR
	GROUND		FEMALE CONNECTOR
	FUSE		DENOTES WIRE CONTINUES ELSEWHERE
	GANG FUSES WITH BUSS BAR		DENOTES WIRE GOES TO ONE OF TWO CIRCUITS
	CIRCUIT BREAKER		SPLICE
	CAPACITOR	J2 2	SPLICE IDENTIFICATION
Ω	OHMS		THERMAL ELEMENT
	RESISTOR	TIMER	TIMER
	VARIABLE RESISTOR		MULTIPLE CONNECTOR
	SERIES RESISTOR		OPTIONAL WIRING WITH WIRING WITHOUT
	COIL		"Y" WINDINGS
	STEP UP COIL	88:88	DIGITAL READOUT
	OPEN CONTACT		SINGLE FILAMENT LAMP
	CLOSED CONTACT		DUAL FILAMENT LAMP
	CLOSED SWITCH		L.E.D. — LIGHT EMITTING DIODE
	OPEN SWITCH		THERMISTOR
	CLOSED GANGED SWITCH		GAUGE
	OPEN GANGED SWITCH		SENSOR
	TWO POLE SINGLE THROW SWITCH		FUEL INJECTOR
	PRESSURE SWITCH	#36	DENOTES WIRE GOES THROUGH BULKHEAD DISCONNECT
	SOLENOID SWITCH	#19 STRG COLUMN	DENOTES WIRE GOES THROUGH STEERING COLUMN CONNECTOR
	MERCURY SWITCH	INST PANEL #14	DENOTES WIRE GOES THROUGH INSTRUMENT PANEL CONNECTOR
	DIODE OR RECTIFIER	ENG #7	DENOTES WIRE GOES THROUGH GROMMET TO ENGINE COMPARTMENT
	BY-DIRECTIONAL ZENER DIODE		DENOTES WIRE GOES THROUGH GROMMET
	MOTOR		HEATED GRID ELEMENTS
	ARMATURE AND BRUSHES		908W-191

Fig. 8—Symbol Identification

CAVITY	FUSE/ COLOR	ITEMS FUSED
1	30 AMP LG	A/C AND HEATER BLOWER MOTOR
2	30 AMP C/BRKR	POWER WINDOWS
3	20 AMP YL	HAZARD FLASHERS
4	10 AMP RD	RADIO AND CLOCK
5	20 AMP YL	TURN SIGNALS, TRANSMISSION OIL TEMPERATURE LAMP, SNOWPLOW CONTROLS, R.W.A.L. MODULE
6	20 AMP YL	WINDSHIELD WIPERS, DIESEL A/C CLUTCH
7	15 AMP BL	HORNS, HORN RELAY
8	20 AMP YL	TAIL, PARKING, SIDEMARKER, LICENSE AND CLEARANCE LAMPS
9	20 AMP YL	STOP LAMPS, KEY-IN-BUZZER
10	30 AMP C/BRKR	POWER DOOR LOCKS
11	10 AMP RD	RADIO AND CLOCK MEMORY, POWER MIRRORS, GLOVE BOX, DOME, READING, MAP AND CARGO LAMPS, UNDERHOOD LAMPS
12	5 AMP TN	GAUGES, BRAKE WARNING LAMP, SEAT BELT WARNING LAMP AND BUZZER, LOW OIL- CHECK ENGINE-EMR-ANTI-LOCK-TAILGATE-AND 4WD LAMPS, SPEED CONTROL, LOW FUEL LAMP, WAIT TO START LAMP, WATER IN FUEL LAMP
13	20 AMP YL	BACK-UP LAMPS, HEATED REAR WINDOW SWITCH AND TIMER
14	3 AMP VT	INSTRUMENT PANEL LAMP, A/C HEATER CONTROL LAMPS, ASH TRAY LAMP, SNOW PLOW CONTROL LAMP, RADIO LAMPS, O/D SWITCH LAMP
15	15 AMP BL	CIGAR LIGHTER



AMPS	FUSE	COLOR CODE
3	VT	VIOLET
5	TN	TAN
10	RD	RED
15	BL	BLUE
20	YL	YELLOW
30	LG	LIGHT GREEN

Fig. 9—Fuse Block

COMPONENT IDENTIFICATION

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A/C and Heater Wiring	14
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Clearance Lamp Wiring with Dual Rear Wheels	3
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Door Wiring	9
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Tail Lamp Wiring	1
Tailgate Wiring	4
Transmission Wiring	21
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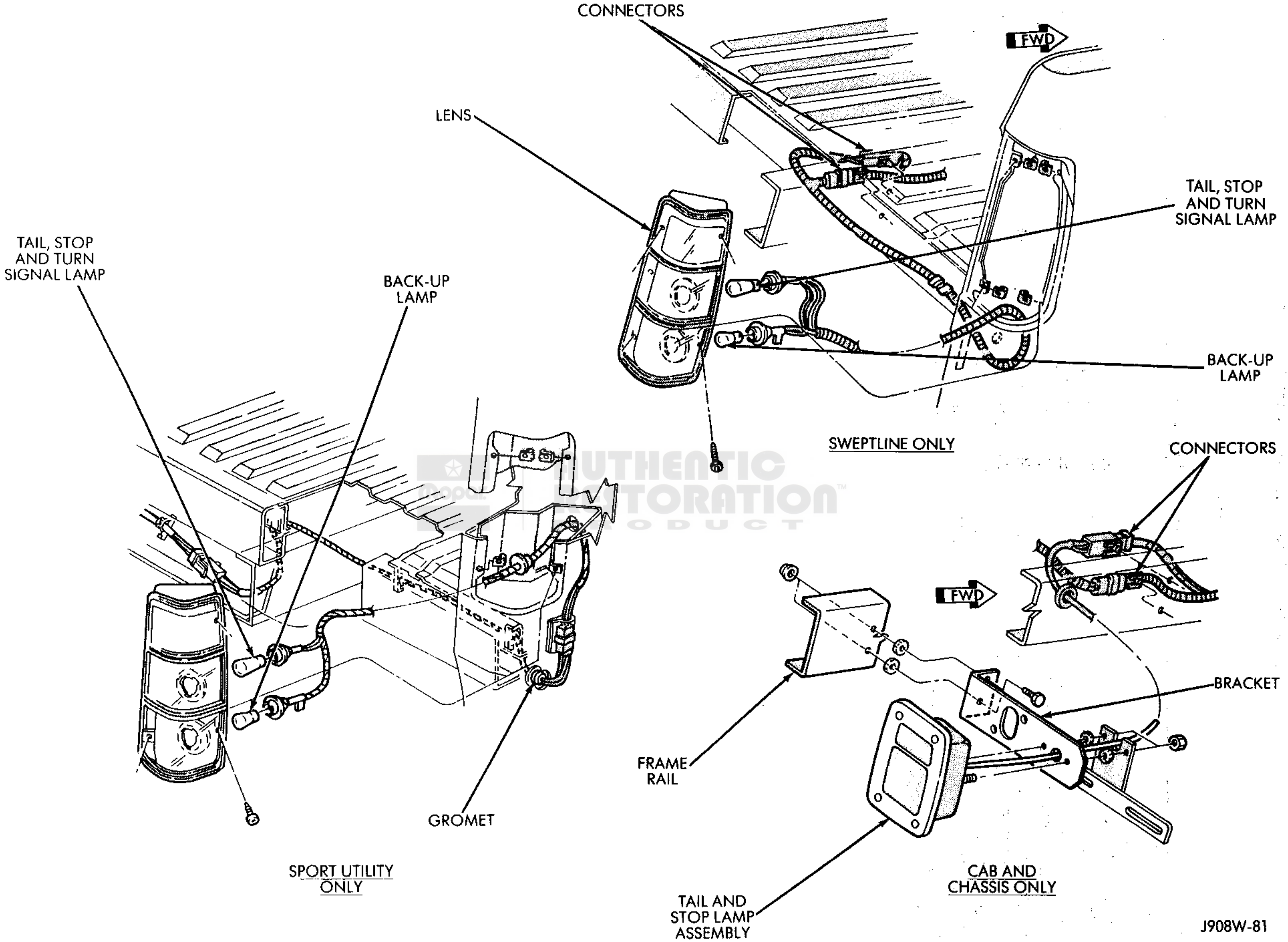
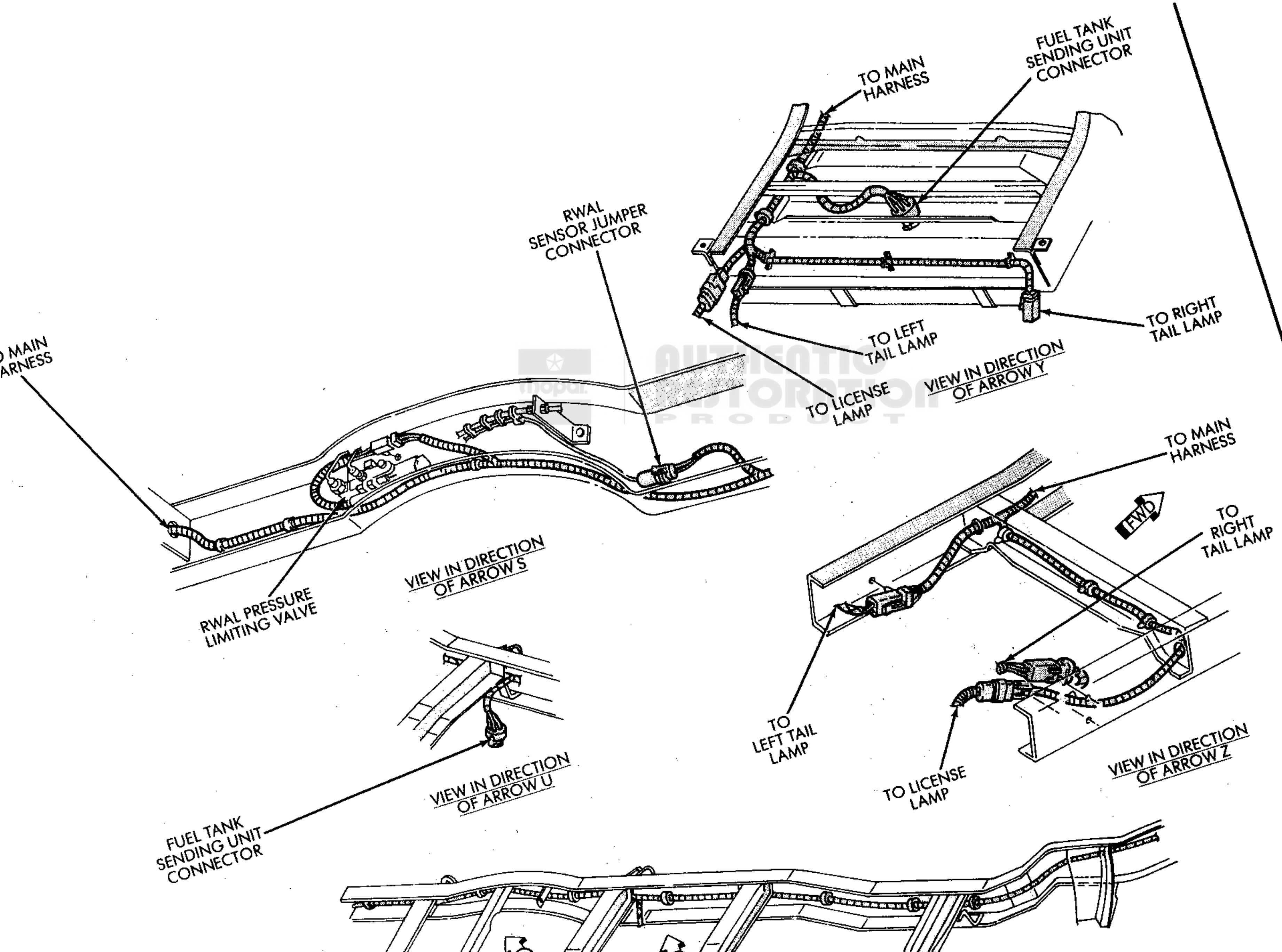


Fig. 1—Tail Lamp Wiring


TO MAIN
HARNESS
FUEL TANK
SENDING UNIT
CONNECTOR
TO RIGHT
TAIL LAMP
TO LEFT
TAIL LAMP
TO LICENSE
LAMP
VIEW IN DIRECTION
OF ARROW Y
RWAL
SENSOR JUMPER
CONNECTOR
O MAIN
ARNESS
RWAL PRESSURE
LIMITING VALVE
VIEW IN DIRECTION
OF ARROW S
TO MAIN
HARNESS
FWD
TO
RIGHT
TAIL LAMP
TO
LEFT TAIL
LAMP
TO LICENSE
LAMP
VIEW IN DIRECTION
OF ARROW Z
VIEW IN DIRECTION
OF ARROW U
FUEL TANK
SENDING UNIT
CONNECTOR

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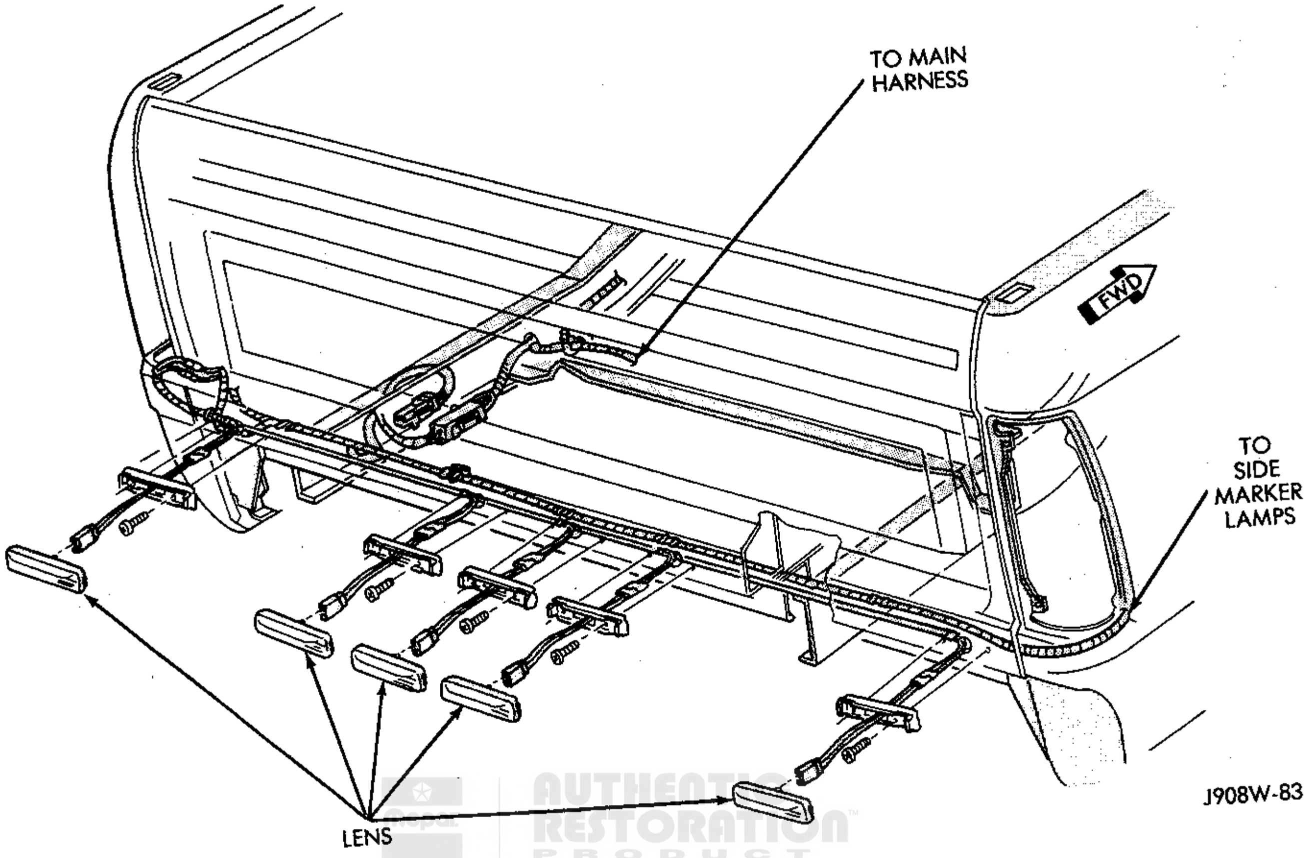


Fig. 3—Clearance Lamp Wiring with Dual Rear Wheels

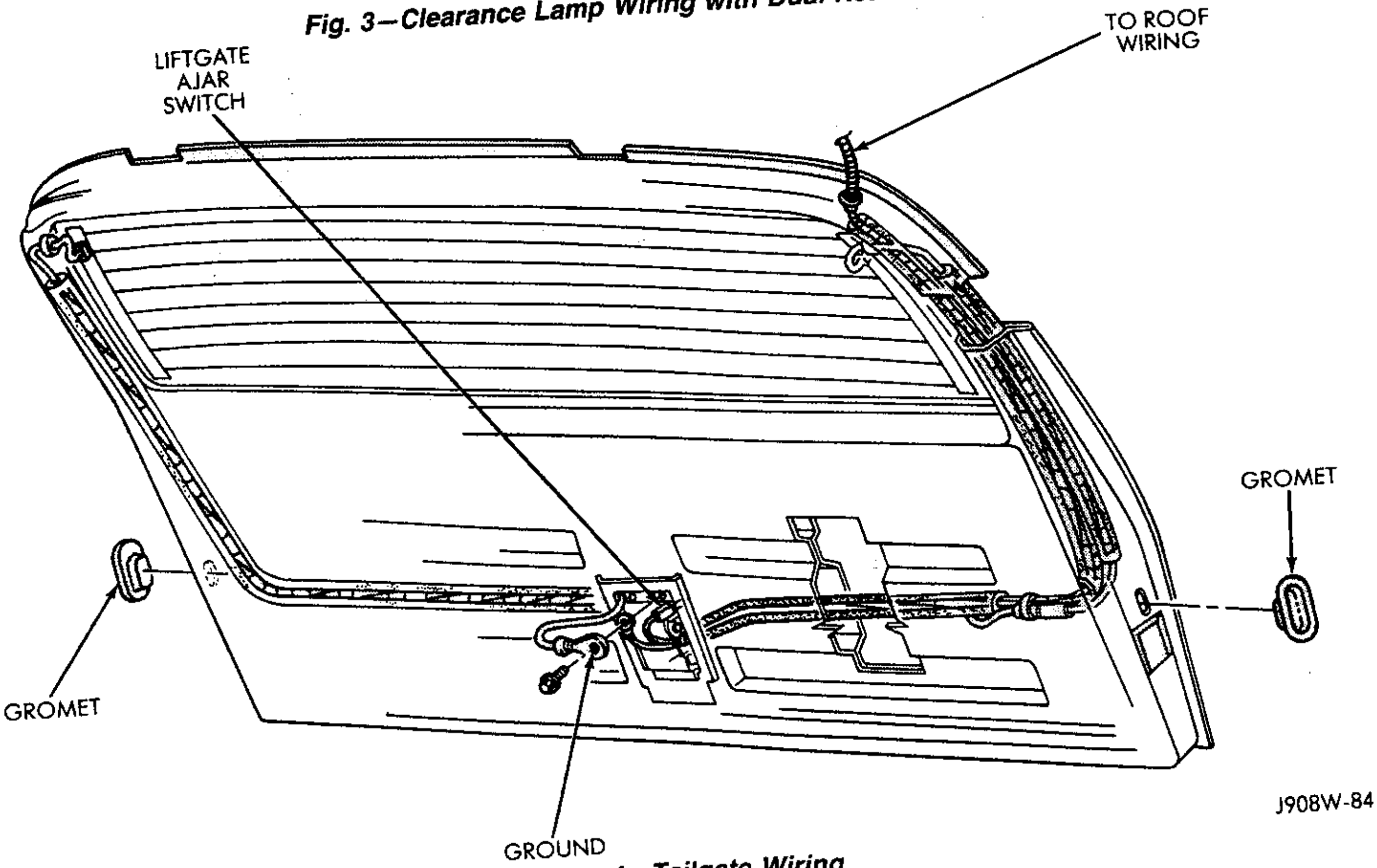


Fig. 4—Tailgate Wiring

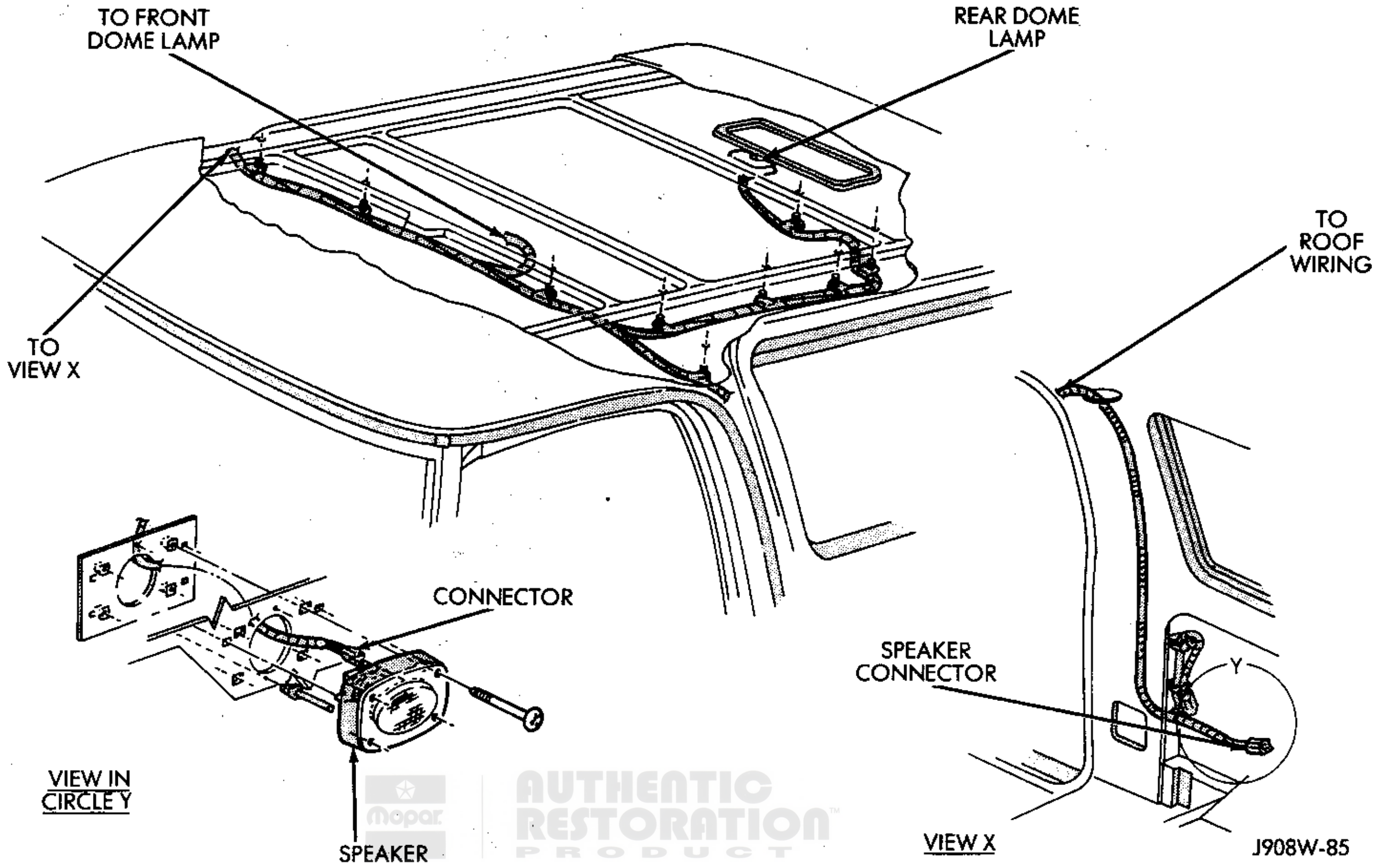


Fig. 5—Roof Wiring

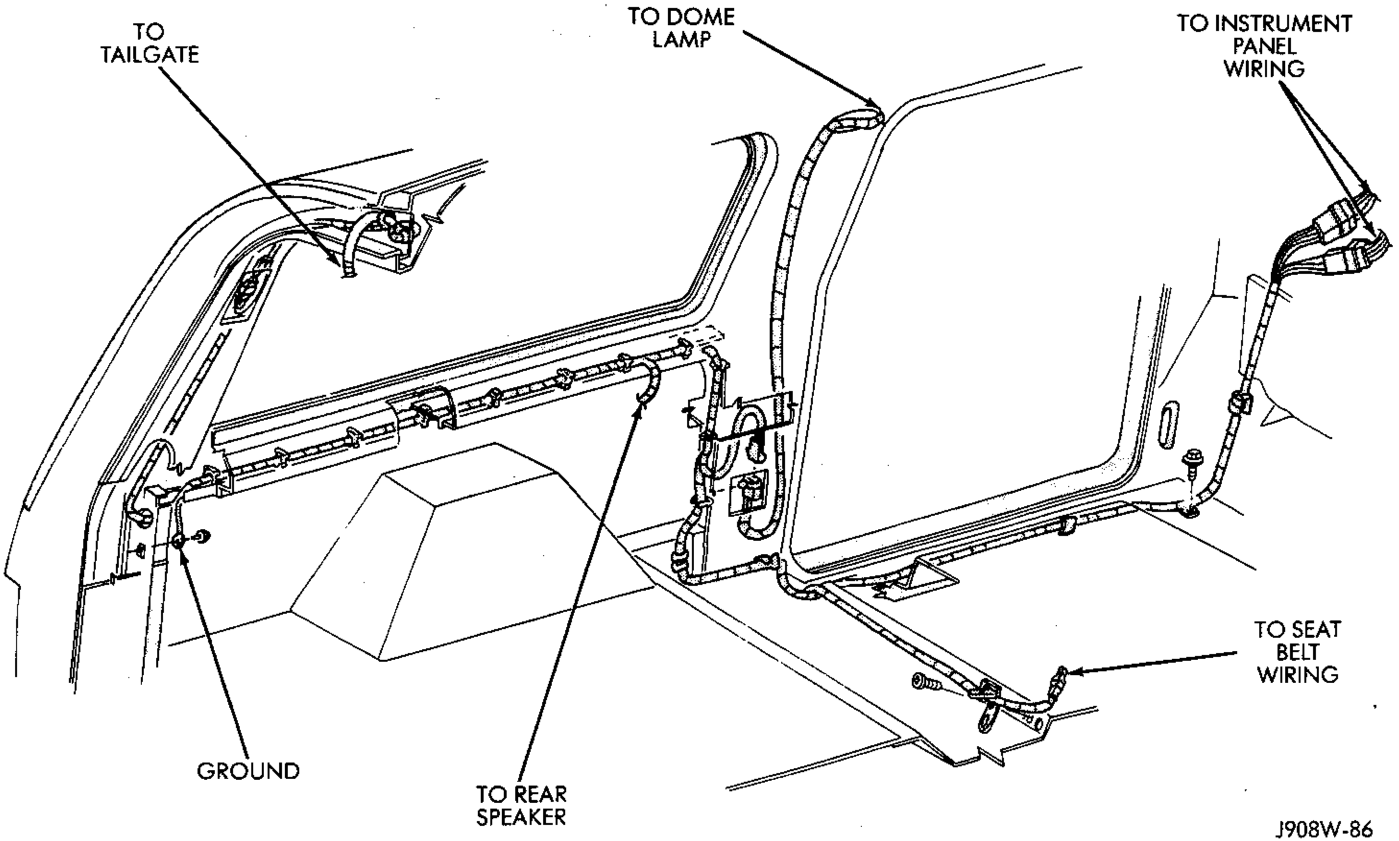


Fig. 6—Interior Wiring

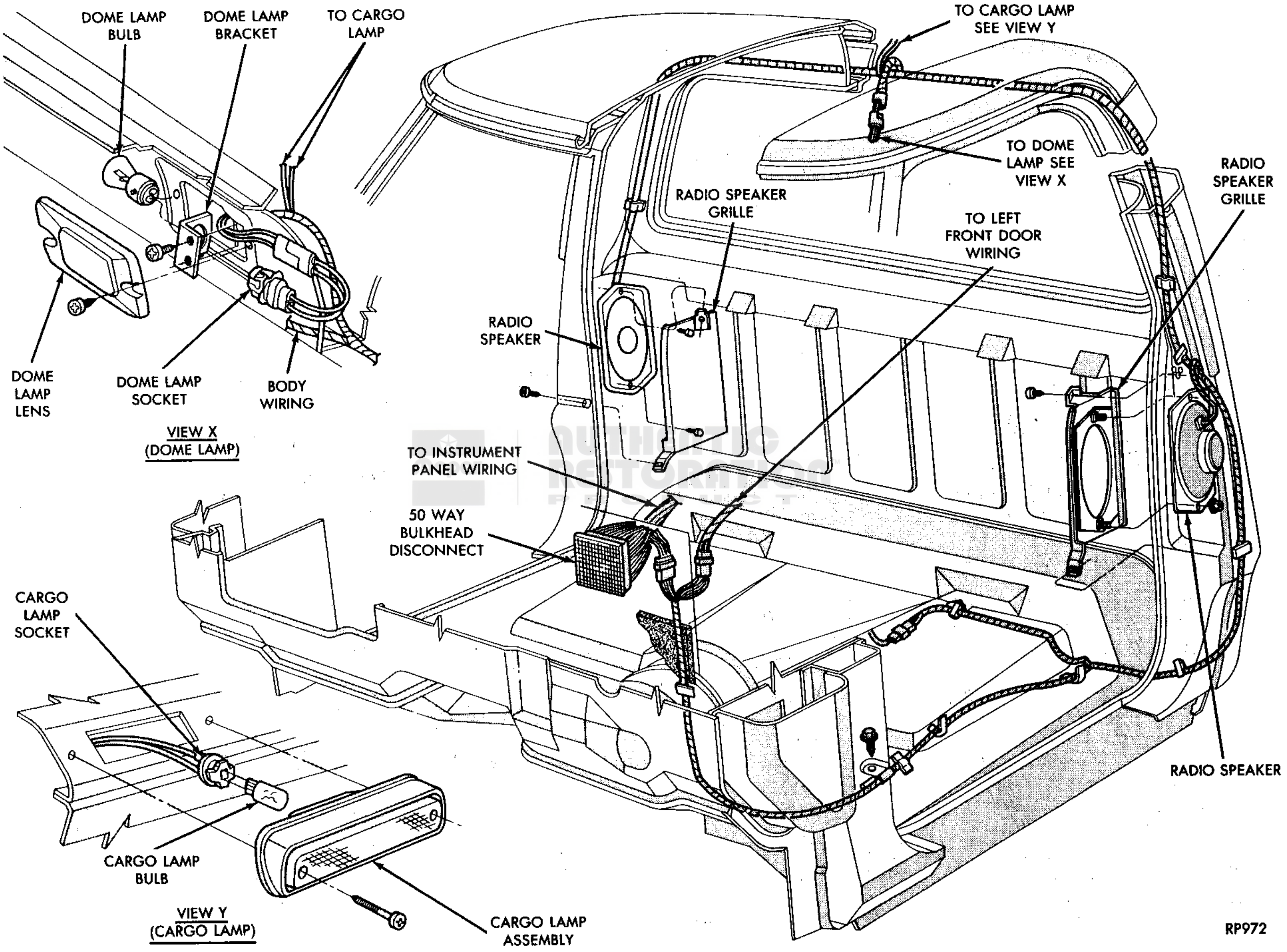


Fig. 7—Cab Wiring

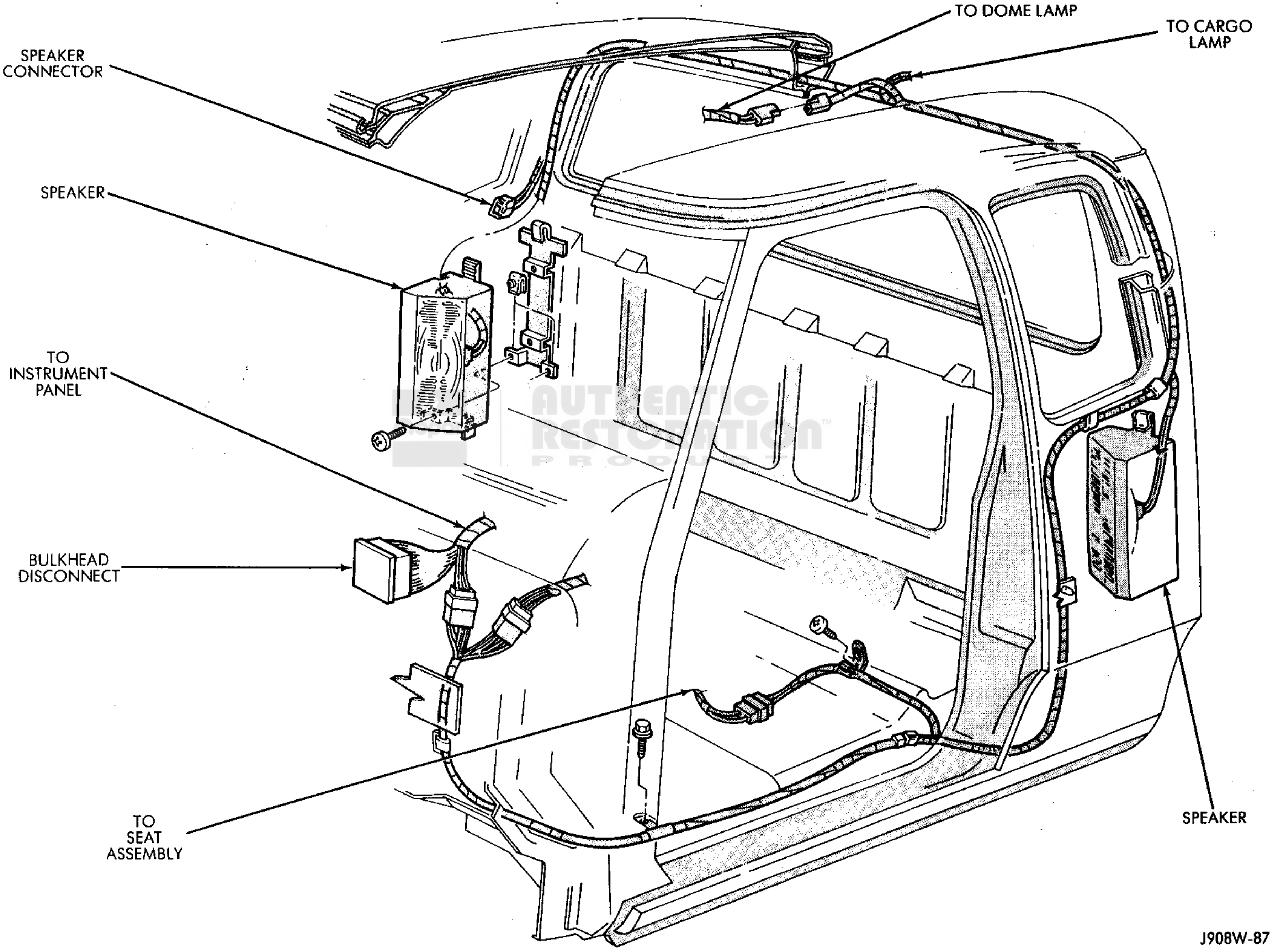


Fig. 8—Extended Cab Wiring

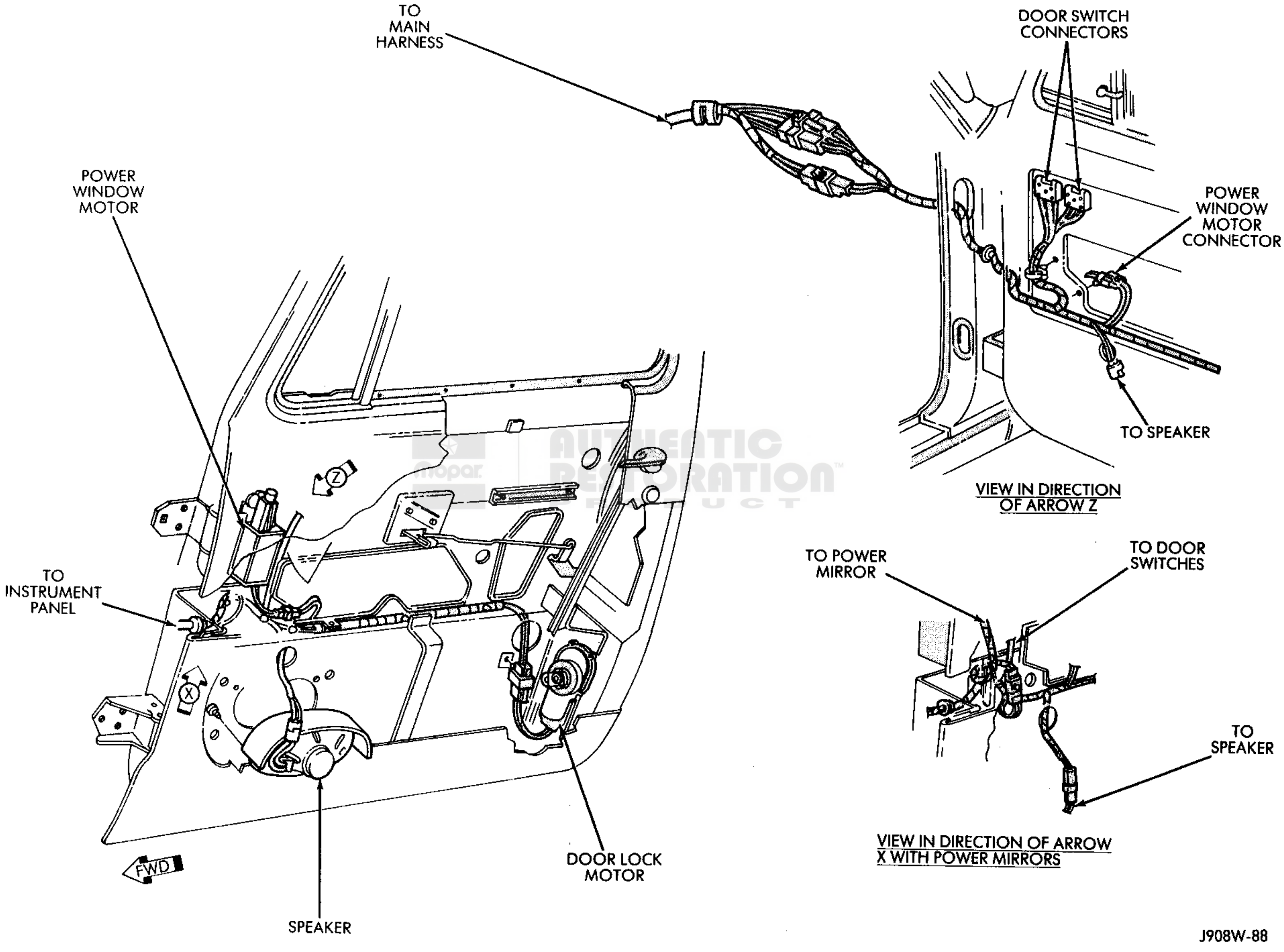


Fig. 9—Door Wiring

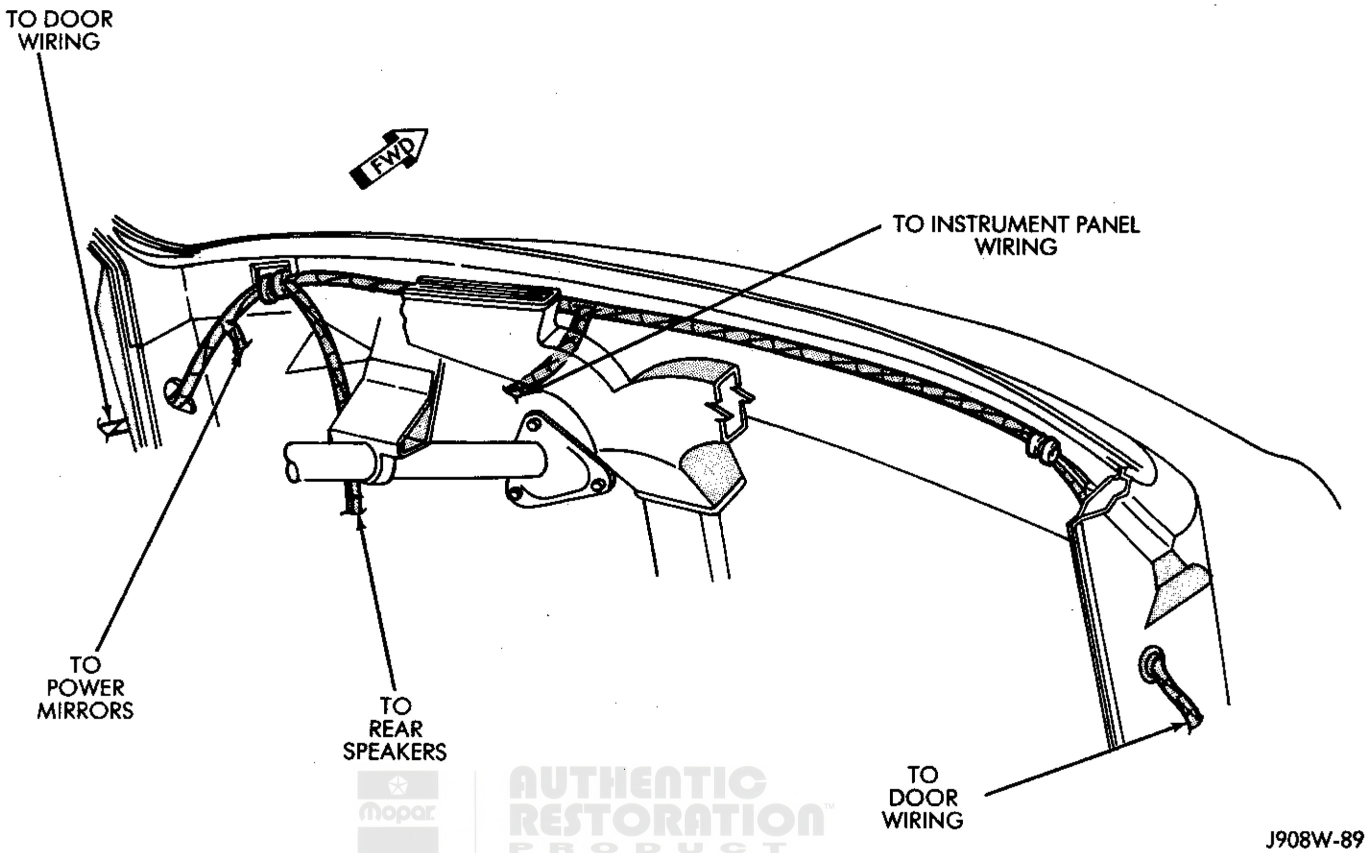


Fig. 10—Cowl Panel Wiring

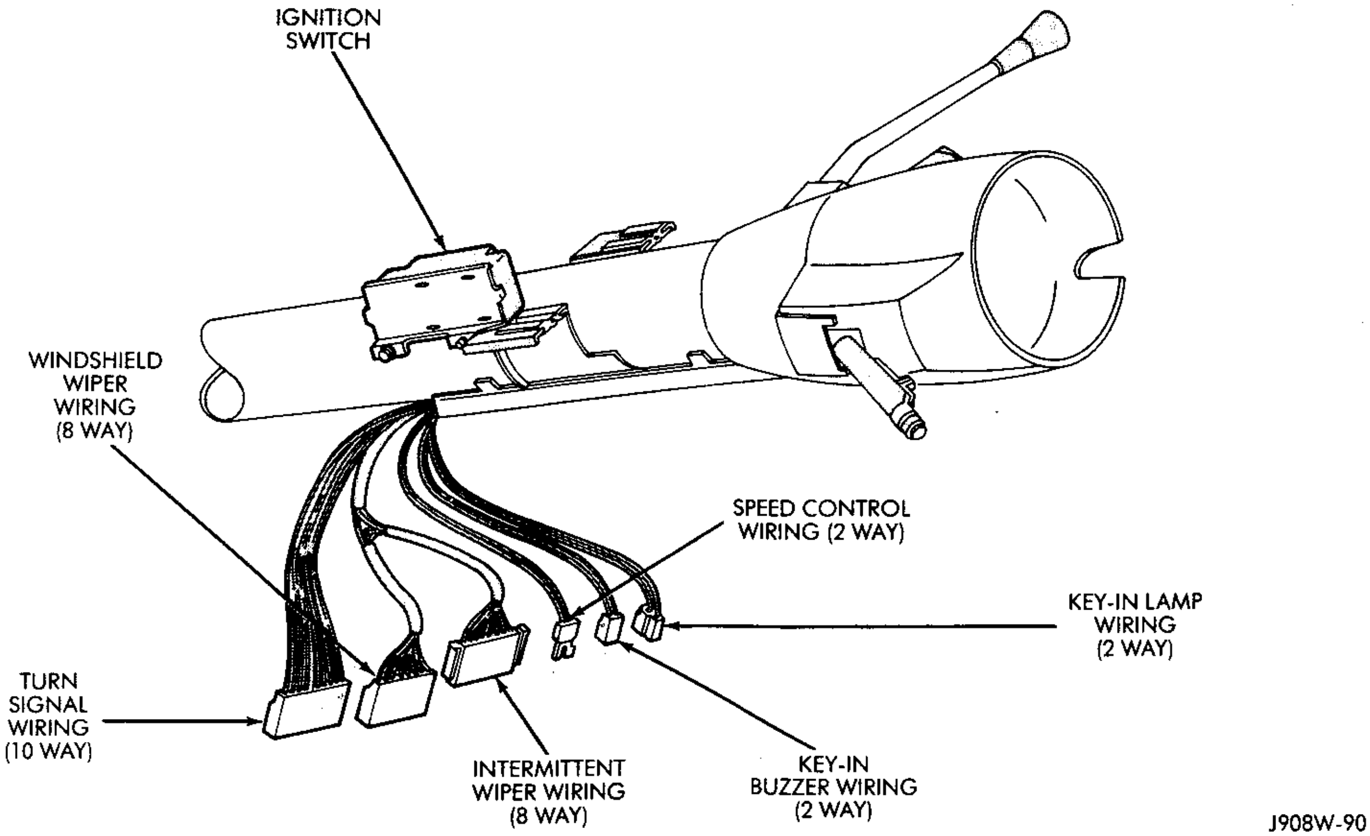


Fig. 11—Steering Column Wiring

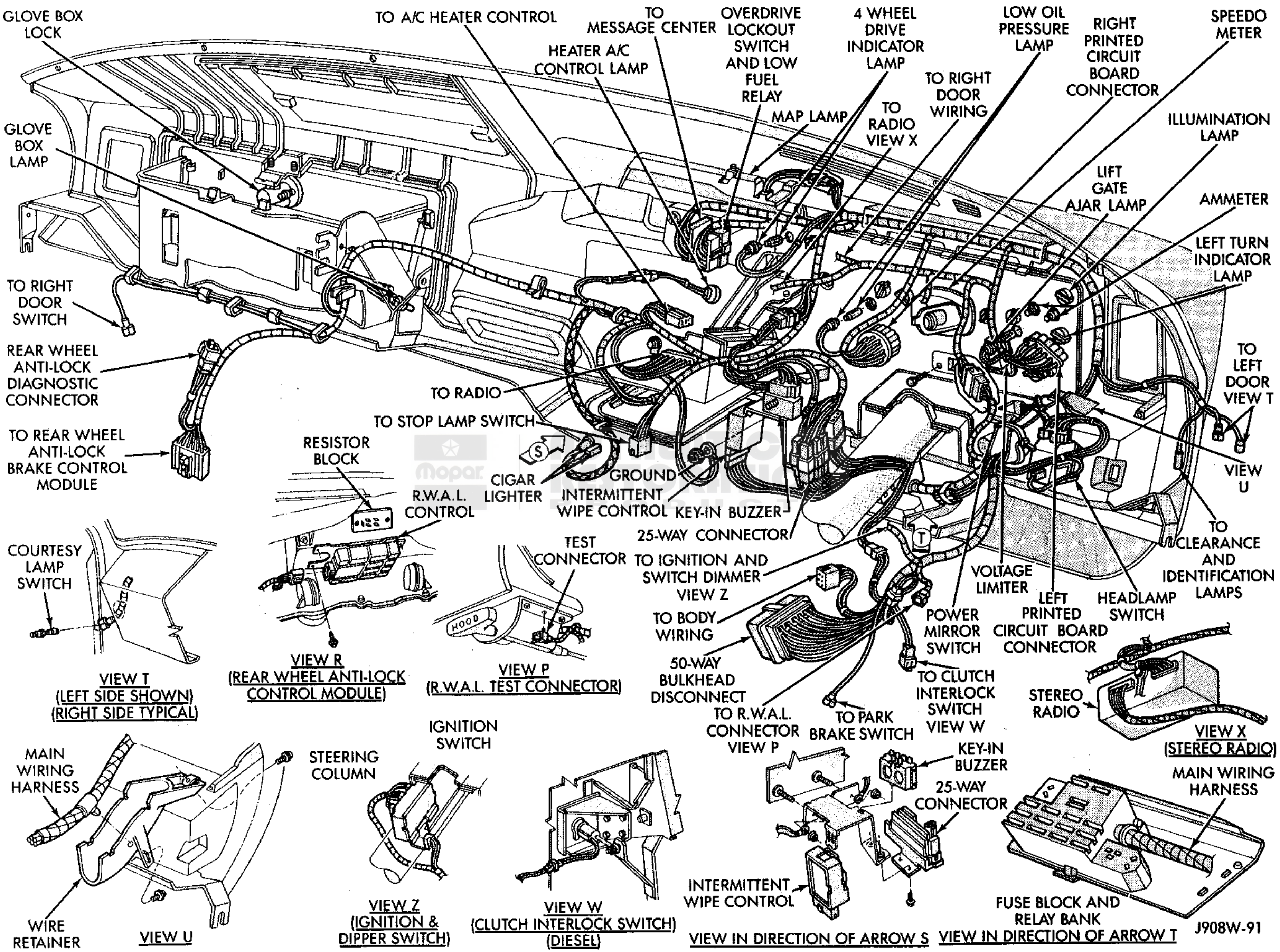


Fig. 12—Instrument Panel Wiring

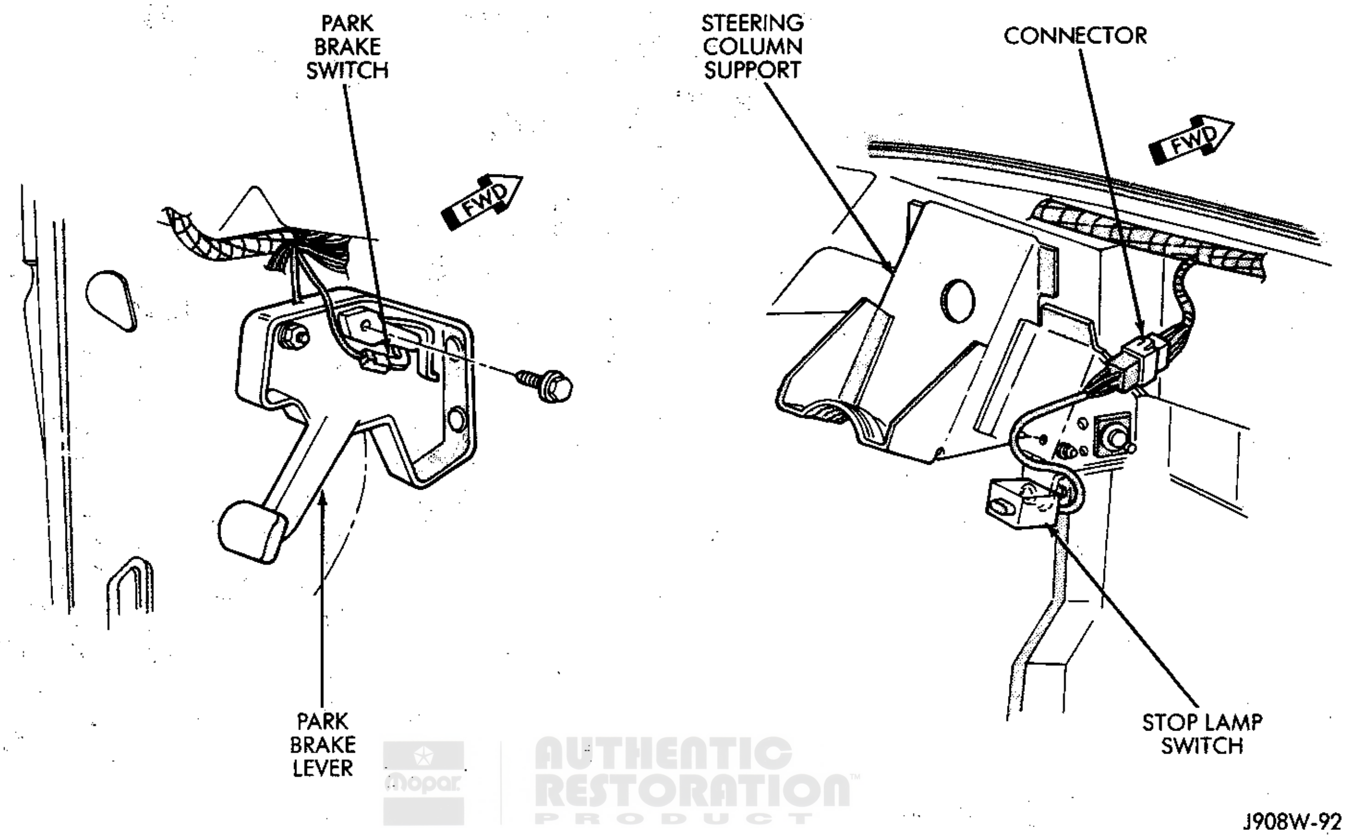


Fig. 13—Stop Lamp and Parking Brake Switch Wiring

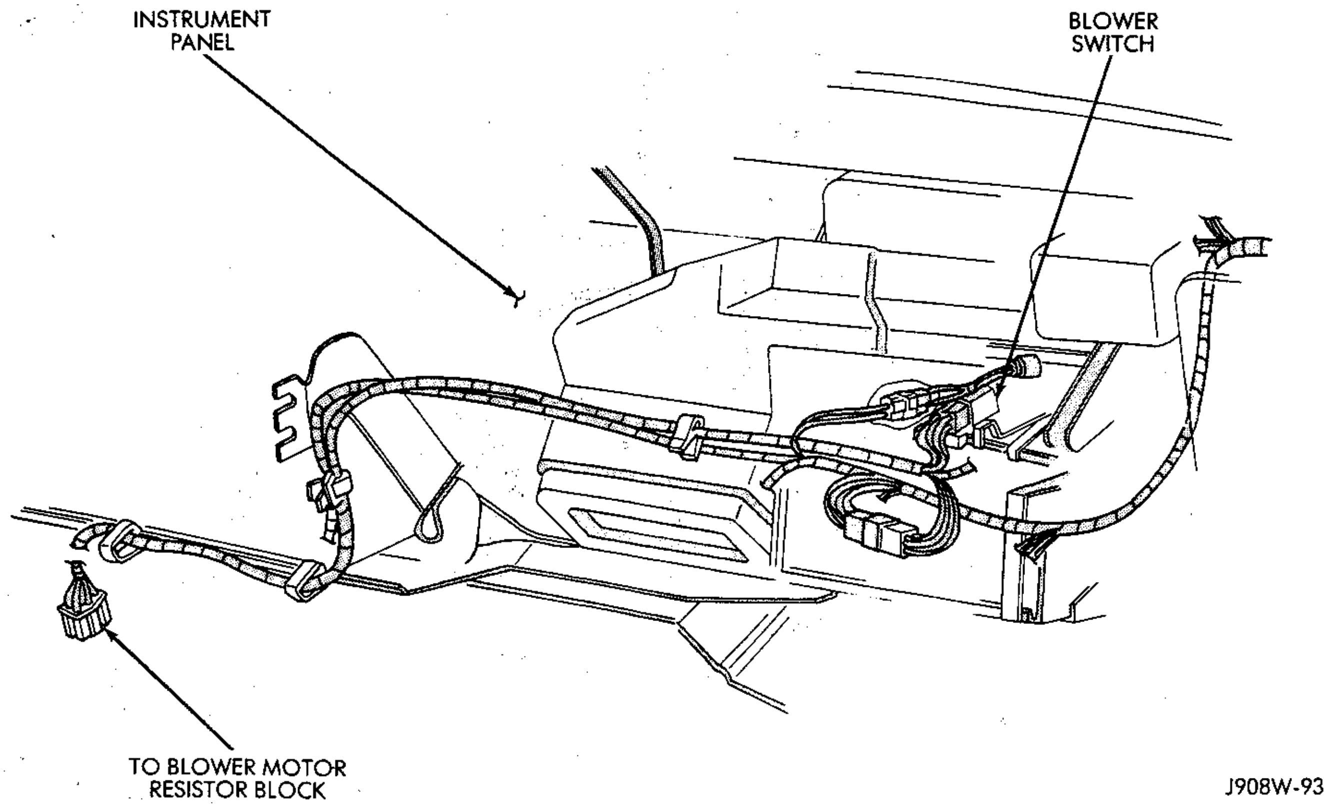


Fig. 14—A/C Heater Wiring

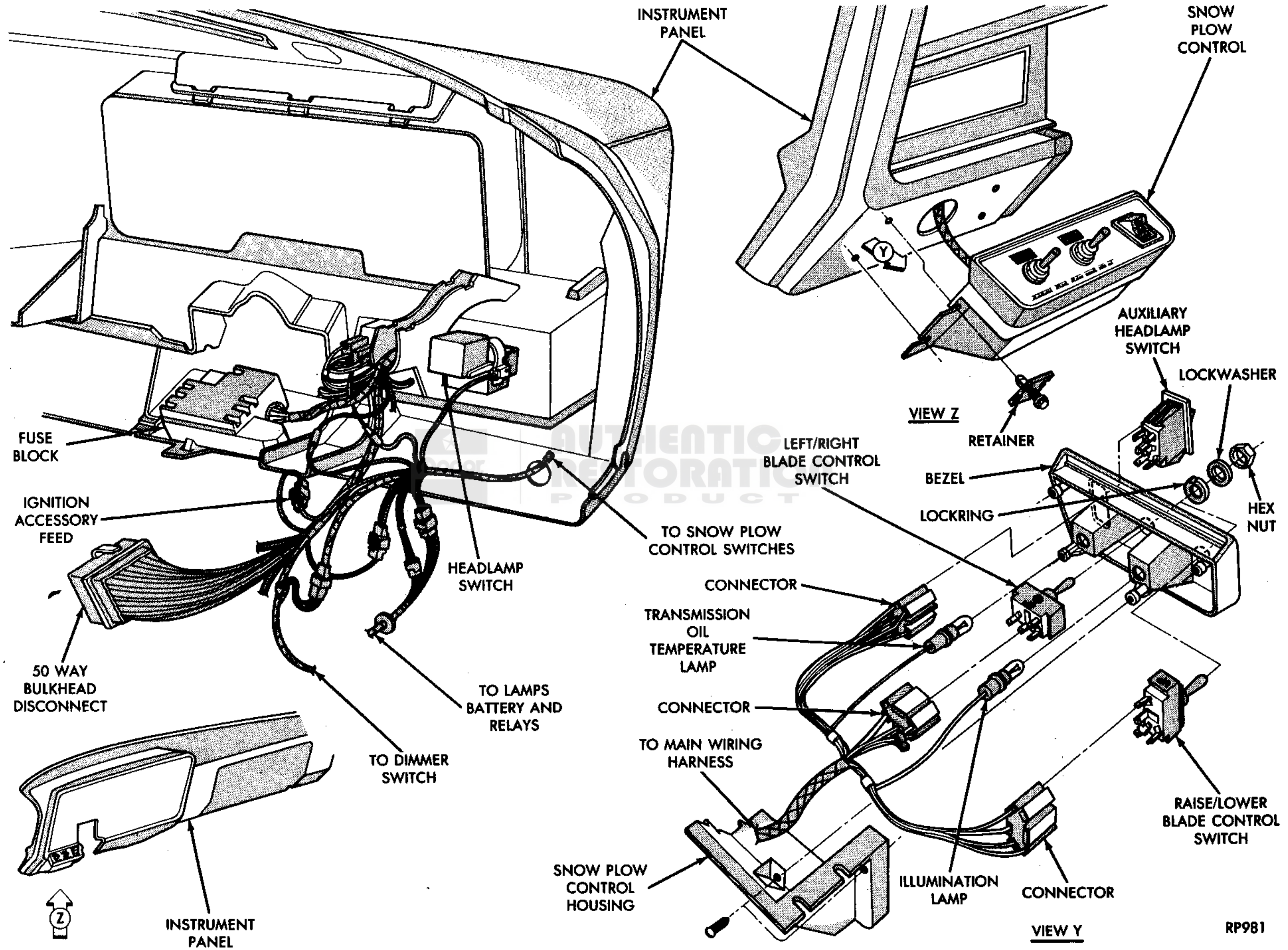


Fig. 15—Snow Plow Control Wiring

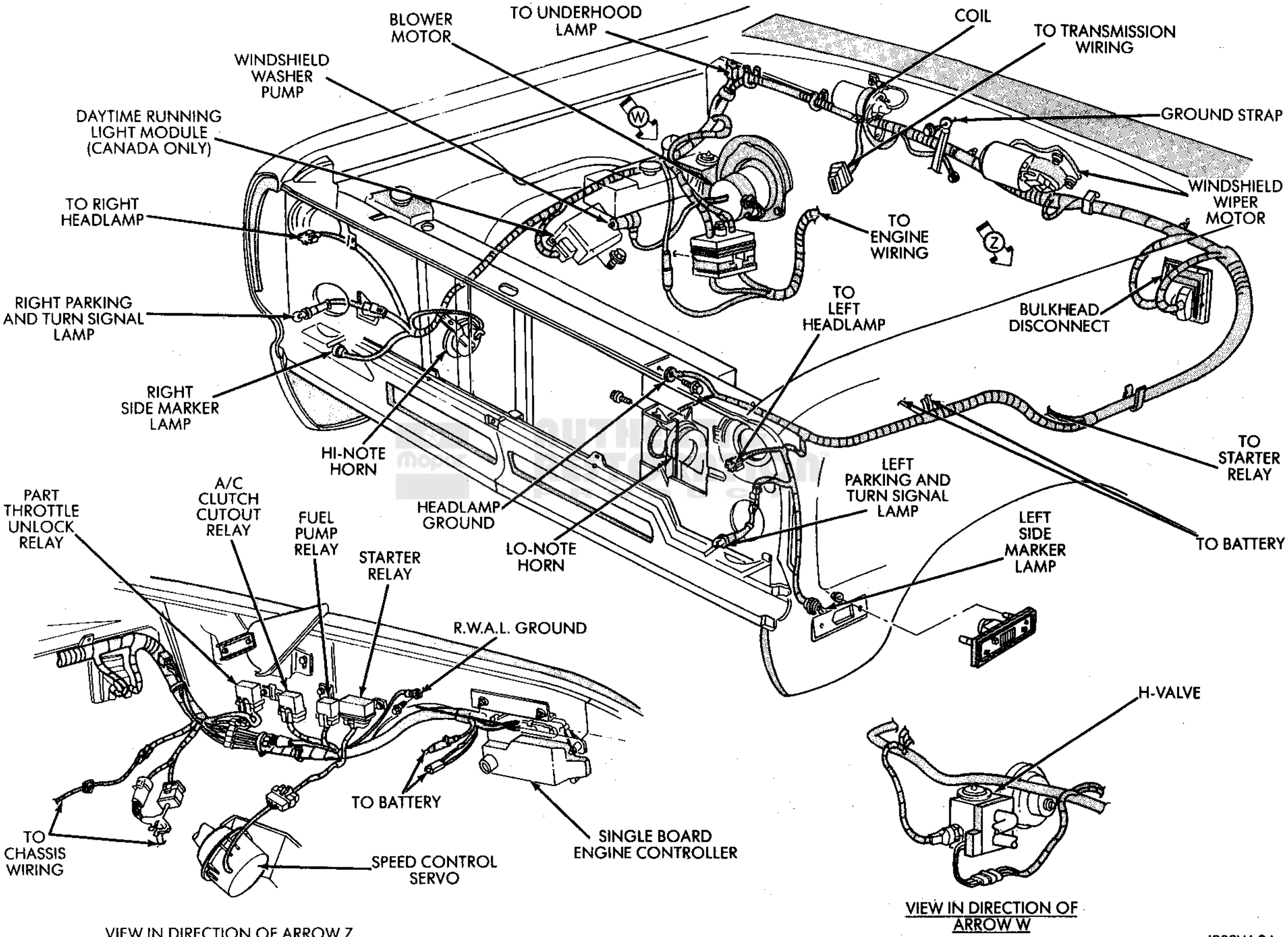


Fig. 16—Engine Compartment Wiring EFI Engine

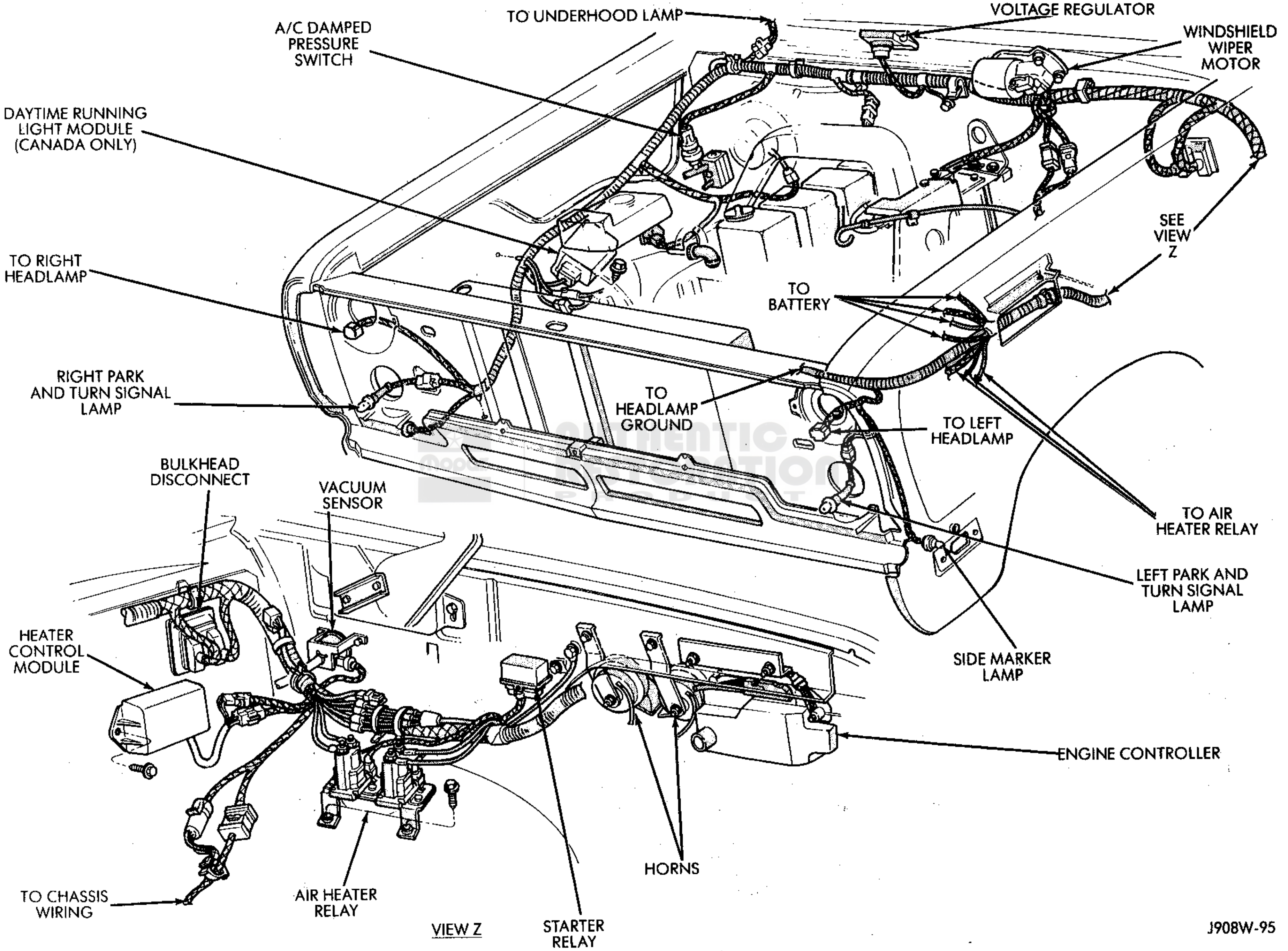


Fig. 17—Engine Compartment Wiring Diesel Engine

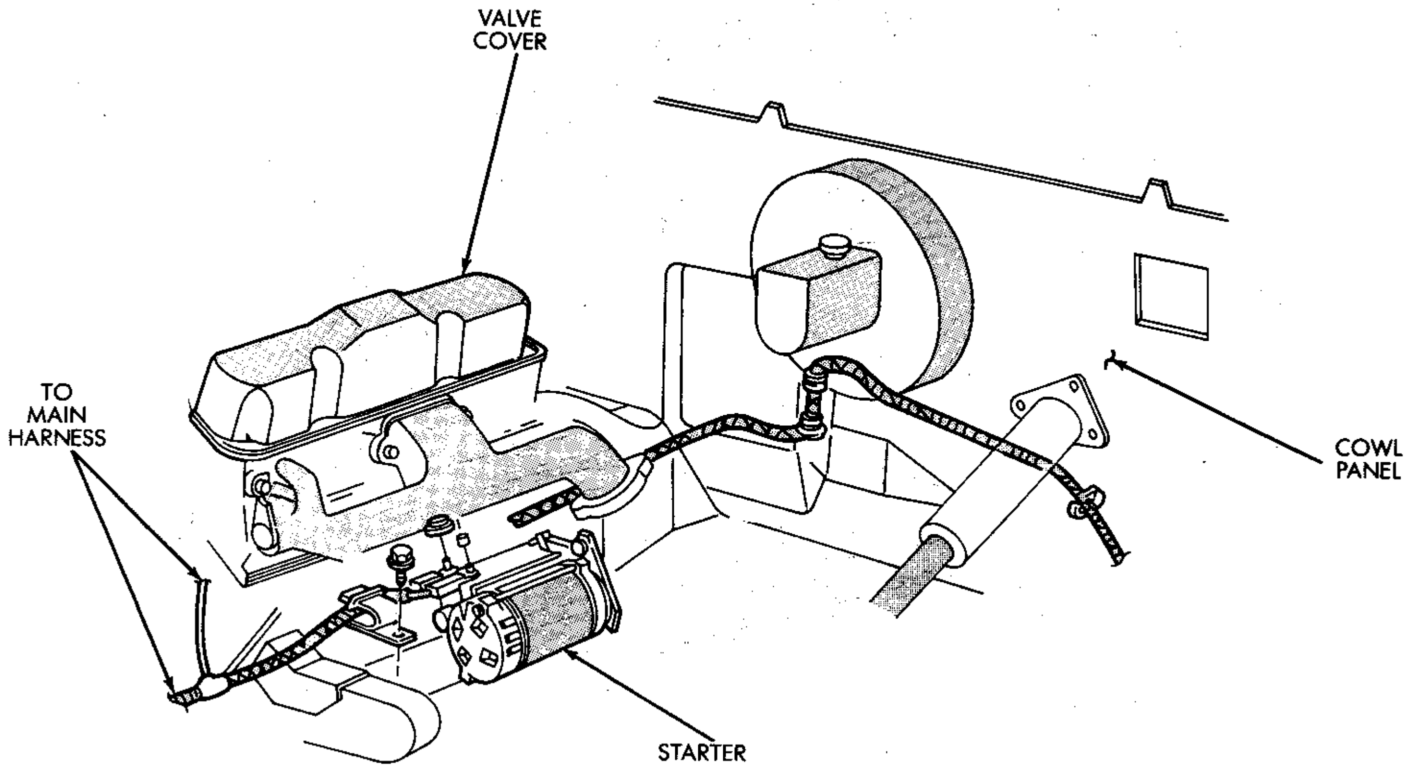
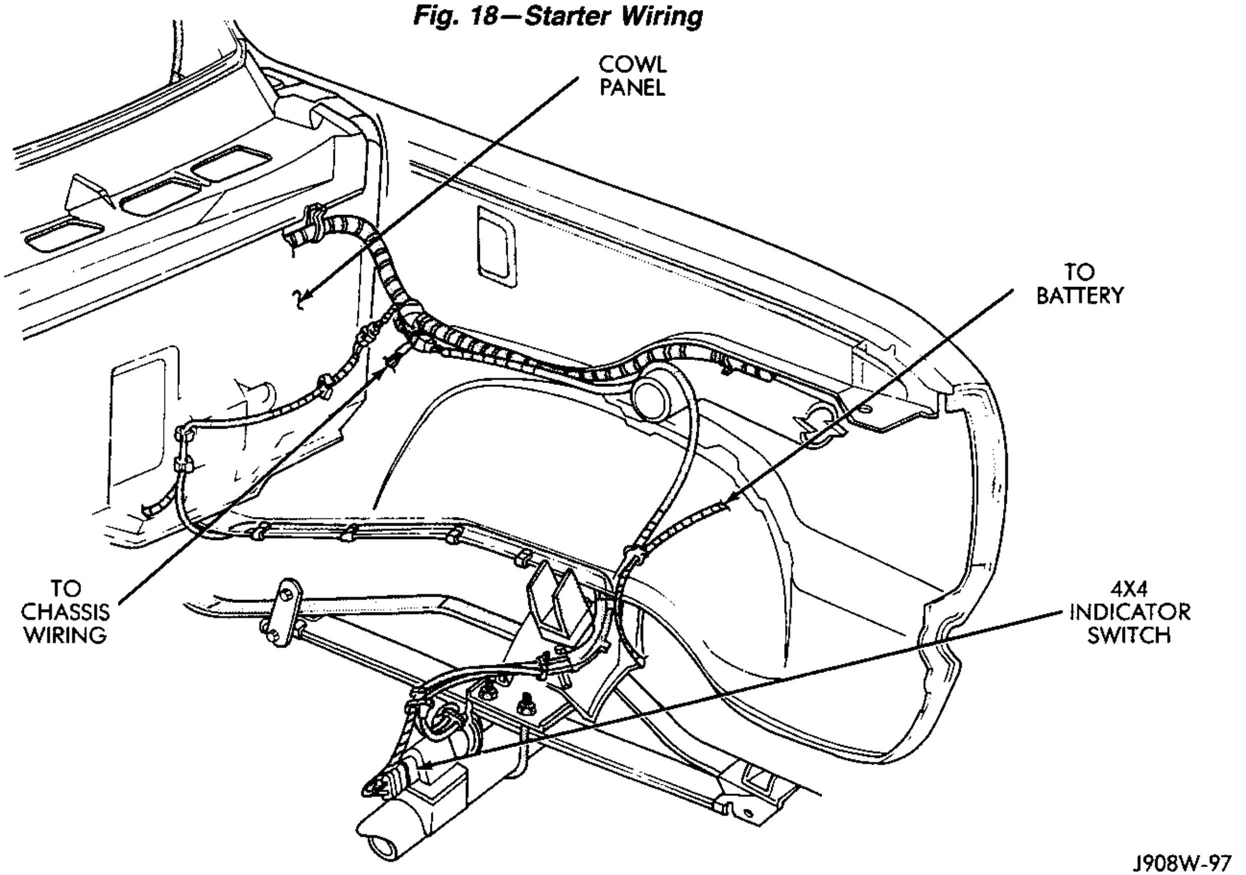


Fig. 18—Starter Wiring



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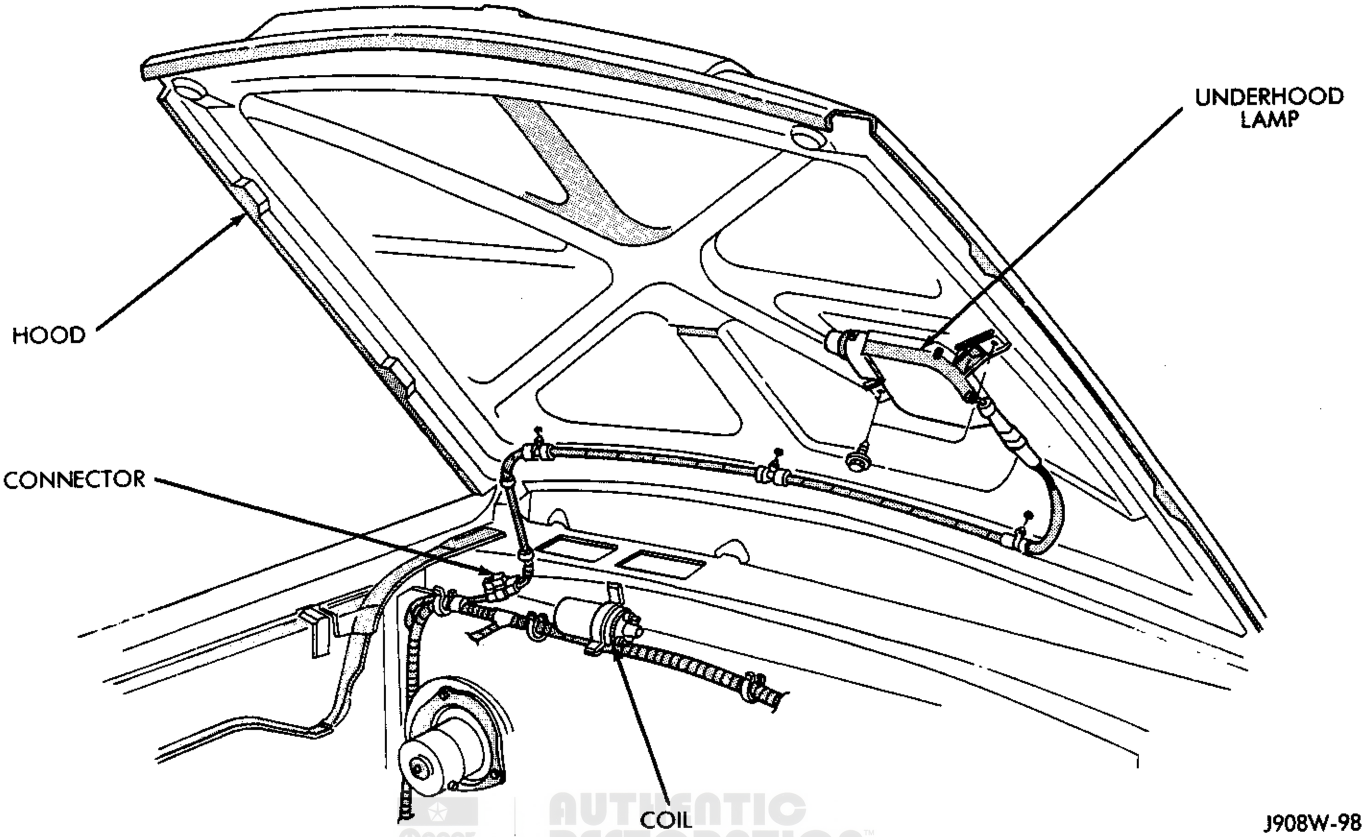


Fig. 20—Underhood Lamp Wiring

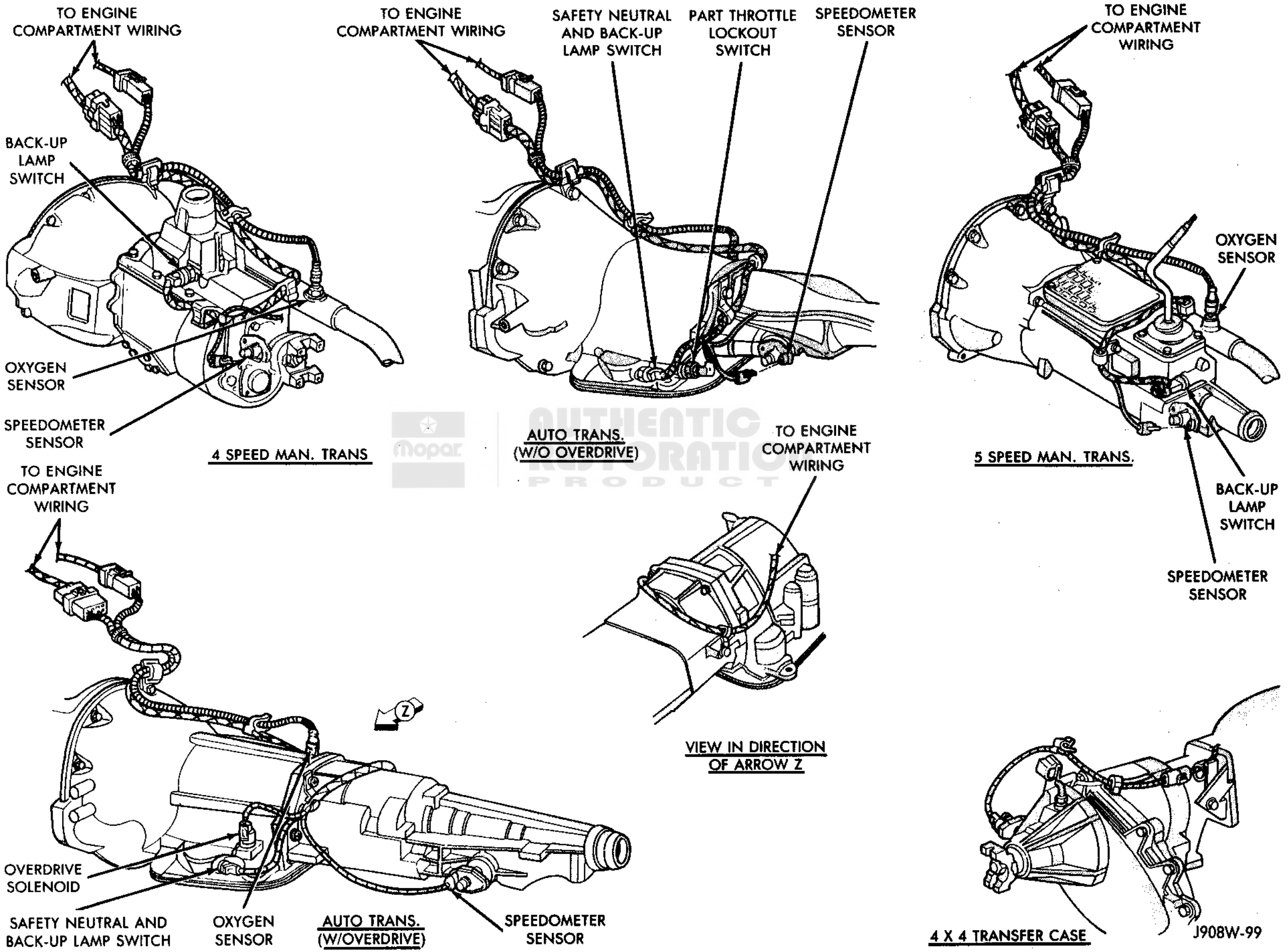
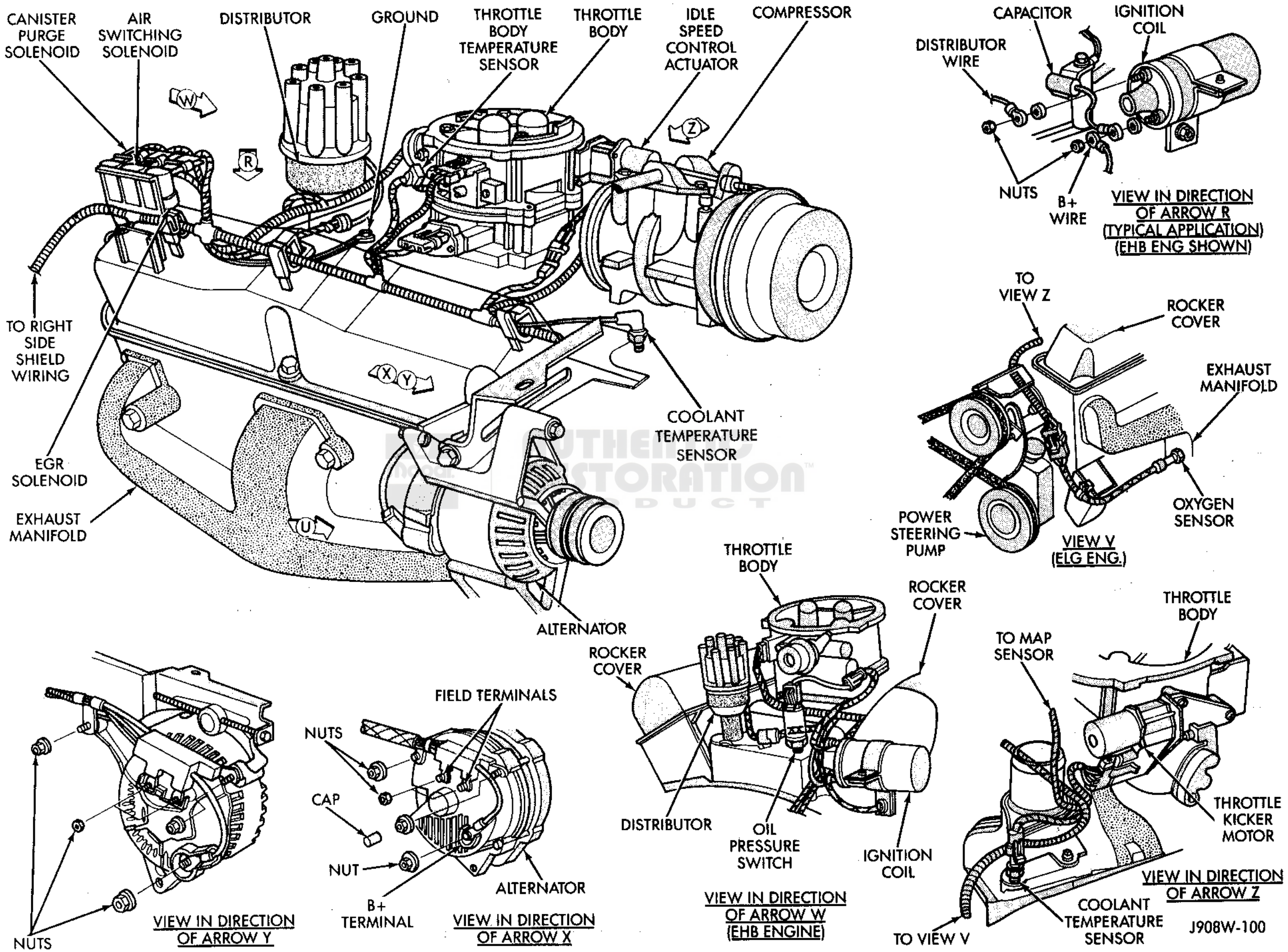


Fig. 21—Transmission Wiring



VIEW IN DIRECTION OF ARROW R (TYPICAL APPLICATION) (EHB ENG SHOWN)

VIEW V (ELG ENG.)

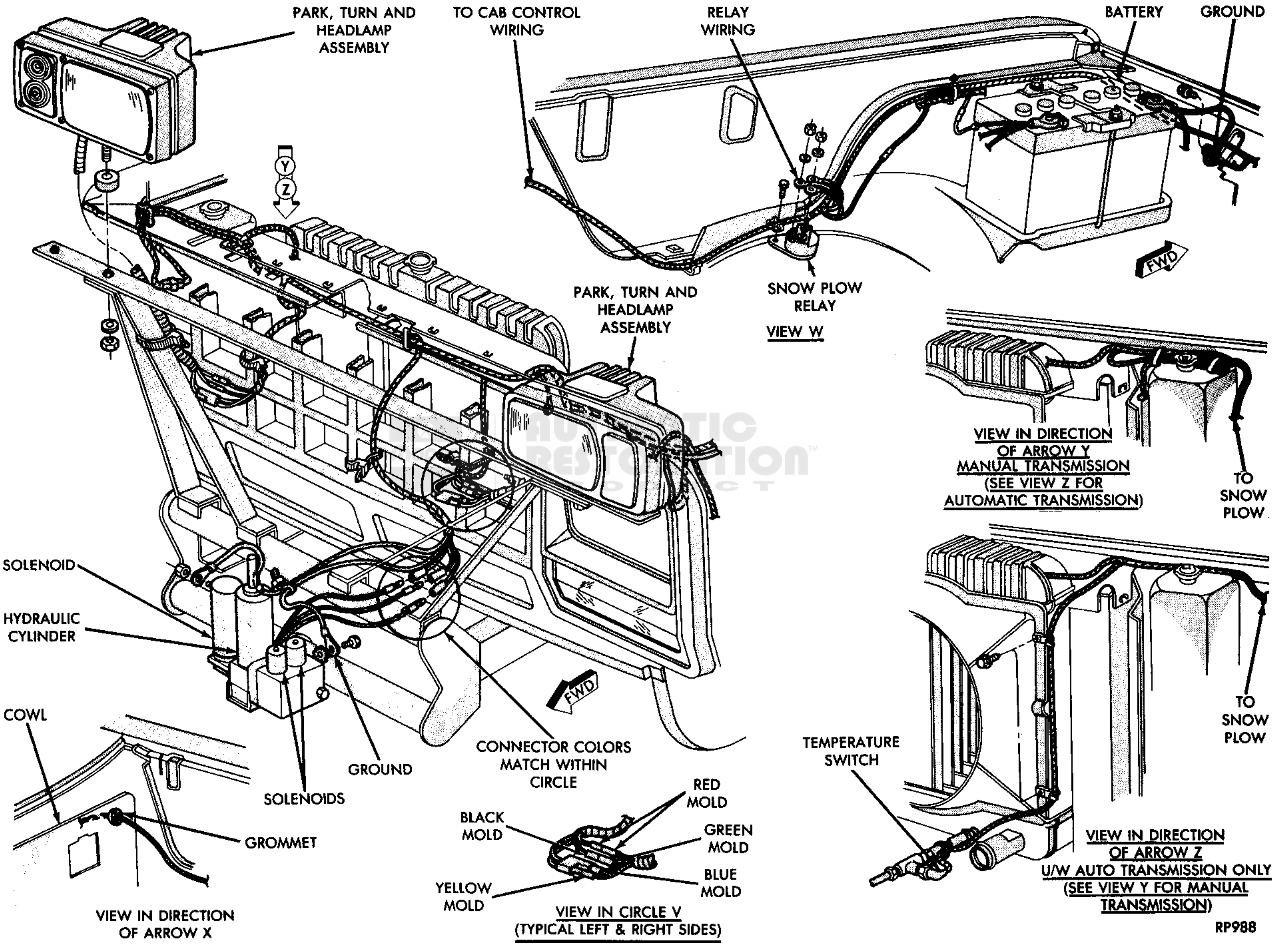
VIEW IN DIRECTION OF ARROW Y

VIEW IN DIRECTION OF ARROW X

VIEW IN DIRECTION OF ARROW W (EHB ENGINE)

VIEW IN DIRECTION OF ARROW Z

Fig. 22—Engine Wiring EFI Engine



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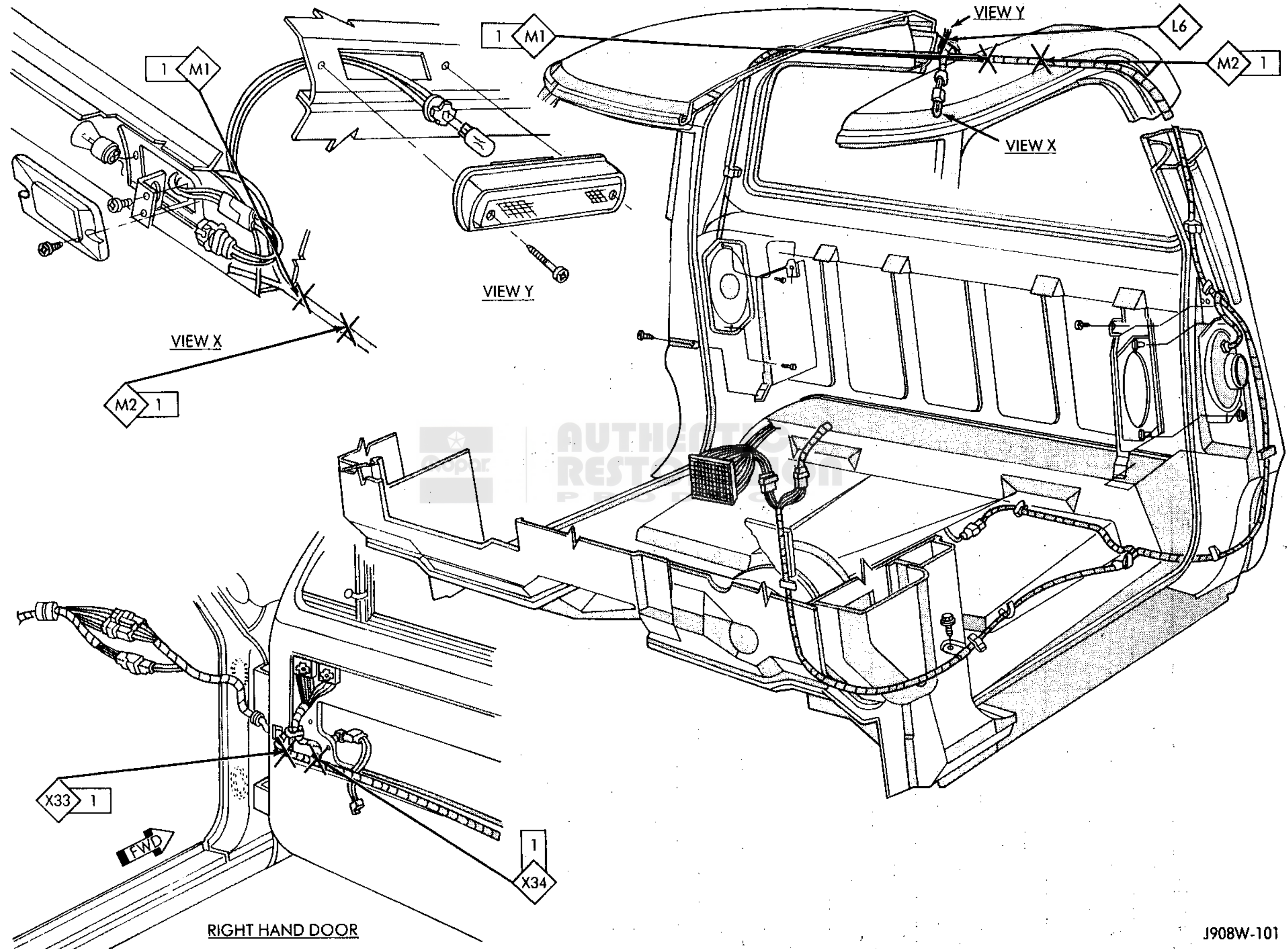


Fig. 1—Door and Cab Splices

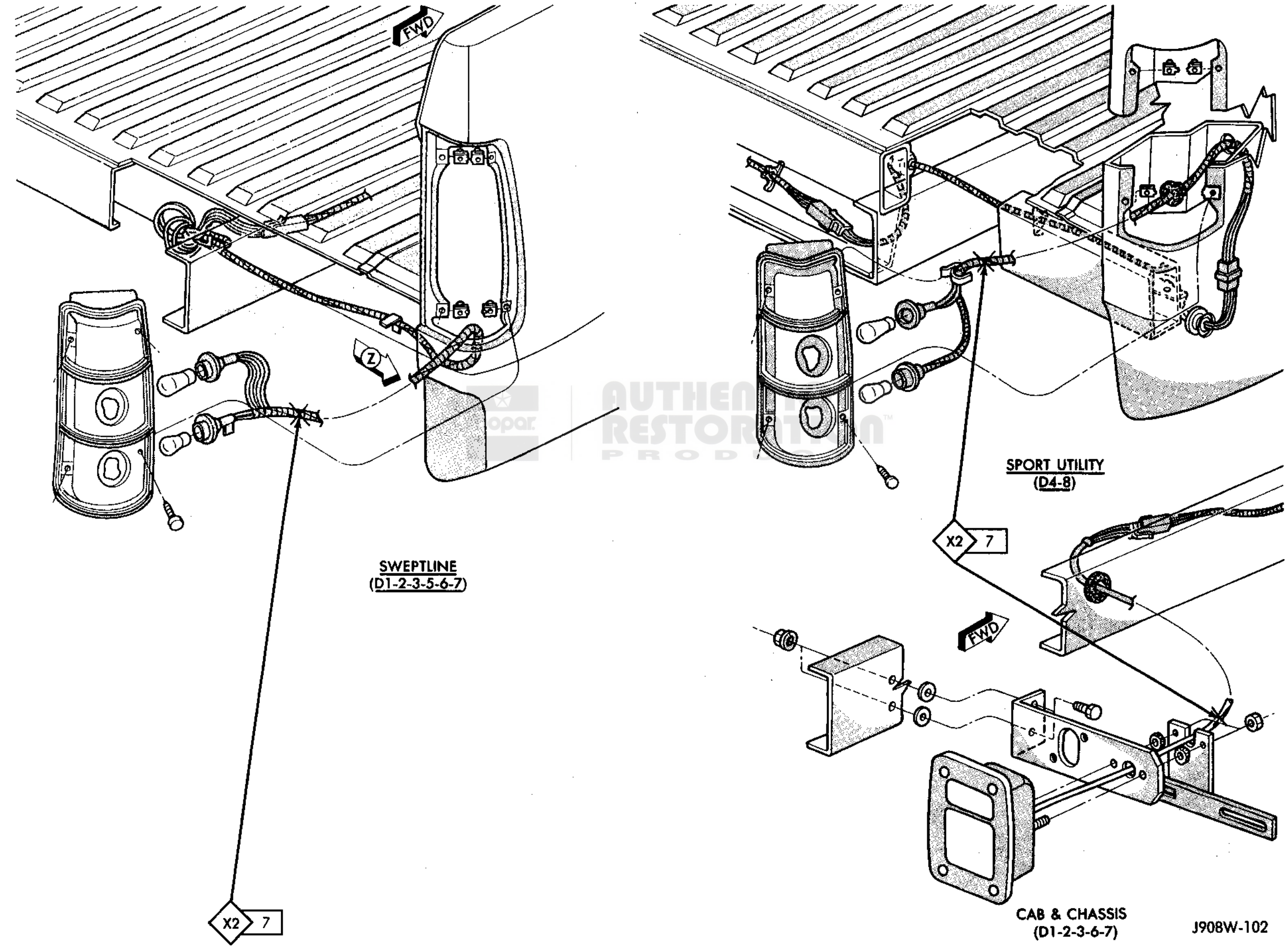
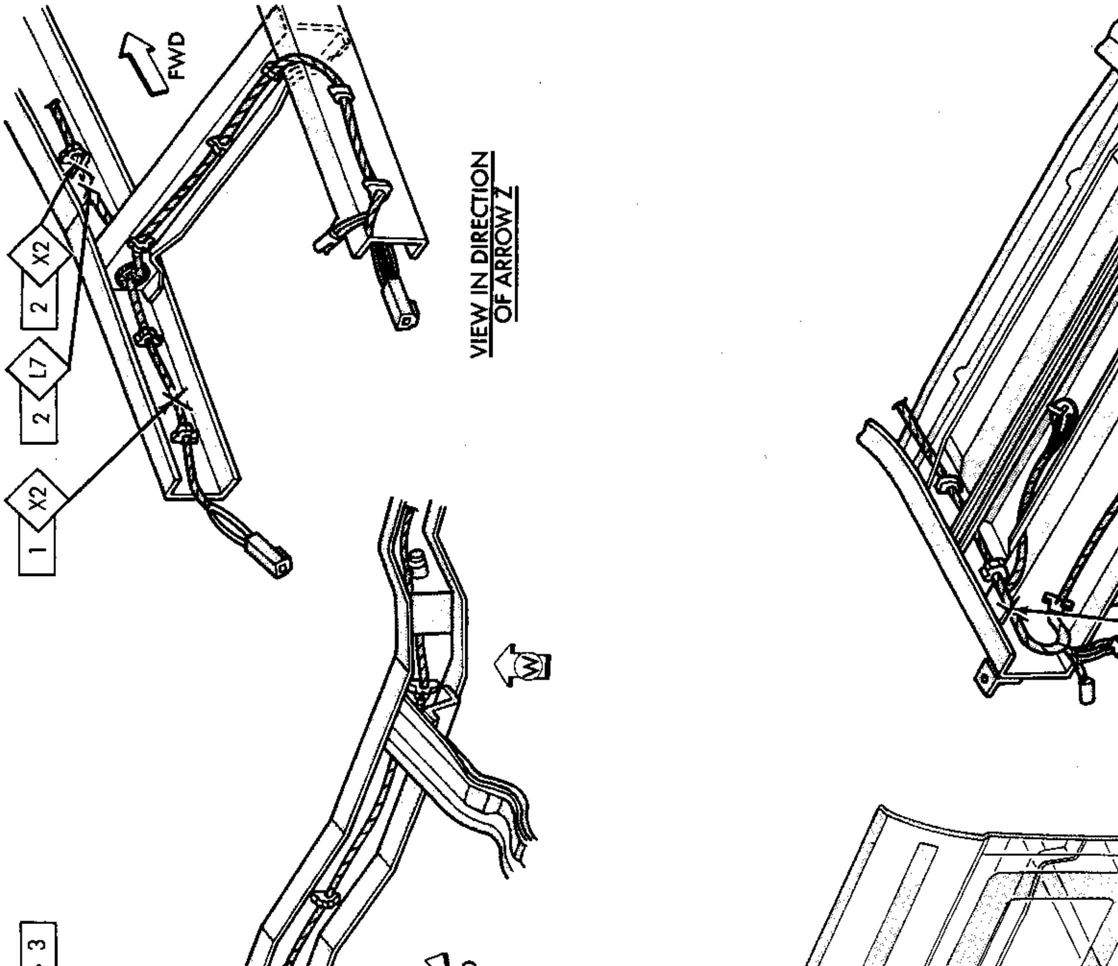


Fig. 2—Tail, Stop, and Turn Signal Splices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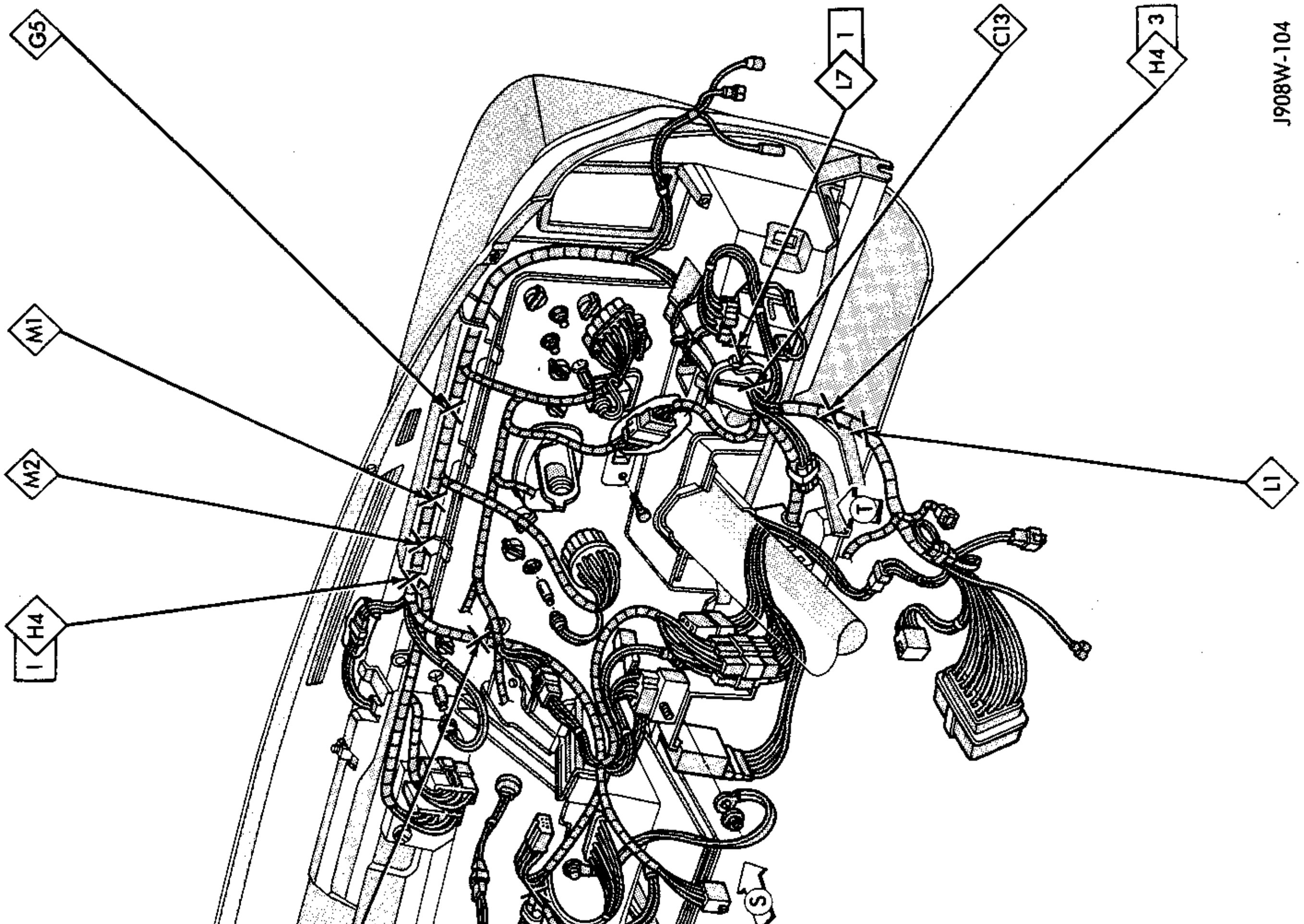

ument Panel Splices

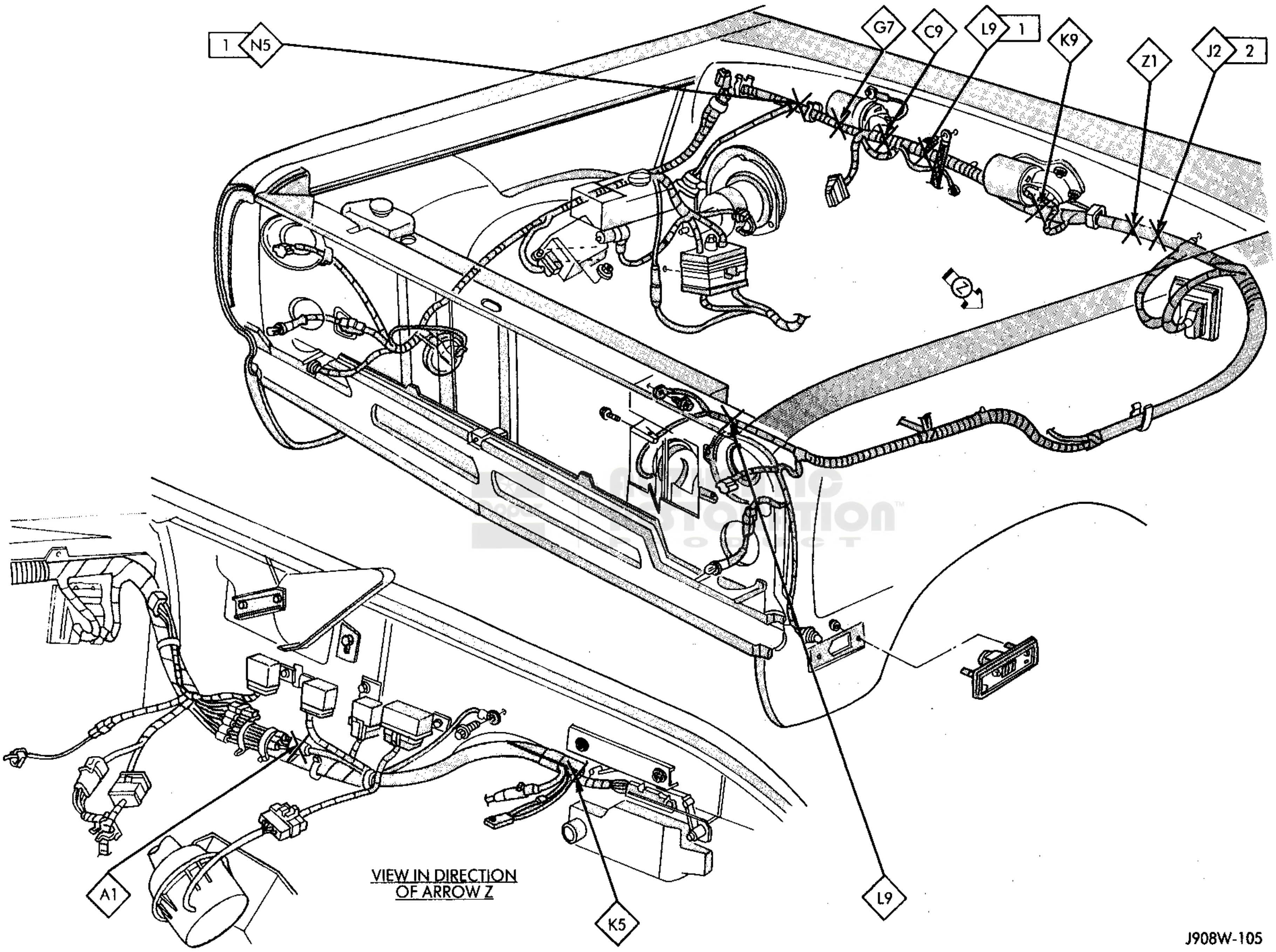

Fig. 5—Engine Compartment Splices with EFI Ignition

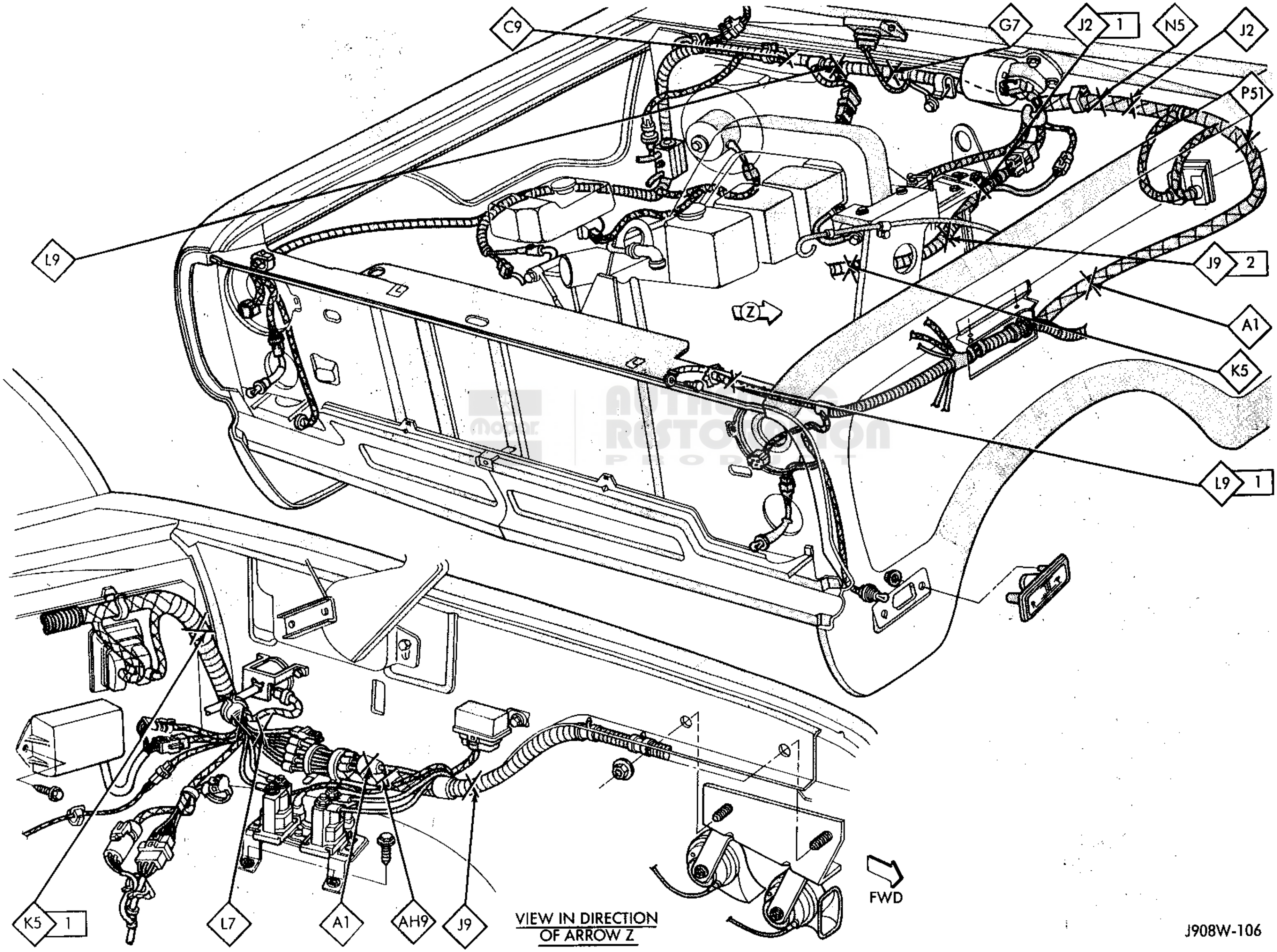

Fig. 6—Engine Compartment Splices with Diesel Ignition

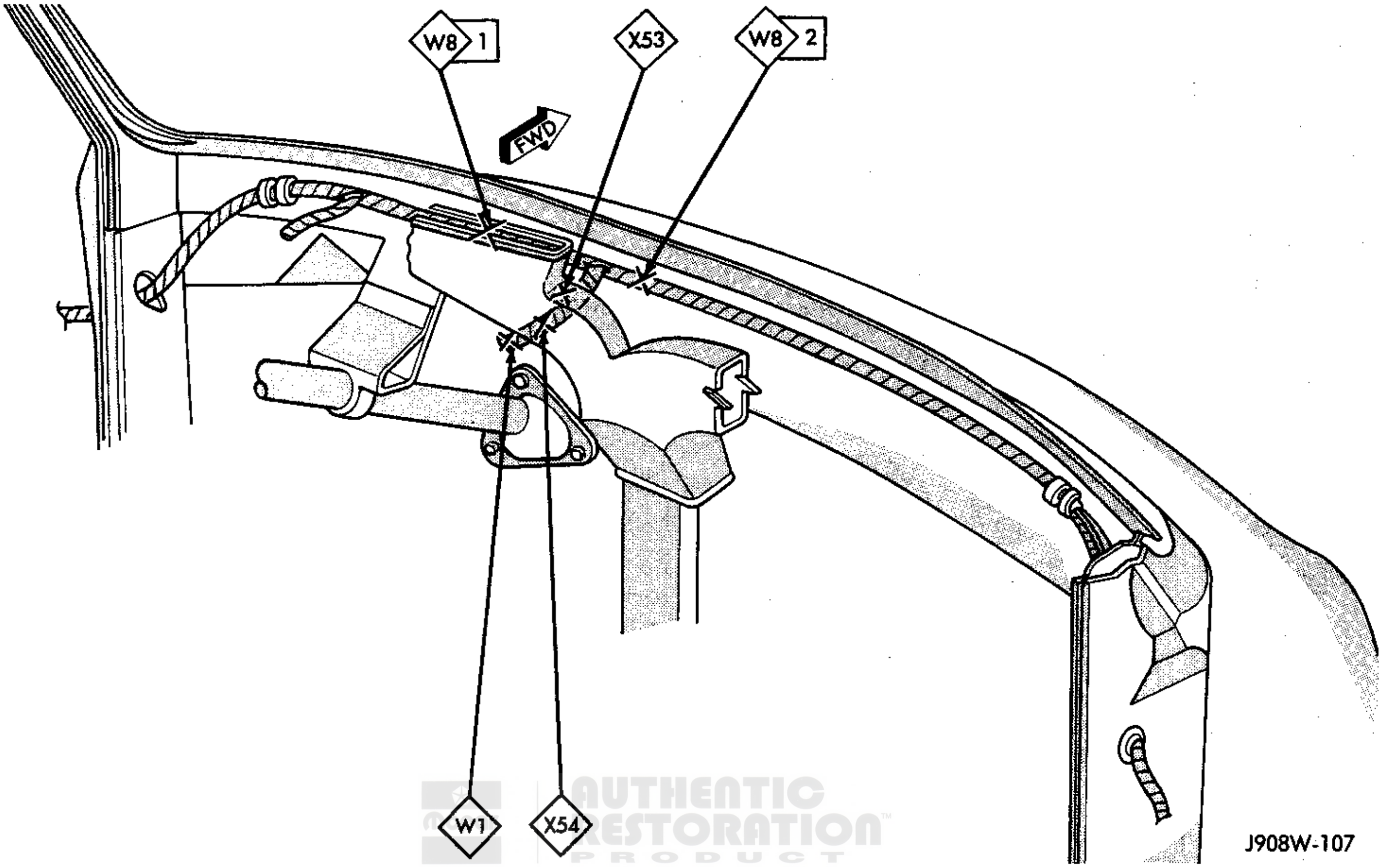

Fig. 7—Dash Panel Splices

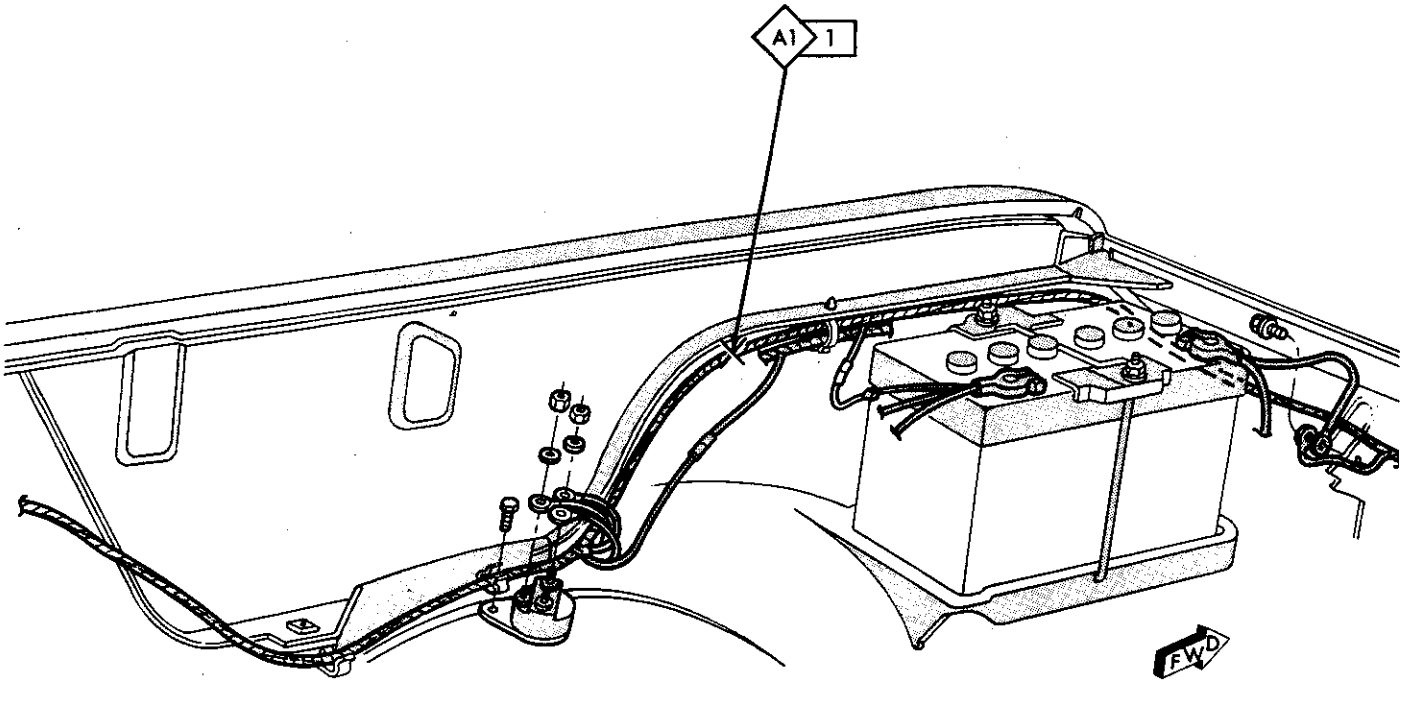

Fig. 8—Snow Plow Wiring Splices

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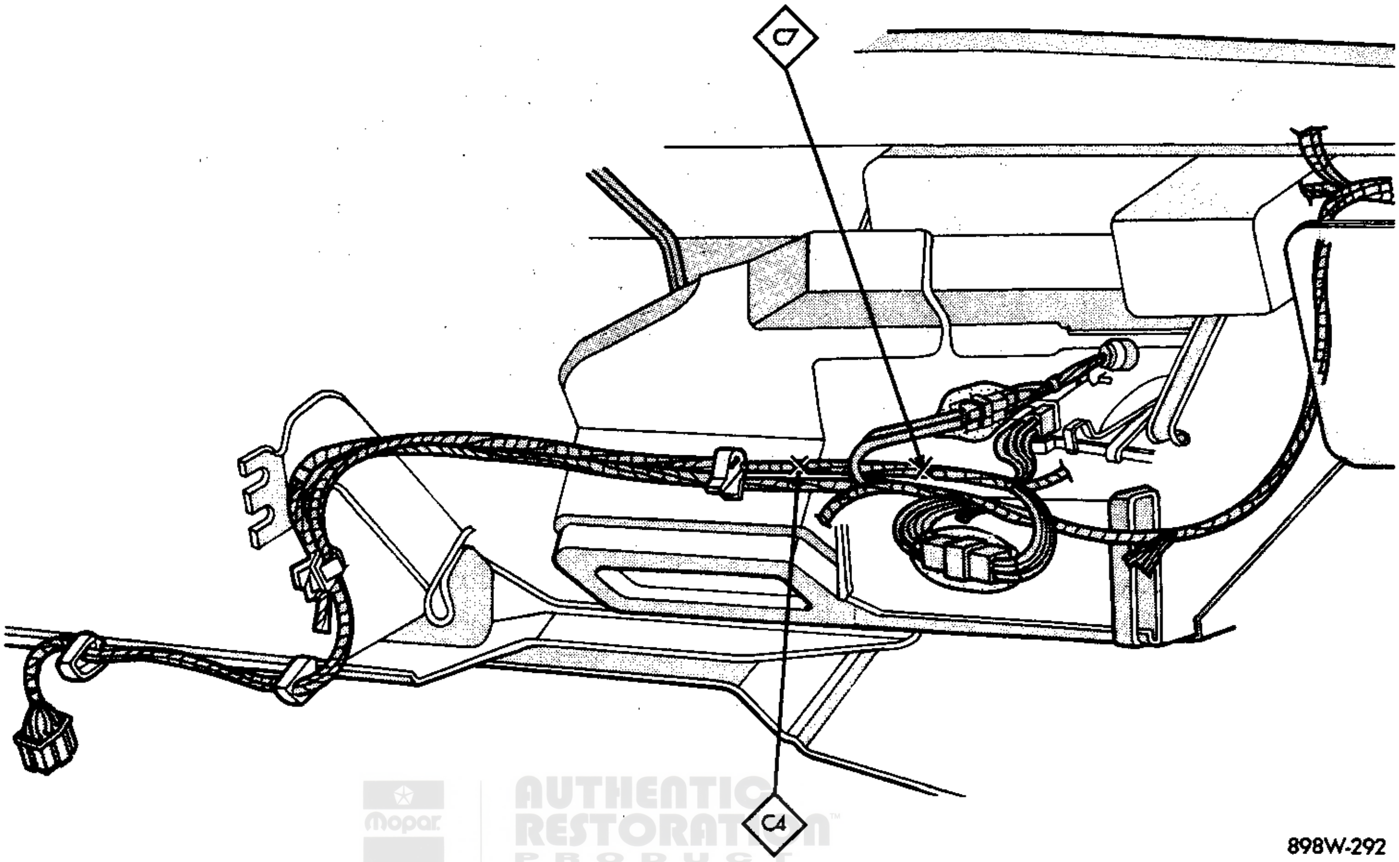


Fig. 9—Heater A/C Splices

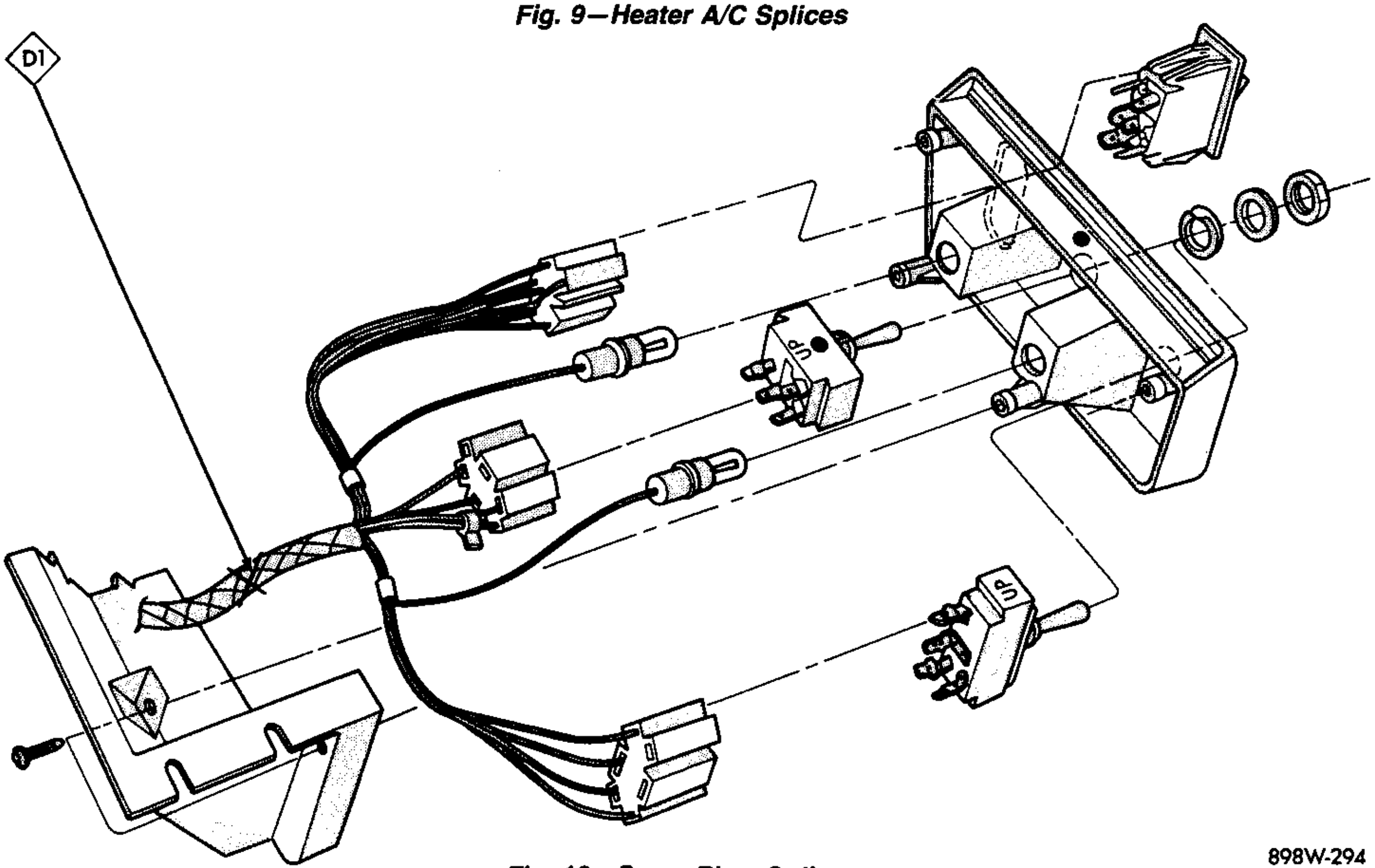
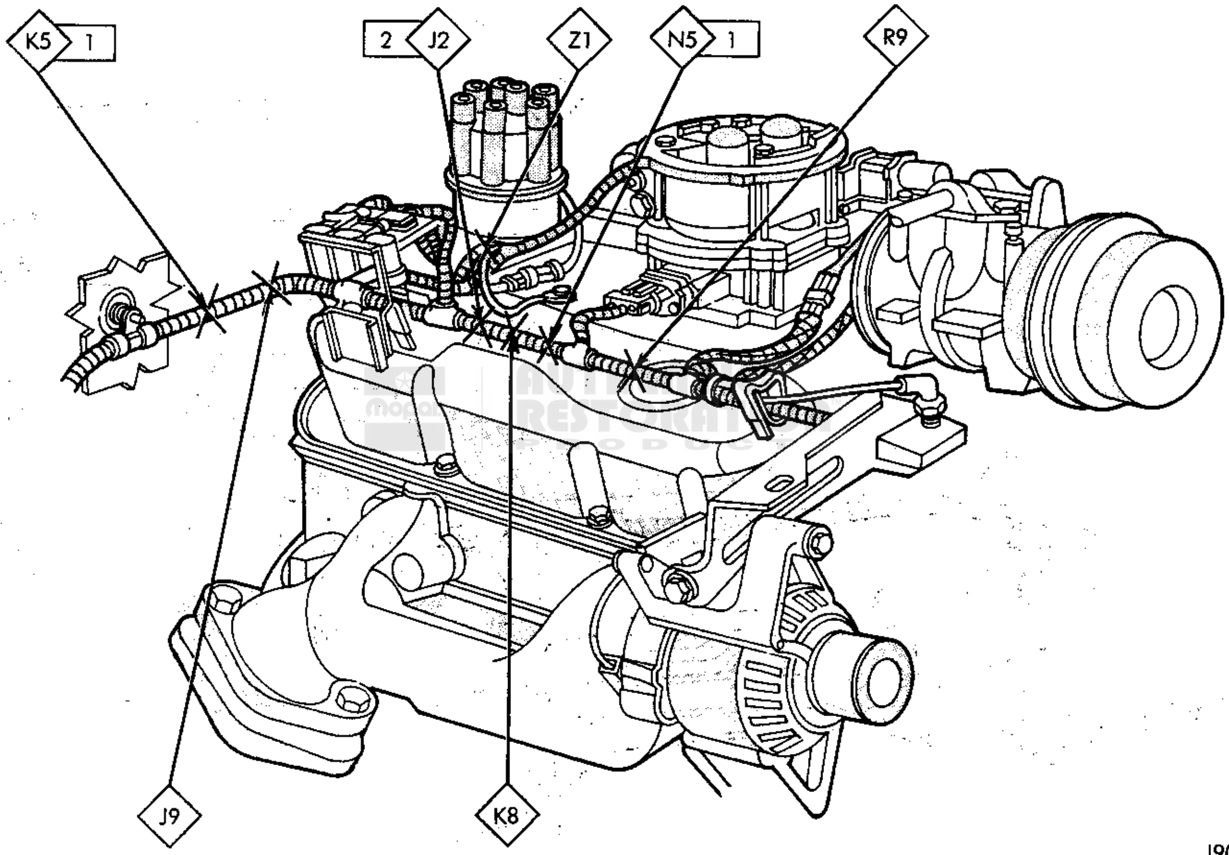


Fig. 10—Snow Plow Splices



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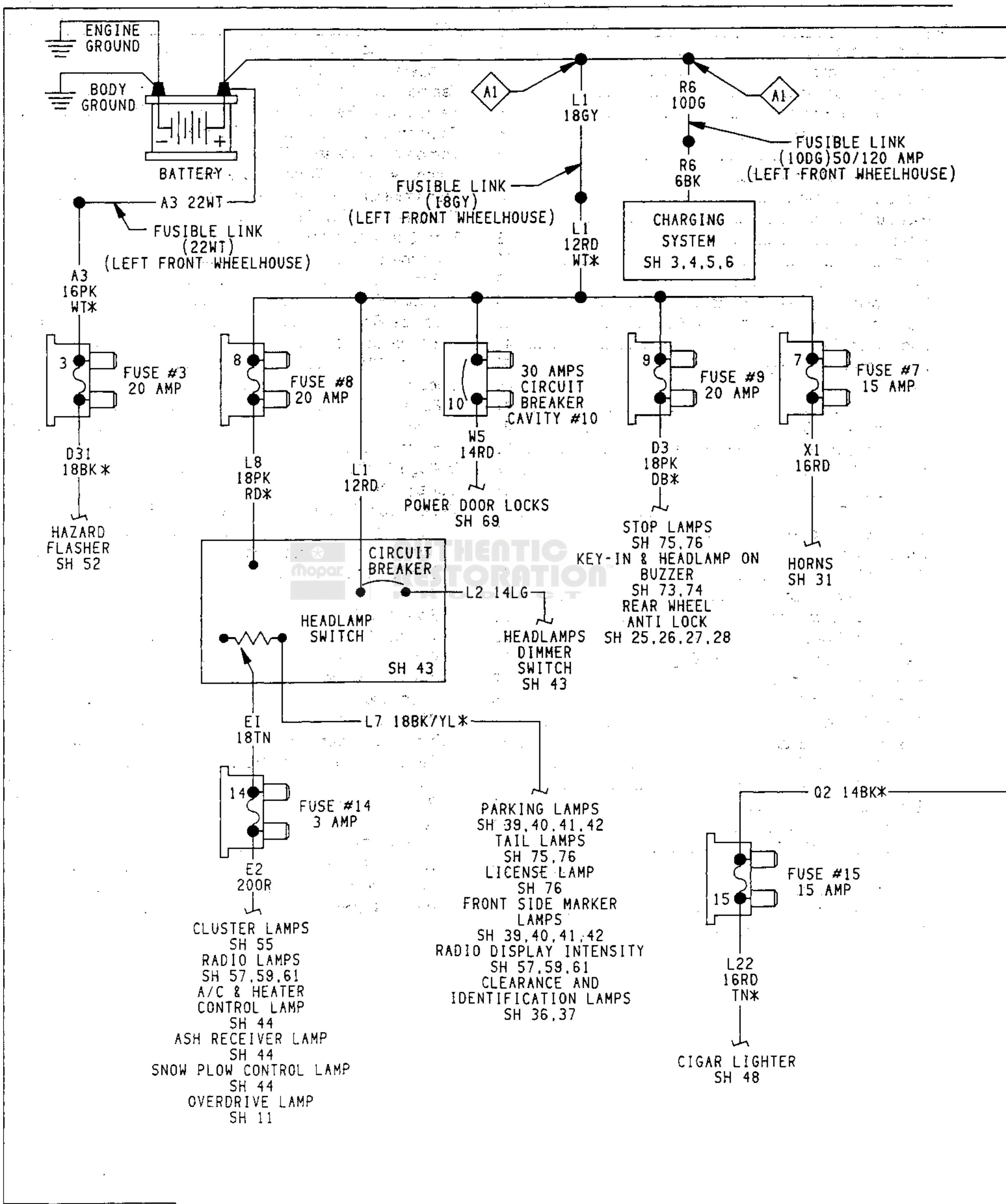
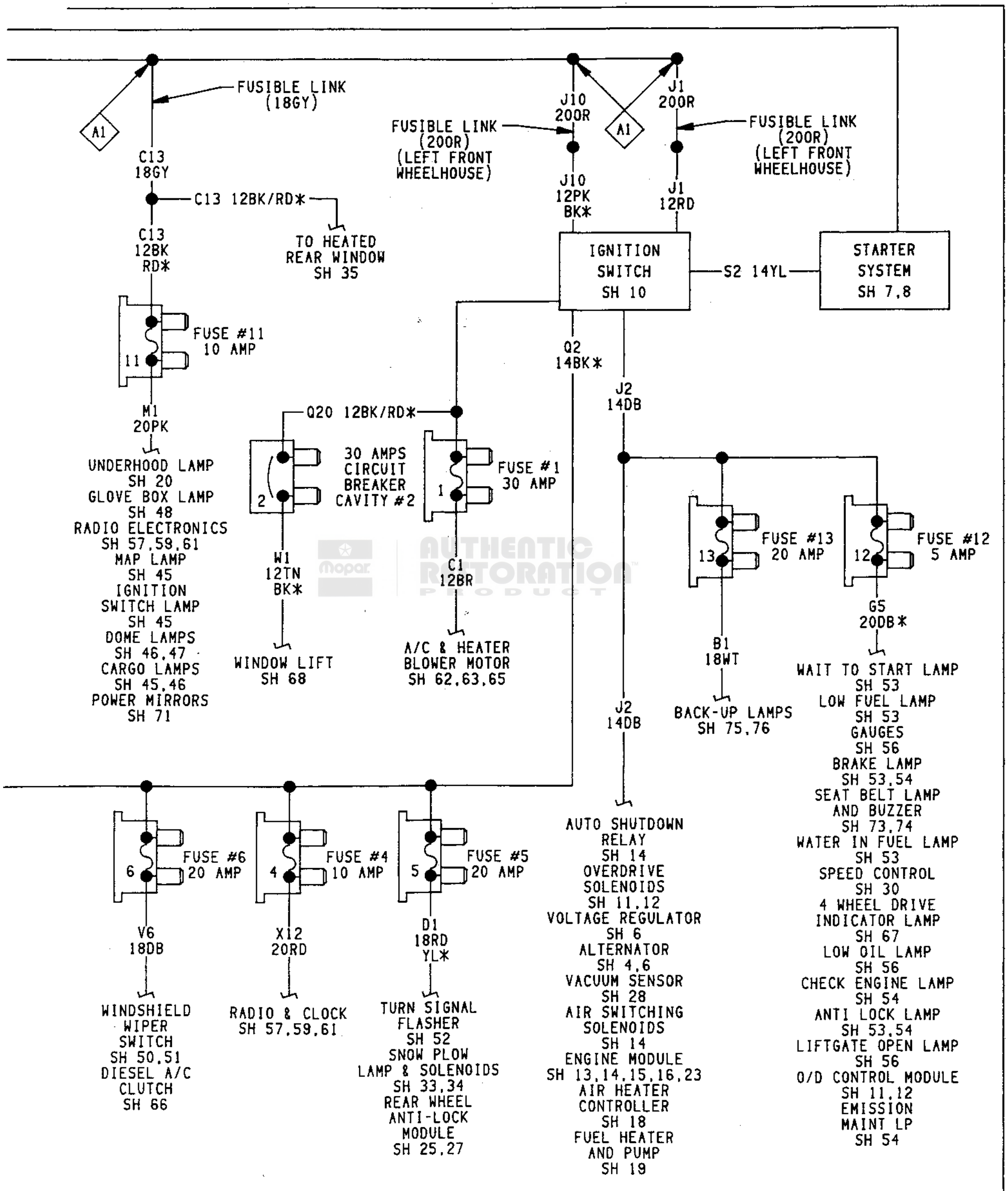


AD 1

FUSE APPLICATION CHART

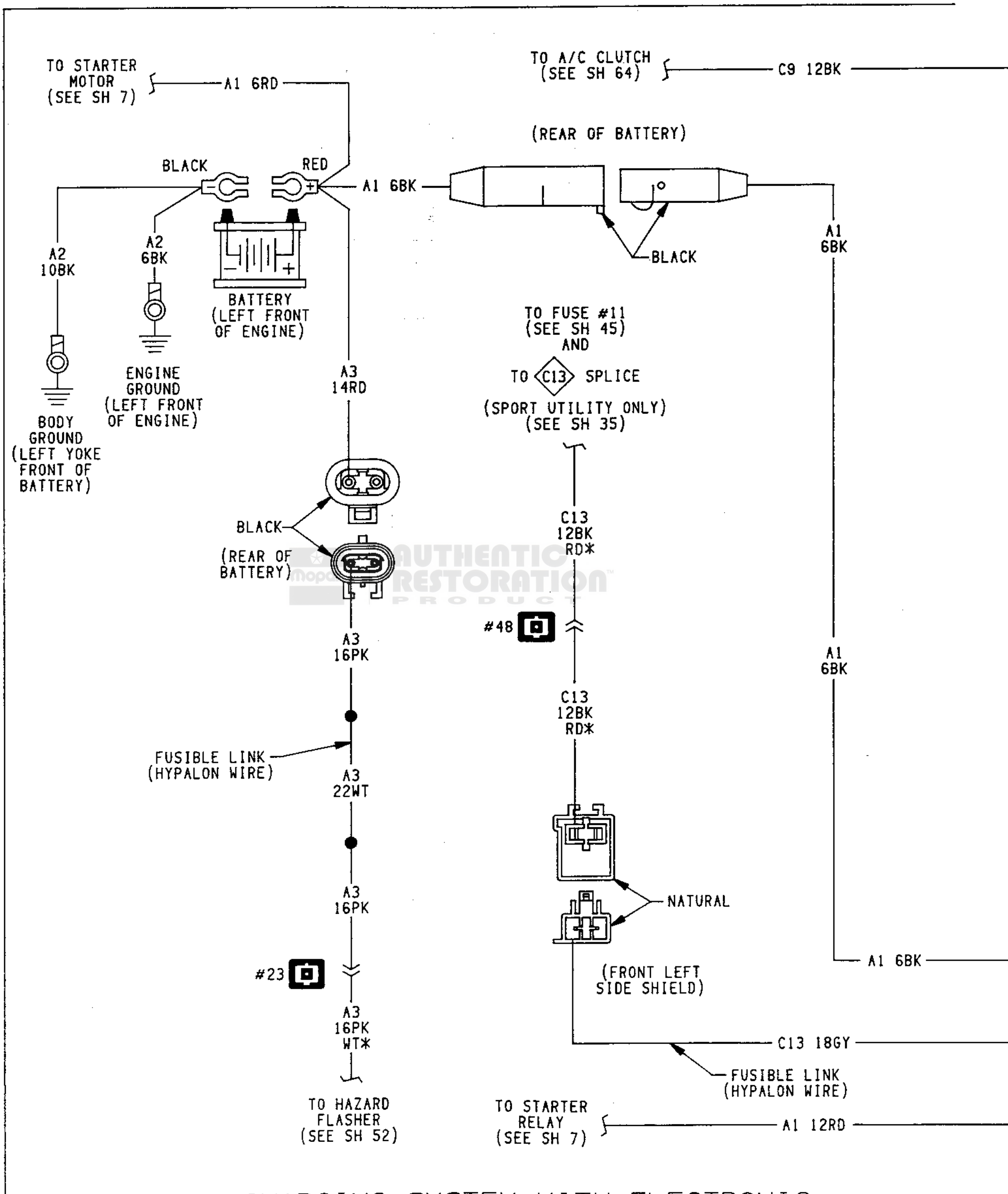
J908W-14



J908W-14

FUSE APPLICATION CHART

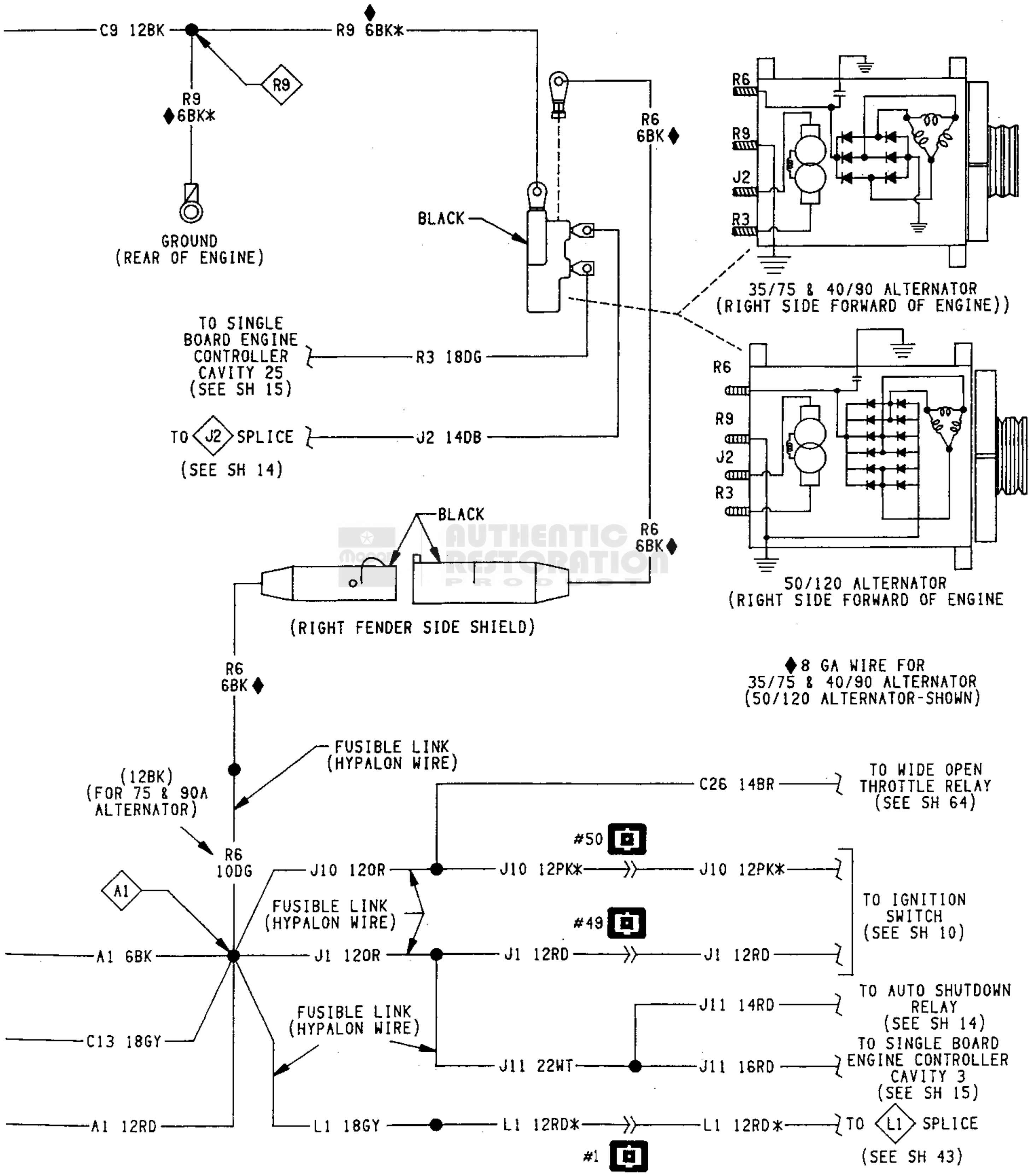
AD 2



AD 3

CHARGING SYSTEM WITH ELECTRONIC FUEL INJECTION IGNITION

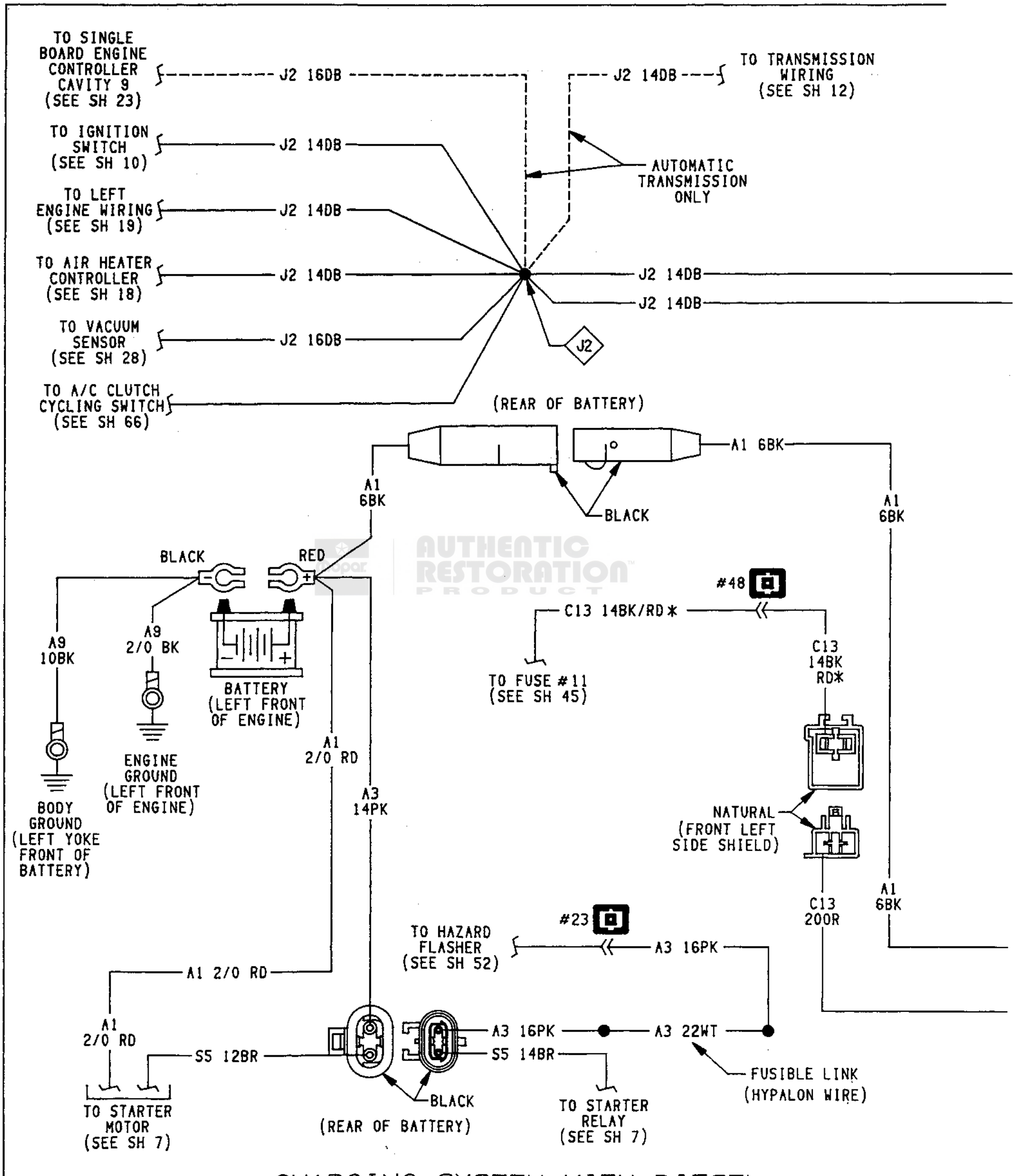
J908W-14



CHARGING SYSTEM WITH ELECTRONIC
FUEL INJECTION IGNITION

J908W-14

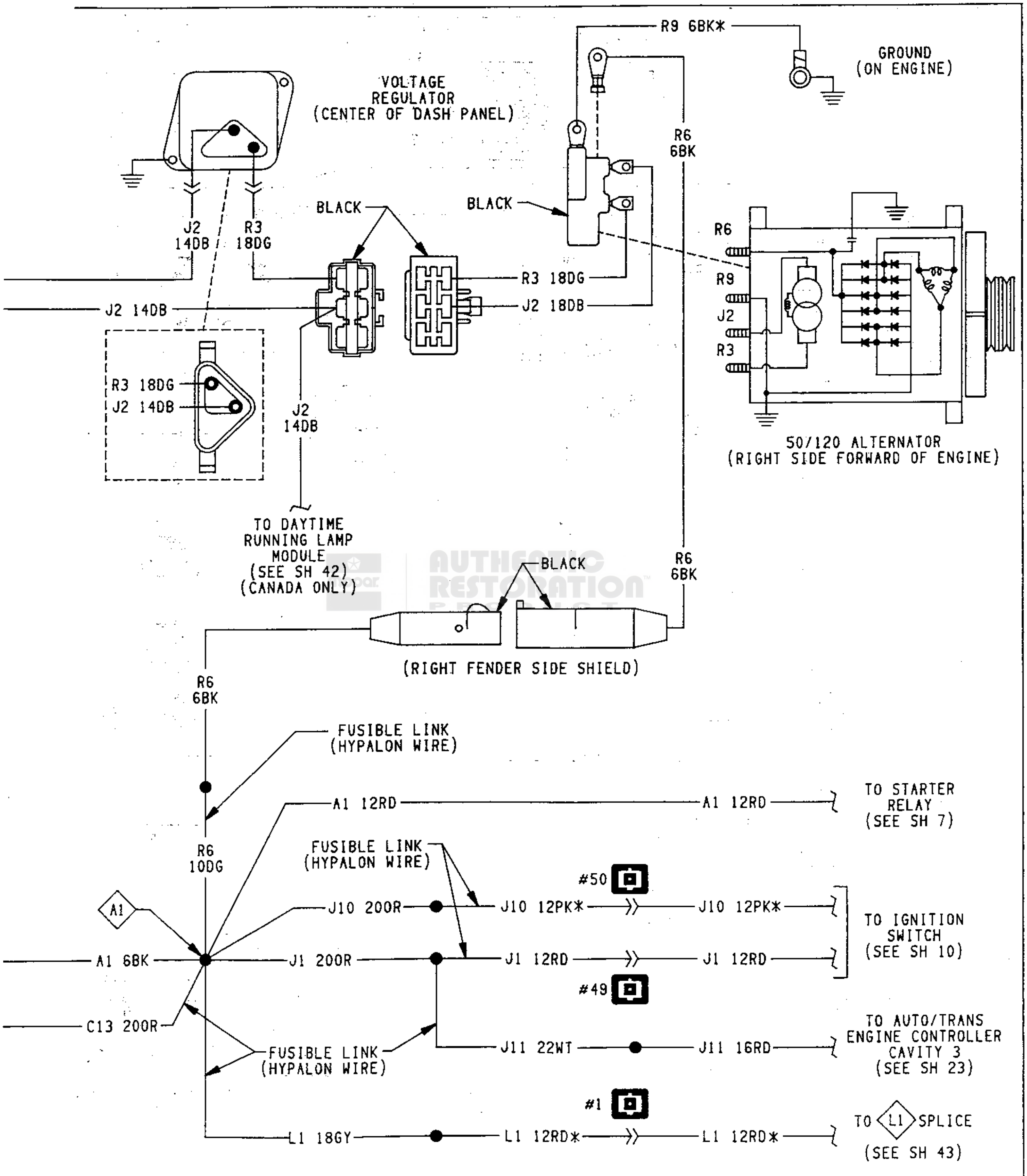
AD 4



CHARGING SYSTEM WITH DIESEL 5.9L ENGINE

AD 5

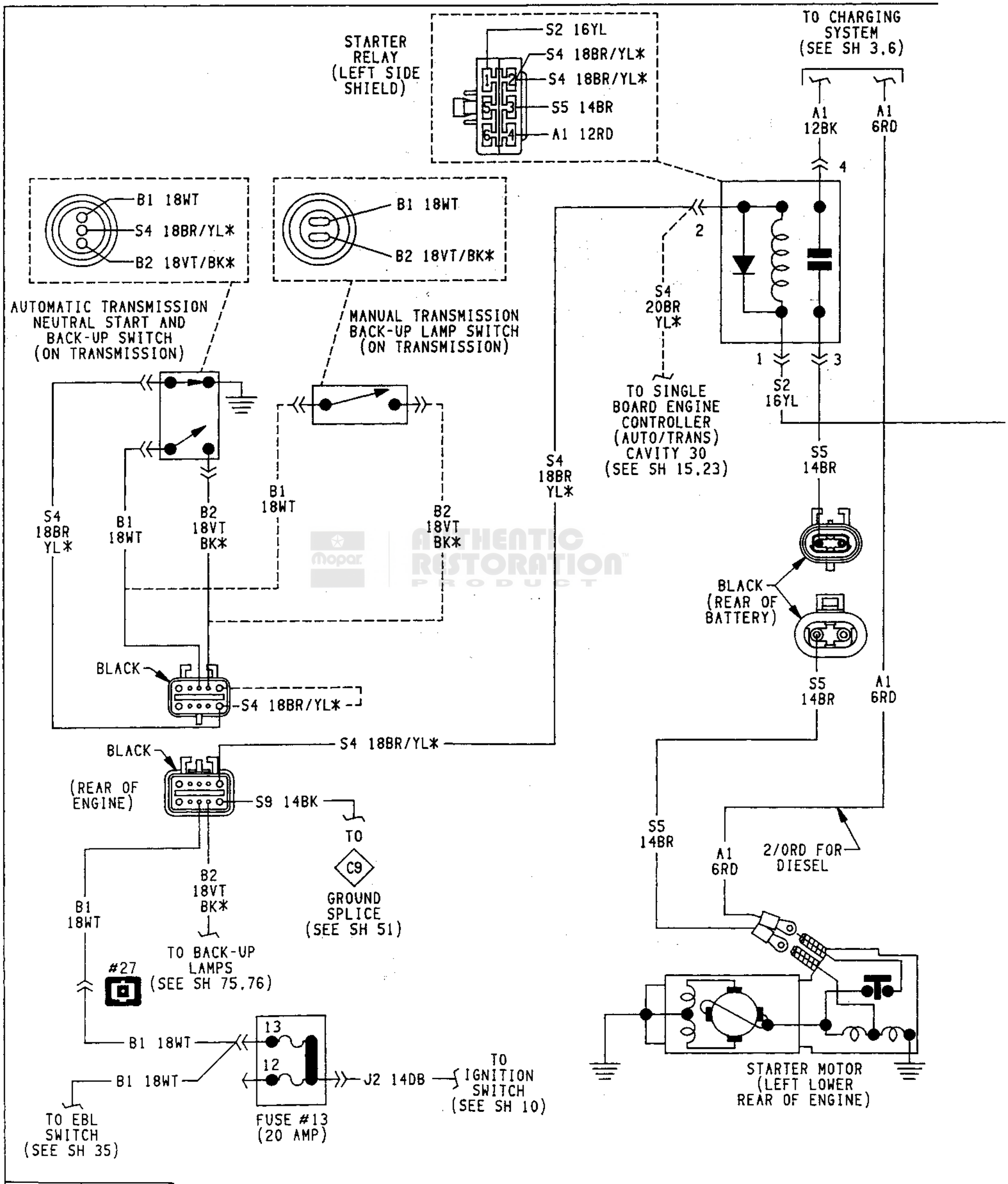
J908W-14



CHARGING SYSTEM WITH DIESEL
5.9L ENGINE

J908W-14

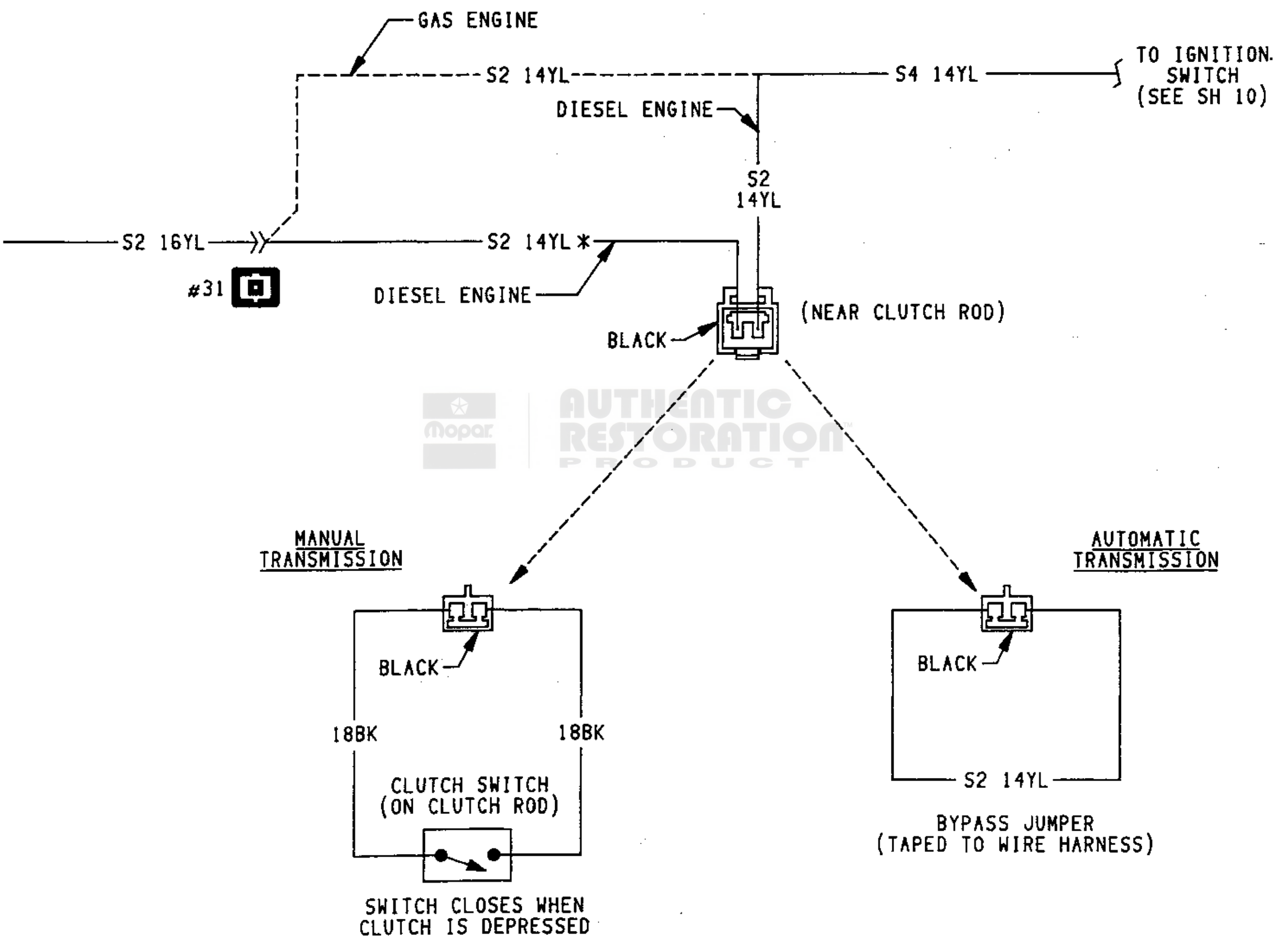
AD 6

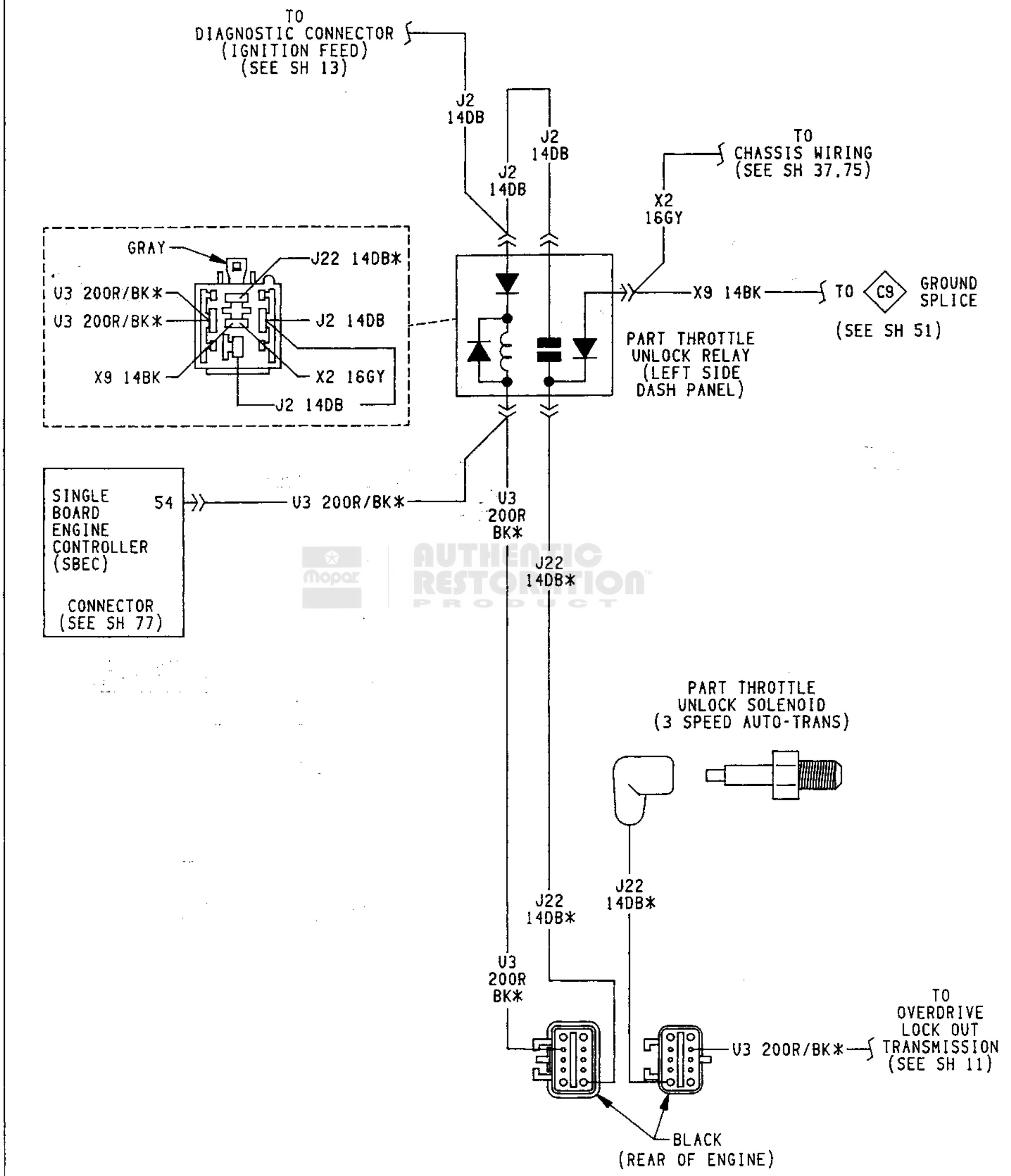


AD 7

STARTER SYSTEM

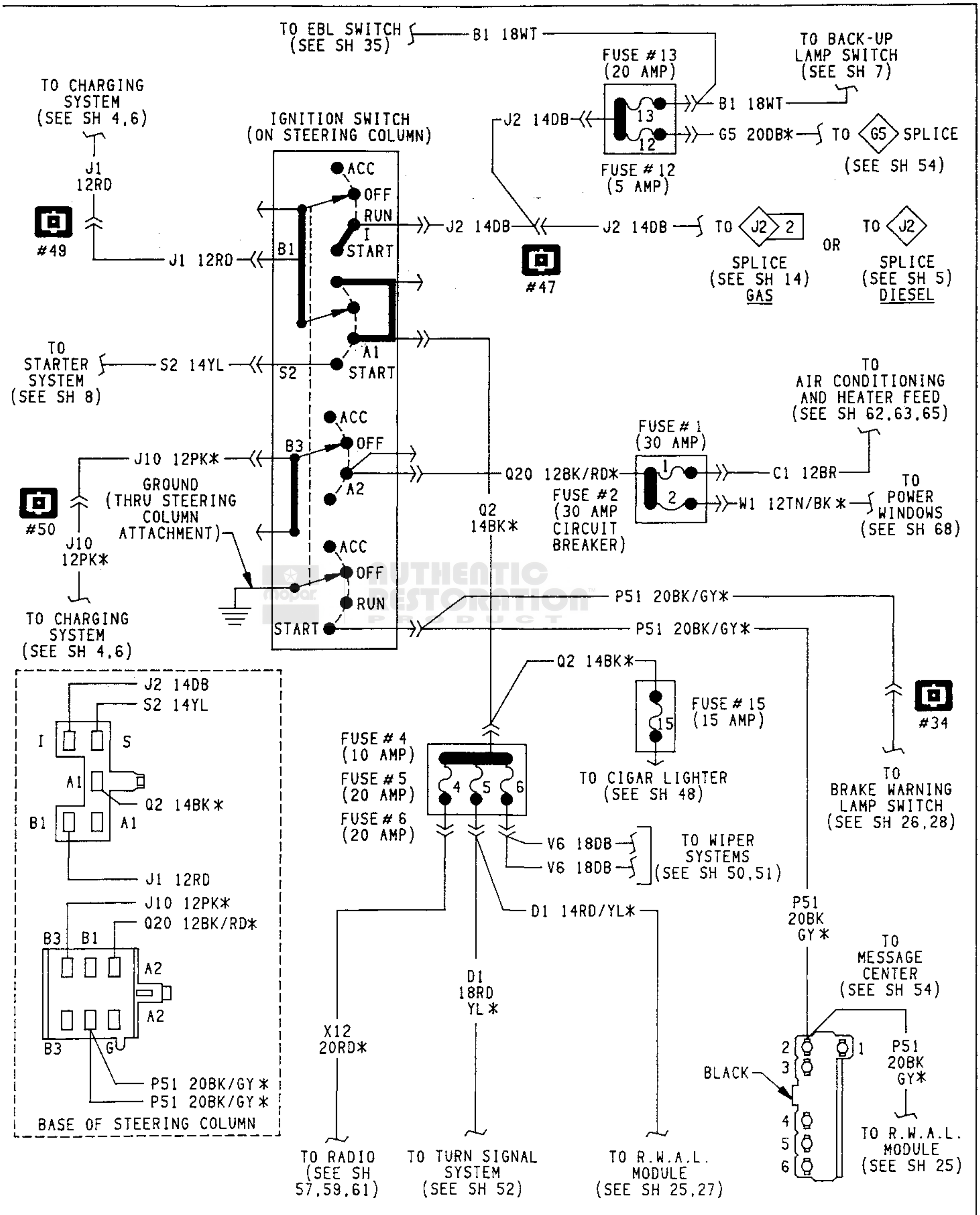
J908W-14


GAS ENGINE
S2 14YL
S4 14YL
TO IGNITION SWITCH (SEE SH 10)
DIESEL ENGINE
S2 14YL
S2 16YL
S2 14YL *
#31
DIESEL ENGINE
(NEAR CLUTCH ROD)
BLACK
MANUAL TRANSMISSION
AUTOMATIC TRANSMISSION
BLACK
18BK
18BK
CLUTCH SWITCH (ON CLUTCH ROD)
SWITCH CLOSES WHEN CLUTCH IS DEPRESSED
BLACK
S2 14YL
BYPASS JUMPER (TAPED TO WIRE HARNESS)



PART THROTTLE UNLOCK
3-SPEED AUTOMATIC TRANSMISSION

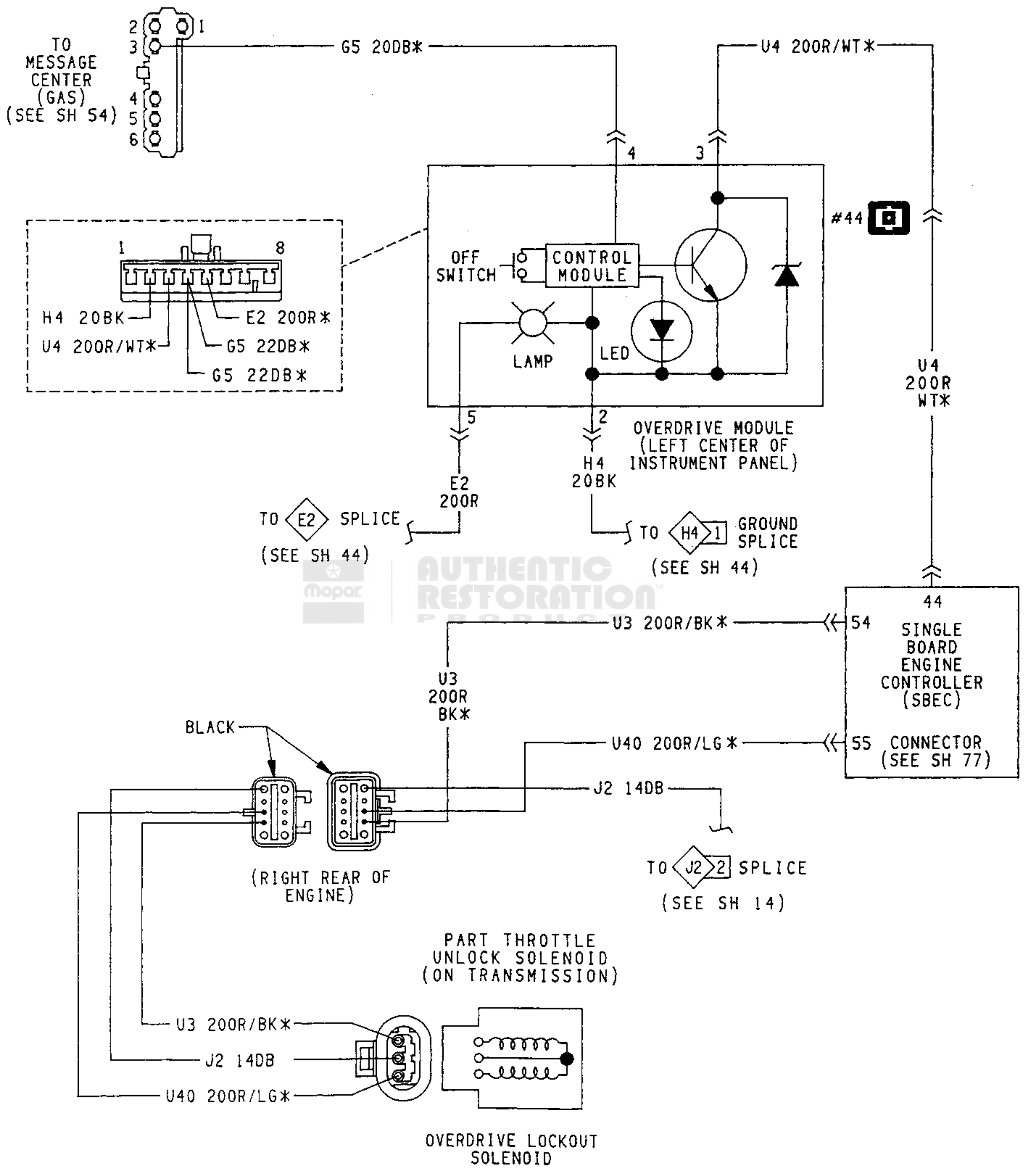
J908W-14



J908W-14

IGNITION SWITCH

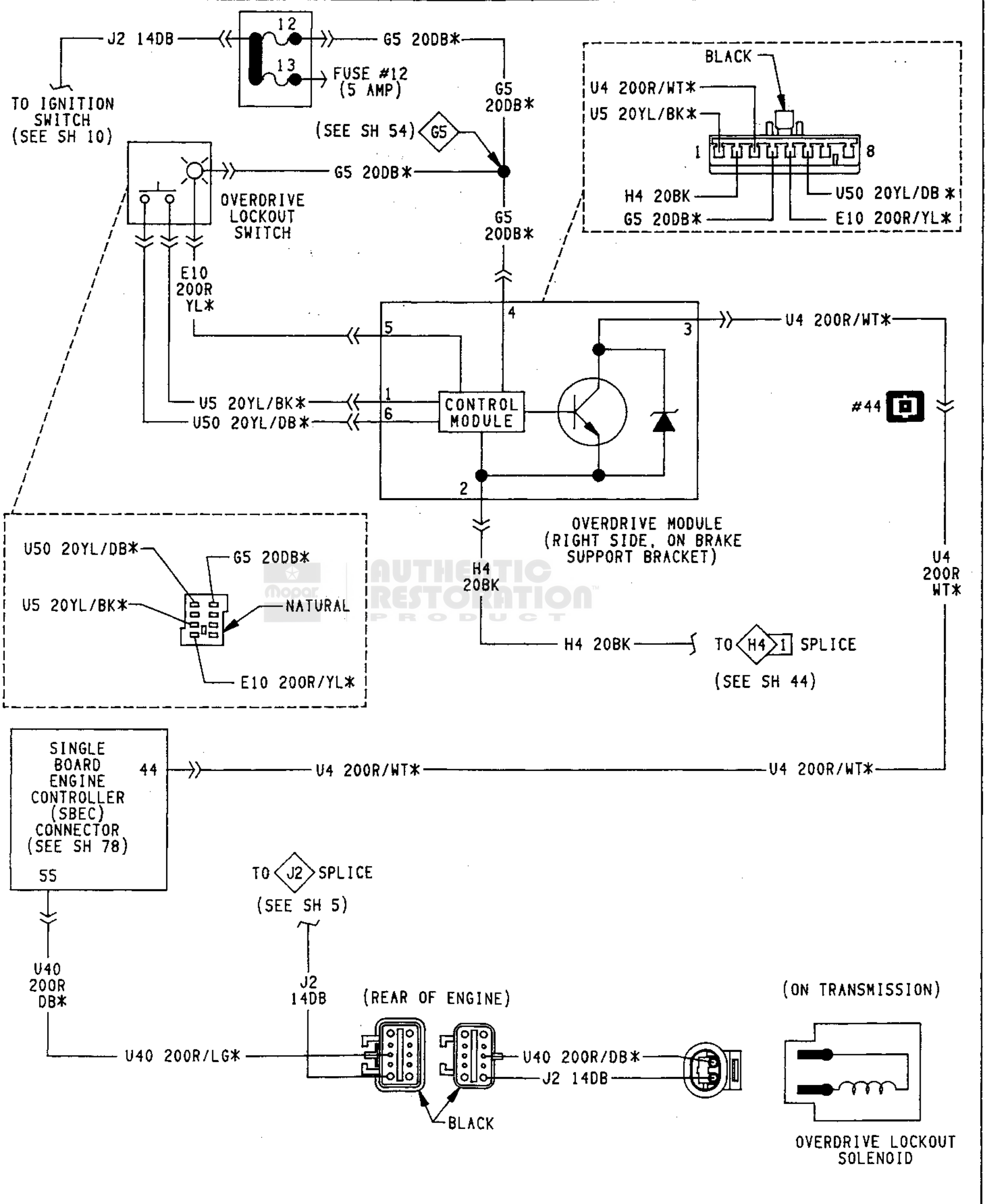
AD 10



AD 11

OVERDRIVE LOCKOUT SYSTEM (GAS)
(A518 AUTO/TRANSMISSION)

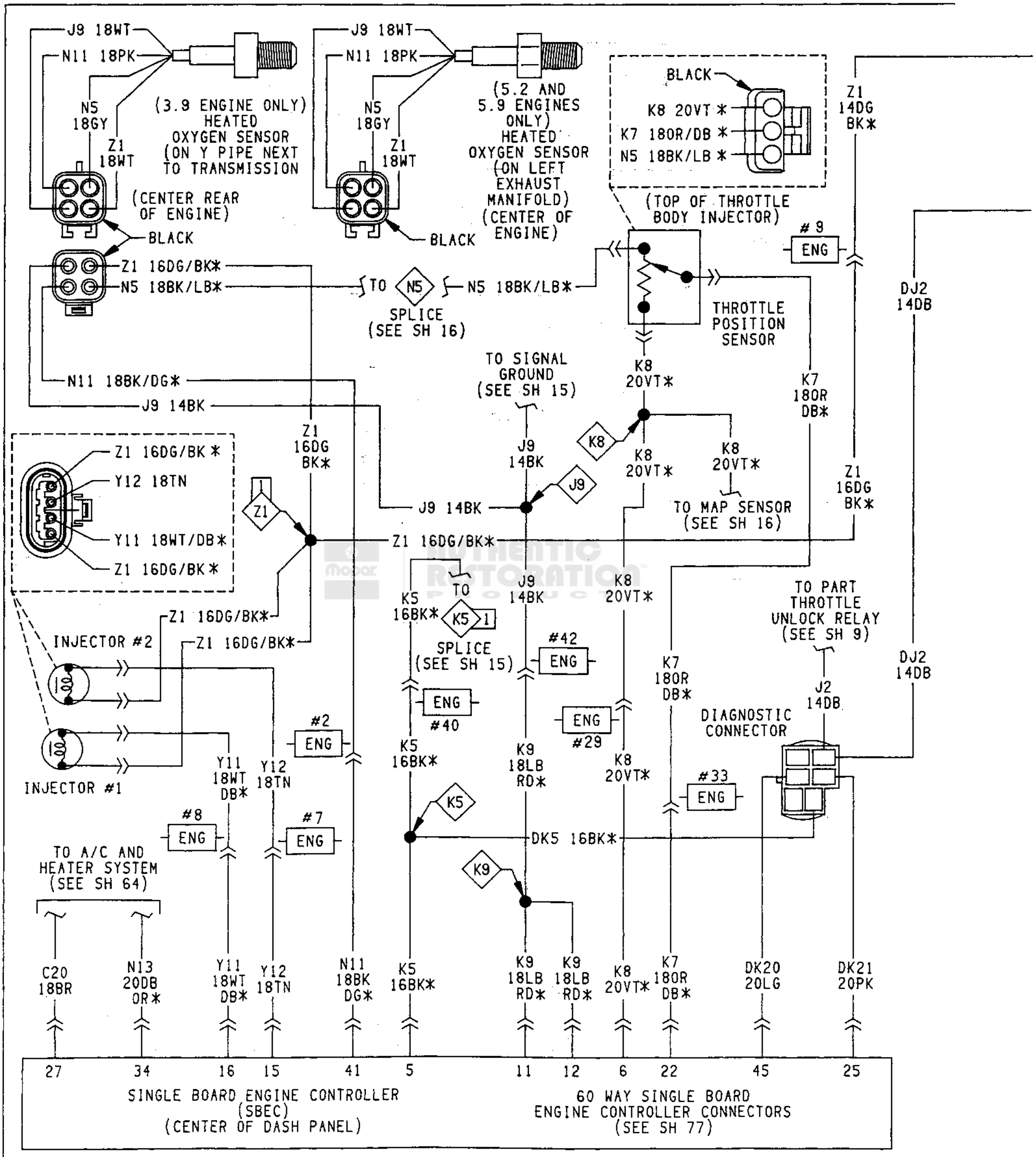
J908W-14



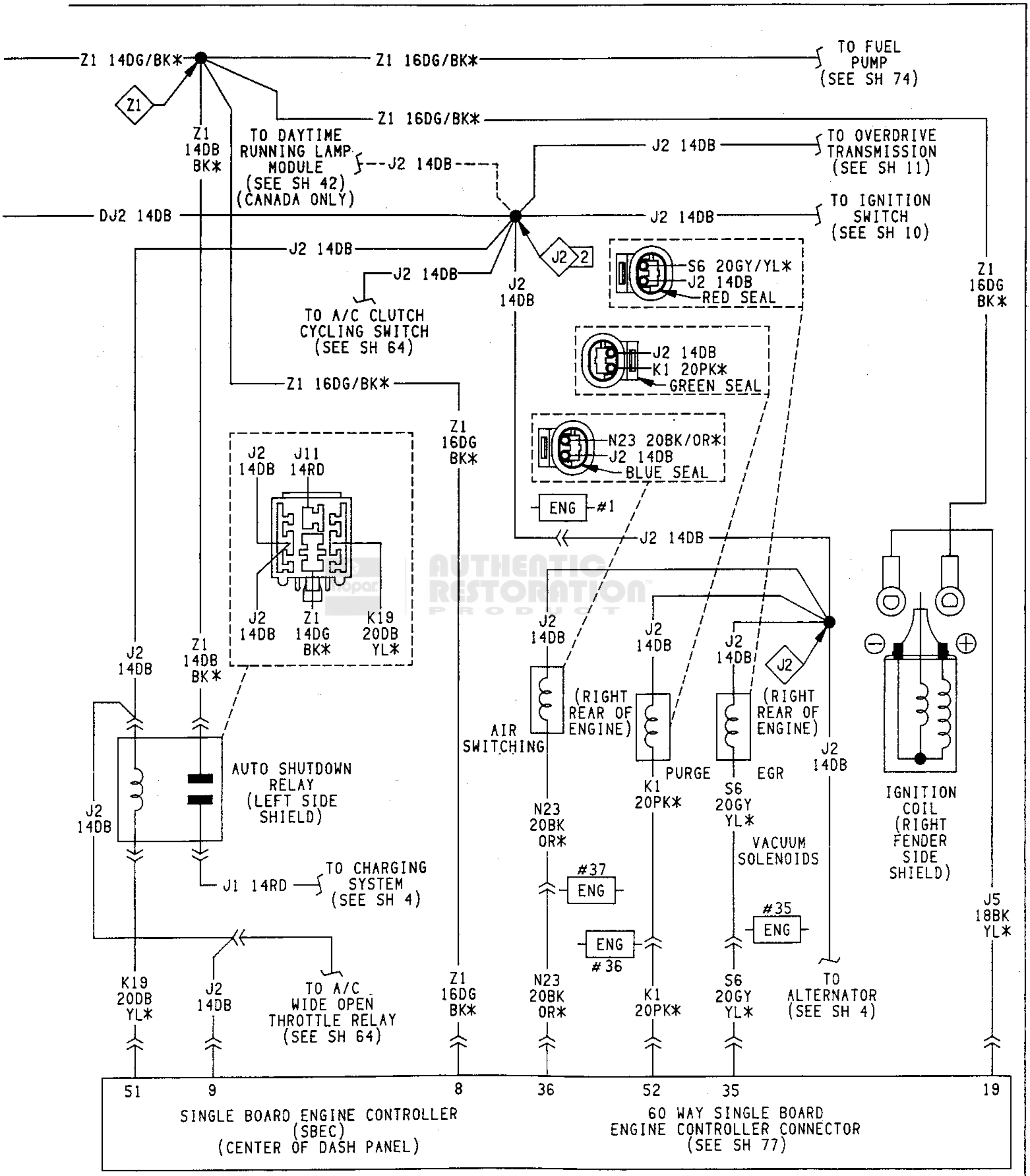
OVERDRIVE LOCKOUT SYSTEM (DIESEL)
(A518 AUTO/TRANSMISSION)

J908W-14

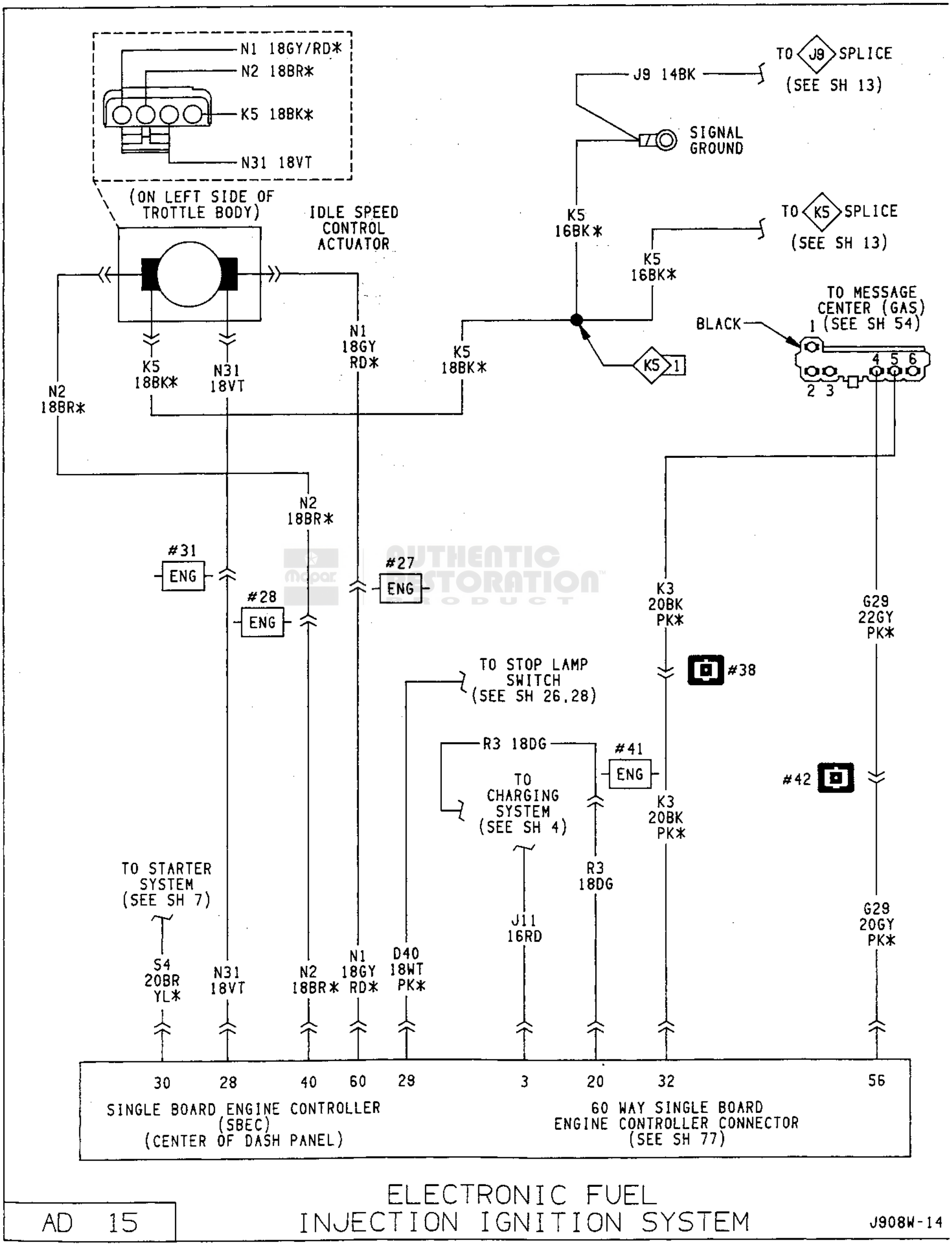
AD 12



ELECTRONIC FUEL
INJECTION IGNITION SYSTEM



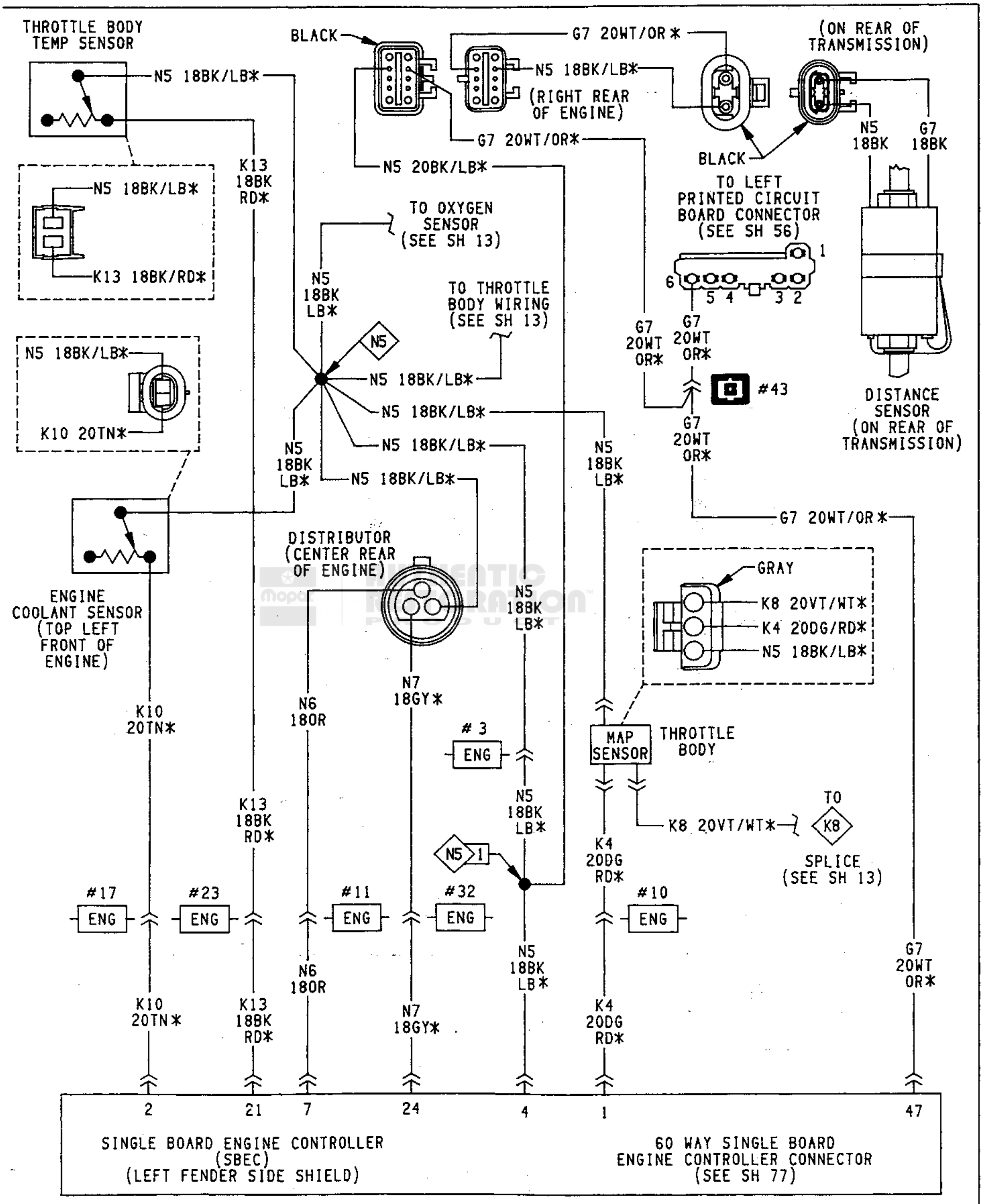
ELECTRONIC FUEL INJECTION IGNITION SYSTEM



AD 15

ELECTRONIC FUEL INJECTION IGNITION SYSTEM

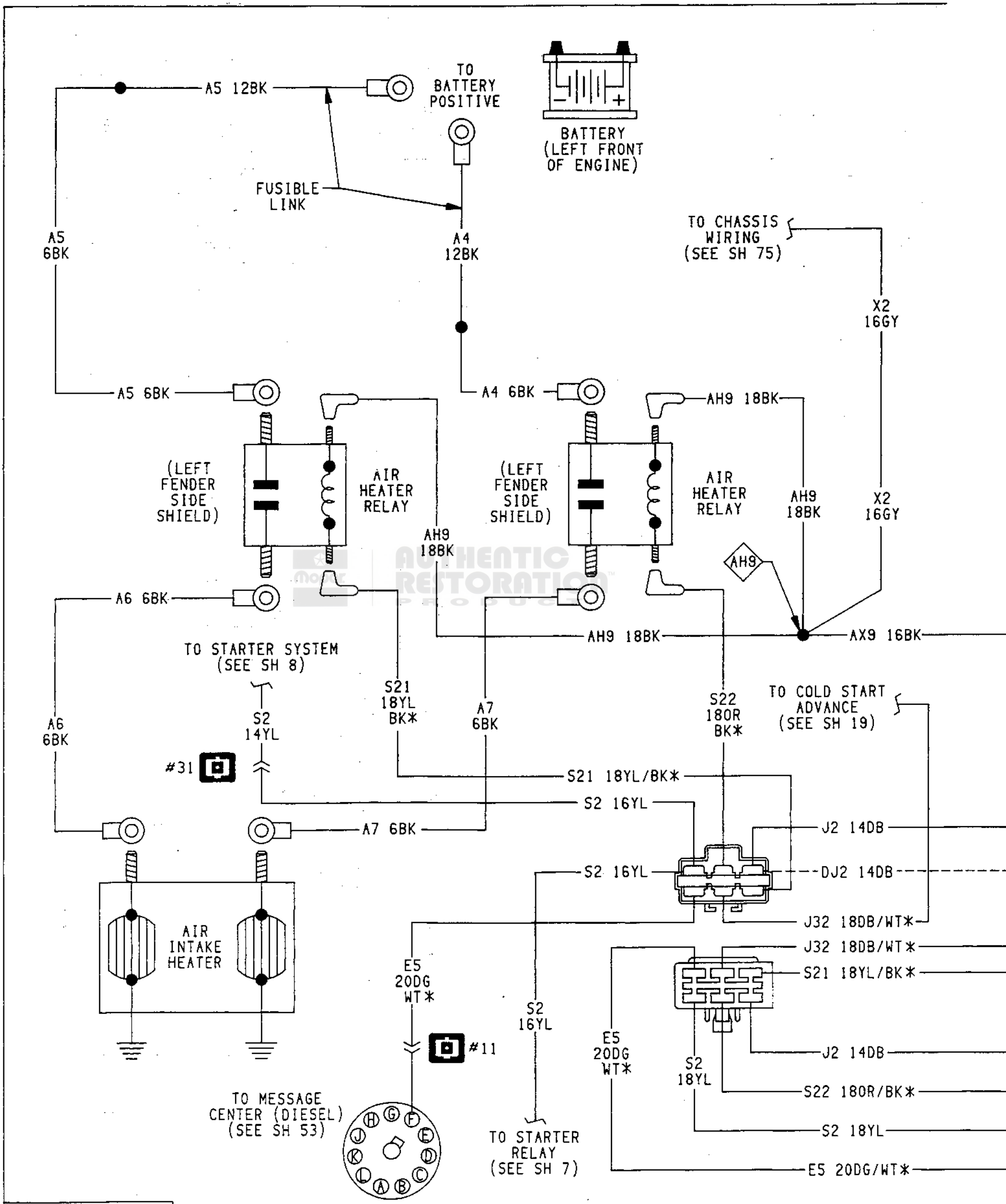
J908W-14



J908W-14

ELECTRONIC FUEL INJECTION IGNITION SYSTEM

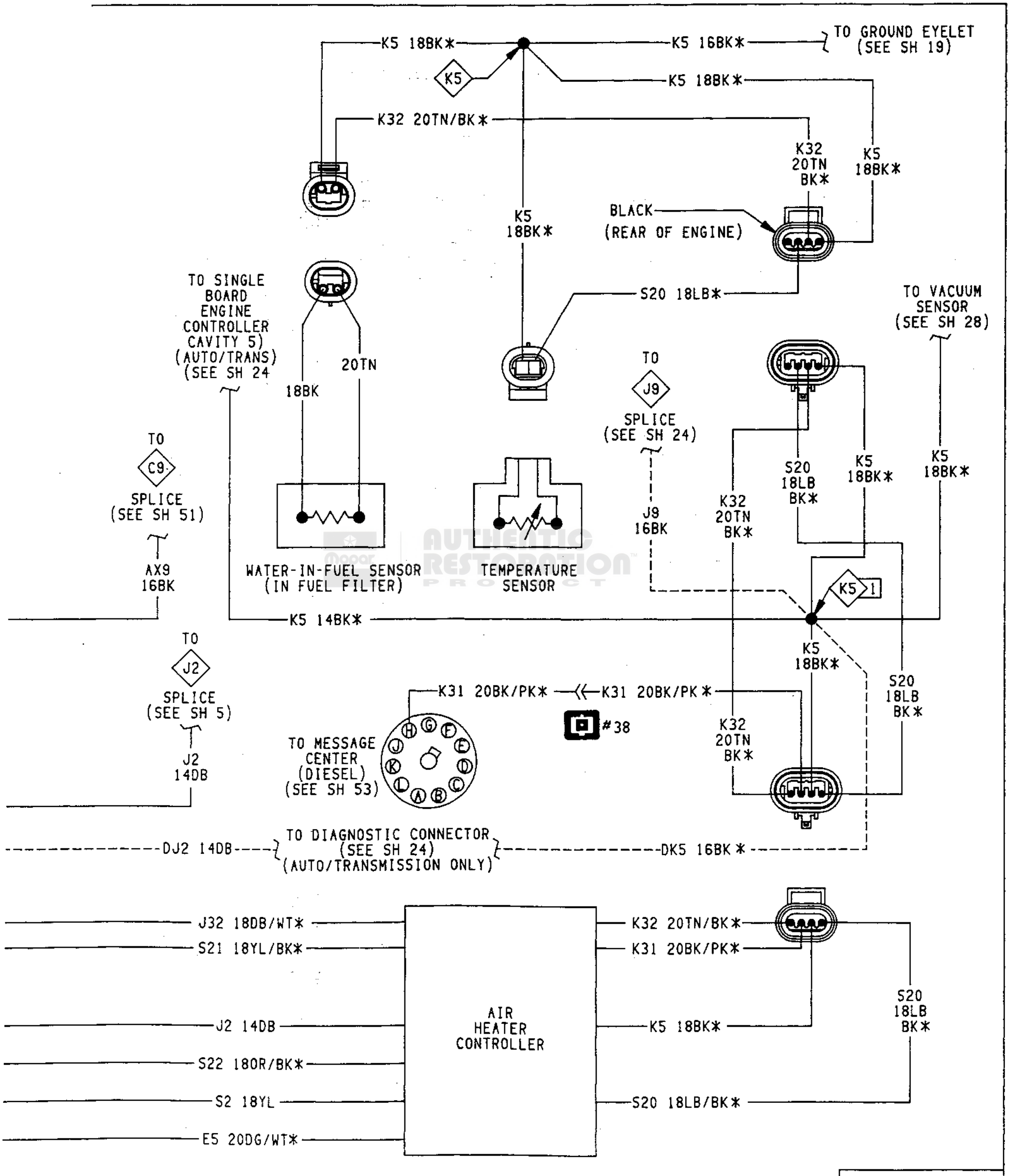
AD 16



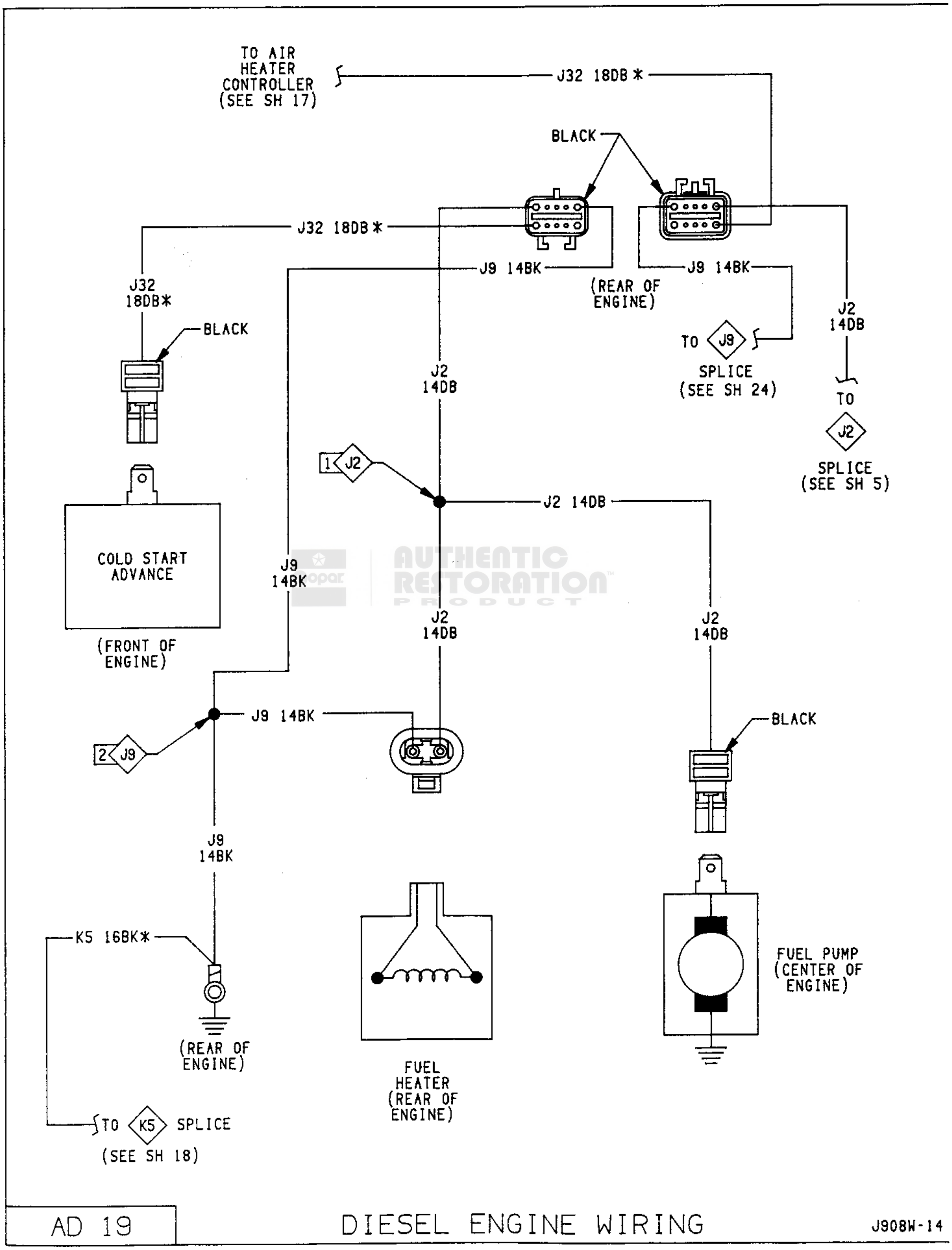
AD 17

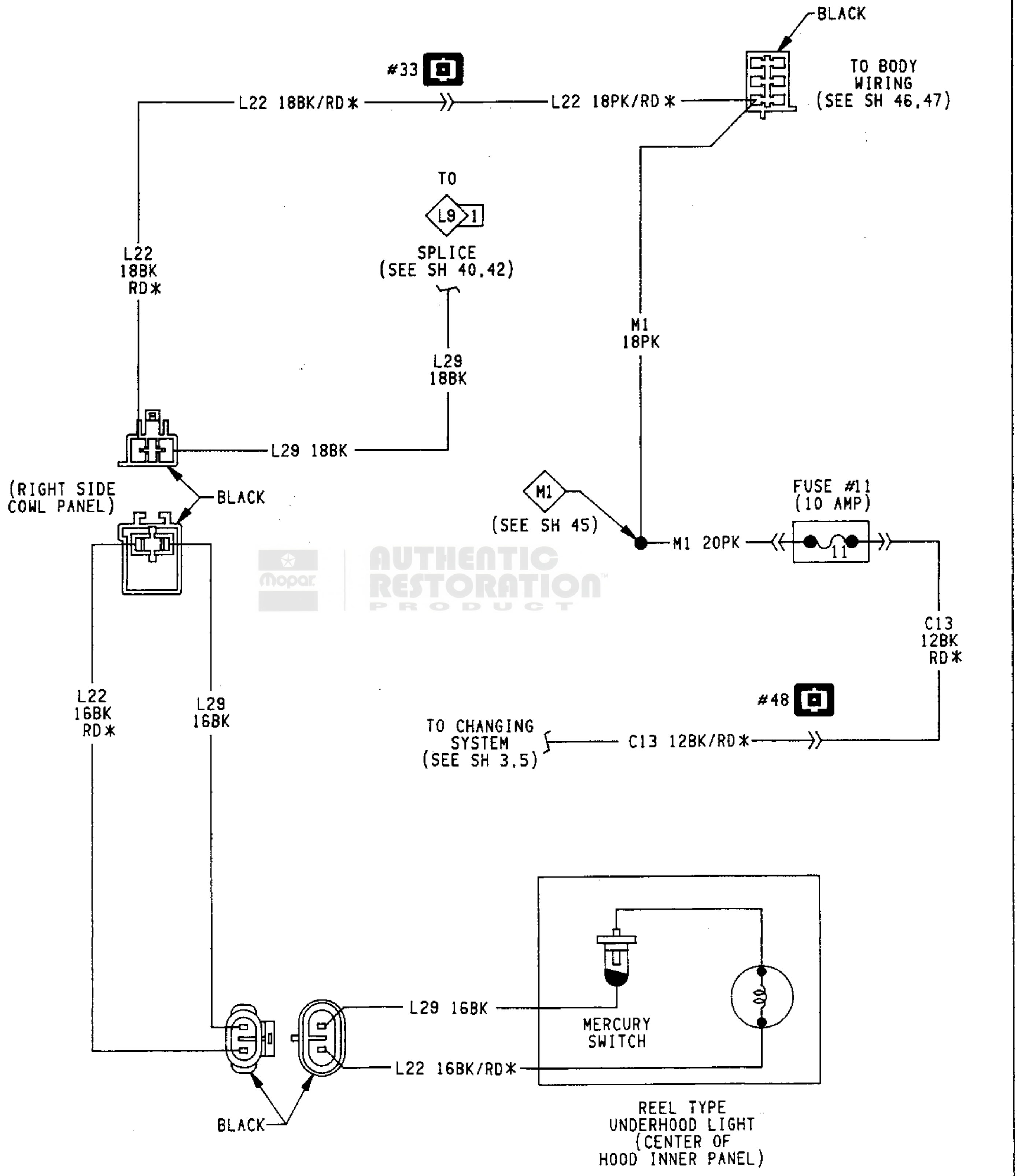
DIESEL ENGINE WIRING

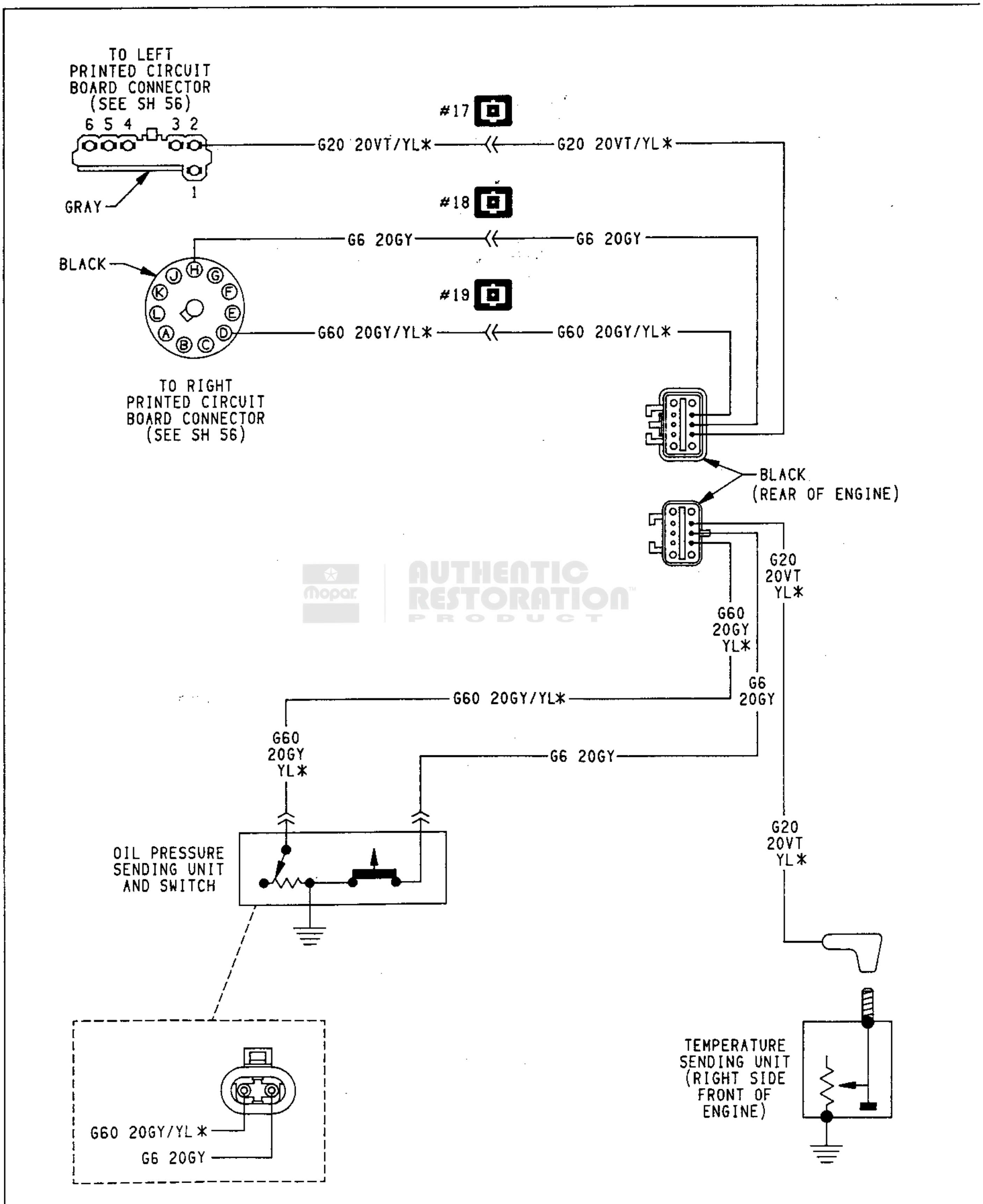
J908W-14



J908W-14 DIESEL ENGINE WIRING AD 18

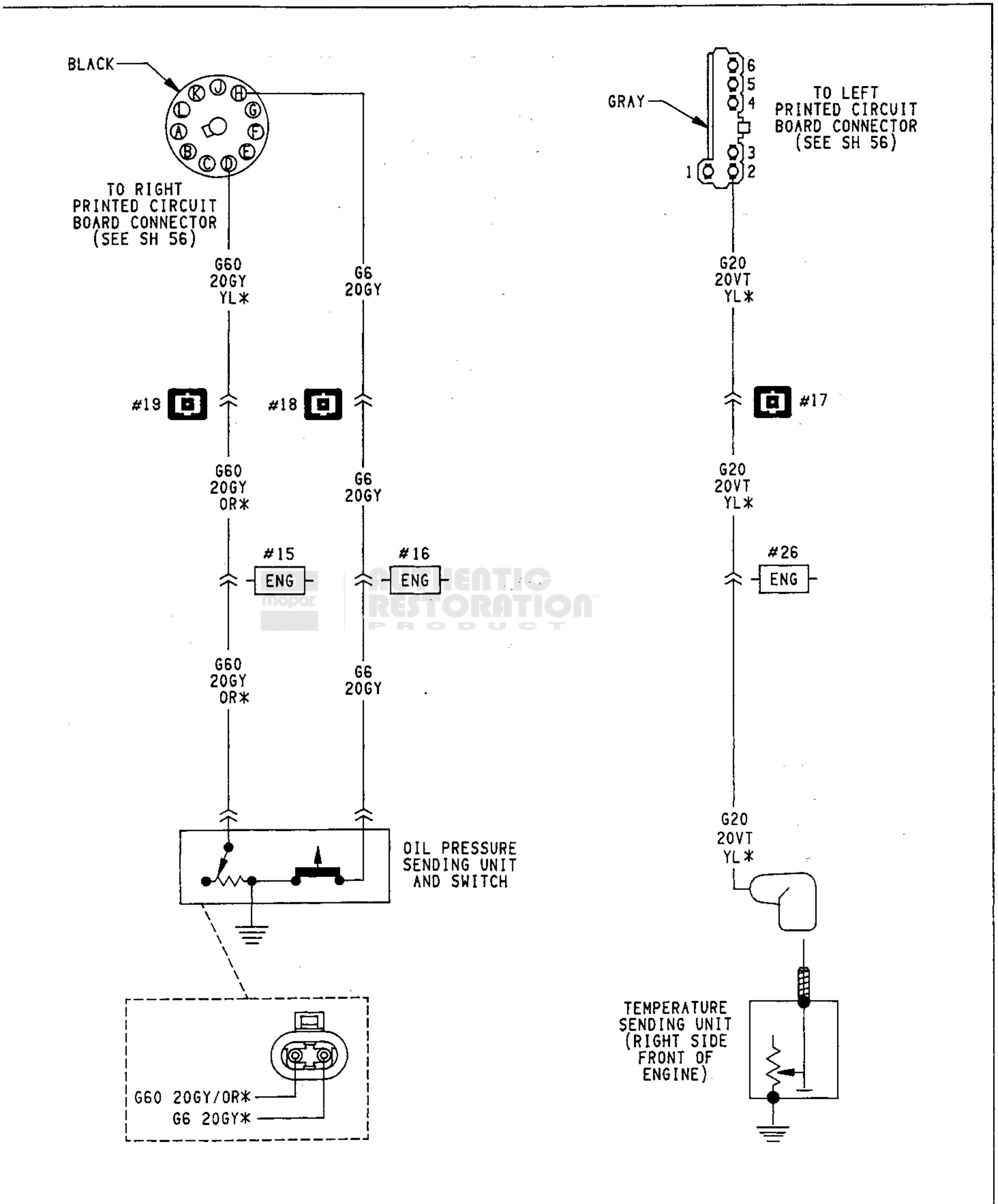

TO AIR
HEATER
CONTROLLER
(SEE SH 17)
J32 18DB *
BLACK
J32 18DB *
J9 14BK
(REAR OF
ENGINE)
J9 14BK
J32
18DB*
BLACK
J2
14DB
TO
J9
SPLICE
(SEE SH 24)
J2
14DB
TO
J2
SPLICE
(SEE SH 5)
1
J2
J2 14DB
COLD START
ADVANCE
(FRONT OF
ENGINE)
J9
14BK
J2
14DB
J2
14DB
J9 14BK
2
J9
BLACK
J9
14BK
K5 16BK*
(REAR OF
ENGINE)
FUEL
HEATER
(REAR OF
ENGINE)
FUEL PUMP
(CENTER OF
ENGINE)
TO
K5
SPLICE
(SEE SH 18)
AD 19
DIESEL ENGINE WIRING
J908W-14


BLACK
#33
L22 18BK/RD*
L22 18PK/RD*
TO BODY WIRING (SEE SH 46,47)
TO
L9 1
SPLICE (SEE SH 40,42)
L22 18BK RD*
L29 18BK
M1 18PK
L29 18BK
(RIGHT SIDE COWL PANEL)
BLACK
M1
(SEE SH 45)
M1 20PK
FUSE #11 (10 AMP)
11
C13 12BK RD*
#48
TO CHANGING SYSTEM (SEE SH 3,5)
C13 12BK/RD*
L22 16BK RD*
L29 16BK
L29 16BK
MERCURY SWITCH
L22 16BK/RD*
BLACK
REEL TYPE UNDERHOOD LIGHT (CENTER OF HOOD INNER PANEL)



OIL PRESSURE AND TEMPERATURE
SYSTEM FOR DIESEL ENGINE

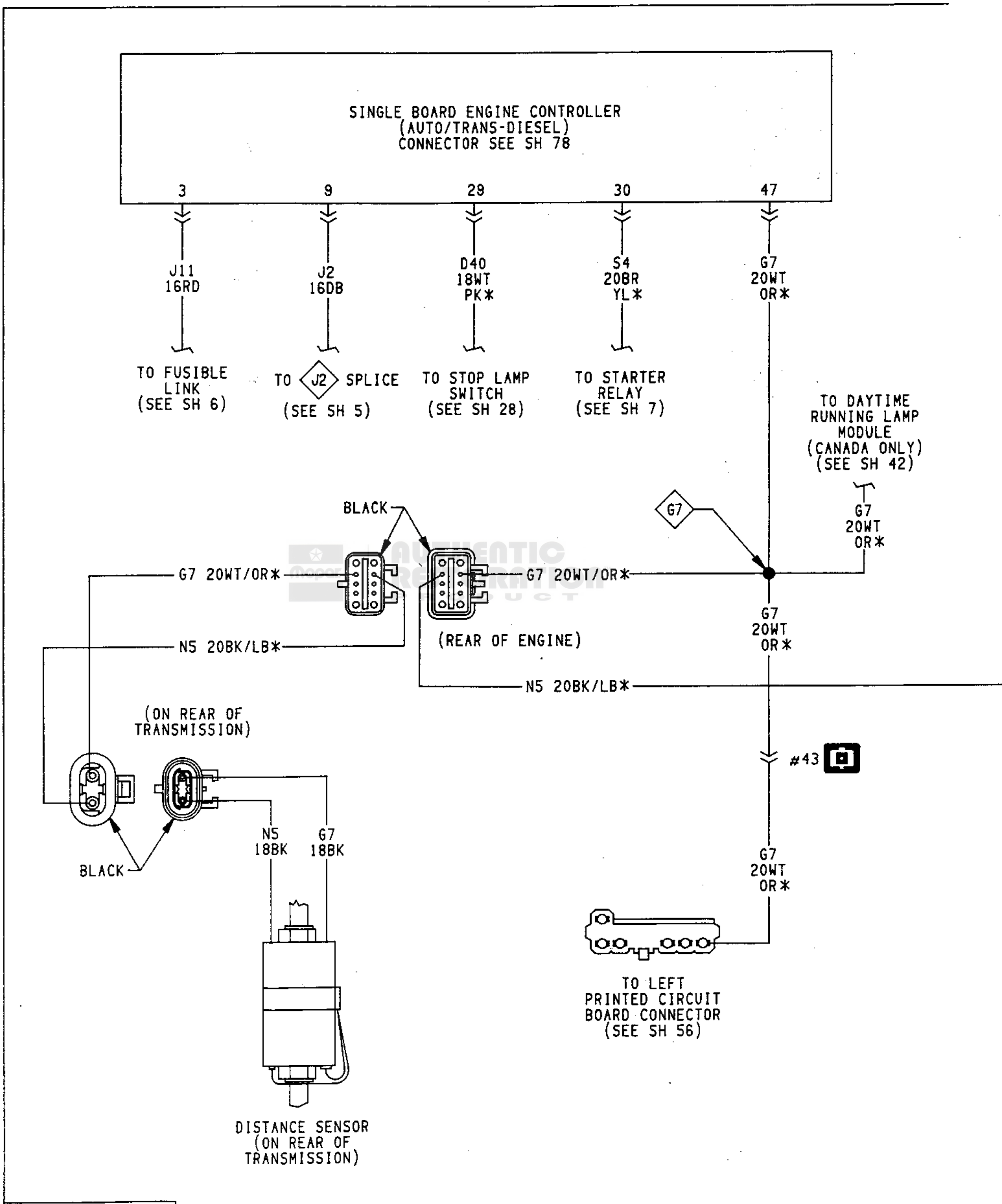
J908W-14



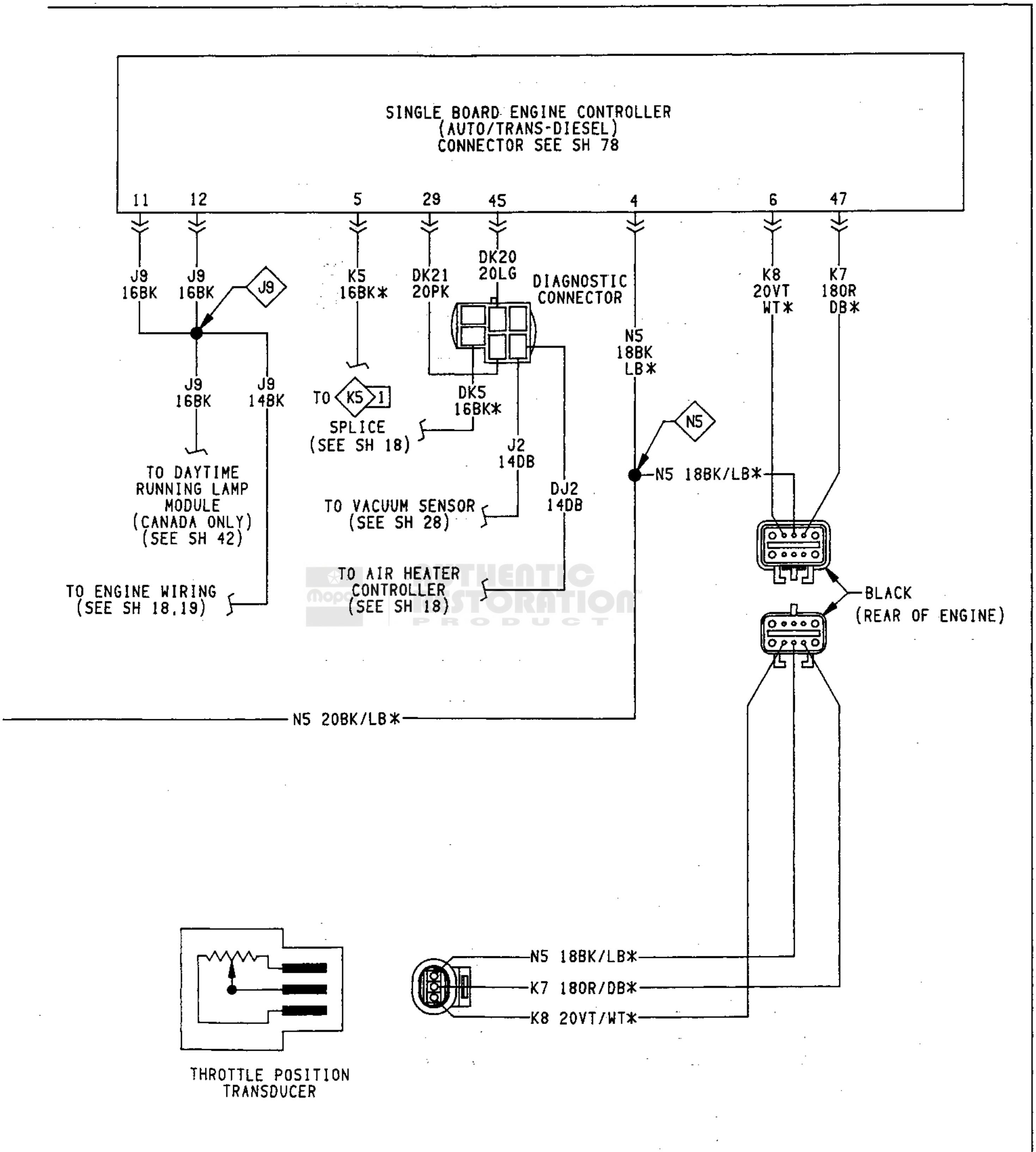
OIL PRESSURE AND TEMPERATURE SYSTEM
FOR ELECTRONIC
FUEL INJECTION IGNITION

J908W-14

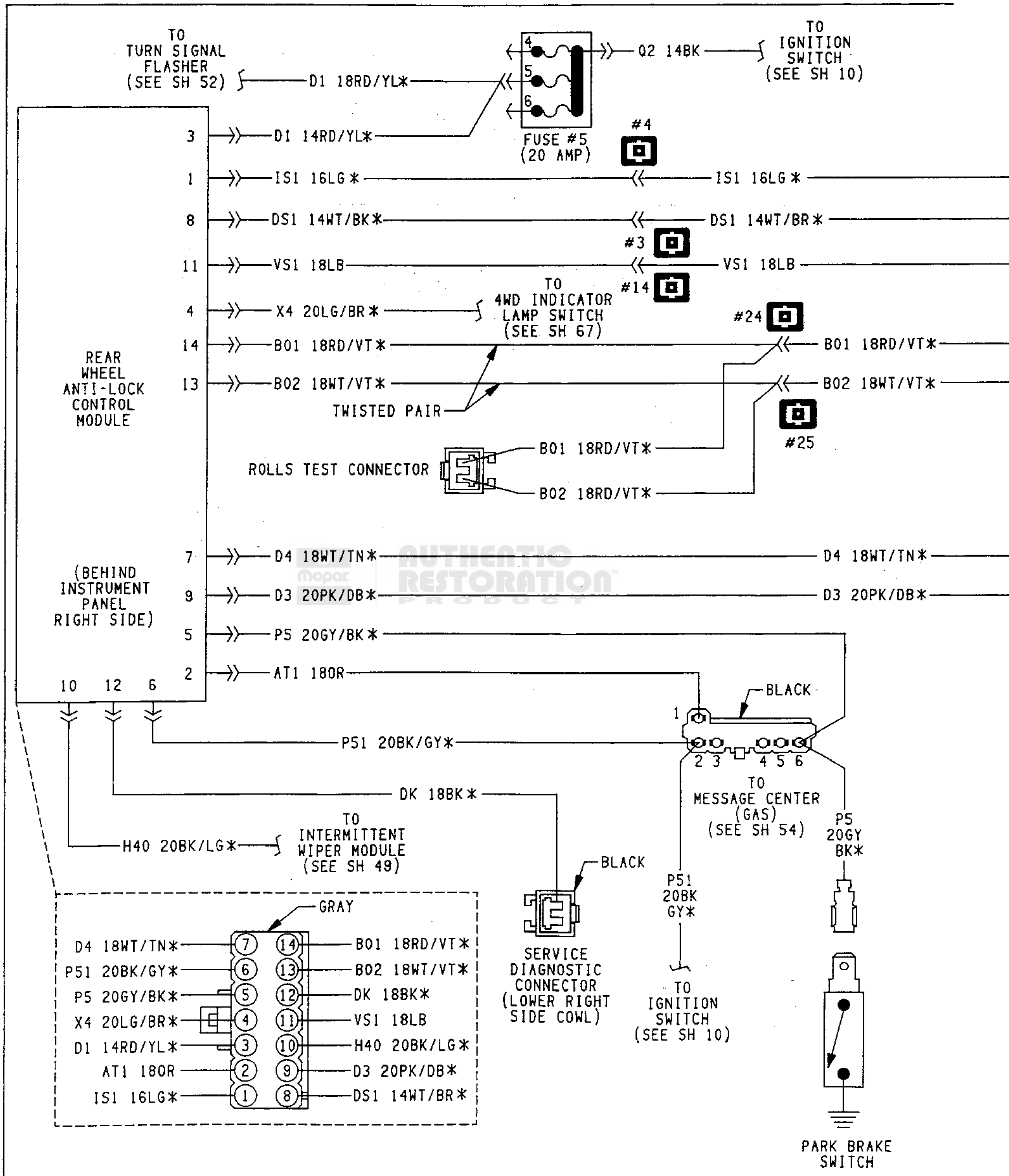
AD 22



AD 23 AUTOMATIC TRANSMISSION WIRING-DIESEL J908W-14



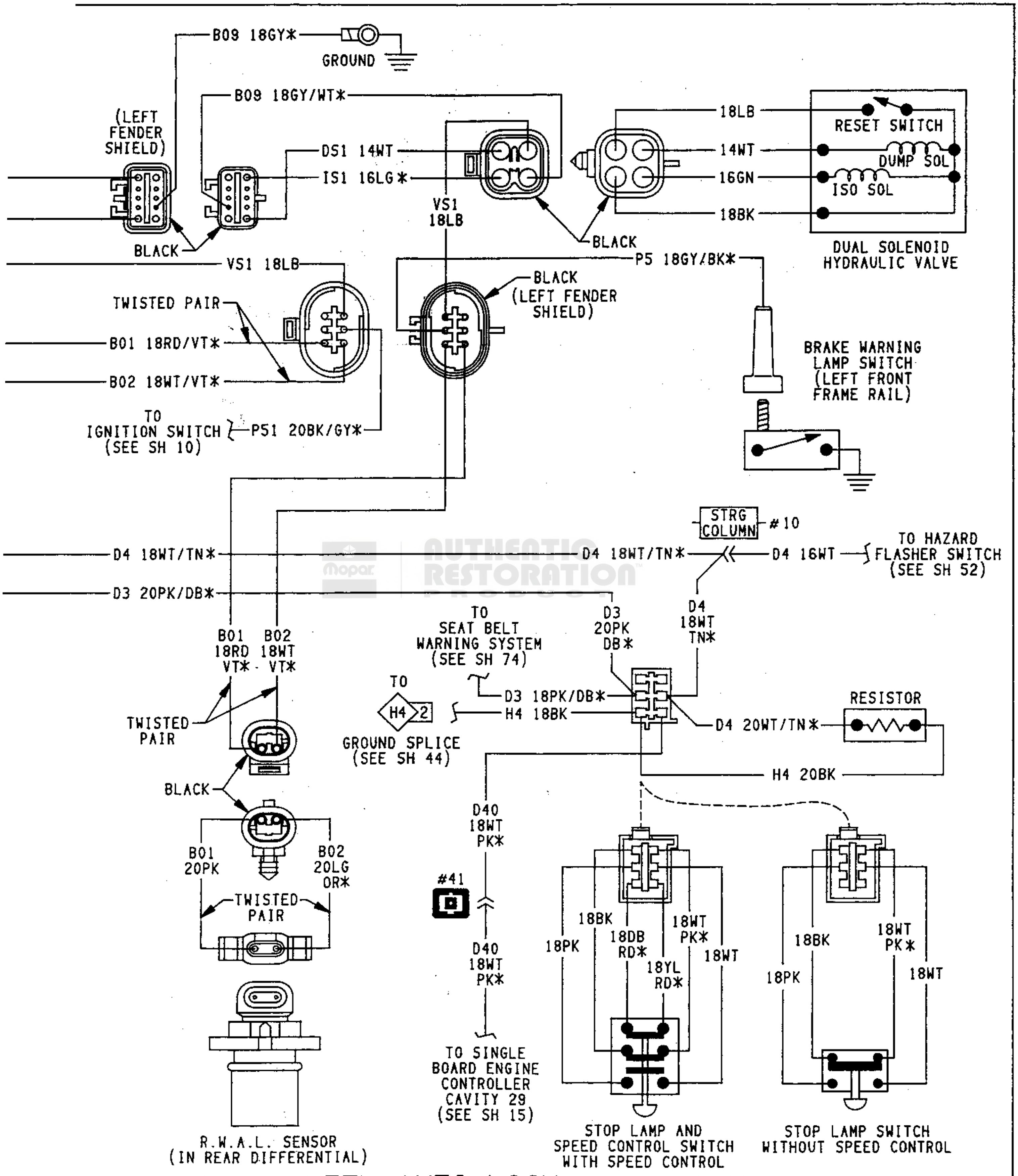
J908W-14 AUTOMATIC TRANSMISSION WIRING-DIESEL | AD 24



REAR WHEEL ANTI-LOCK BRAKE SYSTEM (GAS ENGINE)

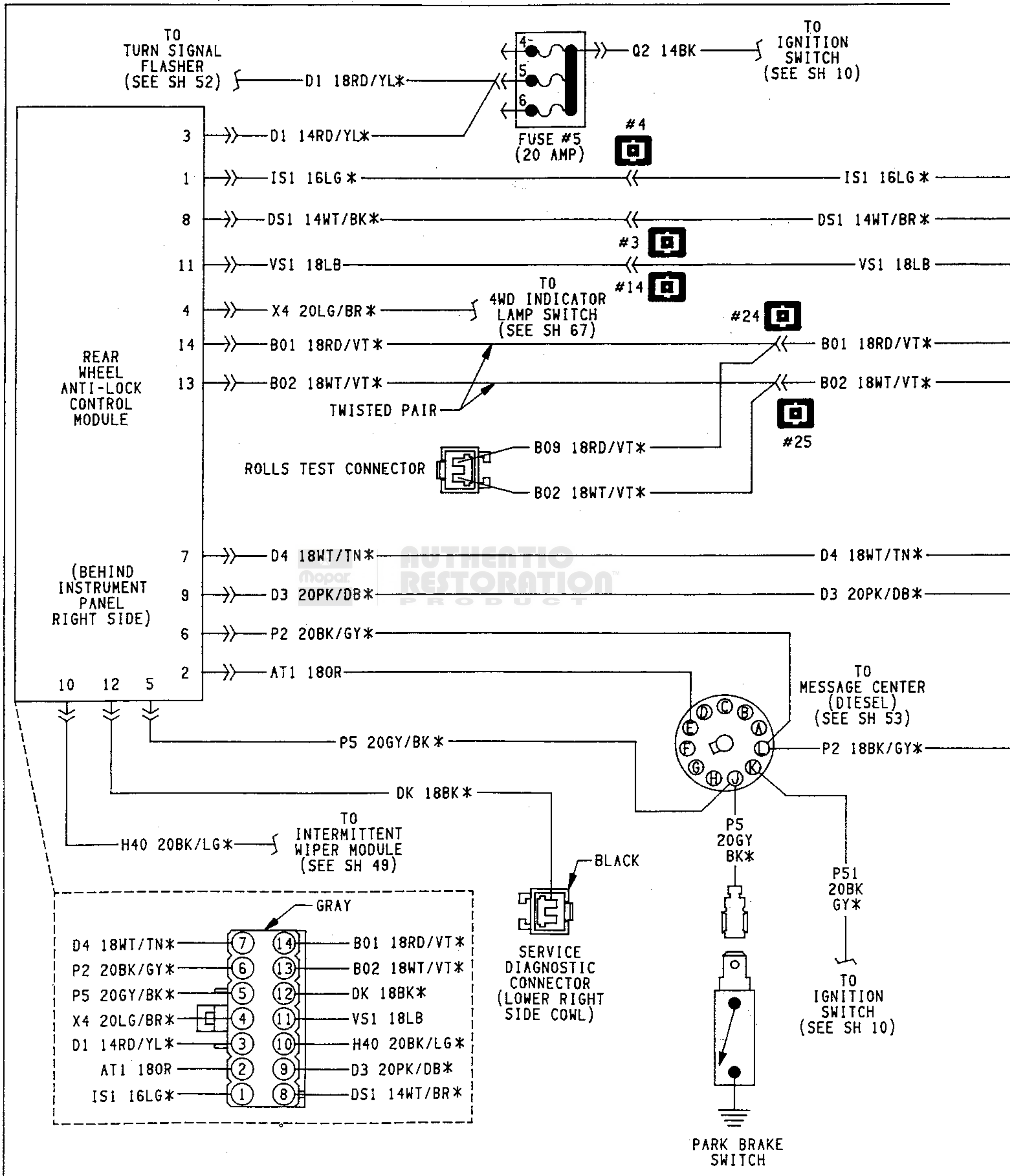
AD 25

J908W-14



REAR WHEEL ANTI-LOCK BRAKE SYSTEM
(GAS ENGINE)

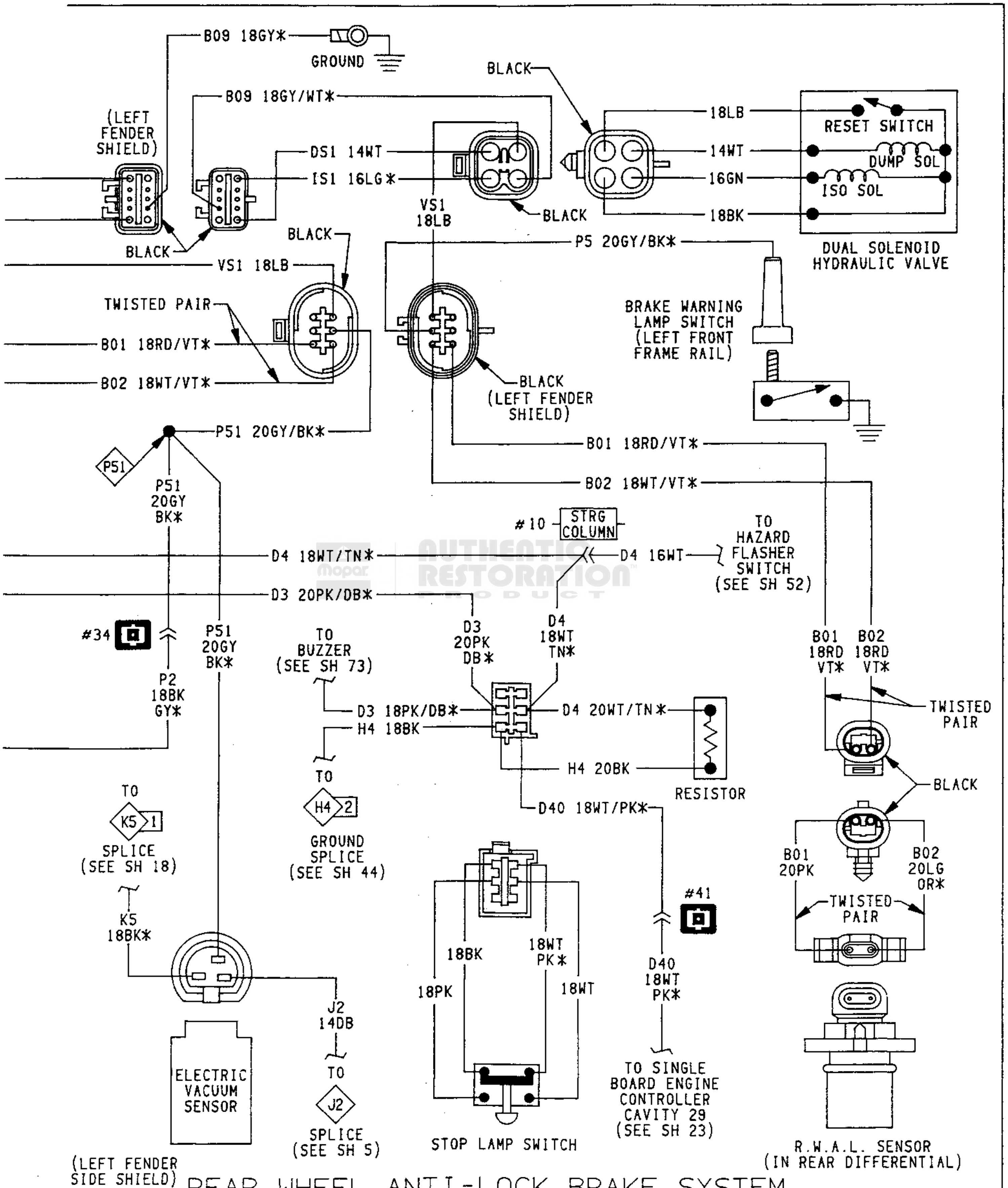
J908W-14



REAR WHEEL ANTI-LOCK BRAKE SYSTEM
(DIESEL ENGINE)

AD 27

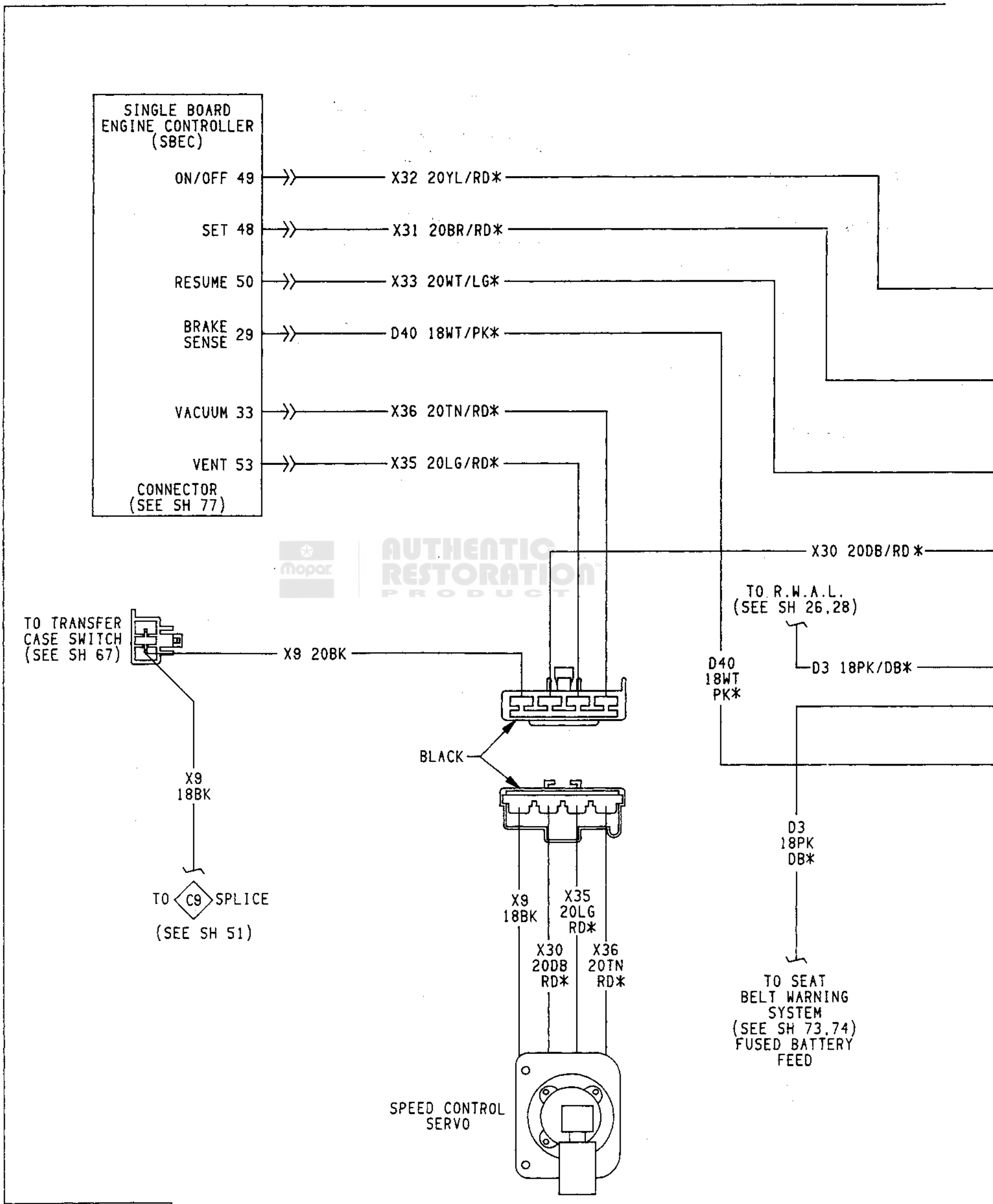
J908W-14



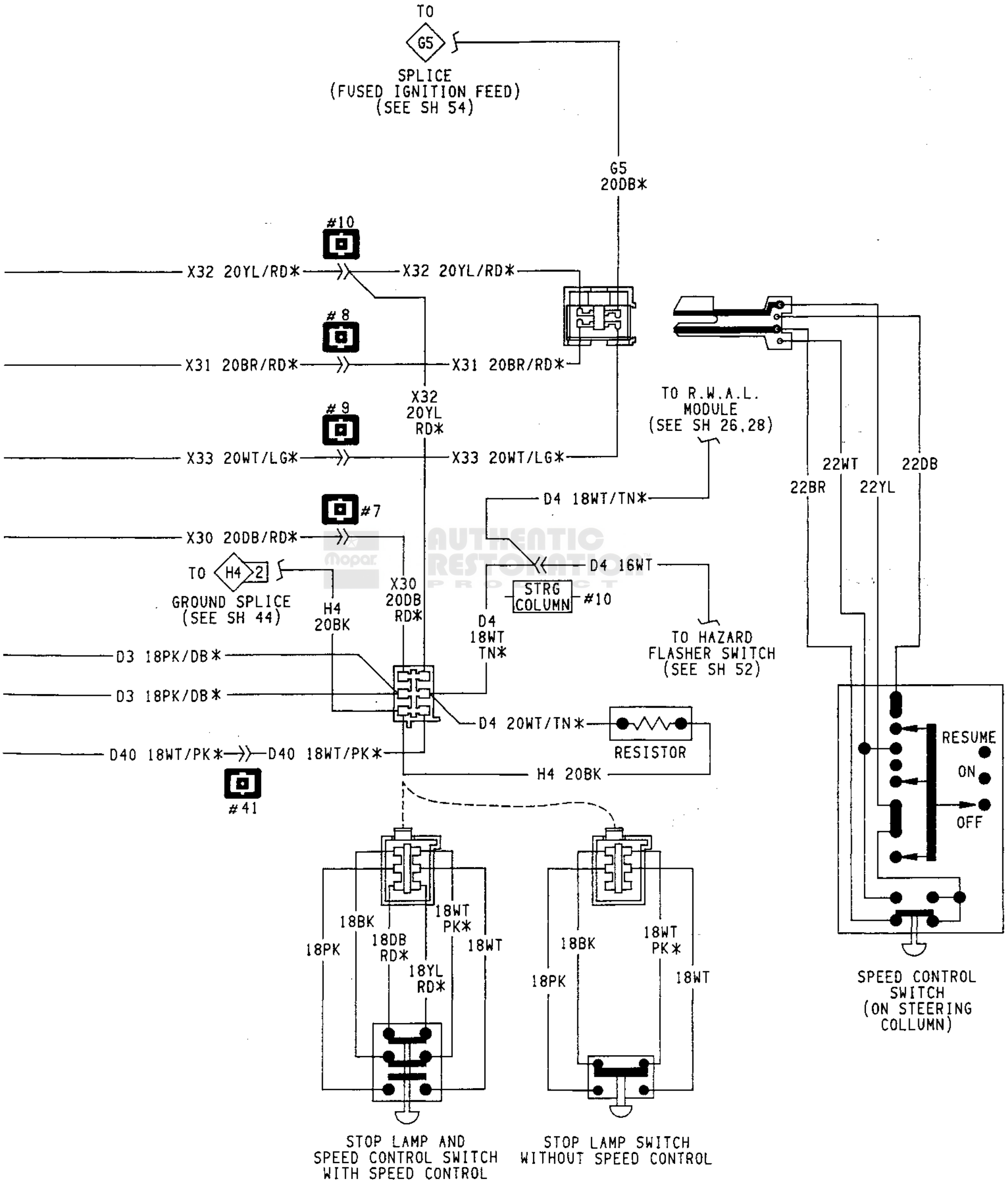
REAR WHEEL ANTI-LOCK BRAKE SYSTEM (DIESEL ENGINE)

J908W-14

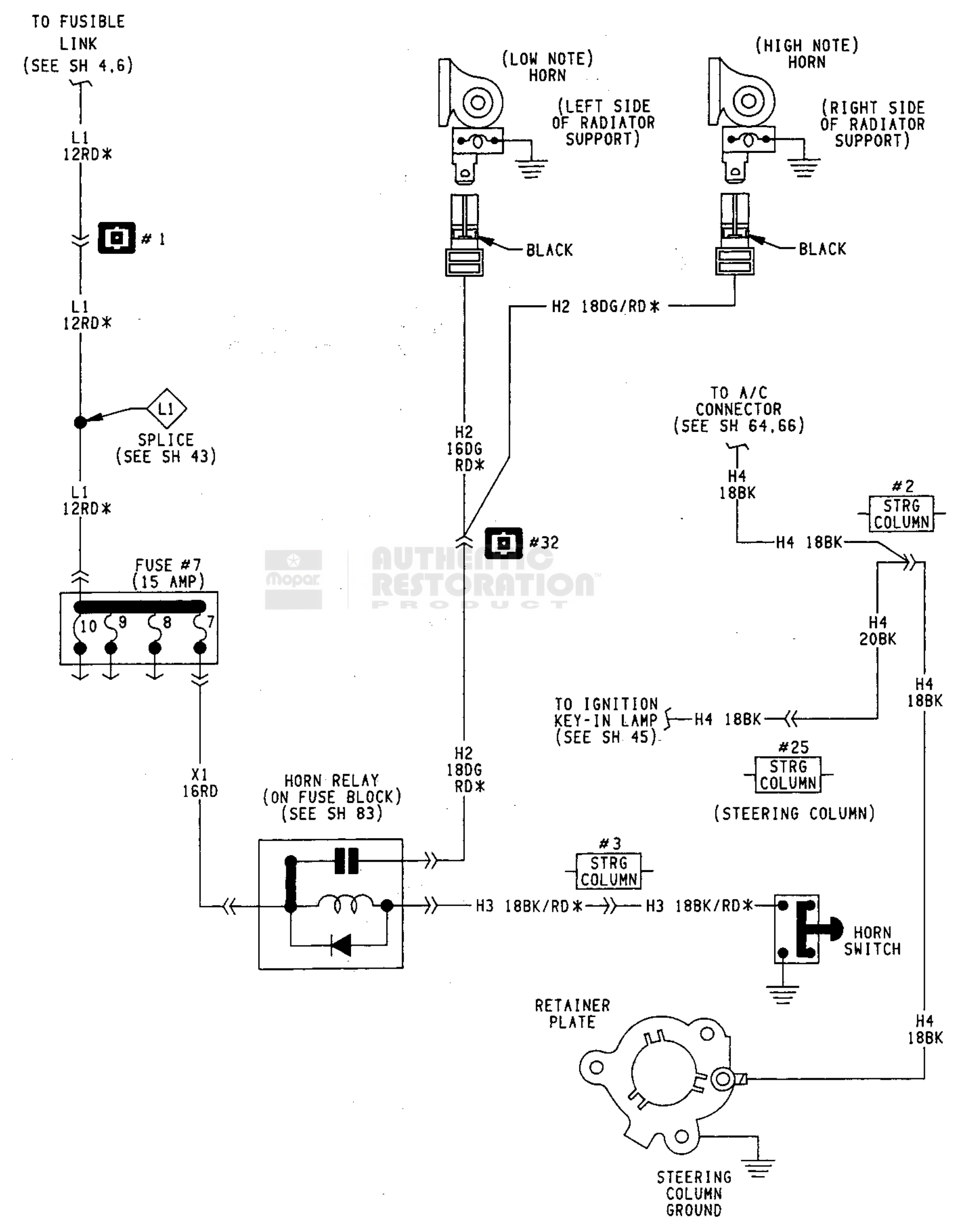
AD 28



AD 29 ELECTRONIC SPEED CONTROL SYSTEM J908W-14



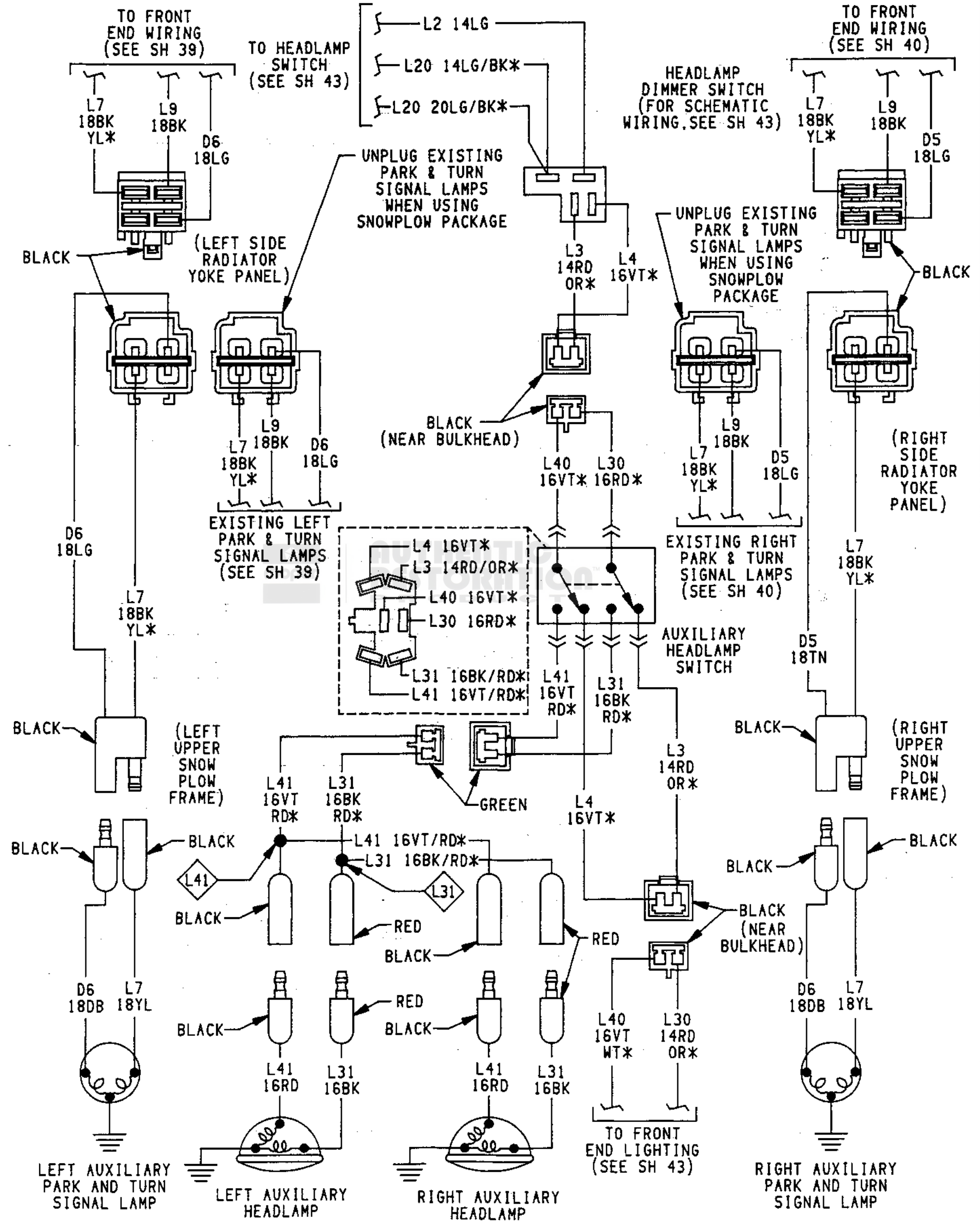
J908W-14 ELECTRONIC SPEED CONTROL SYSTEM AD 30



AD 31

HORN SYSTEM

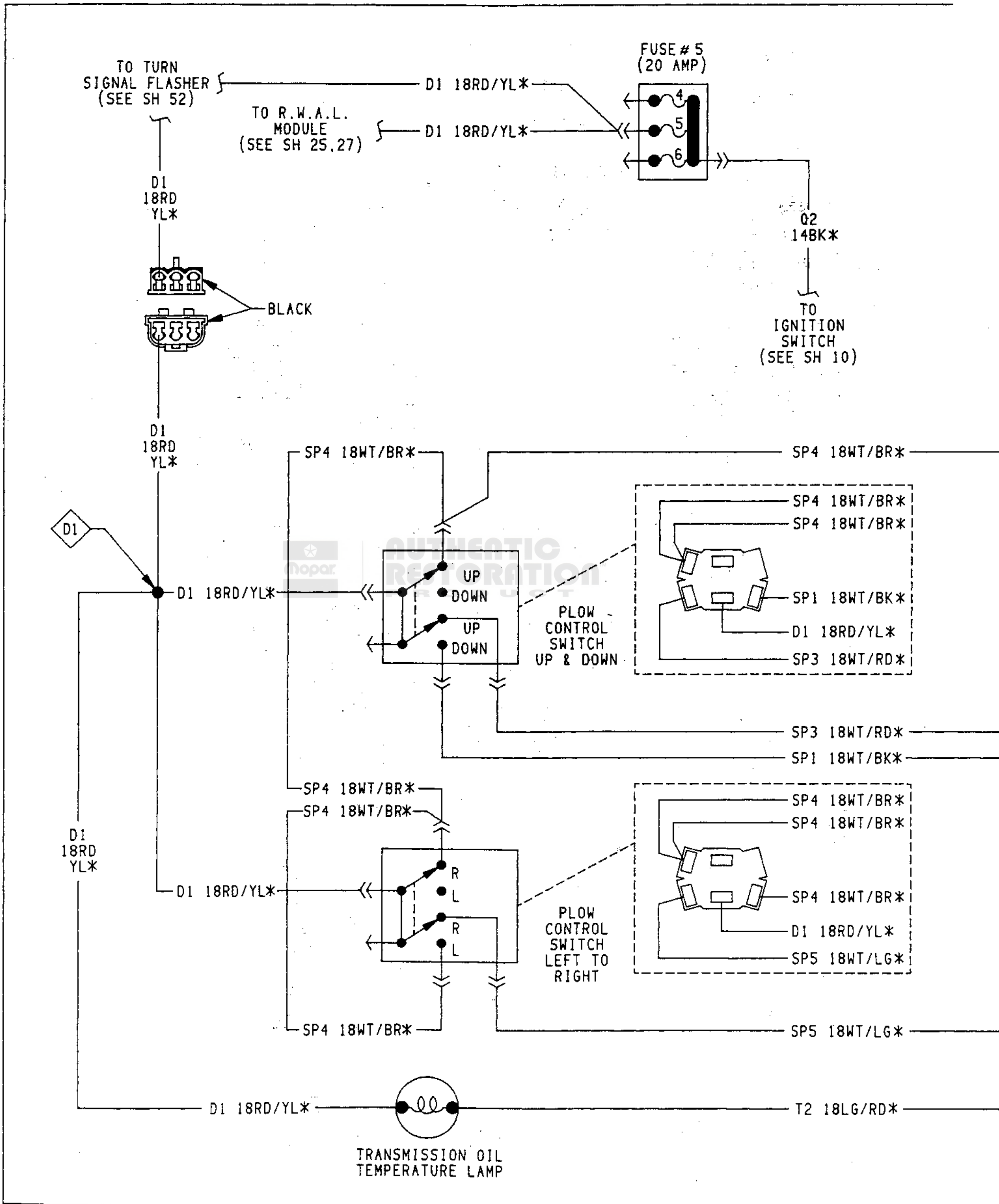
J908W-14



J908W-14

SNOW PLOW EXTERIOR LIGHTING

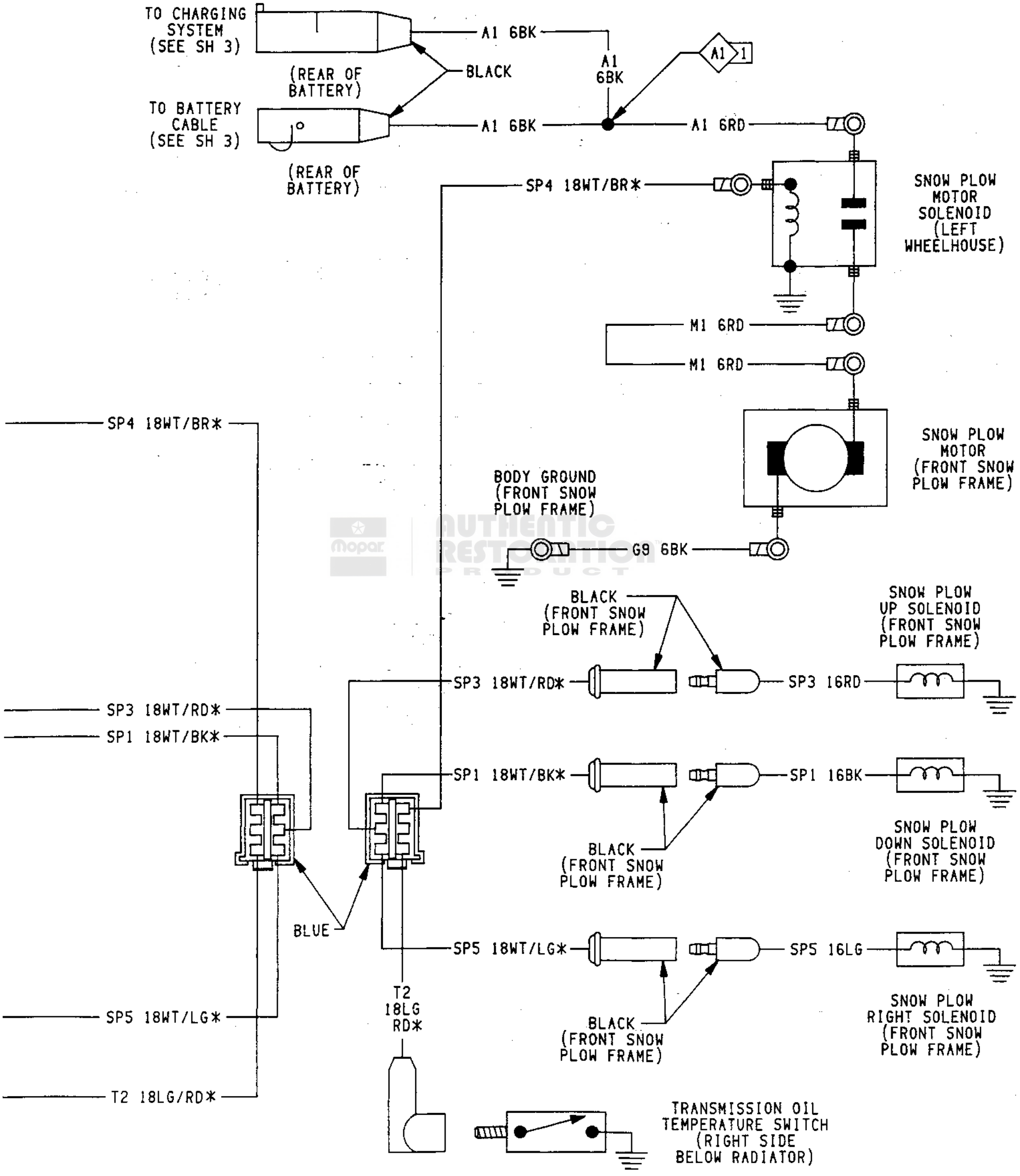
AD 32



AD 33

SNOW PLOW CONTROL

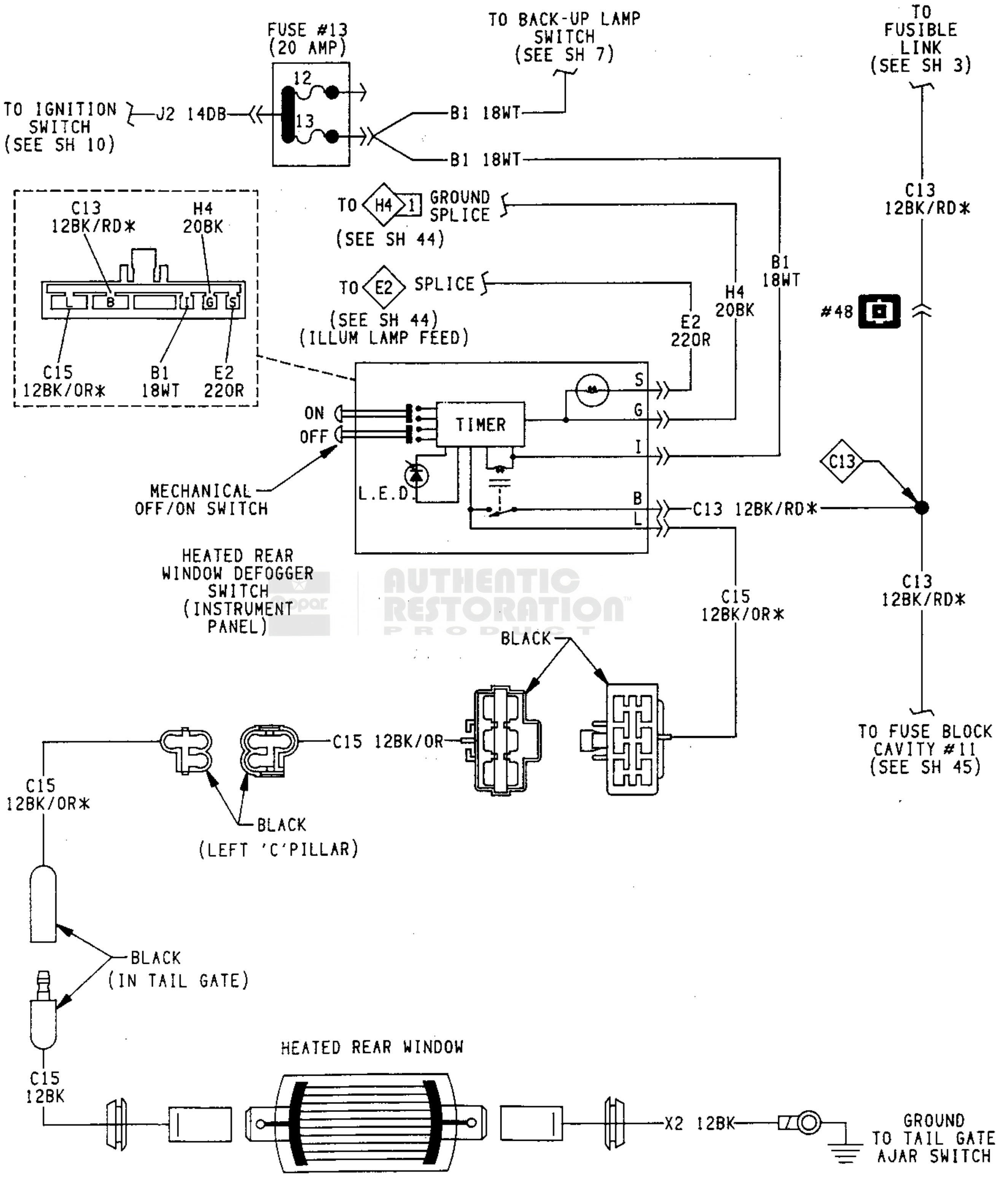
J908W-14



J908W-14

SNOW PLOW CONTROL

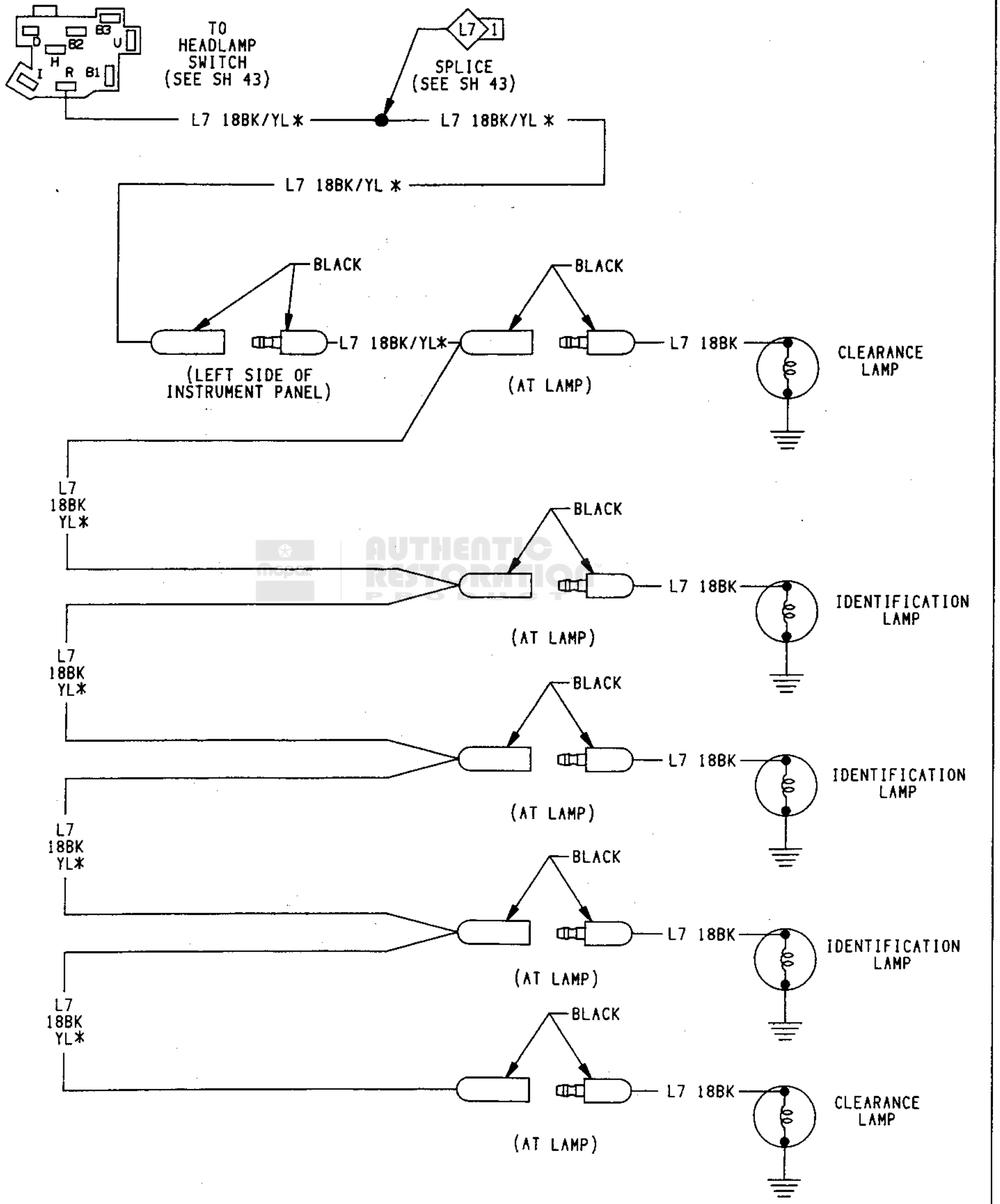
AD 34



ELECTRICALLY HEATED REAR WINDOW
(SPORT UTILITY)

AD 35

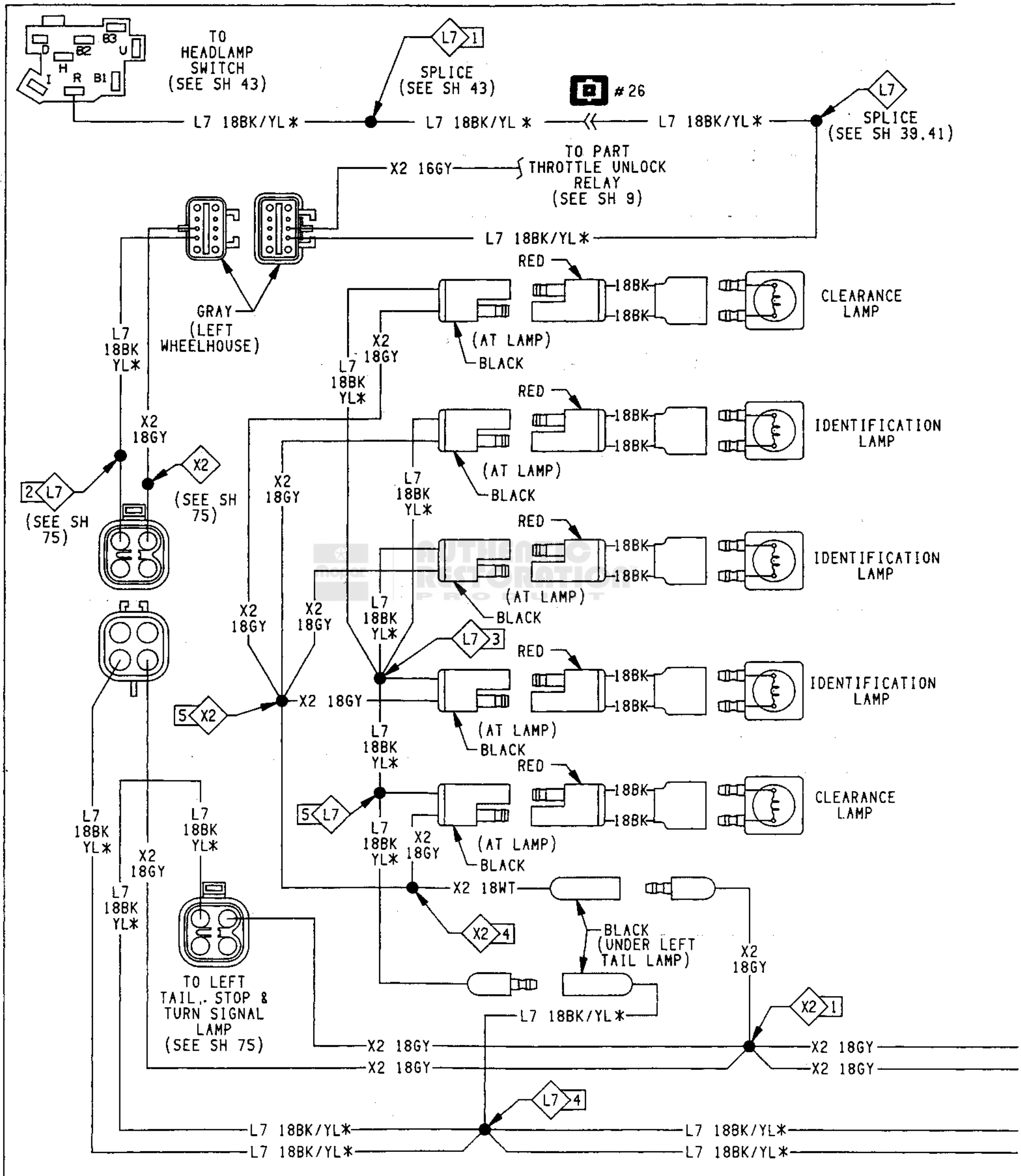
J908W-14



FRONT CLEARANCE AND IDENTIFICATION LAMPS (ROOF)

J908W-14

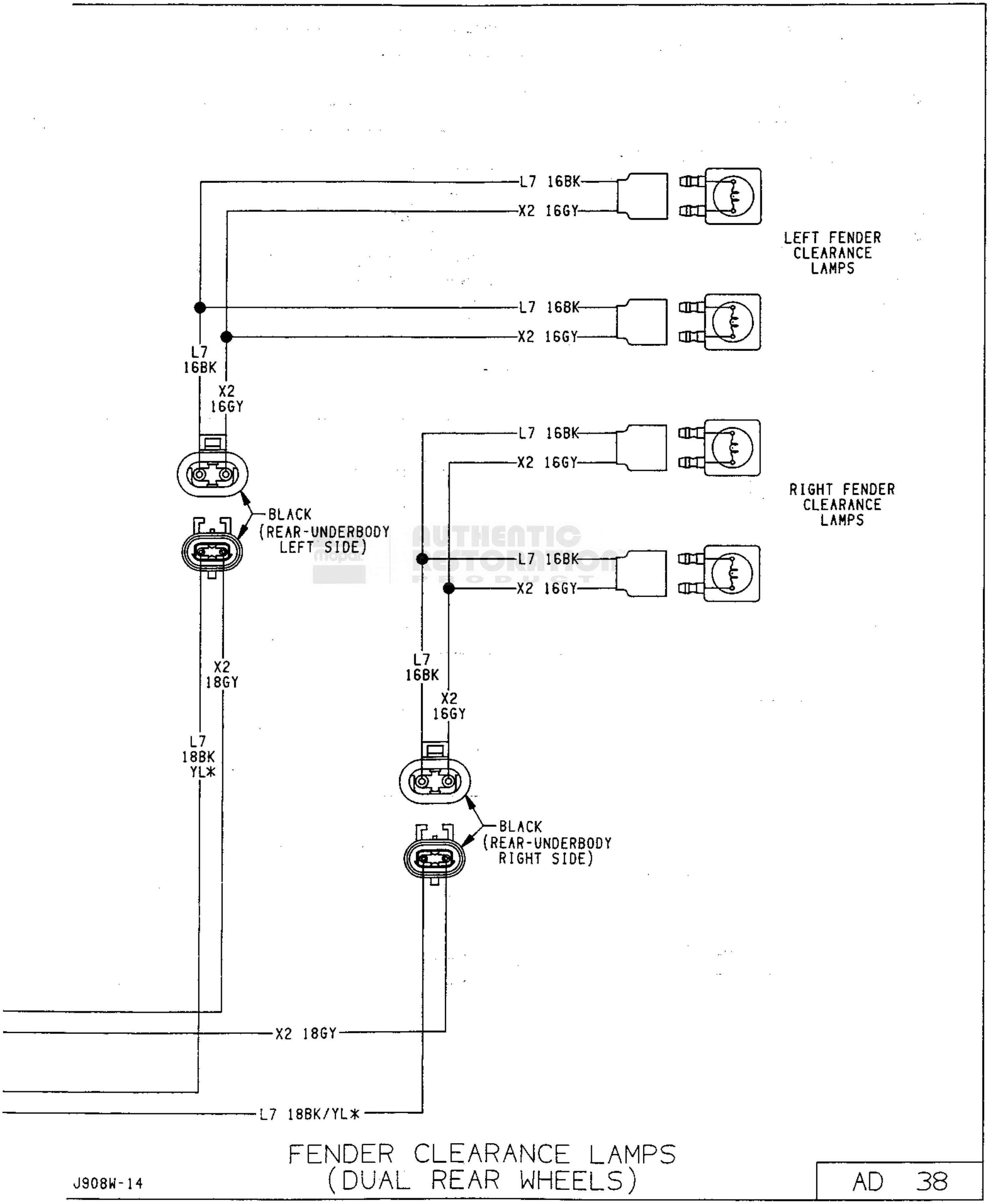
AD 36



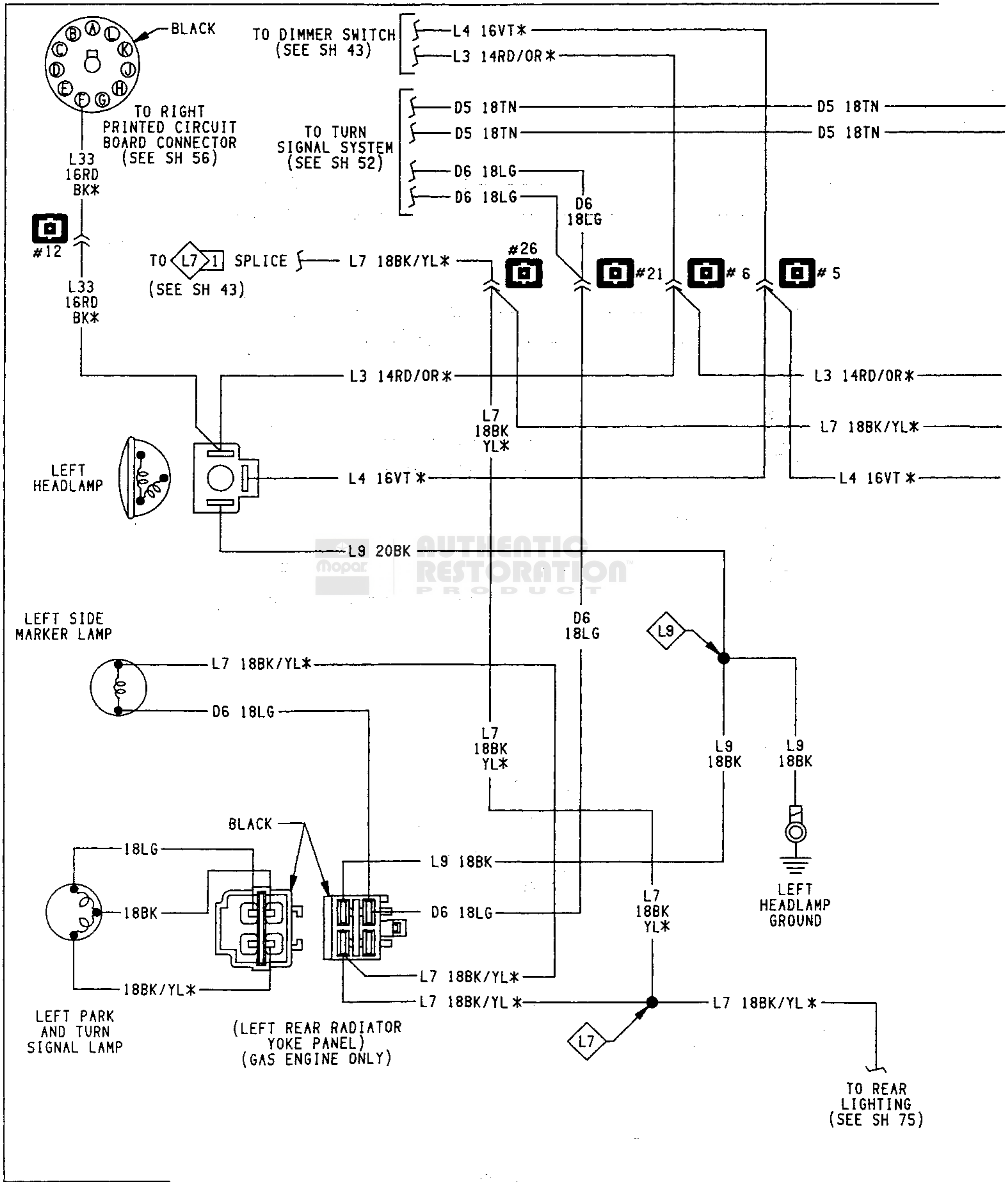
CLEARANCE AND IDENTIFICATION LAMPS
(DUAL REAR WHEELS)

AD 37

J908W-14

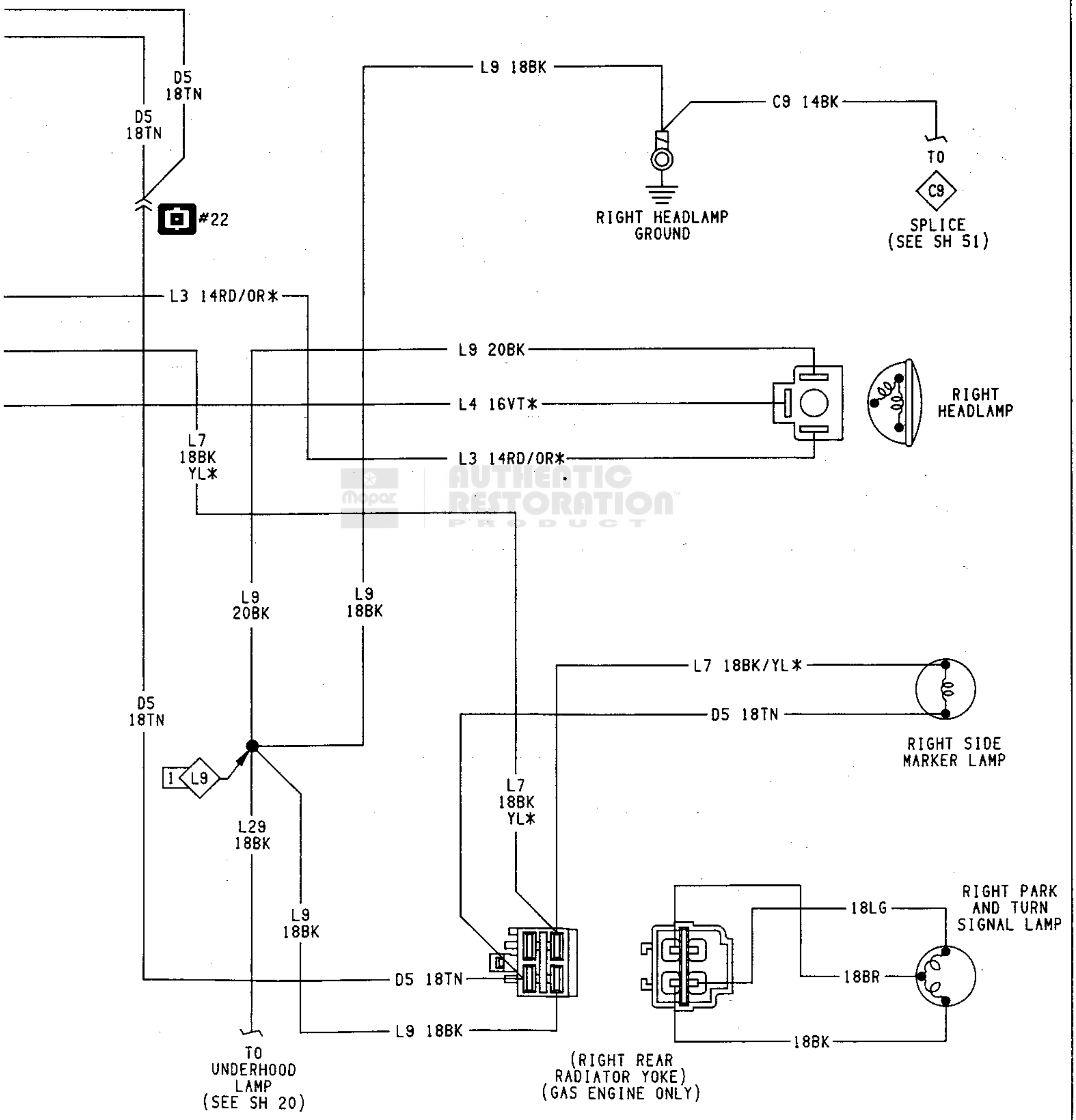


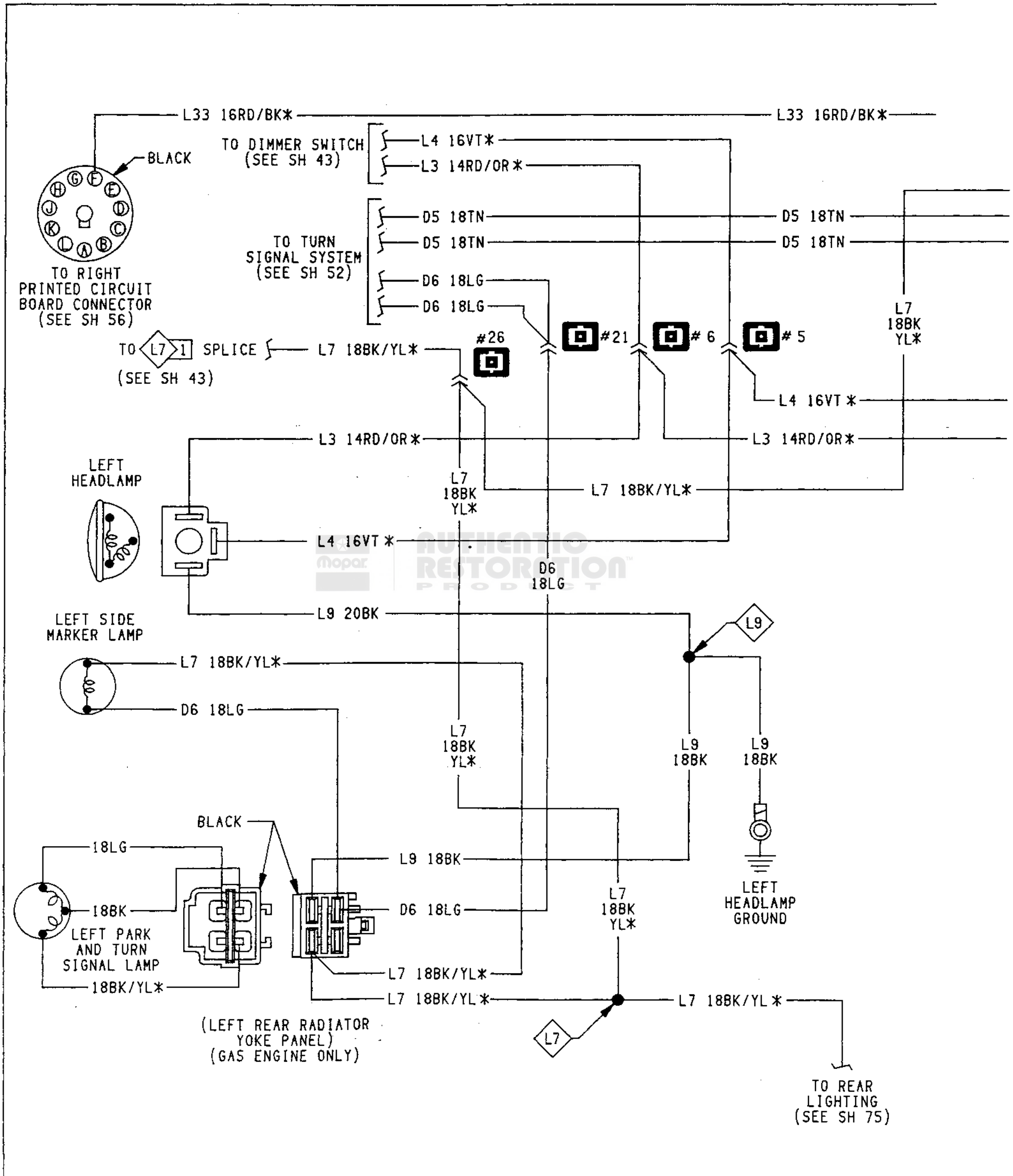
FENDER CLEARANCE LAMPS
(DUAL REAR WHEELS)



FRONT END LIGHTING

J908W-14

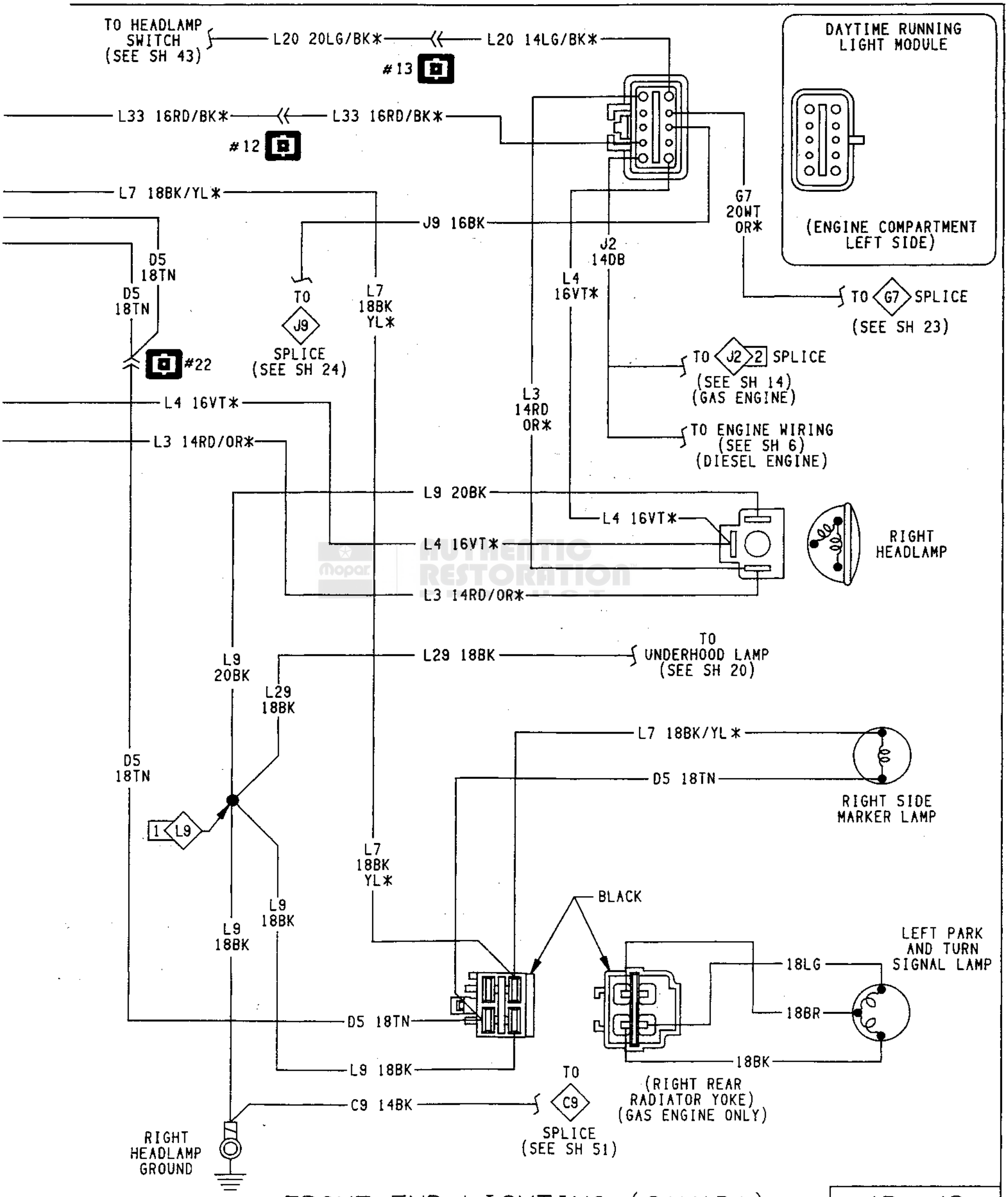

D5
18TN
D5
18TN
#22
L9 18BK
C9 14BK
TO
C9
RIGHT HEADLAMP
GROUND
SPLICE
(SEE SH 51)
L3 14RD/OR*
L9 20BK
L4 16VT*
L3 14RD/OR*
RIGHT
HEADLAMP
L7
18BK
YL*
L9
20BK
L9
18BK
L7 18BK/YL*
D5 18TN
RIGHT SIDE
MARKER LAMP
D5
18TN
1
L9
L29
18BK
L7
18BK
YL*
L9
18BK
RIGHT PARK
AND TURN
SIGNAL LAMP
18LG
18BR
D5 18TN
L9 18BK
18BK
TO
UNDERHOOD
LAMP
(SEE SH 20)
(RIGHT REAR
RADIATOR YOKE)
(GAS ENGINE ONLY)



AD 41

FRONT END LIGHTING (CANADA)

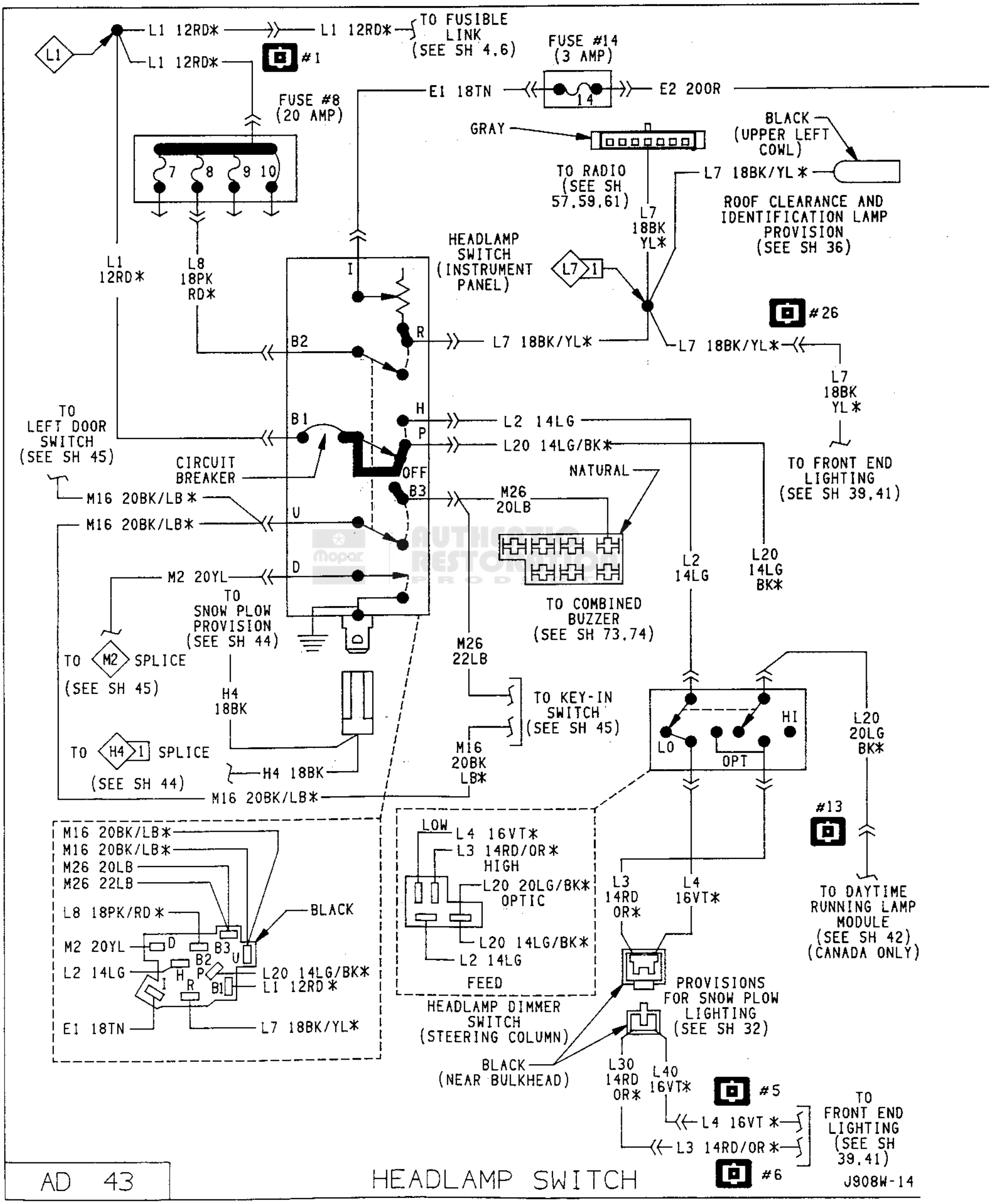
J908W-14



J908W-14

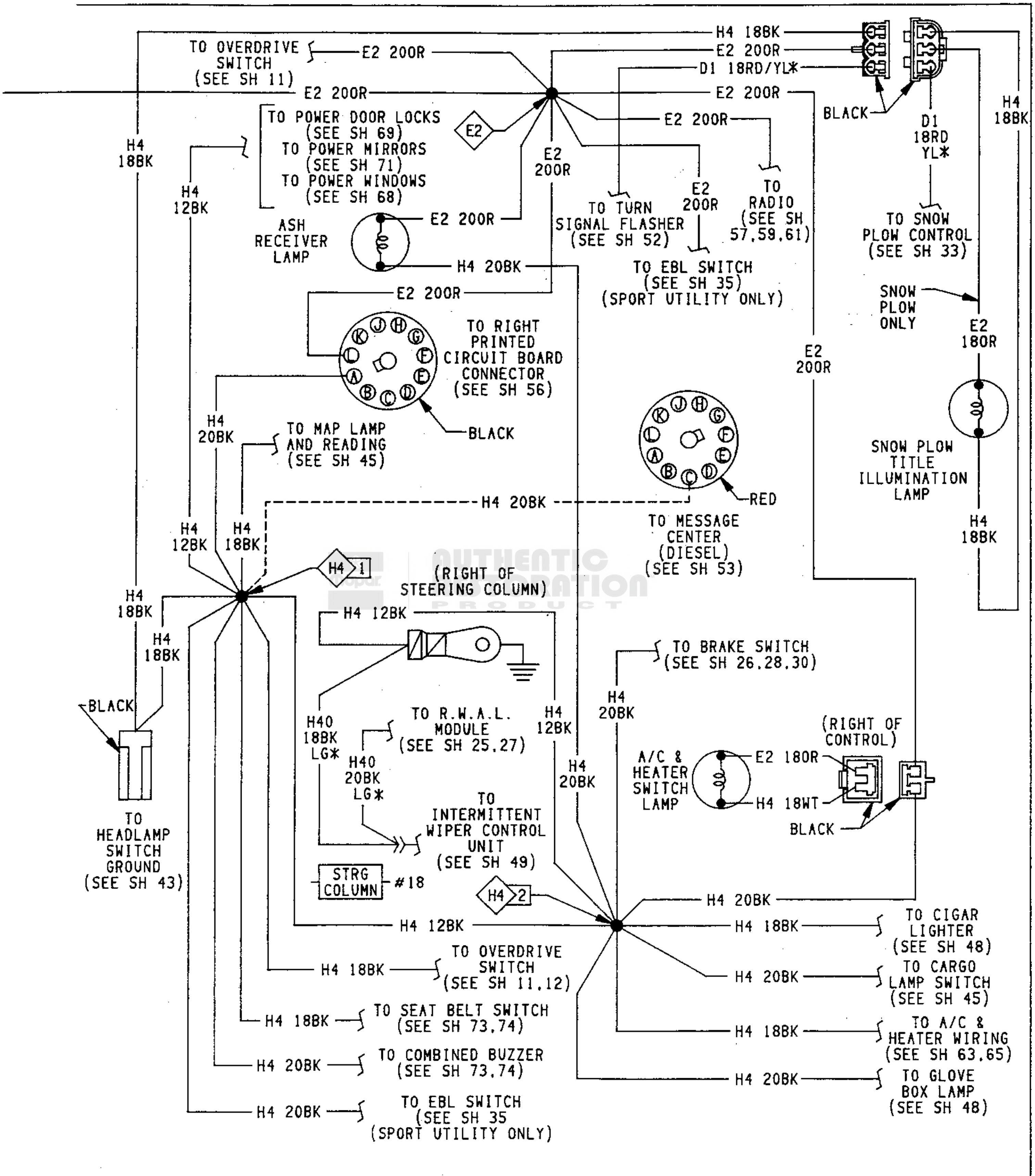
FRONT END LIGHTING (CANADA)

AD 42



HEADLAMP SWITCH

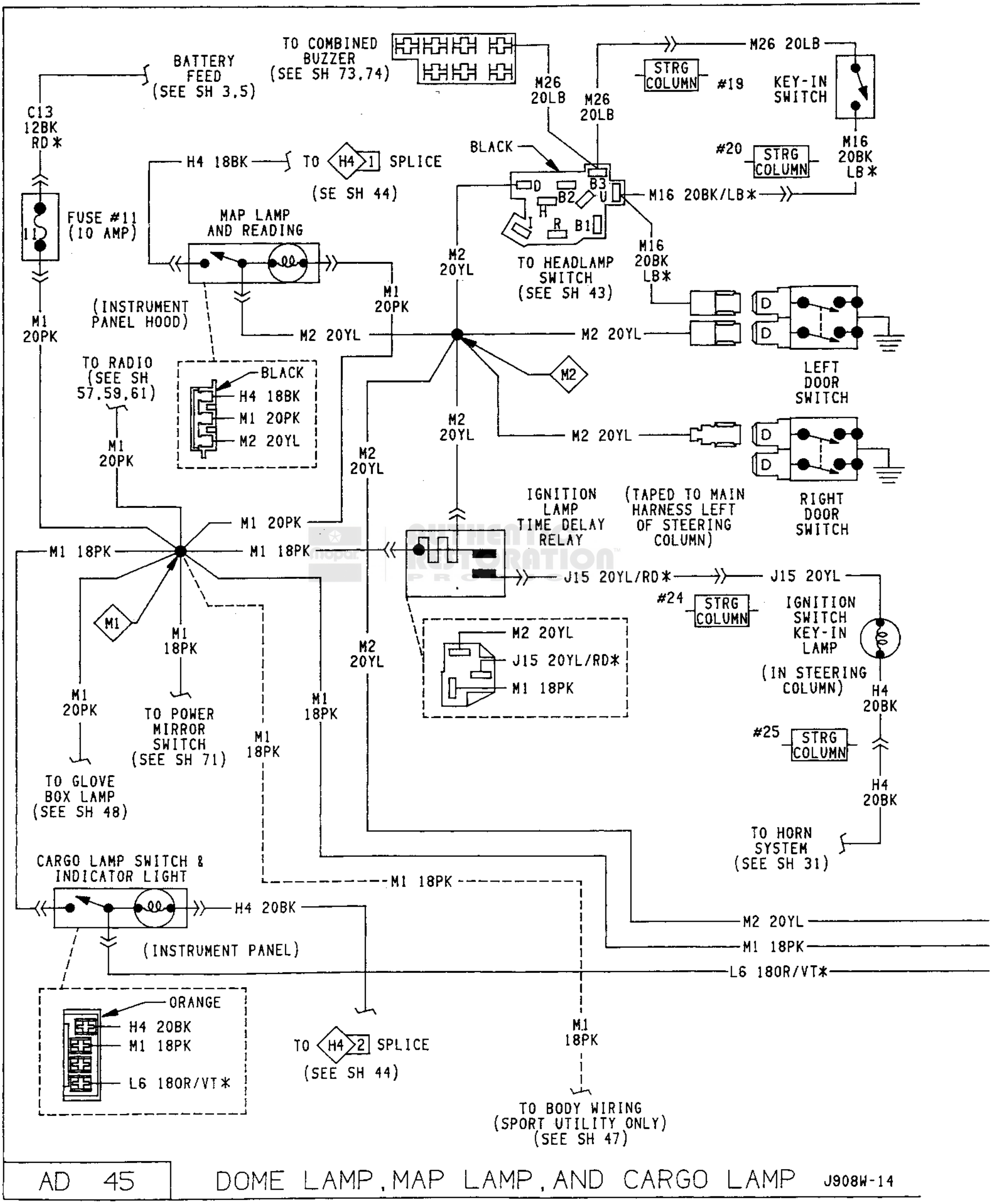
J908W-14



HEADLAMP SWITCH CONTROLLED INTERIOR LIGHTING

J908W-14

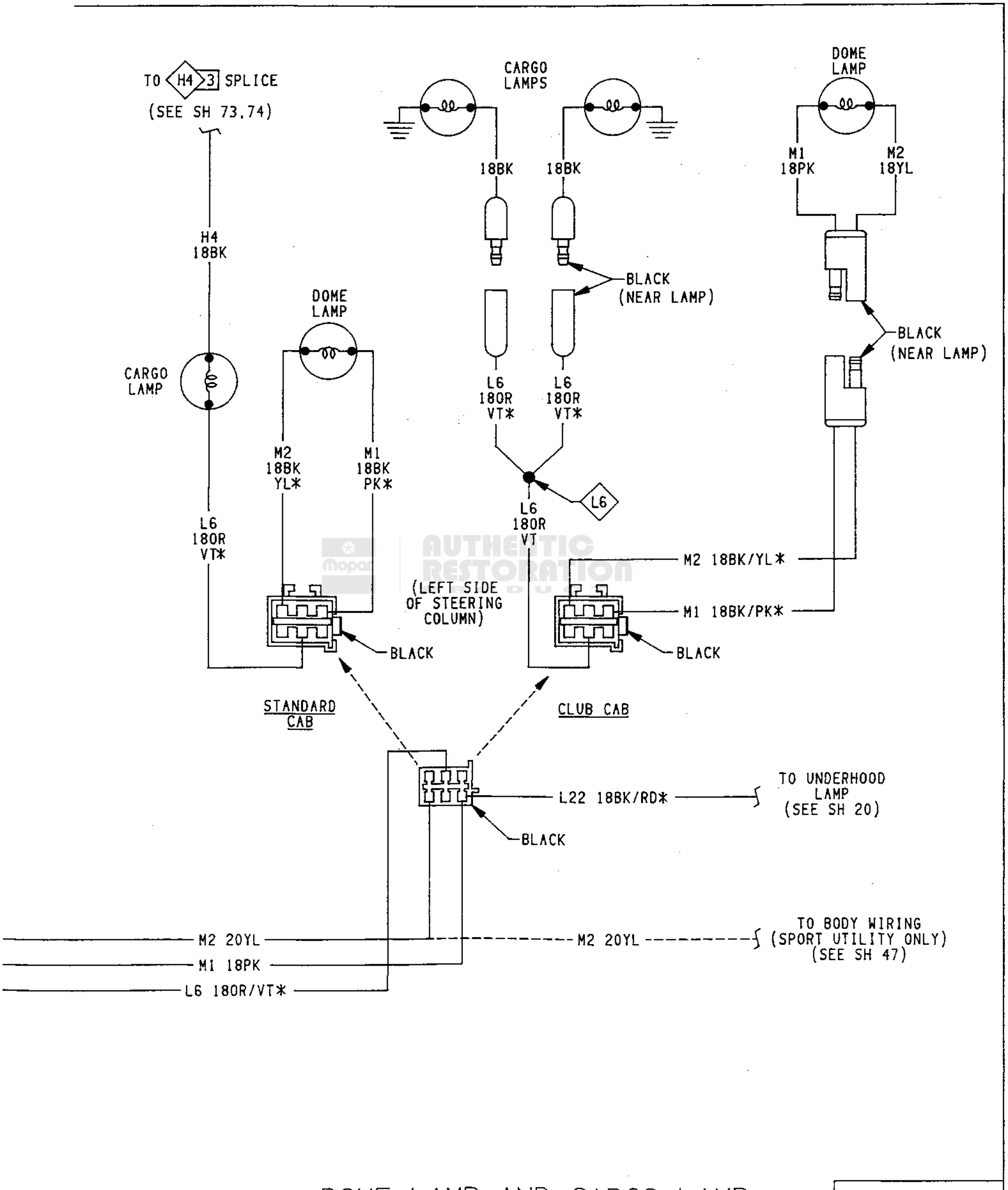
AD 44



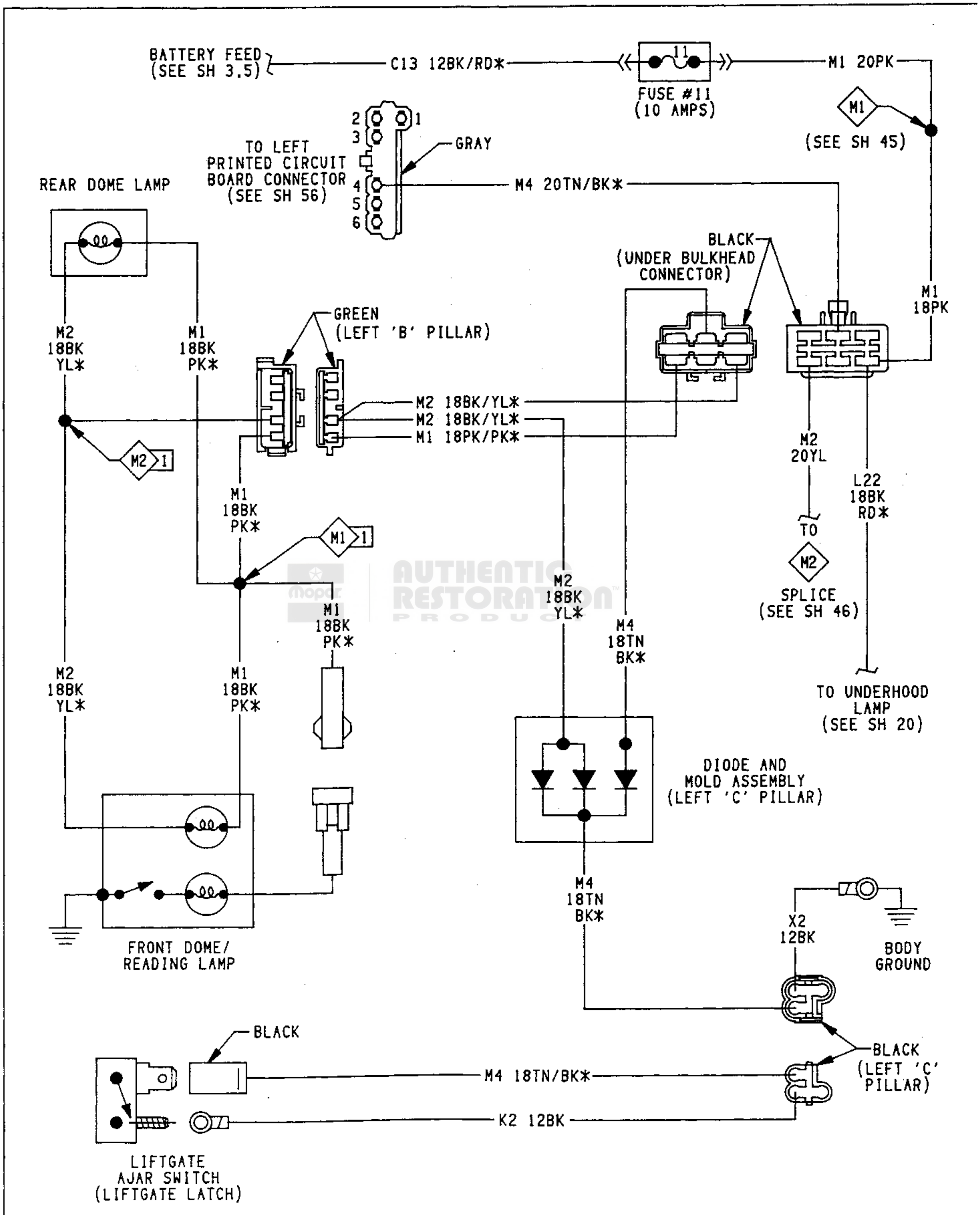
AD 45

DOME LAMP, MAP LAMP, AND CARGO LAMP

J908W-14



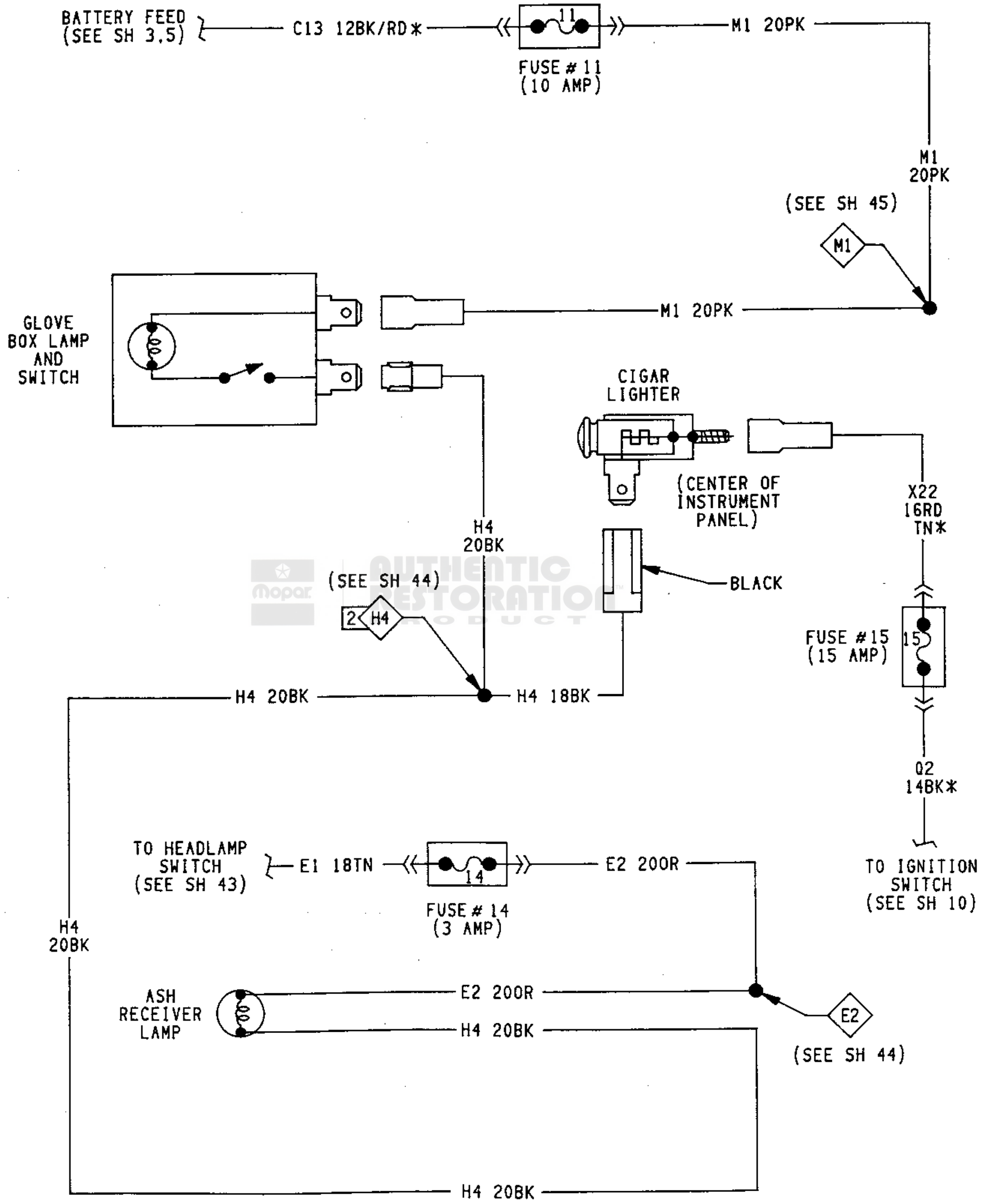
DOME LAMP AND CARGO LAMP



AD 47

LIFTGATE AJAR WARNING SYSTEM & REAR DOME LAMPS (SPORT UTILITY ONLY)

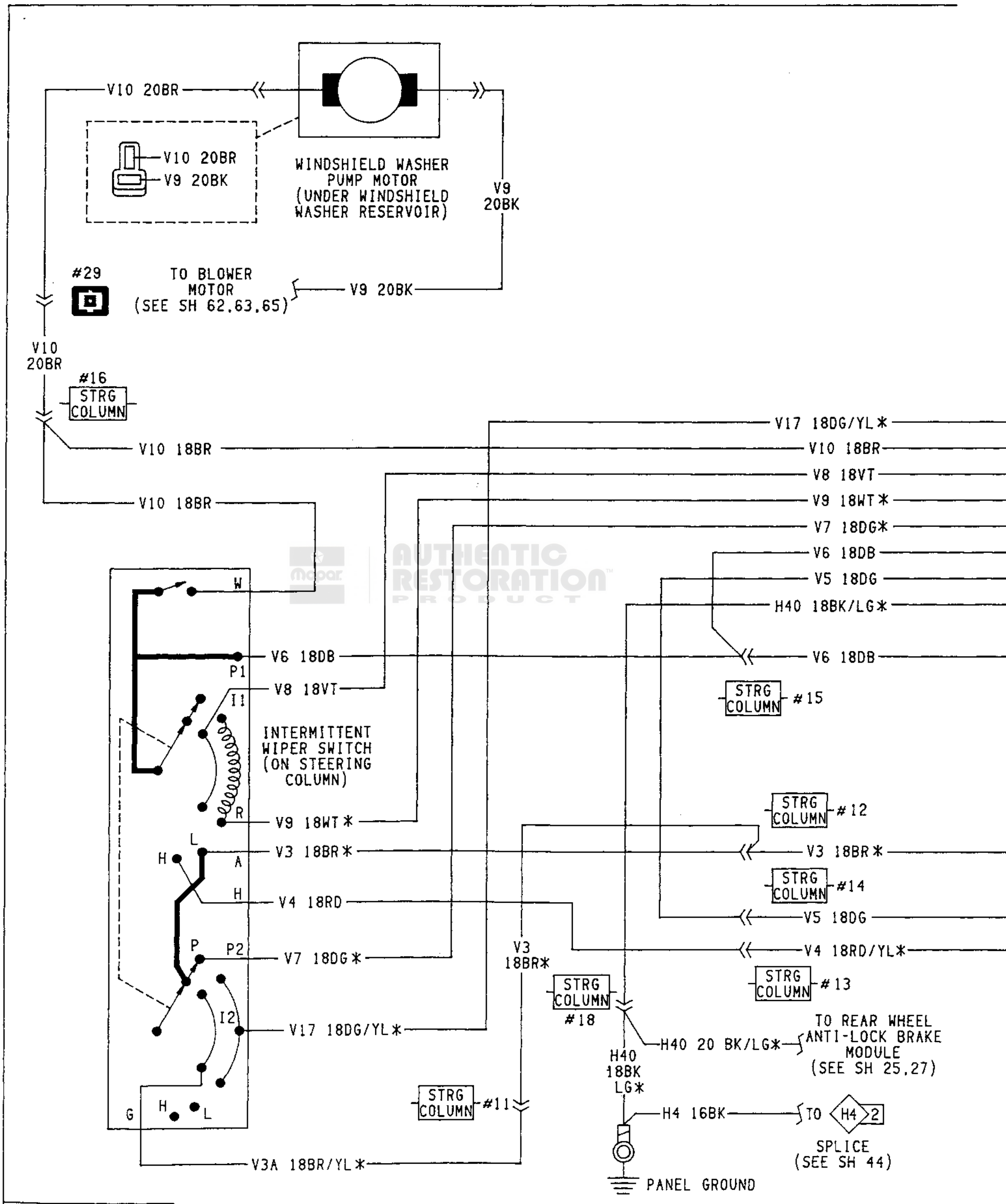
J908W-14



CIGAR LIGHTER, ASH RECEIVER LAMP & GLOVE BOX LAMP

J908W-14

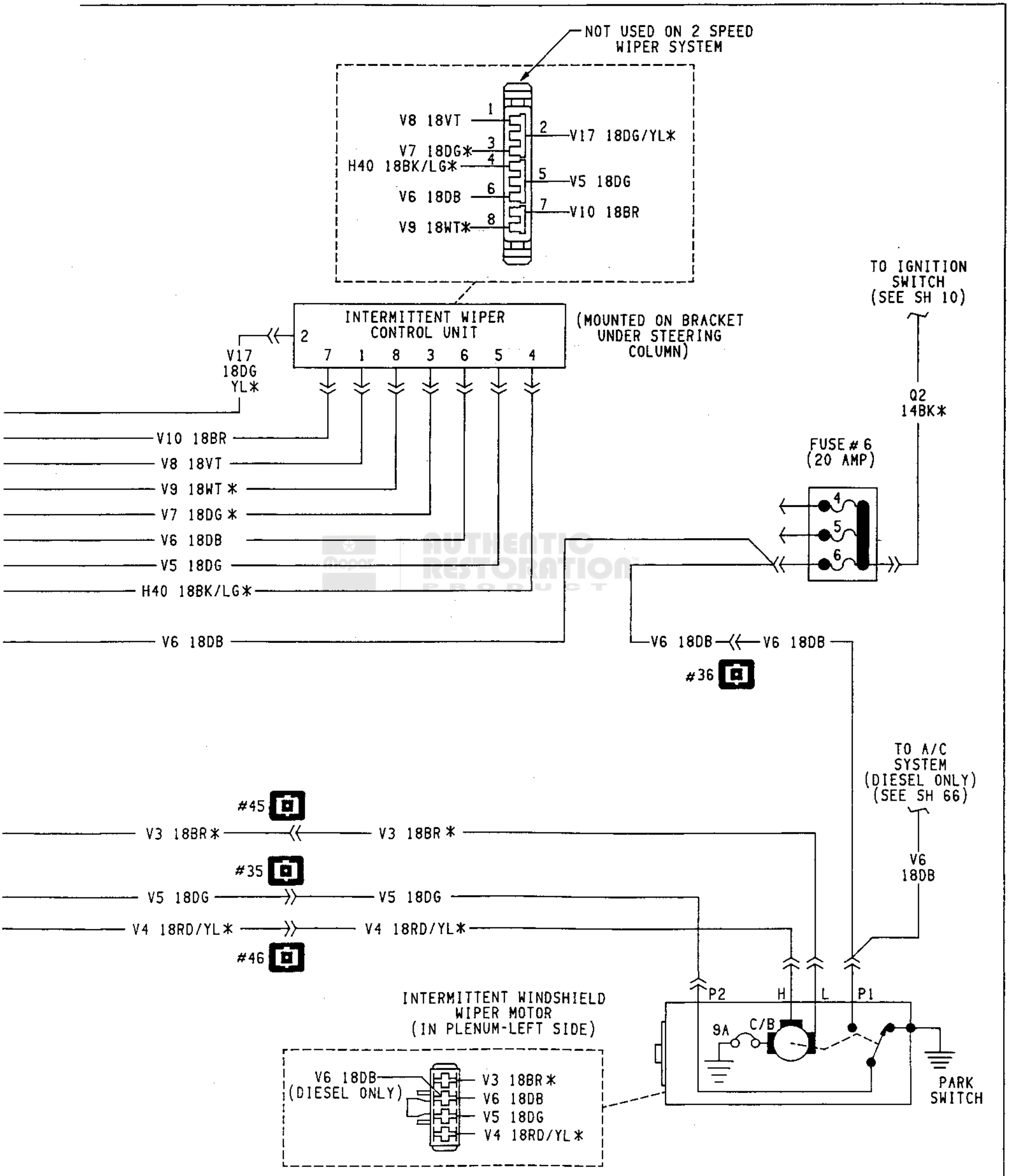
AD 48



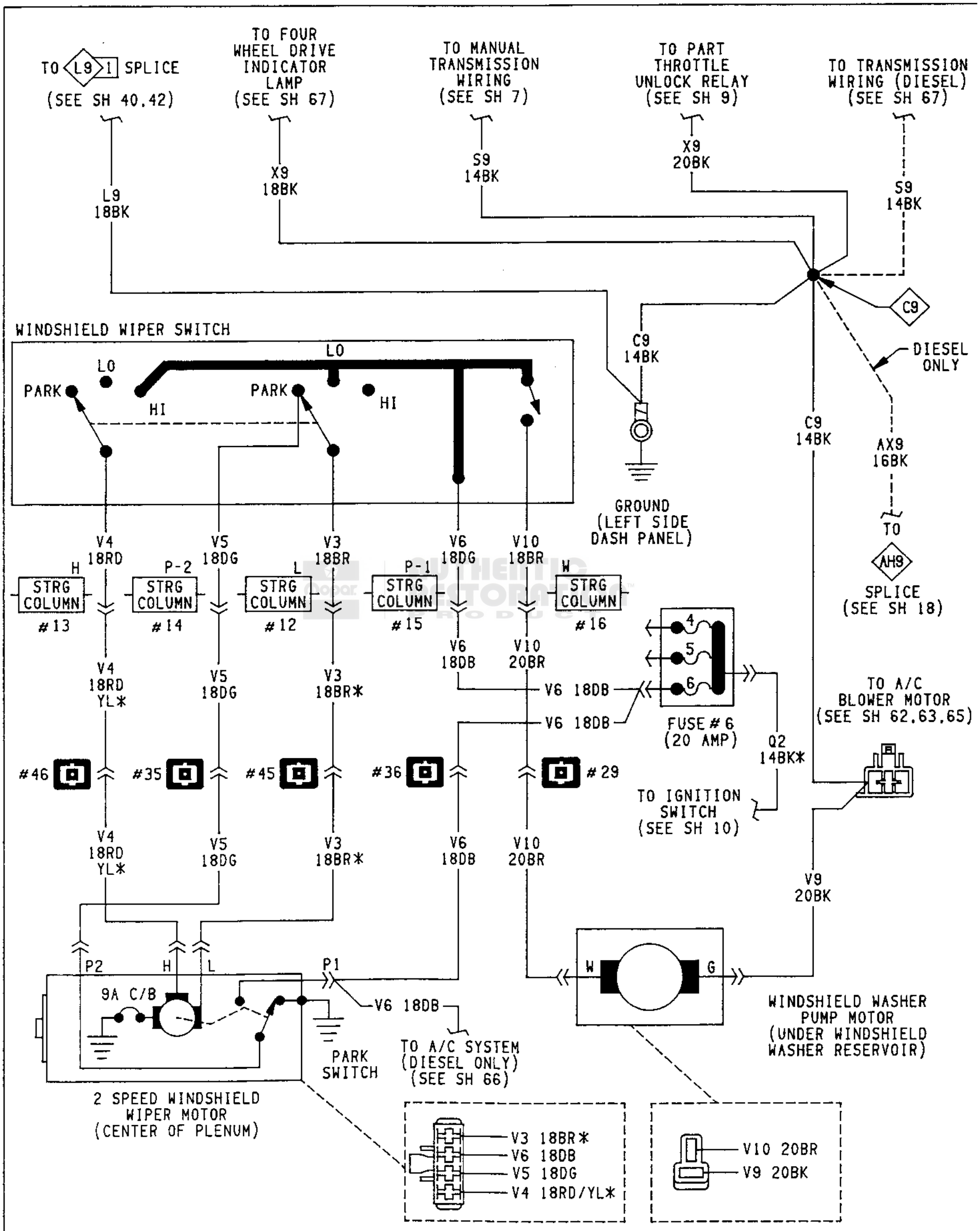
AD 49

INTERMITTENT WIPER SYSTEM

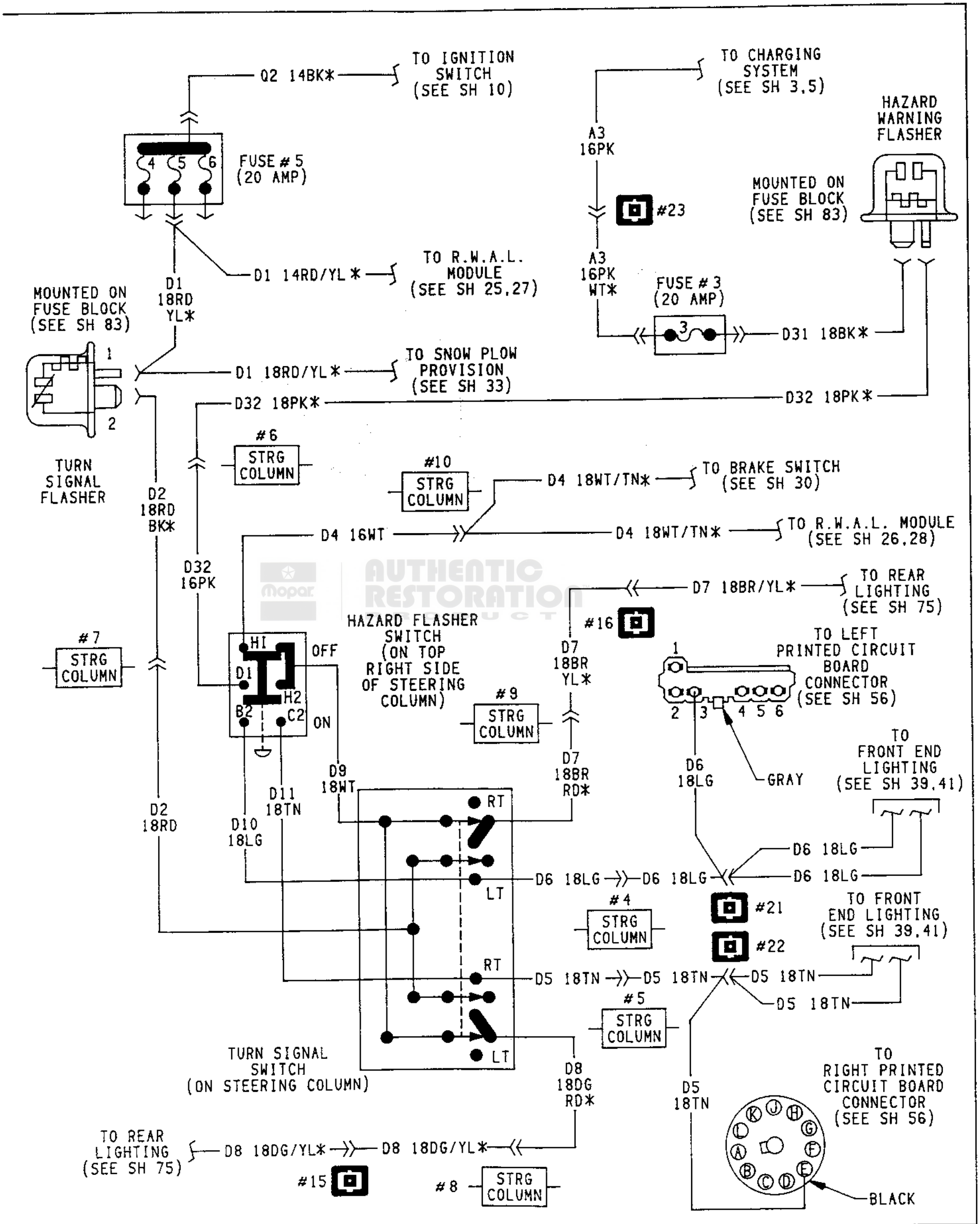
J908W-14



INTERMITTENT WIPER SYSTEM

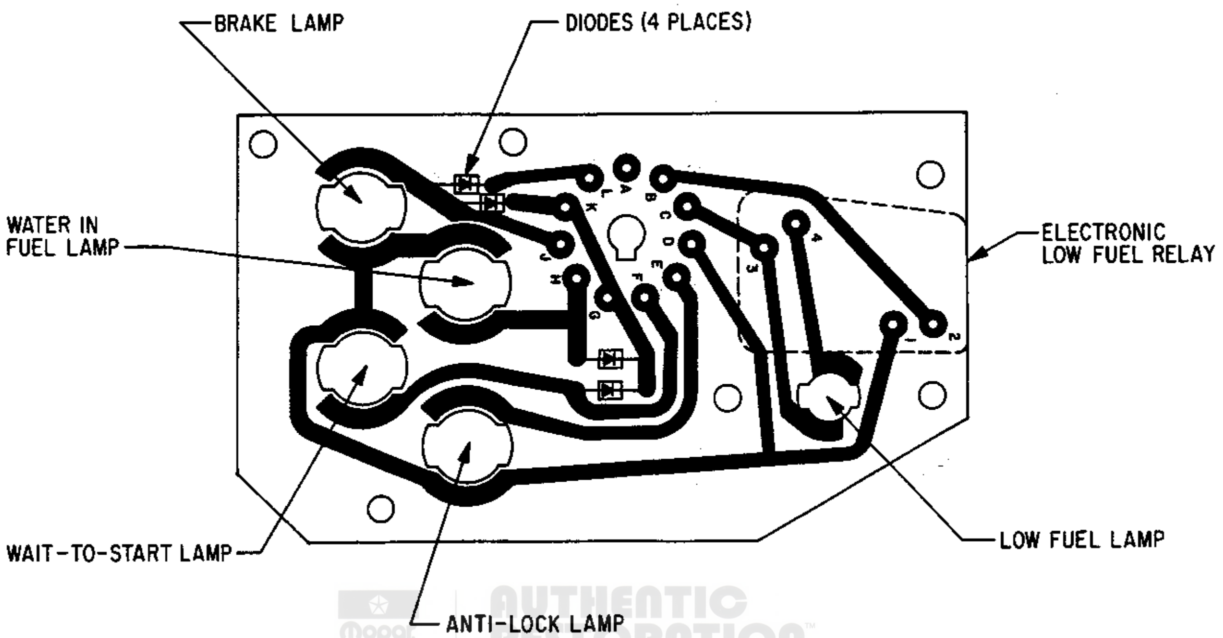


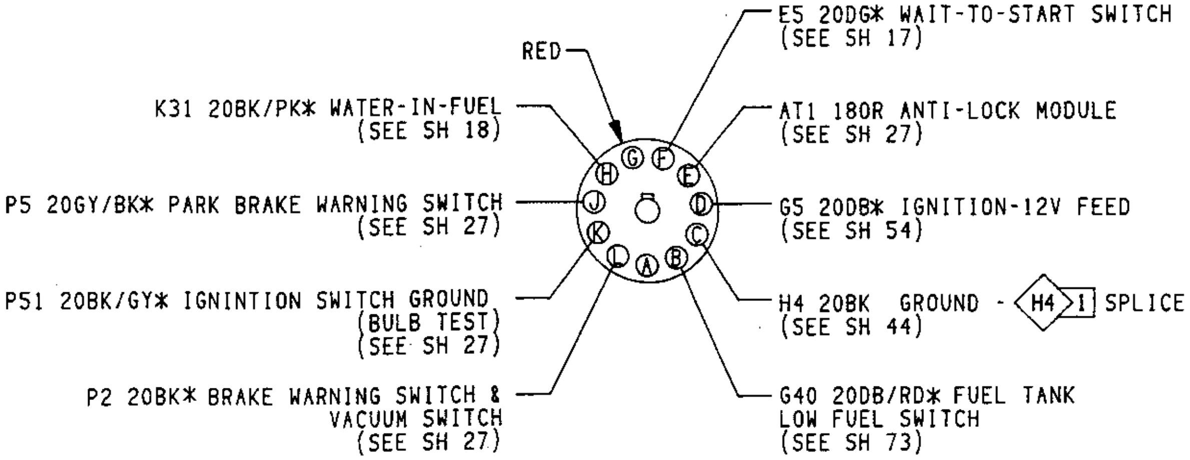
WINDSHIELD WIPER SYSTEM



J908W-14 STOP/TURN AND HAZARD FLASHER SYSTEMS

AD 52

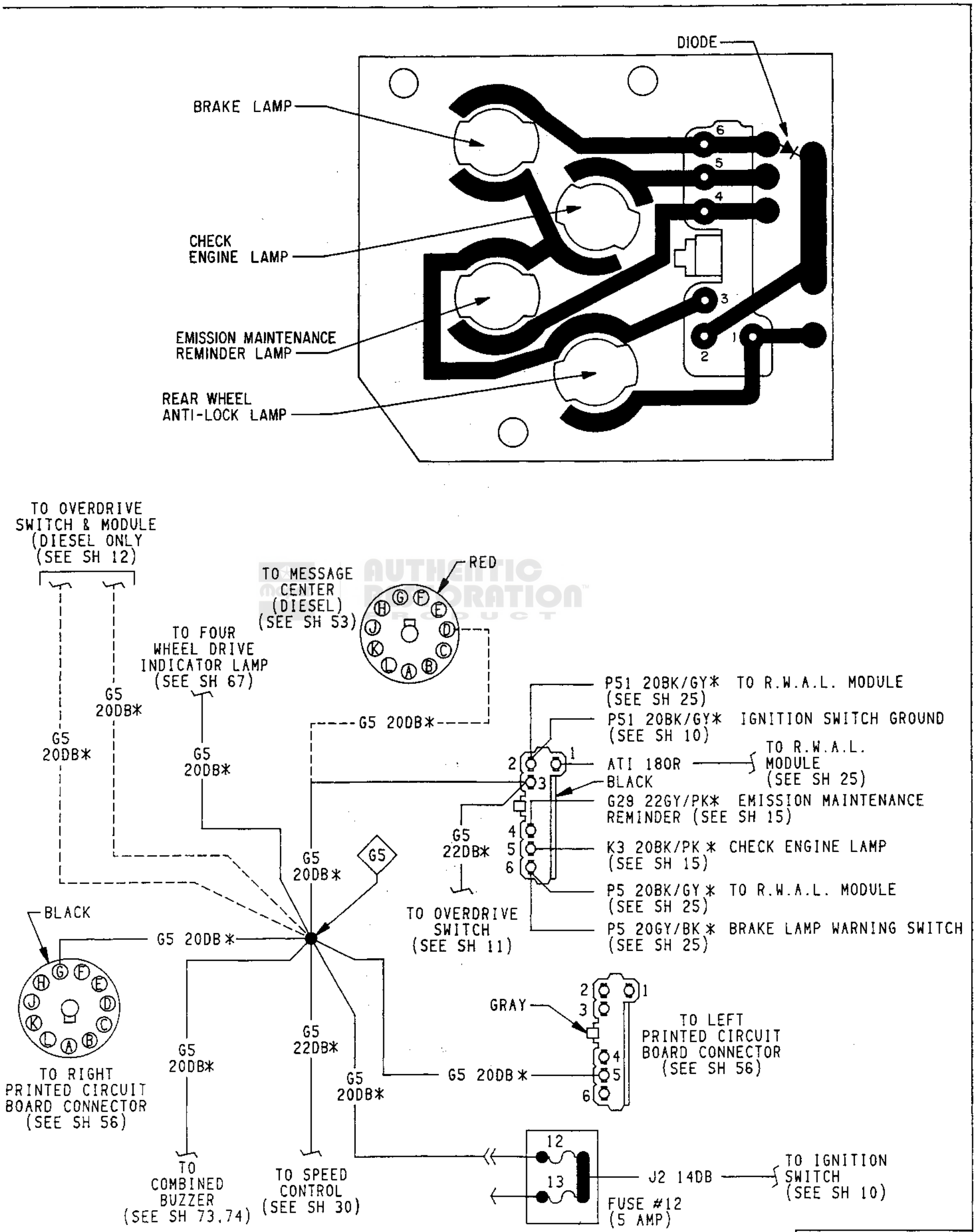




AD 53

MESSAGE CENTER (DIESEL)

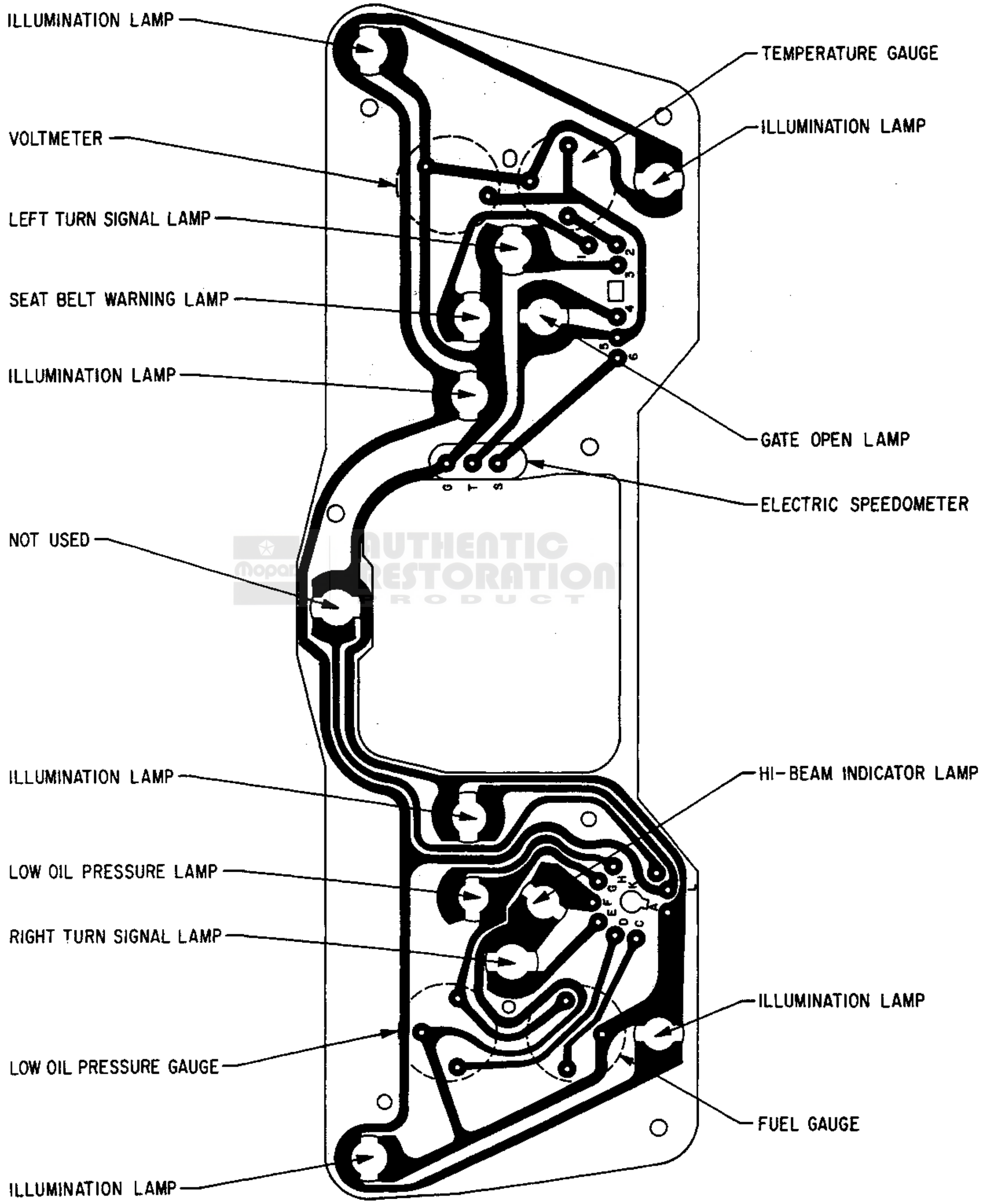
J908W-14



J908W-14

MESSAGE CENTER (GAS)

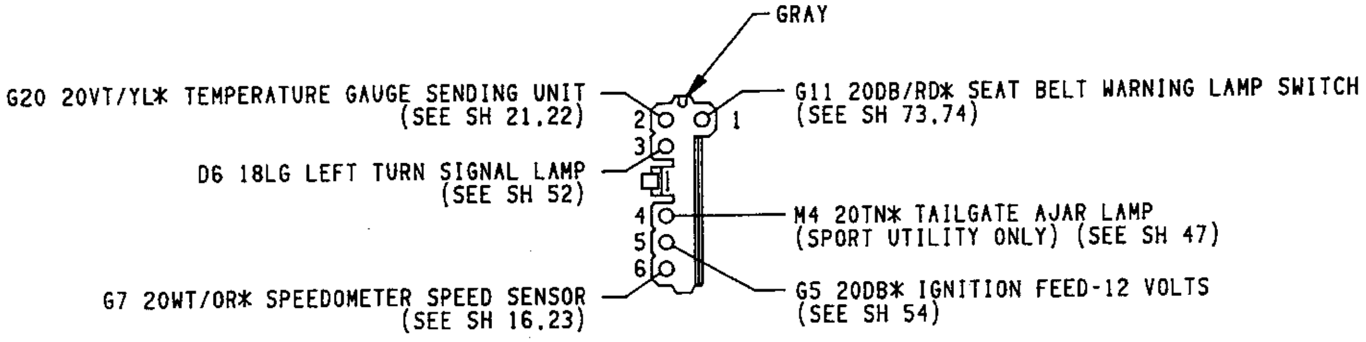
AD 54



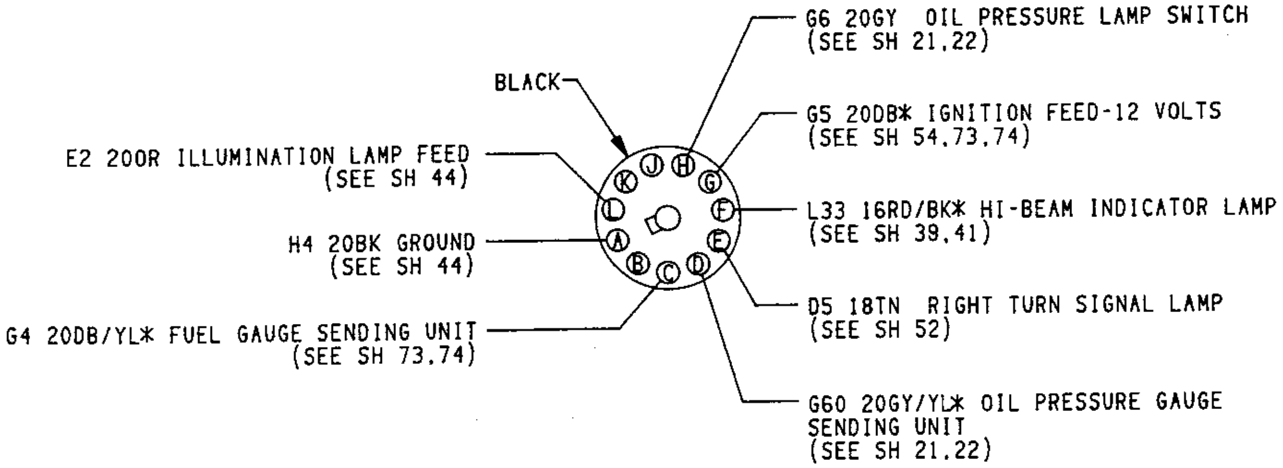
AD 55

CLUSTER - PRINTED CIRCUIT BOARD

J908W-14

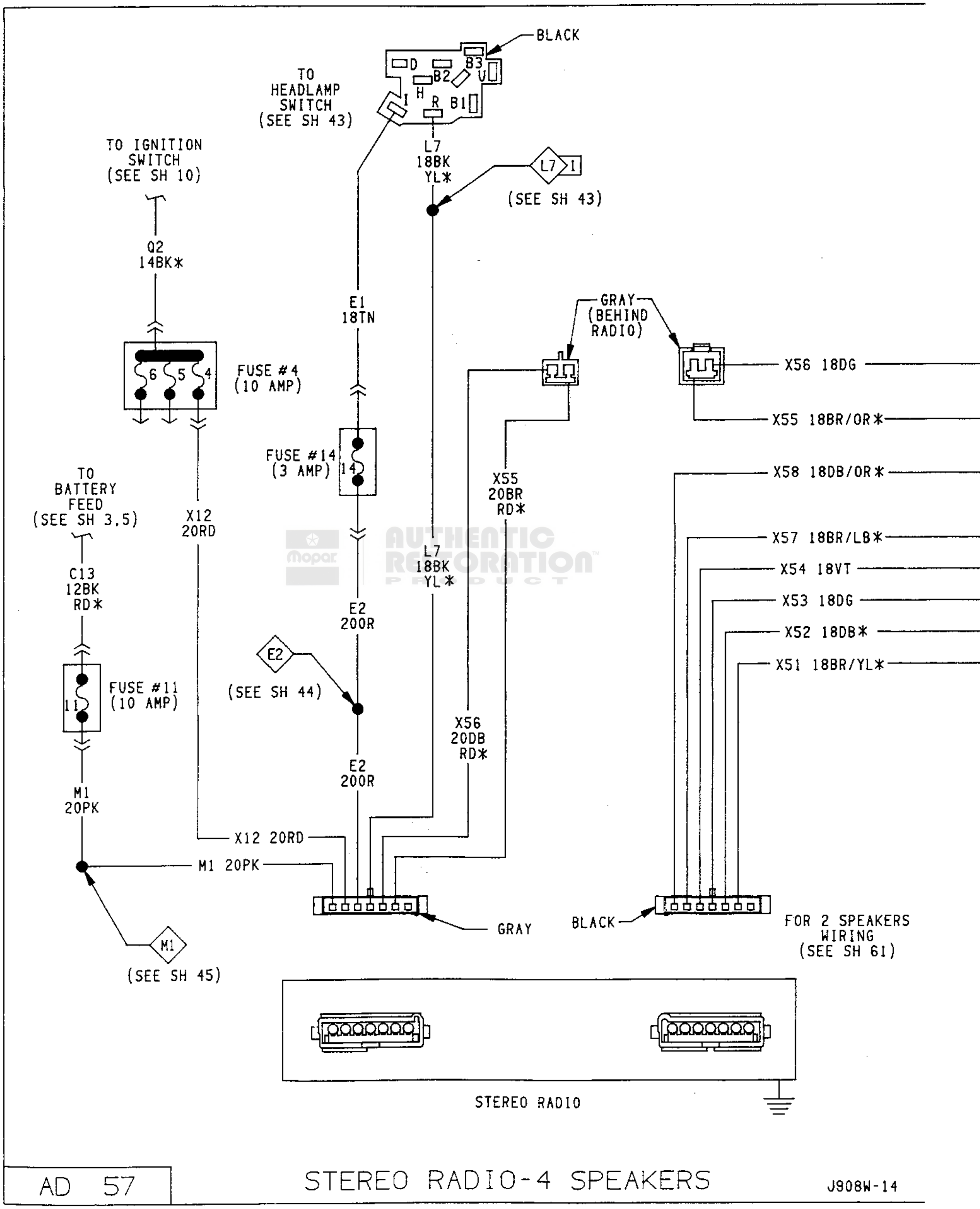


LEFT CONNECTOR



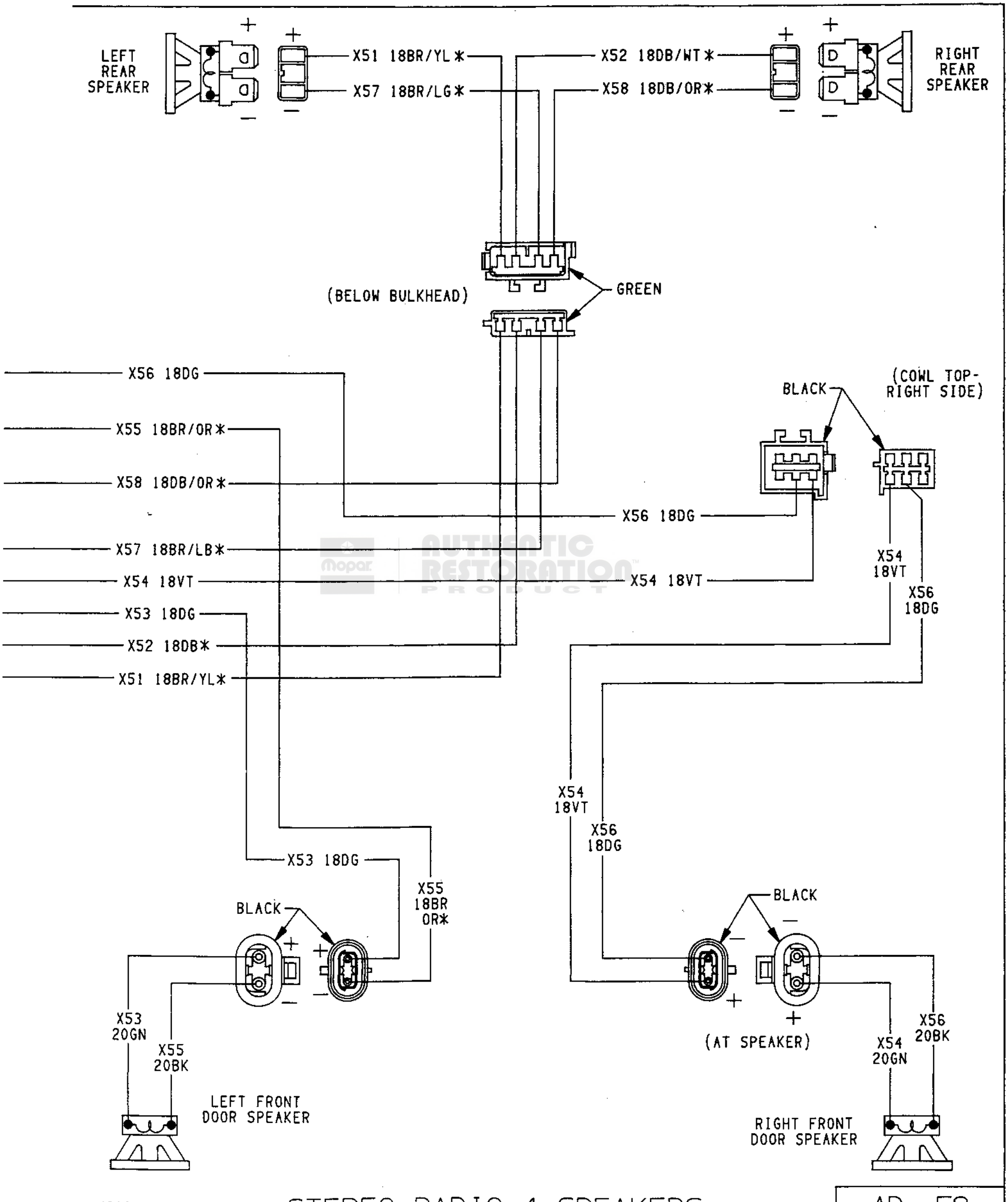
RIGHT CONNECTOR

PRINTED CIRCUIT BOARD CONNECTORS

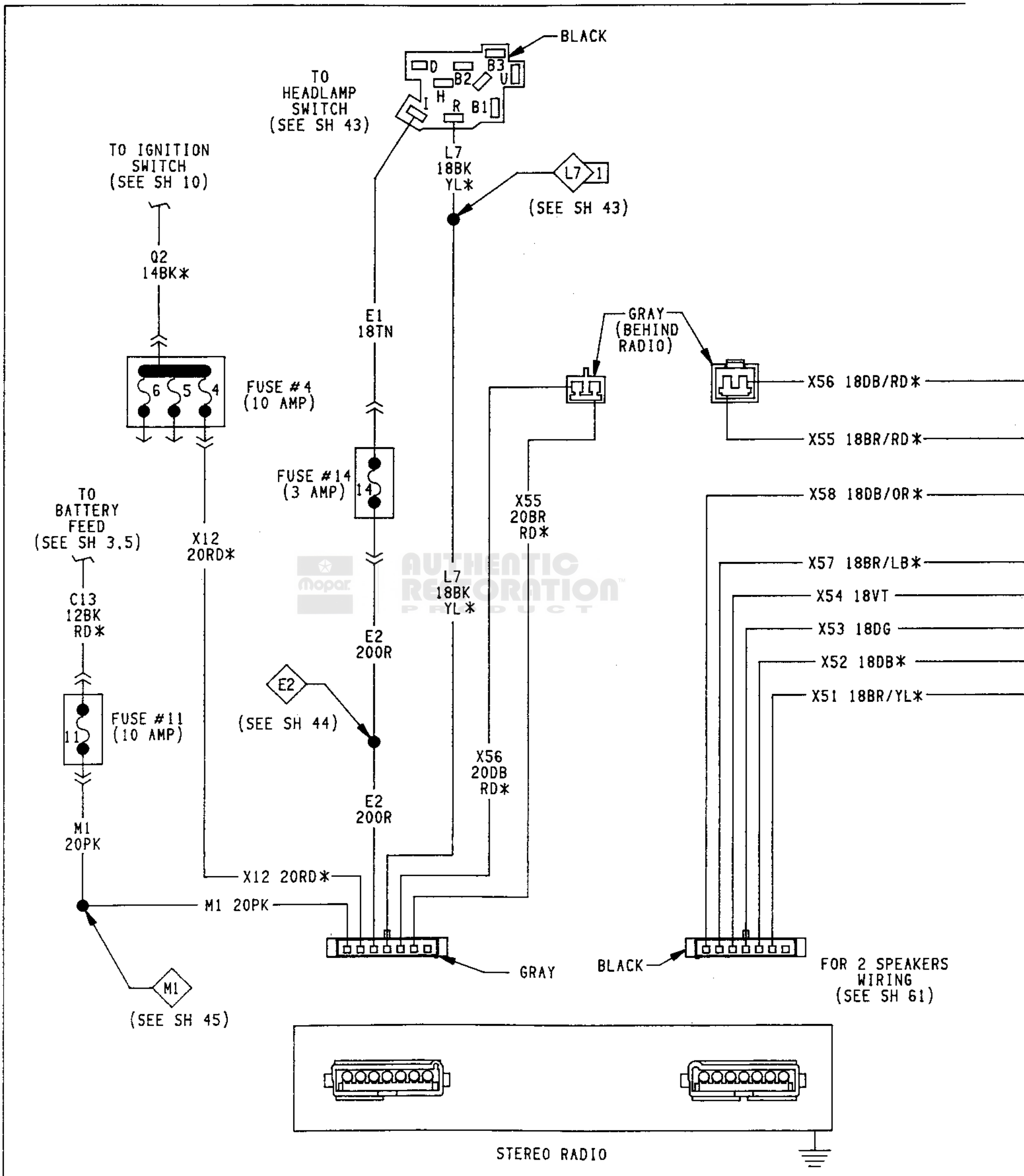


STEREO RADIO-4 SPEAKERS

J908W-14



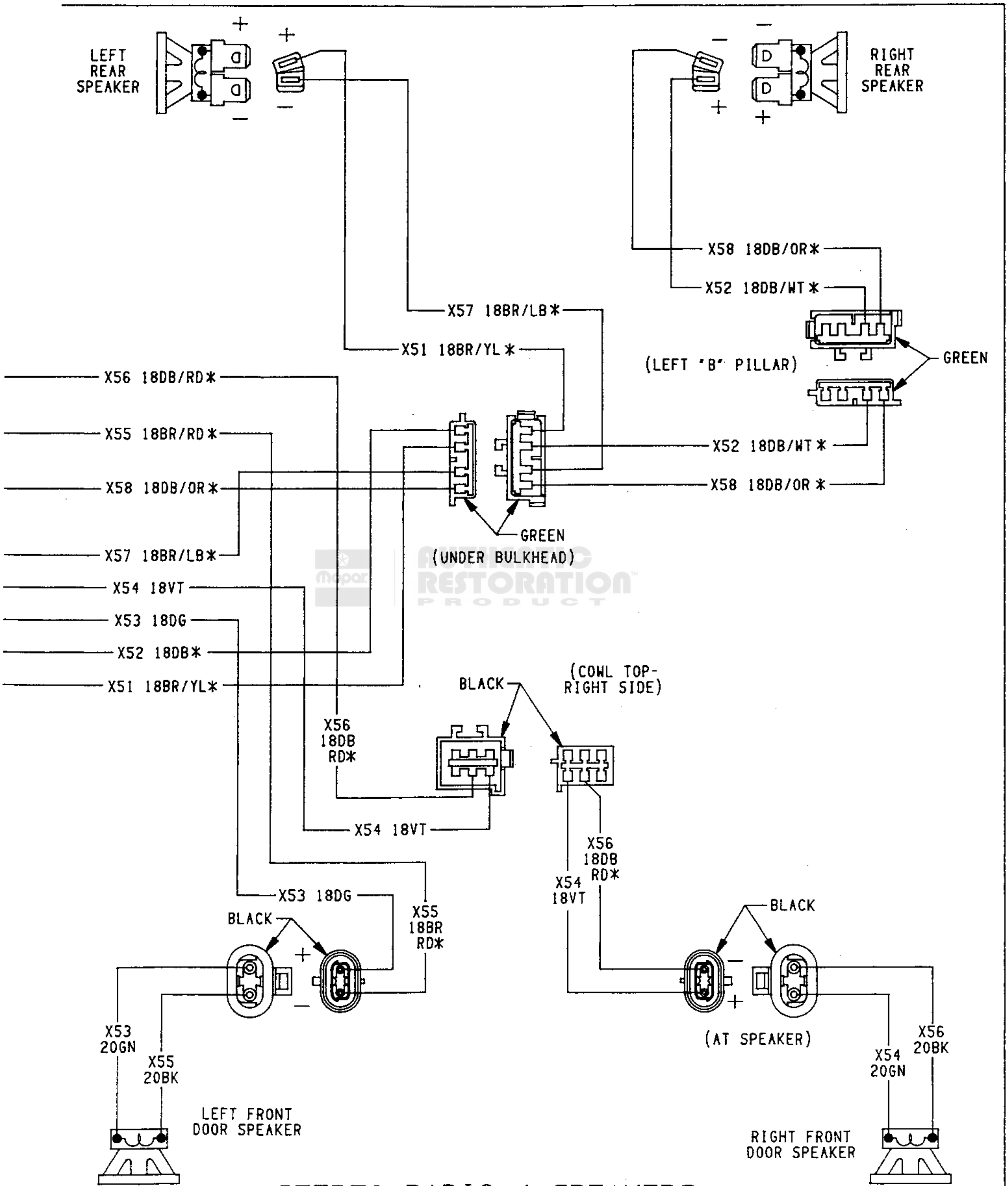
J908W-14 STEREO RADIO-4 SPEAKERS



STEREO RADIO-4 SPEAKERS
(SPORT UTILITY)

AD 59

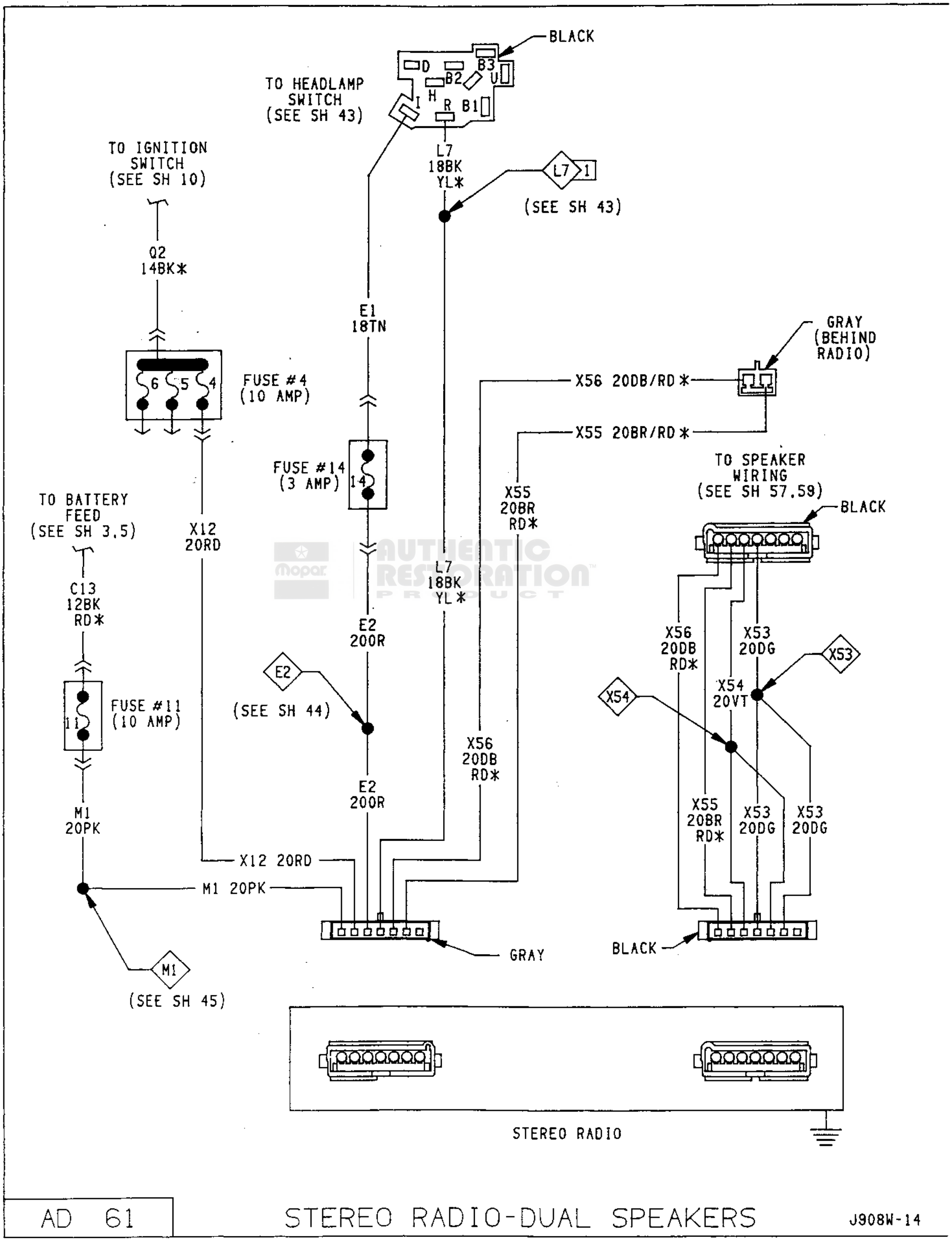
J908W-14



STEREO RADIO-4 SPEAKERS
(SPORT UTILITY)

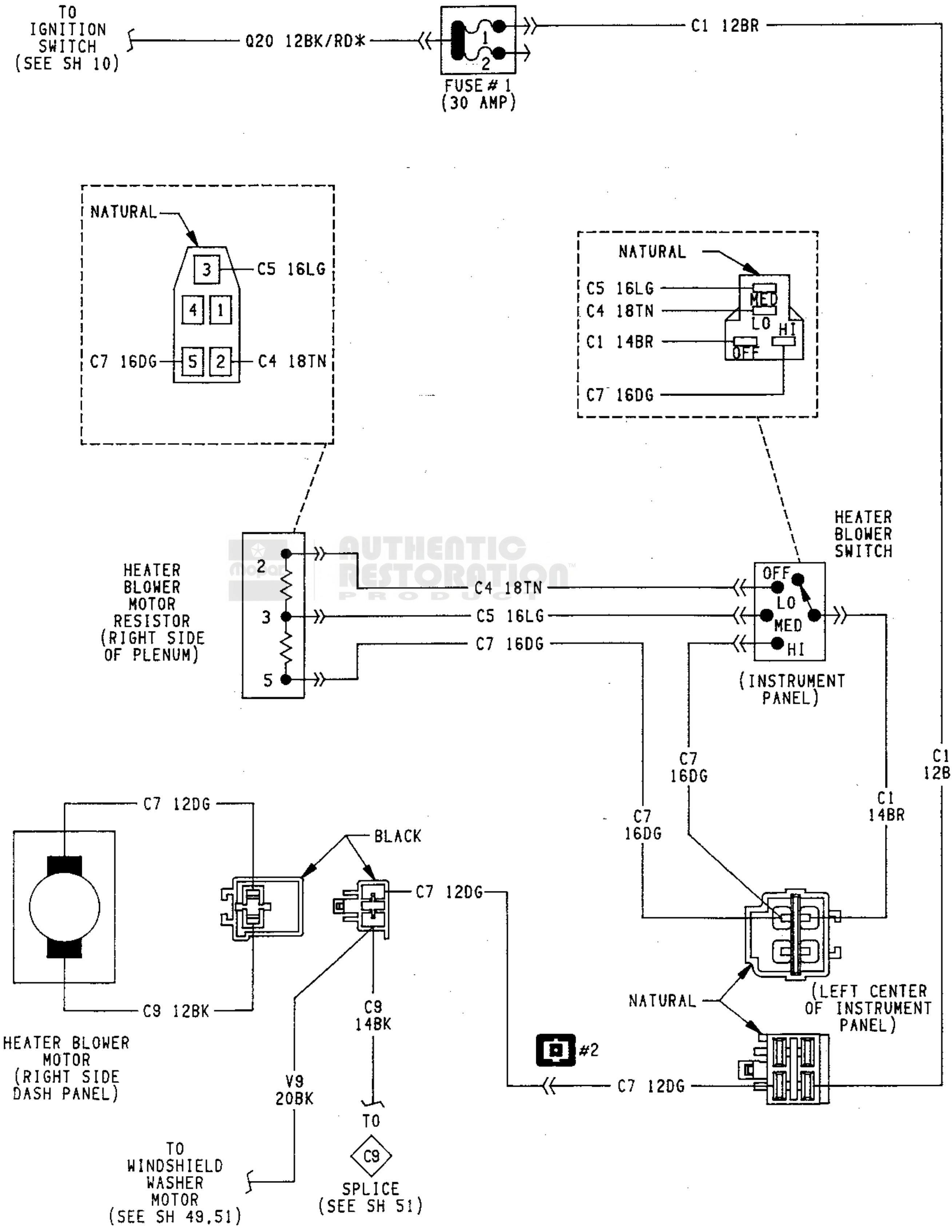
J908W-14

AD 60

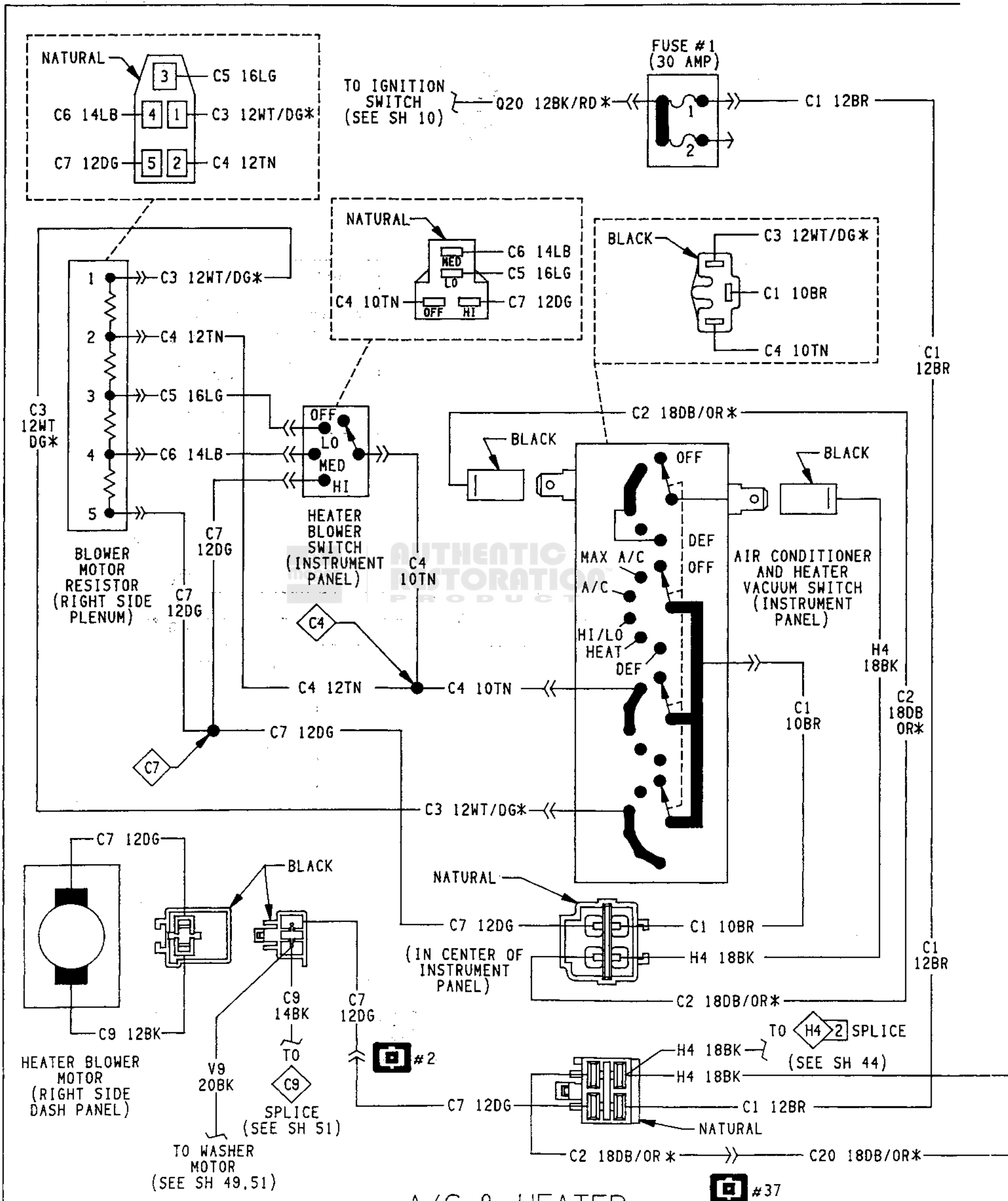


STEREO RADIO-DUAL SPEAKERS

J908W-14

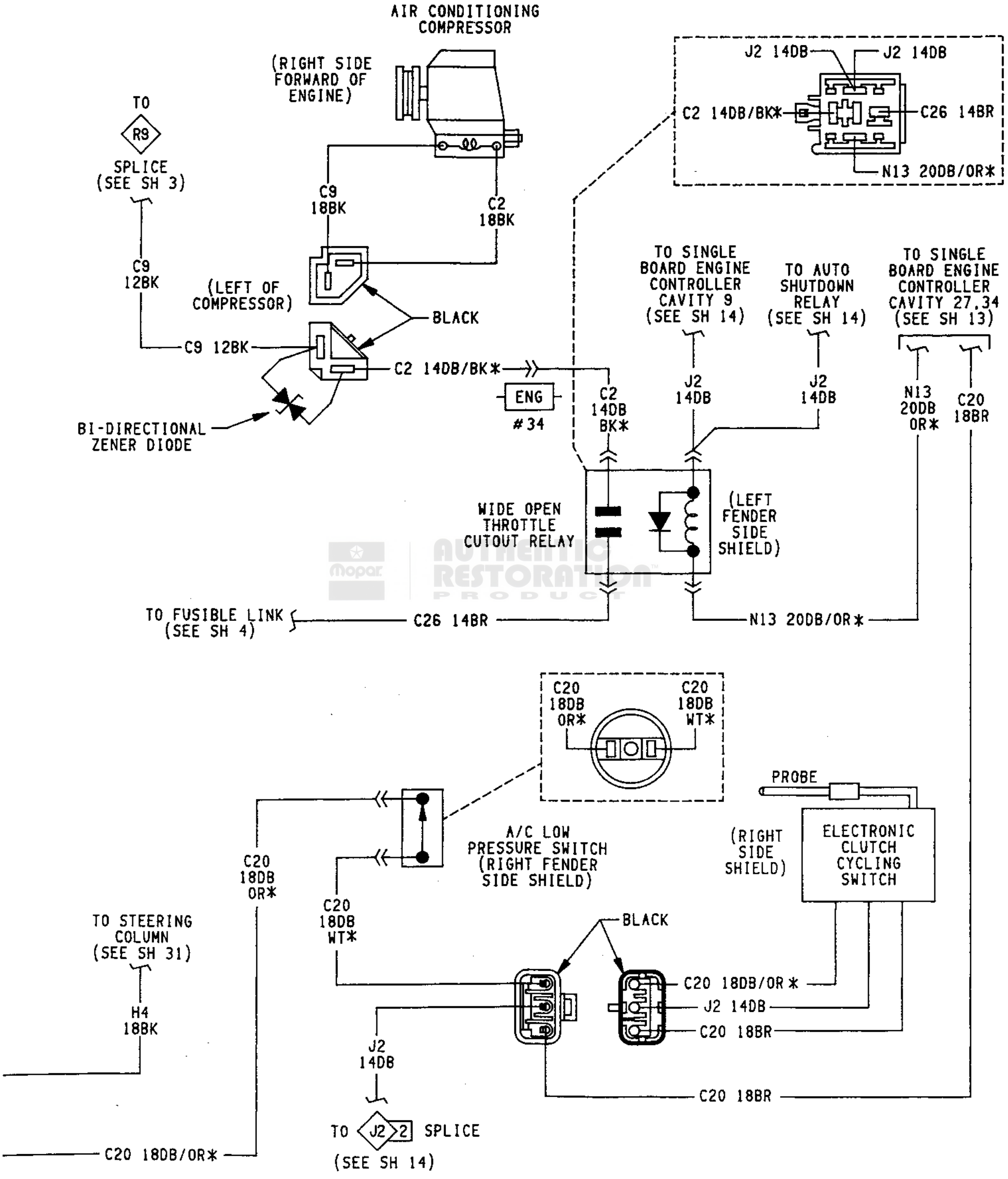

TO
IGNITION
SWITCH
(SEE SH 10)
Q20 12BK/RD*
1
2
FUSE # 1
(30 AMP)
C1 12BR
NATURAL
3
4
1
5
2
C5 16LG
C7 16DG
C4 18TN
NATURAL
C5 16LG
C4 18TN
C1 14BR
C7 16DG
MED
LO
HI
OFF
HEATER
BLOWER
MOTOR
RESISTOR
(RIGHT SIDE
OF PLENUM)
2
3
5
C4 18TN
C5 16LG
C7 16DG
HEATER
BLOWER
SWITCH
OFF
LO
MED
HI
(INSTRUMENT
PANEL)
C7
16DG
C7
16DG
C1
14BR
C1
12BR
C7 12DG
BLACK
C7 12DG
C9 12BK
HEATER BLOWER
MOTOR
(RIGHT SIDE
DASH PANEL)
C9
14BK
V9
20BK
TO
C9
SPLICE
(SEE SH 51)
TO
WINDSHIELD
WASHER
MOTOR
(SEE SH 49,51)
NATURAL
(LEFT CENTER
OF INSTRUMENT
PANEL)
#2
C7 12DG

HEATER

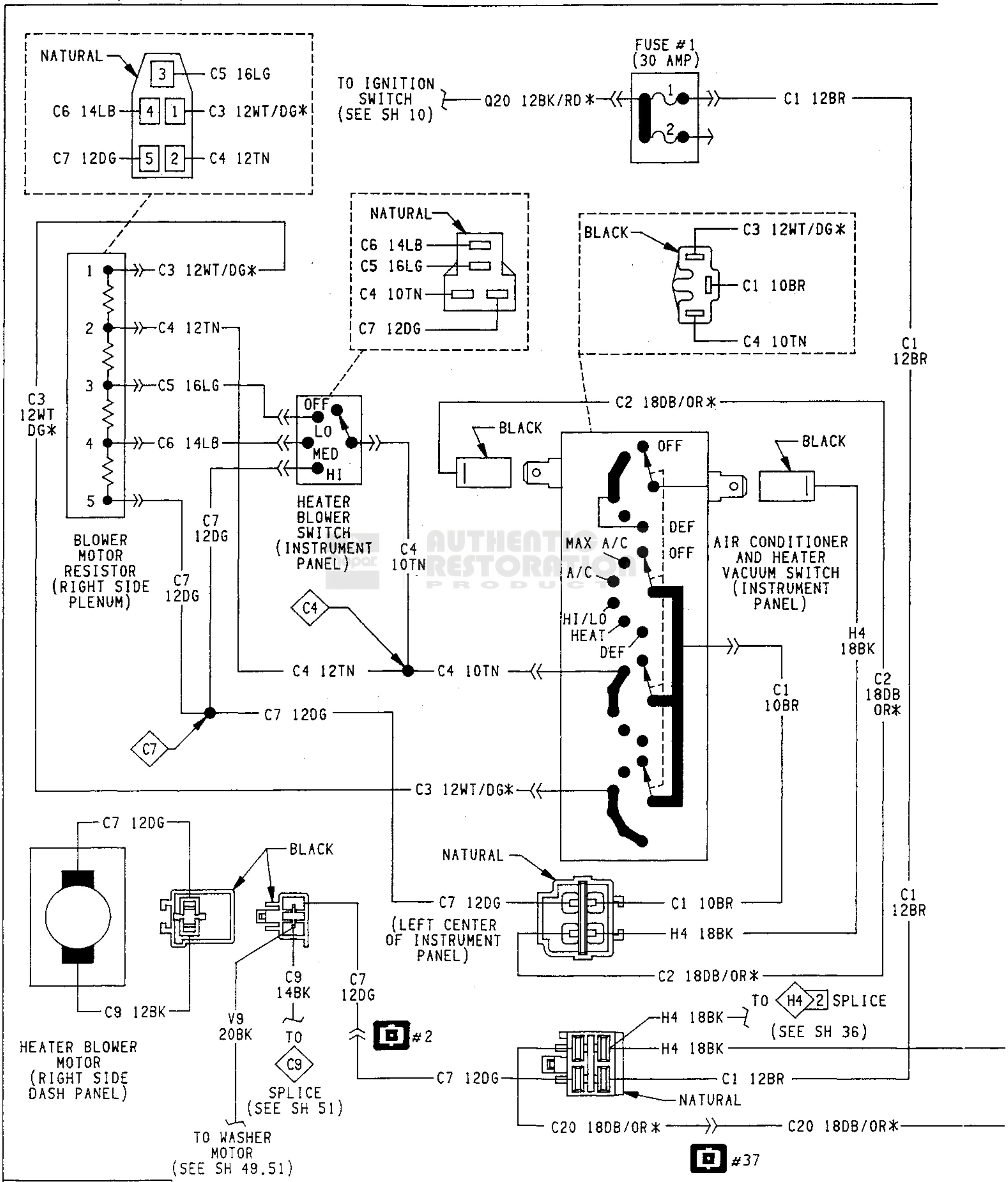


A/C & HEATER-
GAS ENGINE

J908W-14



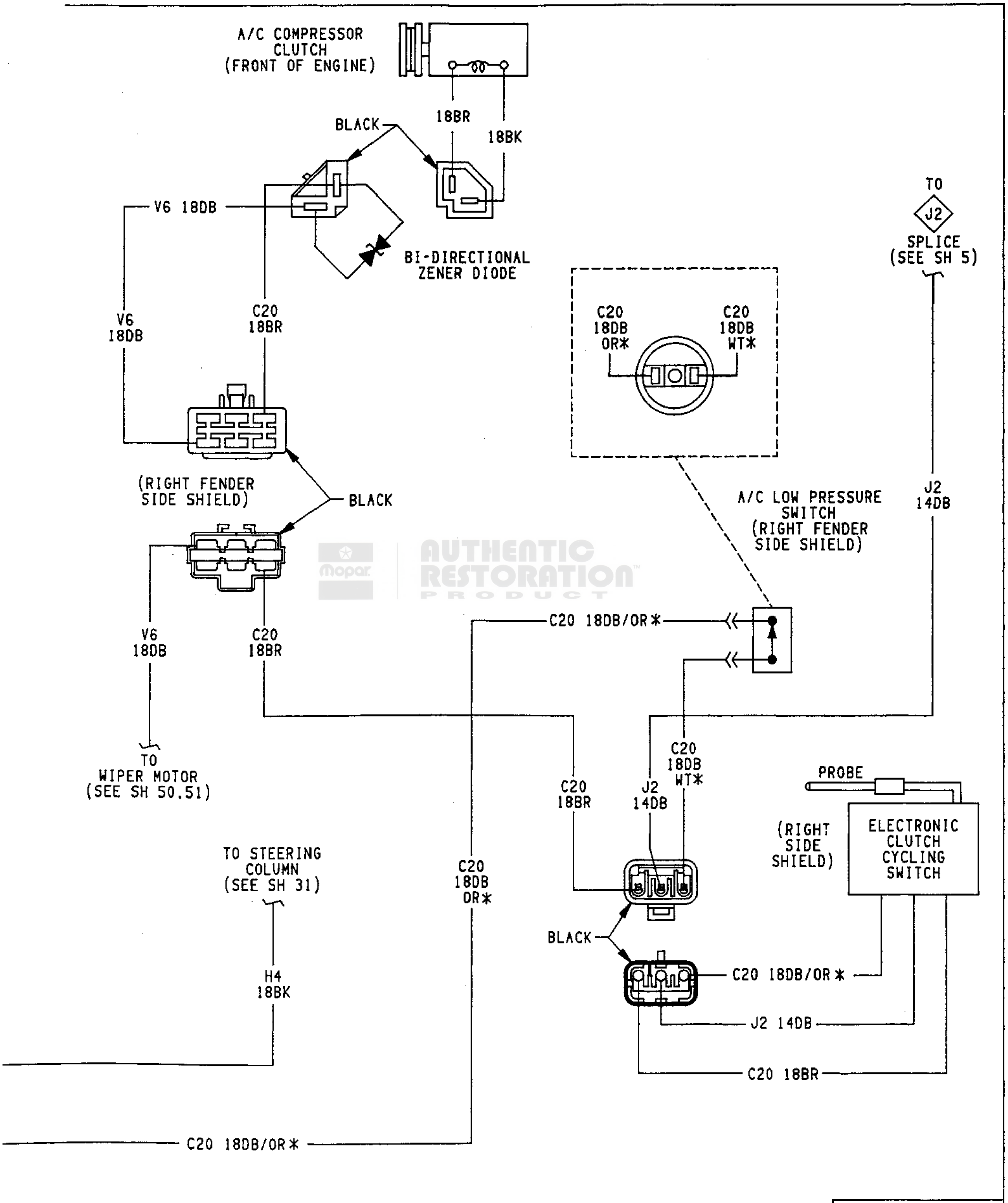
A/C AND HEATER-
GAS ENGINE



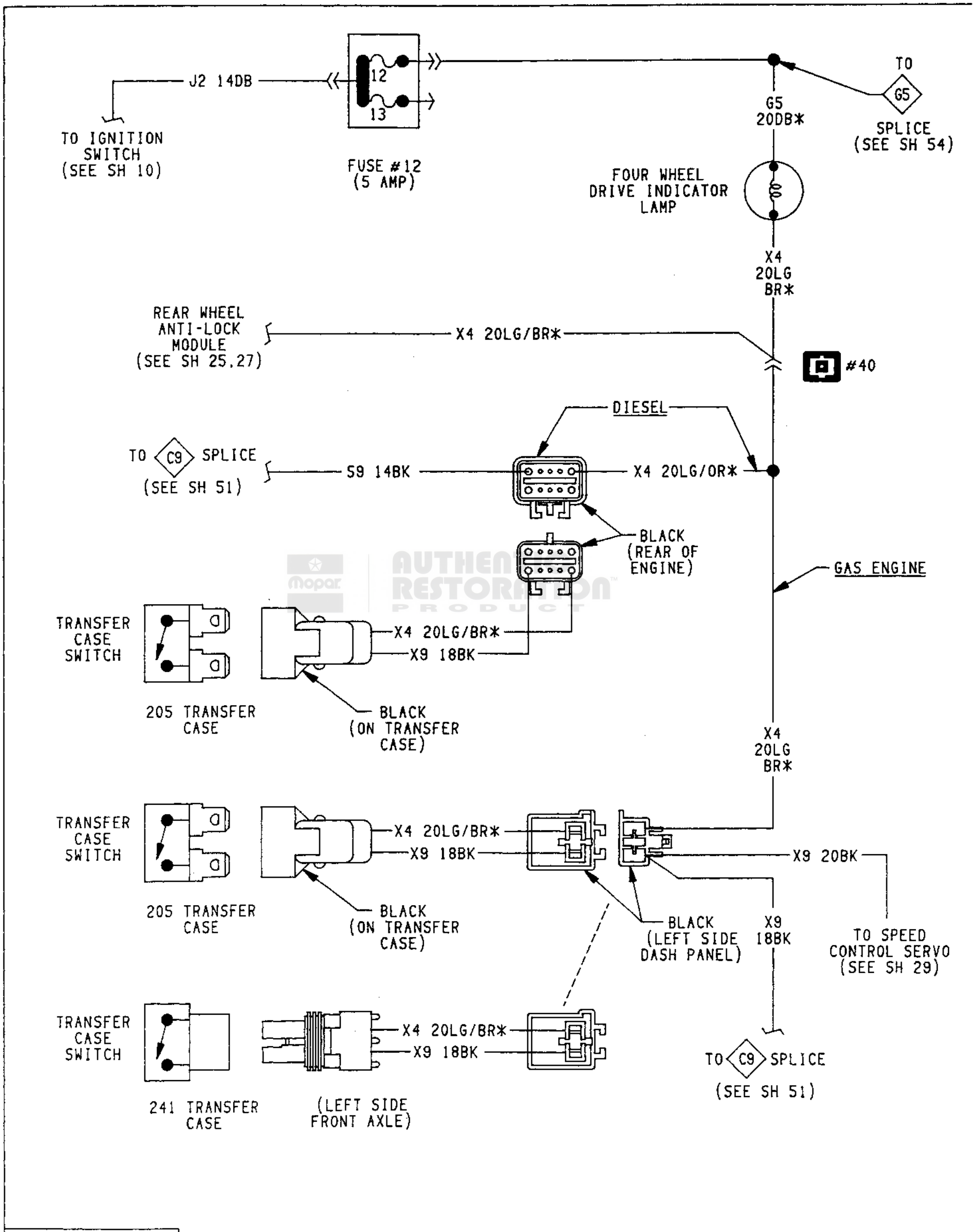
AD 65

A/C & HEATER-DIESEL ENGINE

J908W-14



A/C & HEATER-DIESEL ENGINE



AD 67

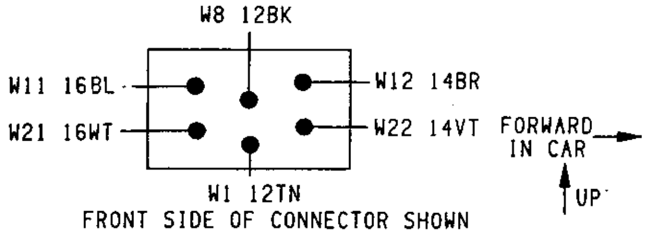
4 WHEEL DRIVE INDICATOR LAMP

J908W-14

ELECTRIC WINDOW LIFT CONNECTOR AND SWITCH FUNCTIONS

LEFT DOOR

B+ POLARITY	B- POLARITY	SWITCH SELECT	WINDOW AND MOVEMENT
LB	WT	1	LEFT FRONT UP
WT	LB	1	LEFT FRONT DOWN
BR	VT	2	RIGHT FRONT UP
VT	BR	2	RIGHT FRONT DOWN
TN	BK	SWITCH	FEED AND GROUND

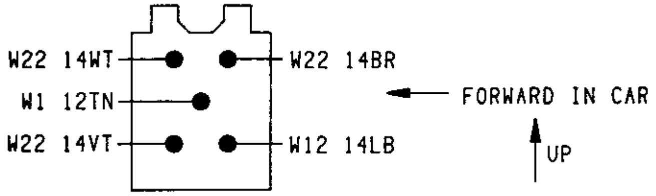


FRONT SIDE OF CONNECTOR SHOWN

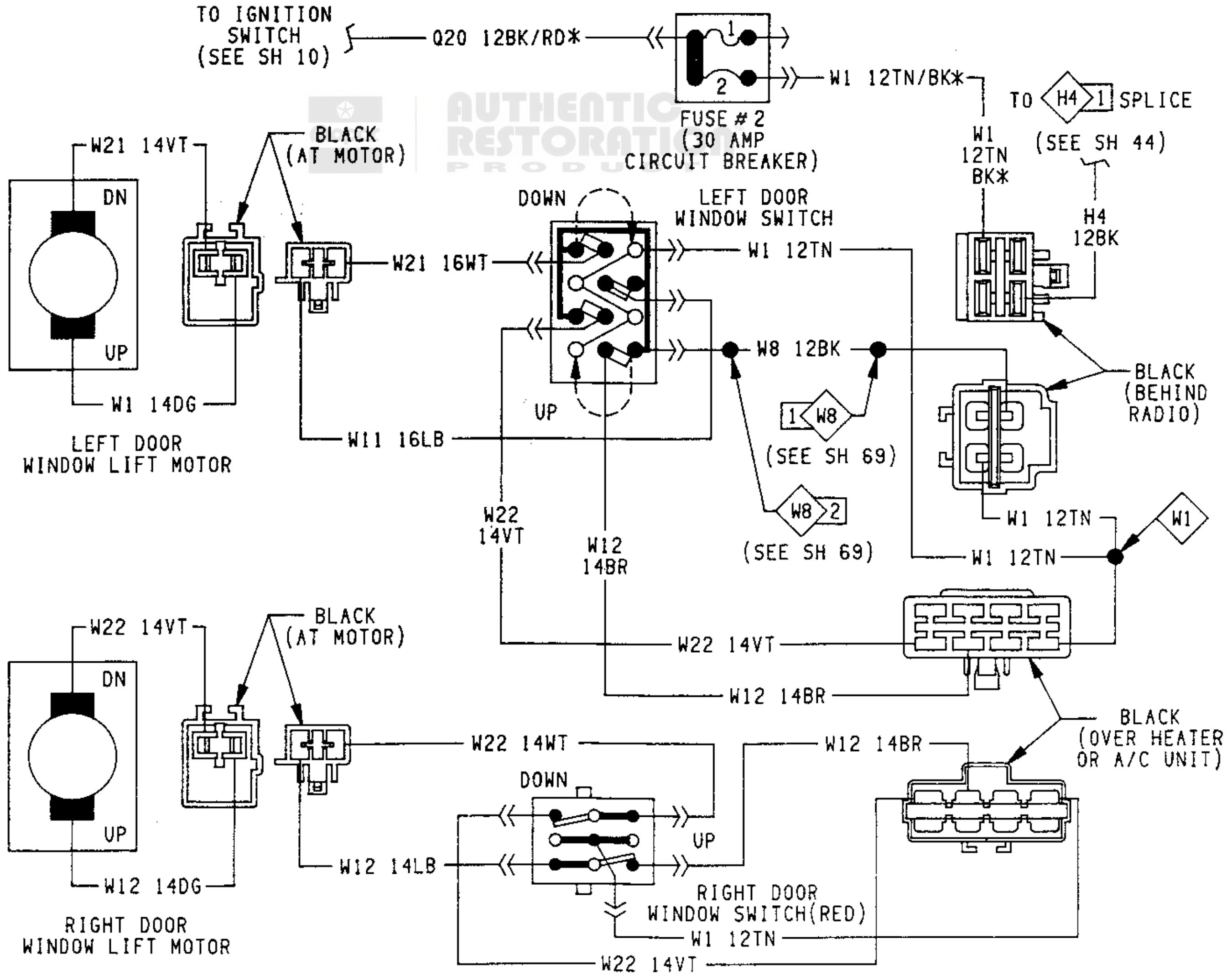
CONNECTOR GANG LEFT FRONT DOOR MASTER SWITCH

RIGHT DOOR

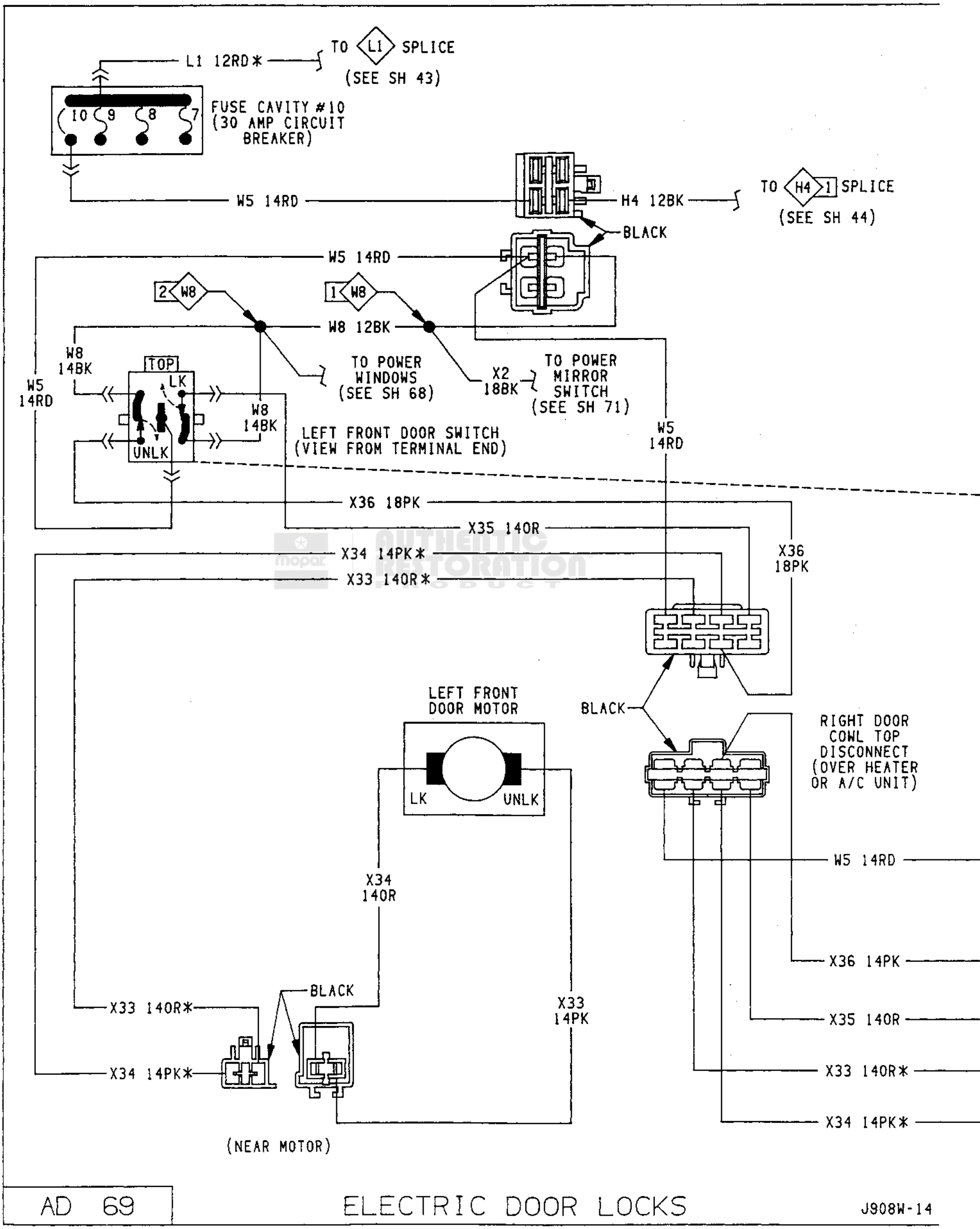
B+ POLARITY	B- POLARITY	WINDOW MOVEMENT AND SWITCH
WT	LB	DOWN FROM DOOR SWITCH
LB	WT	UP FROM DOOR SWITCH
VT	BR	DOWN FROM MASTER SWITCH
BR	VT	UP FROM MASTER SWITCH
TN	---	FEED



RIGHT FRONT WINDOW LIFT SWITCH CONNECTOR



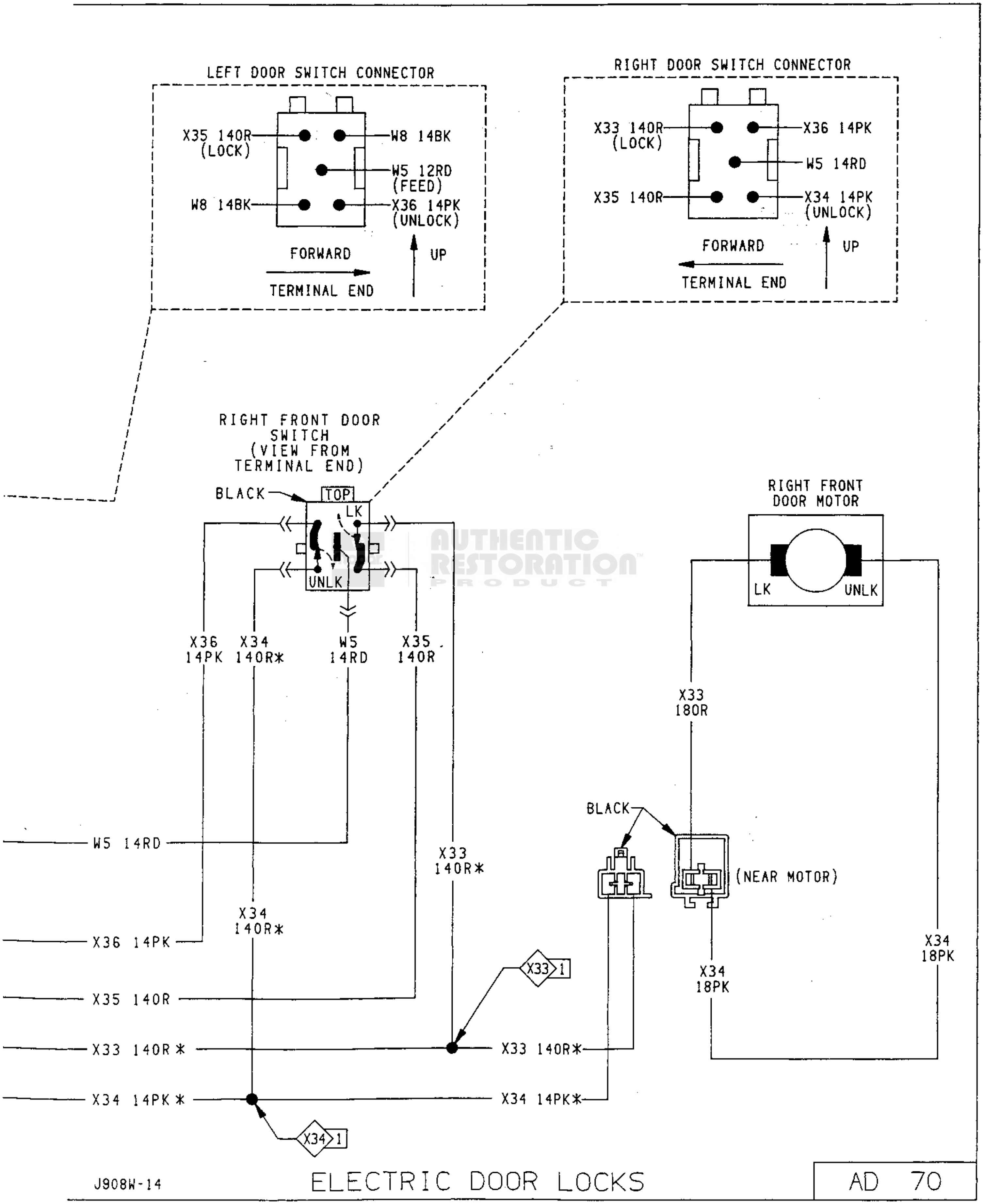
J908W-14 ELECTRIC WINDOW LIFTS



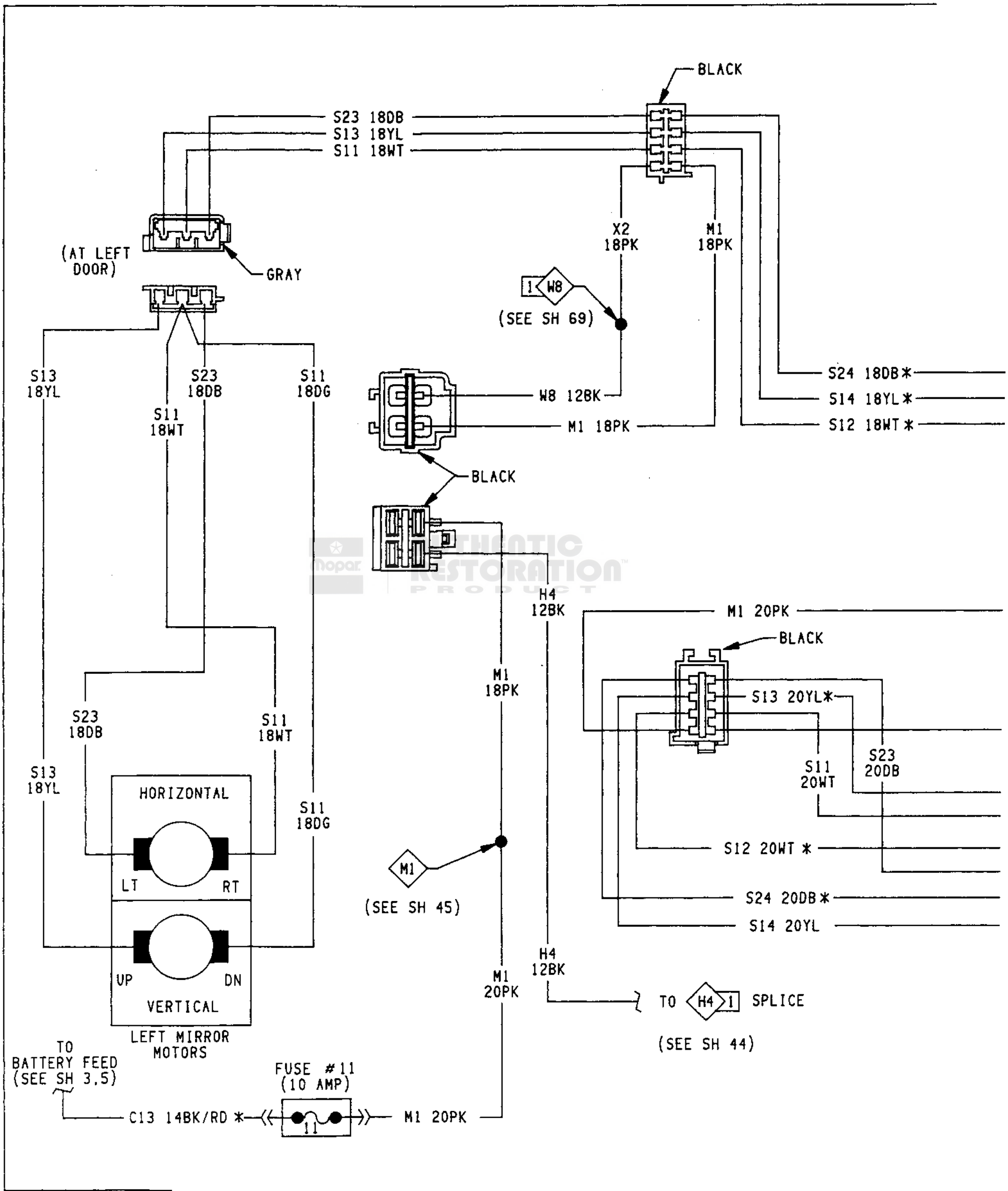
AD 69

ELECTRIC DOOR LOCKS

J908W-14



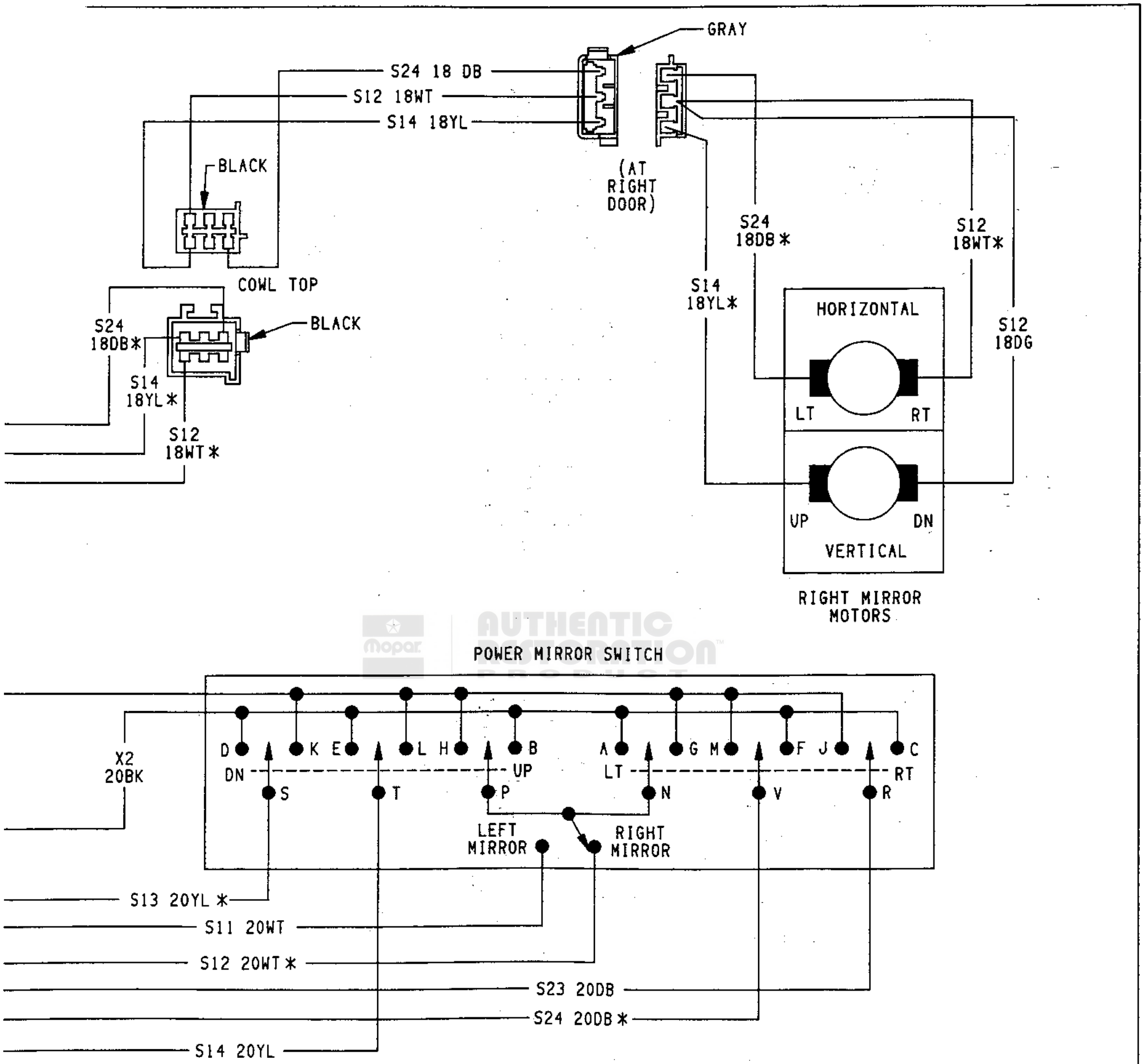
ELECTRIC DOOR LOCKS

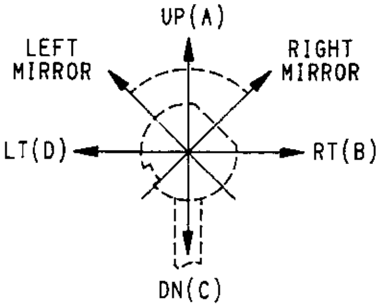


AD 71

POWER REMOTE MIRRORS

J908W-14

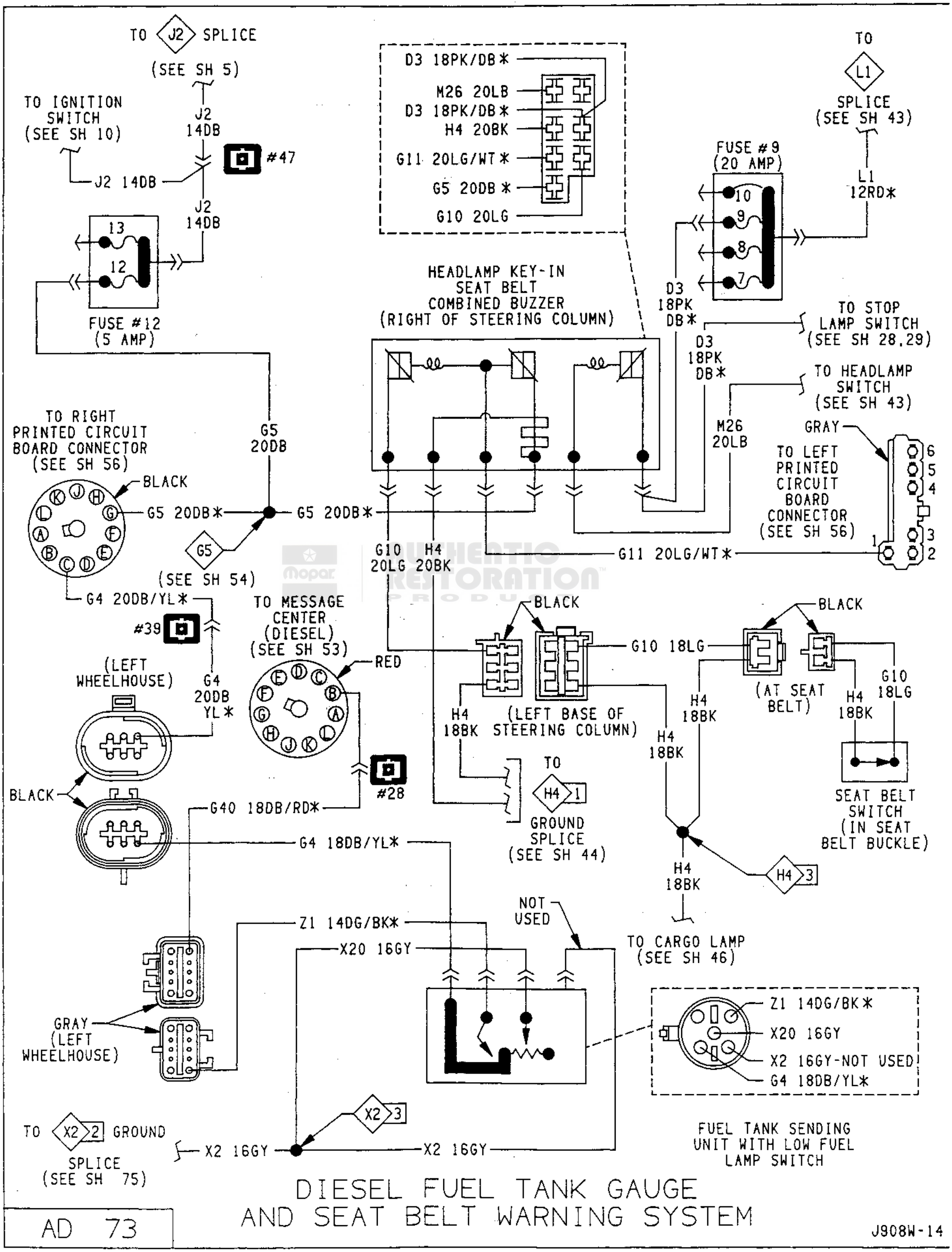




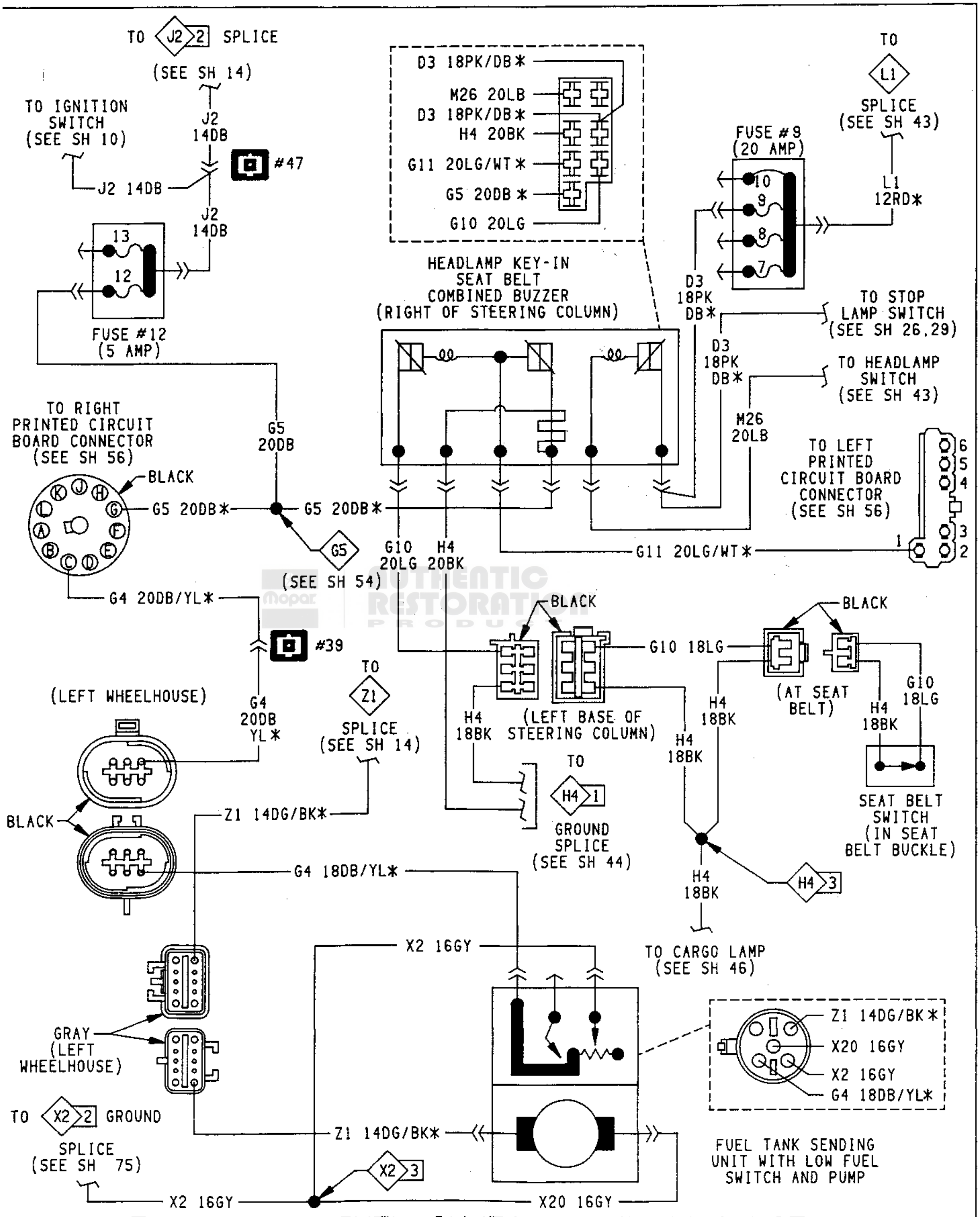
VIEW OF SWITCH INDEXING FROM FRONT OF SWITCH

POWER MIRROR SWITCH FUNCTION		
LEVER POSITION	CIRCUIT	MIRROR DIRECTION
A	SK,TL,PB	UP
B	NG,VP,RC	RIGHT
C	SD,TE,PH	DOWN
D	NA,VM,RJ	LEFT

POWER REMOTE MIRRORS



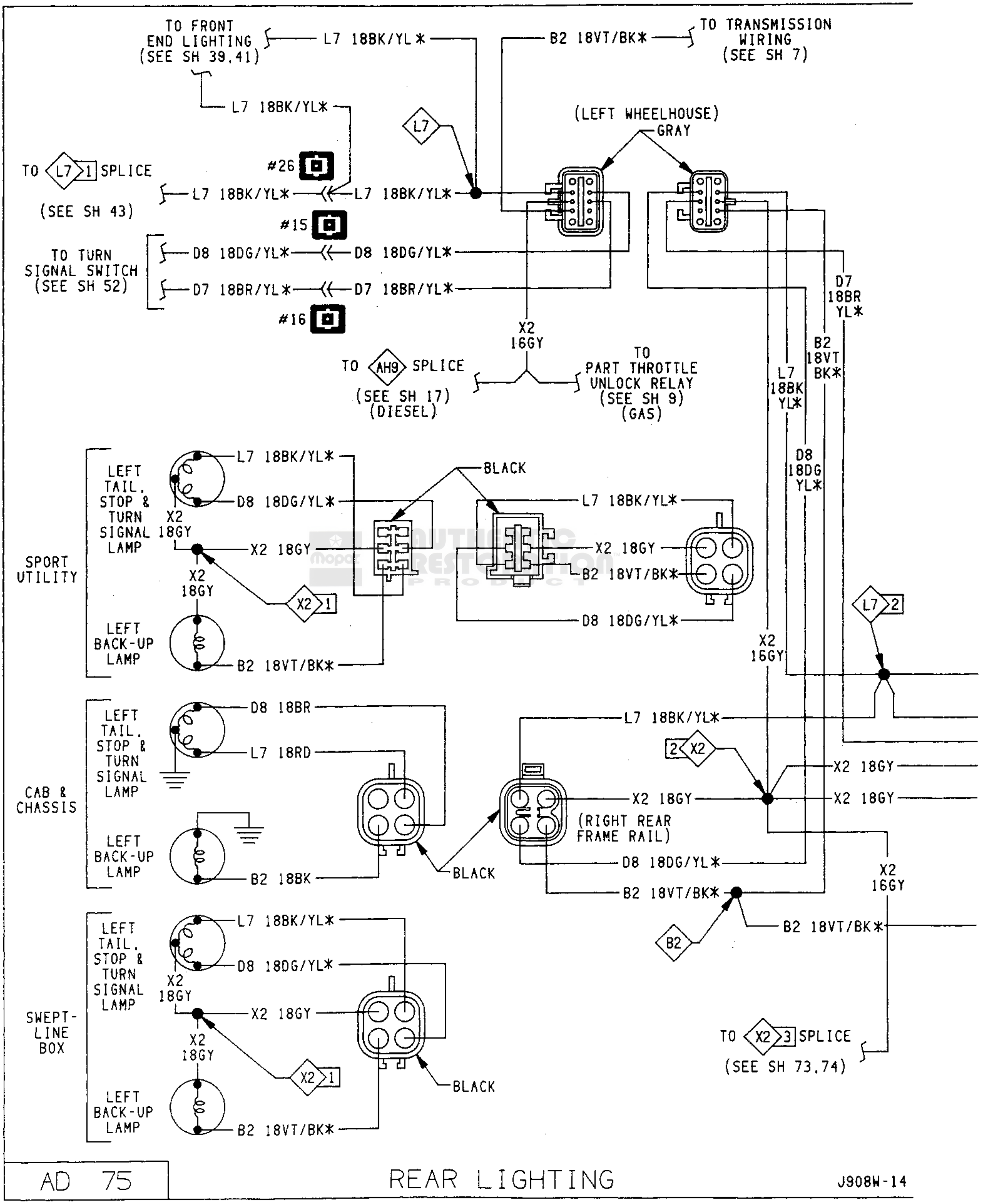
DIESEL FUEL TANK GAUGE AND SEAT BELT WARNING SYSTEM



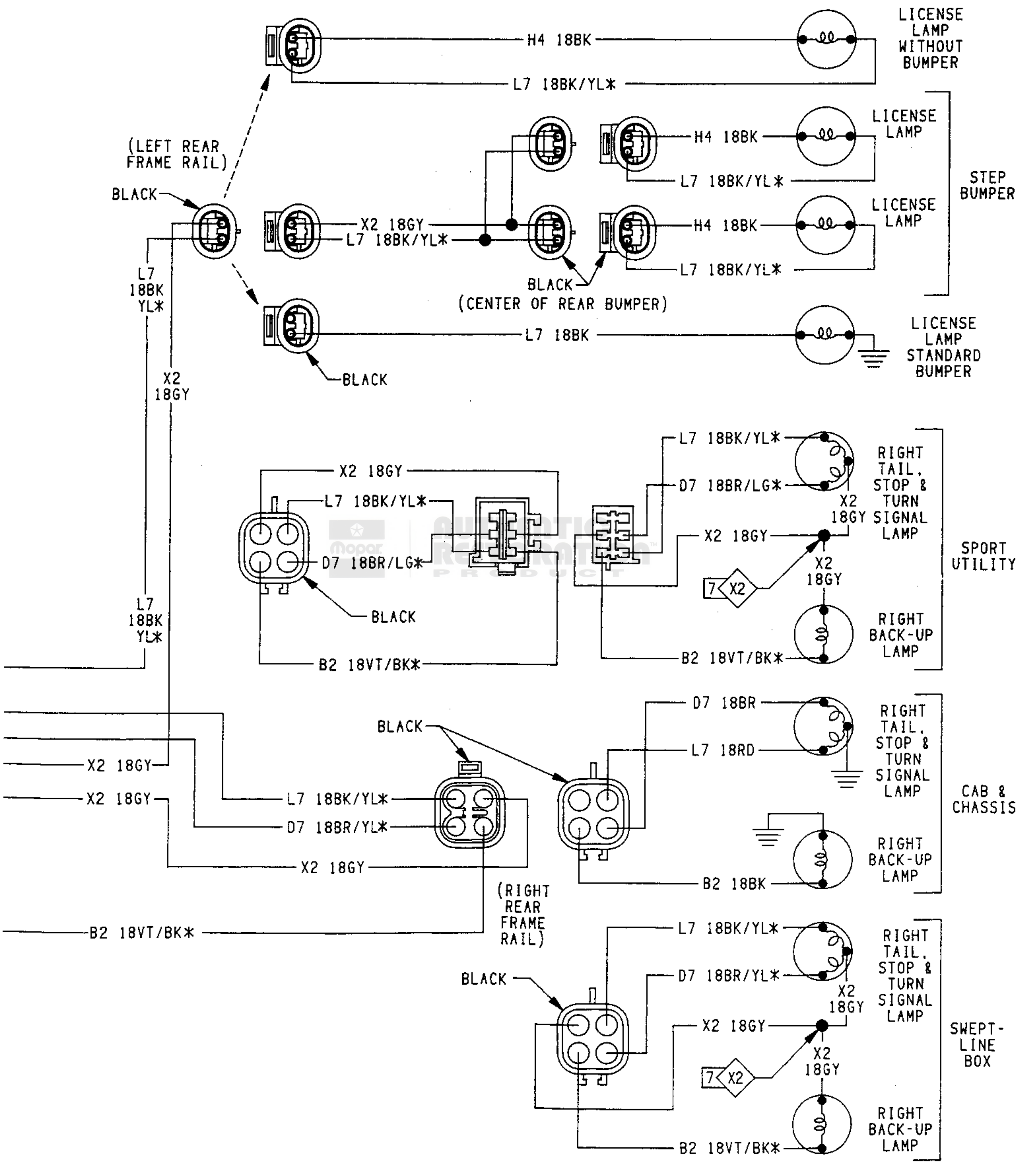
ELECTRONIC FUEL INJECTION TANK GAUGE AND SEAT BELT WARNING SYSTEM

J908W-14

AD 74

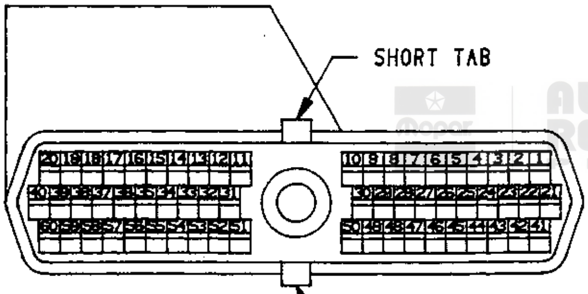


REAR LIGHTING



J908W-14

REAR LIGHTING



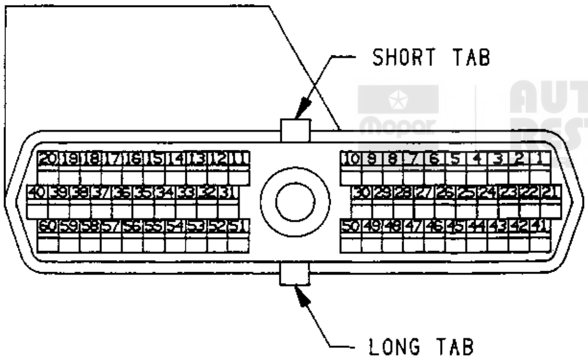
VIEWED FROM WIRE
END OF CONNECTOR

CAV	IGNITION SYSTEM CIRCUITS		SHEET NO.
1	K4 20DG/RD✻	MAP SENSOR	16
2	K10 20TN✻	COOLANT SENSOR	16
3	J11 16RD	DIRECT BATTERY	15
4	N5 18BK/LB✻	SENSOR RETURN	16
5	K5 16BK/WT✻	SIGNAL GROUND	13
6	K8 20VT/WT✻	5 VOLT SUPPLY	13
7	N6 18OR	8 VOLT INPUT	16
8	Z1 16DG/BK✻	AUTO SHUT DOWN-BATTERY SUP.	14
9	J2 14DB	IGNITION FEED	14
10	—	—	—
11	K9 18LB/RD✻	POWER GROUND	13
12	K9 18LB/RD✻	POWER GROUND	13
13	—	—	—
14	—	—	—
15	Y12 18TN	INJECTOR DRIVER 2	13
16	Y11 18WT/DB✻	INJECTOR DRIVER 1	13
17	—	—	—
18	—	—	—
19	J5 18BK/GY✻	IGNITION COIL DRIVER	14
20	R3 18DG	ALTERNATOR FIELD DRIVER	15
21	K13 18BK/RD✻	THROTTLE BODY TEMP. SENSOR	16
22	K7 18OR/DB✻	THROTTLE POSITION SENSOR	13
23	—	—	—
24	N7 18GY✻	REFERENCE PICKUP	16
25	DK21-20PK	SCI TRANSMIT	13
26	—	—	—
27	C20 18BR	A/C CLUTCH INPUT	13
28	N31 18VT	CLOSED THROTTLE SWITCH	15
29	D40 18WT/PK✻	BRAKE SENSE	15,29
30	S4 20BR/YL✻	PARK/NEUTRAL SWITCH	15
31	—	—	—
32	K3 20BK/PK✻	CHECK ENGINE LAMP	15
33	K36 20TN/RD✻	SPEED CONTROL - VACUUM	29
34	N13 20DB/OR✻	A/C W.O.T. CUTOUT RELAY	13
35	S6 20GY/YL✻	EGR SOLENOID	14
36	N23 20BK/OR✻	AIR SWITCHING SOLENOID	14
37	—	—	—
38	—	—	—
39	—	—	—
40	N2 18BR✻	AUTOMATIC IDLE SPEED MOTOR	15
41	N11 18BK/DG✻	OXYGEN SENSOR	13
42	—	—	—
43	—	—	—
44	U4 20OR/WT✻	OVERDRIVE LOCKOUT CONT.	11
45	DK20 20LG	SCI RECEIVE	13
46	—	—	—
47	G7 20WT/OR✻	SPEED SENOR PICKUP	16
48	X31 20BR/RD✻	SPEED CONTROL - SET	29
49	X32 20YL/RD✻	SPEED CONTROL - ON/OFF	27
50	X33 20WT/LG✻	SPEED CONTROL - RESUME	29
51	K19 20DB/YL✻	AUTO SHUT-DOWN RELAY	14
52	K1 20PK/BK✻	PURGE SOLENOID	14
53	X35 20LG/RD✻	SPEED CONTROL - VENT	29
54	U3 20OR/BK✻	PART THROTTLE UNLOCK SOL	9,11
55	U40 20OR/LG✻	OVERDRIVE LOCKOUT SOLENOID	11
56	G29 20GY/PK✻	EMISSIONS MAINT.REMINDER LAMP	15
57	—	—	—
58	—	—	—
59	—	—	—
60	N1 18GY/RD✻	AUTOMATIC IDLE SPEED MOTOR	15

AD 77

SINGLE BOARD
ENGINE CONTROLLER CONNECTOR (GAS)

J908W-14



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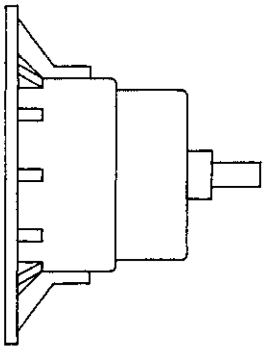
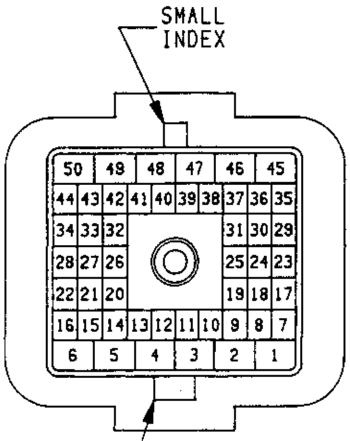
END OF CONNECTOR

CAV.	IGNITION SYSTEM CIRCUITS		SHEET NO.
1	—	—	—
2	—	—	—
3	J11 16RD	DIRECT BATTERY FEED	23
4	N5 18BK/LB*	SENSOR RETURN	24
5	K5 16BK*	SIGNAL GROUND	24
6	K8 20VT/WT*	5 VOLT SUPPLY	24
7	—	—	—
8	—	—	—
9	J2 14DB	IGNITION FEED	23
10	—	—	—
11	J9 16BK	POWER GROUND	24
12	J9 16BK	POWER GROUND	24
13	—	—	—
14	—	—	—
15	—	—	—
16	—	—	—
17	—	—	—
18	—	—	—
19	—	—	—
20	—	—	—
21	—	—	—
22	K7 18OR/DB*	THROTTLE POSITION SENSOR	24
23	—	—	—
24	—	—	—
25	DK21 20PK	SCI TRANSMIT	24
26	—	—	—
27	—	—	—
28	—	—	—
29	D40 18WT/PK*	BRAKE SENSE	23
30	S4 20BR/YL*	PARK/NEUTRAL SWITCH	23
31	—	—	—
32	—	—	—
33	—	—	—
34	—	—	—
35	—	—	—
36	—	—	—
37	—	—	—
38	—	—	—
39	—	—	—
40	—	—	—
41	—	—	—
42	—	—	—
43	—	—	—
44	U4 20OR/WT*	OVERDRIVE LOCKOUT CONTROL	12
45	DK20 20LG	SCI RECEIVE	24
46	—	—	—
47	G7 20WT/OR*	SPEED SENSOR PICKUP	23
48	—	—	—
49	—	—	—
50	—	—	—
51	—	—	—
52	—	—	—
53	—	—	—
54	—	—	—
55	U40 20OR/LG*	OVERDRIVE LOCKOUT SOLENOID	12
56	—	—	—
57	—	—	—
58	—	—	—
59	—	—	—
60	—	—	—

SINGLE BOARD ENGINE CONTROLLER CONNECTOR (AUTOMATIC TRANSMISSION) (DIESEL)

CAVITY	ENGINE COMPARTMENT CIRCUITS	
1	L1 12RD/WT*	HEADLAMP SWITCH
2	C7 12DG	A/C & HEATER BLOWER MOTOR
3	DS1 14WT/BR*	REAR WHEEL ANTI LOCK
4	IS1 16LG*	REAR WHEEL ANTI LOCK
5	L4 16VT/WT*	HEADLAMP LOW BEAM (2 WIRES)
6	L3 14RD/OR*	HEADLAMP HIGH BEAM (2 WIRES)
7	X30 20DB/RD*	SPEED CONTROL (GAS ENGINE ONLY)
8	X31 20BR/RD*	SPEED CONTROL (GAS ENGINE ONLY)
9	X33 20WT/LG*	SPEED CONTROL (GAS ENGINE ONLY)
10	X32 20YL/RD*	SPEED CONTROL (GAS ENGINE ONLY)
11	E5 20DG/WT*	WAIT TO START LAMP (DIESEL ONLY)
12	L33 16RD/BK*	HIGH BEAM INDICATOR LAMP
13	L20 14LG/BK*	HIGH BEAM FEED (D.R.L. MODULE)
14	VS1 18LB	REAR WHEEL ANTI LOCK
15	D8 18DG/YL*	LEFT REAR TURN SIGNAL LAMP
16	D7 18BR/YL*	RIGHT REAR TURN SIGNAL LAMP
17	G20 20VT/YL*	WATER TEMPERATURE SENDING UNIT
18	G6 20GY	OIL PRESSURE SWITCH
19	G60 20GY/YL*	OIL PRESSURE SENDING UNIT
20	——	——
21	D6 18LG	LEFT TURN SIGNAL LAMP
22	D5 18TN	RIGHT TURN SIGNAL LAMP
23	A3 16PK	BATTERY-HAZARD FLASHER
24	B01 18RD/VT*	REAR WHEEL ANTI LOCK
25	B02 18WT/VT*	REAR WHEEL ANTI LOCK
26	L7 18BK/YL*	PARKING LAMPS
27	B1 18WT	BACK-UP LAMP SWITCH
28	G40 18DB/RD*	LOW FUEL RELAY (DIESEL ONLY)
29	V10 20BR	WINDSHIELD WASHER MOTOR
30	——	——
31	S2 16YL	STARTER RELAY-IGNITION
32	H2 18DG/RD*	HORN
33	L22 18BK/RD*	UNDERHOOD LAMP
34	P51 20GY/BK*	BRAKE WARNING LAMP SWITCH
35	V5 18DG	WINDSHIELD WIPER MOTOR
36	V6 18DB	WINDSHIELD WIPER MOTOR
37	C20 18DB/OR*	AIR CONDITIONING DAMPED PRESSURE SWITCH
38	K3 20BK/PK* K31 20BK/PK*	CHECK ENGINE LAMP (GAS ENGINE ONLY) WATER IN FEUL LAMP (DIESEL ONLY)
39	G4 20DB/YL*	FUEL TANK SENDING UNIT
40	X4 20LG/BR*	4 WHEEL DRIVE SWITCH
41	D40 18WT/PK*	BRAKE SENSOR
42	G29 20GY/PK*	EMR LAMP (GAS ENGINE ONLY)
43	G7 20WT/OR*	SPEED SENSOR
44	U4 20OR/WT*	OVERDRIVE LOCKOUT
45	V3 18BR/WT*	WINDSHIELD WIPER MOTOR
46	V4 18RD/YL*	WINDSHIELD WIPER MOTOR
47	J2 14DB	SPLICE-IGNITION RUN CIRCUIT
48	C13 12BK/RD*	IGNITION OFF DRAW
49	J1 12RD	IGNITION SWITCH
50	J10 12PK*	IGNITION SWITCH





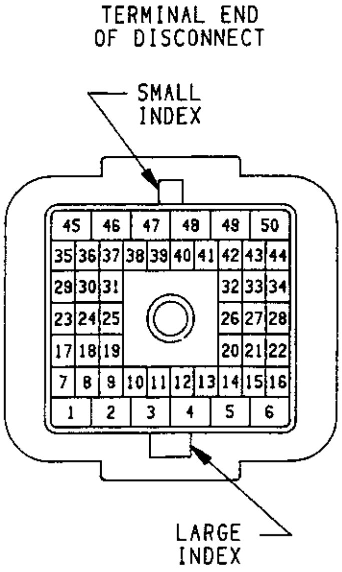
TERMINAL END OF DISCONNECT

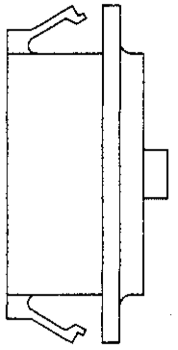
AD 79

50-WAY BULKHEAD DISCONNECT

J908W-14

CAVITY	INSTRUMENT PANEL CIRCUITS		SHEET
1	L1 12RD*	BATTERY FEED	4,6,31,43
2	C7 12DG	A/C & HEATER BLOWER MOTOR	62,63,65
3	DS1 14WT/BR*	REAR WHEEL ANTI LOCK	25,27
4	IS1 16LG*	REAR WHEEL ANTI LOCK	25,27
5	L40 16VT/WT*	HEADLAMP-LOW BEAM	39,41,43
6	L30 14RD/OR*	HEADLAMP-HIGH BEAM	39,41,43
7	X30 20DB/RD*	SPEED CONTROL	30
8	X31 22BR/RD*	SPEED CONTROL	30
9	X33 22WT/LG*	SPEED CONTROL	30
10	X32 22YL/RD* X32 20YL/RD*	SPEED CONTROL	30
11	E5 20DG/WT*	WAIT TO START LAMP (DIESEL ONLY)	17
12	L33 16RD/BK*	HIGH BEAM INDICATOR LAMP	39,42
13	L20 20LG/BK*	HIGH BEAM FEED (DRL MODULE)	42,43
14	VS1 18LB	REAR WHEEL ANTI LOCK	25,27
15	D8 18DG/YL*	LEFT REAR SIGNAL LAMP	52,75
16	D7 18BR/YL*	RIGHT REAR SIGNAL LAMP	52,75
17	G20 20VT/YL*	TEMPERATURE-SEND/UNIT OR SWITCH	21,22
18	G6 20GY	OIL PRESSURE LAMP	21,22
19	G60 20GY/YL*	OIL PRESSURE GAUGE-SEND/UNIT	21,22
20	——	——	——
21	D6 18LG D6 18LG	LEFT FRONT TURN SIGNAL LAMP	39,41,52
22	D5 18TN D5 18TN	RIGHT FRONT TURN SIGNAL LAMP	39,41,52
23	A3 16PK/WT*	HAZARD FLASHER	3,5,52
24	B01 18RD/VT*	REAR WHEEL ANTI LOCK (2 WIRES)	25,27
25	B02 18WT/VT*	REAR WHEEL ANTI LOCK (2 WIRES)	25,27
26	L7 18BK/YL*	PARKING LAMPS	37,39,41,43,75
27	B1 18WT	BACK-UP LAMP FEED	7
28	G40 20DB/RD*	LOW FUEL RELAY	73
29	V10 20BR	WINDSHIELD WASHER MOTOR	49,51
30	——	——	——
31	S2 14YL	IGNITION START	8,17
32	H2 18DG/RD*	HORNS	31
33	L22 18BK/RD*	UNDER HOOD LAMP	20
34	P51 20BK/GY*	BRAKE WARNING LAMP SWITCH	10,28
35	V5 18DG	WINDSHIELD WIPER SWITCH	50,51
36	V6 18DB	WINDSHIELD WIPER SWITCH	50,51
37	C2 18DB/OR*	A/C CLUTCH	63,65
38	K3 20BK/PK* K31 20BK/PK*	CHECK ENGINE LAMP (GAS ENGINE ONLY) WATER IN FEUL LAMP (DIESEL ONLY)	15 18
39	G4 20DB/YL*	FUEL TANK SENDING UNIT	73,74
40	X4 20LG/BR* X4 20LG/BR*	4 WHEEL DRIVE SWITCH	67
41	D40 18WT/PK*	BRAKE SENSOR	26,28,30
42	G29 22GY/PK*	EMR LAMP	15
43	G7 20WT/OR*	SPEED SENSOR	16,23
44	U4 20OR/WT*	OVERDRIVE LOCKOUT SWITCH	11,12
45	V3 18BR*	WINDSHIELD WIPER LOW SPEED	50,51
46	V4 18RD/YL*	WINDSHIELD WIPER HIGH SPEED	50,51
47	J2 14DB J2 14DB	IGNITION-RUN & START	10,73,74
48	C13 12BK/RD*	BATTERY FEED	3,5,20,35
49	J1 12RD	IGNITION SWITCH (B1)	4,6,10
50	J10 12PK*	IGNITION SWITCH (B3)	4,6,10





J908W-14

50-WAY BULKHEAD DISCONNECT

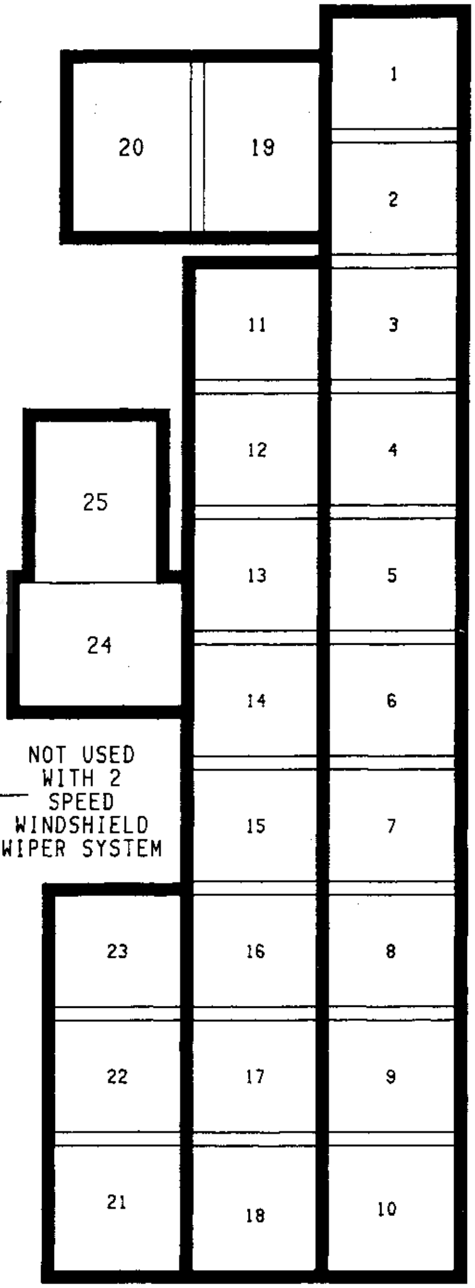
AD 80

STRG COLUMN

VIEWED FROM WIRE END

CAV	CIRCUIT	DESCRIPTION
1	——	——
2	H4 18BK (2)	HORN AND KEY-IN LAMP GROUND (STANDARD COLUMN)
3	H3 18BK/RD*	GROUND FROM HORN SWITCH
4	D6 18LG	LEFT FRONT TURN SIGNAL
5	D5 18TN	RIGHT FRONT TURN SIGNAL
6	D32 18PK*	HAZARD FLASHER FEED
7	D2 18RD/BK*	FEED FROM TURN SIGNAL FLASHER
8	D8 18DG/YL*	LEFT REAR TURN SIGNAL
9	D7 18BR/YL*	RIGHT REAR TURN SIGNAL
10	D4 18WT/TN* (2)	FEED FROM BRAKE SWITCH
11	V3 18BR*	WINDSHIELD WIPER
12	V3 18BR* (2)	WINDSHIELD WIPER LOW SPEED
13	V4 18RD/YL*	WINDSHIELD WIPER HIGH SPEED
14	V5 18DG	WINDSHIELD WIPER MOTOR
15	V6 18DB	WINDSHIELD WIPER SWITCH FEED
16	V10 20BR	WINDSHIELD WASHER MOTOR
17	——	——
18	H40 18BK/LG* (2)	INTERMITTENT WIPER MODULE GROUND
19	M26 22LB	KEY-IN BUZZER
20	M16 20BK/LB*	LEFT FRONT DOOR JAMB SWITCH GROUND
21	——	——
22	——	——
23	——	——
24	J15 20YL/RD*	IGNITION KEY LAMP FEED
25	H4 20BK	IGNITION KEY LAMP GROUND

NOT USED WITH 2 SPEED WINDSHIELD WIPER SYSTEM



(LEFT OF STEERING COLOUM)

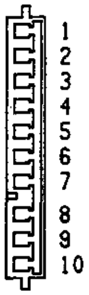
AD 81

INSTRUMENT PANEL TO STEERING COLUMN WIRING

J908W-14

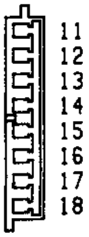
STRG COLUMN

CAVITY	DESCRIPTION		SHEET
1	—	—	
2	H4 18BK	HORN AND KEY-IN LAMP GROUND	31
3	H3 20BK/RD✱	HORN SWITCH GROUND	31
4	D6 18LG	LEFT FRONT TURN SIGNAL	52
5	D5 18TN	RIGHT FRONT TURN SIGNAL	52
6	D32 16PK	HAZARD FLASHER FEED	52
7	D2 18RD/BK✱	TURN SIGNAL FLASHER FEED	52
8	D8 18DG/RD✱	LEFT REAR TURN SIGNAL	52
9	D7 18BR/RD✱	RIGHT REAR TURN SIGNAL	52
10	D4 16WT	BRAKE SWITCH FEED	26,28, 30,52



TURN SIGNAL SWITCH CONNECTOR

11	V3A 18BR/YL✱	INTERMITTENT WIPER SWITCH	49
12	V3 18BR✱ V3 18BR✱	INTERMITTENT WIPER MODULE WINDSHIELD WIPER LOW SPEED	49,51
13	V4 18RD	WINDSHIELD WIPER HIGH SPEED	49,51
14	V5 18DG V5 18DG	INTERMITTENT WIPER MODULE WINDSHIELD WIPER MOTOR	49,51
15	V6 18DB	WINDSHIELD WIPER SWITCH FEED	49,51
16	V10 18BR V10 18BR	INTERMITTENT WIPER MODULE WINDSHIELD WASHER MOTOR	51
17	—	—	
18	H4 18BK	INTERMITTENT WIPER MODULE GROUND	44,49

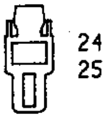


WINDSHIELD WIPER SWITCH CONNECTOR

19	M26 20LB	KEY-IN BUZZER OR CHIME	45
20	M16 20BK/LB✱	LEFT FRONT DOOR JAMB SWITCH GROUND	45

KEY-IN BUZZER SWITCH CONNECTOR

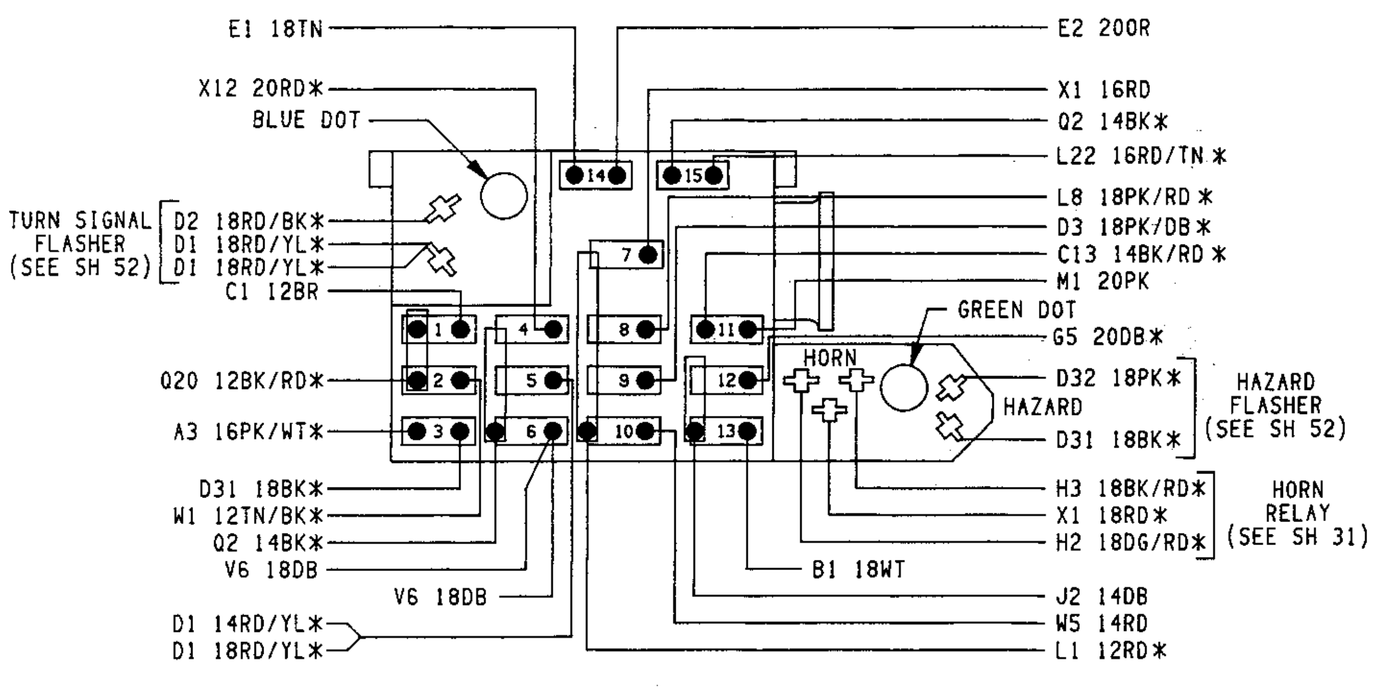
24	J15 18YL ✱	IGNITION KEY LAMP FEED	45
25	H4 18BK	IGNITION KEY LAMP GROUND (TILT COLUMN)	31,45



IGNITION KEY LAMP SWITCH CONNECTOR

(PLUGGED INTO STEERING COLUMN 25 WAY CONNECTOR)

STEERING COLUMN SWITCH TO PANEL WIRING

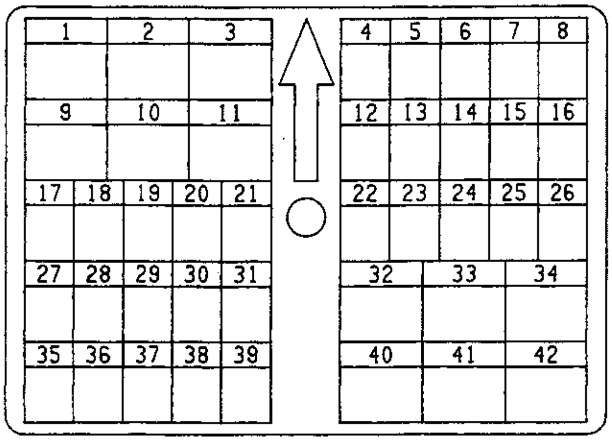


FUSE NUMBER	AMPS	COLOR STRIPE	SHEET
1	30	GREEN	2,10,62,63,65
2	30 CIRCUIT BREAKER	SILVER CAN	2,10,68
3	20	YELLOW	1,52
4	10	RED	2,10,57,59,61
5	20	YELLOW	2,10,25,27,33,52
6	20	YELLOW	2,10,50,51
7	15	LT BLUE	1,31
8	20	YELLOW	1,43
9	20	YELLOW	1,73,74
10	30 CIRCUIT BREAKER	SILVER CAN	1,69
11	10	RED	2,20,45,47,48,57,59,61,71
12	5	TAN	2,10,12,54,67,73,74
13	20	YELLOW	2,7,10,35
14	3	VIOLET	1,43,48,57,59,61
15	15	LT BLUE	1,10,48

AD 83

FUSE BLOCK MODULE AND RELAY BANK

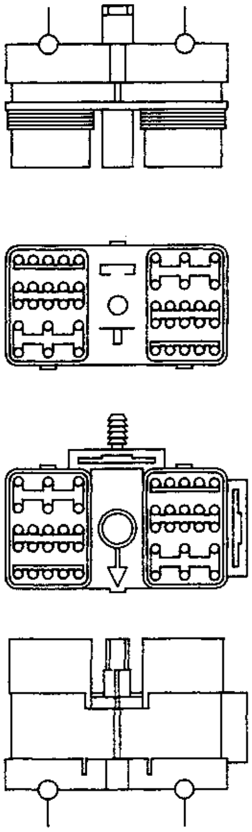
J908W-14



VIEW FROM WIRE END

ENG

CAV	IGNITION SYSTEM CIRCUITS		SHEET NO
1	J2 14DB	IGNITION FEED	14
2	N11 18BK/DG*	OXYGEN SENSOR	13
3	N5 18BK/LB*	SENSOR RETURN	16
4			
5			
6			
7	Y12 18TN	INJECTOR DRIVE #2	13
8	Y11 18WT/DB*	INJECTOR DRIVE #1	13
9	Z1 14DG/BK*	INJECTOR FEED-BATTERY	13
10	K4 20DG/RD*	MAP SENSOR	16
11	N6 18OR	8 VOLT INPUT	16
12			
13			
14			
15	G60 20GY/YL*	OIL PRESSURE SENDING UNIT	22
16	G6 20GY	OIL PRESSURE SWITCH (LAMP)	22
17	K10 20TN/WT*	COOLANT SENSOR	16
18			
19			
20			
21			
22			
23	K13 18BK/RD*	THROTTLE BODY TEMP SENSOR	16
24			
25			
26	G20 20VT/YL*	TEMPERATURE SENDING UNIT	22
27	N1 18GY/RD*	AUTOMATIC IDLE SPEED MOTOR	15
28	N2 18BR/WT*	AUTOMATIC IDLE SPEED MOTOR	15
29	K8 20VT/WT*	5 VOLT SUPPLY	13
30			
31	N31 18VT	THROTTLE KICKER MOTOR	15
32	N7 18GY/BK*	DISTRIBUTOR REF PICKUP	16
33	K7 18OR/DB*	THROTTLE POSITION SENSOR	13
34	C2 14DB/BK*	A/C CLUTCH	64
35	S6 20GY/YL*	EGR SOLENOID	14
36	K1 20PK/BK*	PURGE SOLENOID	14
37	N23 20BK/OR*	AIR SWITCHING SOLENOID	14
38			
39			
40	K5 16BK/WT*	SIGNAL GROUND	13
41	R3 18DG	ALTERNATOR FIED DRIVER	15
42	J9 14BK	POWER GROUND	13



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ENGINE WIRING CONNECTOR

AD 84

ENGINE

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GENERAL INFORMATION

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3.9L ENGINES

The 3.9 Liter (238 CID) six-cylinder engine is a 90° V-Type, lightweight, single cam, overhead valve engine (Fig. 1). The cylinder block and cylinder heads are cast iron. Split crankpins are offset by 22°. The firing intervals alternate between 128° and 112°.

This engine is designed for unleaded fuel.

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. 2).

CRANKSHAFT: The nodular iron crankshaft is supported by four main bearings. The No. 2 bearing is the thrust bearing. Crankshaft end sealing is provided by a front rubber seal and a rear “rope type” seal. The crankshaft rotation is clockwise, when viewed from the front of the engine.

PISTONS: The pistons are cast aluminum (alloy tin coated). Three rings are used. Piston pins (press fitted into the rods) join the pistons to forged steel connecting rods.

CAMSHAFT: The cast iron camshaft is mounted in four steel backed babbitt bearings. A thrust plate located in front of the first bearing, and bolted to the block, controls end play. A helical gear located between the 12th cam lobe and rear bearing journal, operates the oil pump driveshaft and distributor. Either a dual roller chain or an improved silent chain is used to drive the camshaft. These chains are enclosed by a cast aluminum cover. This cover holds the front crankshaft seal, provides front oil pan closure, water pump mounting and is embossed with raised timing marks for strobe timing.

CYLINDER HEADS: Cylinder heads incorporate valve shrouding to create turbulence-producing com

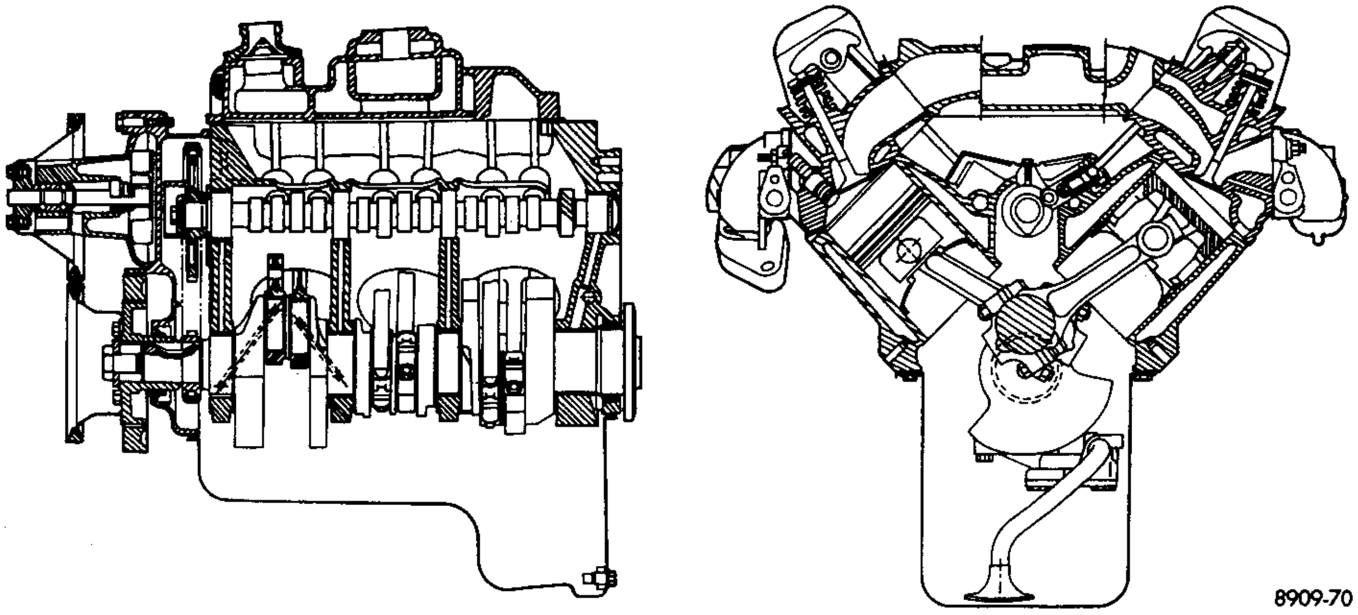

Fig. 1 Six-Cylinder Engine—3.9 Liter

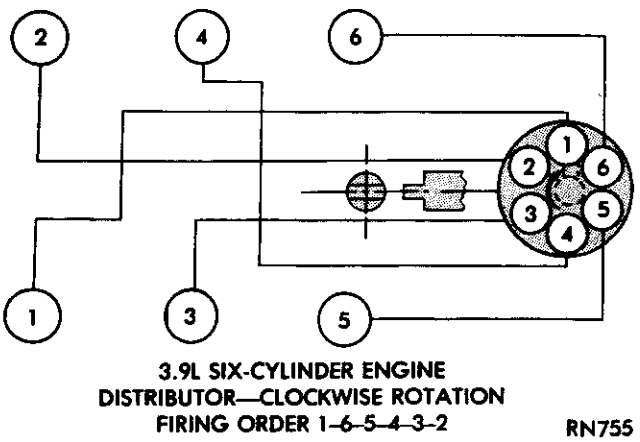

Fig. 2 Engine Firing Order—3.9 Liter

bustion chambers, described as "fast burn". Valve guides and seats are integral and machined (hardened, where required) with the cylinder head. A steel flange composition type gasket is used between head and block. High turbulence cylinder heads allow a 9:1 compression ratio.

VALVE COVERS: The valve covers are sealed with rubber-and-cork gaskets. Gasket compression is controlled by the use of stop-collared studs installed in the cylinder heads.

INTAKE MANIFOLD: This intake manifold is a water cooled, aluminum casting (Fig. 3). The manifold provides for single plane air/fuel induction, exhaust heat and coolant (thermostat water box) crossover. The unit is also cored with passages routing "metered" coolant flow below the exhaust heat crossover and through the full length of the manifold. This metered coolant flows through the right and left manifold side gaskets. The sealing of the manifold is accomplished by steel embossed side gaskets with front and rear molded gaskets. The intake manifold is also cored with upper level EGR passages for balanced (cylinder to cylinder) EGR distribution.

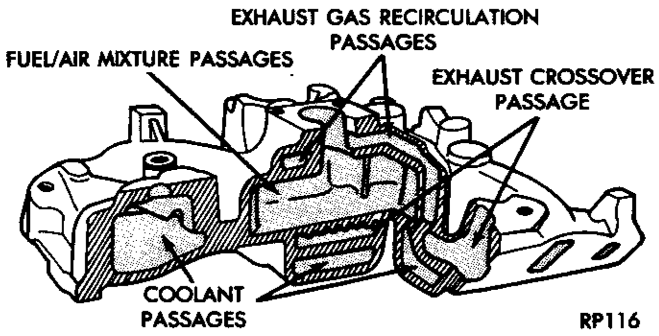

Fig. 3 Water Cooled Intake Manifold

VALVE TRAIN: Valve train has hydraulic roller lifters and exhaust valve rotators. Rocker arms are either right or left, and installed on a rocker arm shaft attached to the cylinder head. Viton valve stem seals provide positive intake valve sealing. Cup shields are installed on exhaust valve stems. Conventional types of push rods, springs, retainers and valve stem locks are used.

EXHAUST MANIFOLDS: Exhaust manifolds are "log" type with rear exits that attach directly to the cylinder heads. Both manifolds provide for air injection, while the right manifold incorporates a heat control valve.

The 3.9L engine description is listed below (Fig. 4):

Type	90° V-6
Bore and Stroke	99.3 × 84.0 mm (3.91 × 3.31 inch)
Displacement	3.9 Liters (238 cubic inch)
Compression Ratio	9.0:1
Engine Torque	265 N·m (195 ft-lbs) @ 2,000 rpm
Firing Order	1-6-5-4-3-2
Lubrication	Pressure Feed—Full Flow Filtration
Engine Oil Capacity	3.8 Liters (4 Quarts)
Cooling System	Liquid Cooled—Forced Circulation
Cooling System Capacity	13.2–13.5 Liters (14–14.3 Quarts)
Cylinder Block	Cast Iron
Crankshaft	Nodular Iron
Cylinder Head	Cast Iron
Combustion Chambers	"Fast Burn" Design
Camshaft	Cast Iron
Pistons	Aluminum Alloy with Strut
Connecting Rods	Forged Steel

J9009-94

Fig. 4 Engine Description—3.9 Liter

5.2L/5.9L ENGINES

The 5.2 Liter (318 CID) and 5.9 Liter (360 CID) eight-cylinder engine are a V-Type valve-in head type with hydraulic tappets.

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.

Engine lubrication system consists of a rotor type oil pump and a full flow oil filter.

The 5.2L and 5.9L engine description is listed below (Fig. 5):

Type	90° V-8
Bore and Stroke (5.2L)	99.3 x 84.0 mm (3.91 x 3.31 inch)
(5.9L)	101.6 x 90.9 mm (4.0 x 3.58 inch)
Displacement	5.2 Liters (318 cubic inch)
	5.9 Liters (360 cubic inch)
Compression Ratio (5.2L)	9.0:1
(5.9L)	8.1:1
Engine Torque (5.2L)	191 N•m (260 ft. lbs.) @ 2,000 rpm
(5.9L)	208 N•m (283 ft. lbs.) @ 1,600 rpm
Firing Order	1-8-4-3-6-5-7-2
Lubrication	Pressure Feed-Full Flow Filtration
Engine Oil Capacity	3.8 Liters (4 Quarts)
Cooling System	Liquid Cooled-Forced Circulation
Cooling Capacity (5.2L)	15.6 Liters (16.5 Quarts) *
(5.9L)	14.2 Liters (15.0 Quarts) *
Cylinder Block	Cast Iron
Crankshaft	Nodular Iron
Cylinder Head	Cast Iron
Combustion Chambers (5.2L)	Wedge-High Swirl Valve Shrouding
(5.9L)	Wedge
Camshaft	Cast Iron
Pistons	Aluminum Alloy with Strut
Connecting Rods	Forged Steel

*Add 0.9 Liters (1.0 Quart) with Rear Seat Heater Wedge

J9009-123

Fig. 5 Engine Description—5.2/5.9 Liter

STANDARD SERVICE PROCEDURES

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FORM-IN-PLACE GASKETS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets. Bead size, continuity and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over. A continuous bead of the proper width is essential to obtain a leak-free joint.

ROOM TEMPERATURE VULCANIZING (RTV)

RTV silicone form-in-place gasket, normally black in color, is available in three ounce tubes. Moisture in the air causes the RTV material to cure. This material is normally used on flexible metal flanges. It has a shelf life of one year and will not properly cure if over age. Always inspect the package for the expiration date before use.

DISASSEMBLY

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. In some instances, it may be necessary to lightly tap the part with a mallet or other suitable tool to break the seal between the mating surfaces. A flat gasket scraper may also be lightly tapped into the joint but care must be taken not to damage the mating surfaces.

SURFACE PREPARATION

Scrape or wire brush all gasket surfaces to remove all loose material. Inspect stamped parts to ensure gasket rails are flat. Flatten rails with a hammer on a flat plate, if required. Gasket surfaces must be free of oil and dirt. Make sure the old gasket material is removed from blind attaching holes.

APPLICATION

Assembling parts using a form-in-place gasket requires care. The RTV gasket material should be applied in a continuous bead approximately 3 mm (0.12 inch) in diameter. All mounting holes must be circled. For corner sealing, a 1/8 or 1/4 inch drop is placed in the center of the gasket contact area. Uncured RTV may be removed with a rag. Components should be torqued in place while the RTV is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing of material off location.

ENGINE PERFORMANCE

To provide best vehicle performance and lowest vehicle emissions, it is most important that the tune-up be done accurately, using the specifications listed on the Vehicle Emission Control Information label found on the engine compartment hood.

(1) Test battery specific gravity. Add water, if necessary. Clean and tighten battery connections.

(2) Test cranking amperage draw (see Group 8B, Battery/Starter Service for the proper procedures).

(3) Tighten the intake manifold bolts (see Group 11, Exhaust System and Intake Manifold for the proper specifications).

(4) Perform cylinder compression test:

(a) Check engine oil level and add oil, if necessary.

(b) Drive the vehicle until engine reaches normal operating temperature.

(c) Select a route free from traffic and other forms of congestion, observe all traffic laws and briskly accelerate through the gears several times. The higher engine speed may help clean out valve seat deposits which can prevent accurate compression readings.

CAUTION: Do not overspeed the engine.

(d) Remove all spark plugs from engine. As spark plugs are being removed, check electrodes for abnormal firing indicators - fouled, hot, oily, etc. Record cylinder number of spark plug for future reference.

(e) Disconnect coil wire from distributor and secure to good ground to prevent a spark from starting a fire.

(f) Be sure throttle blades are fully open during the compression check.

(g) Insert compression gage adaptor into the No. 1 spark plug hole. Crank engine until maximum pressure is reached on gauge. Record this pressure as No. 1 cylinder pressure.

(h) Repeat Step 4g for all remaining cylinders.

(i) Compression should not be less than 689 kPa (100 psi) and not vary more than 172 kPa (25 psi) from cylinder to cylinder.

(j) If one or more cylinders have abnormally low compression pressures, repeat steps 4a through 4h.

(k) If the same cylinder or cylinders repeat an abnormally low reading on the second compression test, it could indicate the existence of a problem in the cylinder in question.

The recommended compression pressures are to be used only as a guide to diagnosing engine problems. An engine should NOT be disassembled to determine the cause of low compression unless some malfunction is present.

(5) Clean or replace spark plugs as necessary and adjust gap. See Group 8D, Ignition System for gap adjustment and torque.

(6) Test resistance of spark plug cables. Refer to Group 8D, Ignition System.

(7) Inspect the primary wire. Test coil output voltage, primary and secondary resistance. Replace parts as necessary. Refer to Group 8D, Ignition System and make necessary adjustment.

(8) Reset ignition timing to specifications (see Specification Label on engine compartment hood).

(9) Perform a combustion analysis.

(10) Test fuel pump for pressure and vacuum. Refer to Group 14, Fuel System for the proper specifications.

(11) Inspect manifold heat control valve in the engine exhaust manifold for proper operation (see Group 0, Lubrication and Maintenance for the proper procedure). Apply Manifold Heat Control Valve Solvent to the bushing and shaft.

(12) Inspect air filter element (see Group 0, Lubrication and Maintenance for the proper procedure).

(13) Inspect crankcase ventilation system (see Group 0, Lubrication and Maintenance for the proper procedure).

(14) For emission controls see Group 25, Emission Controls System for service procedures.

(15) Inspect and adjust accessory belt drives (refer to Group 7, Cooling System for the proper adjustments).

(16) Road test vehicle as a final test.

HONING CYLINDER BORES

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

(1) Used carefully, the cylinder bore sizing hone C-823 equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round as well as removing light scuffing, scoring or scratches. Usually a few strokes will clean up a bore and maintain the required limits.

(2) Deglazing of the cylinder walls may be done using a cylinder surfacing hone, Tool C-3501, equipped with 280 grit stones (C-3501-3810) if the cylinder bore is straight and round. 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. **Do not use engine or transmission oil, mineral spirits or kerosene.**

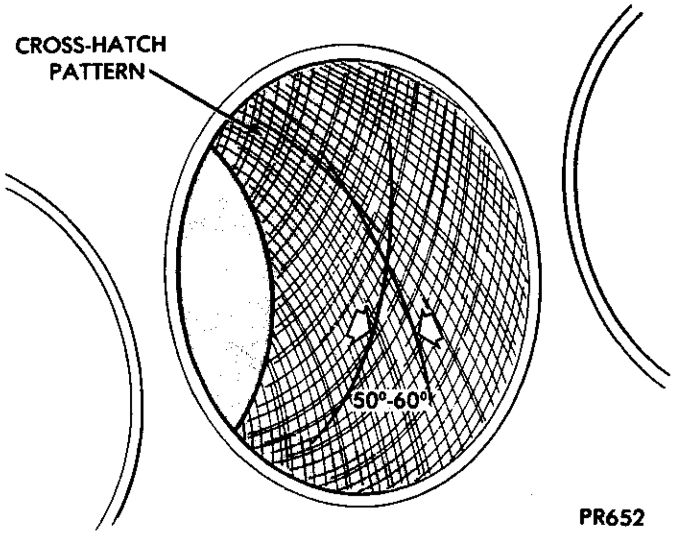

Fig. 1 Cylinder Bore Cross-Hatch Pattern

(3) Honing should be done by moving the hone up and down fast enough to get a cross-hatch pattern. When hone marks **intersect** at 50° to 60°, the cross-hatch angle is most satisfactory for proper seating of rings (Fig. 1).

(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 again to remove all traces of abrasives.

CAUTION: Be sure all abrasives are removed from engine parts after honing. It is recommended that a solution of soap and water be used with a brush and the parts thoroughly dried. The bore can be considered clean when it can be wiped clean with a white cloth remains clean. Oil the bores after cleaning to prevent rusting.

MEASURING WITH PLASTIGAGE

Engine crankshaft bearing clearances can be determined by use of Plastigage or equivalent. The following is the recommended procedures for the use of Plastigage:

(1) Remove oil film from surface to be checked. Plastigage is soluble in oil.

(2) The total clearance of the main bearings can only be determined by removing the weight of the crankshaft. This can be accomplished by either of two methods:

PREFERRED METHOD—Shimming the bearings adjacent to the bearing to be checked in order to

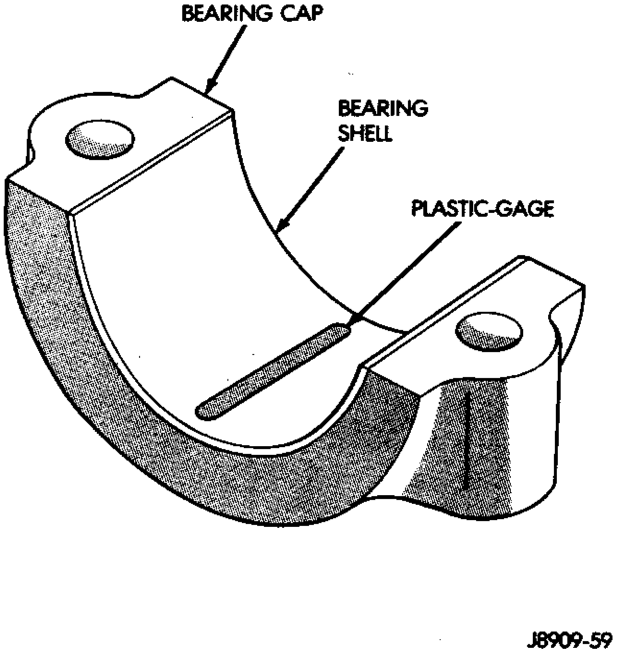

Fig. 2 Placement of Plastigage in Bearing Shell

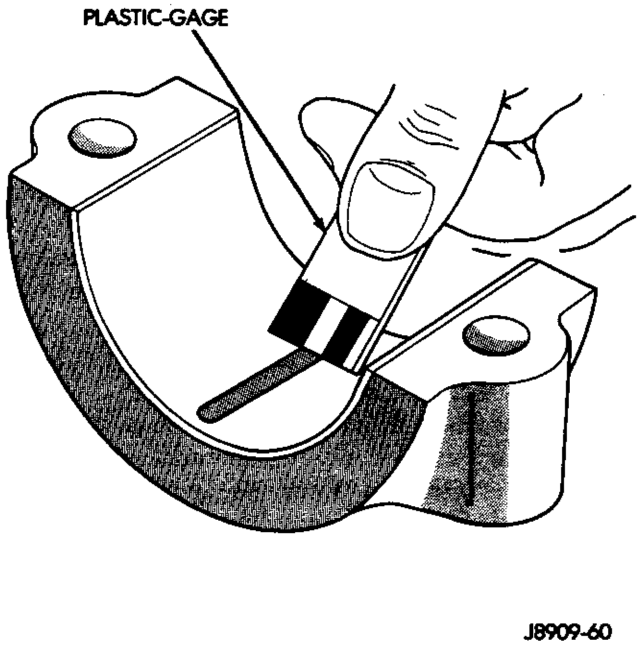

Fig. 3 Clearance Measurement

remove the clearance between upper bearing shell and the crankshaft. This can be accomplished by placing a minimum of 0.254 mm (0.010 inch) shim between the bearing shell and the bearing cap on the adjacent bearings and tightening the bolts to 14-20 N•m (10-15 ft. lbs.) torque.

- When checking No. 1 main bearing; shim #2 main bearing.
- When checking No. 2 main bearing; shim #1 & #3 main bearing.
- When checking No. 3 main bearing; shim #2 & #4 main bearing.
- When checking No. 4 main bearing; shim #3 & #5 main bearing.
- When checking No. 5 main bearing; shim #4 main bearing.
- When checking No. 4 main bearing; shim No. 3 main bearing (3.9 Engine only).

All shims must be removed before reassembling engine.

ALTERNATIVE METHOD—The weight of the crankshaft is supported by a jack under the counterweight adjacent to the bearing being checked.

(3) Place a piece of Plastigage across the entire width of the bearing shell in the cap approximately 6.35 mm (1/4 inch) off center and away from the oil holes (Fig. 2). In addition, suspect areas can be checked by placing the Plastigage in the suspect area. Tighten the bearing cap bolts of the bearing being checked to 115 N•m (85 ft. lbs.) torque.

The checking of connecting rod clearances does not require shimming of the crankshaft. However, before assembling the rod cap with Plastigage in place, the crankshaft must be turned until the connecting rod to be checked starts moving toward the top of the engine. Only then should the cap be assembled and tightened to 61 N•m (45 ft. lbs.) torque. Do not rotate the crankshaft while assembling the cap or the Plastigage may be smeared, giving inaccurate results.

(4) Remove the bearing cap and compare the width of the flattened Plastigage with the metric scale provided on the package (Fig. 3). Locate the band closest to the same width. this band shows the amount of clearance in thousandths of a millimeter. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Refer to Engine Specifications in this section. **Plastigage generally is accompanied by two scales. One scale is in inches, the other is a metric scale.**

(5) Plastigage is available in a variety of clearance ranges. The 0.025-0.076 mm (0.001-0.003 inch) is usually the most appropriate for checking engine bearing clearances.

REPAIR OF DAMAGED OR WORN THREADS

Damaged or worn threads can be repaired. Essentially, this repair consists of drilling out worn or damaged threads, tapping the hole with a special Heli-Coil Tap, (or equivalent), and installing an insert into the tapped hole. This brings the hole back to its original thread size.

CAUTION: Be sure that the tapped holes maintain the original centerline.

Heli-Coil tools and inserts are readily available from automotive parts jobbers.

ENGINE DIAGNOSIS

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GENERAL INFORMATION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine tune-ups.

These malfunctions may be classified as either mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

Refer to the Service Diagnosis—Mechanical chart and the Service Diagnosis—Performance chart for possible causes and corrections of malfunctions. Refer to Group 14, Fuel System for the fuel system diagnosis.

SERVICE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES	• High and low oil level in crankcase • Thin or diluted oil • Low oil pressure • Dirt in lash adjusters • Worn rocker arms • Worn lash adjusters • Worn valve guides • Excessive runout of valve seats or valve faces	• Check for correct oil level. Refer to Group 0, Lubrication and Maintenance. • Change oil. Refer to Group 0, Lubrication and Maintenance. • Check engine oil level. • Clean hydraulic lash adjusters. • Inspect oil supply to rocker arms. • Install new hydraulic lash adjusters. • Ream and install new valves with oversize stems. • Grind valve seats and valves.
CONNECTING ROD NOISE	• Insufficient oil supply • Low oil pressure • Thin or diluted oil • Excessive bearing clearance • Connecting rod journal out-of-round • Misaligned connecting rods	• Check engine oil level. Refer to Group 0, Lubrication and Maintenance. • Check engine oil level. Inspect oil pump relief valve and spring. • Change oil to correct viscosity. • Measure bearings for correct clearance. • Replace crankshaft or grind journals. • Replace bent connecting rods.
MAIN BEARING NOISE	• Insufficient oil supply • Low oil pressure • Thin or diluted oil • Excessive bearing clearance • Excessive end play • Crankshaft journal out-of-round worn • Loose flywheel or torque converter	• Check engine oil level. Refer to Group 0, Lubrication and Maintenance. • Check engine oil level. Inspect oil pump relief valve and spring. • Change oil to correct viscosity. • Measure bearings for correct clearance. • Check No. 3 main bearing for wear on flanges. • Replace crankshaft or grind journals. • Tighten to correct torque.
OIL PRESSURE DROP	• Low oil level • Low oil pressure • Clogged oil filter • Worn parts in oil pump • Thin or diluted oil • Excessive bearing clearance • Oil pump relief valve stuck • Oil pump suction tube loose, bent or cracked	• Check engine oil level. • Check sending unit. • Install new oil filter • Replace worn parts or pump. • Change oil to correct viscosity. • Measure bearings for correct clearance. • Remove valve and inspect, clean and install. • Remove oil pan and install new tube, if necessary.
OIL LEAKS	• Misaligned or deteriorated gaskets • Loose fastner, broken or porous metal part	• Replace the gasket. • Tighten, repair or replace the part.

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SERVICE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT START	• Weak battery	• Charge or replace, as necessary. Refer to Group 8A, Battery/Starting/Charging System Diagnosis.
	• Corroded or loose battery connections	• Clean and tighten battery connections. Apply a coat of light mineral grease to terminals.
	• Faulty starter	• Refer to Group 8B, Battery/Starter Service.
	• Moisture on ignition wires and distributor cap	• Wipe wires and cap clean and dry.
	• Faulty ignition cables	• Replace any cracked or shorted cables.
	• Faulty coil or control unit	• Test and replace, if necessary. Refer to Group 8D, Ignition System.
	• Incorrect spark plug gap	• Set gap. Refer to Group 8D, Ignition System.
	• Incorrect ignition timing	• Refer to Group 8D, Ignition System.
	• Dirt or water in fuel line	• Clean lines.
	• Faulty fuel pump	• Install new fuel pump. Refer to Group 14, Fuel System.
ENGINE STALLS OR ROUGH IDLE	• Idle speed set too low	• Refer to Group 14, Fuel System.
	• Leak in intake manifold	• Inspect intake manifold gasket and replace, if necessary. Refer to Group 11, Exhaust System and Intake Manifold.
	• Worn or burned distributor rotor	• Install new rotor.
	• Incorrect ignition wiring	• Install correct wiring.
	• Faulty coil	• Test and replace, if necessary. Refer to Group 8D, Ignition System.
	• EGR valve leaking	• Test and replace, if necessary. Refer to Group 25, Emissions.
ENGINE LOSS OF POWER	• Incorrect ignition timing	• Refer to Group 8D, Ignition System.
	• Worn or burned distributor rotor	• Install new rotor.
	• Worn distributor shaft	• Remove and repair distributor. Refer to Group 8D, Ignition System.
	• Dirty or incorrectly gapped spark plugs	• Clean plugs and set gap. Refer to Group 8D, Ignition System.
	• Dirt or water in fuel line or filter	• Clean lines and replace filter. Refer to Group 14, Fuel System.
	• Faulty fuel pump	• Install new pump.
	• Incorrect valve timing	• Refer to Valve Timing in this group.
	• Blown cylinder head gasket	• Instal new cylinder head gasket.
	• Low compression	• Test compression of each cylinder.
	• Burned, warped or pitted valves	• Install new valves.
	• Plugged or restricted exhaust system	• Install new parts, as necessary.
	• Faulty ignition cables	• Replace any cracked or shorted cables.
	• Faulty coil	• Test and replace, as necessary.
ENGINE MISSES ON ACCELERATION	• Dirty, or gap too wide in spark plugs	• Clean spark plugs and set gap. Refer to Group 8D, Ignition System.
	• Incorrect ignition timing	• Refer to Group 8D, Ignition System.
	• Burned, warped or pitted valves	• Install new valves.
	• Faulty coil	• Test and replace, if necessary. Refer to Group 8D, Ignition System.
ENGINE MISSES AT HIGH SPEED	• Dirty or gap set too wide in spark plug	• Clean spark plugs and set gap. Refer to Group 8D, Ignition System.
	• Worn distributor shaft	• Remove and repair distributor. Refer to Group 8D, Ignition System.
	• Worn or burned distributor rotor	• Install new distributor rotor.
	• Faulty coil	• Test and replace, if necessary. Refer to Group 8D, Ignition System.
	• Incorrect ignition timing	• Refer to Group 8D, Ignition System.
	• Dirty injector in throttle body	• Refer to Group 14, Fuel System.
	• Dirt or water in fuel line or filter	• Clean lines and replace filter. Refer to Group 14, Fuel System.

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SERVICE DIAGNOSIS - PERFORMANCE (CONT.)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL PUMPING AT RINGS—SPARK PLUGS FOULING	• Worn, scuffed or broken rings	• Hone cylinder bores and install new rings.
	• Carbon in oil ring slot	• Install new rings.
	• Rings fitted too tight in grooves	• Remove the rings. Check grooves. If groove is not proper width, replace piston.
	• Leaking intake gasket	• Replace gasket and tighten to the proper specifications.
	• Worn valve guides	• Ream guides and replace valves with oversize valves and seals.
	• Leaking valve guide seals	• Replace seals.

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INSPECTION FOR ENGINE OIL LEAKS

If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Attach an air hose with pressure gauge and regulator to the dipstick tube.

(2) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(3) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(4) After the engine is sealed, set the air pressure regulator NO HIGHER than 27 kPa (4 psi).

(5) Using a liquid soap solution or preferable a stethoscope, inspect all suspected oil leak areas. If an oil leak area is detected, repair per the service manual instructions.

(6) If no leaks are detected, turn off the air supply and remove the air hose and all plugs. Install the PCV valve and breather cap hose. See step 7 and check for higher pressure leaks occurring during normal engine operation.

(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). Check the engine for signs of an oil leak. If an oil leak is found, repair per the service manual instructions.

(8) If the leakage occurs at the crankshaft rear oil seal:

(a) Raise the vehicle.

(b) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. A circular spray pattern generally indicates seal leakage. Where leakage tends to run straight down, possible causes are a porous block and the rear cam and galley plugs. See Group 9, Engines (Rear Main Bearing Oil Seals), for the proper seal (and retainer) installation.

(c) If no leaks are detected while the crankcase is pressurized 27 kPa (4 psi), very slowly turn the crankshaft and watch for leakage. If a leak is detected while turning the crankshaft, its possible the crankshaft seal surface is damaged in the seal area, minor nicks or scratches can be polished out with emery cloth. See Group 9, Engines (Rear Main Bearing Oil Seals), for the proper seal (and retainer) installation.

CHECKING ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit with Tool C-4597).

(2) Install oil pressure line and gauge (Tool C-3292). Start engine and record pressure. Refer to engine specification (engine lubrication) for proper pressures.

3.9L ENGINE SERVICE PROCEDURES

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ENGINE FRONT MOUNTS (INSULATORS)

REMOVAL

(1) Raise hood and position fan to assure clearance for radiator top tank and hose.

(2) Install engine lifting fixture (Tool C-3487-A).

(3) Raise vehicle on hoist.

(4) Remove bolts and nuts from brackets and insulators (Fig. 1).

(5) Raise engine with lifting fixture only far enough to remove insulators.

INSTALLATION

(1) With engine raised SLIGHTLY, install insulators on frame crossmember. Install bolt and washer assemblies (Fig. 1).

(2) Lower engine with lifting fixture while guiding insulator studs into bracket.

(3) Install insulator to bracket nut and washer. Tighten the attaching nuts to 102 N•m (75 ft. lbs.) torque and the bolts to 41 N•m (30 ft. lbs.) torque (Fig. 1).

(4) Lower the vehicle.

(5) Remove lifting fixture.

ENGINE REAR MOUNT (INSULATOR)

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position transmission jack and raise rear of transmission and engine SLIGHTLY.

(3) Remove rear mount (insulator) through-bolt and nut (Fig. 2).

(4) Remove the bolts attaching the insulator to frame crossmember bracket (Fig. 2).

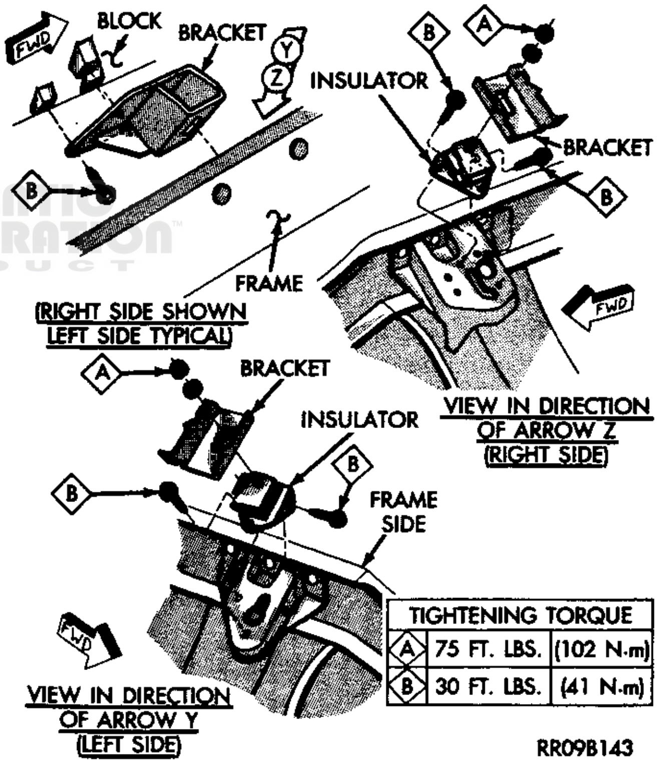


Fig. 1 Engine Front Mounts

(5) Raise rear of transmission enough to provide insulator to crossmember clearance. Remove the insulator.

INSTALLATION

(1) Install insulator in transmission rear support bracket. Install through-bolt.

(2) With insulator secured in a LEVEL position (relative to final attachment to transmission rear support bracket) tighten through-bolt nut to 68 N•m (50 ft. lbs.) torque.

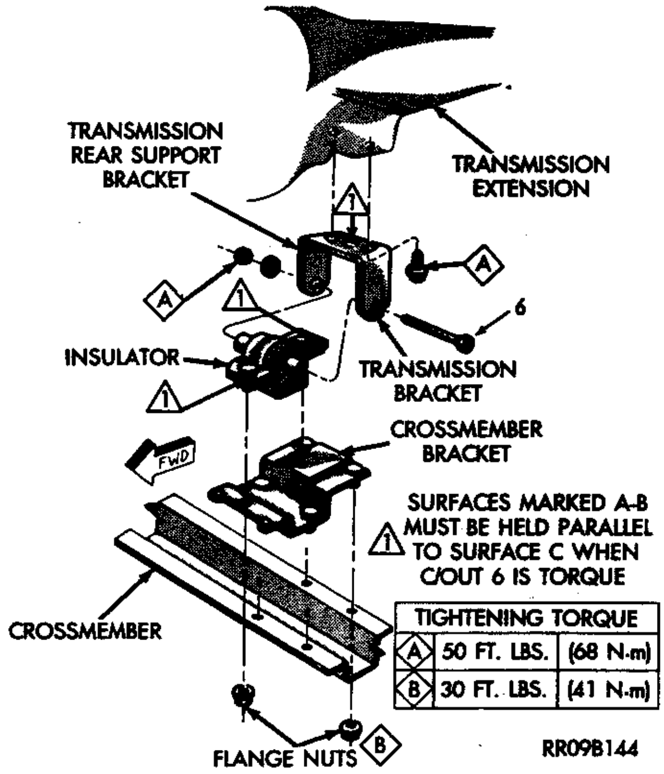


Fig. 2 Rear Engine Support

(3) Using the transmission jack, lower the rear mount (insulator) onto the crossmember bracket.

(4) Tighten the flange nuts to 41 N• m (30 ft. lbs.) torque.

(5) Remove the transmission jack.

(6) Lower the vehicle.

ENGINE ASSEMBLY

CHECK OPERATION OF EXHAUST VALVE ROTATORS

Before an engine is disassembled for valve grinding or major repair work, the performance of the exhaust valve rotators should be checked.

(1) With engine in the vehicle, remove cylinder head covers.

(2) Observe exhaust valve rotation with the engine running at 2000 and 3000 rpm. The valve should rotate at uniform and constant speeds (direction of rotation is not important). There is generally a large difference in rotation speeds between 1000 and 3000 rpm.

(3) Rotators which do not appear to rotate should be replaced.

REMOVAL

(1) Scribe hood hinge outlines on hood and remove the hood.

(2) Remove the battery.

(3) Drain cooling system.

(4) Remove the air cleaner.

(5) Remove radiator and heater hoses. Remove the radiator (see Group 7, Cooling System for the proper procedure).

(6) Set fan shroud aside.

(7) Discharge the air conditioner, if equipped (refer to Group 24, Heating and Air Conditioning for service procedures).

(8) Remove air conditioning hoses

(9) Remove the vacuum lines.

(10) Remove the distributor cap and wiring.

(11) Remove the throttle body, fuel lines and linkage.

(12) Remove the starter wires and oil pressure wire.

(13) Disconnect the power steering hoses, if equipped.

(14) Remove starter motor, alternator, charcoal canister and horns.

(15) Raise and support the vehicle on a hoist.

(16) Disconnect exhaust pipe at manifold.

(17) **Manual Transmission**

See Group 21, Transmissions for the Manual Transmission Removal procedure.

(18) **Automatic Transmission**

(a) Remove bell housing bolts and inspection plate.

(b) Attach a C clamp on front bottom of transmission torque converter housing to prevent torque converter from coming out.

(c) Remove torque converter drive plate bolts. Mark converter and drive plate to aid in assembly.

(d) Support the transmission.

(e) Lower the vehicle.

(19) Install engine lifting fixture. Attach a chain hoist to fixture eyebolt.

(20) Remove engine front mount bolts (Fig. 1).

(21) Remove engine from engine compartment and install on engine repair stand.

(22) Disconnect the torque converter drive plate from the engine crankshaft.

INSTALLATION

(1) Position the torque converter drive plate onto the crankshaft. Tighten the bolts to 75 N•m (55 ft. lbs.) torque.

(2) Remove engine from the repair stand and position it into the engine compartment.

(3) Install the engine front mount bolts. Tighten the bolts to 41 N•m (30 ft. lbs.) torque.

(4) Remove engine lifting fixture.

(5) **Manual Transmission**

See Group 21, Transmissions for the Manual Transmission Installation procedure.

(6) **Automatic Transmission**

(a) Raise and support the vehicle.

(b) Align the torque converter plate to the torque converter. Install and tighten the bolts to 31 N•m (270 in. lbs.) torque.

(c) Install bell housing bolts. Tighten the bell housing bolts to 41 N•m (30 ft. lbs.) torque.

(d) Remove the C clamp.

(e) Install the inspection plate.

(f) Remove the transmission support.

(7) Position the exhaust pipe to the manifold. Tighten the nuts to 33 N•m (24 ft. lbs.) torque.

(8) Lower the vehicle.

(9) Install the starter motor, alternator, charcoal canister and horns.

(10) Remove the starter wires and oil pressure wire.

(11) Install throttle body, fuel lines and linkage.

(12) Connect the vacuum lines.

(13) Install the distributor cap and wiring.

(14) Install the radiator (see Group 7, Cooling Systems). Connect the radiator hoses and heater hoses.

(15) Install fan shroud in position.

(16) Fill the cooling system (see Group 7, Cooling System for the proper procedures).

(17) Install the battery.

(18) Attach the air cleaner to the throttle body.

(19) Connect the power steering hoses, if so equipped.

(20) Install air conditioning equipment and charge air conditioning. Refer to Group 24, Heating and Air Conditioning for proper service.

(21) Warm engine and adjust.

(22) Install hood and line up with the scribe marks.

(23) Road test vehicle.

ROCKER ARMS AND SHAFT ASSEMBLY

REMOVAL

(1) Disconnect spark plug wires by pulling on the boot straight out in line with plug.

(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover.

(3) Remove cylinder head cover and gasket.

(4) Remove four rocker shaft bolts and retainers.

(5) Remove rocker arms and shaft assembly.

(6) If rocker arm assemblies are disassembled for cleaning or replacement, refer to Fig. 1 for rocker arm identification, and Fig. 2 for positioning on the shaft.

(7) The exhaust rocker arm must have relief for clearance (Fig. 1).

INSTALLATION

(1) Install rocker arm and shaft assemblies with NOTCH (Fig. 3) on end of rocker shaft pointing to centerline of engine and toward front (left bank) and to the rear (right bank). Make sure to install the long stamped steel retainers in the number two and four positions. Tighten the bolts to 23 N•m (200 in. lbs.) torque (Fig. 3).

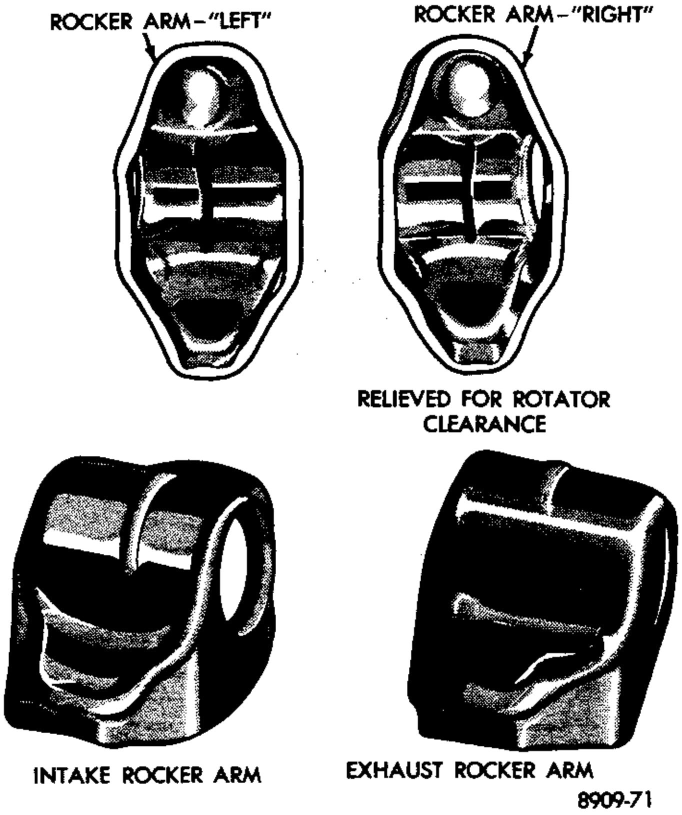


Fig. 1 Intake and Exhaust Rocker Arm Identification

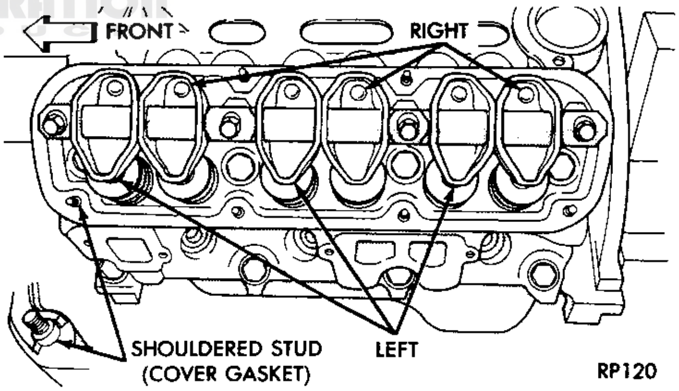


Fig. 2 Rocker Arm Location—Left Bank

CAUTION: THE ROCKER ARM SHAFT SHOULD BE TORQUED DOWN SLOWLY, STARTING WITH THE CENTERMOST BOLTS. ALLOW 20 MINUTES TAPPET BLEED DOWN TIME AFTER INSTALLATION OF THE ROCKER SHAFTS BEFORE ENGINE OPERATION.

(2) Clean cylinder head cover gasket surface. Inspect cover for distortion and straighten, if necessary.

(3) Clean head rail, if necessary. Install cylinder head cover and tighten to 9 N•m (80 in. lbs.) torque.

(4) Install closed crankcase ventilation system and evaporation control system.

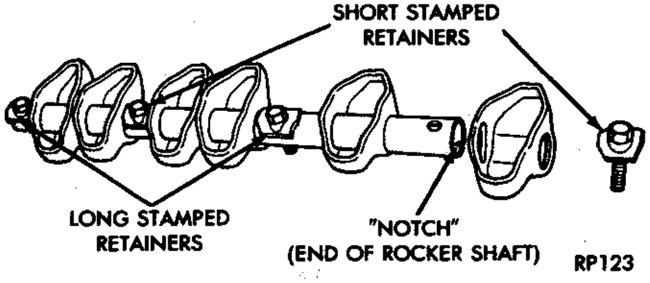


Fig. 3 Rocker Arm Retainers and NOTCH Location

CYLINDER HEADS

The alloy cast iron cylinder heads shown in (Fig. 4) are held in place by eight bolts. The spark plugs are located in peak of the wedge between the valves.

REMOVAL

(1) Drain cooling system.

(2) Disconnect battery ground cable.

(3) Remove alternator, throttle body, air cleaner and fuel line.

(4) Disconnect accelerator linkage.

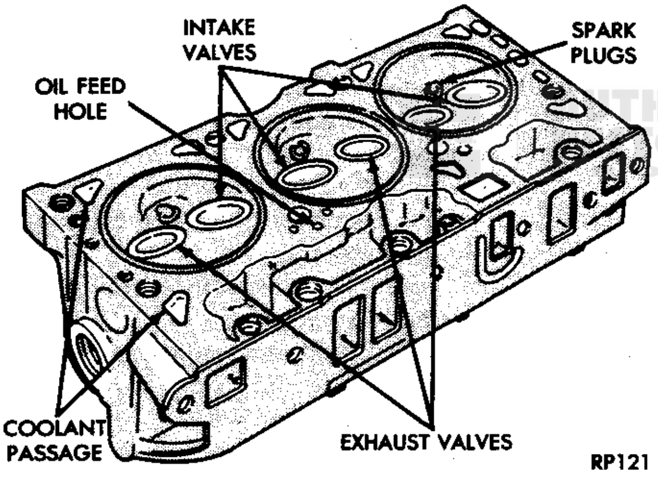


Fig. 4 Cylinder Head Assembly

(5) Remove distributor cap and wires.

(6) Disconnect coil wires, heat indicator sending unit wire, heater hoses and bypass hose.

(7) Remove closed ventilation system, evaporation control system and cylinder head covers.

(8) Remove intake manifold, and throttle body as an assembly.

(9) Remove exhaust manifolds.

(10) Remove rocker arm and shaft assemblies. Remove push rods and identify to ensure installation in original locations.

(11) Remove the head bolts from each cylinder head and remove cylinder heads.

(12) Place cylinder heads in holding fixture Tool C-3626. Remove spark plugs.

INSTALLATION

(1) Clean all surfaces of cylinder block and cylinder heads.

(2) Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out of flatness exceeds 0.00075 mm/mm (0.00075 inch/inch) times the span length in inches in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE—If a 305 mm (12 inch) span is 0.102 mm (0.004 inch) out of flat, allowable is 305 X 0.00075 (12 X 0.00075) equals 0.23 mm (0.009 inch). This amount of out of flat is acceptable.

(3) The cylinder head surface finish should be 1.78-4.57 microns (70-180 microinches).

(4) Install new gaskets on cylinder block.

(5) Remove cylinder heads from holding fixtures and place heads on engine.

(6) On 6 cylinder engines bolt thread sealer is not required. Starting at top center, tighten all cylinder head bolts to 68 N•m (50 ft. lbs.) torque in sequence (Fig. 5). 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.

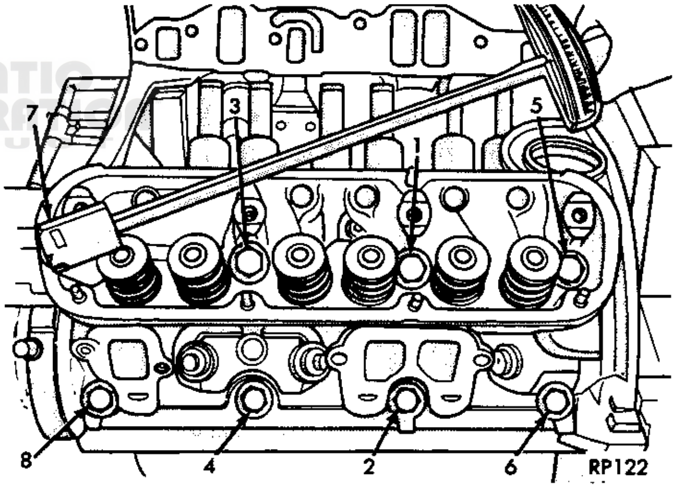


Fig. 5 Cylinder Head Bolt Tightening Sequence

(7) Inspect push rods and replace worn or bent rods.

(8) Install push rods, rocker arm and shaft assemblies with the NOTCH on the end of rocker shaft pointing to centerline of engine and toward front (left bank) and to the rear (right bank). The notch is always to left as facing cylinder head. Make sure to install the long stamped steel retainers in the number two and four positions. Tighten the bolts to 23 N•m (200 in. lbs.) torque (Fig. 6).

(9) Coat intake manifold side gaskets lightly with sealer. RIGHT and LEFT side gaskets are required. Cutouts at top front of each gasket (LT for left side and RT for right side) identifies each gasket position (Fig. 6).

(10) Install side gaskets to cylinder head.

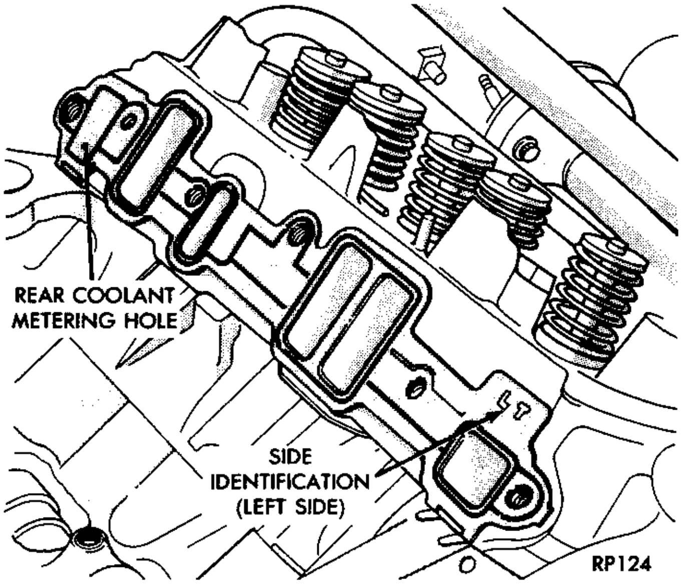


Fig. 6 Intake Manifold Side Gaskets (Left Side Shown)

(11) Clean cylinder block front and rear gasket surfaces using a suitable solvent (Fig. 7).

(12) Apply a thin, uniform coating of a quick dry cement to the intake manifold front and rear gaskets and cylinder block gasket surface. When installing gaskets, the center hole in the gasket MUST engage dowels in block. End holes in seals MUST be locked into tangs of head gasket (Fig. 7).

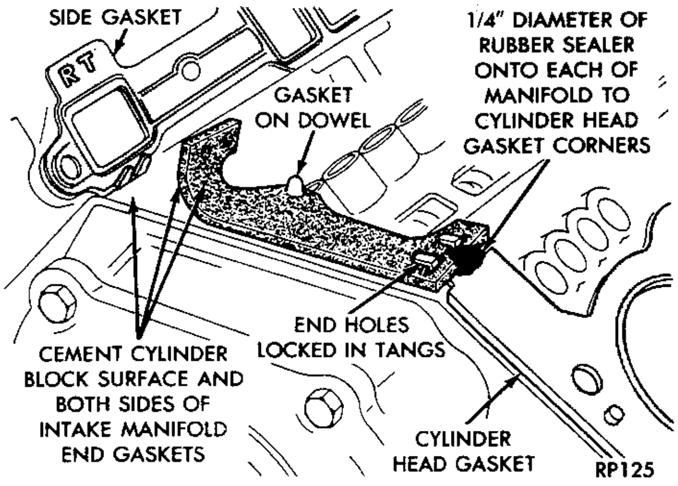


Fig. 7 Intake Manifold Sealing

(13) Carefully install the front and rear intake manifold gaskets.

(14) Place a drop (approximately 1/4 inch diameter) of rubber sealer, or equivalent, onto each of the FOUR manifold to cylinder head gasket corners.

(15) 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.

(16) Install the twelve attaching bolts (Finger Tight). Tighten the bolts to 34 N•m (25 ft. lbs.) torque in the tightening sequence shown in (Fig. 8). Tighten the same bolts to 54 N•m (40 ft. lbs.) torque in sequence shown (Fig. 8).

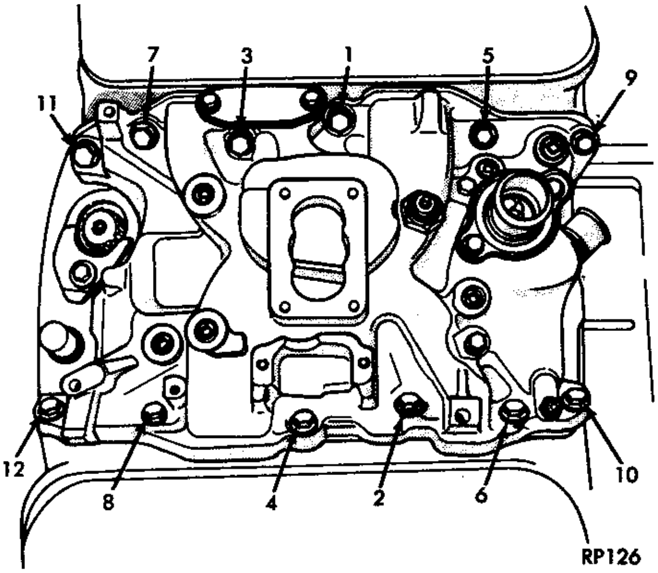


Fig. 8 Intake Manifold Bolt Tightening Sequence

(17) Install exhaust manifolds and tighten bolts to 27 N•m (20 ft. lbs.) torque and tighten the nuts to 20 N•m (15 ft. lbs.) torque.

(18) Adjust spark plugs to specifications (see Group 8D, Ignition System). Install the plugs and tighten to 41 N•m (30 ft. lbs.) torque.

(19) Install coil wires, heat indicator sending unit wire, heater hoses and bypass hose.

(20) Install throttle linkage and adjust, as necessary.

(21) Install distributor cap and wires.

(22) Install fuel lines, alternator and drive belt. Tighten alternator mounting bolt to 41 N•m (30 ft. lbs.) torque and adjusting strap bolt to 23 N•m (200 in. lbs.) torque. See Group 7, Cooling System for adjusting the belt tension.

(23) Install collared studs in cylinder head. Tighten to 13 N•m (115 in. lbs.) torque. Inspect studs to be certain that collar has bottomed on cylinder head. If not, remove stud and clean and tap stud hole.

(24) Place new cylinder head cover gaskets in position and install cylinder head covers. Tighten to 9 N•m (80 in. lbs.) torque.

(25) Install closed crankcase ventilation system and evaporation control system.

(26) Fill cooling system (see Group 7, Cooling System for proper procedure).

(27) Connect the battery negative cable.

VALVES AND VALVE SPRINGS

The valves are arranged in line and inclined 18°. The rocker shaft support and the valve guides are cast integral with the heads.

REMOVAL

(1) With cylinder head removed, compress valve springs using Tool C-3422-A (Fig. 9).

(2) Remove valve retaining locks, valve spring retainers, valve stem cup 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 location.

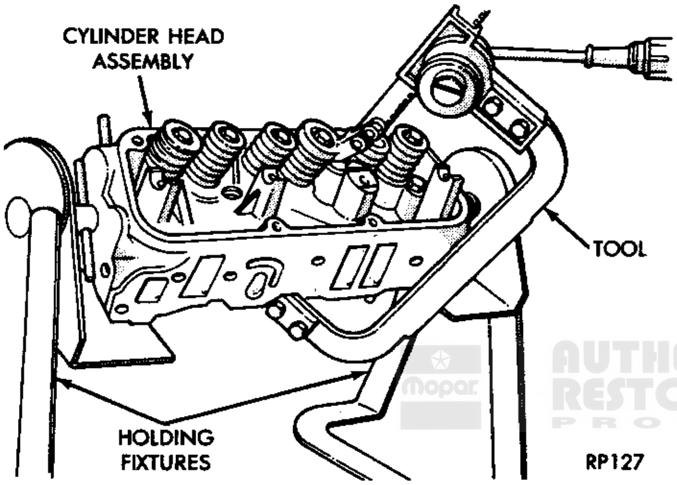


Fig. 9 Compress Valve Springs with Tool C-3422A

VALVE INSPECTION

Clean valves thoroughly and discard burned, warped and cracked valves.

Measure valve stems for wear. New stem diameters should measure (Fig. 10):

Intake	9.449 to 9.474 mm (0.372 to 0.373 inch)
Exhaust	9.423 to 9.449 mm (0.371 to 0.372 inch)

If wear exceeds 0.051 mm (0.002 inch), replace valve

J9009-109

Fig. 10 Valve Stem Diameters

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

Measure valve stem guide clearance as follows:

(a) Install 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.

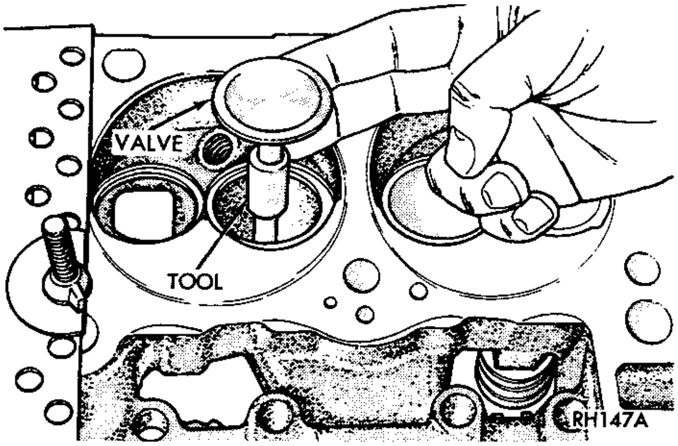


Fig. 11 Positioning Valve with Tool C-3973

(b) Attach dial indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 12).

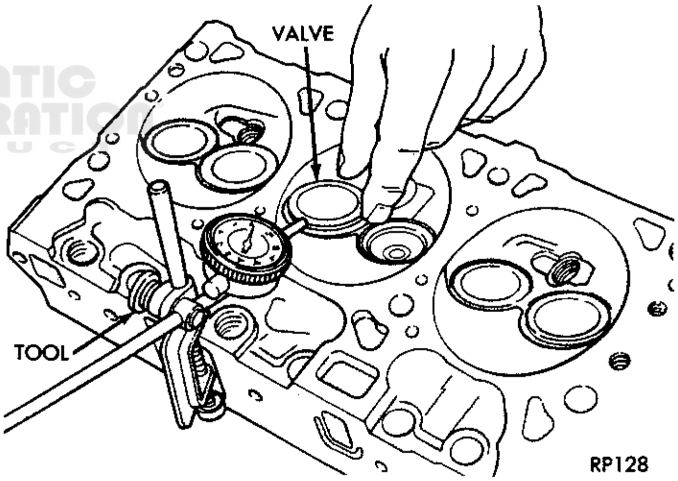


Fig. 12 Measuring Valve Guide Wear

(c) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 inch). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

Service valves with oversize stems are available (Fig. 13).

Slowly turn reamer by hand and clean guide thoroughly before installing new valve.

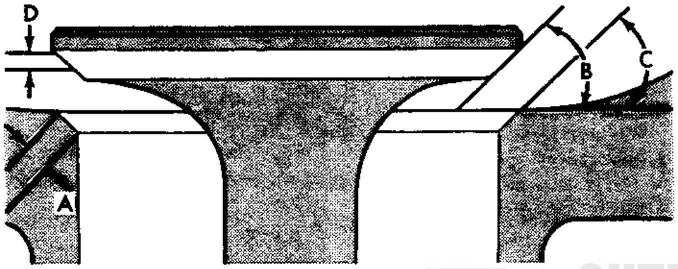
CAUTION: DO NOT attempt to ream the valve guides from standard directly to 0.762 mm (0.030 inch). Use step procedure of 0.127, 0.381 and 0.762 mm (0.005, 0.015 and 0.030 inch) so the valve guides may be reamed true in relation to the valve seat.

Reamer Tool No.	Reamer Oversize	Valve Guide Size
C-3433	0.127 mm (0.005 inch)	9.63-9.65 mm (0.379-0.380 inch)
C-3430	0.381 mm (0.015 inch)	9.88-9.91 mm (0.389-0.390 inch)
C-3427	0.762 mm (0.030 inch)	10.26-10.29 mm (0.404-0.405 inch)
		J9009-100

Fig. 13 Reamer Sizes

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 44-1/2° to 45° face angle. The valve seats have a 45° to 45-1/2° face angle (Fig. 14).



A-SEAT WIDTH (INTAKE 1/16 (1.587 mm) TO 3/32 (2.381 mm) INCH
EXHAUST: (.080-.100 INCH) - (2-2.5 mm)
B-FACE ANGLE (INTAKE & EXHAUST: 44½°-45°)
C-SEAT ANGLE (INTAKE & EXHAUST: 45°-45½°)
D-CONTACT SURFACE

PU605

Fig. 14 Valve Face and Seat Angles

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 15). Valves with less than 1.190 mm (3/64 inch) margin should be discarded.

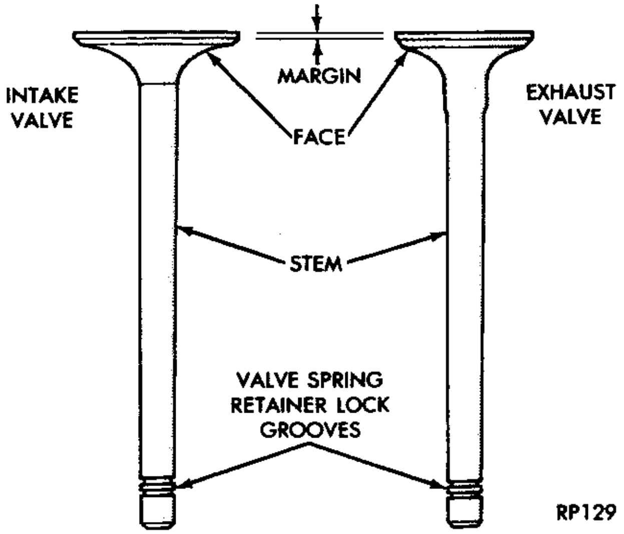


Fig. 15 Intake and Exhaust Valves

VALVE SEATS

CAUTION: DO NOT unshroud valves during valve seat refacing (Fig. 16).

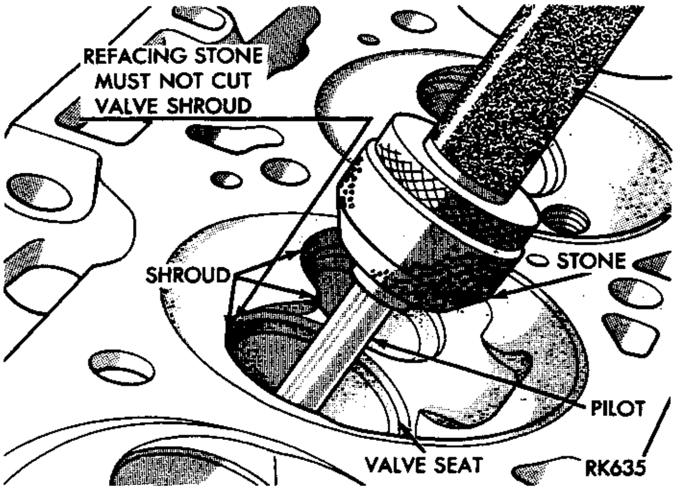


Fig. 16 Refacing Valve Seats

(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 dial indicator No. 13725. Total runout should not exceed 0.051 mm (0.002 inch) 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 1.587 to 2.381 mm (1/16 to 3/32 inch). The width of the exhaust seats should be 2.00-2.50 mm (0.080-0.100 inch).

TESTING VALVE SPRINGS

(1) 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 inch. Turn table of Tool C-647 until surface is in line with the 1-5/16 inch mark on the threaded stud and the zero mark to the front (Fig. 17). 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 two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifica-

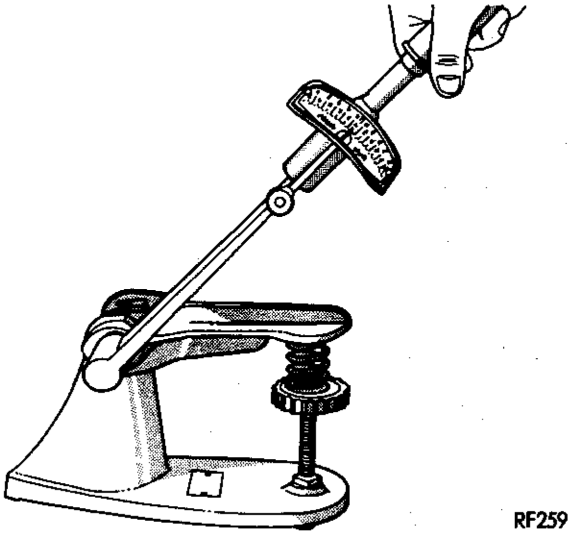


Fig. 17 Testing Valve Spring for Compressed Length with Tool C-647

tions to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

(2) Inspect each valve spring for squareness with a steel square and surface plate, test springs from both ends (Fig. 18). If the spring is more than 1.984 mm (5/64 inch) out-of-square, install a new spring.

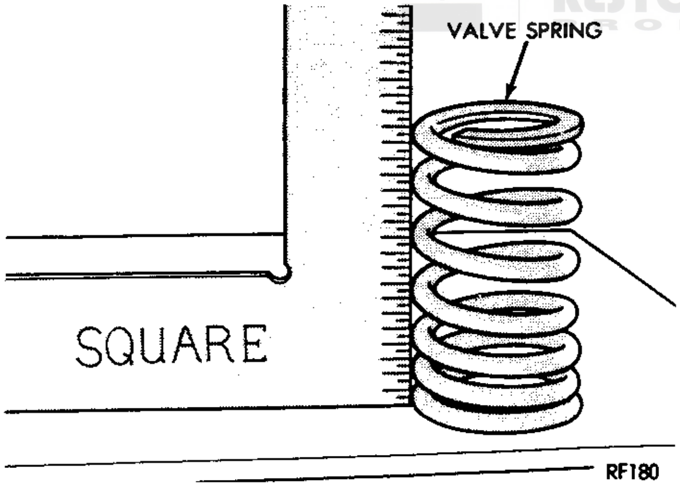


Fig. 18 Checking Valve Spring for Squareness

INSTALLATION

CAUTION: Installing the wrong exhaust valve spring in engines with positive rotators can cause severe engine damage. Refer to specifications for proper identification.

(1) Coat valve stems with lubrication oil and insert them in cylinder head.

(2) If valves or seats are reground, check valve stem height with Tool C-3968 (Fig. 19). If valve is too long, grind off the tip until length is within limits. **Engine is equipped with exhaust valve rotators, do not grind exhaust valve stem tip.**

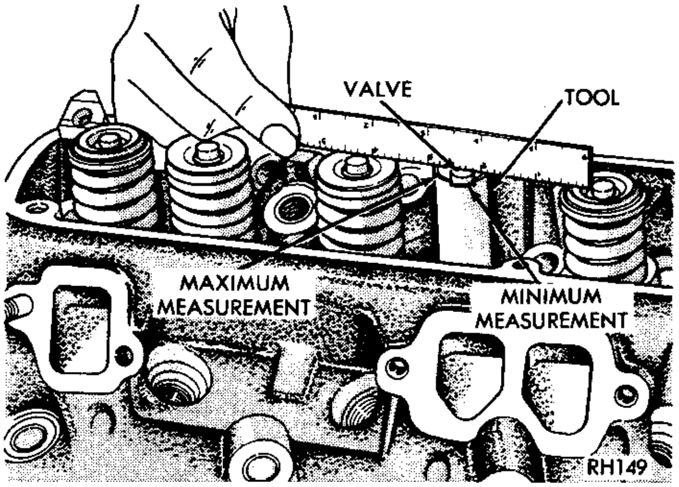


Fig. 19 Measuring Valve Stem Length with Tool C-396B

(3) Install new seals on all valve stems and over valve guides (Fig. 20). Install valve springs and valve retainers.

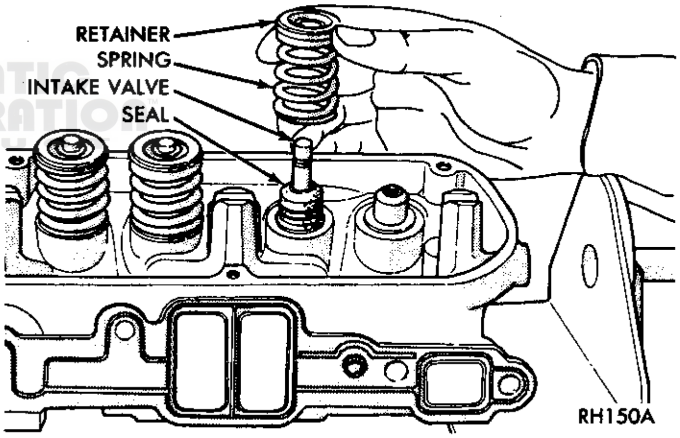


Fig. 20 Installing Valve, Cup Seal, Spring and Retainer

(4) Compress valve springs with Tool C-3422-A, install locks and release tool. If valves and/or seats are reground, measure the installed height of springs, make sure 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 to bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch). Exhaust valve springs with positive rotators should have a length of 36.8-38.1 mm (1.45-1.51 inch) when the valve is closed.

REPLACE VALVE STEM SHIELDS OR VALVE SPRINGS (CYLINDER HEAD NOT REMOVED)

(1) Set engine basic timing to TDC and remove Air Cleaner.

(2) Remove cylinder head covers and spark plugs.

(3) Remove coil wire from distributor and secure to good ground to prevent engine from starting.

(4) Using suitable socket and flex handle at crankshaft pulley retaining bolt, turn engine so the #1 piston is at Top Dead Center on the compression stroke.

(5) Remove rocker arms with rocker shaft and install a dummy shaft. The rocker arms should not be disturbed and left on shaft.

(6) With air hose attached to adapter tool C-3907 installed in #1 spark plug hole, apply 620.5 to 689 kPa (90 to 100 psi) air pressure.

(7) Using Tool C-3906 or C-4228 compress valve spring and remove retainer valve locks and valve spring.

(8) Install seals on the exhaust valve stem and position down against valve guides.

(9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. DO NOT FORCE seal against top of guide. When installing the valve retainer locks, compress the spring only enough to install the locks.

(10) Follow the same procedure on the remaining 5 cylinders using the firing sequence 1-6-5-4-3-2. Make sure piston in cylinder is at TDC on the valve spring that is being removed.

(11) Remove adapter Tool 3907.

(12) Remove dummy shaft and install rocker shaft with rocker arms.

(13) Install covers and coil wire to distributor.

(14) Install air cleaner.

(15) Road test vehicle.

HYDRAULIC TAPPETS

Valve train modifications include roller tappet assemblies, aligning yokes and yoke retainers.

Roller tappet alignment is maintained by machined flats on tappet body being fitted (in pairs)into six aligning yokes. The yokes are secured by an alignment yoke retainer (Fig. 1).

Before disassembling any part of the engine to correct tappet noise, read the oil pressure at the gauge (install a reliable gauge at pressure sending unit). The pressure should be between 207 to 552 kPa (30 and 80 psi) at 2000 R.P.M. If vehicle has no oil pressure gauge, check the oil level in the oil pan.

The oil level in the pan should never be above the FULL mark on dipstick, or below the ADD OIL mark. Either of these two conditions could be responsible for noisy tappets. Check the oil level after the engine reaches normal operating temperature. Allow 5 minutes to stabilize oil level, check dipstick.

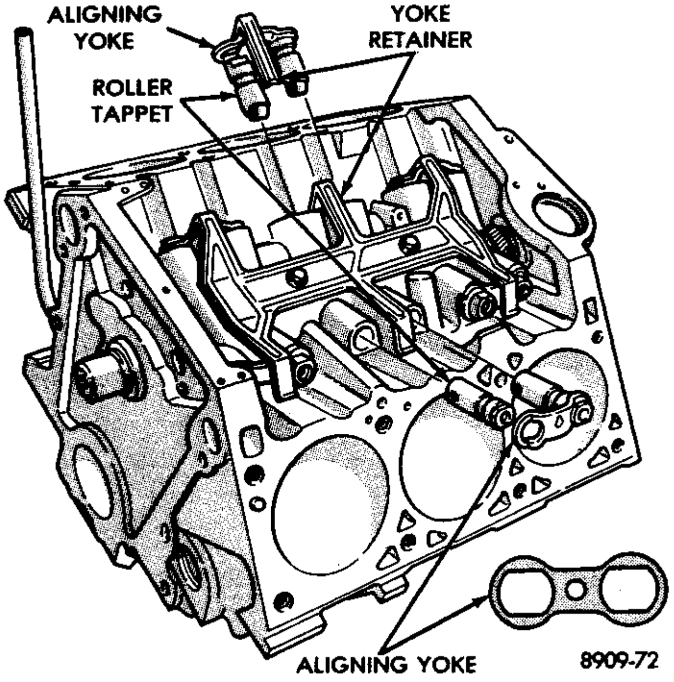


Fig. 1 Roller Tappets Aligning Yoke and Retainer

OIL LEVEL TOO HIGH

If oil level is above the FULL mark on dipstick, it is possible for the connecting rods to dip into the oil while engine is running and create foam. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

OIL LEVEL TOO LOW

Low oil level may allow oil pump to take in air which when fed to the tappets, causes them to lose length and 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, engine should be operated at fast idle for sufficient time to allow all of the air inside of 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.

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 which will necessitate replacing the tappet, or by the plunger partially sticking in the tappet body cylinder. A heavy click is caused either by a tappet check valve not seating, or by foreign particles becoming wedged between the plunger and the tappet body, causing 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.

REMOVAL

(1) Remove valve cover and rocker assembly and push rods and identify push rods to ensure installation in original location.

(2) Remove intake manifold, yoke retainer and aligning yokes (Fig. 1).

(3) Slide Tool C-4129 through opening in cylinder head and seat tool firmly in the head of tappet.

(4) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(5) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize and replace with oversize tappet.

CAUTION: The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts.Mixed parts are not compatible. Do not disassemble a tappet on a dirty work bench.

DISASSEMBLY

(1) Pry out plunger retainer spring clip.

(2) Clean varnish deposits from inside of tappet body above plunger cap.

(3) Invert tappet body and remove plunger cap, plunger, check valve, check valve spring, check valve retainer and plunger spring. Check valve could be flat or ball.

CLEANING AND ASSEMBLY

(1) Clean all tappet parts in a solvent that will remove all varnish and carbon.

(2) Replace tappets that are unfit for further service with new assemblies.

(3) If plunger shows signs of scoring or wear and valve is pitted, or if valve seat on end of plunger indicates any condition that would prevent valve from seating, install a new tappet assembly.

(4) Assemble tappets (Fig. 2).

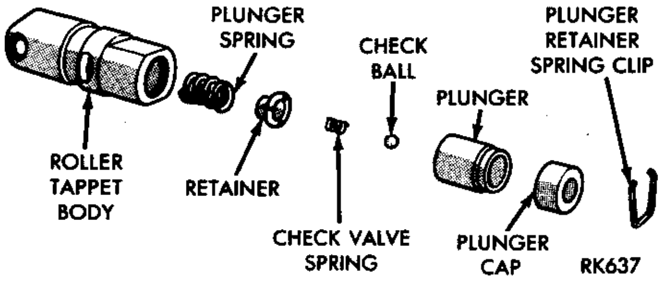


Fig. 2 Hydraulic Tappet Assembly

INSTALLATION

(1) Lubricate tappets.

(2) Install tappets in their original positions.

(3) With roller tappets, install aligning yokes with ARROW toward camshaft (Fig. 1).

(4) With roller tappets, install yoke retainer and tighten bolts to 23 N•m (200 in. lbs.) torque and install intake manifold (Fig. 1).

(5) Install push rods in original positions.

(6) Install rocker arm and shaft assembly.

(7) Install valve cover.

(8) Start and operate engine. Warm up to nor]mal 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.

VALVE TIMING

(1) Turn crankshaft until the #6 exhaust valve is closing and #6 intake valve is opening.

(2) Insert a 6.350 mm (1/4 inch) spacer between rocker arm pad and stem tip of #1 intake valve. Allow spring load to bleed tappet down giving in effect a solid tappet.

(3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible. Zero the indicator.

(4) Rotate the crankshaft clockwise (normal running direction) until the valve has lifted 0.254 mm (0.010 inch).

CAUTION: Do not turn crankshaft any further clockwise as valve spring might bottom and result in serious damage.

(5) The timing of the crankshaft pulley should now read from 10° before top dead center to 2° after top dead center. Remove spacer. If reading is not within specified limits:

(a) Check sprocket index marks.

(b) Inspect timing chain for wear.

(c) Check accuracy of DC mark on timing indicator.

TIMING CHAIN COVER, OIL SEAL AND CHAIN

COVER REMOVAL

(1) Drain cooling system.

(2) Refer to Group 7, Cooling System for procedure to remove water pump.

(3) Remove power steering pump.

(4) Remove pulley from vibration damper and bolt and washer securing vibration damper on crankshaft.

(5) Install bar from Tool (C-3688) and screw from Tool (C-3732A) and pull vibration damper from end of crankshaft (Fig. 3).

(6) Remove fuel lines.

(7) Loosen oil pan bolts and remove the front bolt at each side.

(8) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

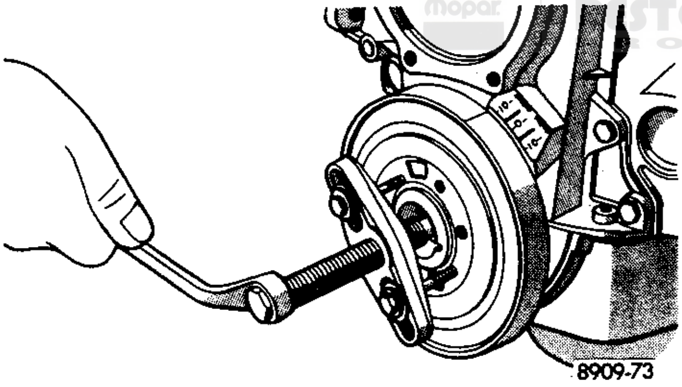


Fig. 3 Removing Vibration Damper Assembly

MEASURING TIMING CHAIN FOR STRETCH

(1) Place a scale next to timing chain so that any movement of chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt and apply torque in the direction of crankshaft rotation to take up slack; 41 N•m (30 ft. lbs.) (with cylinder head installed) or 20 N•m (15 ft. lbs.) (cylinder heads removed). With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block crankshaft to prevent rotation.

(3) Holding a scale with dimensional reading even with edge of a chain link, apply torque in the reverse direction 14 N•m (30 ft. lbs.) (with cylinder heads installed) or 20 N•m (15 ft. lbs.) (cylinder heads removed) and note amount of chain movement (Fig. 4).

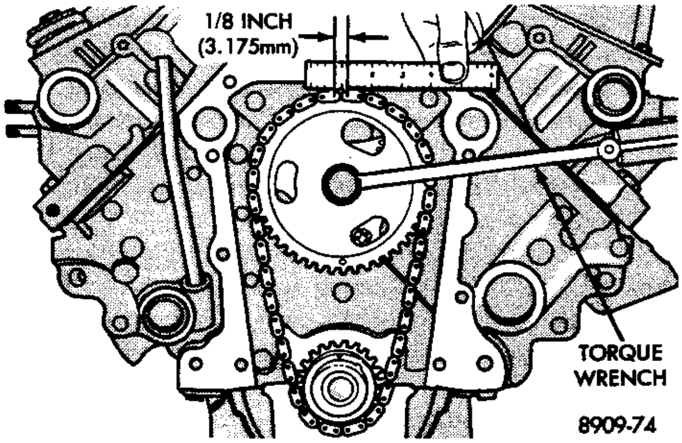


Fig. 4 Measuring Timing Chain Wear and Stretch

(4) Install a new timing chain, if its movement exceeds 3.175mm (1/8 inch).

(5) If chain is not satisfactory, remove camshaft sprocket attaching cup washer, and remove timing chain with crankshaft and camshaft sprockets.

(6) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on 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 straight edge to check alignment of timing marks (Fig. 5).

(11) Install the cup washer, and camshaft bolt. Tighten the bolt to 47 N•m (35 ft. lbs.) torque.

(12) Check camshaft for 0.051to 0.0152 mm (0.002 to 0.006 inch) end play with a new thrust plate and up to 0.254 mm (0.010 inch) end play with a used thrust plate. If not within these limits install a new thrust plate.

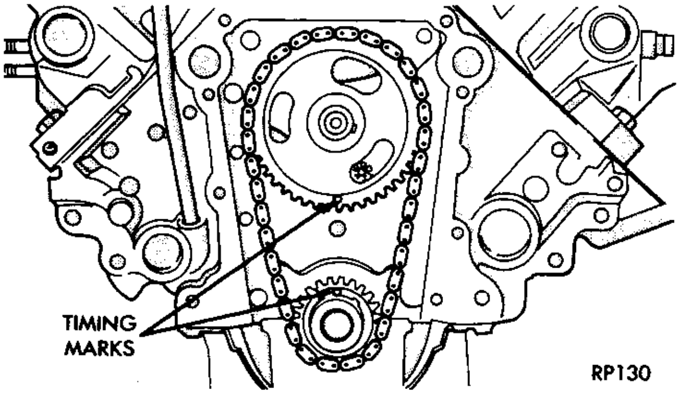


Fig. 5 Alignment of Timing Marks

TIMING CHAIN COVER EXTERNAL OIL SEAL

REMOVAL

(1) Disconnect battery.

(2) Loosen and remove belts from crankshaft pulley.

(3) Remove radiator shroud retainer bolts and set shroud back over engine.

(4) Remove fan and shroud from engine.

(5) Remove crankshaft pulley and vibration damper bolt and washer from end of crankshaft.

(6) Install bar from tool (C-3688) and screw from tool (C-3732A) and pull vibration damper from end of crankshaft (Fig. 3).

(7) Using a suitable tool behind the lips of the oil seal pry outward, being careful not to damage the crankshaft seal surface of cover (Fig. 6).

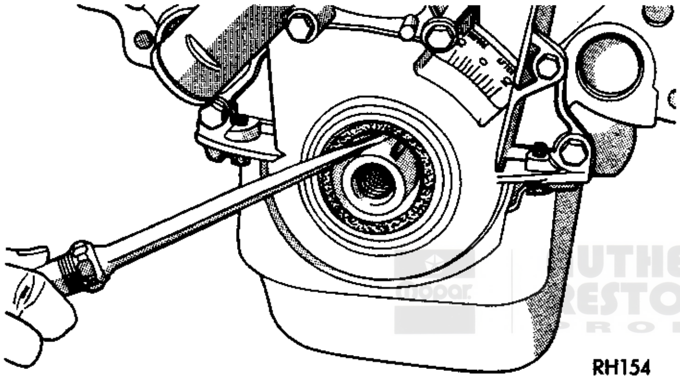


Fig. 6 Removing Oil Seal

INSTALLATION

(1) Install new seal by installing the threaded shaft part of tool (C-4251) into the threads of the crankshaft.

(2) Place seal into opening with seal spring towards the inside of the engine.

(3) Place the installing adapter C-4251-3 with the thrust bearing and nut on the shaft. Tighten the nut until tool is flush with the timing chain cover (Fig. 7).

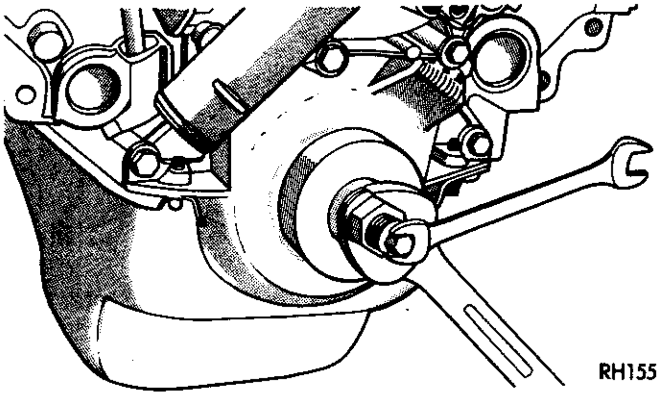


Fig. 7 Installing Oil Seal

(4) Install vibration damper using tool C-3688 (Fig. 8).

(5) Install retainer bolt and washer and tighten the bolt to 183 N•m (135 ft. lbs.) torque.

(6) Install pulley on vibration damper and tighten the bolt to 23 N•m (200 in. lbs.) torque.

(7) Set radiator shroud back over engine and install fan and belts.

(8) Install radiator shroud to radiator.

(9) Connect battery.

COVER 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. A 3.175 mm (1/8 inch) diameter bead of RTV sealer, or equivalent is recommended on the oil pan gasket. **Do not tighten bolts at this time.**

(3) Lubricate seal lip with lubriplate, or equivalent. Position damper hub slot in crankshaft. Damper will act as a pilot for the crankshaft seal.

(4) Place installing tool, part of Puller set Tool C-3688 in position and press vibration damper on crankshaft (Fig. 8).

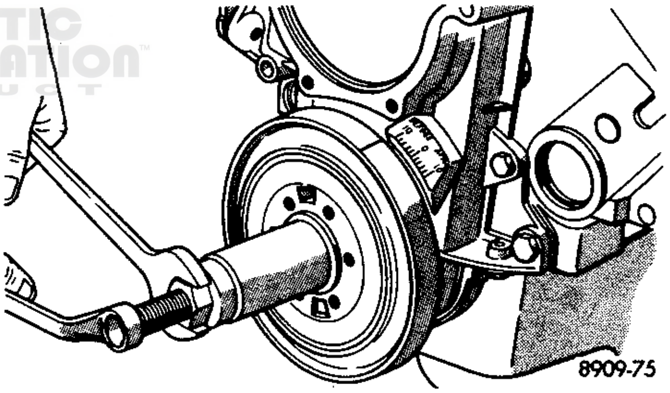


Fig. 8 Installing Vibration Damper with Tool C-3688

(5) Tighten chain case cover bolts to 41 N•m (30 ft. lbs.) torque. Then tighten oil pan bolts to 23 N•m (200 in. lbs.) torque.

(6) Install vibration damper retainer bolt with washer and tighten to 183 N•m (135 ft. lbs.) torque.

(7) Position pulley on vibration damper and attach with bolts and lockwashers. Tighten bolts to 23 N•m (200 in. lbs.) torque.

(8) Install fuel lines.

(9) Install water pump and housing assembly using new gaskets. Tighten bolts to 41 N•m (30 ft. lbs.) torque.

(10) Install power steering pump.

(11) Install fan and belt, hoses and close drains.

(12) Install radiator shroud.

(13) Fill cooling system (see Group 7, Cooling System for the proper procedure).

CAMSHAFT (ENGINE REMOVED FROM VEHICLE)

REMOVAL

The camshaft has an integral oil pump and distributor drive gear (Fig. 9).

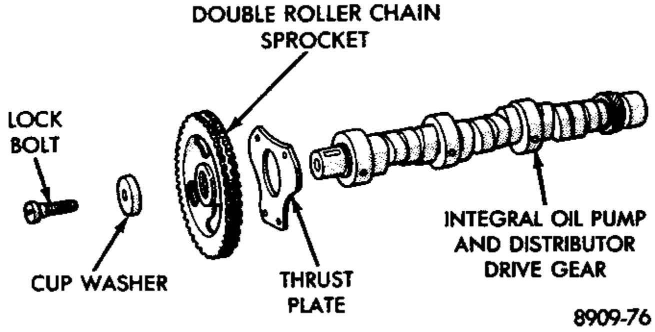


Fig. 9 Camshaft and Dual Sprocket Assembly

(1) Remove intake manifold.

(2) Remove the cylinder head covers.

(3) Remove the timing case cover and timing chain.

(4) Remove rocker arm and shaft assemblies.

(5) Remove push rods and tappets; identify each part so it can be installed in the original location.

(6) Remove distributor and lift out the oil pump and distributor drive shaft.

(7) Remove camshaft thrust plate; note location of oil tab (Fig. 10).

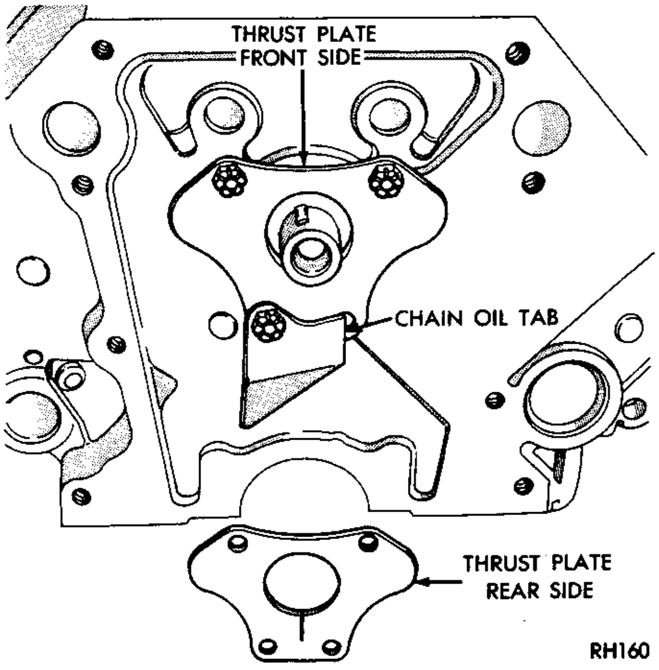


Fig. 10 Timing Chain Oil Tab Installation

(8) Install a long bolt into front of camshaft to facilitate removal of the camshaft. Remove camshaft, being careful not to damage cam bearing with the cam lobes.

To reduce internal leakage and help maintain higher oil pressure at idle, cup plugs have been pressed into the oil galleries behind the camshaft thrust plate (Fig. 11).

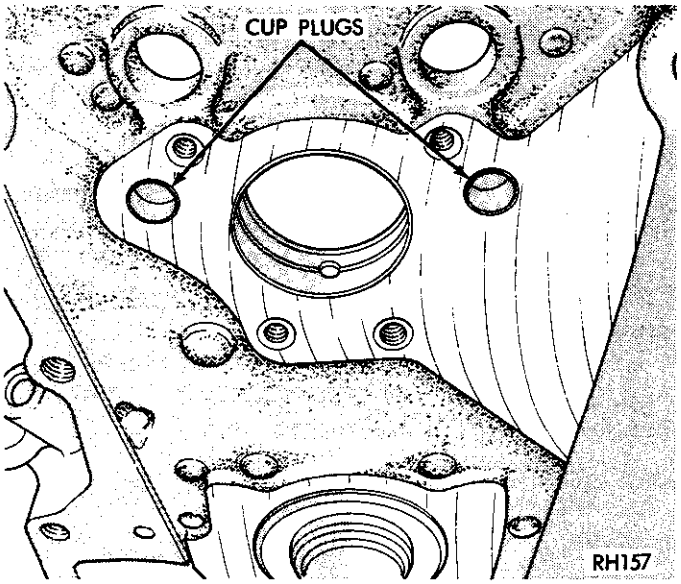


Fig. 11 Location of Cup Plugs in Oil Galleries

INSTALLATION

(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.

Whenever an engine has been rebuilt and/or a new camshaft and/or new tappets have been installed, add one pint of MOPAR Crankcase Conditioner, or equivalent to engine oil to aid in break-in. The oil mixture should be left in engine for a minimum of 805 km (500 miles), and drained at the next normal oil change.

(2) Install Tool C-3509 with tongue back of distributor drive gear (Fig. 12).

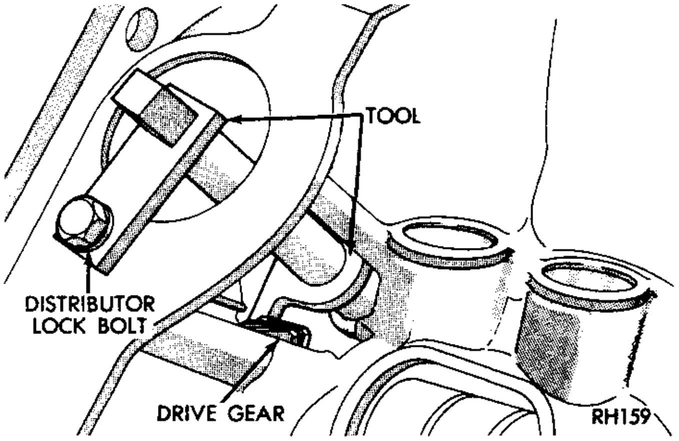


Fig. 12 Camshaft Holding Tool C-3509 (Installed Position)

(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, with three bolts (Fig. 10). **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) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(6) Place timing chain around both sprockets.

(7) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(8) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(9) Slide both sprockets evenly over their respective shafts and use a straight edge to check alignment of timing marks (Fig. 13).

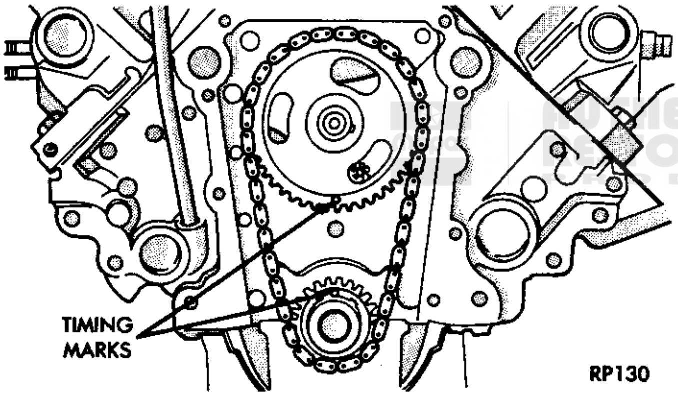


Fig. 13 Alignment of Timing Marks

(10) Install the cup washer, and camshaft bolt. Tighten bolt to 47 N•m (35 ft. lbs.) torque.

(11) Measure camshaft end play. Refer to Specifications for proper clearance. If not within limits install a new thrust plate.

(12) Each tappet reused must be installed in the same position from which it was removed. Tappets must have a definite crown. **When camshaft is replaced, all of the tappets must be replaced.**

CAMSHAFT BEARINGS (ENGINE REMOVED FROM VEHICLE)

REMOVAL

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

(2) Install proper size adapters and horse shoe washers (part of Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 14).

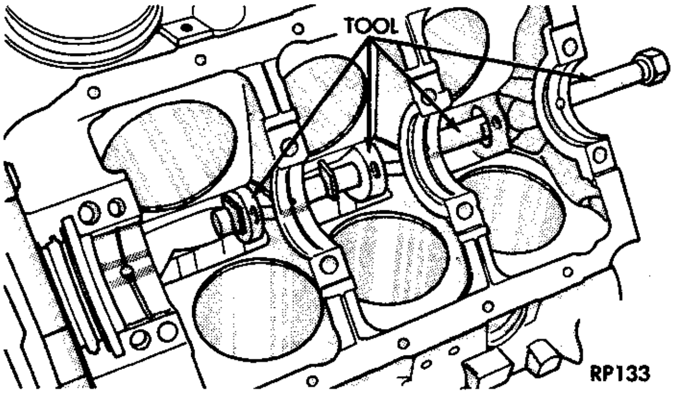


Fig. 14 Removal/Installation Camshaft Bearings (Tool C-3132A)

INSTALLATION

(1) Install new camshaft bearings with 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. Also, No. 2 bearing must index with the oil passage to the left cylinder head and No. 3 bearing must index with the oil passage to the right cylinder head. 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.**

DISTRIBUTOR DRIVE SHAFT BUSHING

REMOVAL

(1) Insert Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 15).

(2) Hold puller screw and tighten puller nut until bushing is removed.

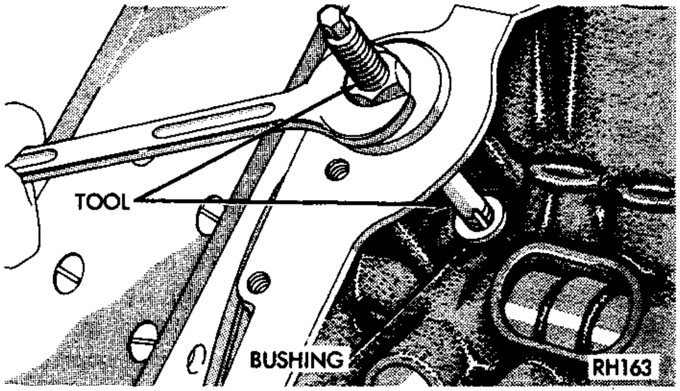


Fig. 15 Removal Distributor Driveshaft Bushing (Tool C-3052)

INSTALLATION

(1) Slide new bushing over burnishing end of Tool C-3053 and insert the tool and bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 16).

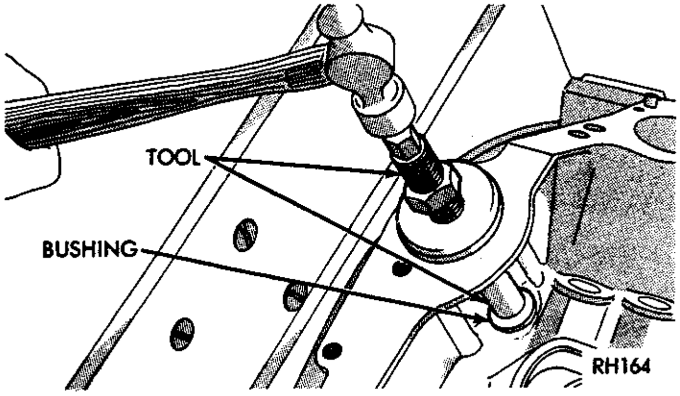


Fig. 16 Installing Distributor Driveshaft Bushing (Tool C-3053)

(3) As the burnisher is pulled through the bushing by tightening the puller nut, the bushing is expanded tight in block and burnished to correct size, (Fig. 17). **Do not ream this bushing.**

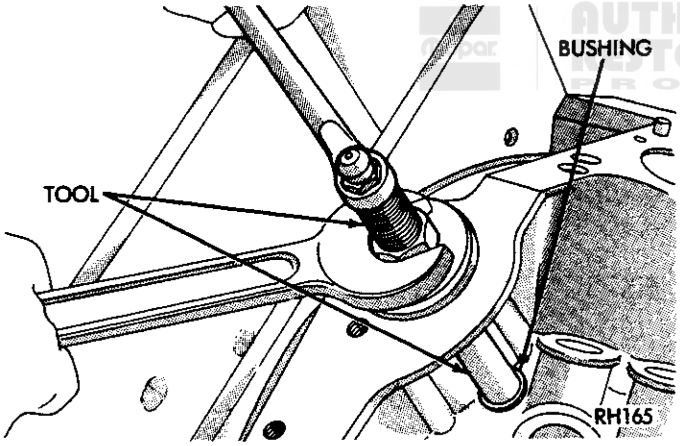


Fig. 17 Burnishing Distributor Driveshaft Bushing

DISTRIBUTOR TIMING

Before installing the distributor and oil pump drive shaft, time engine as follows:

(1) Rotate crankshaft until No. 1 cylinder is at top dead center on the firing stroke.

(2) When in this position, the timing mark on vibration damper should be under "O" on the timing indicator.

(3) Coat shaft and drive gear with engine oil. Install the shaft so that after gear spirals into place. It will index with the oil pump shaft, so slot in top of drive gear will be aligned in a direction (forward) towards left front intake manifold attaching bolt hole (Fig. 18).

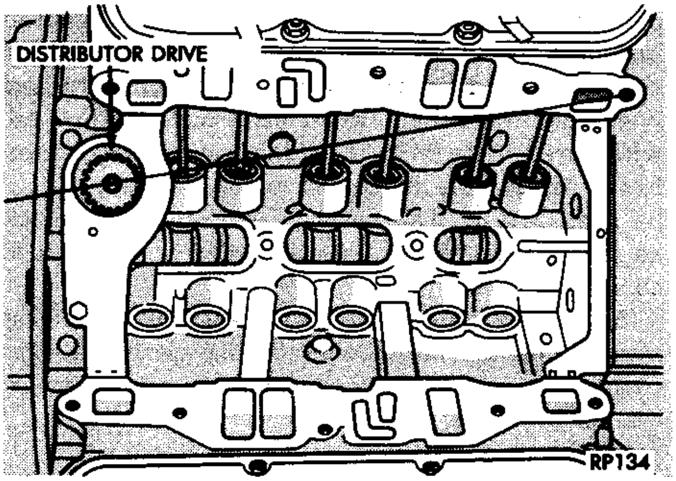


Fig. 18 Position of Installed Distributor Drive Gear

INSTALLATION (DISTRIBUTOR)

(1) Hold the distributor over the mounting pad on cylinder block.

(2) Turn rotor until it points to approximate location of No. 1 tower terminal in distributor cap (Fig. 19).

(3) Place distributor O-Ring in position.

(4) Lower the distributor and engage the shaft in the slot of distributor drive shaft gear.

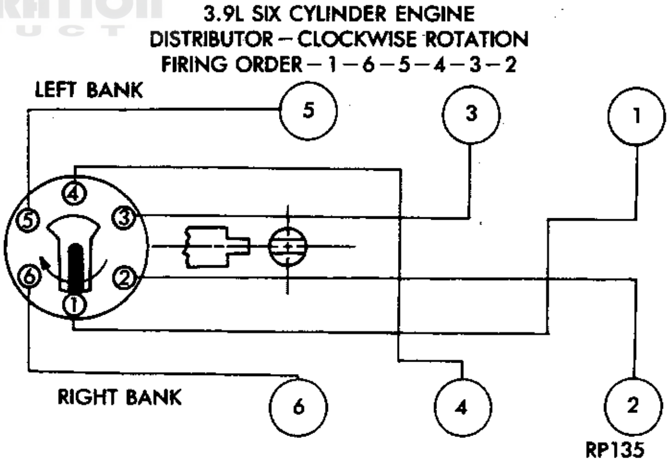


Fig. 19 Distributor with Rotor Positioned Under No. 1 Tower of Cap

CYLINDER BLOCK

PISTON REMOVAL

(1) Remove top ridge of cylinder bores with are liable 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 that each connecting rod is centered in cylinder bore.**

(2) Inspect connecting rods and connecting rod caps for cylinder identification. Identify them, if necessary.

(3) Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts. Push each piston and rod assembly out of cylinder bore. **Be careful not to nick crankshaft journals.**

(4) After removal, install bearing cap on the mating rod.

CLEANING AND INSPECTION

(1) Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

(2) If new core plugs are installed, see "Engine Core Oil and Cam Plugs".

(3) Examine block for cracks or fractures.

CYLINDER BORE INSPECTION

The cylinder walls should be checked for out of-round and taper with Tool C-119. If the cylinder bores show more than 0.127 mm (0.005 inch) out-of-round, or a taper of more than 0.254 mm (0.010 inch), or if the cylinder walls are badly scuffed or scored, the cylinder block should be bored and honed, and new pistons and rings fitted. Whatever type of boring equipment is used, boring and honing operation should be closely coordinated with the fitting of pistons and rings in order that specified clearances may be maintained.

ENGINE CORE OIL AND CAM PLUGS

REMOVAL

Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup plug. With the cup plug rotated, grasp firmly with pliers or other suitable too land remove plug (Fig. 1).

CAUTION: Do not drive cup plug into the casting as restricted cooling can result and cause serious engine problems.

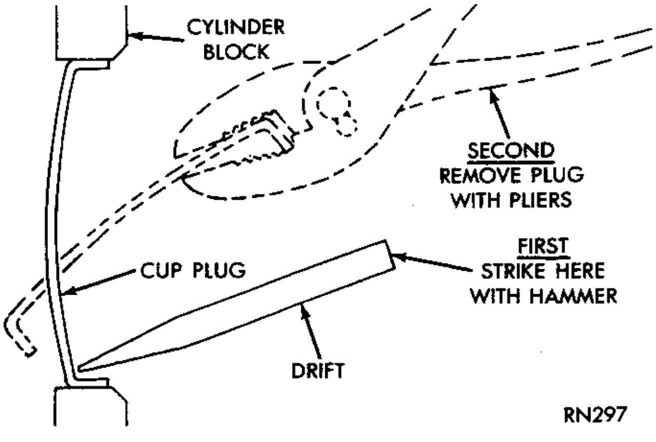


Fig. 1 Core Hole Plug Removal

INSTALLATION

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 Loctite Stud N' Bearing Mount, or equivalent. 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 (0.02 inch) inside the lead-in chamfer.

It is not necessary to wait for curing of the sealant. The cooling system can be filled and the vehicle placed in service immediately.

PISTONS, PINS AND RINGS

The pistons are cam ground so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, thus, causing the piston to assume a more nearly round shape. It is important that pistons be checked for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 2).

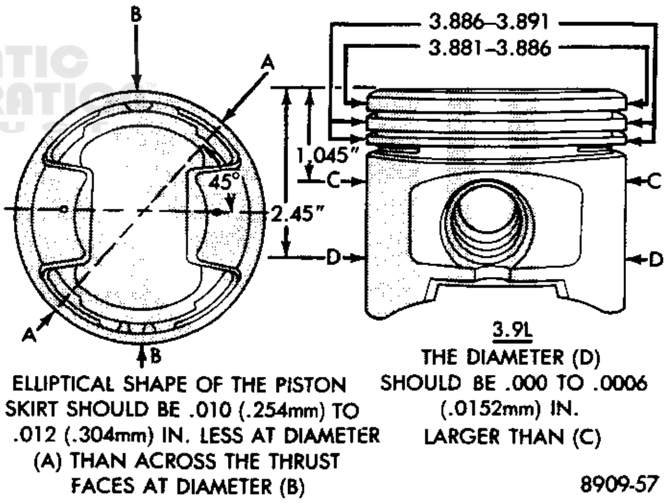


Fig. 2 Piston Measurements

FINISHED PISTONS

All pistons are machined to the same weight in grams, regardless of oversize, to maintain piston balance. For cylinder bores which have been honed or bored new pistons are furnished with fitted pins, available in standard and oversize—0.508 mm (0.020 inch).

FITTING PISTONS

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.0127 to 0.0381 mm (0.0005 to 0.0015 inch).

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).

PISTON PINS

The piston pin rotates in the piston only, and is retained by the press interference fit of the piston pin in the connecting rod.

FITTING RINGS

(1) Measure piston ring gap about two inches from bottom of cylinder bore in which it is to befitted (An inverted piston can be used to push the rings down to insure positioning rings squarely in the cylinder bore before measuring).

(2) Insert feeler stock in the gap. The ring gap should be between 0.254 and 0.508 mm (0.010 and 0.020 inch) for compression rings and 0.381 to 1.575 mm (0.015 to 0.062 inch) for oil ring steel rails in standard size bores (for new service rings).Maximum gap in 0.127 mm (0.005 inch) O/S bores should be 0.907 mm (0.036 inch) for compression rings and 1.778 mm (0.070 inch) for oil ring steel rails.

(3) Measure side clearance between piston ring and ring land (Fig. 3). Clearance should be 0.038 to 0.076 mm (0.0015 to 0.003 inch) for the top compression ring and the intermediate ring. Steel rail service oil ring should be free in groove, but should not exceed 0.127 mm (0.005 inch) side clearance.

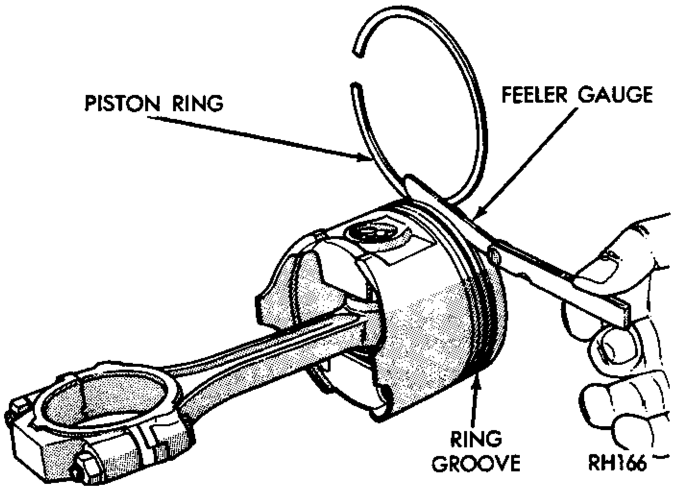


Fig. 3 Measuring Piston Ring Side Clearance

(4) On the 3.9L engine, the keys on the spacer expander must be inserted into the hole in the oil ring groove over the piston pin front boss (Fig. 4).

(5) Arrange oil ring rail gaps on inboard side of piston (Top of Fig. 4).

(6) Install compression rings in middle and top grooves using Ring Installer Tool C-4184. Be sure the compression ring identification mark (a drill point, a stamped letter "O", an oval depression or the word top) is to the top of the piston.

CONNECTING RODS

INSTALLATION PISTON AND CONNECTING ROD ASSEMBLY

(1) Before installing pistons, and connecting rod assemblies into the bore, be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 4).

(3) Immerse the piston head and rings in clean engine oil. Slide the 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. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

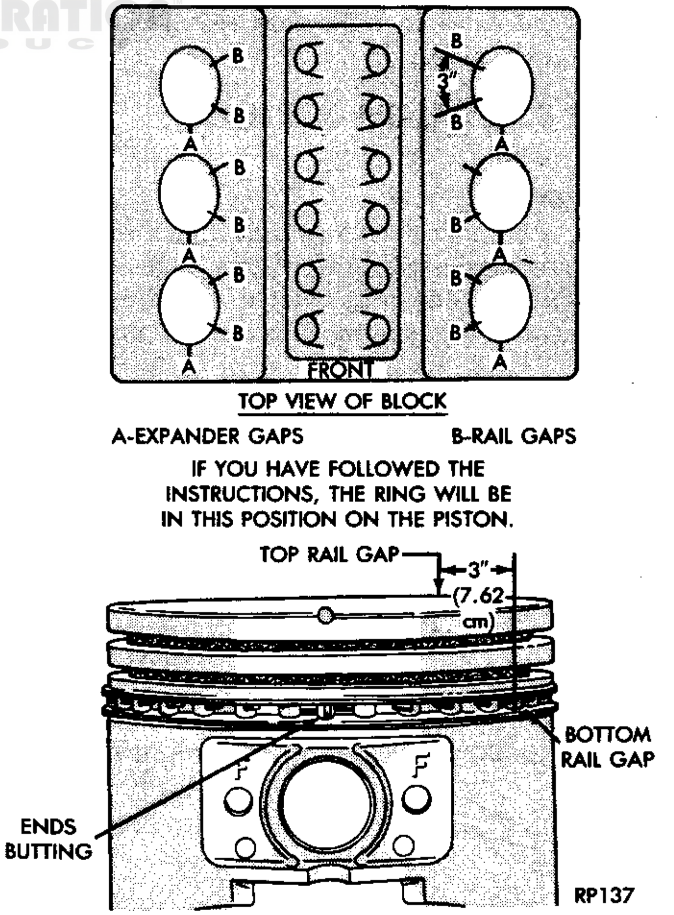


Fig. 4 Proper Oil Ring Installation

(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. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N•m (45 ft. lbs.) torque.

INSTALLATION OF CONNECTING ROD BEARINGS

Fit all rods on one bank until completed. DO NOT alternate from one bank to another, because when the rods are assembled to pistons correctly, they 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, make 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 inch). Bearings are available in 0.025 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch) 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 IDENTIFICATION

A crankshaft which has one or more connecting rod or main bearing journals undersize will be stamped with 1/4 inch letters near the notch of the No. 6 crankshaft counterweight (Fig. 5).

RX indicates ALL rod journals are (0.010 inch) undersize; MX indicates ALL main journals are 0.254 mm (0.010 inch) undersize.

CRANKSHAFT MAIN JOURNALS

The crankshaft journals should be checked for excessive wear, taper and scoring. Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 inch). Journal grinding should not exceed 0.305 mm (0.012 inch) under the standard journal diameter. DO NOT grind thrust faces of No. 3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

Undersize Journal	Identification Stamp
.001 inch (Rod)	R1-R2-R3-Etc.
.010 inch (Rod)	RX
.001 inch (Main)	M1-M2-M3 or M4
.010 inch (Main)	MX

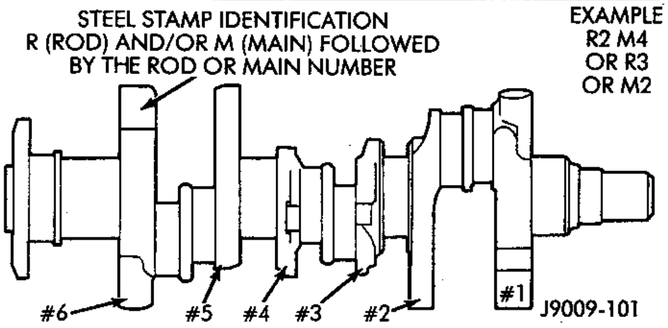


Fig. 5 Location of Crankshaft Identification on No. 6 Counterweight

CAUTION: After any journal grind, it is important that the final paper or cloth polish be in the same direction as the engine rotates.

CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to insure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of No. 1 and No. 3 are interchangeable.

Upper and lower No. 2 bearing halves are flange to carry the crankshaft thrust loads and are NOT interchangeable with any other bearing halves in the engine (Fig. 6). All bearing capbolts removed during service procedures are to be cleaned and oiled before reinstallation. Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch). Never install an undersize bearing that will reduce clearance below specifications.

REMOVAL

(1) Remove oil pan and identify bearing caps before removal.

(2) Remove bearing caps one at a time. Remove upper half of bearing by inserting Tool C-3059 into the oil hole of crankshaft (Fig. 7).

(3) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

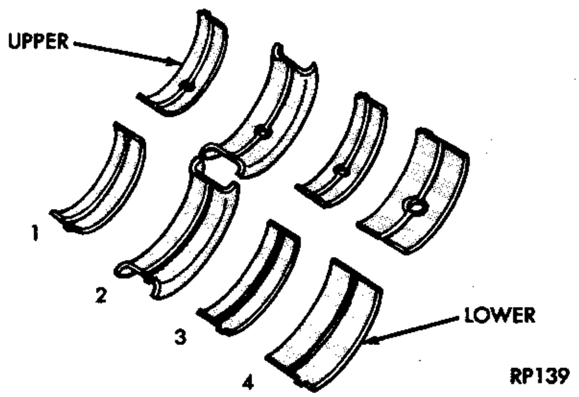


Fig. 6 Main Bearing Identification

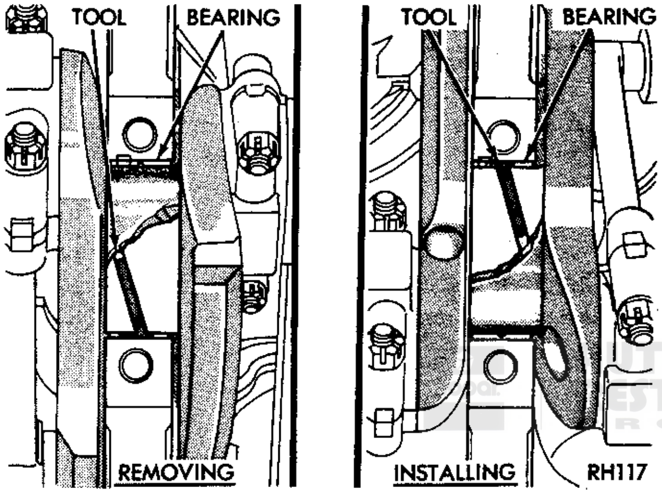


Fig. 7 Removing/Installing Upper Main Bearing with Tool C-3059

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Tool C-3059 into oil hole of crankshaft (Fig. 7).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

REAR MAIN BEARING OIL SEALS

The service seal is a two piece, fitted, "Rope Type." The upper rope seal half can be installed with crankshaft removed or in vehicle with crankshaft installed. Lower rope seal half is required installation when upper seal is installed.

UPPER ROPE SEAL SERVICE (CRANKSHAFT REMOVED)

(1) Install a new rear bearing oil seal in the cylinder block so that both ends protrude.

(2) Using Tool C-3511, tap seal down into position until tool is seated in bearing bore (Fig. 8).

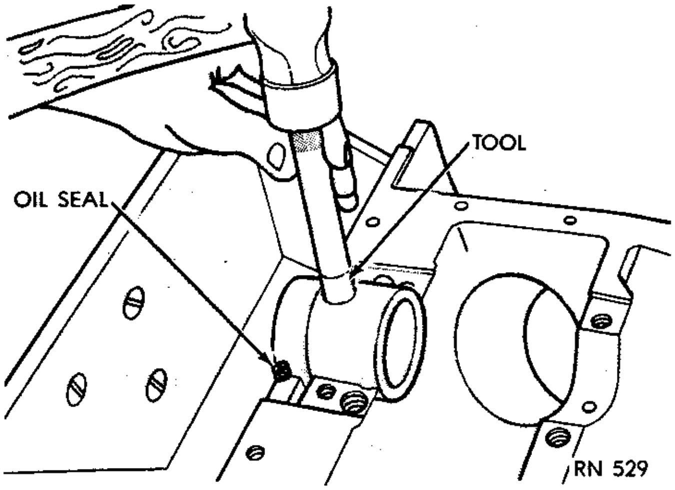


Fig. 8 Installing Upper/Lower Oil Seal with Tool C-3511

(3) Hold tool in this position and cut off the portion of seal that extends below the block (or cap) on both sides (Fig. 9).

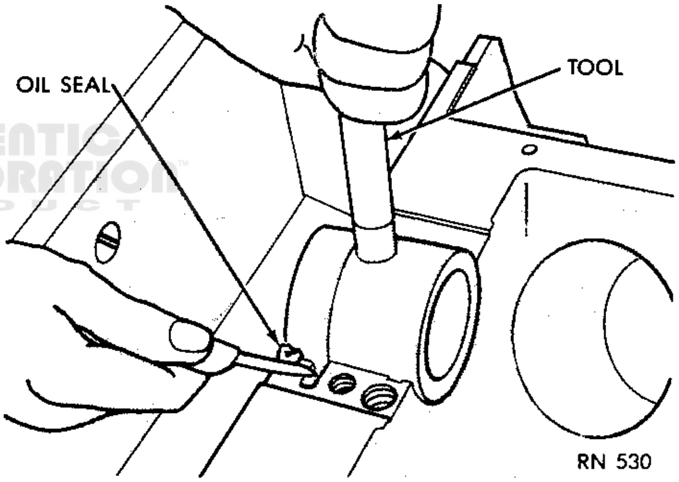


Fig. 9 Trimming Upper/Lower Oil Seal

UPPER ROPE SEAL (IN VEHICLE—CRANKSHAFT INSTALLED)

(1) Remove defective upper seal and install new one using Oil Seal Remover and Installer Tool KD-492, or equivalent (which includes complete instructions and is available from most auto supply stores).

(2) Carefully, trim the upper seal after installation to eliminate frayed ends.

LOWER ROPE SEAL

(1) Install a new seal in bearing cap so that both ends protrude.

(2) Using Tool C-3511, tap seal down into position until tool is seated in bearing bore.

(3) Hold tool in this position and cut off the portion of the seal that extends above the cap on both sides.

(4) Install cap seals into slots in bearing cap (Fig. 10). If this is not done, oil leakage will occur. Lightly oil seals with engine oil.

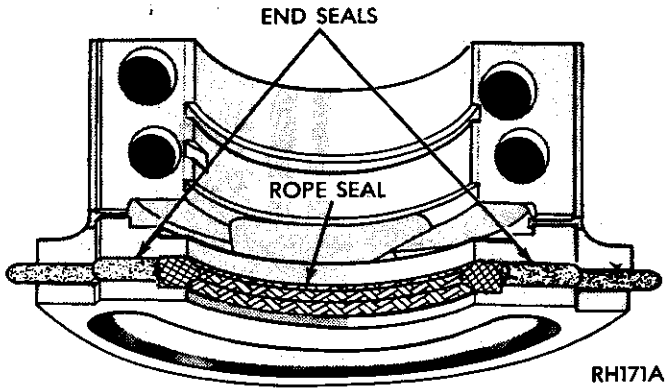


Fig. 10 Rear Main Bearing Cap

(5) Assemble bearing cap to cylinder block. Install cleaned and oiled cap bolts and tighten to 115 N•m (85 ft. lbs.) torque.

(6) Install oil pump. Add sealer at bearing cap to block joint (Fig. 11) to provide oil pan end sealing. Install oil pan.

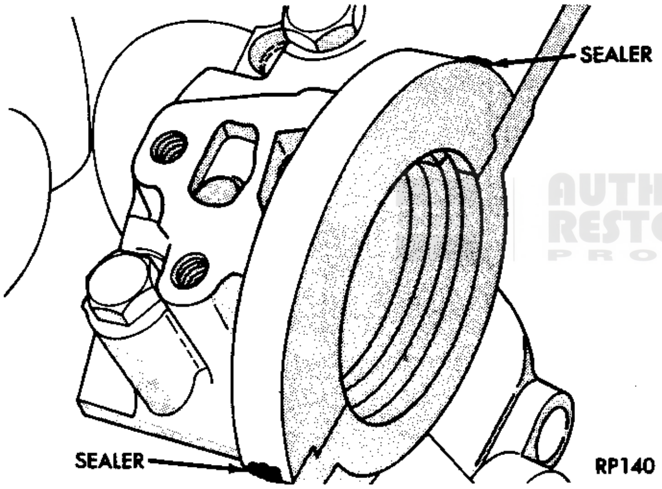


Fig. 11 Oil Pan End Seal at Rear Bearing

OIL PAN

REMOVAL

(1) Disconnect battery ground cable.

(2) Remove engine oil dipstick.

(3) Remove the engine cover and air cleaner assembly.

(4) Remove the engine controller (S.M.E.C.).

(5) Raise vehicle on a hoist.

(6) Remove the right and left transmission support braces.

(7) Loosen the exhaust pipe support bracket.

(8) Remove the starter motor.

(9) Remove the transmission dust shield.

(10) Drain the engine oil.

(11) Remove the O_2 sensor and air injection tube.

(12) Remove the exhaust pipe.

(13) Remove the right engine mount nut. Loosen (DO NOT REMOVE) the left engine mount nut.

(14) Support the right side of the engine with an adjustable jack stand.

(15) Remove the rear engine support (transmission) insulator bolts.

(16) Position a transmission jack under the transmission.

(17) Raise the transmission and engine jacks as required to allow for the oil pan removal.

(18) Remove the oil pan bolts and remove the oil pan.

CLEANING AND INSPECTION

(1) Clean oil pan in solvent and wipe dry with a clean cloth. Clean all gasket material from mounting surfaces of pan and block.

(2) Inspect oil drain plug and plug hole for stripped or damaged threads and repairs necessary. Install a new drain plug gasket. Tighten drain plug to 27 N•m (20 ft. lbs.) torque.

(3) Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

(4) Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSTALLATION

(1) Place a drop of RTV at chain case cover to block parting line.

(2) Using a new pan gasket set, add drop of RTV sealer at corners of rubber and cork (Fig. 12).

(3) Install pan and tighten bolts to 23 N• (200 in. lbs.) torque.

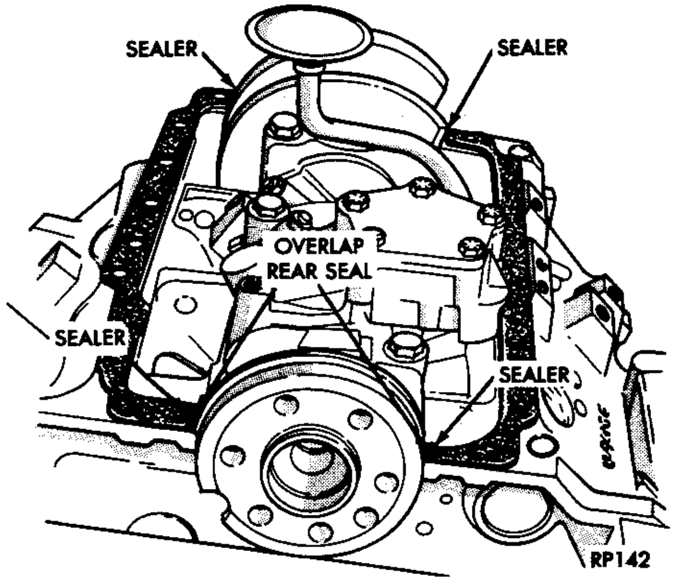


Fig. 12 Oil Pan Gaskets and Seal Installation

(4) Lower the transmission and engine jacks.

(5) Install the rear engine support (transmission) insulator bolts.

(6) Remove the transmission and engine jacks.

(7) Install the right engine mount nut and tighten the left and right engine mount nuts.

(8) Install exhaust cross over pipe. Tighten the nuts to 33 N•m (24 ft. lbs.) torque.

(9) Install the 0_2 sensor and air injection tube.

(10) Install the transmission dust shields.

(11) Install the starter motor.

(12) Tighten the exhaust pipe support bracket.

(13) Install the right and left transmission support braces.

(14) Lower the vehicle.

(15) Install the engine controller (S.M.E.C.).

(16) Install the air cleaner assembly.

(17) Position the engine cover in place and tighten the attaching bolts and latches.

(18) Install oil dipstick.

(19) Connect the battery ground cable.

(20) Fill the crankcase with clean oil to proper level.

OIL PUMP

It is necessary to remove the oil pan, and remove the oil pump from rear main bearing cap to service the oil pump.

DISASSEMBLY

(1) To remove the relief valve, proceed 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 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. 13).

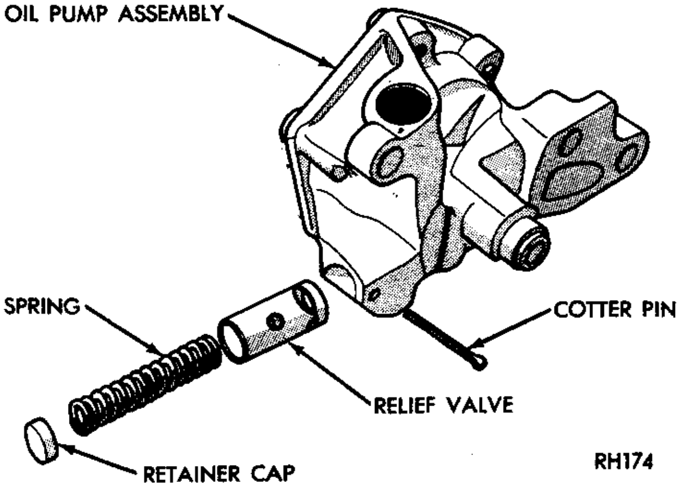


Fig. 13 Oil Pressure Relief Valve

(2) Remove oil pump cover bolts and lock]washers, and lift off cover.

(3) Remove pump rotor and shaft, and lift out outer rotor.

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear (Fig. 14).

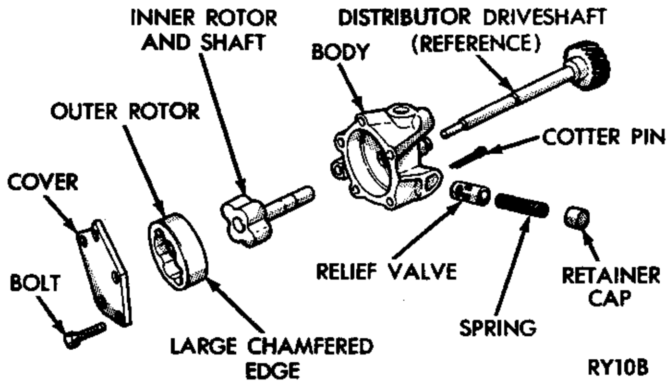


Fig. 14 Oil Pump

INSPECTION AND REPAIR

(1) Clean all parts thoroughly. Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.

(2) Lay a straight edge across the pump cover surface (Fig. 15). If a 0.038 mm (0.0015 inch) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

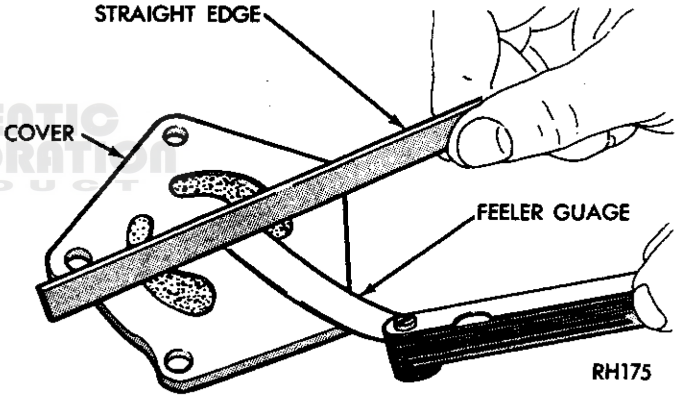


Fig. 15 Checking Oil Pump Cover Flatness

(3) 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. 16).

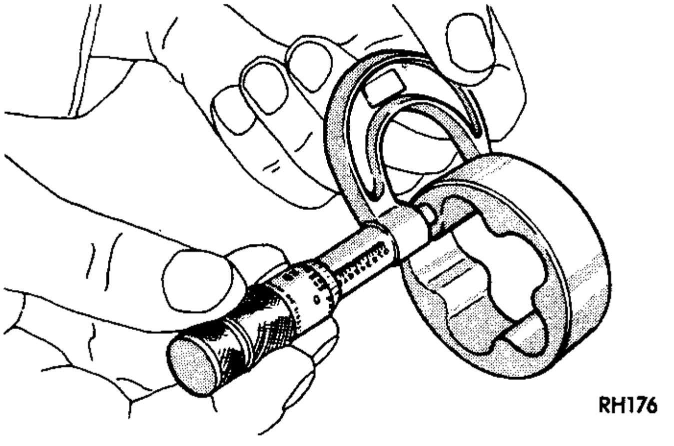


Fig. 16 Measuring Outer Rotor Thickness

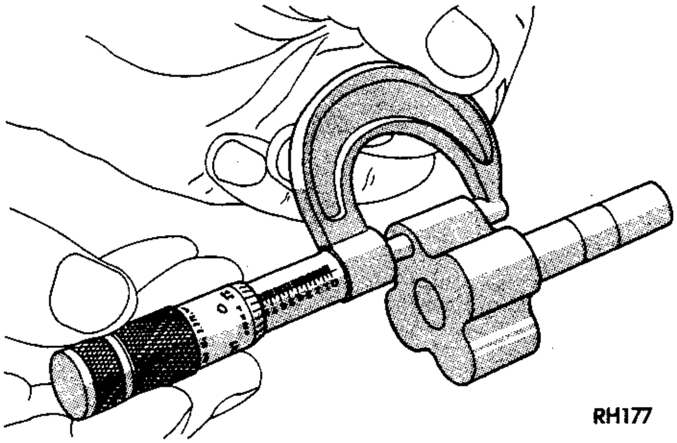


Fig. 17 Measuring Inner Rotor Thickness

(4) If inner rotor measures 20.9 mm (0.825 inch) or less, replace inner rotor and shaft assembly (Fig. 17).

(5) Slide outer rotor into pump body, press to one side with fingers and measure clearance between rotor and pump body (Fig. 18). If measurements is 0.356 mm (0.014 inch) or more, replace oil pump assembly.

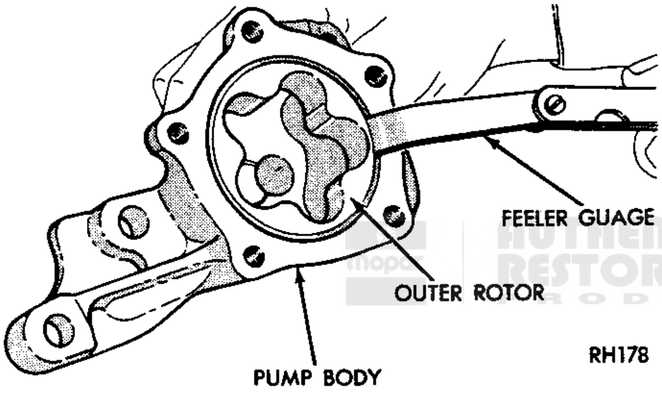


Fig. 18 Measuring Outer Rotor Clearance in Housing

(6) 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. 19).

(7) Place a straight edge 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 straight edge, replace pump assembly (Fig. 20).

(8) 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.

(9) The relief valve spring has a free length of approximately 49.5 mm (1.95 inches) and should test between 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inch). Replace spring that fails to meet specifications (Fig. 21).

(10) If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

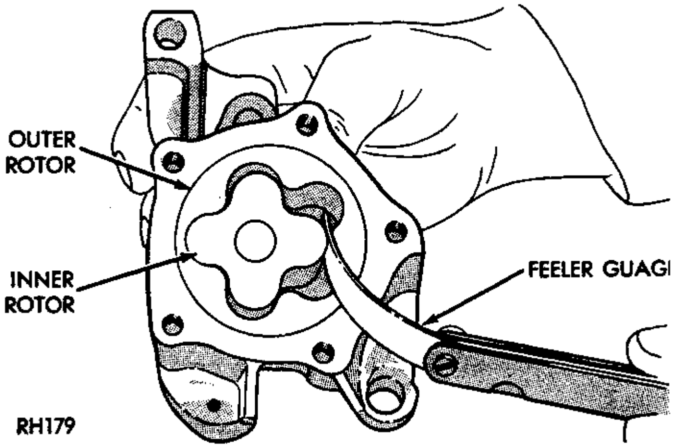


Fig. 19 Measuring Clearance Between Rotors

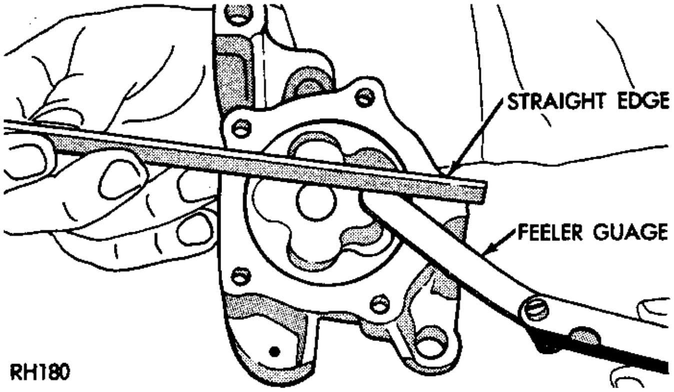


Fig. 20 Measuring Clearance Over Rotors

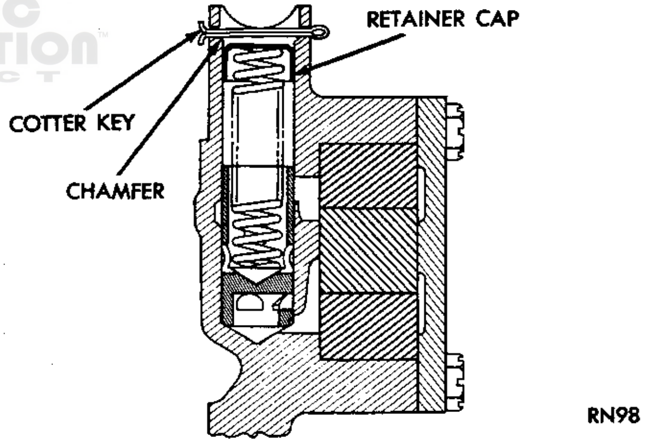


Fig. 21 Proper Installation of Retainer Cap

OIL PUMP ASSEMBLY AND INSTALLATION

(1) Assemble pump, using new parts as required.

(2) Tighten cover bolts to 11 N•m (95 in. lbs.) torque.

(3) Prime oil pump before installation by filling rotor cavity with engine oil.

(4) Install oil pump. During installation slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement. 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.

OIL LINE PLUG INSPECTION

The oil line plug is located in the vertical passage in the block between the Oil-To-Filter and Oil-From-Filter passages (Fig. 22). Erratic, low or no oil pressure could occur, if the plug is not installed correctly or is missing.

(1) Remove oil pressure sending unit from back of block.

(2) Insert a 3.175 mm (1/8 inch) finish wire or equivalent into passage.

(3) Plug should be 190.0 to 195.2 mm (7-1/2 to 7-11/16 inches) from machined surface of block, and 54.0 to 57.7 mm (2-1/8 to 2-5/16 inches) from bottom of the block (Fig. 22).

(4) If plug is too high, use a suitable flat dowel drift to position properly.

(5) If plug is off position. Remove oil pan and No. 4 main bearing cap. Use suitable flat dowel to remove plug.

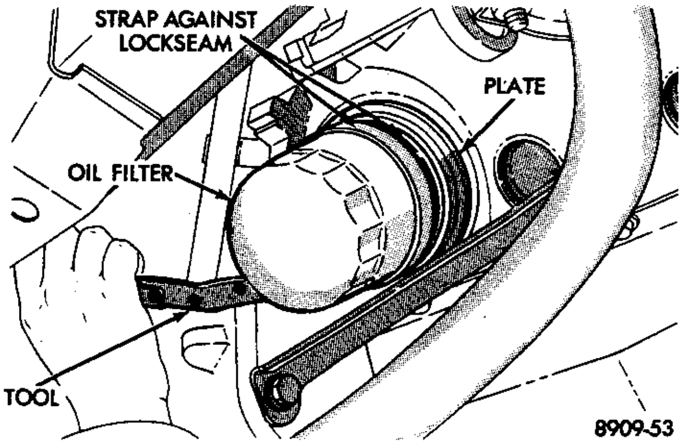


Fig. 23 Removing Oil Filter with Tool C-4065

(6) Use Stud N' Bearing mount adhesive on outside diameter of plug to ensure retention of position. Assemble engine and check oil pressure.

OIL FILTER

When servicing the oil filter, avoid deforming the filter CAN by installing the tool band strap

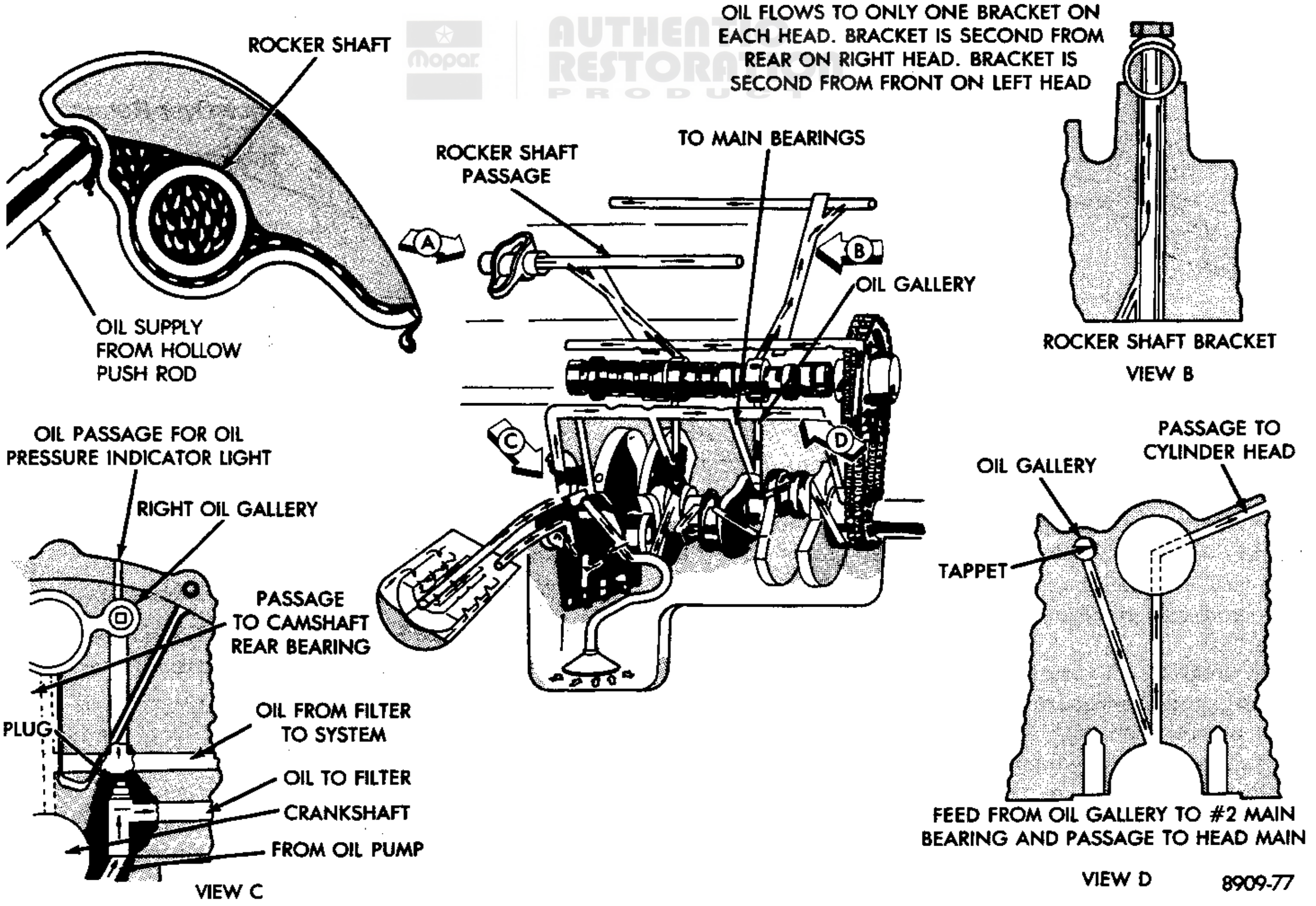


Fig. 22 Engine Lubrication System

against the can-to-base lock seam. The lock seam (joining the can to the base) is reinforced by the base plate.

(1) Using Tool C-4065, unscrew filter from base and discard (Fig. 23).

(2) Wipe base clean, then inspect gasket contact surface.

(3) Lubricate gasket of new filter with clean engine oil.

(4) Install and tighten filter to 20 N•m (15 ft. lbs.) torque, or 3/4 to 1 turns after gasket contacts base. Use filter wrench, if necessary.

(5) Start engine and check for leaks.

ENGINE SPECIFICATIONS—3.9L

Type	90°V
Number of Cylinders	6
Bore	3.91″
Stroke	3.31″
Piston Displacement	238 cu. in.—(3.9L)
Compression ratio	9.0 to 1
Minimum Compression Pressure See "Engine Performance" in Standard Service Procedures	100 psi
Maximum Variation between Cylinders (any one engine)	25 %
Firing Order	1-6-5-4-3-2
Basic Timing	Refer to Emission Control Information Label on Vehicle
CYLINDER NUMBER (front to rear)	
Left Bank	1-3-5
Right Bank	2-4-6
CYLINDER BLOCK	
Cylinder Bore (standard)	3.910″—3.912″
Cylinder Bore Out-of-Round (Maximum allowable before reconditioning)	.005″
Cylinder Bore Taper (Maximum allowable before reconditioning)	.010″
Reconditioning Working Limits (for taper and out-of-round)	.001″
Maximum Allowable Oversize (cylinder bore)	.040″
Tappet Bore Diameter	.9051″—.9059″
Distributor Lower Drive Shaft Bushing (press fit in block)	.0005″—.014″
Shaft to Bushing Clearance	.0007″—.0027″
PISTONS	
Type Material	Alloy Tin Coated
Land Clearance (Diametrical)	.019″—.024″
Clearance at Top of Skirt	.0005″—.0015″
Weight (Std. through .040″ oversize)	594.6 ±2 gms.
Piston Length (overall)	3.40″
Ring Groove Depth	
No. 1	.205″
No. 2	.205″
No. 3	.194″
Pistons for Service	Standard and .020″ Oversize
PISTON PINS	
Type	Press Fit in Rod
Diameter	.9841″—.9843″
Length	2.990″—3.020″
Clearance in Piston (Light Thumb Push @ 70° F.)	.0000″—.0005″
End Play	None
Clearance in Rod	.0007″—.0014″ (Interference)
Pins for Service	Standard .003″ and .008″ oversize

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ENGINE SPECIFICATIONS—3.9L (CONT.)

PISTON RINGS	
Number of Rings per Piston	3
Compression	2
Oil	1
Oil Ring Type	3-piece steel rail chrome-face
Ring Width	
Compression	.0770"—.0780"
Oil—Steel rails	.0252" Max
Ring Gap	
Compression	.010"—.020"
Oil—Steel rails	.015"—.055"
Ring Side Clearance	
Compression	.0015"—.0030"
Oil—Steel rails	.0002"—.005"
Service Rings	
Ring Gap	
Compression	.010"—.020"
Oil (Steel rails)	.010"—.062"
Ring Side Clearance	
Compression	.0015"—.004"
Oil (Steel rails)	.0002"—.005"
CONNECTING RODS	
Length (Center to Center)	6.121"
Weight (less bearing shells)	726 Grams
Side Clearance (two rods)	.006"—.014"
Piston Pin Bore Diameter	.9819"—.9834"
CONNECTING ROD BEARINGS	
Type	Tri-Metal
Diameter and Width	2.126" × .842"
Clearance Desired	.0005"—.0022"
Maximum Allowable	.0022"
Bearings for Service	Std., .001", .002", .010", .012"
CRANKSHAFT	
Type	Counter-Balanced
Bearings	Aluminum Lead
Thrust Taken By	No. 2 Main Bearing
End Play	.002"—.007"
Maximum Allowable	.010"
Diametral Clearance Desired #1	.0005"—.0015"
Maximum Diametral Clearance Allowed #1	.0015"
Diametral Clearance Desired #2, 3, and 4	.0005"—.0020"
Diametral Clearance Allowed #2, 3, and 4	.0025"
Finish at Rear Oil Seal Surface	Diagonal Knurling
MAIN BEARING JOURNALS	
Diameter	2.4995"—2.5005"
Maximum Allowable Out-of-Round and/or Taper	.001"
Bearings for Service Available in Standard and the following undersizes	.001", .002", .003", .010", .012"
CONNECTING ROD JOURNALS	
Diameter	2.124"—2.125"
Maximum Allowable Out-of-Round and/or Taper	.001"

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ENGINE SPECIFICATIONS—3.9L (CONT.)

CAMSHAFT	
Drive	Chain
Bearings	Steel Backed Babbitt
Number	4
Diametral Clearance	.001"—.003"
Maximum Allowable before Reconditioning	.005"
Thrust Taken By	Thrust Plate
End Play	.002"—.010"
Maximum Allowable	.010"
CAMSHAFT JOURNALS	
Diameter	
No. 1	1.998"—1.999"
No. 2	1.967"—1.968"
No. 3	1.951"—1.952"
No. 4	1.5605"—1.5615"
CAMSHAFT BEARINGS	
Diameter	
No. 1	2.000"—2.001"
No. 2	1.984"—1.985"
No. 3	1.953"—1.954"
No. 4	1.5625"—1.5635"
VALVE TIMING	
Intake Opens (BTC)	10°
Intake Closes (ABC)	50°
Exhaust Opens (BBC)	52°
Exhaust Closes (ATC)	16°
Valve Overlap	26°
Intake Valve Duration	240°
Exhaust Valve Duration	248°
TIMING CHAIN	
Number of Links	68
Pitch	.375"
Width	.875"
TAPPETS	
Type	Hydraulic Roller
Body Diameter	.9035"—.9040"
Clearance in Block	.0011"—.0024"
Service Tappets Available	Std., .001", .008", .030"
Dry Lash	.060"—.210"
CYLINDER HEAD	
Valve Seat Run-Out (Maximum)	.003"
Intake Valve Seat Angle	45°—45-1/2°
Seat Width (finish)	.065"—.085"
Exhaust Valve Seat Angle	45°—45-1/2°
Seat Width (finish)	.080"—.100"
Cylinder Head Gasket (Thickness compressed)	.033"
VALVE GUIDES	
Type	Cast in Head
Guide Bore Diameter	.374"—.375" Std.
VALVES—(INTAKE)	
Head Diameter	1.780"
Length (overall)	4.962"—4.987"
Stem Diameter (Standard)	.372"—.373"
Stem to Guide Clearance	.001"—.003"
Maximum Allowable by rocking method	.017"
Face Angle	44-1/2°—45°
Valve for Service (oversize stem diam.)	Std., .005", .015", .030 "
Lift (Zero lash)	.373"

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ENGINE SPECIFICATIONS—3.9L (CONT.)

VALVES—(EXHAUST)	
Head Diameter	1.517″
Length overall Without Rotators	4.969″—5.005″
Length overall With Rotators	4.977″—5.012″
Stem Diameter (Standard)	.371—.372″
Stem to Guide Clearance	.002″—.004″
Maximum Allowable by rocking method	.017″
Face Angle	44-1/2°—45°
Valves for Service (oversize stem diam.)	Std., .005″, .015″, .030″
Lift (Zero Lash)	.400″

ENGINE VALVE SPRINGS

LOCATION/IDENTIFICATION	Intake	Exhaust (With Rotator)
Number	6	6
Color	Blue	White
Free Length (Approx.)	2.00″	1.81″
Wire Diameter	.192″	.185″
Number of coils	6.4	5.8
Load when compressed to (valve closed)	78-88 lbs. @ 1-11/16″	80-90 lbs. @ 1-13/64″
Load when compressed to (valve open)	170-184 lbs. @ 1-5/16″	180-194 lbs. @ 1-1/16″
Maximum allowable out of plumb	1/16″	1/16″
Valve spring installed height (spring seat to retainer)	1-5/8″—1-11/16″	1-29/64″—1-33/64″
Use 1/16″ spacer to reduce spacing height when over specifications		

ENGINE LUBRICATION	
Pump Type	Rotary, Full Pressure
Capacity (qts.) U.S.	4 (with or without Oil Filter)
Pump Drive	Camshaft
Minimum Pressure, Engine Fully warmed up	
*Curb Idle	6 psi
3000 RPM	30 to 80 psi
Oil Filter Bypass Valve Setting	9 to 15 psi
Oil Pressure Switch Minimum Actuating Pressure	5 to 7 psi
Oil Filter Type	Full Flow

*If pressure is "0" at curb idle, do not run engine at 3000 RPM.

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OIL PUMP INSPECTION LIMITS FOR REPLACEMENT—3.9L

Oil Pump Cover Out Of Flat	.0015 inch or more
Outer Rotor Thickness	.825 inch or less
Outer Rotor Diameter	2.469 inch or less
Inner Rotor Thickness	.825 inch or less
Clearance Over Rotors—Outer	.004 inch or more
Inner	.004 inch or more
Outer Rotor Clearance	.014 inch or more
Tip Clearance Between Rotors	.008 inch or more

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OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS—3.9L

Condition	Identification	Location of Identification
.001" U/S Crankshaft	R or M M-2-3 etc. (Indicating No. 2 & 3 main bearing journal) and/or R-1-4 etc. (Indicating No. 1 & 4 connecting rod journal)	Steel stamped (near notch) on number six crankshaft counterweight
.010" U/S Crankshaft	RX or MX MX (Indicates .010" U/S all main journals) and/or RX (Indicating .010" U/S all rod journals)	Steel stamped (near notch) on number six crankshaft counterweight
.020" O/S Cylinder Bores	A	Following engine serial number
.008" O/S Tappets	◆	3/8" diamond shaped stamp Top pad—Front of engine and flat ground on outside surface of each O/S tappet bore.
.005" O/S Valve Stems	X	Milled pad adjacent to two 3/8" tapped holes on each end of cylinder head.

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TORQUE SPECIFICATIONS—3.9L

	Thread Size	*Torque Foot-Pounds	*Newton Metres
Alternating Adjusting Strap Bolt	5/16"—18	200 in.-lbs.	(23)
Alternator Adjusting Strap Mounting Bolt	3/8"—16	30	(41)
Alternator Bracket Bolt	3/8"—16	30	(41)
Alternator Mounting Pivot Nut	3/8"—16	30	(41)
Camshaft Sprocket Lockbolt	7/16"—14	50	(68)
Camshaft Thrust Plate	5/16"—18	210 in.-lbs.	(24)
Chain Case Cover Bolt	3/8"—16	35	(47)
Clutch Housing Bolt	3/8"—16	30	(41)
	7/16"—14	50	(68)
Connecting Rod Nut	3/8"—24	45	(61)
Crankshaft Bolt (Vibration Damper)	3/4"—16	135	(181)
Cylinder Head Bolt	1/2"—13	105	(143)
Cylinder Head Covers—Nut	1/4"—20	80 in.-lbs.	(9)
Stud	1/4"—20	115 in.-lbs.	(13)
Distributor Clamp Bolt	5/16"—18	200 in.-lbs.	(23)
Engine Front Mount Insulator to Frame Bracket (4 × 2)		50	(68)
Engine Front Mount Insulator to Engine Adaptor (4 × 2)		30	(41)
Engine Rear Mount Insulator to Crossmember (4 × 2)		30	(41)
Engine Rear Mount Insulator to Extension Bracket		75	(102)
Engine Rear Mount Bracket to Extension (4 × 2)		50	(68)
Exhaust Manifold Screw	5/16"—18	20	(27)
Nut	5/16"—24	15	(20)
Exhaust Pipe Flange Nut	7/16"—14	24	(33)
Fan Blade Attaching Bolts	5/16"—18	200 in.-lbs.	(23)
Flex Plate to Converter	5/16"—24	270 in.-lbs.	(31)
Flex Plate to Crankshaft	7/16"—20	55	(75)
Flywheel to Crankshaft	7/16"—20	55	(75)
Intake Manifold Bolt	3/8"—16	45	(61)
Main Bearing Cap Bolt	1/2"—13	85	(115)
Oil Pan Drain Plug	1/2"—20	20	(27)
Oil Pan Screw	5/16"—18	200 in.-lbs.	(23)
Oil Pump Cover Bolt	1/4"—20	95 in.-lbs.	(11)
Oil Pump Attaching Bolt	3/8"—16	30	(41)
Oil Filter Attaching Stud	3/4"—16	50	(61)
Oil Pressure Gauge Sending Unit	1/8" NPTF	60in.-lbs.	(7)
Rocker Shaft Bracket Bolt	5/16"—18	200 in.-lbs.	(23)
Spark Plug	14mm	30	(41)
Starter Mounting Bolt	7/16"—14	50	(68)
Temperature Gauge Sending Unit	1/8" NPTF	60 in.-lbs.	(7)
Vibration Damper Screw to Crankshaft	3/4"—16	100	(136)
Water Pump to (Chain Case Cover) Bolt	3/8"—16	30	(41)
A/C Compressor Bracket to Water Pump Bolt	3/8"—16	30	(41)
A/C Compressor to Bracket Nut	7/16"—14	50	(68)
A/C Compressor Support Bolts	3/8"—16	30	(41)

*All Critical Fastners should be clean and lightly oiled.

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5.2L/5.9L ENGINE SERVICE PROCEDURES

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ENGINE FRONT MOUNTS

REMOVAL

(1) Raise hood and position fan to assure clearance for radiator top tank and hose.

(2) Install engine lifting fixture Tool C-3487-A, with adapter rods DD-2179.

(3) Raise vehicle on hoist.

(4) Remove nuts from brackets and insulators (Fig. 1).

(5) Raise engine with lifting fixture only far enough to remove insulators.

INSTALLATION

(1) With engine raised slightly, install insulators and brackets.

(2) Lower engine with lifting fixture while guiding insulator studs into attaching holes in crossmember and brackets.

(3) Tighten attaching nuts and bolts to specified torques (Fig. 1).

(4) Lower the vehicle.

(5) Remove lifting fixture.

ENGINE REAR SUPPORT—2-WD

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position a transmission jack under the transmission and raise rear of transmission and engine SLIGHTLY.

(3) Remove rear mount through-bolt from frame crossmember or bracket (Fig. 2).

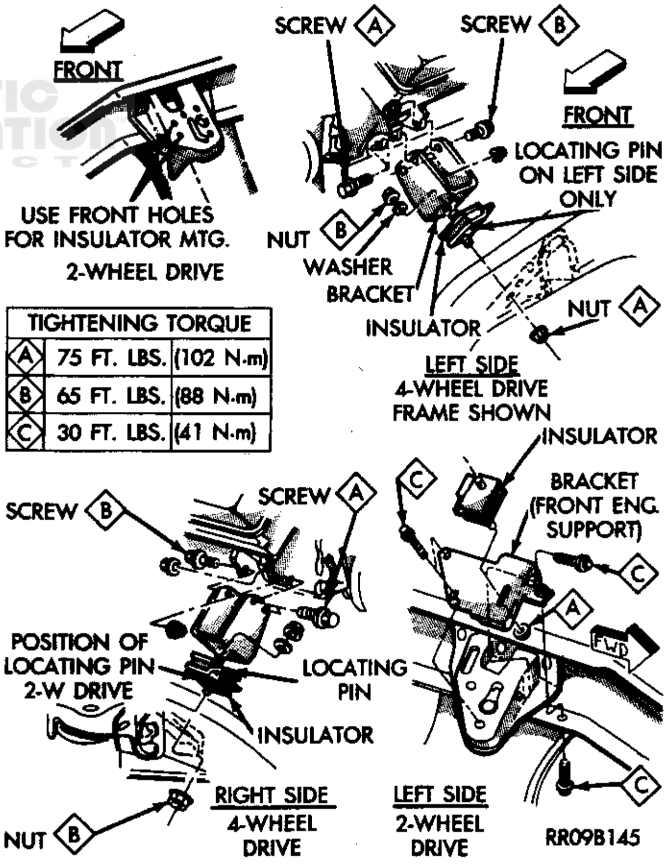


Fig. 1 Engine Front Mounts

(4) Remove insulator from bottom face of transmission extension housing (sport utility) or from the crossmember bracket (Fig. 2).

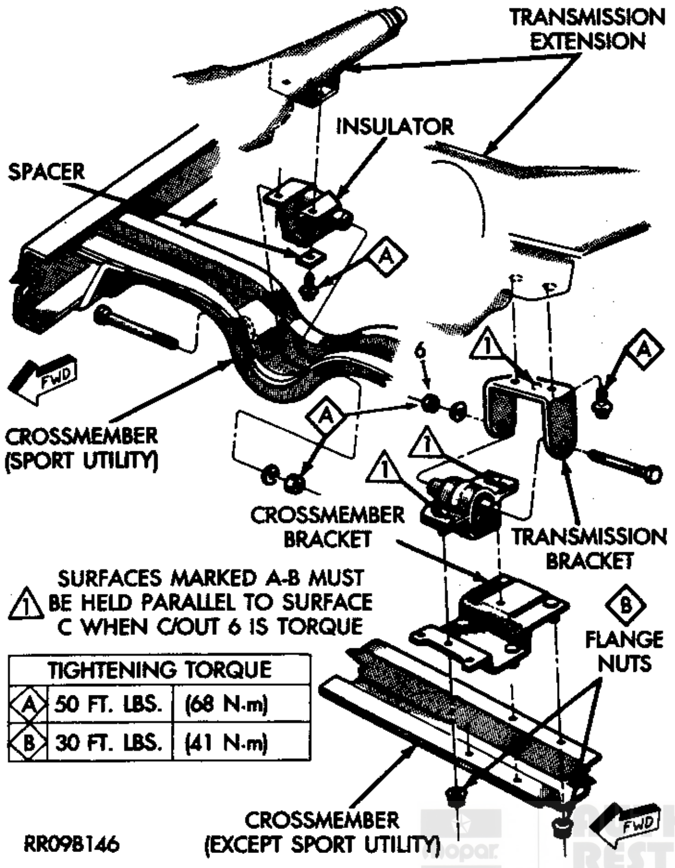


Fig. 2 Engine Supports—Rear

INSTALLATION

(1) Install insulator on transmission extension housing. Tighten the bolts to 68 N•m (50 ft. lbs.) torque.

(2) Install through-bolt through crossmember and mount (sport utility) or through bracket and mount (Fig. 2). Tighten these bolts to 68 N•m (50 ft. lbs.) torque.

(3) Remove the transmission jack.

(4) Lower the vehicle.

ENGINE REAR MOUNTS—4-WD

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Remove the skid plate (if equipped) from the rear crossmember and transmission crossmember (Fig. 3).

(3) Position transmission jack under transmission and raise rear of transmission and engine SLIGHTLY.

(4) Remove mounting bolts and insulators (Fig. 4).

INSTALLATION

(1) Install insulators and mounting bolts (Fig. 4).

(2) Install the skid plate (Fig. 3).

(3) Lower the vehicle.

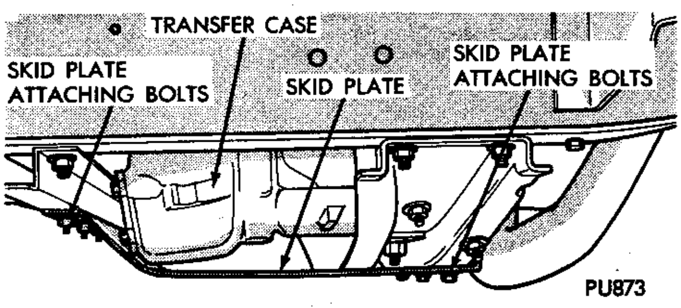


Fig. 3 Skid Plate

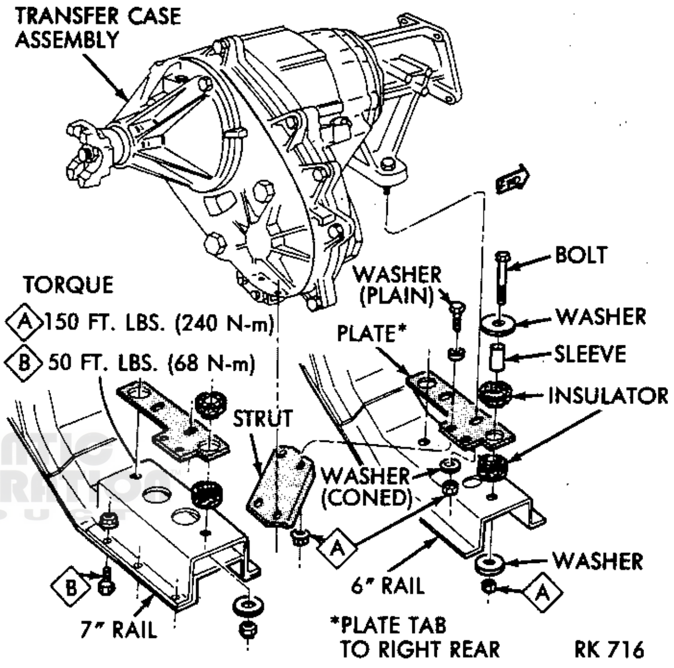


Fig. 4 Engine Mounts—Rear

ENGINE ASSEMBLY

CHECKING OPERATION OF EXHAUST VALVE ROTATORS

Before an engine is disassembled for valve grinding or major repair work, the performance of the exhaust valve rotators should be checked.

(1) With engine in the vehicle, remove cylinder head covers.

(2) Observe exhaust valve rotation with the engine running at 2000 and 3000 RPM. The valve should rotate at uniform and constant speeds, (direction of rotation is not important). There is generally a large difference in rotation speeds between 1000 and 3000 RPM.

(3) Rotators which do not appear to function properly should be replaced.

REMOVAL

(1) Scribe hood hinge outlines on hood and remove the hood.

(2) Remove the battery.

(3) Drain cooling system.

(4) Remove the air cleaner.

(5) Remove radiator and heater hoses. Remove the radiator (see Group 7, Cooling System for the proper procedure).

(6) Set fan shroud aside.

(7) Discharge the air conditioner, if equipped (refer to Group 24, Heating and Air Conditioning for service procedures).

(8) Remove air conditioning hoses

(9) Remove the vacuum lines.

(10) Remove the distributor cap and wiring.

(11) Remove the throttle body, fuel lines and linkage.

(12) Remove the starter wires and oil pressure wire.

(13) Disconnect the power steering hoses, if equipped.

(14) Remove starter motor, alternator, charcoal canister and horns.

(15) Raise and support the vehicle on a hoist.

(16) Disconnect exhaust pipe at manifold.

(17) **Manual Transmission**

See Group 21, Transmissions for the Manual Transmission Removal procedure.

(18) **Automatic Transmission**

(a) Remove bell housing bolts and inspection plate.

(b) Attach a C clamp on front bottom of transmission torque converter housing to prevent torque converter from coming out.

(c) Remove torque converter drive plate bolts. Mark converter and drive plate to aid in assembly.

(d) Support the transmission.

(e) Lower the vehicle.

(19) Install engine lifting fixture. Attach a chain hoist to fixture eyebolt.

(20) Remove engine front mount bolts (Fig. 1).

(21) Remove engine from engine compartment and install on engine repair stand.

(22) Disconnect the torque converter drive plate from the engine crankshaft.

INSTALLATION

(1) Position the torque converter drive plate onto the crankshaft. Tighten the bolts to 75 N•m (55 ft. lbs.) torque.

(2) Remove engine from the repair stand and position it into the engine compartment.

(3) Install the engine front mount bolts. Tighten the bolts to 41 N•m (30 ft. lbs.) torque.

(4) Remove engine lifting fixture.

(5) **Manual Transmission**

See Group 21, Transmissions for the Manual Transmission Installation procedure.

(6) **Automatic Transmission**

(a) Raise and support the vehicle.

(b) Align the torque converter plate to the torque converter. Install and tighten the bolts to 31 N•m (270 in. lbs.) torque.

(c) Install bell housing bolts. Tighten the bell housing bolts to 41 N•m (30 ft. lbs.) torque.

(d) Remove the C clamp.

(e) Install the inspection plate.

(f) Remove the transmission support.

(7) Position the exhaust pipe to the manifold. Tighten the nuts to 33 N•m (24 ft. lbs.) torque.

(8) Lower the vehicle.

(9) Install the starter motor, alternator, charcoal canister and horns.

(10) Remove the starter wires and oil pressure wire.

(11) Install throttle body, fuel lines and linkage.

(12) Connect the vacuum lines.

(13) Install the distributor cap and wiring.

(14) Install the radiator (see Group 7, Cooling Systems). Connect the radiator hoses and heater hoses.

(15) Install fan shroud in position.

(16) Fill the cooling system (see Group 7, Cooling System for the proper procedures).

(17) Install the battery.

(18) Attach the air cleaner to the throttle body.

(19) Connect the power steering hoses, if so equipped.

(20) Install air conditioning equipment and charge air conditioning. Refer to Group 24, Heating and Air Conditioning for proper service.

(21) Warm engine and adjust.

(22) Install hood and line up with the scribe marks.

(23) Road test vehicle.

ROCKER ARMS AND SHAFT ASSEMBLY

REMOVAL

(1) Disconnect spark plug wires by pulling on the boot straight out in line with plug.

(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover.

(3) Remove cylinder head cover and gasket.

(4) Remove five rocker shaft bolts and retainers.

(5) Remove rocker arms and shaft assembly.

(6) If rocker arm assemblies are disassembled for cleaning or replacement, refer to (Fig. 1) for rocker arm identification, and (Fig. 2) for positioning on the shaft.

(7) On engines with exhaust valve rotators, exhaust rocker arm must have relief for clearance (Fig. 1).

INSTALLATION

(1) Install rocker arm and shaft assemblies with NOTCH on end of rocker shaft pointing to center line of engine and toward front of engine on the left bank and to the rear on right bank, making sure to install

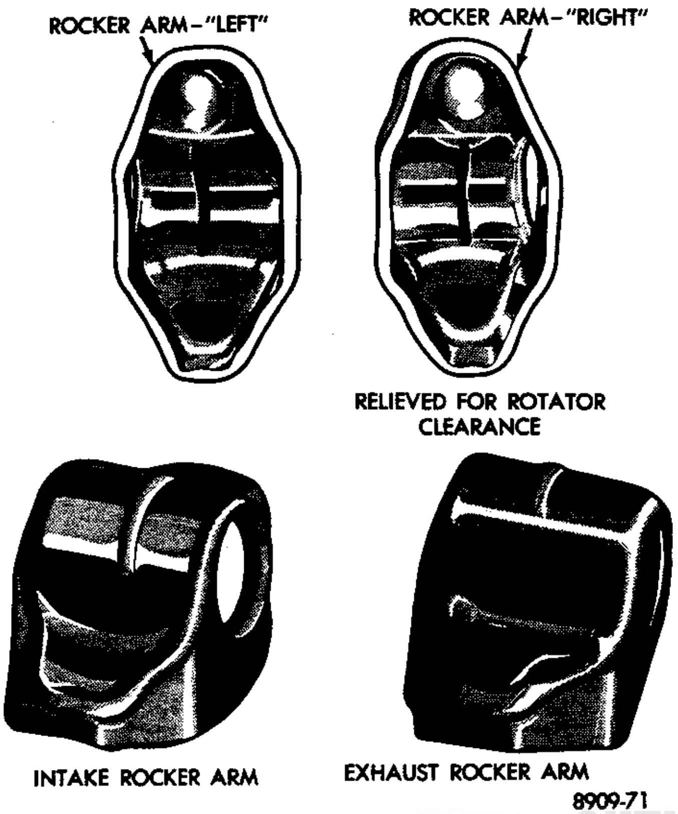


Fig. 1 Intake and Exhaust Rocker Arm Identification

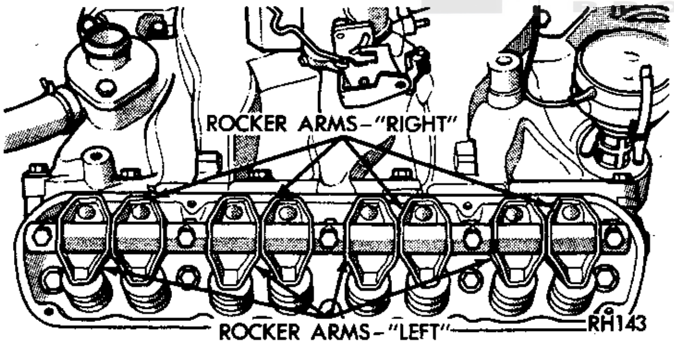


Fig. 2 Proper Rocker Arm Location on Shaft

the long stamped steel retainers in the number two and four positions, tighten to 23 N•m (200 in. lbs.) torque (Fig. 2).

CAUTION: The rocker arm shaft should be torqued down slowly, starting with the centermost bolts. Allow 20 minutes tappet bleed down time after installation of the rocker shafts before engine operation.

(2) Clean cylinder head cover gasket surface. Inspect cover for distortion and straighten if necessary.

(3) Clean head rail if necessary. Install cylinder head cover and tighten to 11 N•m (95 in. lbs.) torque.

(4) Whenever the cylinder head cover gasket flange has been reworked, it may be necessary to install load spreader washers.

(5) Make sure that the load spreader washers are so positioned that they will fit free when the cover attaching bolts are tightened as specified.

(6) If any interference is noticed between the load-spreader washer and the cover, remove bolt and washer. Position the washer to eliminate the interference. Install bolt and tighten as specified.

(7) Install closed crankcase ventilation system and evaporation control system.

CYLINDER HEADS

The alloy cast iron cylinder heads shown in (Fig. 3) are held in place by 10 bolts. The spark plugs are located in peak of the wedge between the valves.

REMOVAL

(1) Drain cooling system and disconnect battery ground cable.

(2) Remove alternator, air cleaner and fuel line.

(3) Disconnect accelerator linkage.

(4) Remove vacuum control hose from throttle body.

(5) Remove distributor cap and wires.

(6) Disconnect coil wires, heat indicator sending unit wire, heater hoses and bypass hose.

(7) Remove closed ventilation system, evaporation control system and cylinder head covers.

(8) Remove intake manifold, ignition coil and throttle body as an assembly.

(9) Remove exhaust manifolds.

(10) Remove rocker arm and shaft assemblies. Remove push rods and identify to insure installation in original locations.

(11) Remove the 10 head bolts from each cylinder head and remove cylinder heads.

(12) Place cylinder heads in holding fixture Tool C-3626. Remove spark plugs.

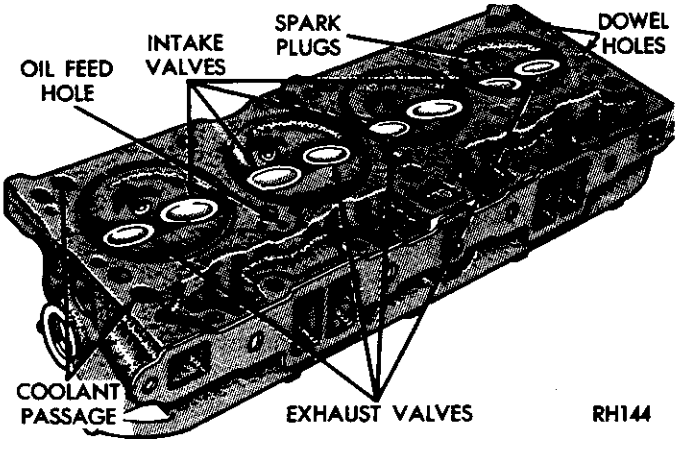


Fig. 3 Cylinder Head Assembly (Typical)

INSTALLATION

(1) Clean all surfaces of cylinder block and cylinder heads.

(2) Inspect all surfaces with a straightedge if there

is any reason to suspect leakage. If out of flatness exceeds 0.00075 mm/mm (0.00075 inch/inch) times the span length in inches in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE—If a 305 mm (12 inch) span is 0.102 mm (0.004 inch) out of flat, allowable is 305 X 0.00075 (12 X 0.00075) equals 0.23 mm (0.009 inch). This amount of out of flat is acceptable.

(3) The cylinder head surface finish should be 1.78-4.57 microns (70-180 microinches).

(4) Install new gaskets on cylinder block.

(5) Remove cylinder heads from holding fixtures and place heads on engine.

(6) Thread sealer is not required. Starting at top center, tighten all cylinder head bolts to 68 N•m (50 ft. lbs.) torque in sequence (Fig. 4). 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.

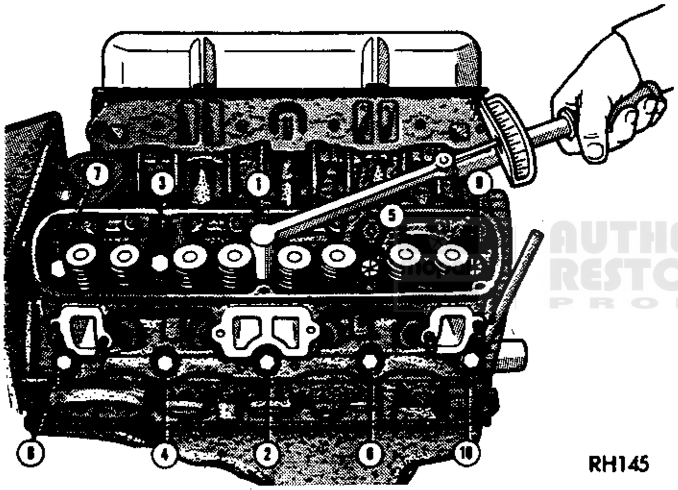


Fig. 4 Cylinder Head Bolt Tightening Sequence

(7) Inspect push rods and replace worn or bent rods.

(8) Install push rods, rocker arm and shaft assemblies with the NOTCH on the end of rocker shaft pointing to centerline of engine and toward front (left bank) and to the rear (right bank). The notch is always to left as facing cylinder head. Make sure to install the long stamped steel retainers in the number two and four positions. Tighten the bolts to 23 N•m (200 in. lbs.) torque.

(9) Coat intake manifold side gaskets lightly with sealer. RIGHT and LEFT side gaskets are required. Cutouts at top front of each gasket (LT for left side and RT for right side) identifies each gasket position (Fig. 5).

(10) Install side gaskets to cylinder head.

(11) Clean cylinder block front and rear gasket surfaces using a suitable solvent (Fig. 6).

(12) Apply a thin, uniform coating of a quick dry cement to the intake manifold front and rear gaskets and cylinder block gasket surface. When installing gaskets, the center hole in the gasket MUST engage dowels in block. End holes in seals MUST be locked into tangs of head gasket (Fig. 6). Allow to dry 4 to 5 minutes or until tack free.

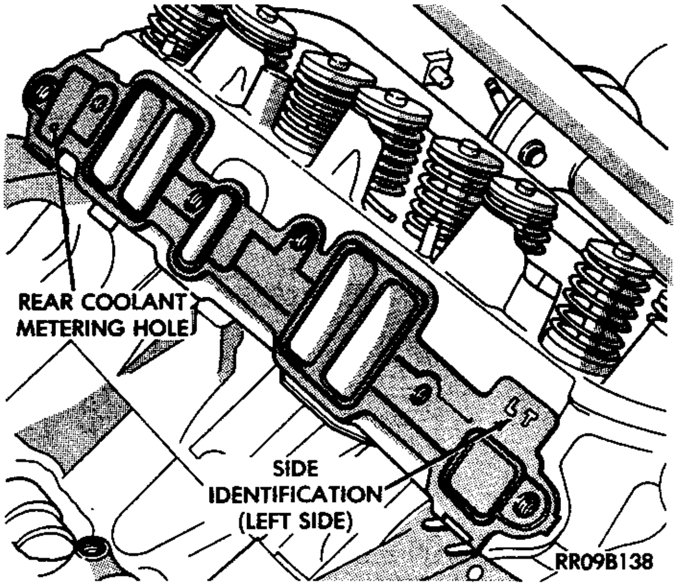


Fig. 5 Engine Intake Manifold Side Gaskets (Left Side Shown)—5.2L

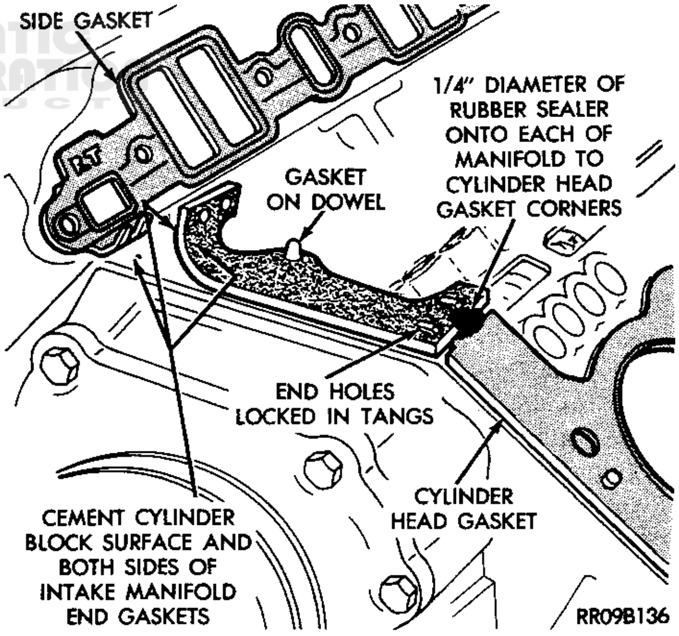


Fig. 6 Intake Manifold Sealing

(13) Carefully install the front and rear intake manifold gaskets.

(14) Place drop (approximately 1/4″ diameter) of rubber sealer RTV onto each of the four manifold to cylinder head gasket corners.

(15) 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.

(16) Install the twelve attaching bolts Finger Tight. Tighten the bolts to 34 N•m (25 ft. lbs.) torque in the tightening sequence shown in (Fig. 7). Tighten the same bolts to 54 N•m (40 ft. lbs.) in sequence shown (Fig. 7). Check that all bolts are at 54 N•m (40 ft. lbs.) torque.

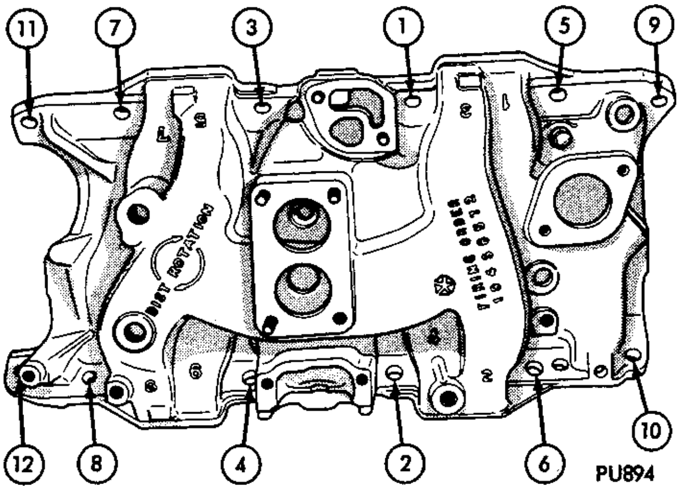


Fig. 7 Intake Manifold Screw Tightening Sequence

(17) Install exhaust manifolds and tighten bolts to 27 N•m (20 ft. lbs.) torque and tighten the nuts to 20 N•m (15 ft. lbs.) torque.

(18) Adjust spark plugs to specifications (see Group 8D, Ignition System). Install the plugs and tighten to 41 N•m (30 ft. lbs.) torque.

(19) Install coil wires, heat indicator sending unit wire, heater hoses and bypass hose.

(20) Install vacuum control hose to the throttle body.

(21) Install throttle linkage and adjust, as necessary.

(22) Install distributor cap and wires.

(23) Install fuel lines, alternator and drive belt. Tighten alternator mounting bolt to 41 N•m (30 ft. lbs.) torque and adjusting strap bolt to 23 N•m (200 in. lbs.) torque (see Group 7, Cooling Section on adjusting belt tension).

(24) Place new cylinder head cover gaskets in position and install cylinder head covers. Tighten to 11 N•m (95 in. lbs.) torque using load spreader fasteners.

(25) Install closed crankcase ventilation system and evaporation control system.

(26) Fill cooling system.

(27) Install battery ground cable.

VALVES AND VALVE SPRINGS

The valves are arranged in line in the cylinder heads and inclined 18 degrees. The rocker shaft support and the valve guides are cast integral with the heads.

REMOVAL

(1) With cylinder head removed, compress valve springs using Tool C-3422-A (Fig. 8).

(2) Remove valve retaining locks, valve spring retainers, valve stem cup 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 insure installation in original location.

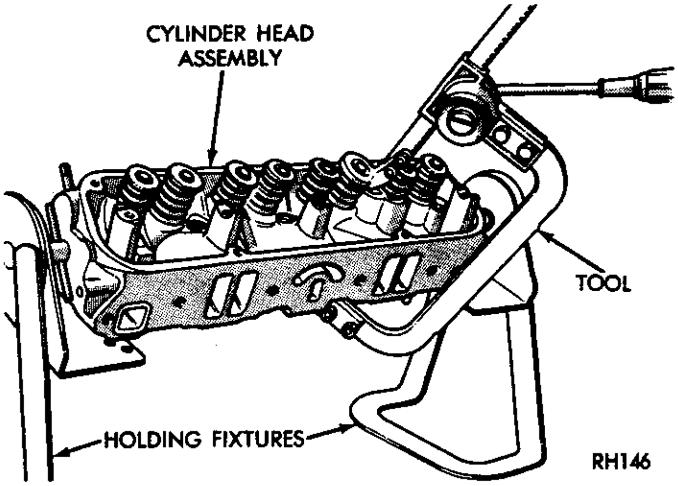
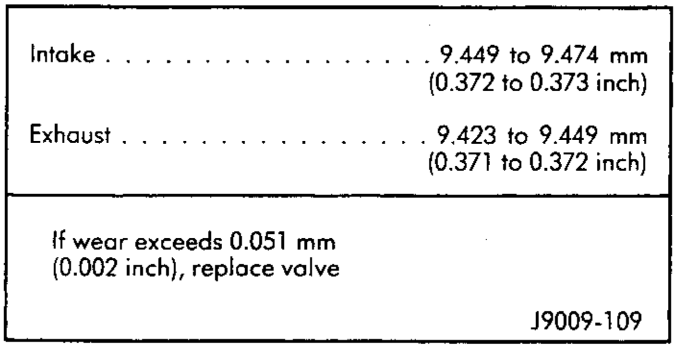


Fig. 8 Compressing Valve Springs with Tool C-3422A

VALVE INSPECTION

Clean valves thoroughly and discard burned, warped and cracked valves.

Measure valve stems for wear. New stem diameters should measure (Fig. 9):



Intake	9.449 to 9.474 mm (0.372 to 0.373 inch)
Exhaust	9.423 to 9.449 mm (0.371 to 0.372 inch)

If wear exceeds 0.051 mm
(0.002 inch), replace valve

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Fig. 9 Valve Stem Diameters

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

Measure valve stem guide clearance as follows:

(a) Install sleeve Tool C-3973 over valve stem (Fig. 10) and install valve. The special sleeve places the valve at the correct height for checking with a dial indicator.

(b) Attach dial indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 11).

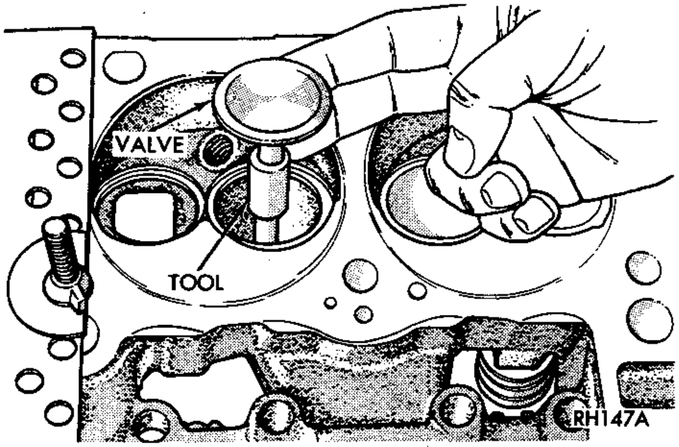


Fig. 10 Positioning Valve with Tool C-3973

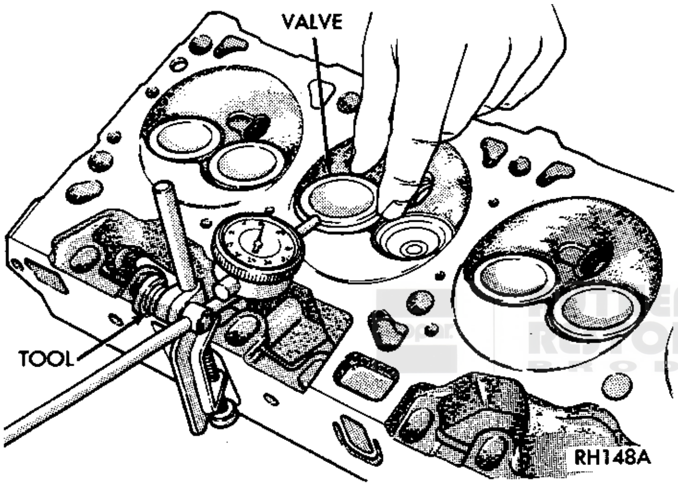
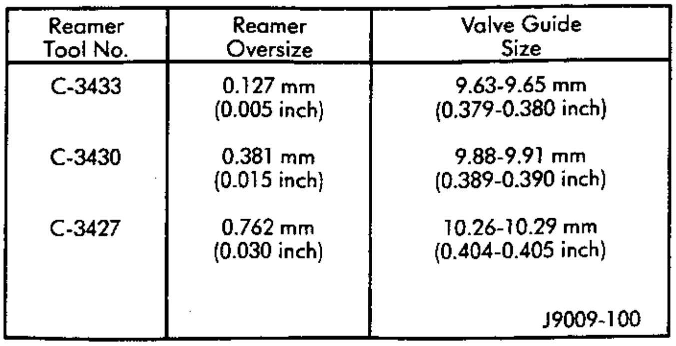


Fig. 11 Measuring Valve Guide Wear

(c) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 inch). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

Service valves with oversize stems are available in 0.127 mm (0.005 inch), 0.381 mm (0.015 inch) and 0.762 mm (0.030 inch) inch oversize. Reamers to accommodate the oversize valve stem are as follows (Fig. 12):



Reamer Tool No.	Reamer Oversize	Valve Guide Size
C-3433	0.127 mm (0.005 inch)	9.63-9.65 mm (0.379-0.380 inch)
C-3430	0.381 mm (0.015 inch)	9.88-9.91 mm (0.389-0.390 inch)
C-3427	0.762 mm (0.030 inch)	10.26-10.29 mm (0.404-0.405 inch)

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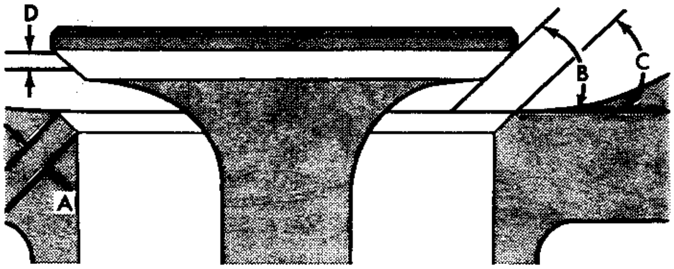
Fig. 12 Reamer Sizes

Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **DO NOT attempt to ream the valve guides from standard directly to 0.762 mm (0.030 inch). Use step procedure of 0.127 mm, 0.381 mm and 0.762 mm (0.005 inch, 0.015 inch and 0.030 inch) so the valve guides may be reamed true in relation to the valve seat.**

REFACING VALVES AND VALVE SEATS

The intake and exhaust valve seats and valve faces have a 45° angle. The valve face and valve seat angles are shown in (Fig. 13).



A-SEAT WIDTH (INTAKE 1/16 (1.587 mm) TO 3/32 (2.381 mm) INCH
EXHAUST: (.080-.100 INCH) – (2-2.5 mm)
B-FACE ANGLE (INTAKE & EXHAUST: 44½°-45°)
C-SEAT ANGLE (INTAKE & EXHAUST: 45°-45½°)
D-CONTACT SURFACE

PU605

Fig. 13 Valve Face and Seat Angles

VALVES

Inspect the remaining margin after the valves are refaced. Valves with less than 1.190 mm (3/64 inch) margin should be discarded (Fig. 14).

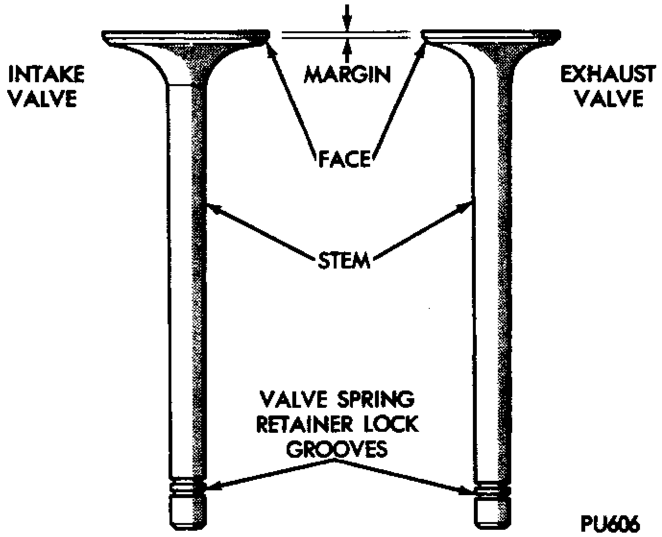


Fig. 14 Intake and Exhaust Valves (Typical)

VALVE SEATS

CAUTION: The 5.2L engine cylinder head combustion chambers have been modified by valve shrouding. DO NOT UNSHROUD VALVES DURING VALVE SEAT REFACING (Fig. 15).

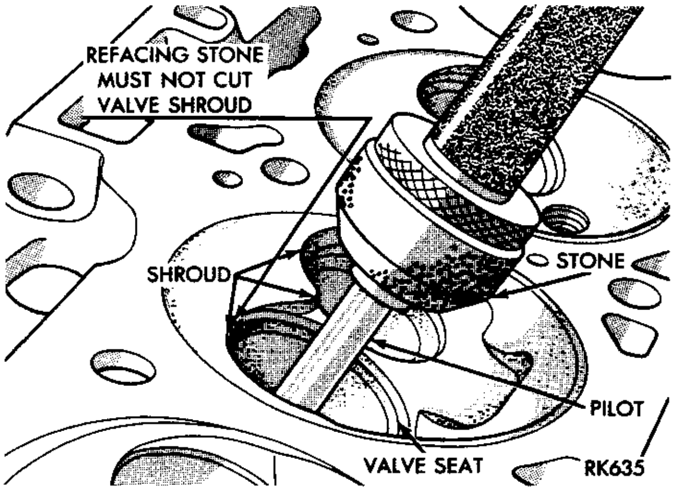


Fig. 15 Refacing 5.2L Engine Valve Seats

(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 dial indicator No. 13725. Total runout should not exceed 0.051 mm (0.002 inch) (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 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 1.587 to 2.381 mm (1/16 to 3/32 inches). The width of the exhaust seats should be 2.0 to 2.5 mm (5/64 to 3/32 inches).

TESTING VALVE SPRINGS

(1) 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 inches. Turn table of Tool C-647 (Fig. 16) until surface is in line with the 1-5/16 inch mark on the threaded stud and the zero mark to the front. 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 two. 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.

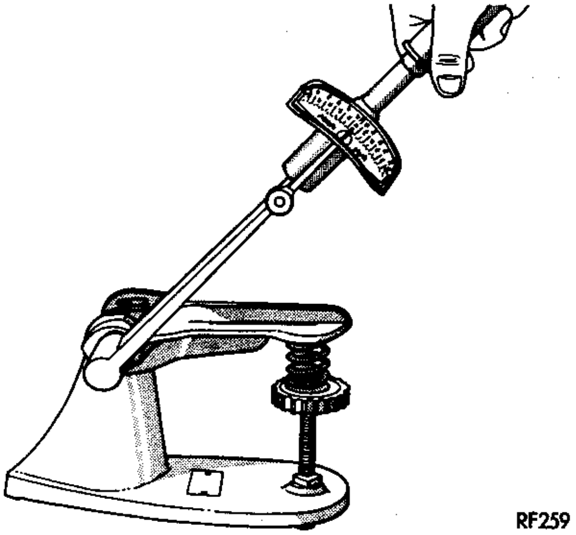


Fig. 16 Testing Valve Spring with Tool C-647

(2) Inspect each valve spring for squareness with a steel square and surface plate, test springs from both ends (Fig. 17).

(3) If the spring is more than 1.984 mm (5/16 inch) out of square, install a new spring.

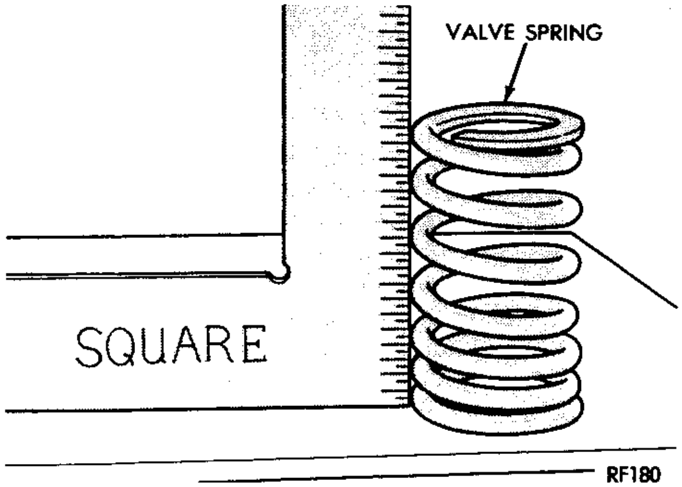


Fig. 17 Checking Valve Spring for Squareness

INSTALLATION

Installing the wrong exhaust valve spring in engines with positive rotors can cause severe engine damage. Refer to specifications for proper identification.

(1) Coat valve stems with lubrication oil and insert them in cylinder head.

(2) If valves or seats are reground, check valve stem height with Tool C-3968 (Fig. 18). If valve is

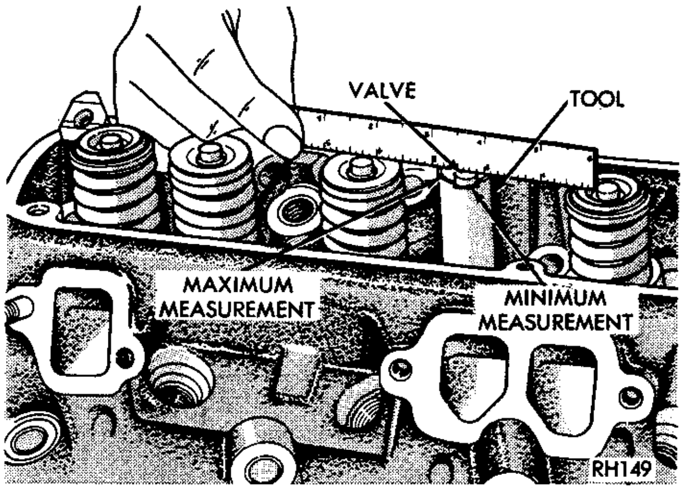


Fig. 18 Measuring Valve Stem Length with Tool C-3968

too long, grind off tip until length is within limits. **If engine is equipped with rotators, do not grind valve stem tip.**

(3) Install new cup seals on all valve stems and over valve guides (Fig. 19). Install valve springs and valve retainers.

(4) Compress valve springs with Tool C-3422-A, install locks and release tool. If valves and/or seats are reground, measure the installed height of springs, make sure 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 to bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 inches) Exhaust valve springs with positive rotators should have a length of 36.8-38.1 mm (1.45-1.51 inch) when the valve is closed.

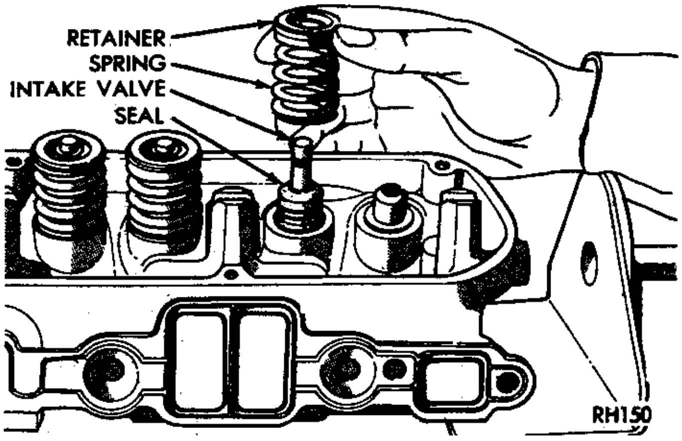


Fig. 19 Installing Valve, Cup Seal, Spring, and Retainer

REPLACING VALVE STEM SHIELDS OR VALVE SPRINGS, CYLINDER HEAD NOT REMOVED

(1) Set engine basic timing to TDC and remove Air Cleaner.

(2) Remove cylinder head covers and spark plugs.

(3) Remove coil wire from distributor and secure to good ground to prevent engine from starting.

(4) Using suitable socket and flex handle at crankshaft pulley retaining bolt, turn engine so the number 1 piston is at Top Dead Center on the compression stroke.

(5) Remove rocker arms with rocker shaft and install a dummy shaft. (The rocker arms should not be disturbed and left on shaft).

(6) With air hose attached to adapter Tool C-3907 installed in number 1 spark plug hole, apply 620 to 689 kPa (90 to 100 psi) air pressure. Make sure piston in cylinder is at TDC on the valve spring that is being removed.

(7) Using Tool C-3906 or C-4228 compress valve spring and remove retainer valve locks and valve spring.

(8) Install cup shields on the exhaust valve stem and position down against valve guides.

(9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. DO NOT Force seal against top of guide. When installing the valve retainer locks, compress the spring only enough to install the locks.

(10) Follow the same procedure on the remaining 7 cylinders using the firing sequence 1-8-4-3-6-5-7-2.

(11) Remove adapter Tool 3907.

(12) Remove dummy shaft and install rocker shaft with rocker arms.

(13) Install covers and coil wire to distributor.

(14) Install air cleaner.

(15) Road test vehicle.

HYDRAULIC TAPPETS

PRELIMINARY STEP TO CHECKING THE HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, read the oil pressure at the gauge (Install a reliable gauge at pressure sending unit if vehicle has no oil pressure gauge) and check oil level in the oil pan. The pressure should be between 207 to 552 kPa (30 and 80 psi) at 3000 rpm.

The oil level in the pan should never be above the FULL mark on the dipstick, or below the ADD OIL mark. Either of these two conditions could be responsible for noisy tappets.

OIL LEVEL TOO HIGH

If oil level is above the FULL mark on dipstick, it is possible for the connecting rods to dip into the oil while engine is running and create foam. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

OIL LEVEL TOO LOW

Low oil level may allow pump to take in air which when fed to the tappets, cause them to lose length and 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. 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, engine should be operated at fast idle for sufficient time to allow all of the air inside of 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.

Worn valve guides or cocked springs are some times 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 which will necessitate replacing the tappet, or by the plunger partially sticking in the tappet body cylinder. A heavy click is caused either by a tappet check valve not seating, or by foreign particles becoming wedged between the plunger and the tappet body, causing 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.

REMOVAL

(1) Remove the air cleaner.

(2) Remove valve cover and rocker assembly and push rods and identify push rods to insure installation in original location.

(3) With roller tappets, remove intake manifold, yoke retainer and aligning yoke.

(4) Slide Tool C-4129 through opening in cylinder head and seat tool firmly in the head of tappet.

(5) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to insure installation in original location.

CAUTION: The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts. Mixed parts are not compatible. Do not disassemble a tappet on a dirty work bench.

DISASSEMBLY

(1) Pry out plunger retainer spring clip.

(2) Clean varnish deposits from inside of tappet body above plunger cap.

(3) Invert tappet body and remove plunger cap, plunger, flat or ball check valve, check valve spring, check valve retainer and plunger spring.

CLEANING AND ASSEMBLY

(1) Clean all tappet parts in a solvent that will remove all varnish and carbon.

(2) Replace tappets that are unfit for further service with new assemblies.

(3) If plunger shows signs of scoring or wear and valve is pitted, or if valve seat on end of plunger indicates any condition that would prevent valve from seating, install a new tappet assembly.

(4) Assemble tappets (Fig. 1).

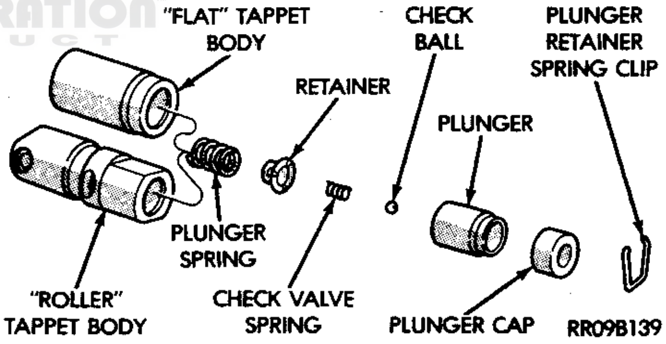


Fig. 1 Hydraulic Tappet Assemblies

INSTALLATION

(1) Lubricate tappets.

(2) Install tappets and push rods in their original positions.

(3) Install rocker arm and shaft assembly.

(4) Install vent cover.

(5) Install distributor, start engine and reset timing.

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.

VALVE TIMING

(1) Turn crankshaft until the No. 6 exhaust valve is closing and No. 6 intake valve is opening.

(2) Insert a 6.350 mm (1/4 inch) spacer between rocker arm pad and stem tip of No. 1 intake valve. Allow spring load to bleed tappet down giving in effect a solid tappet.

(3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible. Zero the indicator.

(4) Rotate the crankshaft clockwise (normal running direction) until the valve has lifted 0.254 mm (0.010 inch) for 5.2L engines, 0.863 mm (0.034 inch) for 5.9L engine.

CAUTION: Do not turn crankshaft any further clockwise as valve spring might bottom and result in serious damage.

The timing of the crankshaft pulley should now read from 10° before top dead center to 2° top dead center. Remove spacer.

(5) If reading is not within specified limits:
  (a) Check sprocket index marks.
  (b) Inspect timing chain for wear.
  (c) Check accuracy of DC mark on timing indicator.

TIMING CHAIN COVER, OIL SEAL AND CHAIN

COVER REMOVAL

(1) Drain cooling system.

(2) Refer to Group 7, Cooling System for procedure to remove water pump.

(3) Remove power steering pump.

(4) Remove pulley from vibration damper and bolt and washer securing vibration damper on crankshaft.

(5) Install bar from Tool (C-3688) and screw from Tool (C-3732A) and pull vibration damper from end of crankshaft (Fig. 2).

(6) Remove fuel lines.

(7) Loosen oil pan bolts and remove the front bolt at each side.

(8) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

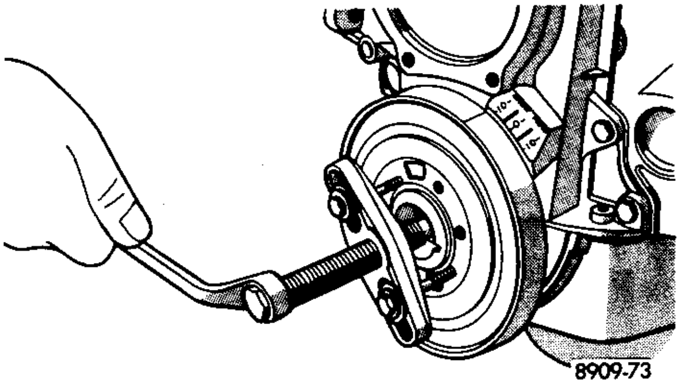


Fig. 2 Removing Vibration Damper with Tool C-3688

MEASURING TIMING CHAIN FOR STRETCH

(1) Place a scale next to the timing chain so that any movement of the chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt and apply torque in direction of crankshaft rotation to take up slack; 41 N•m (30 ft. lbs.) with (cylinder head installed) or 20 N•m (15 ft. lbs.) (cylinder heads removed). With a 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) Holding a scale with dimensional reading even with the edge of a chain link, apply torque in the reverse direction 14 N•m (30 ft. lbs.) (with cylinder heads installed) or 20 N•m (15 ft. lbs.) (cylinder heads removed) and note amount of chain movement (Fig. 3).

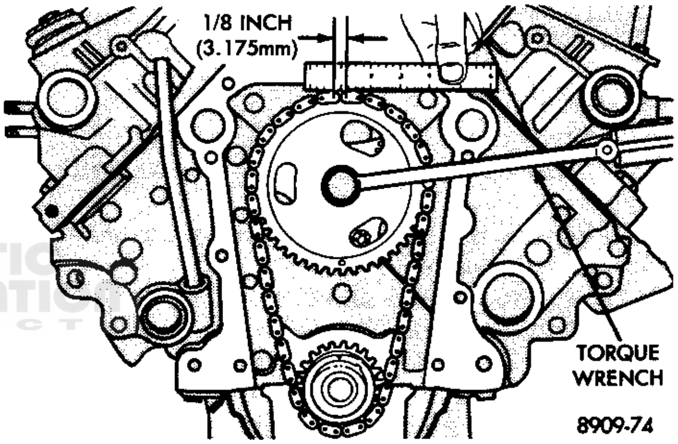


Fig. 3 Measuring Timing Chain Wear and Stretch

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

(5) If chain is not satisfactory, remove camshaft sprocket attaching cup washer, and remove timing chain with crankshaft and camshaft sprockets.

(6) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on 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. 4).

(11) Install the cup washer, and camshaft bolt. Tighten bolt to 47 N•m (35 ft. lbs.).

(12) Check camshaft for 0.051 to 0.0152 mm (0.002 to 0.006 inch) end play with a new thrust plate and

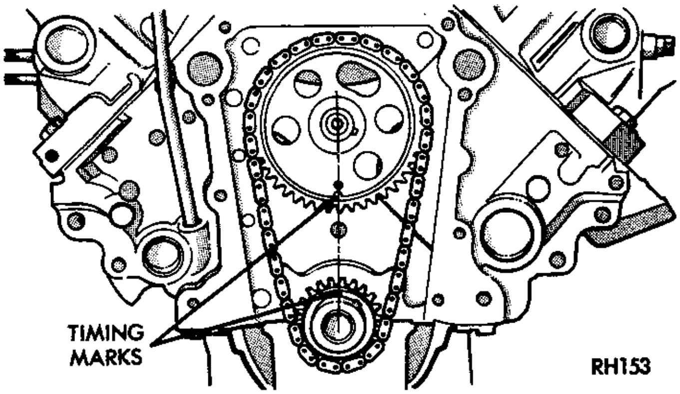


Fig. 4 Alignment of Timing Marks

up to 0.254 mm (0.010 inch) end play with a used thrust plate. If not within these limits install a new thrust plate.

TIMING CHAIN COVER EXTERNAL OIL SEAL

REMOVAL

(1) Disconnect battery.

(2) Loosen and remove belts from crankshaft pulley.

(3) Remove radiator shroud retainer screws and set shroud back over engine.

(4) Remove fan and shroud from engine.

(5) Remove crankshaft pulley and vibration damper belt and washer from end of crankshaft.

(6) Install bar from Tool (C-3688) and screw from Tool (C-3732A) and pull vibration damper from end of crankshaft (Fig. 2).

(7) Using a suitable tool behind the lips of the oil seal pry outward, being careful not to damage the crankshaft seal surface of cover (Fig. 5).

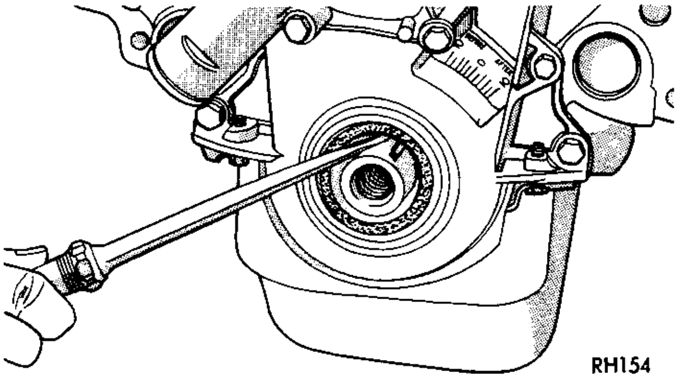


Fig. 5 Removing Oil Seal

INSTALLATION

(1) Install new seal by installing the threaded shaft part of Tool (C-4251) into the threads of the crankshaft.

(2) Place seal into opening with seal spring towards the inside of the engine.

(3) Place the installing adapter C-4251-3 with the thrust bearing and nut on the shaft. Tighten nut until tool is flush with the timing chain cover (Fig. 6).

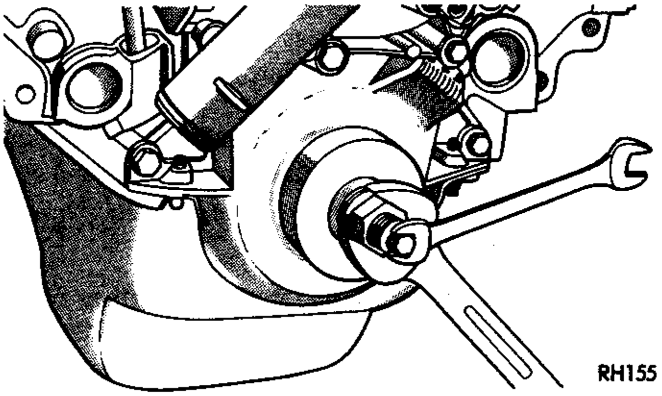


Fig. 6 Installing Oil Seal

(4) Install vibration damper using Tool C-3688 (Fig. 7).

(5) Install retainer bolt and washer and torque to 183 N•m (135 ft. lbs.) torque.

(6) Install pulley on vibration damper and torque to 23 N•m (200 in. lbs.) torque.

(7) Set radiator shroud back over engine and install fan and belts.

(8) Install radiator shroud to radiator.

(9) Connect battery.

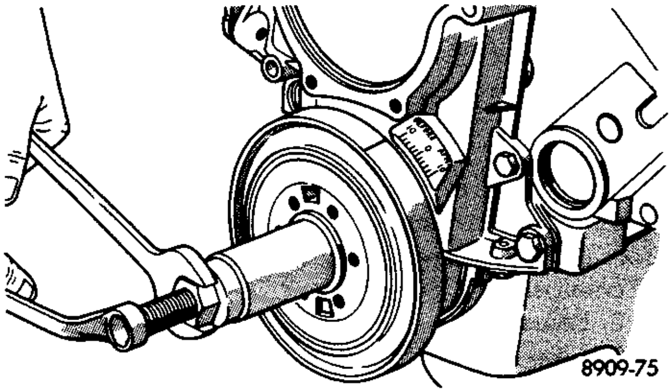


Fig. 7 Installing Vibration Damper with Tool C-3688

COVER 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. A 3.175 mm (1/8th inch) diameter bead of RTV sealer is recommended on the oil pan gasket. DO NOT tighten bolts at this time.

(3) Lubricate seal lip with lubriplate, position vibration damper hub slot on crankshaft. Damper will act as a pilot for the crankshaft seal.

(4) Place installing tool, part of Puller set Tool C-3688 in position and press vibration damper on crankshaft (Fig. 7).

(5) Tighten chain case cover bolts to 41 N•m (30 ft. lbs.) torque first, then tighten oil pan bolts to 23 N•m (200 in. lbs.) torque.

(6) Install vibration damper retainer bolt with washer and tighten to 183 N•m (135 ft. lbs.) torque.

(7) Position pulley on vibration damper and attach with bolts and lockwashers. Tighten to 23 N•m (200 in. lbs.) torque.

(8) Install fuel lines.

(9) Install water pump and housing assembly using new gaskets. Tighten bolts to 41 N•m (30 ft. lbs.) torque.

(10) Install power steering pump.

(11) Install fan and belt, hoses and close drains.

(12) Install radiator shroud.

(13) Fill cooling system.

CAMSHAFT (ENGINE REMOVED FROM VEHICLE)

The camshaft has an integral oil pump and distributor drive gear, as shown in (Fig. 8). Remove intake manifold, cylinder head covers, timing case cover and timing chain.

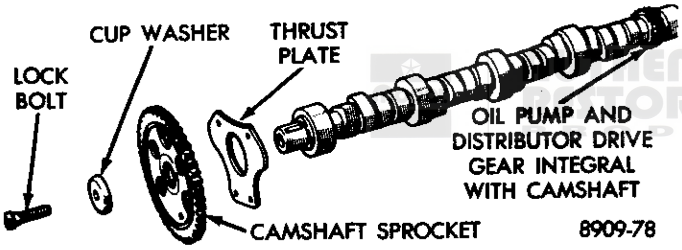


Fig. 8 Camshaft and Sprocket Assembly

REMOVAL

(1) Remove rocker arm and shaft assemblies.

(2) Remove push rods and tappets; identify so each part will be replaced in its original location.

(3) Remove distributor and lift out the oil pump and distributor drive shaft.

(4) Remove camshaft thrust plate, note location of oil tab.

(5) Install a long bolt into front of camshaft to facilitate removal of the camshaft; remove camshaft, being careful not to damage cam bearings with the cam lobes.

(6) To reduce internal leakage and help maintain higher oil pressure at idle, cup plugs have been pressed into oil galleries behind the camshaft thrust plate (Fig. 9).

INSTALLATION

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft to within 2 inches of its final position in cylinder block.

(2) Install Tool C-3509 with tongue back of distributor drive gear (Fig. 10).

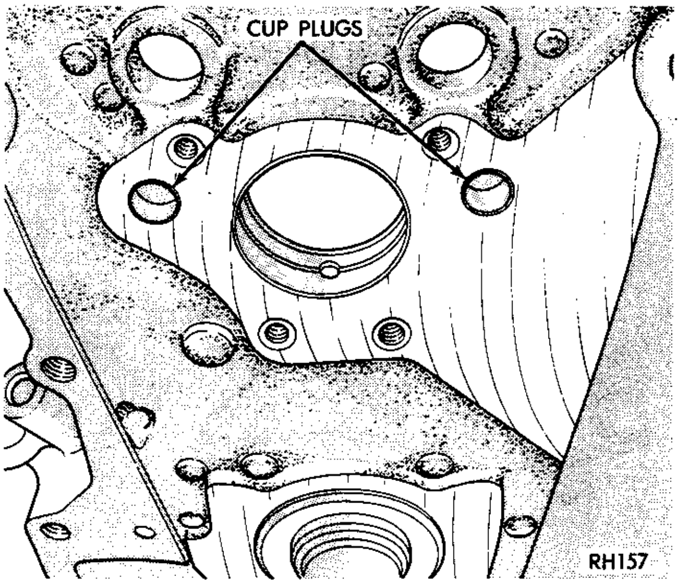


Fig. 9 Location of Cup Plugs in Oil Galleries

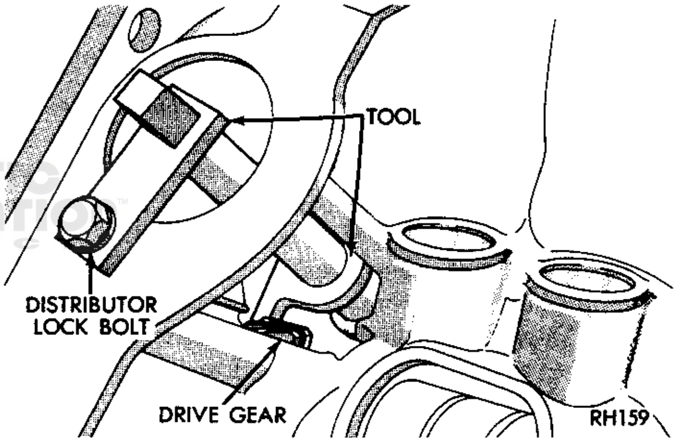


Fig. 10 Camshaft Holding Tool C-3509 in Installed Position

(3) Hold tool in position with 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, with three bolts as shown in (Fig. 11). Make sure tang enters lower right hole in thrust plate. Tighten 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) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(6) Place timing chain around both sprockets.

(7) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

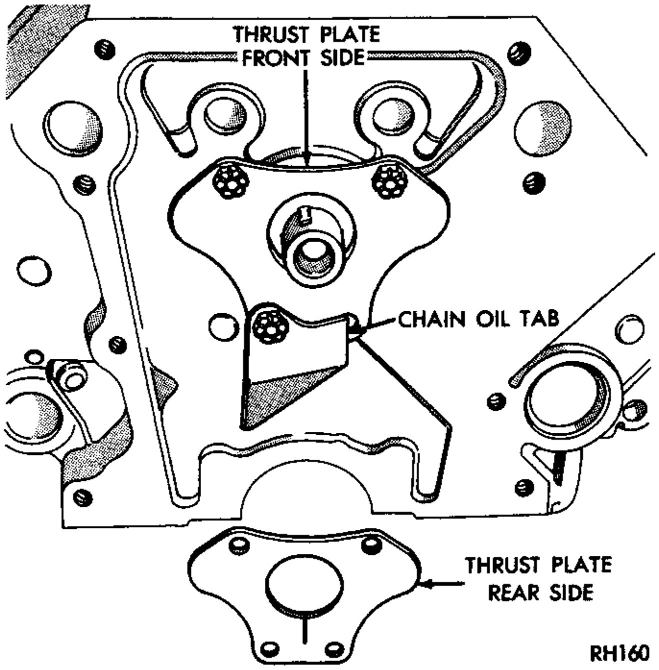


Fig. 11 Timing Chain Oil Tab Installation

(8) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(9) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 12).

(10) Install the cup washer, and camshaft bolt. Tighten bolt to 47 N•m (35 ft. lbs.) torque.

(11) Measure camshaft end play. Refer to Specifications for proper clearance. If not within limits new thrust plate.

(12) Each tappet reused must be installed in the same position from which it was removed. Tappets must have a definite crown. When camshaft is replaced, all of the tappets must be replaced.

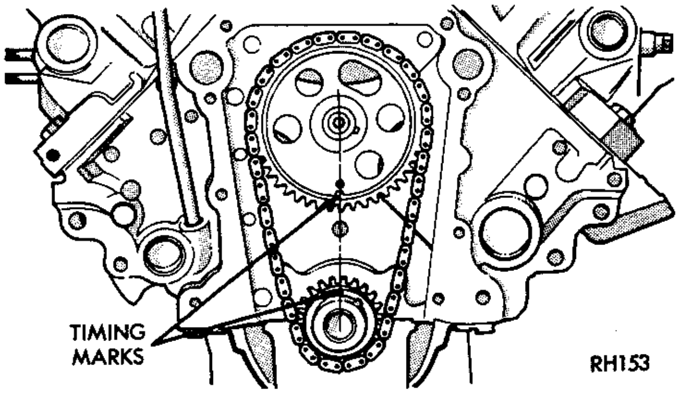


Fig. 12 Alignment of Timing Marks

CAMSHAFT BEARINGS (ENGINE REMOVED FROM VEHICLE)

REMOVAL

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

(2) Install proper size adapters and horseshoe washers (part of Tool C-3132-A) at back of each bearing shell to be removed and drive out bearing shells (Fig. 13).

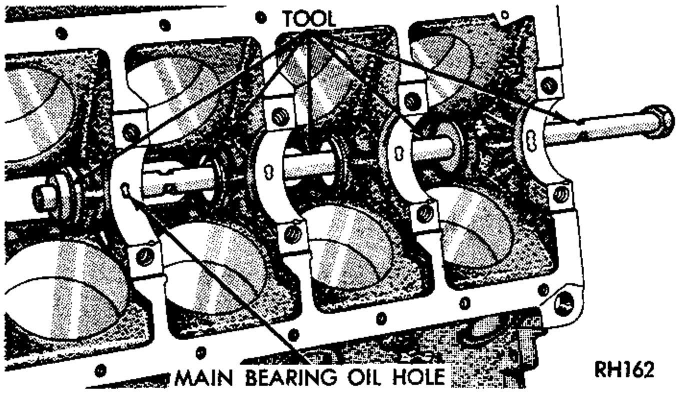


Fig. 13 Removal and Installation of Camshaft Bearings with Tool C-3132A

INSTALLATION

(1) Install new camshaft bearings with 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. Also, number two bearing must index with the oil passage to the left cylinder head and number four bearing must index with the oil passage to the right cylinder head. 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.

DISTRIBUTOR DRIVE SHAFT BUSHING

REMOVAL

(1) Insert Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 14).

(2) Hold puller screw and tighten puller nut until bushing is removed.

INSTALLATION

(1) Slide new bushing over burnishing end of Tool C-3053 and insert the tool and bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 15).

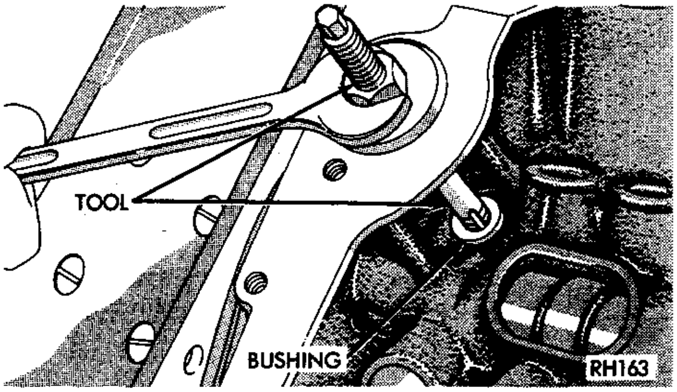


Fig. 14 Removing Distributor Drive Shaft Bushing with Tool C-3052

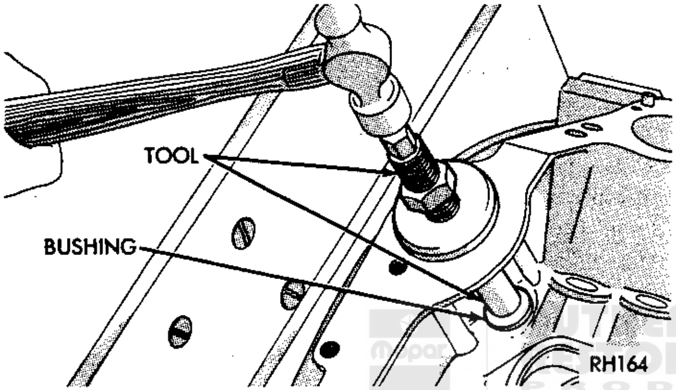


Fig. 15 Installing Distributor Drive Shaft Bushing with Tool C-3053

(3) As the burnisher is pulled through the bushing by tightening the puller nut, the bushing is expanded tight in block and burnished to correct size (Fig. 16). DO NOT REAM THIS BUSHING.

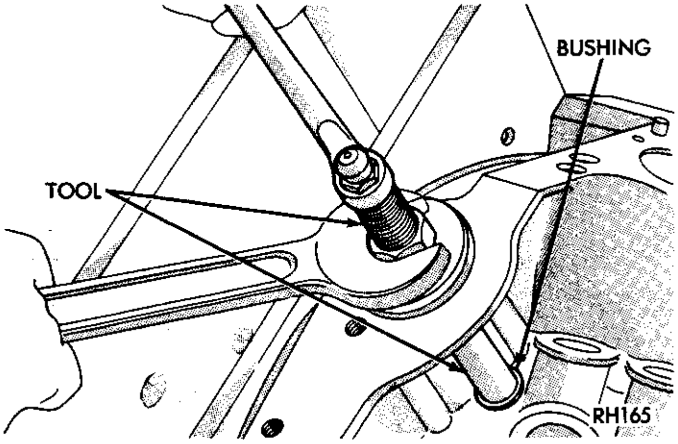


Fig. 16 Burnishing Distributor Drive Shaft Bushing

DISTRIBUTOR TIMING

Before installing the distributor and oil pump drive shaft, time engine as follows:

(1) Rotate crankshaft until No. 1 cylinder is at top dead center on the firing stroke.

(2) When in this position, the timing mark on vibration damper should be under "0" on the timing indicator.

(3) Coat shaft and drive gear with engine oil. Install the shaft so that after gear spirals into place, it will index with the oil pump shaft, so slot in top of drive gear will point in a direction parallel to the centerline of the crankshaft (Fig. 17).

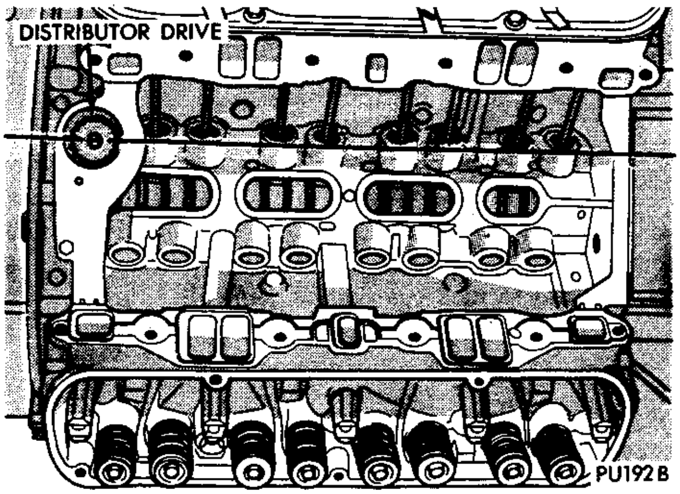


Fig. 17 Position or Installed Distributor Drive Gear

INSTALLATION OF DISTRIBUTOR

(1) Hold the distributor over the mounting pad on cylinder block with vacuum chamber pointing toward right front of engine.

(2) Turn rotor until it points forward and to approximate location of No. 1 tower terminal in distributor cap (Fig. 18).

(3) Place distributor "O" ring in position.

(4) Lower the distributor and engage the shaft in the slot of distributor drive shaft gear.

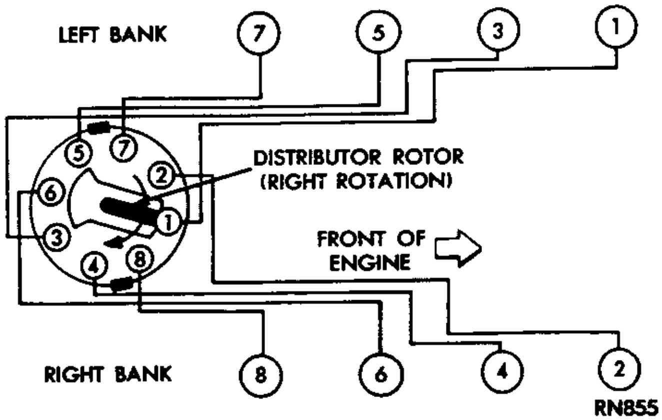


Fig. 18 Distributor with Rotor Positioned Under No. 1 Tower of Cap

CYLINDER BLOCK

PISTON REMOVAL

(1) 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 that each connecting rod is centered in cylinder bore.

(2) Inspect connecting rods and connecting rod caps for cylinder identification. Identify them if necessary.

(3) Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts. Push each piston and rod assembly out of cylinder bore. Be careful not to nick crankshaft journals.

(4) After removal, install bearing cap on the mating rod.

CLEANING AND INSPECTION

(1) Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

(2) If new core plugs are installed, coat edges of plug and core hole with MOPAR Gasket Maker or equivalent. Drive the core plug in so that the rim lies at least 0.397 mm (1/64 inch) below the lead-in chamfer.

(3) Examine block for cracks or fractures.

CYLINDER BORE INSPECTION

The cylinder walls should be checked for out-of-bound and taper with Tool C-119. If the cylinder bores show more than 0.127 mm (0.005 inch) out-of-round, or a taper of more than 0.254 mm (0.010 inch) or if the cylinder walls are badly scuffed or scored, the cylinder block should be bored and honed, and new pistons and rings fitted. Whatever type of boring equipment is used, boring and honing operation should be closely coordinated with the fitting of pistons and rings in order that specified clearances may be maintained.

ENGINE CORE OIL AND CAM PLUGS

REMOVAL

Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup plug (Fig. 1). With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 1).

CAUTION: Do not drive cup plug into the casting as restricted cooling can result and cause serious engine problems.

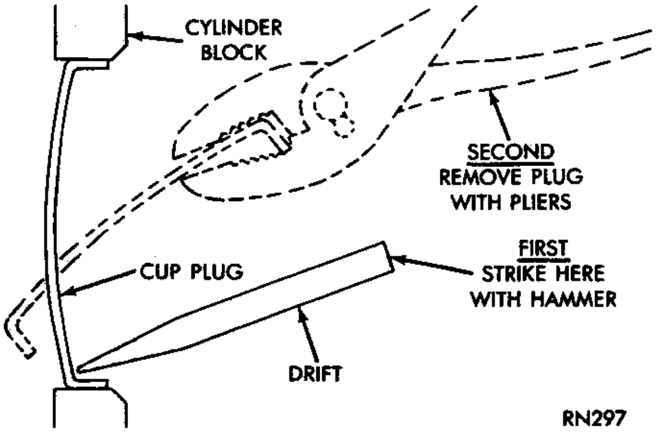


Fig. 1 Core Hole Plug

INSTALLATION

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 Loctite Stud N' Bearing Mount or equivalent. 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 0.50 mm (0.020 inch) inside the lead-in chamfer.

It is not necessary to wait for curing of the sealant. The cooling system can be filled and the vehicle placed in service immediately.

PISTONS, PINS AND RINGS

The pistons are cam ground so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, thus, causing the piston to assume a more nearly round shape. It is important that pistons be checked for taper and elliptical shape before they are fitted into the cylinder bore (Figs. 2 and 3).

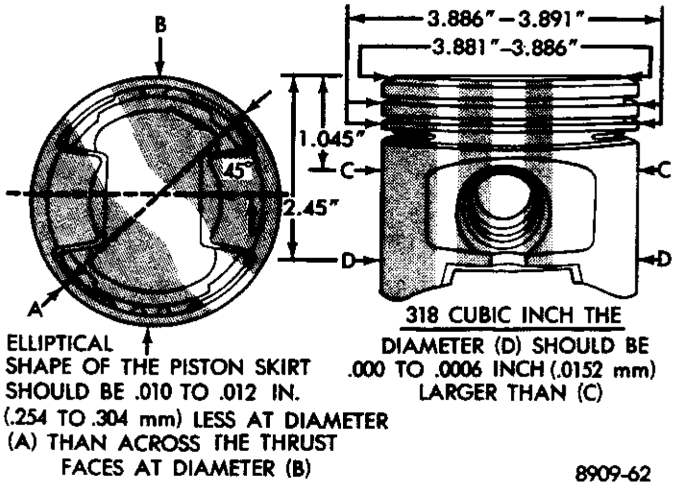


Fig. 2 Piston Measurements—5.2L Engine

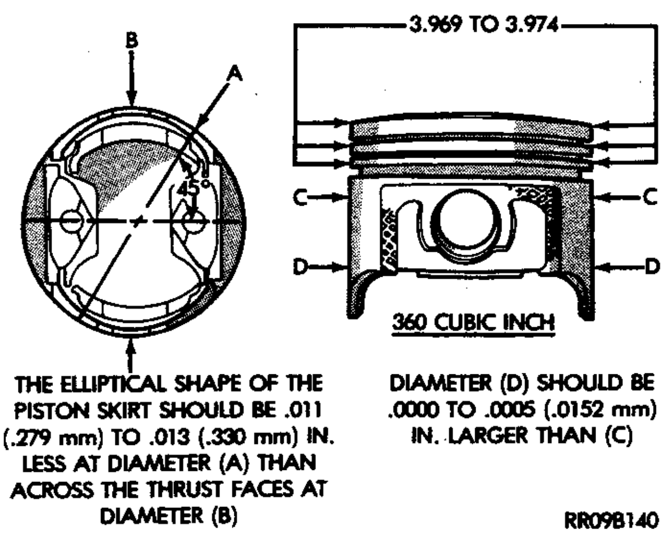


Fig. 3 Piston Measurements—5.9L Engine

FINISHED PISTONS

All pistons are machined to the same weight in grams, regardless of oversize, to maintain piston balance. For cylinder bores which have been honed or bored new pistons are furnished with fitted pins, available in standard and the following oversize: 0.508 mm (0.020 inch).

FITTING PISTONS

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.0127 to 0.0381 mm (0.0005 to 0.0015 inch).

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).

PISTON PINS

On both the 5.2L and 5.9L engines, the piston pin rotates in the piston only, and is retained by the press interference fit of the piston pin in the connecting rod.

FITTING RINGS

(1) Measure piston ring gap about two inches from bottom of cylinder bore in which it is to be fitted. (An inverted piston can be used to push the rings down to insure positioning rings squarely in the cylinder bore before measuring).

(2) Insert feeler stock in the gap. The ring gap should be between 0.254 and 0.508 mm (0.010 and 0.020 inch) for compression rings and 0.381 to 1.575 mm (0.015 to 0.062 inch) for oil ring steel rails in standard size bores (for new service rings). Maximum gap in 0.127 mm (0.005 inch) O/S bores should be 0.907 mm (0.036 inch) for compression rings and 1.778 mm (0.070 inch) for oil ring steel rails.

(3) Measure side clearance between piston ring and ring land (Fig. 4). Clearance should be 0.038 to 0.076 mm (0.0015 to 0.003 inch) for the top compression ring and the intermediate ring. Steel rail service oil ring should be free in groove, but should not exceed 0.127 mm (0.005 inch) side clearance.

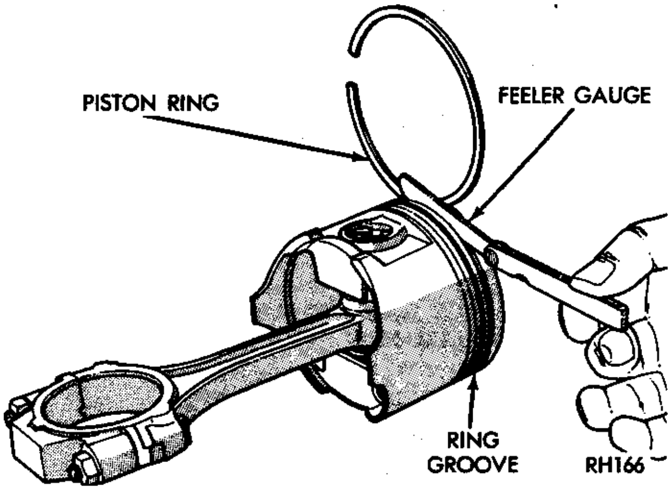


Fig. 4 Measuring Piston Ring Side Clearance

(4) On both the 5.2L and 5.9L engines, the keys on the spacer expander must be inserted into the hole in the oil ring groove over the piston pin front boss (Fig. 5).

(5) Arrange oil ring rail gaps on inboard side of piston as shown at top of (Fig. 5).

(6) Install compression rings in middle and top grooves; use Ring Installer Tool C-3586 for 5.2L engines, and Tool C-3562 for 5.9L engines or C-4184 for both engines. Be sure the identification mark (a drill point, stamped letter O, oval depression or word top) on each compression ring is to the top of the piston when ring is installed.

CRANKSHAFT IDENTIFICATION

A crankshaft which has one or more connecting rod or main bearing journals undersize will be stamped with 1/4" letters on the milled flat on the No. 8 crankshaft counterweight on 5.2L crankshafts and on the No. 3 crankshaft counterweight of the 5.9L crankshafts (Fig. 6).

RX indicates ALL rod journals are 0.254 mm (0.010 inch) undersize; MX indicates ALL main journals are 0.254 mm (0.010 inch) undersize.

BALANCE OF V8 ENGINE DAMPER, CRANKSHAFT AND TORQUE CONVERTER

The 5.9L engines have external crankshaft balance. External balance is identified by the off-center weight cast in the vibration damper hub and the

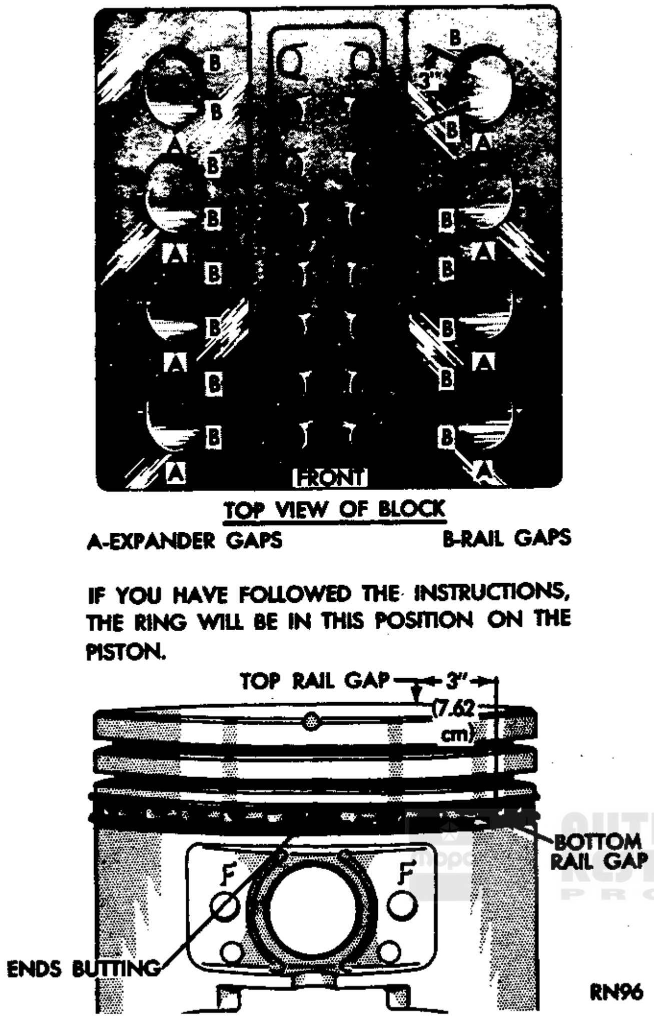


Fig. 5 Proper Oil Ring Installation

larger balance weights welded on the torque converter. Both of these items will be present on a crankshaft with external balance.

Therefore, when replacing the damper, crank shaft, or torque converter on any V8 engine it is important to use correct part numbers. In addition a damper or torque converter being replaced should look the same with respect to having or not having off-center weights.

Undersize Journal	Identification Stamp
0.025 mm (0.001 inch) (Rod)	R1-R2-R3 or R4
0.254 mm (0.010 inch) (Rod)	RX
0.025 mm (0.001 inch) (Main)	M1-M2-M3-M4 or M5
0.254 mm (0.010 inch) (Main)	MX

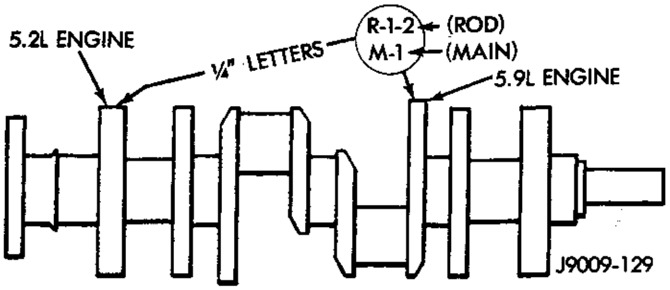


Fig. 6 Location of Crankshaft Identification on No. 8 Counterweight

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

CONNECTING RODS

INSTALLING PISTON AND CONNECTING ROD ASSEMBLY

(1) Before installing pistons, and connecting rod assemblies into the bore, be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 5).

(3) Immerse the piston head and rings in clean engine oil, slide the 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. 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 and the larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install rod caps, tighten nuts to 61 N•m (45 ft. lbs.) torque.

INSTALLATION OF CONNECTING ROD BEARINGS

Fit all rods on one bank until completed. Do not alternate from one bank to another, because when the rods are assembled to pistons correctly, they are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to insure correct assembly.

Each bearing cap has a small V groove across the parting face. When installing the lower bearing shell, make 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 inch). Bearings are available in 0.025 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch) 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 MAIN JOURNALS

The crankshaft journals should be checked for excessive wear, taper and scoring. Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 inch). Journal grinding should not exceed 0.305 mm (0.012 inch) under the standard journal diameter. DO NOT grind thrust faces of Number 3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: With the nodular cast iron crankshafts used in all 5.2L and 5.9L engines it is important that the final paper or cloth polish after any journal grind be in the same direction as normal rotation in the engine.

CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to insure correct assembly. Upper and lower bearing halves are NOT interchangeable on the 5.2L engine. Lower main bearing halves of 2 and 4 are interchangeable. Upper main bearing halves of 2 and 4 are interchangeable. On the 5.9L engine 1, 2 and 4 upper and lower bearings are grooved and are interchangeable on high performance only. Standard 5.9L engine uses plain lower main bearings, (except No. 5).

Upper and lower Number 3 bearing halves are have flanges to carry the crankshaft thrust loads and are NOT interchangeable with any other bearing halves in the engine (Fig. 7). All bearing cap bolts removed during service procedures are to be cleaned and oiled before installation. Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch). Never install an undersize bearing that will reduce clearance below specifications.

REMOVAL

(1) Remove oil pan and identify bearing cap before removal.

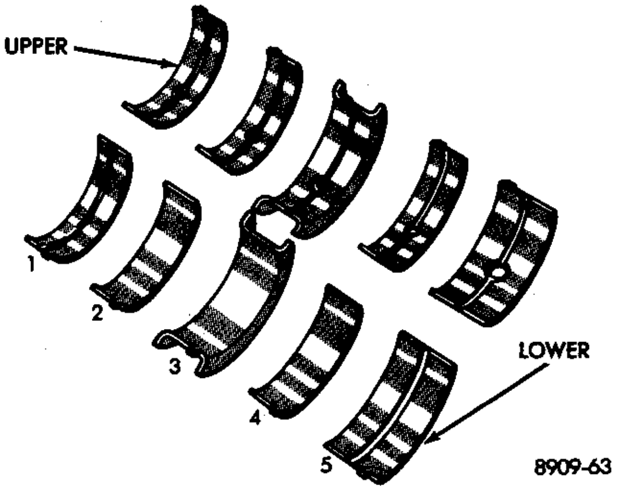


Fig. 7 Main Bearing Identification

(2) Remove bearing caps one at a time. Remove upper half of bearing by inserting Tool C-3059 (Fig. 8) into the oil hole of crankshaft.

(3) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

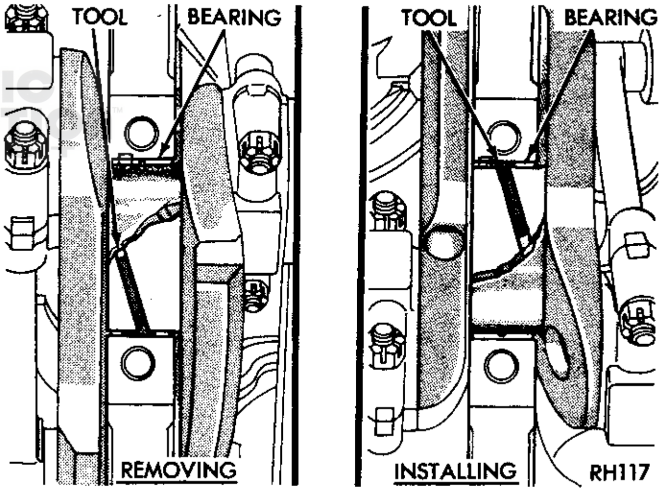


Fig. 8 Removing and Installing Upper Main Bearing with Tool C-3059

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Tool C-3059 into oil hole of crankshaft (Fig. 8).

(2) Slowly rotate crankshaft counter-clockwise sliding the bearing into position. Remove Tool C-3059.

REAR MAIN BEARING OIL SEALS

The 5.2L engine service seal is a two piece, fitted, ROPE TYPE. The upper rope seal half can be installed with crankshaft removed or in vehicle with crankshaft installed. Lower rope seal half is required installation when upper seal is installed.

The 5.9L engine service seals are of split RUBBER TYPE composition. The upper seal (half) can be installed without removing the crankshaft. The seal must be used as a complete upper and lower set.

5.2L ENGINE SEAL SERVICE

UPPER ROPE SEAL (IN VEHICLE—CRANKSHAFT INSTALLED)

(1) Remove defective upper seal and install new one using Oil Seal Remover and Installer Tool KD-492 or equivalent (which includes complete instructions and is available from most auto supply stores).

(2) Carefully, trim the upper seal after installation to eliminate frayed ends.

UPPER ROPE SEAL (CRANKSHAFT REMOVED)

(1) Install a new rear bearing oil seal in the cylinder block so that both ends protrude.

(2) Using Tool C-3511, tap seal down into position until tool is seated in bearing bore (Fig. 9).

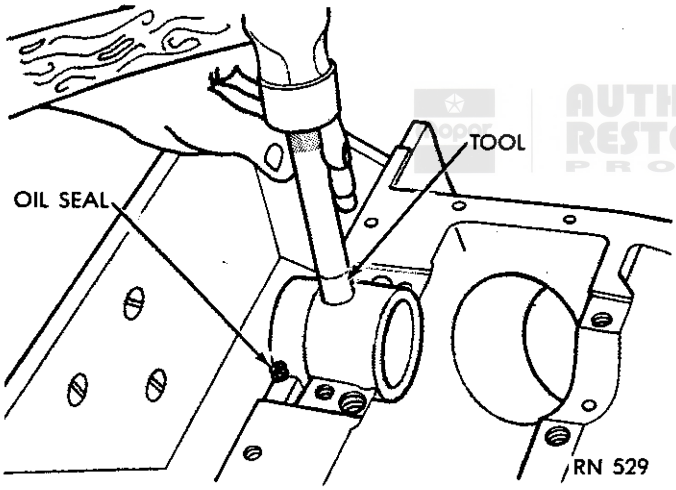


Fig. 9 Installing Upper/Lower Oil Seal with Tool C-3511

(3) Hold tool in this position and cut off the portion of seal that extends below the block (or cap) on both sides (Fig. 10).

LOWER ROPE SEAL (CRANKSHAFT REMOVED)

(1) Install a new seal in bearing cap so that both ends protrude.

(2) Using Tool C-3511, tap seal down into position until tool is seated in bearing bore.

(3) Hold tool in this position and cut off the portion of the seal that extends above the cap on both sides.

(4) Install cap seals into slots in bearing cap (Fig. 11). If this is not done, oil leakage will occur. Lightly oil seals with engine oil.

(5) Assemble bearing cap to cylinder block. Install cleaned and oiled cap bolts and torque to 115 N•m (85 ft. lbs.) torque.

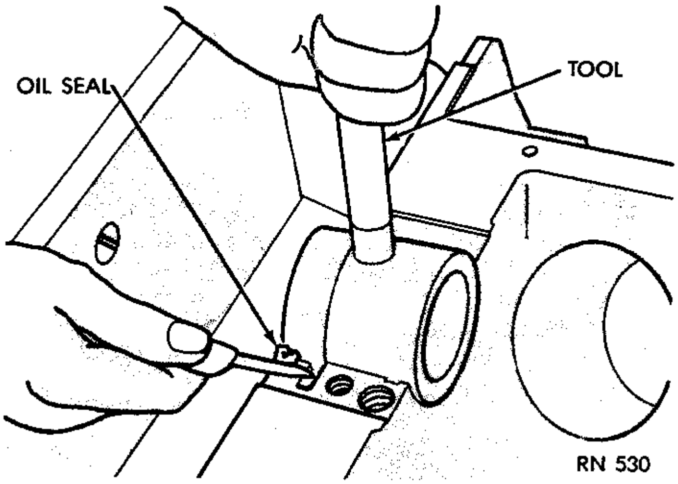


Fig. 10 Trimming Upper/Lower Oil Seal

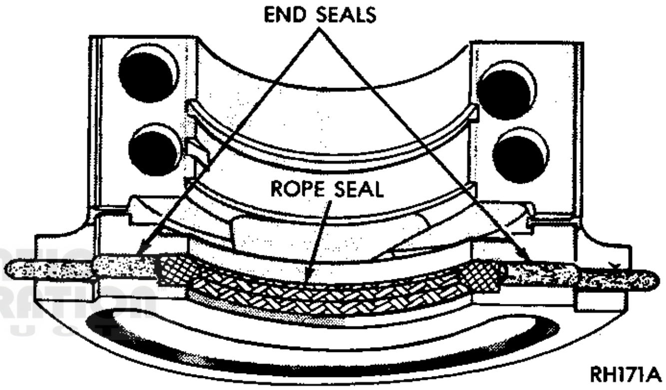


Fig. 11 Rear Main Bearing Cap (5.2L Engine)

(6) Install oil pump. Add sealer at bearing cap to block joint (Fig. 12) to provide oil pan end sealing. Install oil pan.

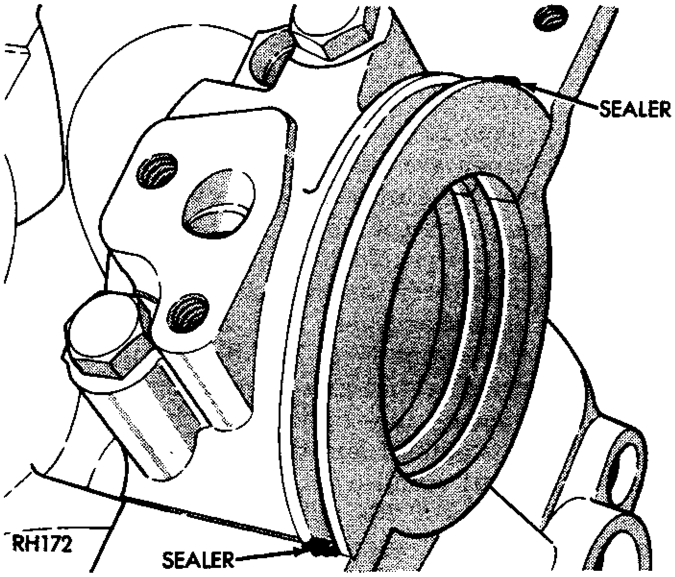


Fig. 12 Oil Pan End Seal at Rear Bearing

5.9L ENGINE SEAL SERVICE

REMOVING SEALS

Rubber Type-Lower. Remove oil seal by pushing the end with a small screwdriver.

Rubber Type-Upper. Remove upper seal by pressing with a small screwdriver on the end of the seal being careful not to damage the crankshaft (Fig. 13).

INSTALLING SEALS

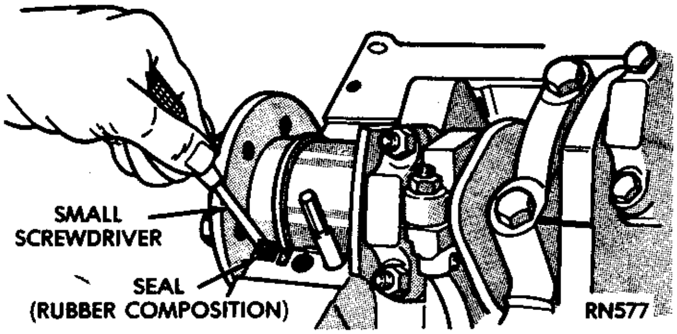


Fig. 13 Removing Composition (Rubber Type) Seal

CAUTION: Always wipe crankshaft surface clean, then oil lightly before installing a new seal.

(1) Lightly oil lips of crankshaft seals.

(2) Rotate half seal into cylinder block with paint stripe toward rear. Be careful not to shave or cut outer surface of seal.

(3) Place the other half seal in bearing cap with paint stripe toward rear.

(4) Apply RTV sealer adjacent to rubber seal (Fig. 14). Assemble bearing cap to block immediately after applying sealer. Install cleaned and oiled bolts. Tighten the bolts to 115 N•m (85 ft. lbs.) torque.

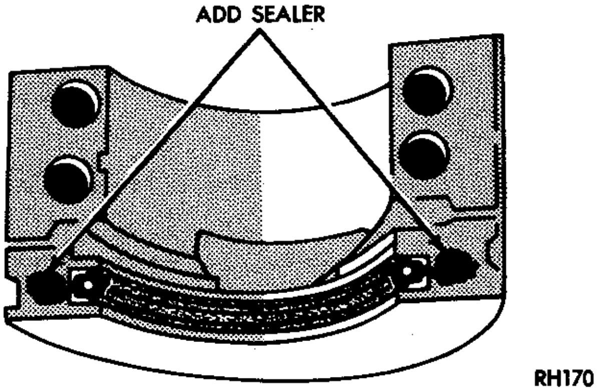


Fig. 14 Rear Main Bearing Cap (5.9L Engine)

OIL PAN

REMOVAL

(1) Disconnect battery ground cable; remove engine oil dipstick.

(2) Raise vehicle. Drain engine oil, remove exhaust cross over pipe and remove left engine to transmission strut.

(3) Remove oil pan bolts and remove oil pan.

CLEANING AND INSPECTION

(1) Clean oil pan in solvent and wipe dry with a clean cloth. Clean all gasket material from mounting surfaces of pan and block.

(2) Inspect oil drain plug and plug hole for stripped or damaged threads and repair as necessary. Install a new drain plug gasket. Tighten plug to 27 N•m (20 ft. lbs.) torque.

(3) Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

(4) Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSTALLATION

(1) Using a new pan gasket, add drop of RTV sealer at corners of rubber and cork (Fig. 15). Be sure notches on side gaskets are installed as shown in Fig. 15 (5.9L engines).

(2) Install pan and tighten bolts to 23 N•m (200 in. lbs.) torque.

(3) Install engine to transmission strut.

(4) Install exhaust cross over pipe. Tighten to 33 N•m (24 ft. lbs.) torque.

(5) Lower vehicle and install oil dipstick.

(6) Connect battery ground cable.

(7) Fill crankcase with oil to proper level.

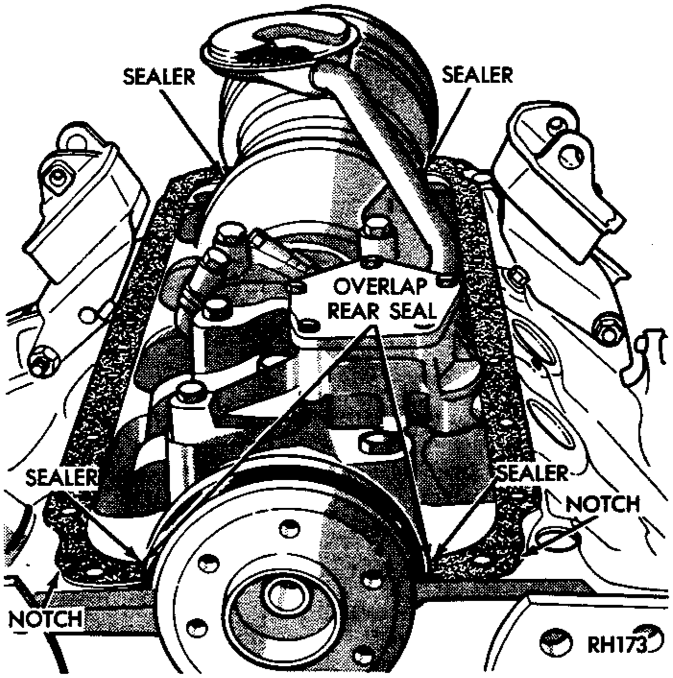


Fig. 15 Oil Pan Gaskets and Rear Seal Installation

OIL PUMP

It is necessary to remove the oil pan, and remove the oil pump from rear main bearing cap to service the oil pump.

DISASSEMBLY

(1) To remove the relief valve, proceed 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 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. 16).

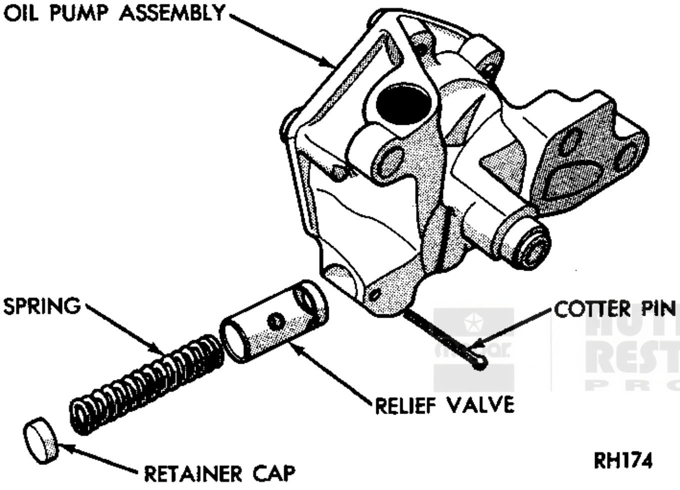


Fig. 16 Oil Pressure Relief Valve (Disassembled)

(2) Remove oil pump cover bolts and lockwashers, and lift off cover.

(3) Discard oil seal ring.

(4) Remove pump rotor and shaft, and lift out outer rotor.

(5) Wash all parts in a suitable solvent and inspect carefully for damage or wear (Fig. 17).

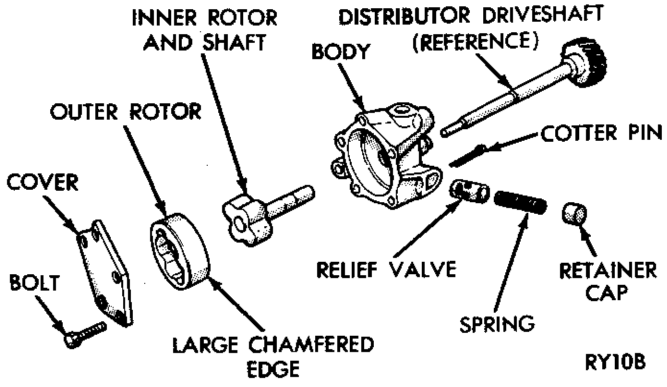


Fig. 17 Oil Pump

INSPECTION AND REPAIR

(1) Clean all parts thoroughly. Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.

(2) Lay a straightedge across the pump cover surface (Fig. 18). If a 0.038 mm (0.0015 inch) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

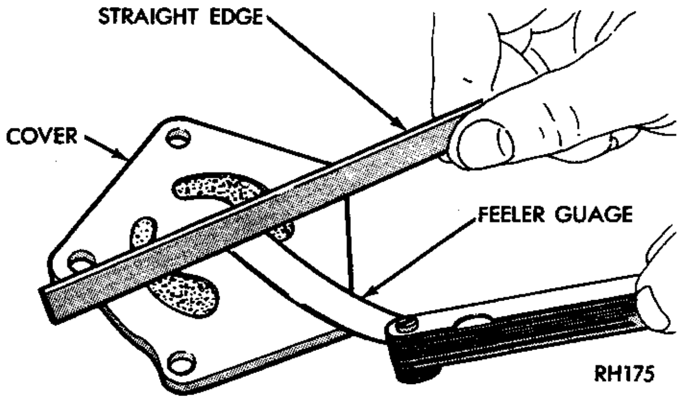


Fig. 18 Checking Oil Pump Cover Flatness

(3) Measure thickness and diameter of OUTER rotor. If outer rotor thickness measures 20.9 mm (0.825 inch) or less, (Fig. 19), or the diameter is 62.7 mm (2.469 inches) or less, replace outer rotor.

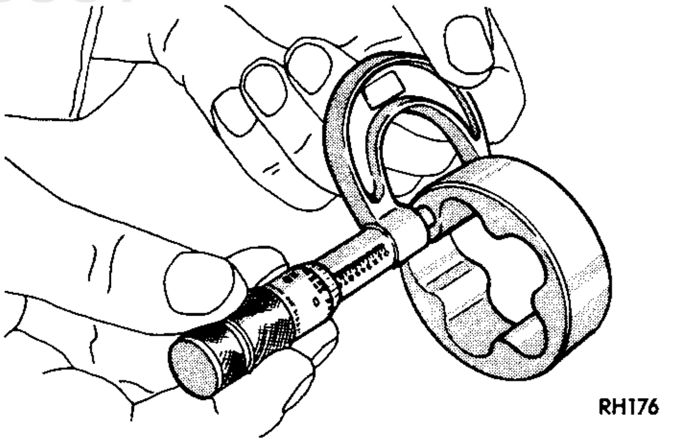


Fig. 19 Measuring Outer Rotor Thickness

(4) If INNER rotor measures 20.9 mm (0.825 inch) or less replace inner rotor and shaft assembly (Fig. 20).

(5) Slide outer rotor into pump body with large chamfered edge installed inward into pump body (Fig. 21), press to one side with fingers and measure clearance between rotor and pump body (Fig. 21). If measurement is 0.356 mm (0.014 inch) or more, replace oil pump assembly.

(6) Install inner rotor and shaft into pump body. If clearance between inner and outer rotors (Fig. 22) is 0.203 mm (0.008 inch) or more, replace shaft and both rotors.

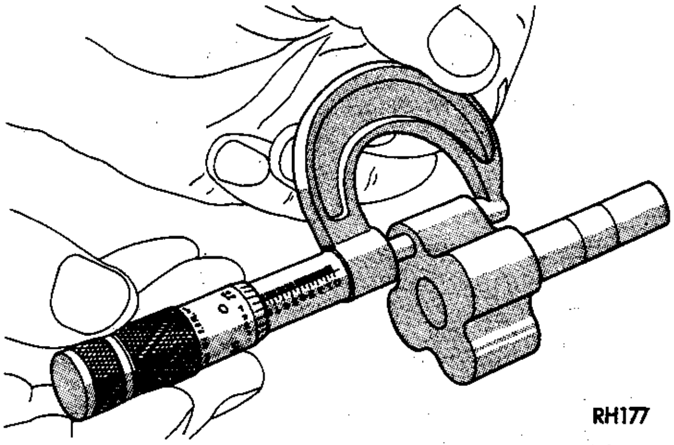


Fig. 20 Measuring Inner Rotor Thickness

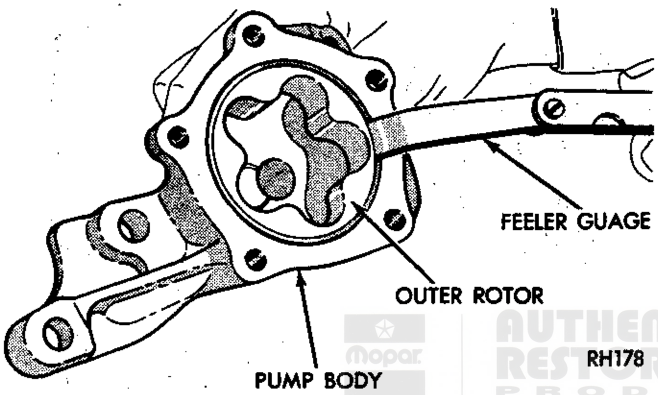


Fig. 21 Measuring Outer Rotor Clearance in Housing

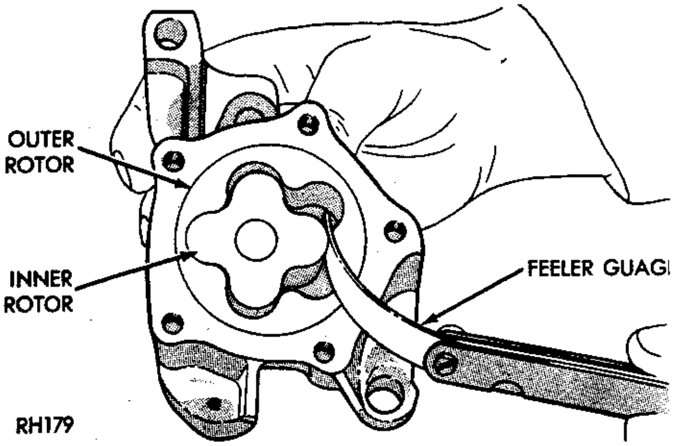


Fig. 22 Measuring Clearance Between Rotors

(7) Place a straightedge across the face of the pump, between bolt holes. If a feeler gauge of 0.004 inch (0.102 mm) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 23).

(8) 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.

(9) The relief valve spring has a free length of approximately 49.0 mm (1.95 inch) and should test between 19.5 and 20.5 pounds when compressed to 34.0 mm (1-11/32 inches). Replace spring that fails to meet specifications (Fig. 24).

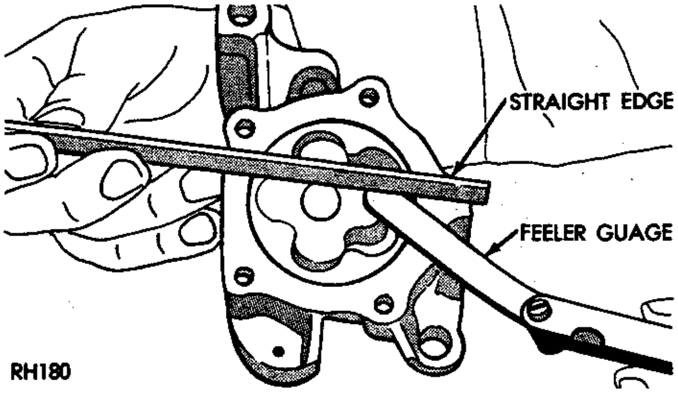


Fig. 23 Measuring Clearance Over Rotors

(10) If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

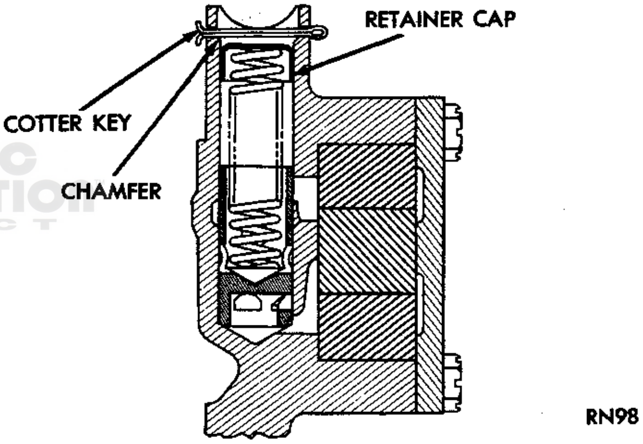


Fig. 24 Proper Installation of Retainer Cap

OIL LINE PLUG

The oil line plug is located in the vertical passage in the block between the Oil-To-Filter and Oil-From-Filter passages (Fig. 25). Improper installation or absence could cause erratic, low or no oil pressure.

INSPECTION

(1) Remove oil pressure sending unit from back of block.

(2) Insert a 3.175 mm (1/8 inch) wire or equivalent into passage.

(3) Plug should be 190.0 to 195.2 mm (7-1/2 to 7-11/16 inches) from machined surface of block (Fig. 25).

(4) If plug is off location. Remove oil pan and No. 5 main bearing cap. Use suitable flat dowel to remove plug and position plug properly. Plug should be 54.0 to 57.7 mm (2-1/8 to 2-5/16 inches) from bottom of the block. Coat outside diameter of plug with MO-

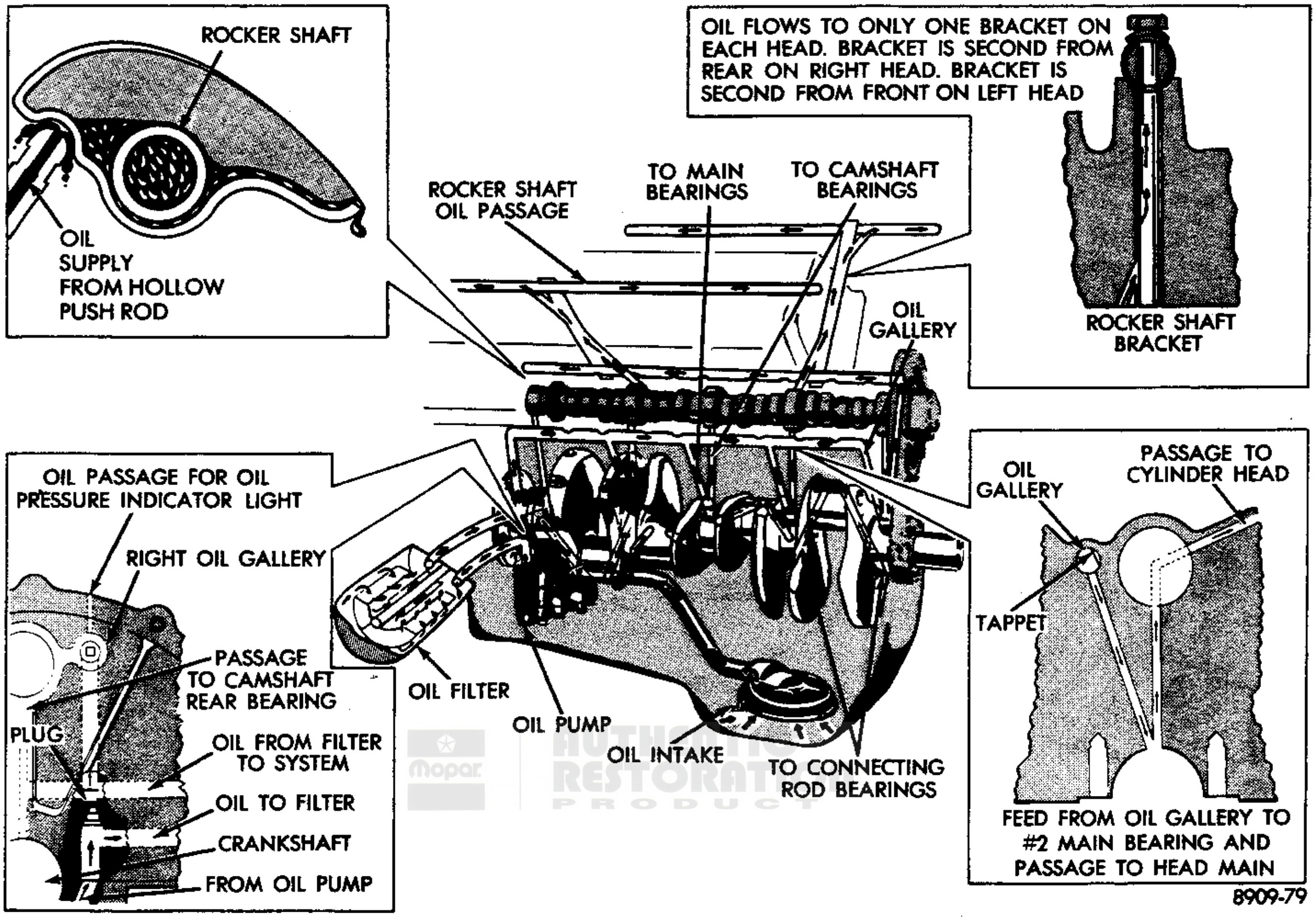


Fig. 25 Engine Lubrication System

PAR (stud and bearing mount adhesive) or equivalent to assure retention of position.

(5) Assemble engine and check oil pressure.

OIL PUMP ASSEMBLY AND INSTALLATION

(1) Assemble pump, using new parts as required.

(2) Install new oil seal rings between cover and pump body. Tighten cover bolts to 11 N•m (95 in. lbs.) torque.

(3) Prime oil pump before installation by filling rotor cavity with engine oil.

(4) Install oil pump. During installation slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement and that pump is fully seated before installing fasteners. Tighten attaching bolts to 41 N•m (30 ft. lbs.) torque.

OIL FILTER

The oil filter should be replaced to coincide with every second oil change.

(1) Using Tool C-4065, unscrew filter from base and discard (Figs. 26 and 27).

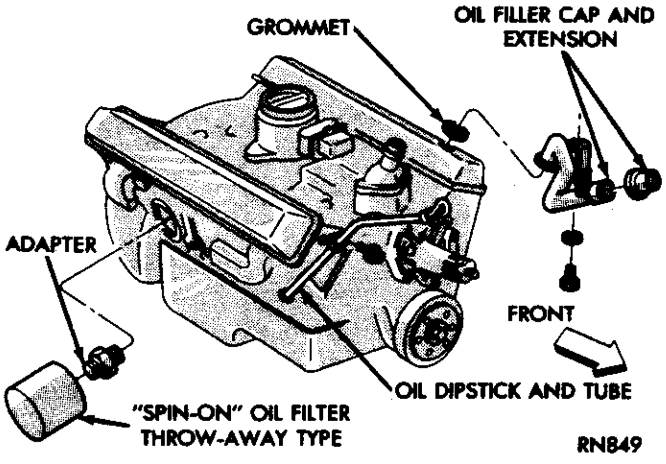


Fig. 26 Oil Filter, Dipstick and Oil Filter

(2) Wipe base clean, then inspect gasket contact surface.

(3) Lubricate gasket of new filter with clean engine oil.

(4) Install and tighten filter to 20 N•m (15 ft. lbs.) torque, or, 3/4 to 1 turns after gasket contacts base. Use filter wrench, if necessary.

(5) Start engine and check for leaks.

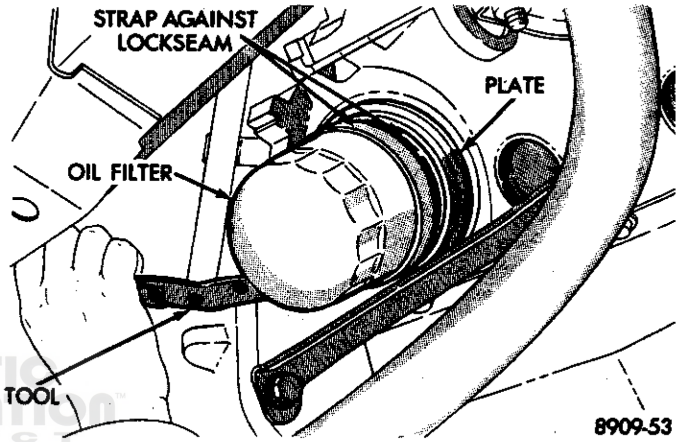


Fig. 27 Removing Oil Filter with Tool C-4065

ENGINE SPECIFICATIONS—5.2L/5.9L

CYLINDER HEAD		
Valve Seat Run-Out (Max.)	0.0762 mm	0.003 inch
Intake Valve Seat Angle	45°-45½°	
Intake Valve Seat Width (Finish)	1.651-2.159 mm	0.065-0.085 inch
Exhaust Valve Seat Angle	45°-45½°	
Exhaust Valve Seat Width (Finish)	2.032-2.540 mm	0.080-0.100 inch
Head Gasket (Thickness Compressed)	0.8382 mm	0.033 inch
VALVE GUIDES		
Type	Cast in the Cylinder Head	
Guide Bore Diameter (Standard)	9.500-9.525 mm	0.374-0.375 inch
VALVES (INTAKE)		
Head Diameter (5.2L)	45.212 mm	1.780 inch
(5.9L)	47.752 mm	1.880 inch
Length Overall (5.2L)	126.03-126.67 mm	4.962-4.987 inch
(5.9L)	126.21-126.85 mm	4.969-4.994 inch
Stem Diameter (Standard)	9.449-9.474 mm	0.372-0.373 inch
Stem-to-Guide Clearance	0.0254-0.0762 mm	0.001-0.003 inch
Max. Clearance (Rocking Method)	0.4318 mm	0.017 inch
Face Angle	44½°-45°	
Lift (Zero Lash) (5.2L)	9.474 mm	0.373 inch
(5.9L)	10.414 mm	0.410 inch
Valves for Service	Standard 0.127 mm 0.381 mm 0.762 mm	Standard 0.005 inch 0.0015 inch 0.030 inch
VALVES (EXHAUST)		
Head Diameter (5.2L)	38.532 mm	1.517 inch
(5.9L)	41.072 mm	1.617 inch
Length (Overall)		
Without Rotators (5.2L)	126.21-127.13 mm	4.969-5.005 inch
With Rotators (5.2L)	126.42-127.30 mm	4.977-5.012 inch
(5.9L)	126.44-127.30 mm	4.978-5.012 inch
Stem Diameter (Standard)	9.423-9.449 mm	0.371-0.372 inch
Stem-to-Guide Clearance	0.0508-0.1016 mm	0.002-0.004 inch
Max. Clearance (Rocking Method)	0.4318 mm	0.017 inch
Face Angle	44½°-45°	
Lift (Zero Lash) (5.2L)	10.160 mm	0.400 inch
(5.9L)	10.414 mm	0.410 inch
Valves for Service	Standard 0.127 mm 0.381 mm 0.762 mm	Standard 0.005 inch 0.0015 inch 0.030 inch
VALVE TIMING		
Intake Opens (BTC)	10° (5.2L)	18° (5.9L)
Intake Closes (ABC)	50° (5.2L)	54° (5.9L)
Exhaust Opens (BBC)	52° (5.2L)	57° (5.9L)
Exhaust Closes (ATC)	16° (5.2L)	15° (5.9L)
Valve Overlap	26° (5.2L)	33° (5.9L)
Intake Valve Duration	240° (5.2L)	252° (5.9L)
Exhaust Valve Duration	248° (5.2L)	252° (5.9L)

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ENGINE SPECIFICATIONS—5.2L/5.9L (CONT.)

VALVE SPRINGS

Number (Intake and Exhaust)		8 Springs	
Color Code (Intake)		Blue	
(Exhaust with Rotators - 5.2L)		White	
(Exhaust with Rotators - 5.9L)		Yellow	
Free Length (Approx.) (Intake)	50.80 mm		2.00 inch
(Exhaust)	45.97 mm		1.81 inch
Wire Diameter (Intake)	4.877 mm		0.192 inch
(Exhaust with Rotators - 5.2L)	4.699 mm		0.185 inch
(Exhaust with Rotators - 5.9L)	4.877 mm		0.192 inch
Number of Coils (Intake)		6.4 coils	
(Exhaust with Rotators - 5.2L)		5.8 coils	
(Exhaust with Rotators - 5.9L)		5.6 coils	
Load When Compressed (Intake)	347-391 N		78-88 lbs.
(Valve Closed)	@ 42.86 mm		@ 1-11/16 inch
(Exhaust)	356-400 N		80-90 lbs.
	@ 37.70 mm		@ 1-31/64 inch
Load When Compressed (Intake)	756-818 N		170-184 lbs.
(Valve Open)	@ 33.34 mm		@ 1-5/16 inch
(5.2L - Exhaust)	801-863 N		180-194 lbs.
	@ 27.38 mm		@ 1-5/64 inch
(5.9L - Exhaust)	805-876 N		181-197 lbs.
	@ 26.99 mm		@ 1-1/16 inch
Max. Allowable Out-of-Plumb	1.588 mm		1/16 inch
Valve Spring Installed (Intake)	41.275-42.86 mm		1-5/8 1-11/16 inch
Height (Seat-to-Retainer) (Exhaust)	36.909-38.497 mm		1-29/64 1-33/64 inch

Use a 1/16 inch spacer to reduce spacing height when over specifications

TIMING CHAIN

Number of Links		68 links	
Pitch	9.525 mm		0.375 inch
Width	15.875 mm		0.625 inch

TAPPETS

Type		Hydraulic	
Body Diameter	22.949-22.962 mm		0.9035-0.904 inch
Clearance in Block	0.0279-0.0610 mm		0.0011-0.0024 inch
Dry Lash	1.524-5.334 mm		0.060-0.210 inch
Push Rod Length (5.2L)	172.57-173.08 mm		6.794-6.814 inch
(5.9L)	190.63-191.14 mm		7.505-7.525 inch
Service Tappets Available	Standard		Standard
	0.0254 mm		0.001 inch
	0.2032 mm		0.008 inch
	0.7620 mm		0.030 inch

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ENGINE SPECIFICATIONS—5.2L/5.9L (CONT.)

CAMSHAFT

Drive	Chain	
Bearings	Steel Backed Babbitt	
Number	5	
Diametral Clearance	0.0254-0.0762 mm	0.001-0.003 inch
Max. before Reconditioning	0.127 mm	0.005 inch
Thrust Taken By	Thrust Plate	
End Play	0.0508-0.254 mm	0.002-0.010 inch
Max. Allowable End Play	0.254 mm	0.010 inch

CAMSHAFT JOURNALS

Diameter #1	50.749-50.775 mm	1.998-1.999 inch
Diameter #2	50.343-50.368 mm	1.982-1.983 inch
Diameter #3	49.962-49.987 mm	1.967-1.968 inch
Diameter #4	49.555-49.581 mm	1.951-1.952 inch
Diameter #5	39.637-39.662 mm	1.5605-1.5615 inch

CAMSHAFT BEARINGS

Diameter #1	50.800-50.825 mm	2.000-2.001 inch
Diameter #2	50.394-50.419 mm	1.984-1.985 inch
Diameter #3	50.013-50.038 mm	1.969-1.970 inch
Diameter #4	49.606-49.632 mm	1.953-1.954 inch
Diameter #5	39.688-39.713 mm	1.5625-1.5635 inch

CYLINDER BLOCK

Cylinder Bore (5.2L)	99.31-99.36 mm	3.910-3.912 inch
(5.9L)	101.60-101.65 mm	4.000-4.002 inch
Cylinder Bore Out-of-Round (Max. before reconditioning)	0.127 mm	0.005 inch
Cylinder Bore Taper Max. before reconditioning)	0.254 mm	0.010 inch
Reconditioning Working Limits	0.025 mm	0.001 inch
Cylinder Bore (Max. Oversize)	0.102 mm	0.040 inch
Tappet Bore Diameter	22.99-23.01 mm	0.9051-0.9059 inch
Distributor Lower Drive Shaft Bushing (press fit in block)	0.013-0.356 mm	0.0005-0.014 inch
Shaft-to-Bushing Clearance	0.018-0.069 mm	0.0007-0.0027 inch

CONNECTING RODS

Length (Center-to-Center)	155.473 mm	6.121 inch
Weight (Less Bearing Shells) (5.2L)	726 grams	
(5.9L)	758 grams	
Side Clearance (Two Rods)	0.152-0.356 mm	0.006-0.014 inch
Piston Pin Bore Diameter	24.966-24.978 mm	0.9829-0.9834 inch

CONNECTING ROD JOURNALS

Diameter	53.950-53.975 mm	2.124-2.125 inch
Max. Out-of-Round and/or Taper	0.0254 mm	0.001 inch

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ENGINE SPECIFICATIONS—5.2L/5.9L (CONT.)

CONNECTING ROD BEARINGS

Type (5.2L)	Tin-Aluminum	
(5.9L)	Tri-Metal	
Diameter	54.000 mm	2.126 inch
Width	21.387 mm	0.842 inch
Clearance	0.0127-0.0559 mm	0.0005-0.0022 inch
Max. Clearance Allowable (5.2L)	0.0559 mm	0.0022 inch
(5.9L)	0.0635 mm	0.0025 inch
Bearings for Service	Standard 0.0254 mm 0.0508 mm 0.2540 mm 0.3048 mm	Standard 0.001 inch 0.002 inch 0.010 inch 0.012 inch

CRANKSHAFT

Type (5.2L)	Fully Counter-Balanced	
(5.9L)	Fully Externally-Balanced	
Bearings (5.2L)	Steel Backed Babbitt #3 Thrust Aluminum	
(5.9L)	Steel Backed Lead Aluminum #5 Babbitt	
Thrust Taken By	#3 Main Bearing	
End Play (5.2L)	0.051-0.178 mm	0.002-0.007 inch
(5.9L)	0.051-0.229 mm	0.002-0.009 inch
End Play (Maximum Allowable)	0.254 mm	0.010 inch
Diametral Clearance #1	0.0127-0.0381 mm	0.0005-0.0015 inch
Max. Clearance #1	0.0381 mm	0.0015 inch
Diametral Clearance #2, 3, 4 & 5	0.0127-0.0508 mm	0.0005-0.0020 inch
Max. Clearance #2, 3, 4 & 5	0.0635 mm	0.0025 inch
Finish st Rear Oil Seal Surface	Diagonal Knurling	

MAIN BEARING JOURNALS

Diameter (5.2L)	63.487-63.513 mm	2.4995-2.5005 inch
(5.9L)	71.361-71.387 mm	2.8095-2.8105 inch
Max. Out-of-Round and/or Taper	0.0254 mm	0.001 inch
Bearings for Service	Standard 0.0254 mm 0.0508 mm 0.0762 mm 0.2540 mm 0.3048 mm	Standard 0.001 inch 0.002 inch 0.003 inch 0.010 inch 0.012 inch

ENGINE LUBRICATION

Pump Type	Rotary	Full Pressure
Pump Drive	Camshaft	
*Minimum Pump Pressure & Idle	41.4 kPa	6 psi
*Operating Pressure @ 3000 rpm	207-552 kPa	30-80 psi
Pressure Drop Resulting from Clogged Filter	48.3-62.1 kPa	7-9 psi

*CAUTION: If pressure is 0 at curb idle, DO NOT run engine at 3000 rpm.

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ENGINE SPECIFICATIONS—5.2L/5.9L (CONT.)

PISTONS		
Type of Material	Alloy Tin Coated	
Land Clearance (Diameter) (5.2L)	0.483-0.610 mm	0.019-0.024 inch
(5.9L)	0.508-0.660 mm	0.020-0.026 inch
Clearance at Top of Skirt	0.013-0.038 mm	0.0005-0.0015 inch
Weight (5.2L)		594.6 ±2 grams
(5.9L)		584.0 ±2 grams
Piston Length (Overall) (5.2L)	86.36 mm	3.40 inch
(5.9L)	81.03 mm	3.19 inch
Ring Groove Depth (5.2L)		
No. 1	5.207 mm	0.205 inch
No. 2	5.207 mm	0.205 inch
No. 3	4.928 mm	0.194 inch
Ring Groove Depth (5.9L)		
No. 1	5.334 mm	0.210 inch
No. 2	5.334 mm	0.210 inch
No. 3	5.055 mm	0.199 inch
Pistons for Service	Standard	
Oversize	0.508 mm	0.020 inch

PISTON PINS		
Type	Press Fit in Rod	
Diameter	24.996-25.001 mm	0.9841-0.9843 inch
Length	75.946-76.708 mm	2.990-3.020 inch
Clearance in Piston (5.2L)	0.0000-0.0127 mm	0.0000-0.0005 inch
(Light Thumb Push (5.9L)	0.0064-0.0191 mm	0.00025-0.00075 inch
End Play	None	
Clearance in Rod	0.0178-0.0356 mm	0.0007-0.0014 inch
	Interference	
Pins for Service	Standard	
Oversize	0.076 & 0.203 mm	0.003 & 0.008 inch

PISTON RINGS		
Number of Rings per Piston	3	
Compression Rings	2	
Oil Ring	1	
Oil Ring Type	3-piece steel rail chrome-face	
Ring Width		
Compression	1.9558-1.9812 mm	0.077-0.078 inch
Oil Ring (Steel Rails)	0.640 mm Max.	0.0252 inch Max.
Ring Gap		
Compression	0.254-0.508 mm	0.010-0.020 inch
Oil Ring (Steel Rails)	0.381-1.397 mm	0.015-0.055 inch
Ring Side Clearance		
Compression	0.038-0.076 mm	0.0015-0.003 inch
Oil Ring (Steel Rails)	0.005-0.127 mm	0.0002-0.005 inch
Ring Gap - Service Rings		
Compression	0.254-1.508 mm	0.010-0.020 inch
Oil Ring (Steel Rails - 5.2L)	0.254-1.575 mm	0.010-0.062 inch
(5.9L)	0.381-1.575 mm	0.015-0.062 inch
Ring Side Clearance		
Compression	0.038-0.102 mm	0.0015-0.004 inch
Oil Ring (Steel Rails)	0.005-0.127 mm	0.0002-0.005 inch

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OIL PUMP INSPECTION LIMITS FOR REPLACEMENT—5.2L/5.9L

Oil Pump Cover Out Of Flat	.0015 inch or more
Outer Rotor Thickness	.825 inch or less
Outer Rotor Diameter	2.469 inch or less
Inner Rotor Thickness	.825 inch or less
Clearance Over Rotors—Outer	.004 inch or more
Inner	.004 inch or more
Outer Rotor Clearance	.014 inch or more
Tip Clearance Between Rotors	.008 inch or more

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OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS—5.2L/5.9L

CONDITION	IDENTIFICATION	LOCATION OF IDENTIFICATION
0.025 mm (0.001 inch) U/S Crankshaft	R or M M-2-3 etc. (Indicating No. 2 & 3 main bearing journal) and/or R-1-4 etc. (Indicating No. 1 & 4 connecting rod journal)	Milled flat on number eight crankshaft counterweight on 5.2L cranks. On 5.9L cranks it is on the number three counterweight.
0.254 mm (0.010 inch) U/S Crankshaft	RX or MX MX (Indicates 0.254 mm (0.010 inch) U/S all main journals) and/or RX (Indicating 0.254 mm (0.010 inch) U/S all rod journals)	Milled flat on number eight crankshaft counterweight on 5.2L cranks. On 5.9L cranks it is on the number three counterweight.
0.508 mm (0.020 inch) O/S Cylinder Bores	A	Following engine serial number.
0.203 mm (0.008 inch) O/S Tappets	◆	3/8″ diamond-shaped stamp Top pad — Front of engine and flat ground on outside surface of each O/S tappet bore.
0.127 mm (0.005 inch) O/S Valve Stems	X	Milled pad adjacent to two 3/8″ tapped holes on each end of cylinder head.

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TORQUE SPECIFICATIONS—5.2L/5.9L

COMPONENT	TORQUE	
A/C Compressor Bracket to Water Pump Bolts	41 N•m	30 ft. lbs.
A/C Compressor to Bracket Nut	68 N•m	50 ft. lbs.
A/C Compressor Support Bolts	41 N•m	30 ft. lbs.
Alternator Adjusting Strap Bolt	23 N•m	(200 in. lbs.)
Alternator Adjusting Strap Mounting Bolts	41 N•m	30 ft. lbs.
Alternator Bracket Bolts	41 N•m	30 ft. lbs.
Alternator Mounting Pivot Nuts	41 N•m	30 ft. lbs.
Camshaft Sprocket Lockbolts	68 N•m	50 ft. lbs.
Camshaft Thrust Plate	24 N•m	(210 in. lbs.)
Chain Case Cover Bolts	47 N•m	35 ft. lbs.
Clutch Housing 3/8" Bolts	41 N•m	30 ft. lbs.
7/16" Bolts	68 N•m	50 ft. lbs.
Connecting Rod Nuts	61 N•m	45 ft. lbs.
Crankshaft Bolts (Vibration Damper)	136 N•m	100 ft. lbs.
Cylinder Head Bolts	143 N•m	105 ft. lbs.
Cylinder Head Cover with Load Spreader Washers	9 N•m	(80 in. lbs.)
Distributor Clamp Bolt	23 N•m	(200 in. lbs.)
Engine Front Mount Insulator to Frame Nuts	102 N•m	75 ft. lbs.
Engine Front Mount Insulator to Engine Nuts	88 N•m	65 ft. lbs.
Engine Rear Mount Insulator to Crossmember Nuts	68 N•m	50 ft. lbs.
Engine Rear Mount Insulator to Extension Nuts	68 N•m	50 ft. lbs.
Engine Rear Mount Crossmember to Frame Nuts	102 N•m	75 ft. lbs.
Engine Manifold Bolts	27 N•m	20 ft. lbs.
Nuts	20 N•m	15 ft. lbs.
Exhaust Pipe Flange Nuts	33 N•m	24 ft. lbs.
Fan Blade Attaching Bolts	23 N•m	(200 in. lbs.)
Flex Plate to Converter Bolts	31 N•m	(270 in. lbs.)
Flex Plate to Crankshaft Bolts	75 N•m	55 ft. lbs.
Flywheel to Crankshaft Bolts	75 N•m	55 ft. lbs.
Intake Manifold Bolts	54 N•m	40 ft. lbs.
Main Bearing Cap Bolts	115 N•m	85 ft. lbs.
Oil Pan Drain Plug	27 N•m	20 ft. lbs.
Oil Pan Bolts	23 N•m	(200 in. lbs.)
Oil Pump Cover Bolts	11 N•m	(95 in. lbs.)
Oil Pump Attaching Bolts	41 N•m	30 ft. lbs.
Oil Filter Attaching Stud	68 N•m	50 ft. lbs.
Oil Pressure Gauge Sending Unit	7 N•m	(60 in. lbs.)
Rocket Shaft Bracket Bolts	23 N•m	(200 in. lbs.)
Spark Plugs	41 N•m	30 ft. lbs.
Starter Mounting Bolts	68 N•m	50 ft. lbs.
Temperature Gauge Sending Unit	7 N•m	(60 in. lbs.)
Water Pump to Housing Bolts	41 N•m	30 ft. lbs.

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EXHAUST SYSTEM AND INTAKE MANIFOLD

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GENERAL INFORMATION

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EXHAUST SYSTEM

The basic exhaust system consists of exhaust manifolds, exhaust pipe, catalytic converter(s), extension pipe, heat shields, muffler and tailpipe (Fig. 1).

All engines have a thermostatic controlled heat valve in the exhaust manifold for faster warmup and improved driveability after cold start.

The exhaust manifolds are equipped with ball flange outlets to assure a tight seal and strain free connections. The exhaust system must be properly aligned to prevent stress, leakage and body contact. If the system contacts any body panel, it may amplify objectionable noises originating from the engine or body.

When inspecting an exhaust system, critically inspect for cracked or loose joints, stripped screw or bolt threads, corrosion damage and worn, cracked or broken hangers. Replace all components that are badly corroded or damaged. DO NOT attempt to repair.

When replacement is required, use original equipment parts (or their equivalent) to assure proper alignment and to provide acceptable exhaust noise levels.

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

CATALYTIC CONVERTER

The stainless steel catalytic converter body is designed to last the life of the vehicle. Excessive heat can result in bulging or other distortion, but excessive heat will not be the fault of the converter. A fuel system, air injection system or ignition system malfunction that permits unburned fuel to enter the converter will usually cause overheating. If a converter is heat-damaged, correct the cause of the damage at the same time the converter is replaced. Also, inspect all other components of the exhaust system for heat damage.

Unleaded gasoline must be used to avoid contaminating the catalyst core.

HEAT SHIELDS

Heat shields are needed to protect both the vehicle and the environment from the high temperatures developed in the vicinity of the catalytic converter. The combustion reaction facilitated by the catalyst releases additional heat in the exhaust system. Under severe operating conditions, the temperature increases in the area of the reactor. Such conditions can exist when the engine misfires or otherwise does not operate at peak efficiency. DO NOT remove spark plug wires from plugs or by any other means short out cylinders. Failure of the catalytic converter can occur due to a temperature increase caused by unburned fuel passing through the converter.

Do not allow the engine to operate at fast idle for extended periods (over five minutes). This condition may result in excessive temperatures in the exhaust system and on the floor pan.

EXHAUST GAS RECIRCULATION (EGR)

To assist in the control of oxides of nitrogen (NOx) in engine exhaust, all engines are equipped with an exhaust gas recirculation system. The use of exhaust gas to dilute incoming air/fuel mixtures lowers peak flame temperatures during combustion, thus limiting the formation of NOx.

Exhaust gases are taken from openings in the exhaust gas crossover passage in the intake manifold. Refer to Group 25, Emission Control Systems of this

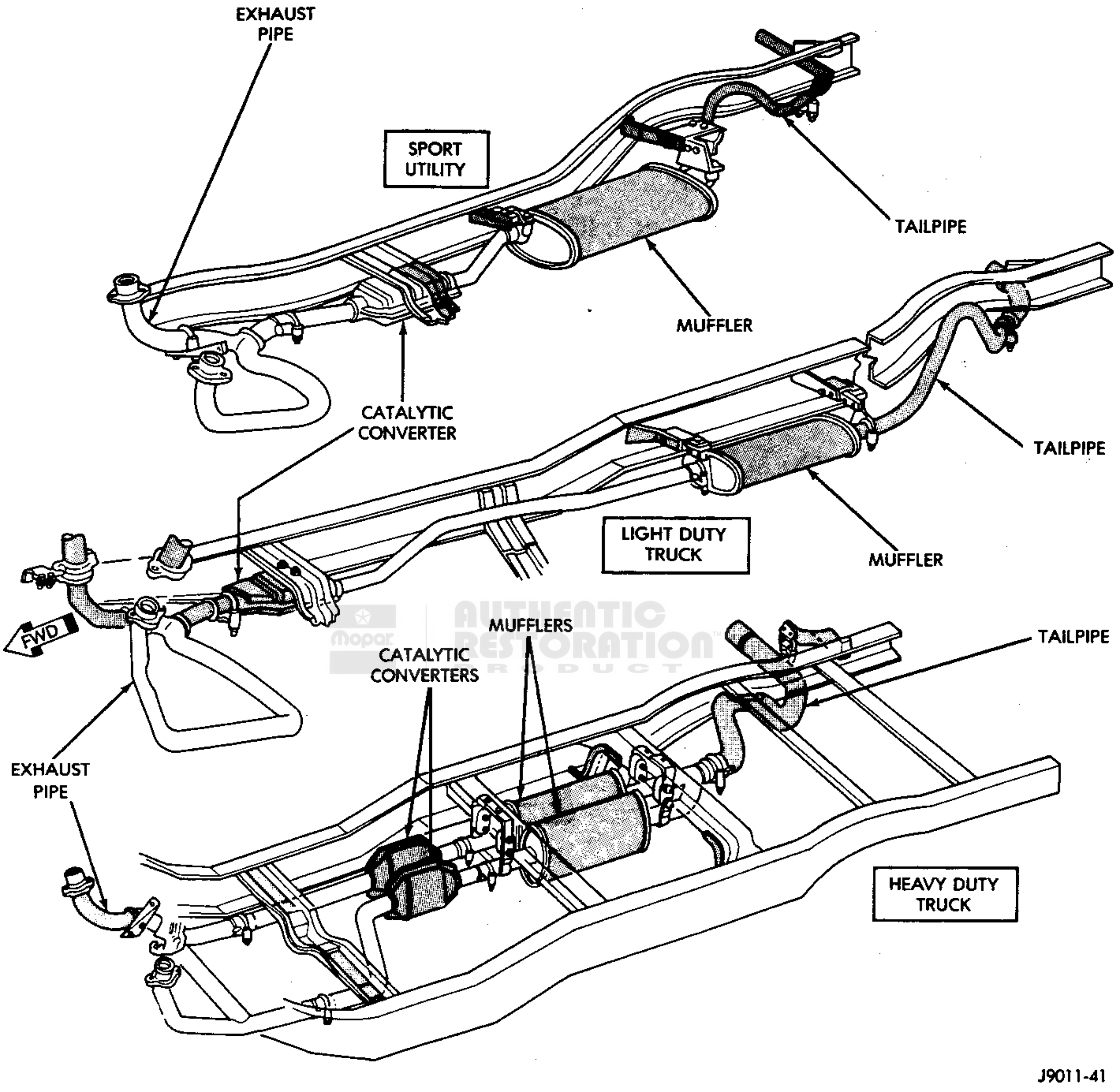

Fig. 1 Exhaust Systems (Typical)

manual for a complete description, diagnosis and service procedures on the exhaust gas recirculation system and components.

MANIFOLD HEAT CONTROL VALVE

A manifold heat control valve is located in the right exhaust manifold. The thermostatic controlled valve directs heated exhaust gases to the heat chamber in the intake manifold beneath the throttle body. This helps vaporize the fuel mixture during the engine warm-up period. When the valve is closed, the exhaust gases are directed to the heat chamber through the right side of the exhaust crossover passage. After circulating through the heat chamber, the gases are returned to the exhaust manifold through the left side of the passage.

EXHAUST DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE	(a) Leaks at pipe joints. (b) Burned or blown out muffler. (c) Burned or rusted out exhaust pipe. (d) Exhaust pipe leaking at manifold flange. (e) Exhaust manifold cracked or broken. (f) Leak between manifold and cylinder head. (g) Restriction in muffler or tail pipe.	(a) Tighten clamps at leaking joints. (b) Replace muffler assembly. (c) Replace exhaust pipe. (d) On all engines, tighten ball joint connection attaching bolt nuts to 33 N•m (24 ft. lbs.) alternate tightening. (e) Replace manifold. (f) Tighten manifold to cylinder head stud nuts or bolts to specifications. (g) Remove restriction, if possible, or replace as necessary.
LEAKING EXHAUST GASES	(a) Leaks at pipe joints. (b) Damaged or improperly installed gaskets.	(a) Tighten U-bolts at leaking joints to 17 N•m (150 in. lbs.) (b) Replace gaskets as necessary.
ENGINE HARD TO WARM UP OR WILL NOT RETURN TO NORMAL IDLE	(a) Heat control valve frozen in the open position. (b) Blocked crossover passage in intake manifold.	(a) Free up manifold heat control valve using a suitable solvent. (b) Remove restriction or replace intake manifold.
HEAT CONTROL VALVE NOISY	(a) Thermostat broken. (b) Broken, weak or missing anti-rattle spring.	(a) Replace thermostat. (b) Replace spring.

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SERVICE PROCEDURES

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EXHAUST PIPE, MUFFLERS, CONVERTERS AND TAILPIPE

REMOVAL (GENERAL)

(1) Raise vehicle on hoist and apply penetrating oil to clamp bolts and nuts of component being removed.

(2) Remove clamps and supports from exhaust system to permit alignment of parts during assembly.

(3) Clean ends of pipes and/or muffler to assure mating of all parts. Discard broken or worn insulators, rusted clamps, supports and attaching parts.

When replacement is required on any component of the exhaust system, it is most important that original equipment parts (or their equivalent) be used to assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

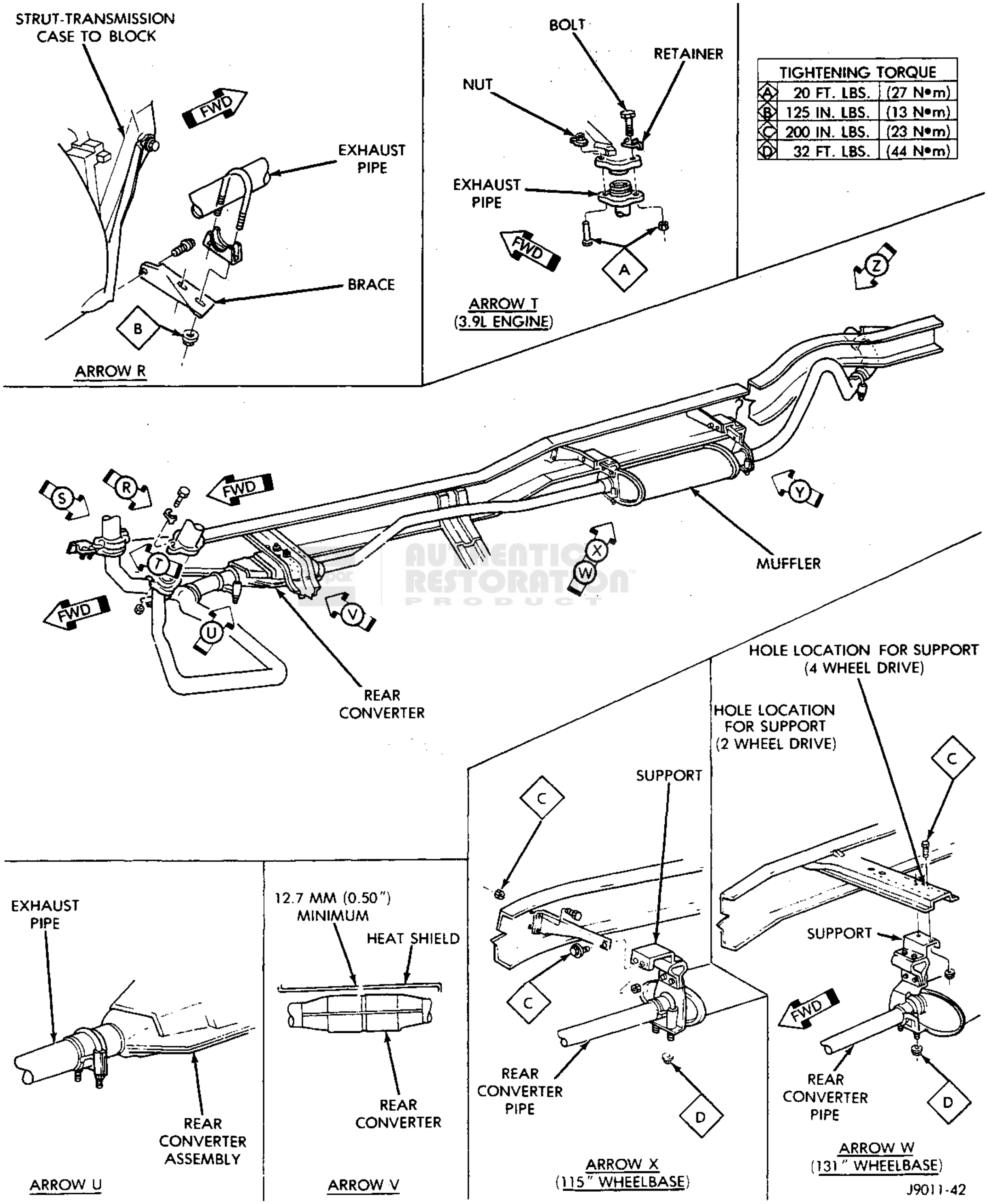
INSTALLATION (GENERAL)

(1) Assemble pipes, muffler, supports and clamps loosely to permit proper alignment of all parts.

(2) Beginning at front of system, align and clamp each component to maintain position and proper clearance with underbody parts.

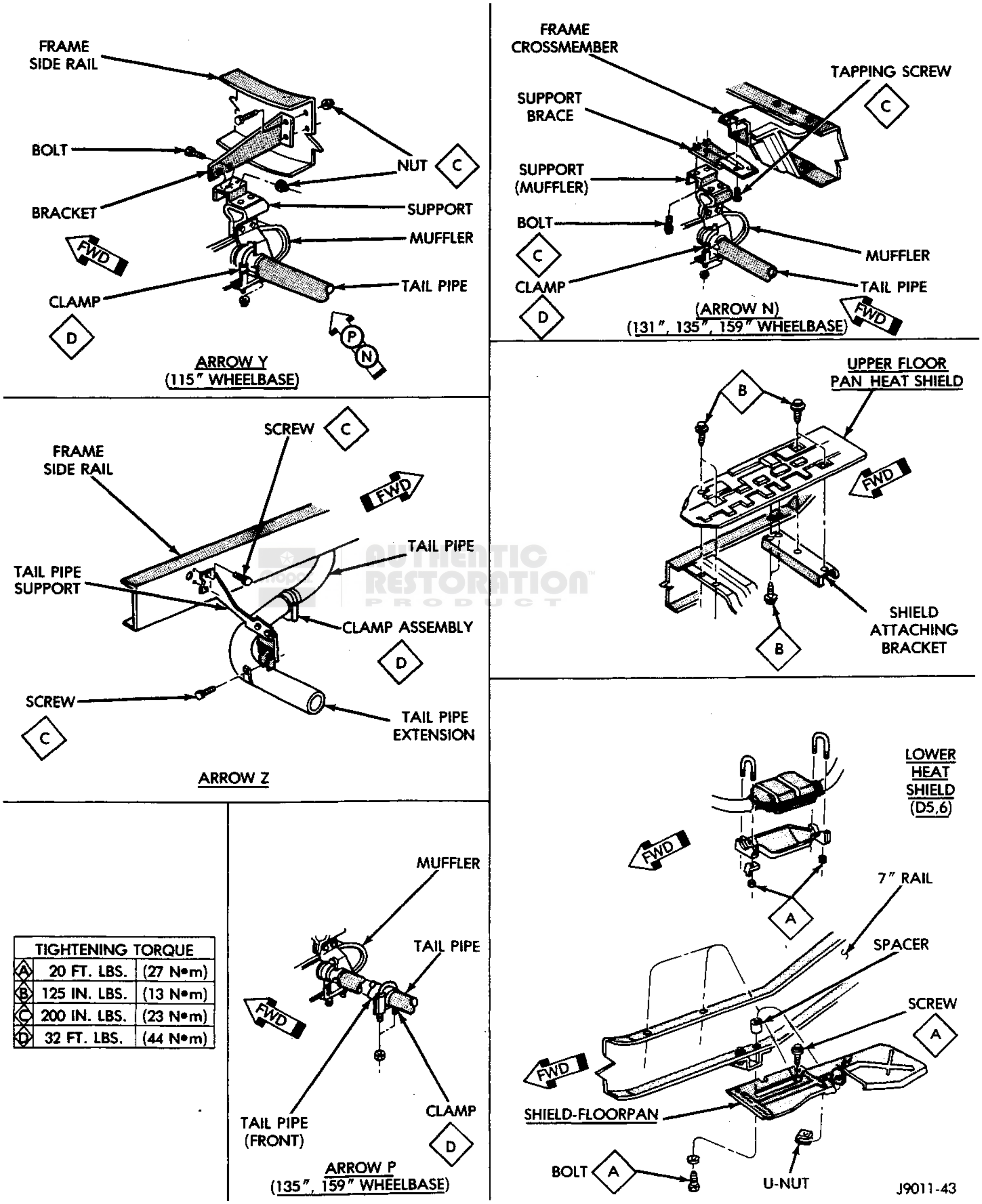
(3) On models using ball-type connections, alternately tighten bolts to assure flanges are even and parallel.

(4) Tighten all clamps and supports to the proper torques (Figs. 1 thru 6).



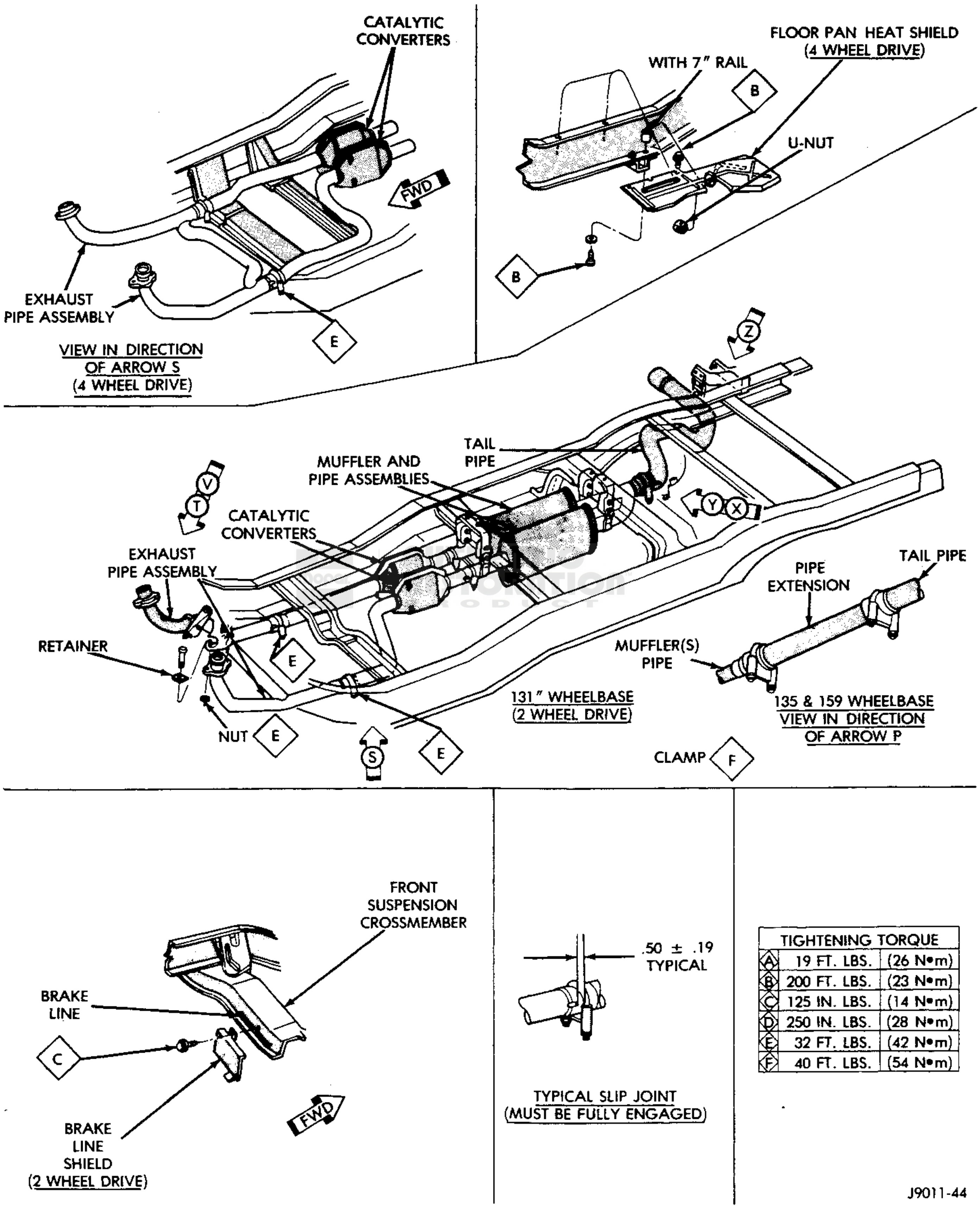
	TIGHTENING TORQUE	
A	20 FT. LBS.	(27 N•m)
B	125 IN. LBS.	(13 N•m)
C	200 IN. LBS.	(23 N•m)
D	32 FT. LBS.	(44 N•m)

Fig. 1 Single Exhaust System—Light Duty Trucks (Not Sport Utility)



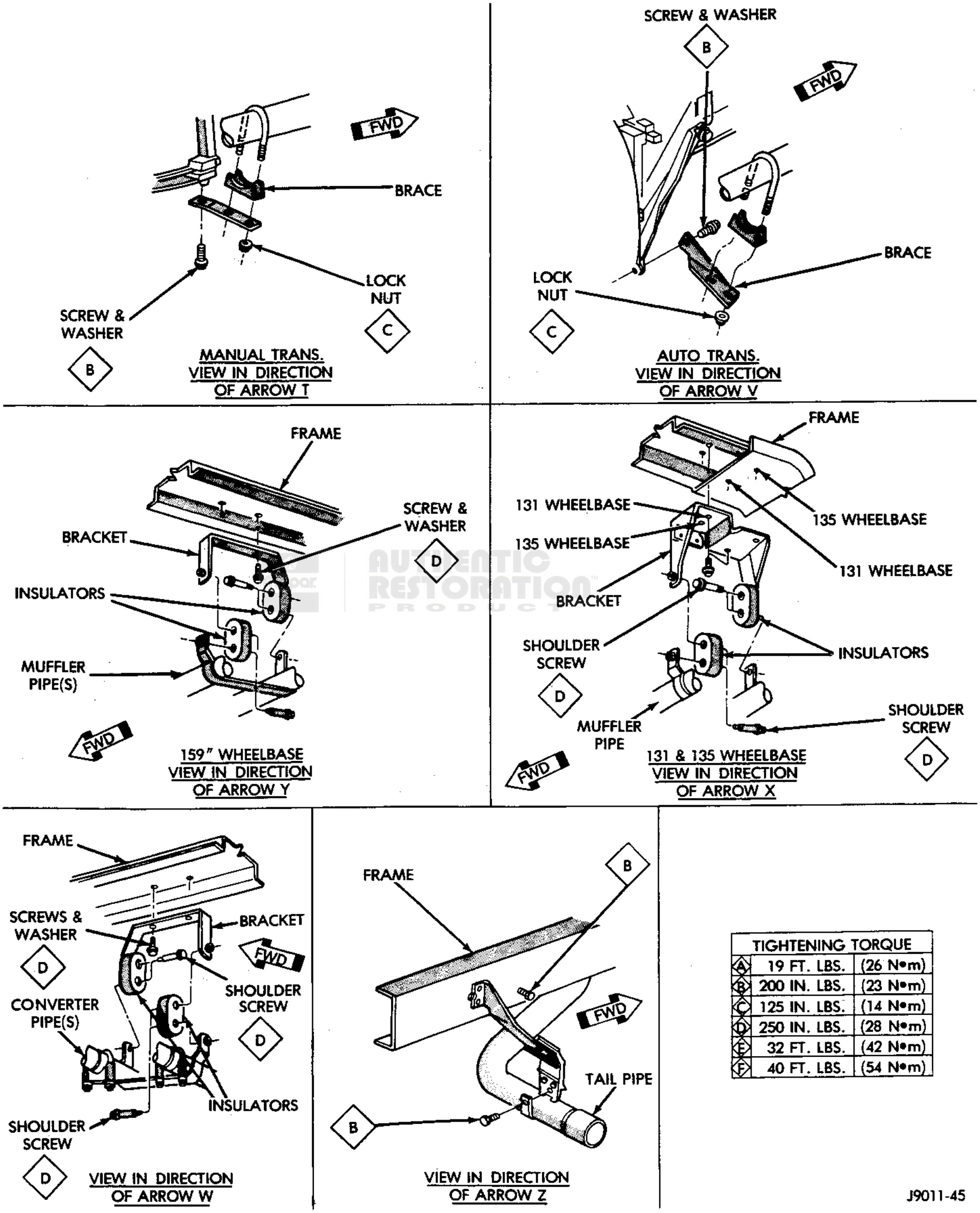
TIGHTENING TORQUE		
A	20 FT. LBS.	(27 N•m)
B	125 IN. LBS.	(13 N•m)
C	200 IN. LBS.	(23 N•m)
D	32 FT. LBS.	(44 N•m)

Fig. 2 Single Exhaust System—Light Duty Trucks (Not Sport Utility)



TIGHTENING TORQUE		
A	19 FT. LBS.	(26 N•m)
B	200 FT. LBS.	(23 N•m)
C	125 IN. LBS.	(14 N•m)
D	250 IN. LBS.	(28 N•m)
E	32 FT. LBS.	(42 N•m)
F	40 FT. LBS.	(54 N•m)

Fig. 3 Dual Exhaust System—Heavy Duty Trucks



TIGHTENING TORQUE	
A 19 FT. LBS.	(26 N•m)
B 200 IN. LBS.	(23 N•m)
C 125 IN. LBS.	(14 N•m)
D 250 IN. LBS.	(28 N•m)
E 32 FT. LBS.	(42 N•m)
F 40 FT. LBS.	(54 N•m)

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Fig. 4 Dual Exhaust System—Heavy Duty Trucks

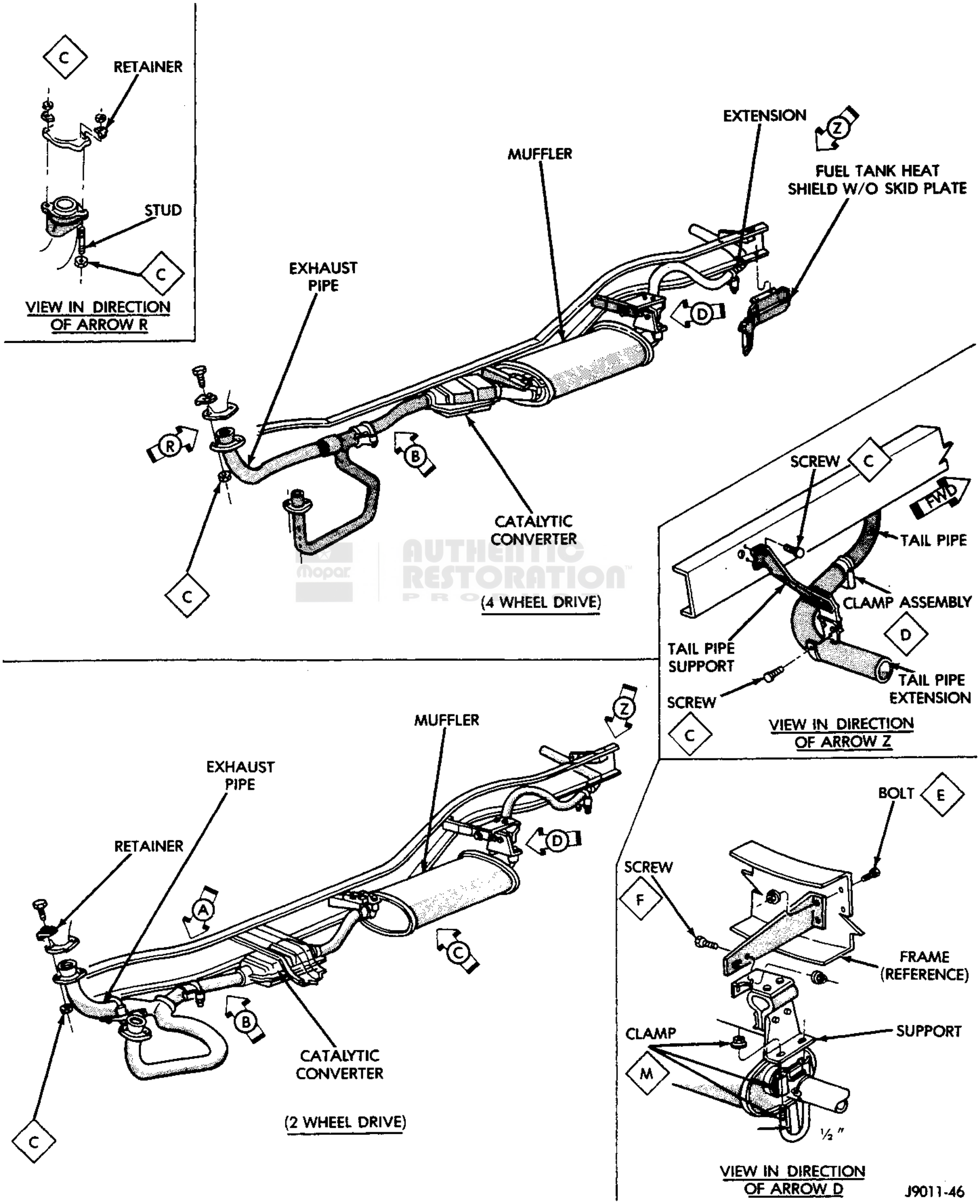
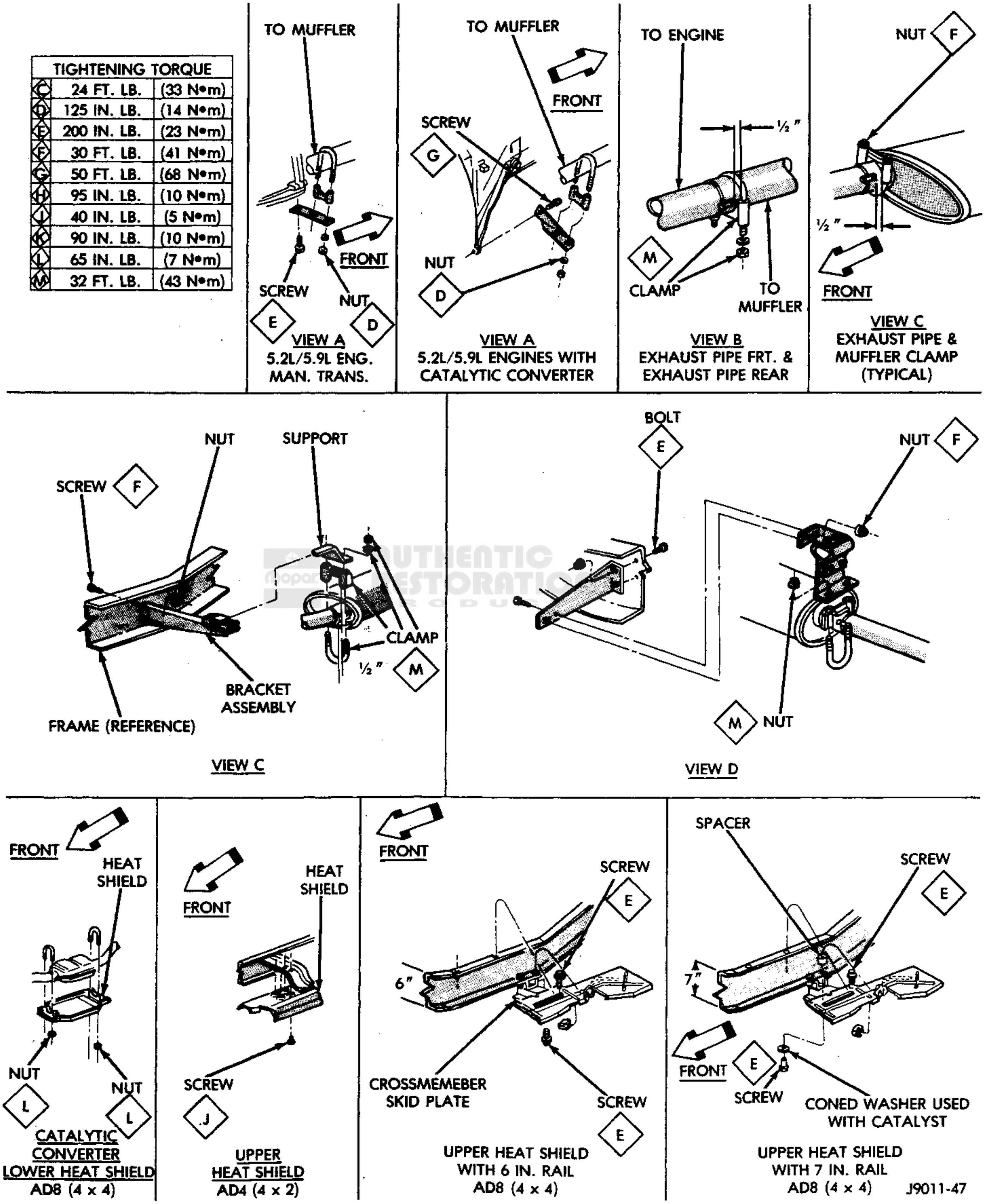


Fig. 5 Sport Utility Exhaust System



TIGHTENING TORQUE		
C	24 FT. LB.	(33 N•m)
D	125 IN. LB.	(14 N•m)
E	200 IN. LB.	(23 N•m)
F	30 FT. LB.	(41 N•m)
G	50 FT. LB.	(68 N•m)
H	95 IN. LB.	(10 N•m)
J	40 IN. LB.	(5 N•m)
K	90 IN. LB.	(10 N•m)
L	65 IN. LB.	(7 N•m)
M	32 FT. LB.	(43 N•m)

Fig. 6 Sport Utility Exhaust System

INTAKE MANIFOLD

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain the cooling system (refer to Group 7, Cooling System for the proper procedures).

(3) Remove the alternator, air cleaner and fuel lines (intake and return).

(4) Disconnect the accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(5) Remove the return spring.

(6) Remove the distributor cap and wires.

(7) Disconnect the coil wires, heat indicator sending unit wire, heater hoses and bypass hose.

(8) Remove the closed crankcase ventilation and evaporation control systems.

(9) Remove the right cylinder head cover.

(10) Remove intake manifold bolts.

(11) Lift the intake manifold and throttle body out of the engine compartment as an assembly.

(12) Remove the throttle body bolts and lift the throttle body off the intake manifold (Fig. 7). Discard the throttle body gasket.

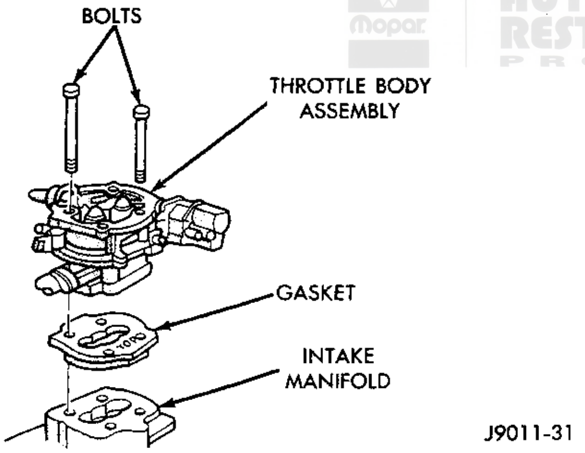


Fig. 7 Throttle Body Assembly

CLEANING AND INSPECTION

Clean manifold in solvent and blow dry with compressed air.

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

Inspect exhaust crossover passages through manifold. If passages are coated with hard, black carbon, they should be scraped clean and sandblasted to remove the carbon deposits.

INSTALLATION

(1) Using a new gasket, install the throttle body onto the intake manifold. Tighten the bolts to 20 N•m (175 in. lbs.) torque.

CAUTION: Intake manifold SIDE gaskets are identified with cutouts (RT for RIGHT side and LT for LEFT side) (Figs. 8 and 9). They MUST be installed as designated to provide proper coolant flow through the water cooled intake manifold.

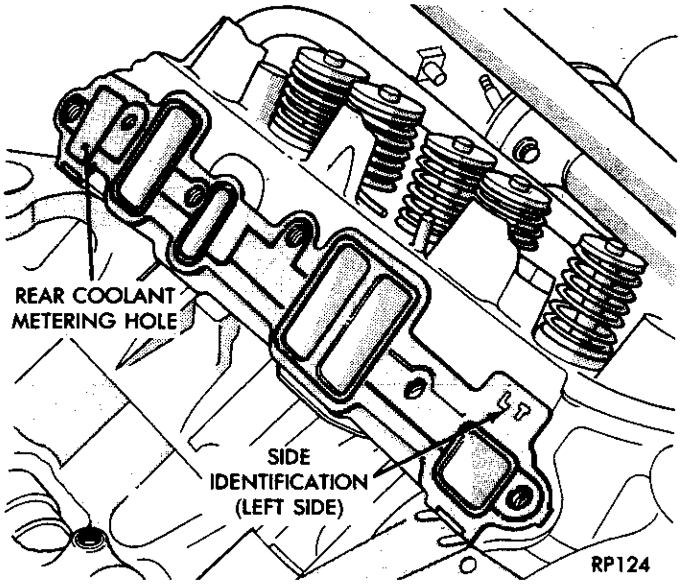


Fig. 8 Intake Manifold Side Gaskets (3.9L Left Side Shown)

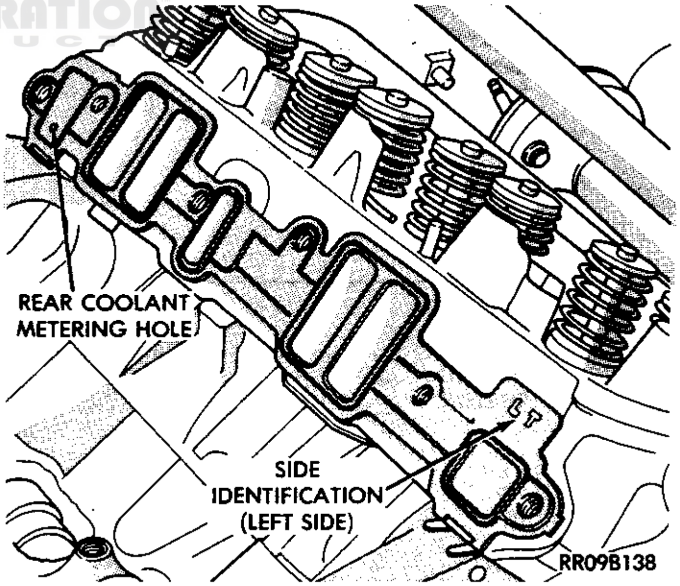


Fig. 9 Intake Manifold Side Gaskets (5.2L Left Side Shown)

(2) Place a drop (approximately 1/4 inch diameter) of Rubber Sealer (RTV) into each of the four block to cylinder head corners.

(3) Apply a thin, uniform coating of a quick dry cement to the intake manifold front and rear gaskets and cylinder block gasket surface.

(4) Allow to dry 4 to 5 minutes or until tack-free to the touch.

(5) Carefully install the front and rear intake manifold gaskets. When installing gaskets, the center

hole in the gasket MUST engage dowels in the block. End holes in seals MUST be locked into tangs of head gasket (Figs. 10 and 11).

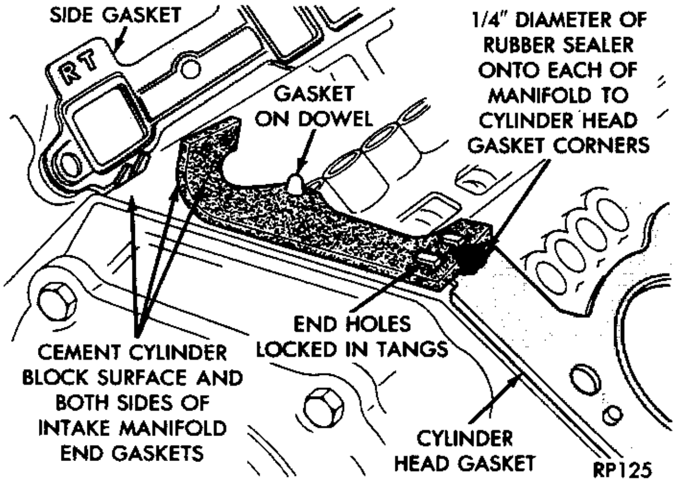


Fig. 10 Intake Manifold END Sealing—3.9L Engine

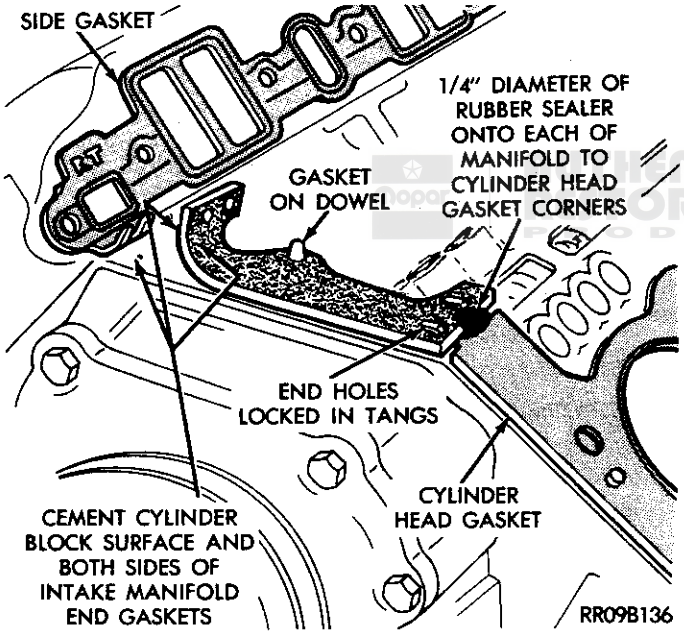


Fig. 11 Intake Manifold END Sealing—5.2L/5.9L Engines

(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 all attaching cap bolts (finger tight). Tighten the cap bolts to 34 N•m (25 ft. lbs.) torque in the tightening sequence shown in Fig. 12 or 13. Then tighten the cap bolts to 54 N•m (40 ft. lbs.) torque in the sequence shown in Fig. 12 or 13.

(8) Install closed crankcase ventilation and evaporation control systems.

(9) Install coil wires, heat indicator sending unit wire, heater hoses and bypass hose.

(10) Install distributor cap and wires.

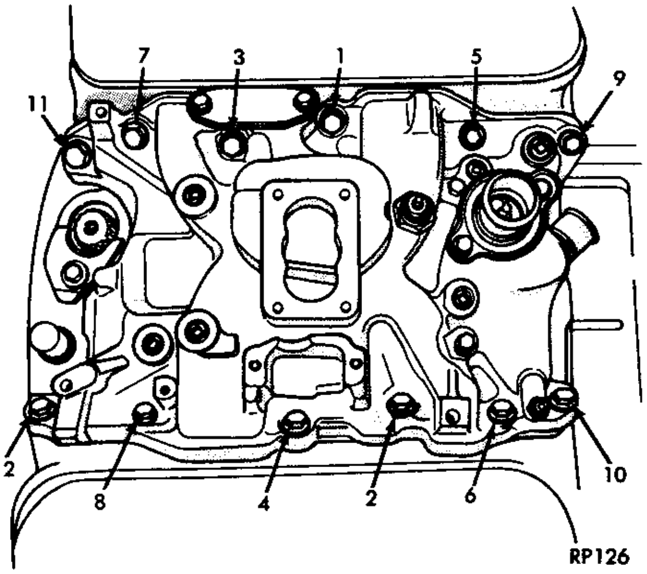


Fig. 12 Intake Manifold Bolt Tightening Sequence—3.9L

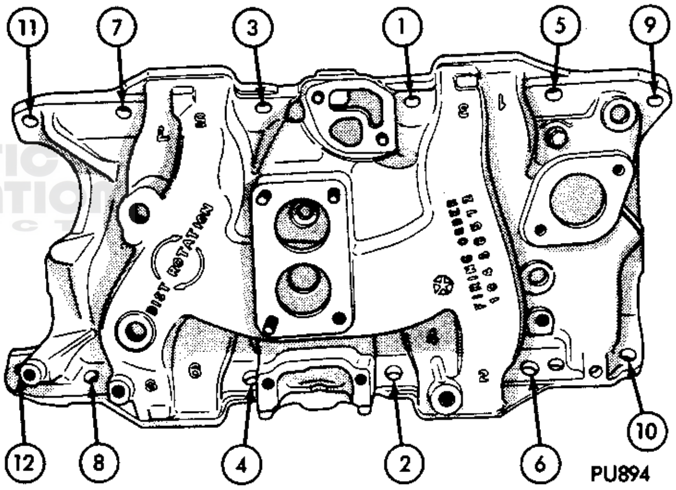


Fig. 13 Intake Manifold Bolt Tightening Sequence—5.2L/5.9L

(11) Hook up the return spring.

(12) Connect the accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(13) Install the fuel lines (intake and return).

(14) Install the alternator and drive belt. Tighten alternator mounting bolt to 41 N•m (30 ft. lbs.) torque. Tighten the adjusting strap bolt to 23 N•m (200 in. lbs.) torque. See Group 7, Cooling System for the proper adjusting of belt tension.

(15) Install the air cleaner.

(16) Install the right cylinder head cover.

(17) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).

(18) Connect the battery negative cable.

EXHAUST MANIFOLD

REMOVAL

(1) Disconnect the battery negative cable.

(2) Raise and support the vehicle.

(3) Remove the bolts and nuts attaching the exhaust pipe to the exhaust manifold.

(4) Lower the vehicle.

(5) Remove bolts, nuts and washers attaching manifold to cylinder head.

(6) Remove manifold from the cylinder head.

CLEANING AND INSPECTION

Clean mating surfaces on cylinder head and manifold. Wash with solvent and blow dry with compressed air.

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).

On the Right Hand manifold, test manifold heat control valve for free operation. If necessary, apply a suitable manifold heat control valve solvent to both ends of the valve shaft. Be sure the manifold is COOL and solvent is allowed to soak a few minutes to dissolve deposits. Then, work valve back and forth until it turns freely. Be sure studs are fully seated.

INSTALLATION

CAUTION: If the studs came out with the nuts when removing the 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 exhaust manifolds on the two studs located on the cylinder head. Install conical washers and nuts on these studs (Fig. 14 and 15).

(2) Install two bolts and conical washers at the inner ends of the exhaust manifold outboard arms. Install two bolts WITHOUT washers on the center arm of exhaust manifold (Figs. 14 and 15). Starting at the center arm and working outward, tighten the bolts to 27 N•m (20 ft. lbs.) torque and the stud nuts to 20 N•m (15 ft. lbs.) torque.

(3) Raise and support the vehicle.

(4) Assemble the exhaust pipe to the exhaust manifold and secure with bolts, nuts and washers. Tighten these nuts to 33 N•m (24 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Connect the battery negative cable.

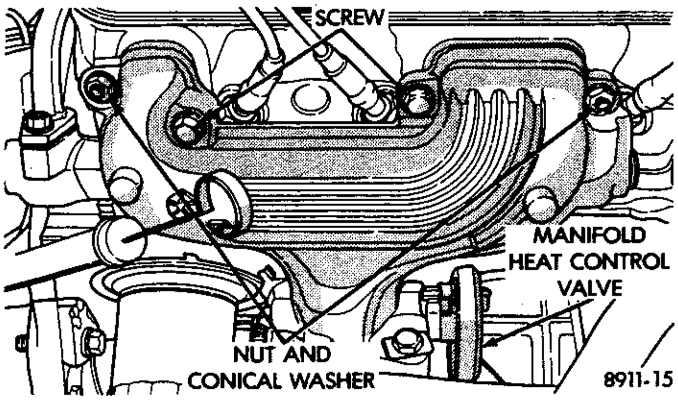


Fig. 14 Exhaust Manifold Installation (Right Manifold Shown)—3.9L

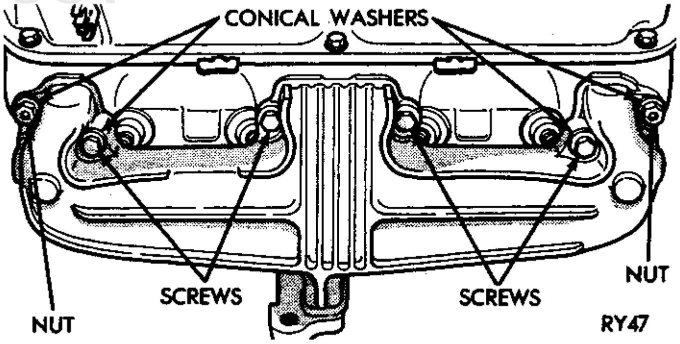


Fig. 15 Exhaust Manifold Installation (5.2L Engine Shown)

MANIFOLD HEAT CONTROL VALVE (FIG. 16)

REMOVAL

(1) Remove the right exhaust manifold.

(2) Position the valve plate and grind off the spot welds from valve plate and shaft.

(3) Remove the anti-rattle spring.

(4) Remove counterweight and shaft assembly.

(5) Press out the bushings and seals from the exhaust manifold.

(6) Inspect the vent holes and clean out, if necessary.

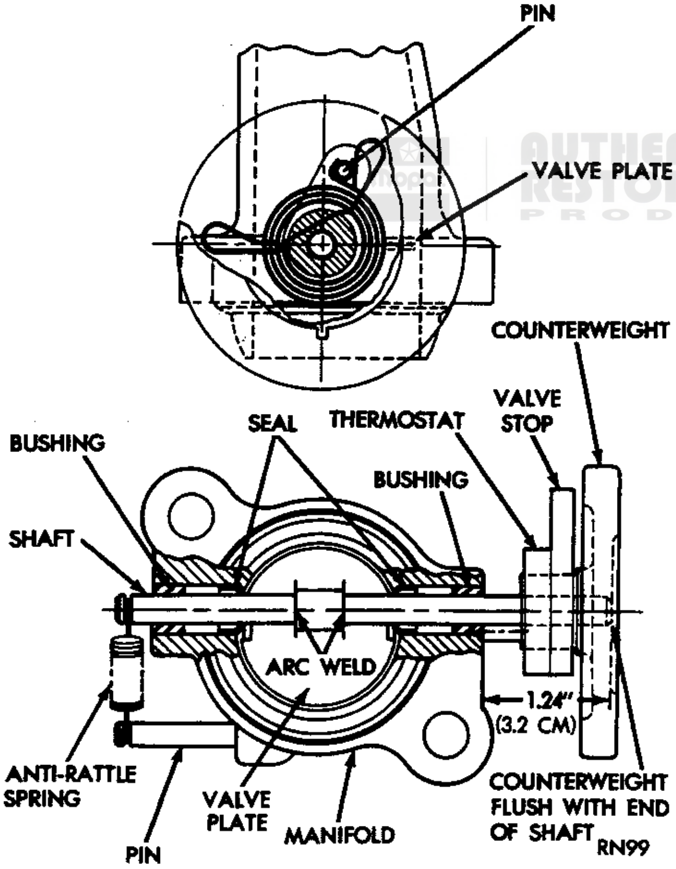


Fig. 16 Manifold Heat Control Valve

INSTALLATION

(1) Press cup seals in (cupped ends facing outward) until seals extend into manifold 2.54 mm (0.100 inch) on each side.

(2) Press in bushings flush with outer edge of exhaust manifold.

(3) Line ream bushings and seals to 7.8163-7.8994 mm (0.3095-0.3110 inch) diameter. **Do not use 7.9 mm (5/16 inch) reamer.** Test for free fit of shaft in bushings and seals.

(4) Install valve stop in slot on counterweight so looped ends face outward, away from the counterweight shaft hole (Fig. 16).

(5) Position thermostat so the center end or tab is pointing to the left and the hook or outer end points down. Install thermostat on the counterweight.

(6) At 32.00 mm (1.24 inch), mark one end of shaft with a suitable dye. Press counterweight on the marked end of the shaft until flush with shaft end.

(7) With the counterweight end of the shaft facing you, wrap the thermostatic spring 140° in a counterclockwise direction. Install the shaft assembly through outer bushing, seal and valve plate with the center strap facing the flange end of the manifold. Attach hook end of thermostatic spring to stop pin.

(8) Position the counterweight end of the shaft at the 32.00 mm (1.24 inch) mark. With the valve plate centered between the seals and the valve plate closed, arc weld valve plate to shaft with a stainless steel rod. Arc welding ground must be made at counterweight.

(9) Test for free operation. Install anti-rattle spring.

(10) Install exhaust manifold. Tighten the bolts to 27 N•m (20 ft. lbs.) and the nuts to 20 N•m (15 ft. lbs.) torque.

(11) Install the exhaust pipe to manifold. Tighten the nuts to 33 N•m (24 ft. lbs.) torque.

TORQUE SPECIFICATIONS

COMPONENT	TORQUE
Adjusting Strap Bolt	23 N•m (200 in. lbs.)
Air Injection Tube (Downstream) Nut	41 N•m (30 ft. lbs.)
Alternator Mounting Bolt	41 N•m (30 ft. lbs.)
Exhaust Manifold-to-Cylinder Head Bolts	27 N•m (20 ft. lbs.)
Exhaust Manifold-to-Cylinder Head Stud Nuts	20 N•m (15 ft. lbs.)
Exhaust Pipe-to-Converter "U" Bolt Nut	41 N•m (30 ft. lbs.)
Exhaust Pipe-to-Manifold Nuts	33 N•m (24 ft. lbs.)
Exhaust Pipe-to-Support Clamp "U" Bolt Nut	15 N•m (125 in. lbs.)
Intake Manifold Capbolts (1st Step)	34 N•m (25 ft. lbs.)
(2nd Step)	54 N•m (40 ft. lbs.)
Muffler "U" Bolt Nuts	41 N•m (30 ft. lbs.)
Rear Muffler Support Bolt and Nut	23 N•m (200 in. lbs.)
Rear Muffler Support-to-Underbody Bolt	23 N•m (200 in. lbs.)
Tail Pipe Clamp Hanger Bolt	23 N•m (200 in. lbs.)
Throttle Body Bolts	20 N•m (175 in. lbs.)

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FRAME STRUCTURES

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GENERAL INFORMATION

The main function of the truck frame is to provide support for all chassis components, body mounting and to carry the payload while keeping deflections at a tolerable level.

The frame is a complex structural mechanism which reacts to applied loads and road inputs by bending and twisting. The main bending members are the siderails. Resistance to frame twist is provided by crossmembers which are rigidly attached to the siderails with either rivets or bolts to form the so-called "ladder type" frame (Figs. 1 thru 4).

FRAME SIDERAIL MATERIAL

Carbon steel with a minimum yield strength of 32000 psi is used to fabricate the light and the medium duty truck frame siderails.

Since the yield strength for the same steel can vary considerably it has been Dodge's practice to specify the minimum yield strength. Thus the 32000 psi minimum frame has in reality a range of 32000 to 44000 psi with a typical average value of 38000 psi.

For severe applications, high strength steel frame siderail reinforcements of the same steel are used.

FRAME LOAD-CARRYING CAPACITY

Since by far the most important factor of frame action is its flexing, it is customary to compare the frames by their "Resisting Bending Moment" (R.B.M.), term denoting the maximum bending the siderails can safely withstand.

The resisting bending moment can be used for quick comparison of frames having different rail configuration and materials.

The Resisting Bending Moment consists of two terms: Section Modulus and Material Yield Strength.

(Section Modulus × Yield Strength = R.B.M.)

The greater the section modulus and the higher the yield strength, the stronger the siderails.

The term Section Modulus pertains to the cross-section of the siderail and is determined by rail depth, flange width, and material thickness.

Yield strength is a measurement in psi of stress at which a material exhibits a specified permanent deformation.

FRAME TYPE

Light Duty Truck and Sport Utility frames are of a ladder type with drop center section channel siderail and crossmembers. Crossmembers are riveted or bolted to the frame. Body support and suspension mounting brackets are riveted to siderails. (See Figs. 6, 7, and 8 for inch dimensions.)

AD1-AD4 frames are designed to accommodate independent front suspension with the suspension crossmember as a part of the frame assembly as are engine front mounting brackets which are welded to the suspension crossmember and riveted to the siderail.

AD5-AD8 (four-wheel-drive vehicles) frames are basically the same, except front suspension crossmember is replaced with a smaller engine support crossmember.

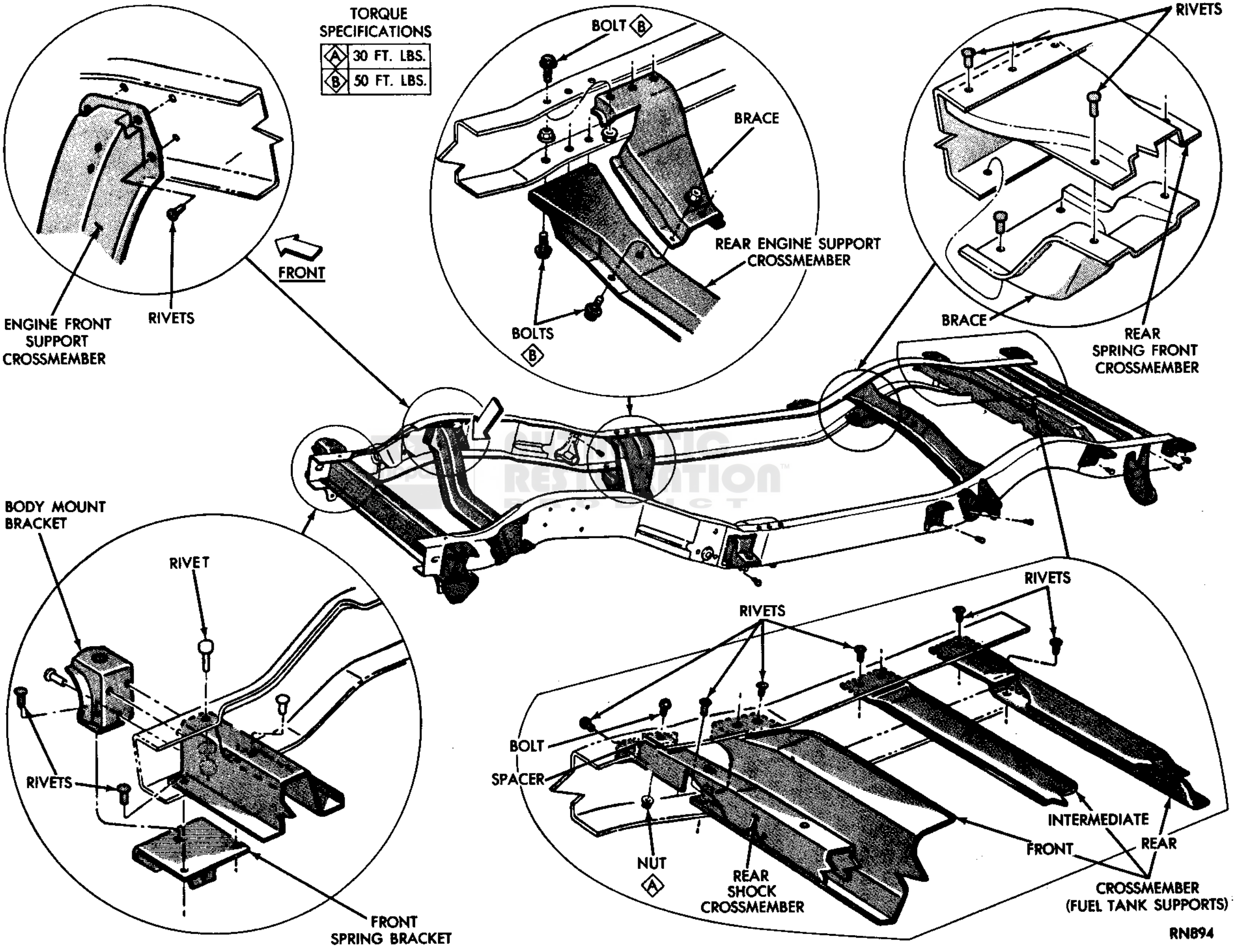


Fig. 1—AD8 Frame Structure with Body Mount and Spring Hanger Brackets

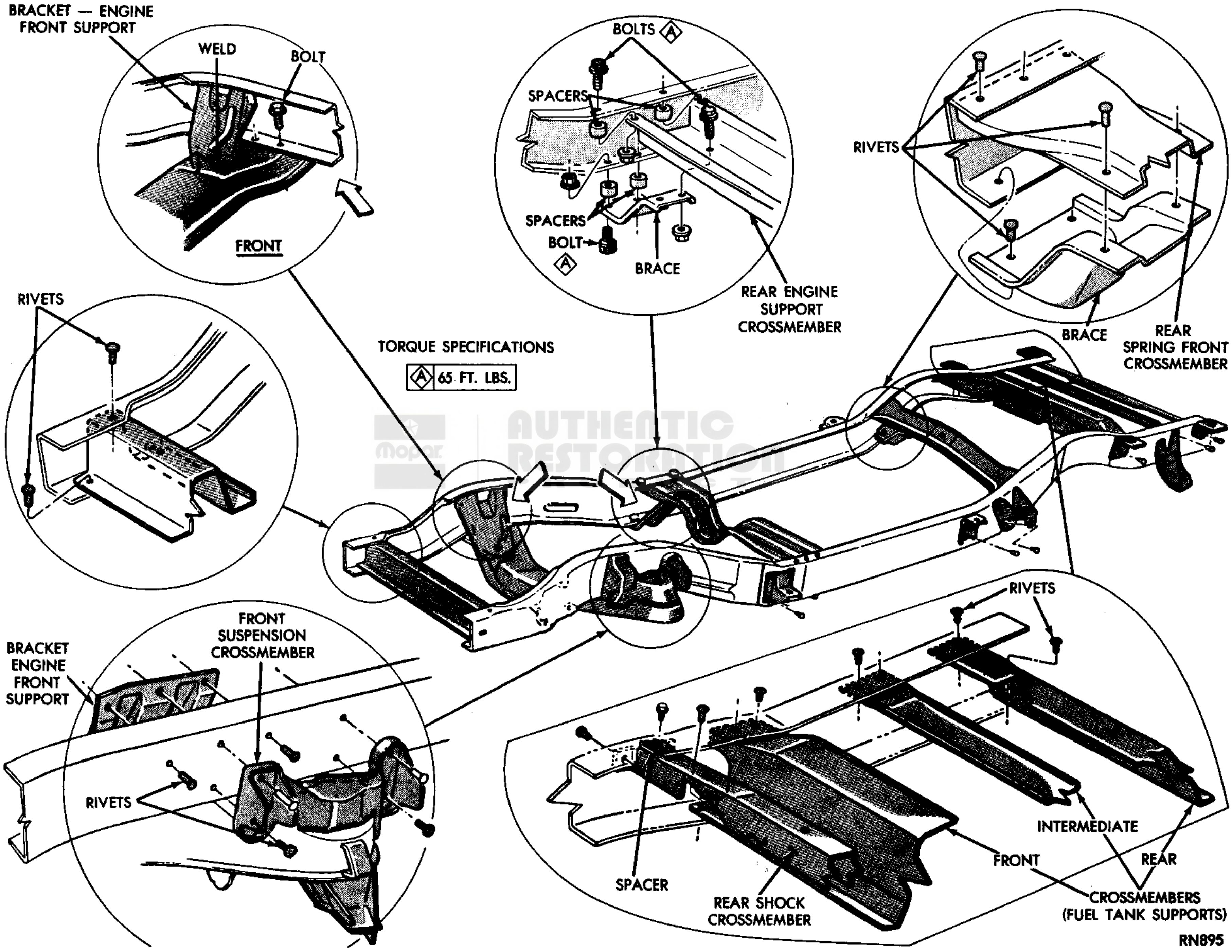
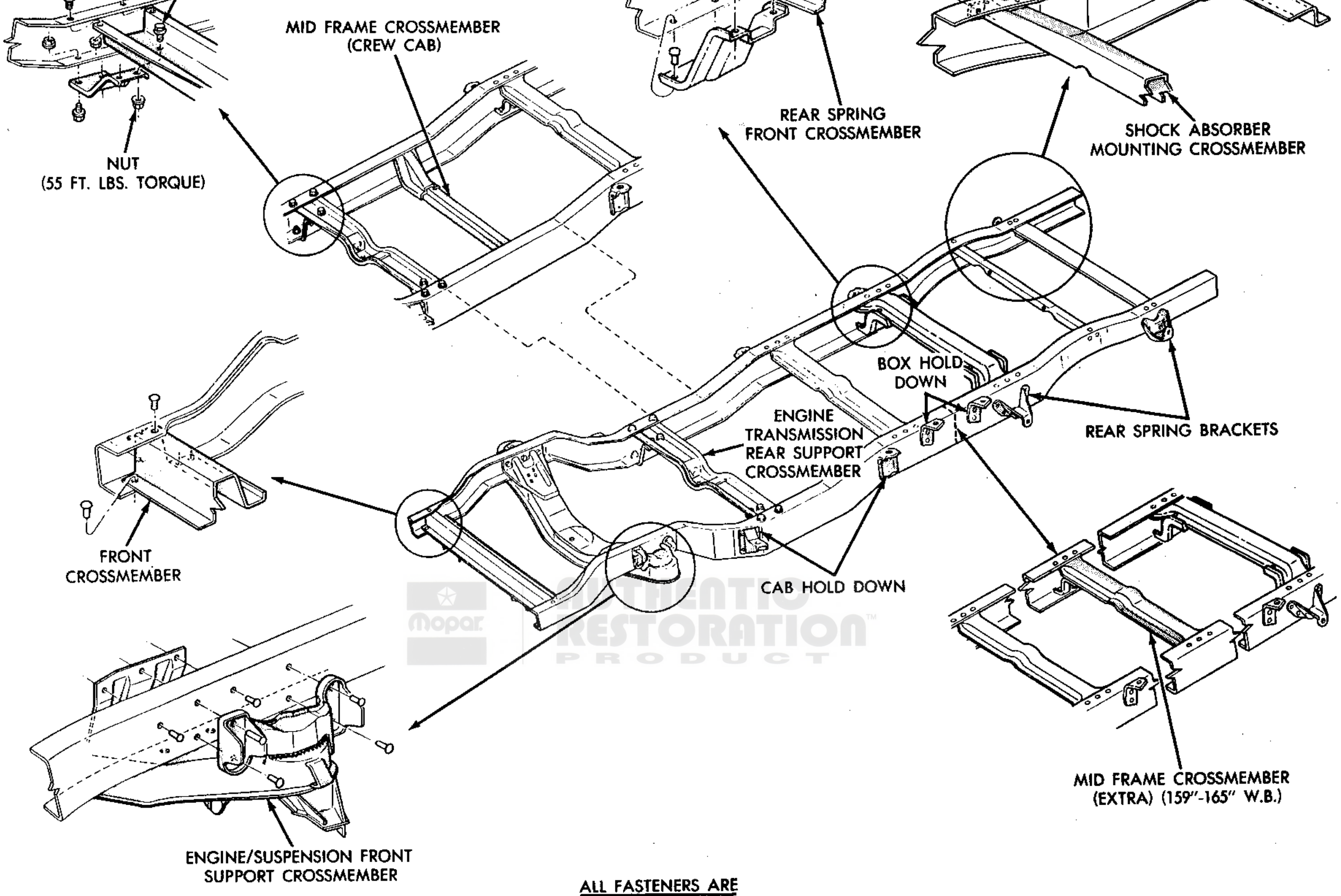


Fig. 2—AD4 Frame Structure with Body Mount and Suspension Brackets



ALL FASTENERS ARE
RIVETS EXCEPT AS NOTED

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Fig. 3—AD1, 2 and 3 Frame Structure

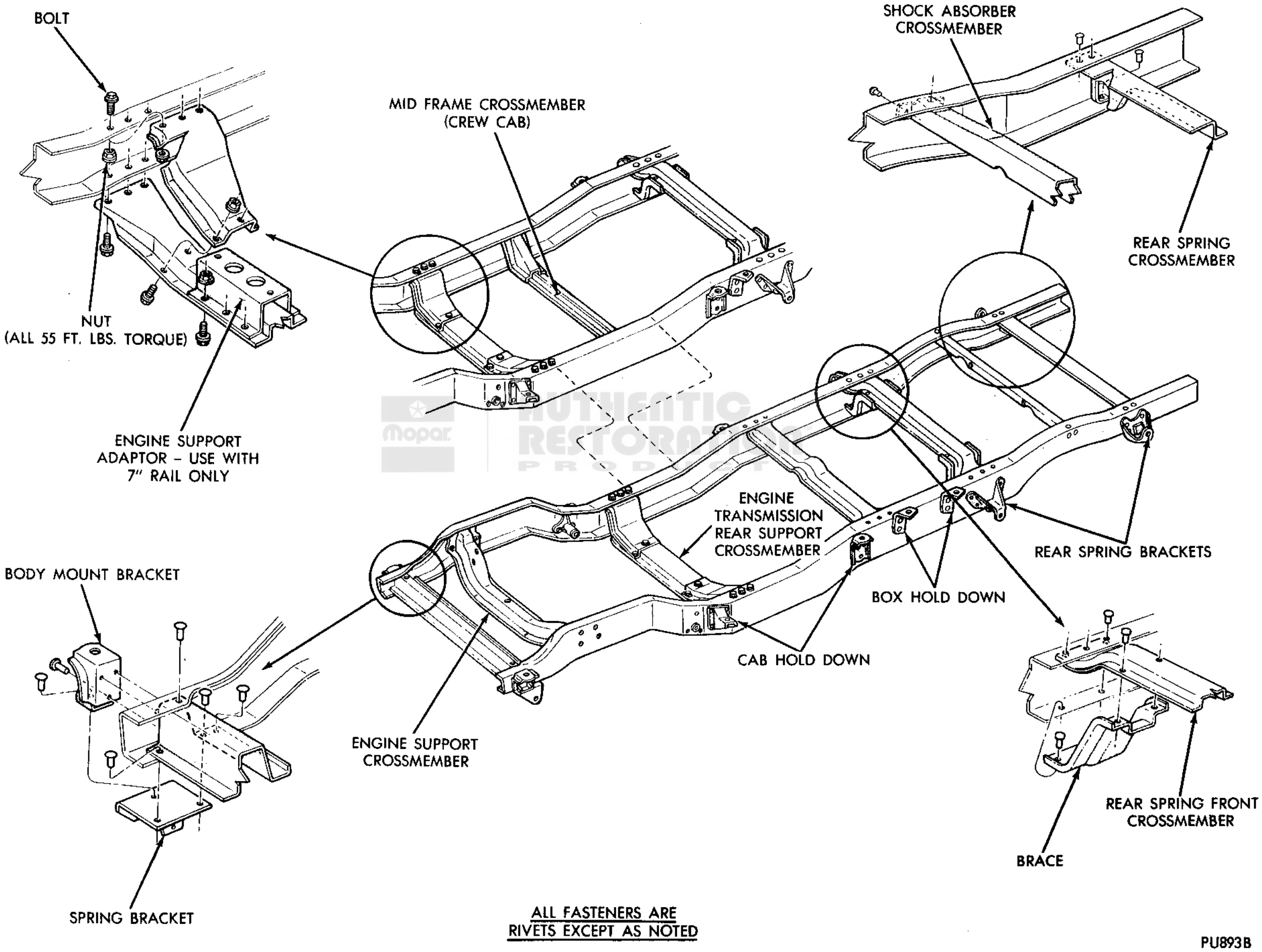

Fig. 4—AD5, 6 and 7 Frame Structure

INSPECTION PROCEDURES

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GENERAL INFORMATION

Improper frame alignment is usually a result of an accident or vehicle being operated with excessive loads or with loads not positioned in a reasonably distributed manner.

A distorted frame will affect front wheel or rear axle alignment and cause excessive wear, mechanical failures in power train, window glass cracks and door opening problems. Vehicle performance, handling and ride quality can be impaired.

INSPECTION

Before proceeding with frame alignment checks, inspect all frame parts for visible damage such as cracks, twists, bends, or other excessive deformations. Also, riveted, bolted, or welded connections, looseness or missing parts.

All damaged areas must be repaired or parts replaced as necessary.

HORIZONTAL OR DIAGONAL

Determine frame deviation from being square by the following procedure:

(1) Select several points along one siderail, preferably at crossmember locations.

(2) Transfer these with a plumb bob to floor, paper sheets can be fastened to floor at these points for better acuracy.

(3) Locate corresponding points on other siderail and transfer them in the same manner to the floor.

(4) Move truck away and measure between all points diagonally and parallel to siderails, corresponding measurements should not differ by more than 1/4 inch.

(5) Take measurement across at front and rear marks and by dividing distances in half, indicate the two points on floor.

(6) Stretch a chalk-line between points 1 and 2 in Fig. 5 and snap string.

(7) Check to see how close centerline is to diagonal intersection points A, B, C, D, E, and F in Fig. 5.

(8) Markings on floor will now give an indication of frame distortion in plain view.

(9) Any point on one siderail should be within 1/8 inch ahead or behind corresponding point on opposite side.

(10) Frame bow sideways should not exceed 1/8 inch per 100 inch length of frame.

(11) Overall width of frame should not vary more than 1/8 inch.

(12) Repeat steps (1) through (11) after straightening frame.

VERTICAL OR SIDEVIEW

Determine twist of frame and degree of siderails not being parallel to one another as follows:

Vertical dimensions are measured from a level floor to corresponding points on left and right siderails. Dimensions should then be plotted to scale vertical and horizontal on a sheet of paper and points connected for each sidemember separately. Graph will show the relative position of the sidemembers.

Points on siderail or for horizontal check are selected at rear frame crossmembers and any one of these points on one sidemember should be maximum 1/8 inch above or below corresponding point on other siderail.

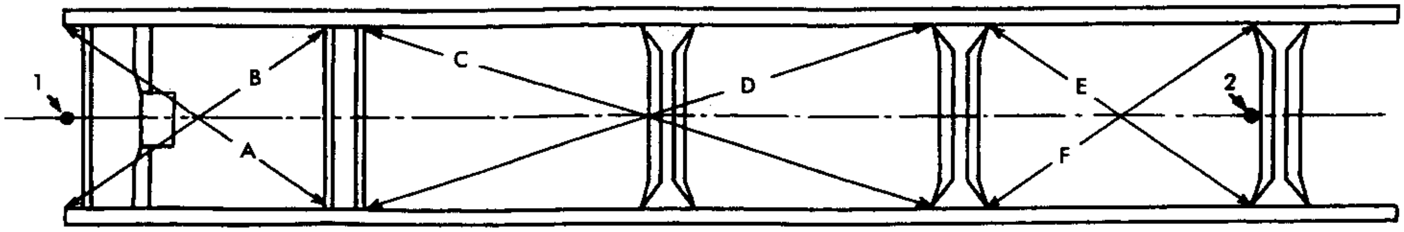

Fig. 5—Alignment Markings

MEASUREMENTS

Obtain measurements for frame alignment checks with the body on vehicle. Figures 6, 7, and 8 as identified, indicate dimensions in chosen areas to determine frame alignment. The procedures are recommended as follows:

(1) Place vehicle on level floor.

(2) If vehicle is loaded, make sure payload does not exceed specified limit and the load is distributed as evenly as possible. For better accuracy of measurements, all payload should be removed.

(3) Check tires for recommended air pressure and adjust as necessary.

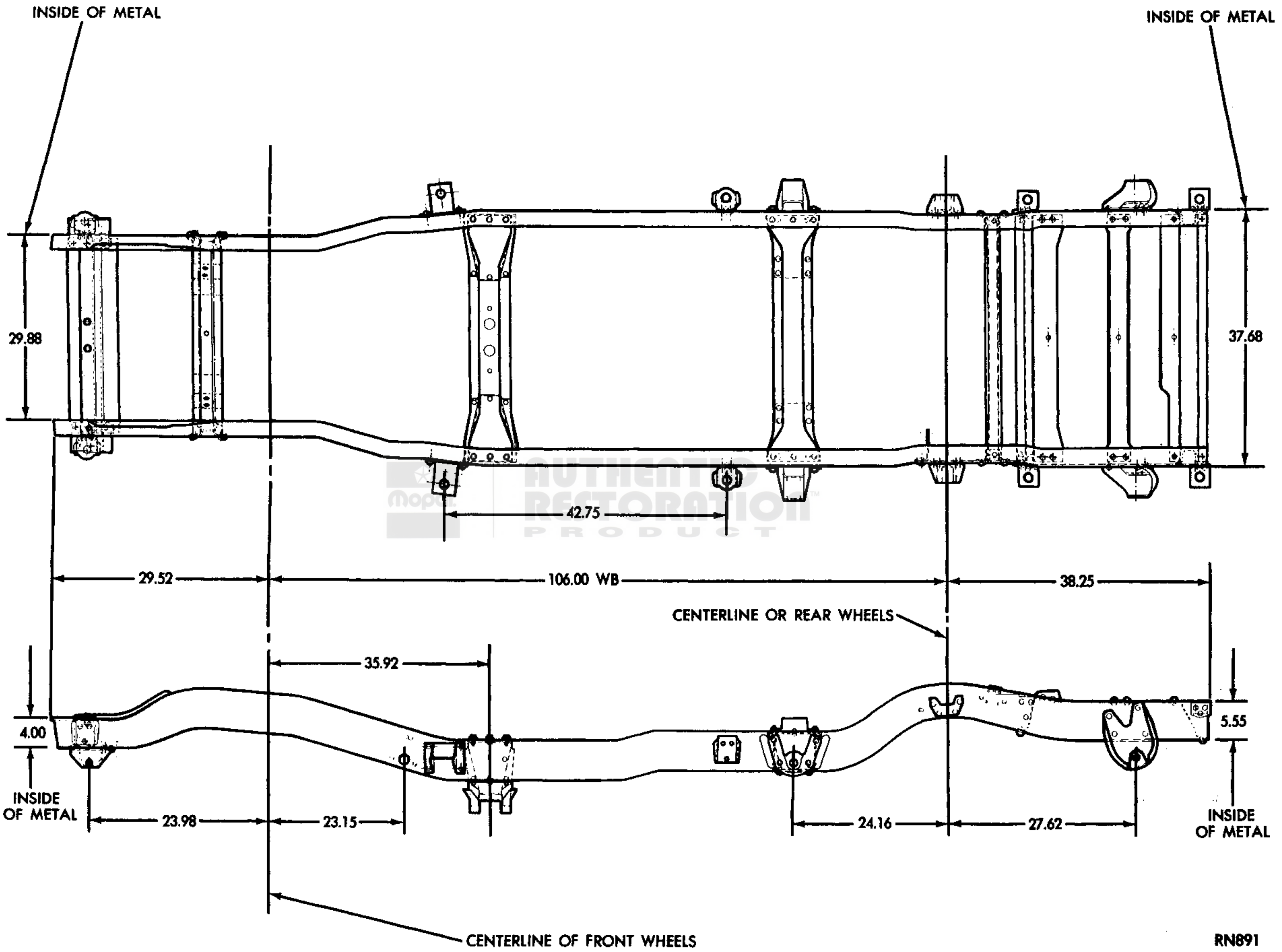

Fig. 6—Frame Dimensions (AD4 and 8)

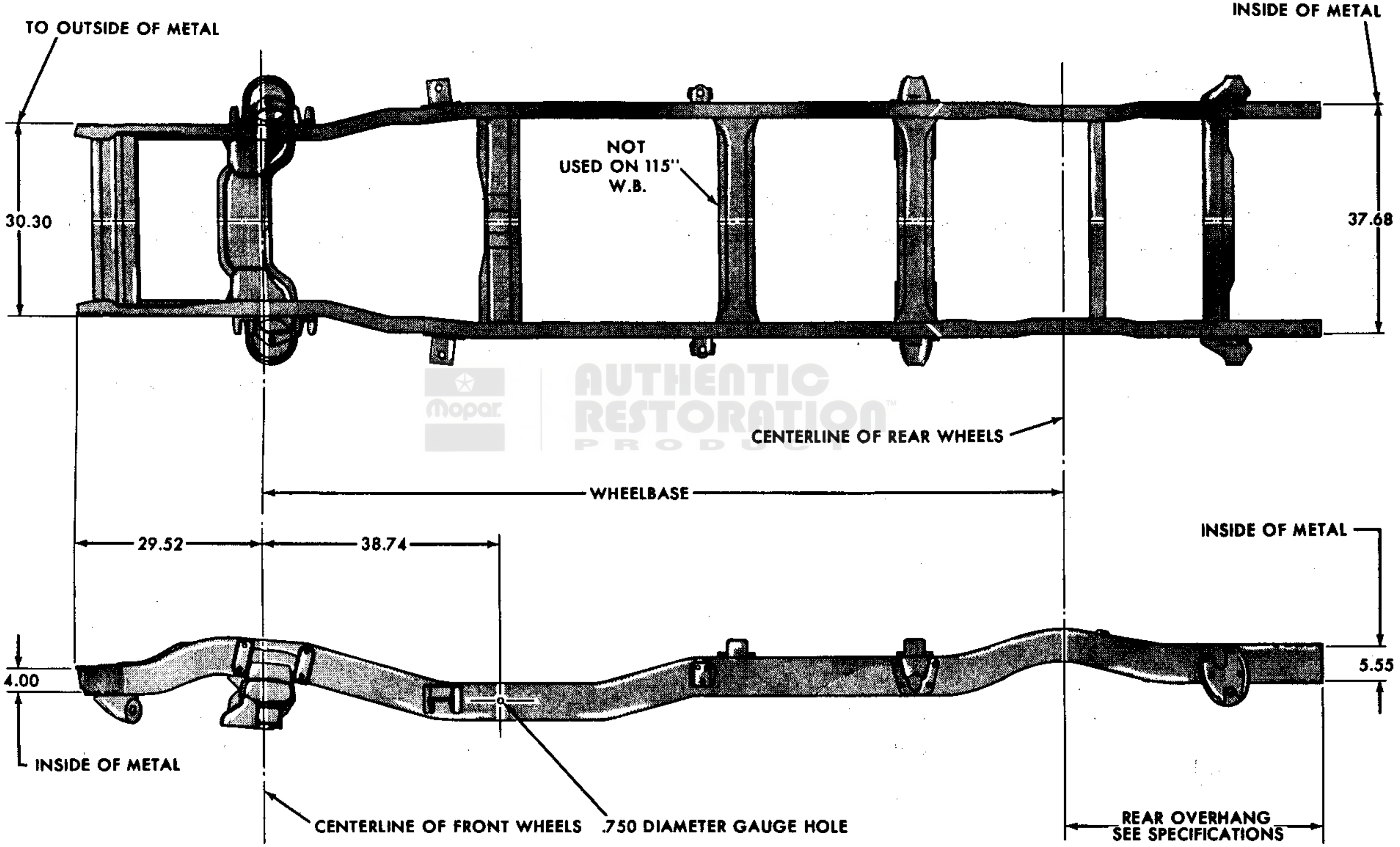

Fig. 7—Frame Dimensions (AD1, 2 and 3)

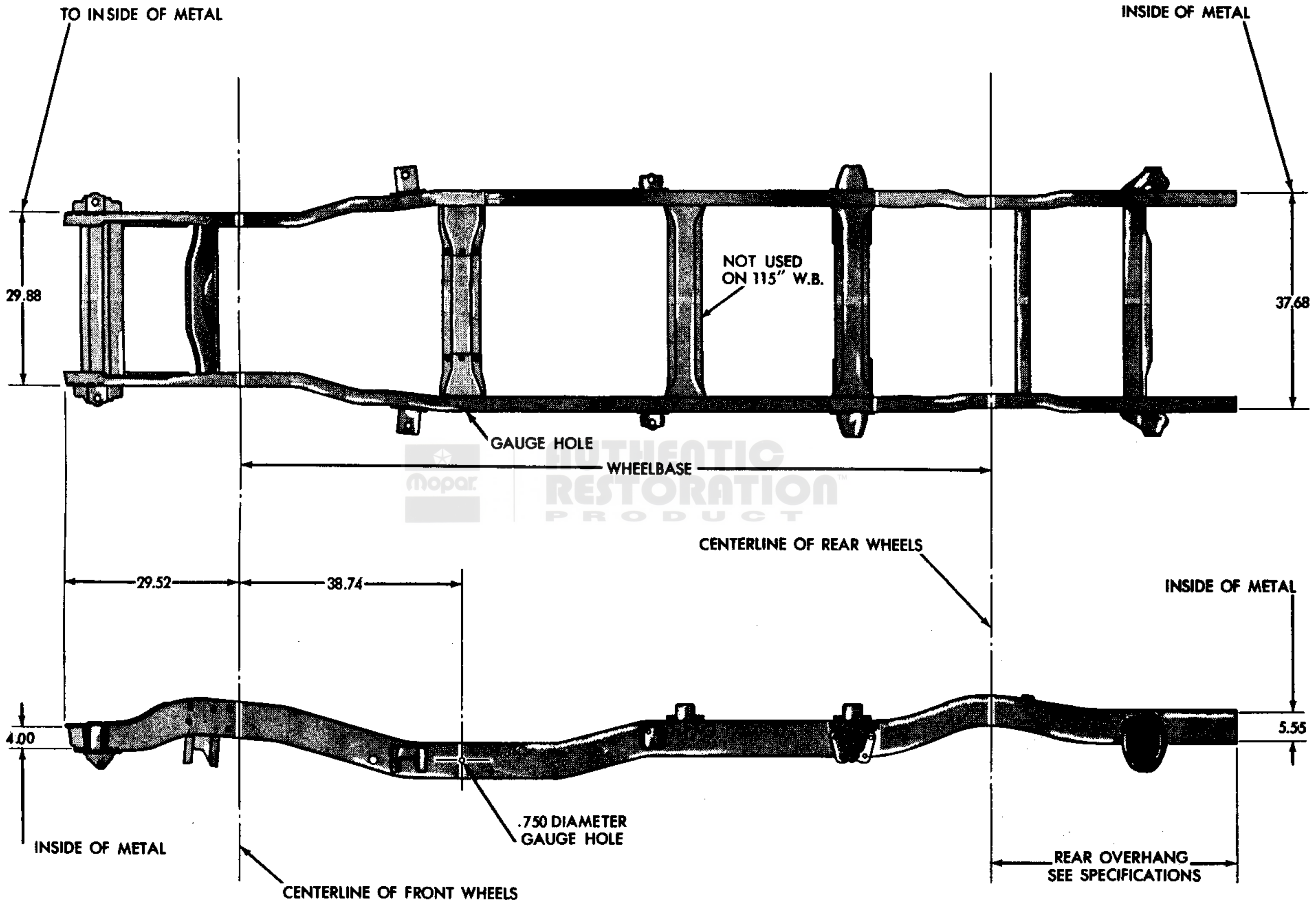

Fig. 8—Frame Dimensions (AD5, 6 and 7)

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SERVICE PROCEDURES

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GENERAL INFORMATION

Frames which are bent or twisted can be straightened, if necessary, by heat application. The temperature is to be kept under 1050°F (a dull red glow) as excessive heat will impair the strength of the material, resulting in a weakened frame.

This heat method is permissible on Light and Medium duty frames only. Damaged frame rails, crossmembers and brackets can be repaired by straightening or replacing.

Welded connections between rails and crossmembers are not recommended.

STRAIGHTENING

Straightening should be limited to parts not severely damaged. New bolts or rivets for attaching the parts should be of same specifications as original bolts or rivets.

REPLACEMENT

Replacement is recommended as the original shape of the part may not be easily recognizable. Also, improperly straightened frame components will have harmful effects on alignment.

REPAIRING

DRILLING

No holes should be drilled in siderail flanges as this will reduce frame strength. Holes drilled in siderail vertical web must be 1-1/2 inches minimum from top and bottom flanges.

New holes should be located a distance away from existing holes, as not to reduce cross section of siderails in any one vertical section by more than 30%.

WELDING

Welding of siderails and crossmembers should be done, preferably, with electric welding equipment as it retains heat in a small area limiting the change of hardness of metal.

A damaged frame member is to be closely inspected for cracks. It is possible that cracks will appear as a result of straightening of a member. In either case, crack or cracks are to be repaired as follows:

(1) Stop-drill at the end point of the crack with 1/8 inch drill.

(2) V-groove crack to allow good weld penetration.

(3) Weld up the crack.

(4) Grind surface smooth if reinforcement is to be used.

USE OF FASTENERS

Bolts or rivets can be used in repairing frames or adding reinforcement. When it is more practical to substitute a bolt for a rivet, use next larger size bolt to prevent bolt from working loose. Ream holes if necessary.

Coned washers are preferred to split lock type. Generally Grade 5 bolts will suffice in repair work. Grade 3 bolts should be avoided. Proper torque is mandatory to provide adequate locking and preclude loosening of fasteners. Refer to the Specifications chart for bolt grades and torques.

REINFORCING

Reinforcement can be made from channel, angle or flat stock of common carbon steel and approximately equal in thickness to the part to be repaired. It is not possible to recommend proper reinforcement for all repairs. A reinforcement should provide an adequate section in cracked area and have sufficient overlap with the original part and be properly attached.

Reinforcing channel should have flanges shorter than sidemember flanges to preclude welding along edge of rail flange. Otherwise, longitudinal welds are quite acceptable. Complete transverse welds are to be avoided.

SPECIFICATIONS

Values of the section modulus, yield strength and R.B.M. are shown for each siderail in the following tables.

LIGHT DUTY MODELS

Model	Wheel Base	Depth	Siderail Section Flange	Siderail Section Gage	Section Modulus	R.B.M.*	Rear Overhand
CONVENTIONAL CAB	**Inch (cm)**	**Inch (cm)**	**Inch (cm)**	**Inch (cm)**	**Inch (cm)**	**Inch Pounds (kg)**	**Inch (cm)**
AD1	115 (292)	6.06 (15)	2.27 (6)	.156 (.396)	2.86 (7.26)	91520 (41513)	38.25 (97.15)
AD1	131 (332)	6.06 (15)	2.27 (6)	.156 (.396)	2.86 (7.26)	91520 (41513)	42.25 (107.31)
AD2	131 (332)	6.17 (16)	2.32 (6)	.210 (.533)	3.88 (9.86)	124160 (56319)	42.25 (107.31)
AD3	131 (332)	7.20 (18)	2.73 (7)	.194 (.493)	5.02 (12.75)	160640 (72866)	42.25 (107.31)
AD3	135 (342)	7.20 (18)	2.73 (7)	.194 (.493)	5.02 (12.75)	160640 (72866)	42.25 (107.31)
AD3	159 (404)	7.31 (18)	2.79 (7)	.250 (.635)	6.56 (16.66)	160640 (72866)	48.25 (122.55)
AD5	115 (292)	6.12 (18)	2.30 (6)	.188 (.477)	3.43 (8.71)	109760 (49787)	38.25 (97.15)
AD5, 6	131 (332)	6.17 (18)	2.32 (6)	.210 (.533)	3.88 (9.86)	124160 (56319)	42.25 (107.31)
AD7	135 (318)	7.20 (18)	2.73 (7)	.194 (.493)	5.02 (12.75)	160640 (72866)	48.25 (122.55)
CLUB CAB							
AD1	133 (338)	7.16 (18)	2.72 (7)	.176 (.447)	4.57 (11.60)	146240 (66334)	38.25 (97.15)
AD1-2	149 (378)	7.20 (18)	2.73 (7)	.194 (.493)	5.02 (12.75)	160640 (72866)	42.25 (107.31)
AD5-6	149 (378)	7.23 (18)	2.75 (7)	.210 (.533)	5.47 (13.87)	175040 (79398)	42.25 (107.31)
SPORT UTILITY							
AD4	106 (269)	6.06 (15)	2.27 (6)	.156 (.396)	2.86 (7.26)	91520 (41513)	38.25 (97.15)
AD8	106 (269)	6.06 (15)	2.27 (6)	.156 (.396)	2.86 (7.26)	91520 (41513)	38.25 (97.15)

* Resisting Bending Moment based on 32000 psi minimum yield strength of siderail steel.

TIGHTENING REFERENCE

Torque in Ft.-Lbs. (N•m)

Bolt Size	Grade 5		Grade 8	
3/8 × 16	20-40	(27-54)	30-50	(41-68)
3/8 × 24	25-45	(34-61)	30-60	(41-81)
7/16 × 14	35-65	(47-88)	50-80	(68-108)
7/16 × 20	40-70	(54-95)	60-90	(81-122)
1/2 × 13	55-95	(75-129)	80-120	(108-163)
1/2 × 20	65-105	(88-142)	85-135	(115-183)
9/16 × 12	80-130	(108-166)	110-160	(149-217)
9/16 × 18	90-140	(122-190)	125-175	(169-237)

FUEL SYSTEM

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GENERAL INFORMATION

Throughout this group, references may be made to a particular vehicle by letter or number designation. A chart showing the breakdown of these designations is included in the Introduction Section at the front of this service manual.

The Fuel System consists of the fuel tank, fuel pump, fuel filter, throttle body, fuel lines and vacuum lines.

The **Fuel Delivery System** consists of the fuel pump, fuel pressure regulator, fuel filter, fuel tubes, fuel hoses, and fuel injectors.

The **Fuel Tank Assembly** consists of the fuel tank, filler tube, a fuel gauge sending unit assembly and a pressure-vacuum filler cap.

Also, to be considered part of the fuel system is the **Evaporation Control System,** which is designed to reduce the emission of fuel vapor into the atmosphere.

The description and function of the Evaporation Control System is found in Group 25 of this manual.

FUEL REQUIREMENTS

Your vehicle was designed and developed for optimum operating performance and efficiency using high quality unleaded gasoline.

In order to retain the optimum performance qualities and enjoy trouble-free operation of your vehicle, it is recommended that only gasolines from reputable dealers be used.

Use unleaded gasolines having a minimum octane rating of 87, (R + M) /2.

Should your vehicle develop spark knock (ping), purchase your fuel from another source. Vehicles may respond differently to gasolines having the same octane rating. Occasional trace knock at low engine speeds is not harmful. However, continued knock at high speeds can damage your engine and should be reported to your dealer immediately. Engine damage as a result of prolonged operation of a vehicle with continuous high speed knock may not be covered by the new vehicle warranty.

In addition to using unleaded gasoline with the proper octane rating, gasolines that contain detergents and anti-corrosion additives are recommended. The use of gasoline containing these additives help improve fuel economy, reduce emissions and maintain vehicle performance.

Low quality fuel can cause problems such as hard starting, stalling, and driveability deterioration. If problems of this type are experienced, it is recommended that another brand of gasoline be used prior to considering service for the vehicle.

The exhaust emission system of your vehicle is designed to meet all emission regulations while at the same time providing excellent fuel economy. Catalyst systems require that only unleaded gasoline be used. Use of leaded fuel will not only destroy the effectiveness of the catalytic converter used to reduce exhaust emissions, but will also make part of the fuel control system inoperative and lead to high fuel consumption.

All vehicles have warning labels on the instrument panel and adjacent to the fuel filler cap or door that state **UNLEADED FUEL ONLY.** These vehicles also have fuel filler tubes designed to accept only the unleaded gasoline dispensing nozzle. Damage resulting from the use of leaded gasoline may not be covered by the new vehicle warranty.

GASOLINES CONTAINING ALCOHOL

Your vehicle was designed and developed for optimum operating performance and efficiency using gasoline. Some fuel suppliers sell gasoline/alcohol blends as motor vehicle fuel. The type and amount of alcohol used in the blend is important. Many states require that the service station pumps dispensing gasoline containing alcohol be properly labeled with the type and amount of alcohol present. If your state does not have this requirement, we recommend that you ask the gasoline station operator if their fuel contains alcohol and if so, what type and amount.

The following two types of alcohols are generally used in gasoline blends:

ETHANOL (Ethyl or Grain Alcohol) is used as a mixture of 10 percent ethanol and 90 percent unleaded gasoline and identified as "ethanol enhanced", "contains ethanol", or "gasohol". Gasoline blended with ethanol, may be used in your vehicle. Note that these blends, due to their generally higher volatility, may adversely affect the starting, driveability and fuel efficiency of your vehicle. If problems are experienced with ethanol/gasoline blends, it is recommended that the vehicle be operated on gasoline.

METHANOL (Methyl or Wood Alcohol) is used in a variety of concentrations blended with unleaded gasoline. You may encounter fuels containing three percent or more methanol along with other alcohols, called cosolvents.

Do not use gasolines containing methanol.

Use of methanol/gasoline blends may result in starting and driveability deterioration and damage to critical fuel system components.

Fuel system damage and vehicle performance problems, resulting from the use of gasolines containing methanol, are not the responsibility of Chrysler Motors and may not be covered by the new vehicle warranty.

GASOLINES CONTAINING MTBE

Fuels that are a mixture of unleaded gasoline and up to 15 percent MTBE (Methyl Tertiary Butyl Ether) may be used in your vehicle.

MATERIALS ADDED TO FUEL

Indiscriminate use of fuel system cleaning agents should be avoided. Many of these materials intended for gum and varnish removal may contain active solvents or similar ingredients that can be harmful to gasket and diaphragm materials used in fuel system component parts.

FUEL DELIVERY SYSTEM

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FUEL PUMP

The fuel pump used in this system has a permanent magnet electric motor. The pump is part of the fuel pump module located in the fuel tank and immersed in the fuel (Fig. 1). The fuel is drawn in through a filter and pushed through the electric motor to the outlet. The pump contains a check valve, located near the pump outlet, restricting fuel movement in either direction to maintain fuel supply line pressure when the pump is not operational. Voltage to operate the pump is supplied through the Auto Shutdown Relay.

WARNING: THE TBI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 100 KPA (14.5 PSI). BEFORE SERVICING THE FUEL PUMP, FUEL LINES, FUEL FILTER, THROTTLE BODY OR FUEL INJECTOR, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

Perform fuel system pressure release procedure before servicing the fuel pump.

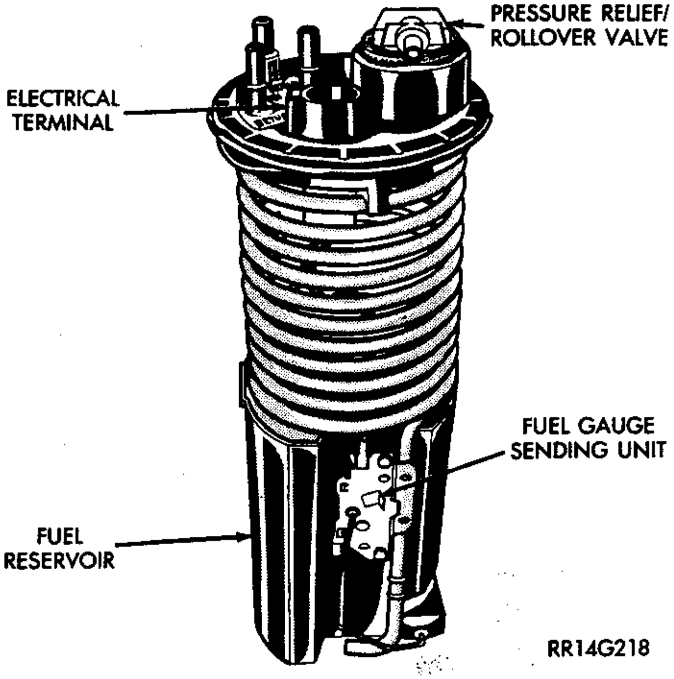

Fig. 1 Fuel Pump

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

(1) Loosen fuel filler cap to release fuel tank pressure.

(2) Disconnect injector wiring harness from engine harness.

(3) Connect a jumper wire to ground terminal Number 1 of the injector harness (Fig. 2) to engine ground.

(4) Connect a jumper wire to the positive terminal Number 2 of the injector harness (Fig. 2) and touch the battery positive post for no longer than 5 seconds. This releases system pressure.

(5) Remove jumper wires.

(6) Continue fuel system service.

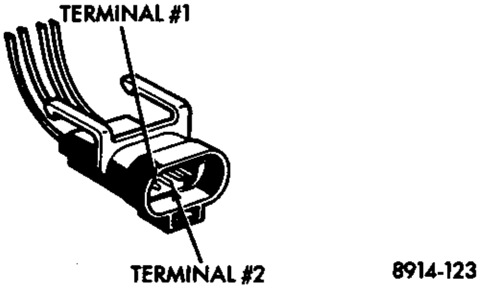

Fig. 2 Injector Harness Connector

FUEL PUMP PRESSURE TEST

WARNING: THE TBI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 100 KPA (14.5 PSI). BEFORE PERFORMING THE FUEL PUMP PRESSURE TEST THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(1) Fuel system pressure must be released prior to servicing a fuel system hose or component. Perform fuel system pressure release.

(2) Disconnect the 5/16 diameter fuel supply hose from the engine fuel line assembly. Use care when removing the fuel hose to prevent damage to the hose or the fuel line. Replace hose if damaged. Connect fuel system pressure tester C-4799A between fuel supply hose and engine fuel line assembly.

(3) Using diagnostic tester, with the key in the "Run" position, use Actuate Outputs Test "Auto Shutdown Relay", this will activate the fuel pump

and pressurize the system. If the gauge reads 100 Kpa ±7 Kpa (14.5 psi ± 1 psi), pressure is correct and further testing is not required. Reinstall fuel hose using a new original equipment type clamp, and tighten to 1 N•m (10 in-lbs.) torque. If pressure is not correct, record the pressure and continue with test procedure.

(4) If fuel pressure is below specifications, install tester in the fuel supply line, between the fuel tank and fuel filter at the rear of vehicle.

(5) Repeat test. If pressure is 5 psi higher than previously recorded pressure, replace fuel filter. If no change is observed, gently squeeze return hose. If pressure increases, replace pressure regulator. If no change is observed, problem is either a plugged pump filter (sock) or defective fuel pump.

(6) If pressure is above specifications, remove the fuel return line hose from the chassis line at fuel tank and connect a 3 foot piece of fuel hose to the return line. Put the other end into an approved gasoline container (minimum 2 gallon size) so that all return fuel will flow into container. Repeat test. If pressure is now correct, check in-tank return hose for kinking. Replace fuel pump assembly if in-tank reservoir check valve or aspirator jet is obstructed. (This test should be performed when fuel tank is 1/2 full or greater.)

(7) If pressure is still above specifications, remove fuel return hose from throttle body. Connect a substitute hose to the throttle body return nipple and place other end of hose in clean container. Repeat test. If pressure is now correct, check for restricted fuel return line. If no change is observed, replace fuel pressure regulator.

MECHANICAL MALFUNCTIONS

Mechanical malfunctions are more difficult to diagnose with this system. The Single Board Engine Controller (SBEC) has been programmed to compensate for some mechanical malfunctions such as incorrect cam timing or vacuum leaks. If engine performance problems are encountered, and no fault codes are displayed, the problem may be mechanical rather than electronic.

FUEL PUMP MODULE

The fuel pump module is installed in the top of the fuel tank (Fig. 3). It contains the fuel pump, fuel pump reservoir, in-tank fuel filter, pressure relief/ rollover valve, electrical connector for the fuel pump gauge sending unit, fuel filler vent, fuel supply and return tube connections, and the fuel drain tube nipple.

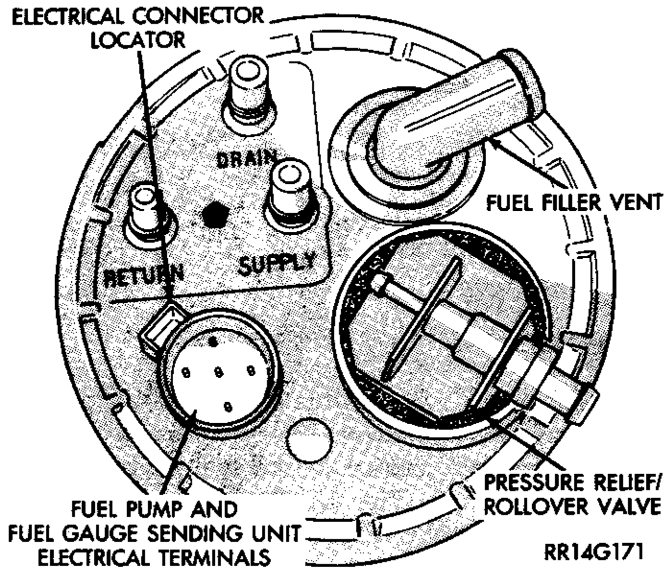

Fig. 3 Top View of Fuel Pump Module

REMOVAL

WARNING: THE TBI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 100 KPA (14.5 PSI). BEFORE SERVICING THE FUEL PUMP MODULE THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(1) Drain the fuel tank. Refer to "Draining Fuel Tank" in this group.

(2) Remove fuel tank. Refer to "Fuel Tanks" in this group.

(3) While holding the fuel pump module down, remove the holding clamp (Fig. 4)

(4) Release the module. It will spring up from its position.

(5) Remove module from fuel tank.

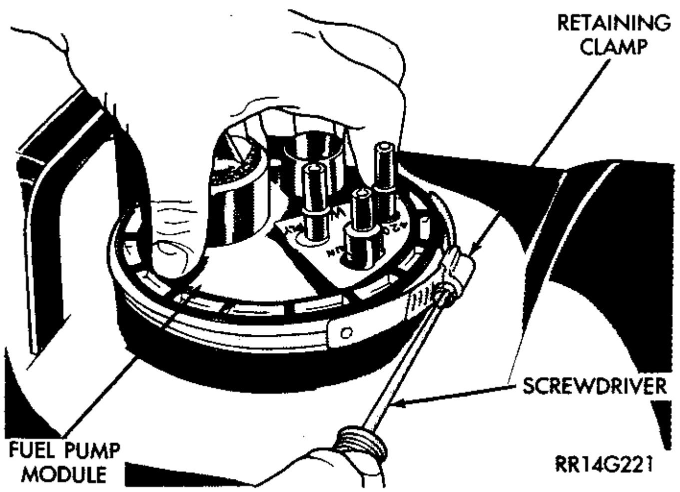

Fig. 4 Fuel Pump Module Removal/Installation

DISASSEMBLY

(1) Remove sending unit attaching screws from mounting bracket located on the drain tube (Fig. 5).

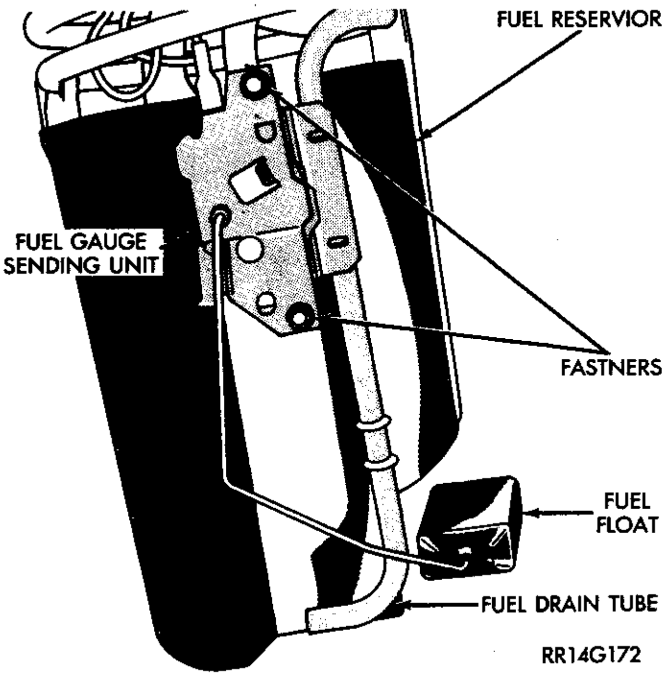

Fig. 5 Fuel Gauge Sending Unit Service

(2) Disconnect electrical wires from sending unit (Fig. 6) Remove sending unit.

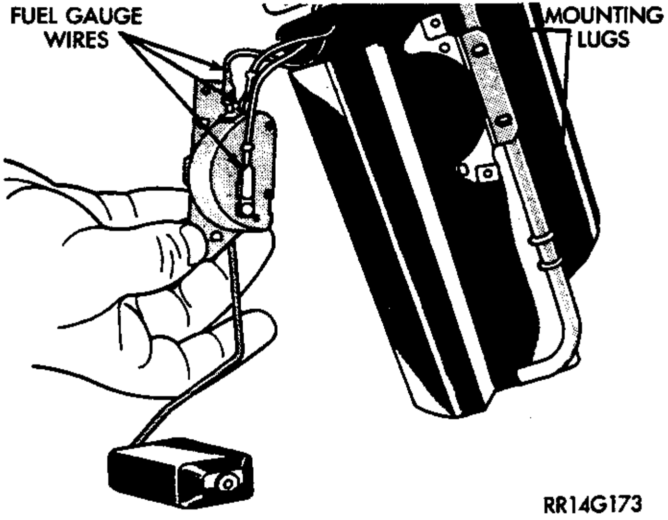

Fig. 6 Fuel Gauge Sending Unit Wiring Terminals

(3) Remove the drain tube from the mounting lug at the bottom of the reservoir (Fig. 7).

(4) Remove the lower-most coil of the drain tube out of the mounting lugs on top of the reservoir (Fig. 8). Care should be taken to avoid unsnapping the return line check valve cover from the bottom of the reservoir. If this cap comes free, snap back into place (Fig. 8).

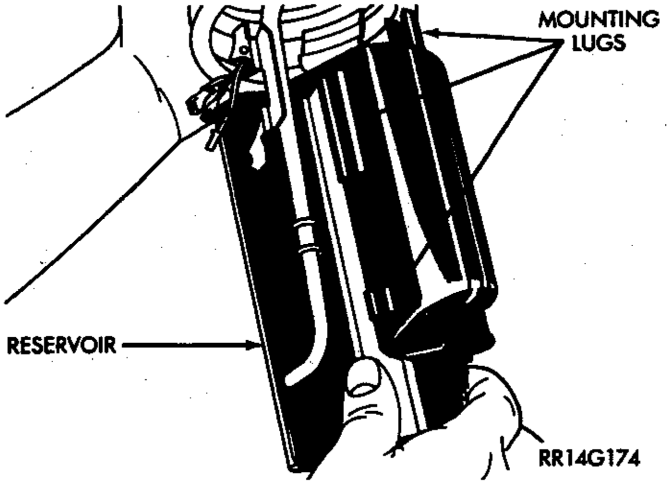

Fig. 7 Removing Fuel Line Coil from Reservoir

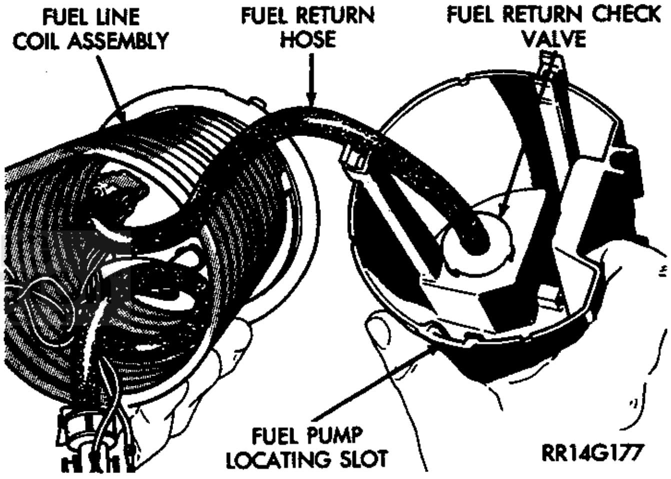

Fig. 8 Fuel Pump and Reservoir Assembly

(5) Release the pump mounting bracket from the reservoir using thumb and fore fingers. Press the bracket with both thumbs toward the center of the reservoir (Figs. 9 and 10).

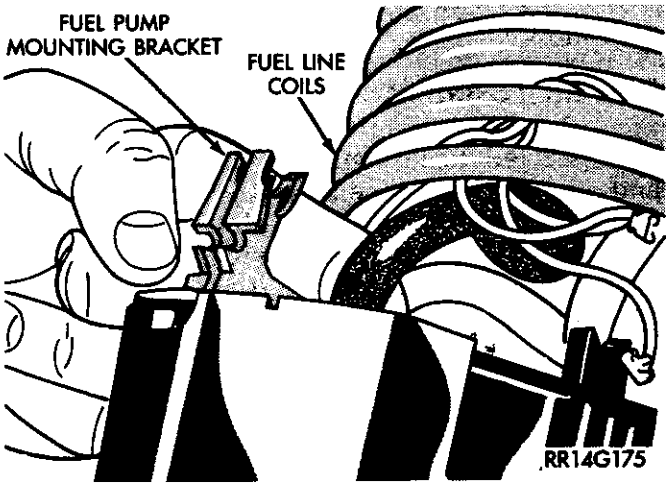

Fig. 9 Fuel Pump Mount Bracket

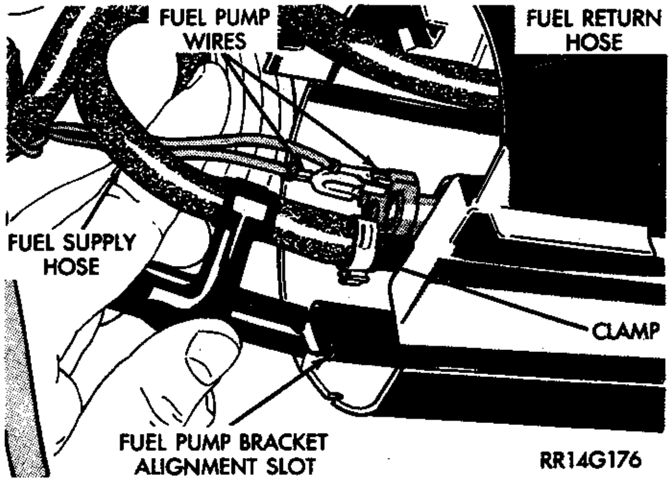

Fig. 10 Removal and Installation of Fuel Pump

(6) Remove and retain pump mounting bracket and rubber collar from hose. Cut hose clamp on the supply line to the pump. Discard clamp. Remove pump/ filter assembly from hose (Fig. 11).

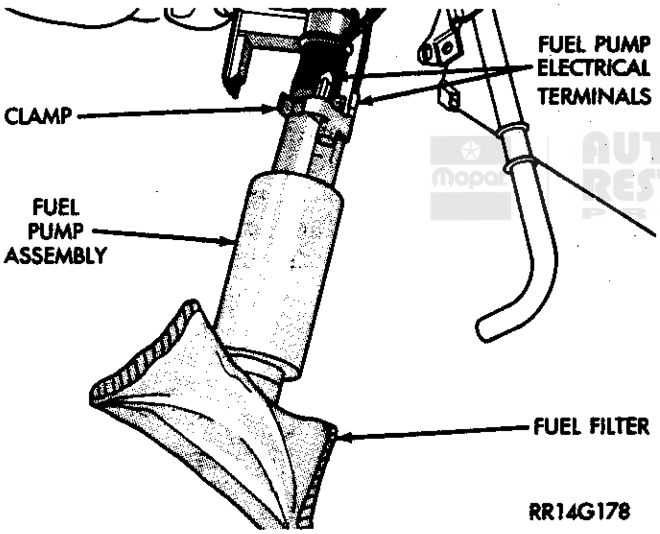

Fig. 11 Servicing Fuel Pump

(7) If pump is operational but the filter requires replacement, gently "walk" a broad blade screwdriver around the filter mounting ferrule to remove filter (Fig. 12). Care should be taken to avoid damage to the pump inlet. If pump is not operational, discard entire assembly. Do not reuse filter.

ASSEMBLY

(1) Press new filter onto pump. (A new pump is provided with new filter.)

(2) Use a new clamp to attach the pump to the supply hose. Use Tool C-4124 to crimp clamp.

(3) Reposition pump mounting bracket and rubber collar on supply hose between the bulge in the hose and the pump. (Fig. 11).

(4) Position the pump in the reservoir so that the filter aligns with the cavity in the reservoir (Fig. 10).

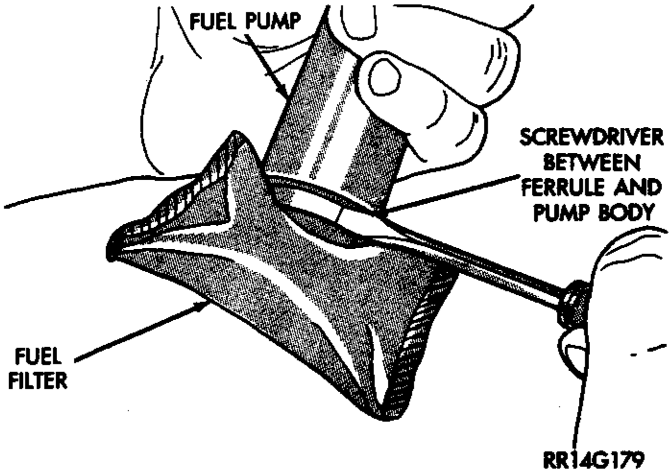

Fig. 12 Servicing Fuel Filter

(5) Snap pump bracket/collar into the reservoir (Fig. 9).

(6) Position coil tube onto reservoir so that the drain tube aligns with mounting lugs on reservoir. (Fig. 7).

(7) Snap lower-most coil into mounting lugs on top of the reservoir.

(8) Snap the drain tube into the lugs on the bottom of the reservoir.

(9) Connect electrical wires to new sending unit (Fig. 6).

(10) Align index tab on new level unit with index hole on mounting bracket.

(11) Attach new level unit to mounting bracket with screws. (Fig. 5).

(12) Install reassembled unit into fuel tank.

INSTALLATION

(1) Wipe seal area of tank clean.

(2) Install a new O-ring seal on the pump.

(3) Align fuel pump module with retaining bracket on bottom of fuel tank (Fig. 13). The fuel pump module may have a slight interference fit with the bracket.

(4) Push the module down and install the retaining clamp. Tighten clamp to 4.5 N•m (40 in. lbs.) torque.

(5) Install fuel tank. Refer to "Fuel Tanks"

FUEL FILTER

REMOVAL

WARNING: THE TBI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 100 KPA (14.5 PSI). BEFORE SERVICING THE FUEL FILTER THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(1) Perform Fuel System Pressure Release procedure.

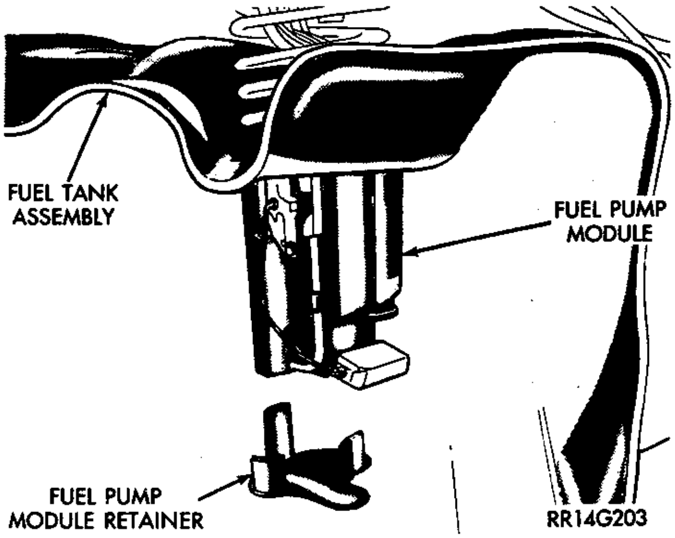

Fig. 13 Fuel Pump Module Retaining Bracket

(2) Disconnect battery negative cable from battery.

(3) Remove filter retaining screw and remove filter assembly from mounting plate (Fig. 14).

(4) Loosen outlet hose clamp on filter and inlet hose clamp on rear fuel tube (Fig. 14).

(5) Wrap a shop towel around hoses to absorb fuel. Remove hoses at filter and fuel tube. Discard clamps.

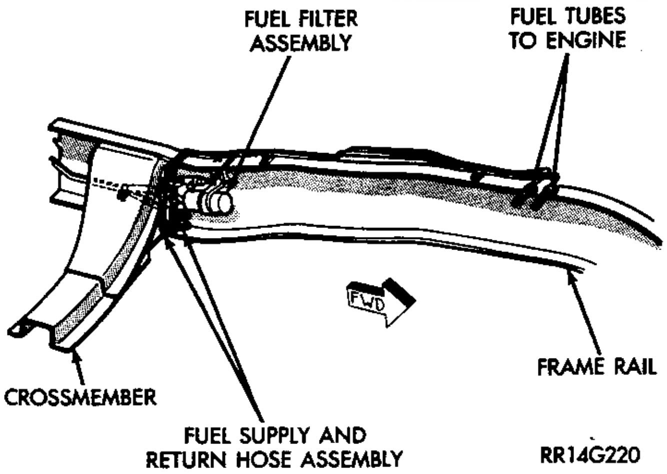

Fig. 14 Fuel Filter

INSTALLATION

(1) Install inlet hose on fuel tube and tighten new clamp to 1 N•m (10 in. lbs.) torque.

(2) Install outlet hose on filter outlet fitting and tighten new clamp to 1 N•m (10 in. lbs.) torque.

(3) Position filter assembly on mounting plate and tighten mounting screw to 8 N•m (75 in. lbs.) torque.

FUEL HOSES AND CLAMPS

WARNING: THE TBI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 100 KPA (14.5 PSI). BEFORE SERVICING FUEL SYSTEM HOSES OR LINES THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

Inspect all hose connections. Ensure they are secure and not leaking. Hoses should be replaced immediately if there is any evidence of degradation that could result in failure.

Avoid contact with clamps or other components that cause abrasions or scuffing. Ensure that the rubber hoses are properly routed to prevent pinching and to avoid heat sources.

The hoses used on fuel injected vehicles are of special construction due to the possibility of contaminated fuel in this system. If it is necessary to replace these hoses, only hoses marked EFM/EFI may be used.

The hose clamps used on fuel injected vehicles are of a special rolled edge construction to prevent the edge of the clamp cutting into the hose. Only these rolled edge type clamps may be used in this system, all other types of clamps may cut into the hoses and cause high pressure fuel leaks.

Use new original equipment type hose clamps, tighten hose clamps to 1 N•m (10 in. lbs.) torque.

QUICK-CONNECT FUEL TUBE FITTINGS

Quick-connect fuel tube fittings at the ends of the chassis fuel lines (Fig. 15). The fitting consists of O-rings and a plastic release collar to disconnect the fitting from the fuel tube.

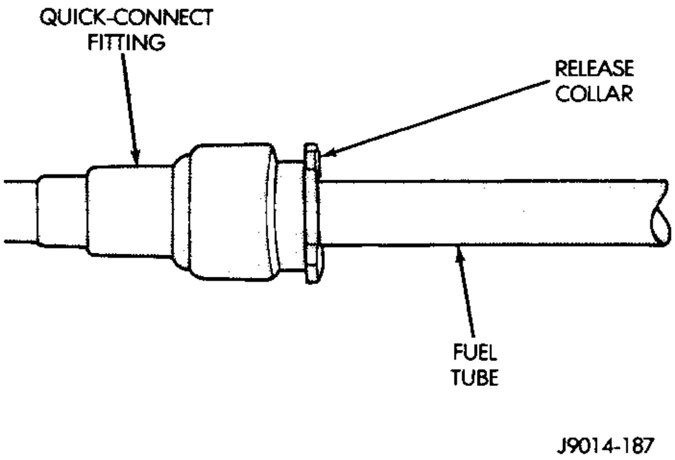

Fig. 15 Quick-Connect Fitting

At the end of the fuel tube nipple is a raised shoulder. When the fuel tube is installed into the quick-connect fitting the shoulder is locked in place by tangs inside the fitting (Fig. 16). After the tube is installed into the fitting, Verify that connection is secure by firmly pulling back on fuel tube (Fig. 17). The tube should be locked in place.

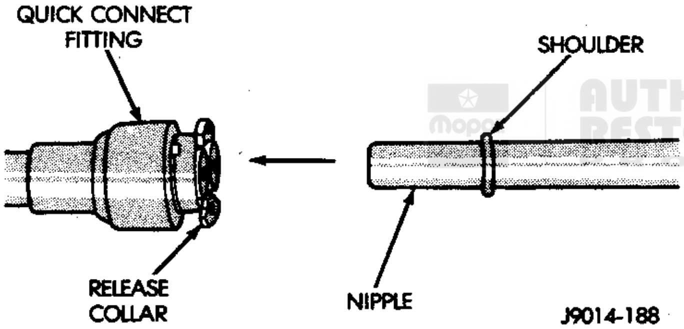

Fig. 16 Quick-Connect Fitting Assembly

To disconnect the fitting from the fuel tube, pull the release collar back into the fitting and slide the fitting off of the fuel tube (Fig. 18).

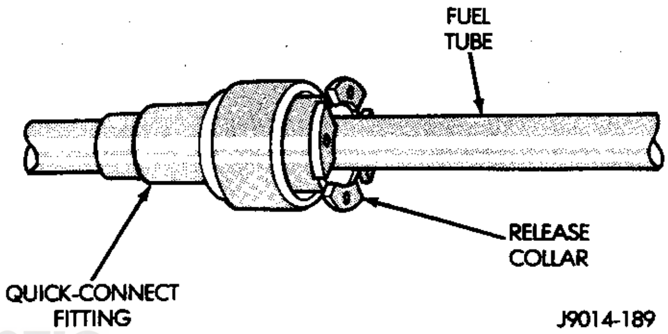

Fig. 17 Assembled Quick-Connect Fitting

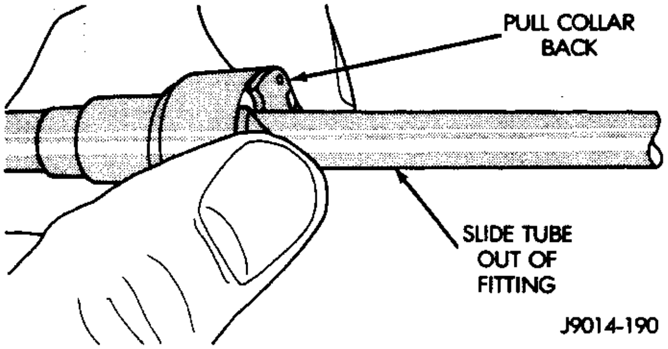

Fig. 18 Quick-Connect Fitting Disassembly

FUEL TANKS

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GENERAL INFORMATION

Chrysler Motors built vehicles pass a full 360° rollover without fuel leakage. To accomplish this, fuel and vapor flow controls are required for all fuel tank connections.

All models are equipped with a rollover valve mounted in the top of the fuel tank. On vehicles equipped with a return line from the fuel pump to the fuel tank a one-way check valve is used to provide the required protection. In addition to the valve, improved flow control is used in the fuel pump to control flow when the pump is subjected to the higher than normal pressure which can occur during rollover. A fuel filler cap with a higher pressure setting is used for the same reason on vehicles with side fill.

An evaporation control system is used to reduce the emissions of fuel vapors into the atmosphere by evaporation and reduce the unburned hydrocarbons emitted by the vehicle engine. When fuel evaporates from the fuel tank, the vapors pass through vent hoses or tubes to a charcoal canister where they are temporarily held until they can be drawn into the intake manifold when the engine is running.

Inspect all hose connections such as clamps and couplings to make sure they are secure and no leaks are present. Hoses should be replaced immediately if there is any evidence of degradation that could result in failure.

Avoid contact with clamps or other components that cause abrasions or scuffing. Ensure that the rubber hoses are properly routed to prevent pinching and to avoid heat sources.

The hoses used on fuel injected vehicles are of a special construction due to the higher fuel pressures involved in this system. If it is necessary to replace these hoses, only hoses marked EFM/EFI may be used.

The hose clamps used on fuel injected vehicles are of a special rolled edge construction to prevent the edge of the clamp cutting into the hose. Only these rolled edge type clamps may be used on this system, all other types of clamps may cut into the hoses and cause high pressure fuel leaks.

NO-LEAD FUEL TANK FILLER TUBE

All catalyst equipped vehicles have a special fuel tank filler tube. The fuel filler opening is smaller in diameter than those used for non-catalyst vehicles to permit entry of only the smaller no-lead fuel nozzles. In addition a deflector, which is opened by the no-lead fuel nozzle, deters the addition of fuel by means other than the proper nozzle.

The fuel filler tube on these models is equipped with a one way ball check valve designed to prevent fuel back splash which may occur while filling the tank.

A label is attached to the instrument panel under the fuel gauge that reads "UNLEADED FUEL ONLY" as a reminder to the driver. A similar label is located near the fuel tank filler.

PRESSURE-VACUUM FILLER CAP

The loss of any fuel or vapor out of the filler neck is prevented by the use of a pressure-vacuum filler cap. Relief valves inside the cap will release only under significant pressure of 6.58 to 8.44 kPa (1.95 to 2.5 psi). The vacuum release for all gas caps is between .97 and 2.0 kPa (.14 and .29 psi). This cap must be replaced by a similar unit if replacement is necessary, in order for the system to remain effective.

CAUTION: Remove filler cap prior to removing or repairing fuel lines to relieve tank pressure.

FUEL TANK CAPACITIES

TANK:	LITERS	GALLONS
Standard	83.0	22
Optional	114	30
Ramcharger	120.9	34
Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerances and refill procedures.		

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FUEL TANK SKID PLATE

A protective metal skid plate is available for the Ramcharger 34 gallon fuel tank (Fig. 1). The plate is mounted to the frame rails and to brackets attached to the crossmembers.

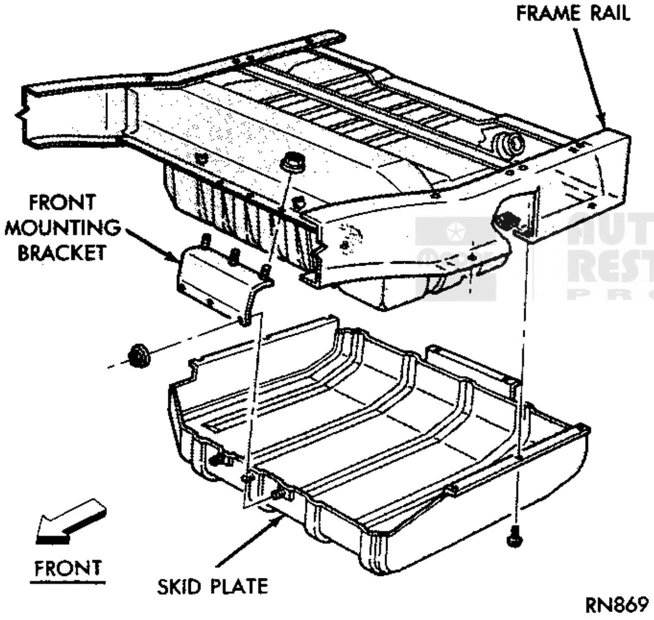


Fig. 1 Fuel Tank Skid Plate

HEAT SHIELDS

The sheet metal heat shields must be removed when servicing the fuel tank, fuel lines or vapor vent line. It is very important that these heat shields be reinstalled after service to protect the lines and tank from the heat of the exhaust system. See Group 11 in this manual for proper installation.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

The fuel system is under a constant pressure of approximately 100 kPa (15 psi). Before servicing the fuel tank the fuel pressure must be released as follows:

(1) Loosen fuel filler cap to release fuel tank pressure.

(2) Disconnect injector wiring harness from engine harness.

(3) Connect a jumper wire to ground terminal Number 1 of the injector harness (Fig. 2) to engine ground.

(4) Connect a jumper wire to the positive terminal Number 2 of the injector harness (Fig. 2) and touch the battery positive post for no longer than 5 seconds. This releases system pressure.

(5) Remove jumper wires.

(6) Continue fuel system service.

FUEL TANKS

DRAINING FUEL TANK

(1) Remove fuel filler cap to release fuel tank pressure.

(2) Perform Fuel System Pressure Release procedure as described in this group.

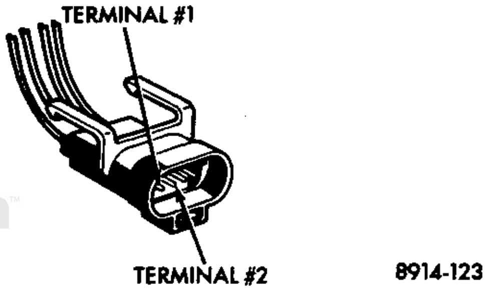


Fig. 2 Injector Harness Connectors

(3) Raise vehicle on hoist.

(4) Drain fuel into a portable holding tank or a properly labeled "gasoline" safety container.

- If the fuel pump operates, fuel can be drained through the fuel supply hose.
- If the pump does not operate, but the fuel level in the fuel tank is below the fuel filler hose, fuel can be siphoned through the fuel filler hose. The hose will have to be disconnected from the filler neck.
- If the fuel tank is full and the fuel pump does not operate, drain fuel from filler neck. Support fuel tank with a transmission jack. Loosen fuel tank mounting straps with the passenger side fuel strap loosened slightly more than driver side strap. Lower the tank slightly. Loosen the filler neck to filler hose clamp. Slide clamp back on hose. Wrap shop towels around fuel filler hose to absorb any spilled fuel. Disconnect filler hose from filler neck. Drain fuel tank through filler hose.

REMOVAL—MID-FRAME MOUNTED TANKS

(1) Drain fuel tank. Refer to Draining Fuel Tank in this group.

(2) Disconnect battery negative cable.

(3) Remove fuel tank filler cap before disconnecting any fuel or vent lines. The tank could be under a slight pressure.

(4) Pump all fuel from fuel tank into an approved portable holding tank. If this equipment is not available, disconnect the fuel line and drain tank dry into a properly identified "Gasoline" safety container.

(5) Raise vehicle on hoist and disconnect all vent hoses and filler hose (Fig. 3 and 4).

(6) Place a transmission jack under the center of the fuel tank and apply slight pressure.

WARNING: WRAP SHOP TOWELS AROUND HOSES TO CATCH ANY GASOLINE SPILLAGE.

(7) Remove fuel tank mounting strap nuts at the crossmembers (Fig. 5). Lower fuel tank enough to permit fuel gauge wire and fuel tubes to be disconnected from the fuel pump module at the top of the fuel tank. To remove fuel tubes squeeze locking tabs on connector and pull tube back (Fig. 6).

(8) Lower fuel tank.

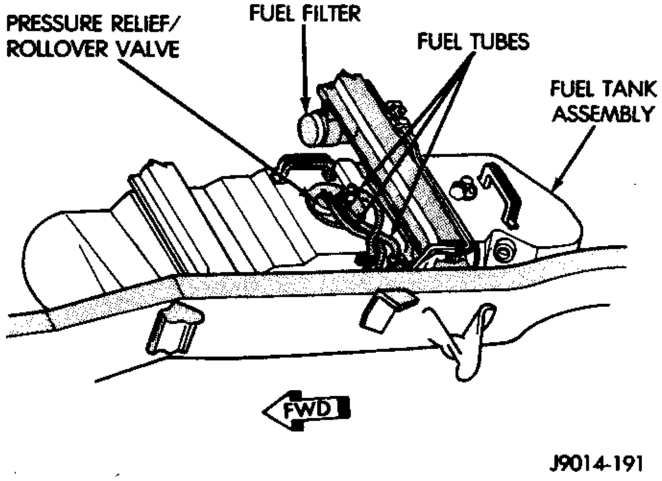


Fig. 3 Fuel Hose Connections to Fuel Tank—Mid-Frame Mounted Fuel Tanks

INSTALLATION—MID-FRAME MOUNTED TANKS

(1) Place fuel tank on top of transmission jack and raise high enough to connect the fuel tubes and gauge wire to the fuel pump module on the top of the tank.

(2) Raise tank into position under crossmembers and connect the two end mounting straps. Remove transmission jack. Tighten all straps firmly. Do not over tighten retaining strap nuts.

(3) Connect vent hoses.

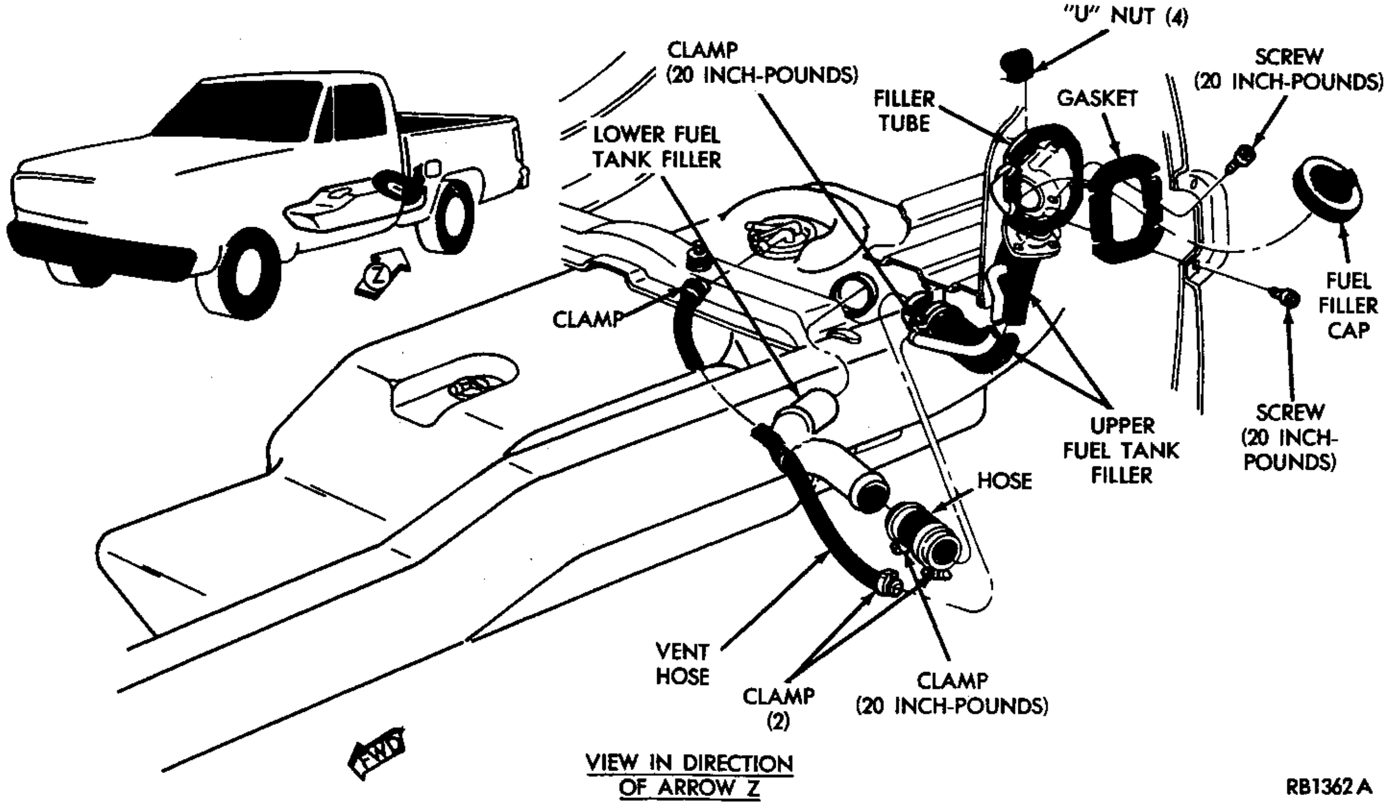
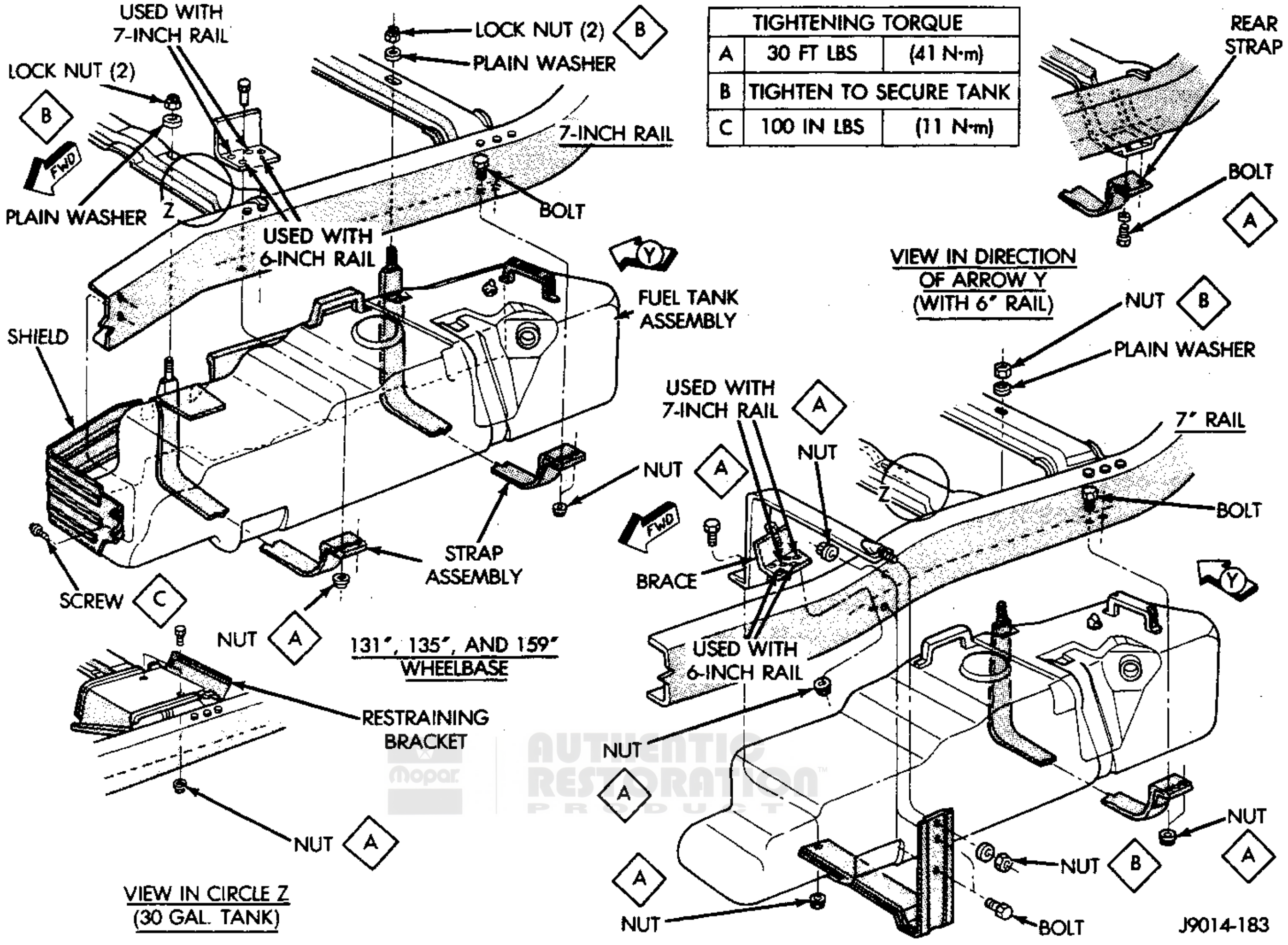


Fig. 4 Fuel Filler Neck and Vent Hose Connections—Mid-Frame Mounted Fuel Tanks



TIGHTENING TORQUE		
A	30 FT LBS	(41 N·m)
B	TIGHTEN TO SECURE TANK	
C	100 IN LBS	(11 N·m)

Fig. 5 Mid-Frame Mounted Fuel Tank Removal/Installation

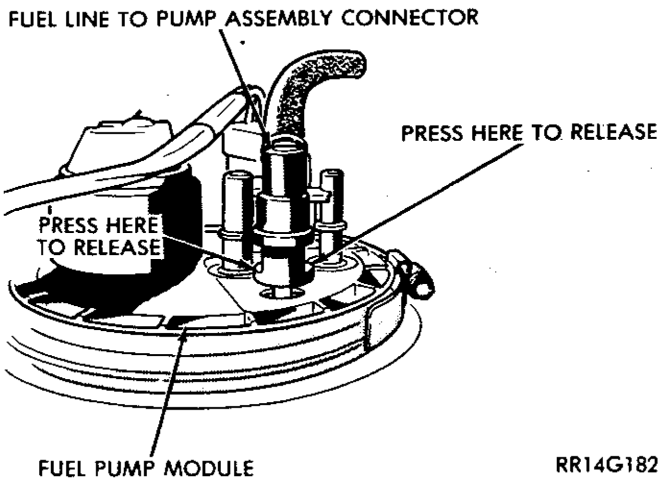


Fig. 6 Fuel Tube to Fuel Pump Module Connection

(4) Connect fuel line if it was disconnected to drain tank. Recap drain tube.

(5) Refill fuel tank and inspect all hoses and lines for leaks. Connect battery cable.

REMOVAL—RAMCHARGER MODELS

(1) Drain fuel tank. Refer to Draining Fuel Tank in this section.

(2) Disconnect battery ground cable.

(3) Remove fuel tank filler cap to release fuel tank pressure.

(4) Pump all fuel from fuel tank into an approved portable holding tank. If this equipment is not available, disconnect the fuel line and drain tank dry into a properly identified "Gasoline" safety container. Refer to "Draining Fuel Tank".

(5) Raise vehicle on hoist.

(6) Place transmission jack under center of tank and apply slight pressure. Disconnect the tank mounting straps "J" bolts and remove retaining straps (Fig. 7).

(7) Lower tank on transmission jack far enough to permit access to the fuel tubes and fuel gauge sending unit electrical connection at the fuel pump module on top of the tank (Fig. 8).

(8) To remove fuel tubes squeeze locking tabs on connector and pull tube back (Fig. 6). Disconnect fuel

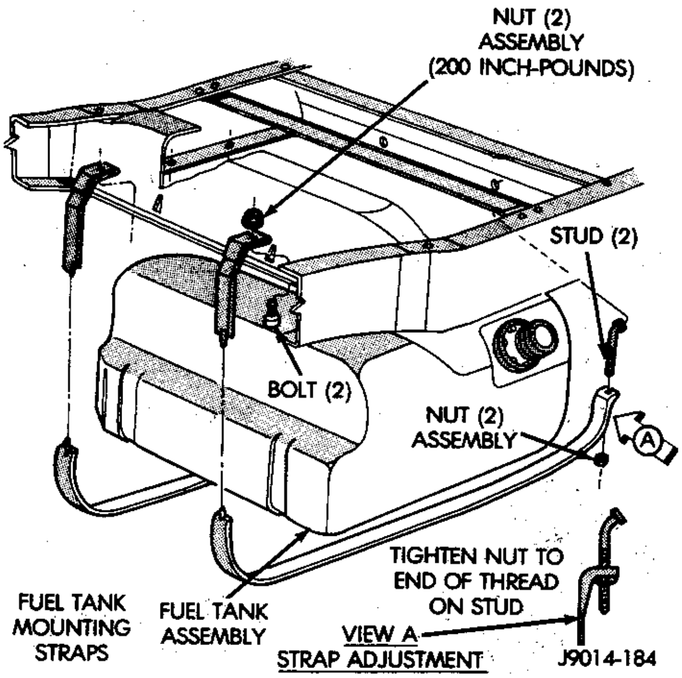


Fig. 7 Ramcharger Fuel Tank Removal/Installation

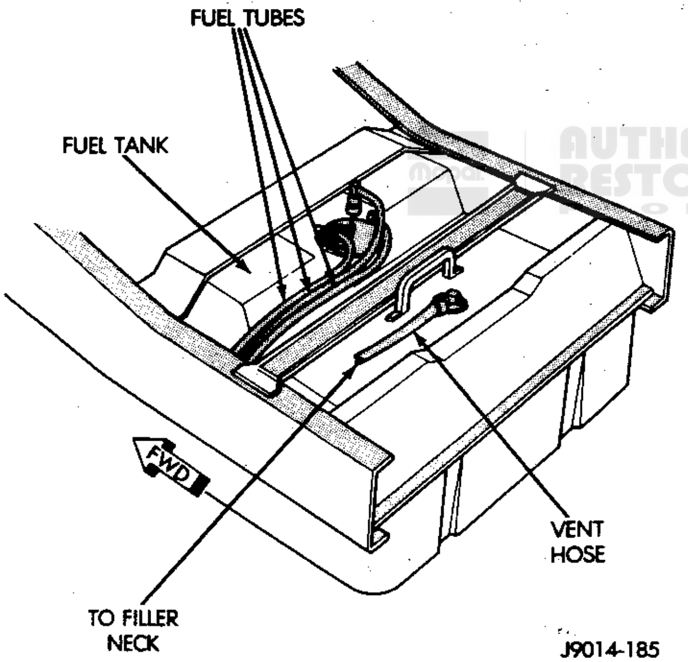


Fig. 8 Fuel Tube Connections—Ramcharger

gauge sending unit electrical connector from fuel pump module. Remove ground strap.

(9) Remove fuel filler tube hose and fill vent hose from tank (Fig. 8 and Fig. 9).

(10) Lower fuel tank.

INSTALLATION

(1) Position tank on transmission jack.

(2) Raise tank high enough to connect the fuel tubes and gauge sending unit electrical connector to the fuel pump module at the top of the tank.

(3) Raise tank into position.

(4) Install tank mounting straps. Connect "J" bolts and tighten the nuts as shown in Fig. 8.

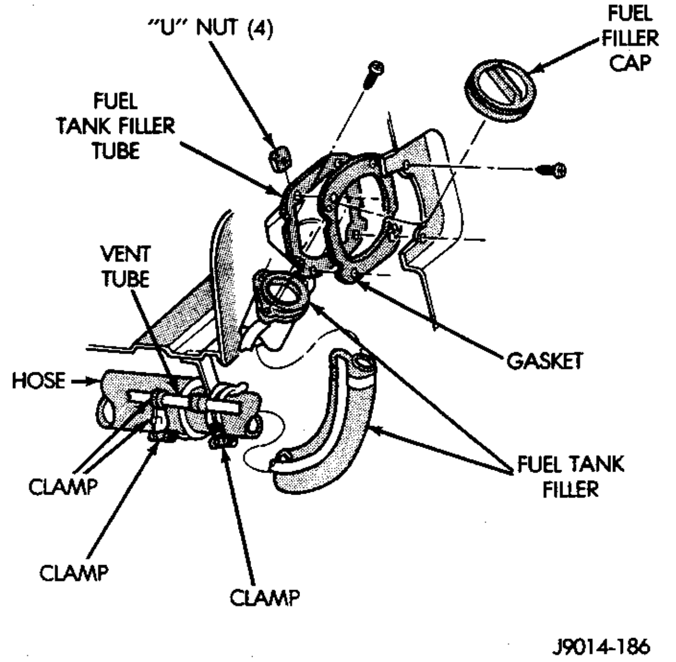


Fig. 9 Fuel Filler Tube and Vent Tube to Filler Neck Connections

(5) Remove jack.

(6) Connect filler tube and all vent hoses. Install new hose clamps and tighten securely.

(7) Connect fuel line if disconnected to drain tank. Recap drain tube.

(8) Refill fuel tank and inspect all hoses and lines for leaks.

(9) Reconnect battery ground cable.

FUEL RESERVOIR

The fuel reservoir (Fig. 10) is attached to the lower end of the fuel pump module. The purpose of the res-

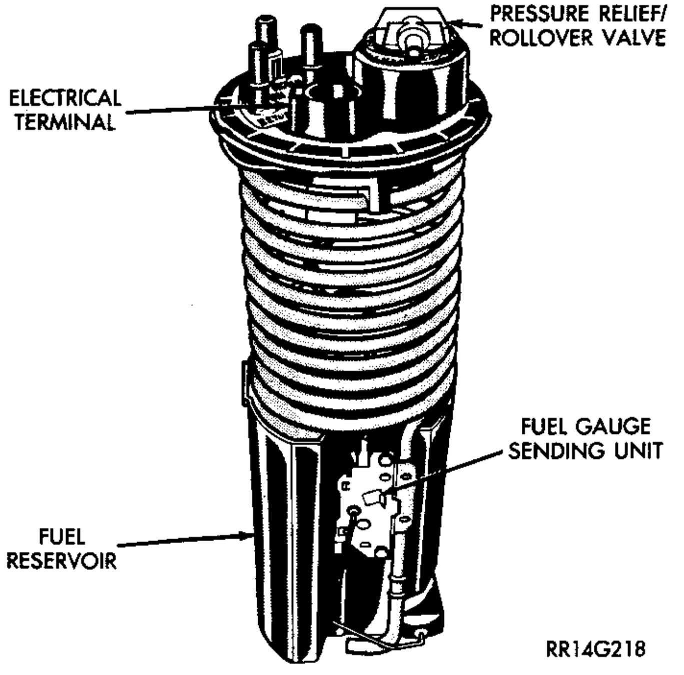


Fig. 10 Fuel Pump Module

ervoir is to provide fuel at the pump intake during all driving conditions, especially those when low fuel levels are present. The fuel return line directs fuel into the reservoir.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit is attached to the fuel pump module (Fig. 11). The fuel pump module must be removed to service the fuel gauge sending unit.

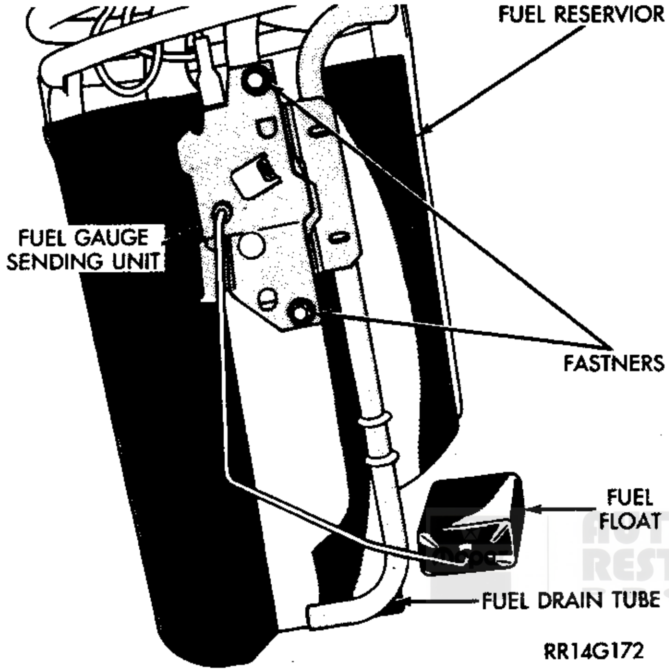


Fig. 11 Fuel Gauge Sending Unit

REMOVAL

(1) Remove fuel gauge sending unit fasteners from mounting bracket on drain tube (Fig. 11).

(2) Disconnect electrical wires from level unit (Fig. 12).

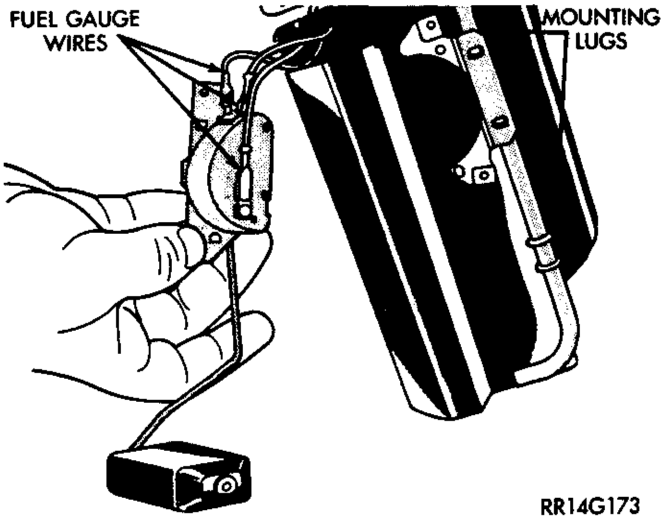


Fig. 12 Servicing Fuel Gauge Sending Unit

(3) Reverse above procedure for installation.

FUEL TANK PRESSURE RELIEF/ROLLOVER VALVE

The fuel tanks of all vehicles are equipped with a pressure relief/rollover valve. The dual function valves relieve fuel tank pressure and prevent fuel flow through the fuel tank vent hoses in the event of vehicle rollover. All vehicles pass a full 360° rollover without fuel leakage.

The pressure relief/rollover valve (Fig. 13) is mounted at the top of the fuel pump module.

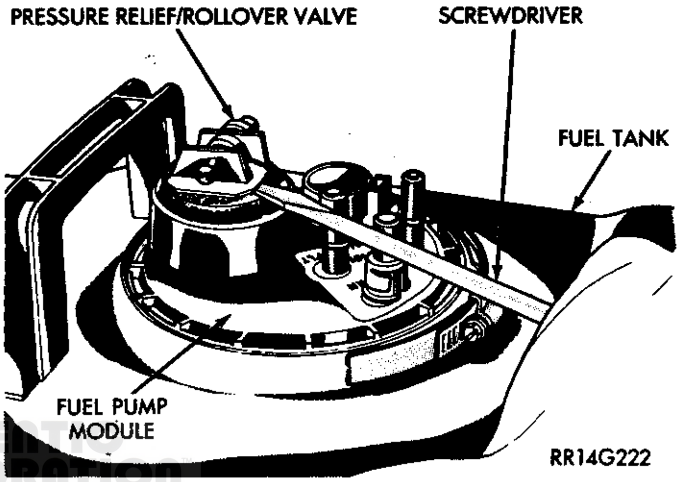


Fig. 13 Servicing Pressure Relief/Rollover Valve

REMOVAL

(1) Remove fuel tank refer to "Fuel Tanks" section in this group.

(2) Wedge the blade of a straight screwdriver between the rubber grommet and the fuel tank where the support rib is located (Fig. 13). **Do not wedge between the valve and the grommet or damage to the valve may result upon removal.**

(3) Use a second screwdriver as a support to pry the valve and grommet assembly from the tank.

(4) To remove the grommet from the valve, place the valve upright on a flat surface and push down on the grommet peeling it down off the valve.

INSTALLATION

(1) Install the rubber grommet in the fuel tank and work it around the curled lip.

(2) Lubricate the grommet with **Power Steering Fluid** and push the valve downward into the grommet. Twist valve until properly positioned.

(3) Install fuel tank. Refer to "Fuel Tank Installation".

ACCELERATOR PEDAL AND THROTTLE CABLE

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GENERAL INFORMATION

All models have two torsion return springs on the throttle body, and an accelerator pedal return spring (extension spring) which gives positive throttle return and lower throttle pedal efforts while meeting safety requirements.

ACCELERATOR PEDAL

CAUTION: Be careful not to damage or kink throttle or speed control core wire during installation or removal of accelerator pedal or cables.

REMOVAL

From inside the vehicle, hold up the pedal and remove the cable retainer and throttle cable from the upper end of the pedal shaft (Fig. 1).

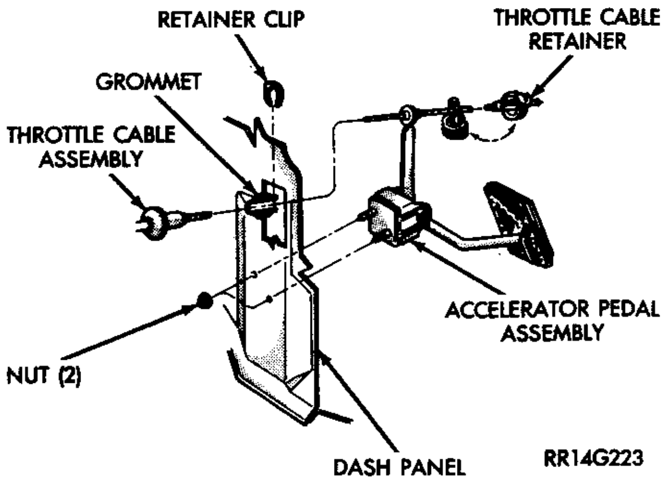

Fig. 1 Accelerator Pedal Removal or Installation

Working from the engine compartment, remove nuts from pedal shaft and bracket assembly studs. Remove assembly from vehicle.

INSTALLATION

Position assembly on dash panel and install retaining nuts, tighten to specifications. From inside the vehicle, hold up the pedal and install the throttle cable and cable retainer in the upper end of the pedal shaft.

THROTTLE CABLE

CAUTION: Be careful not to damage or kink throttle or speed control core wire during installation or removal of accelerator pedal or cables.

REMOVAL

(1) From inside the vehicle, remove the cable housing retainer clip and core wire cable retainer (Fig. 1).

(2) Remove the core wire from the pedal shaft.

(3) From the engine compartment, pull the housing end-fitting out of the dash panel grommet (Fig. 1). The grommet should remain in the dash panel hole.

(4) Remove the cable slug from the throttle body cam. Separate the cable mounting bracket with wide-jaw pliers by compressing the end-fitting tabs (Fig. 2 or 3).

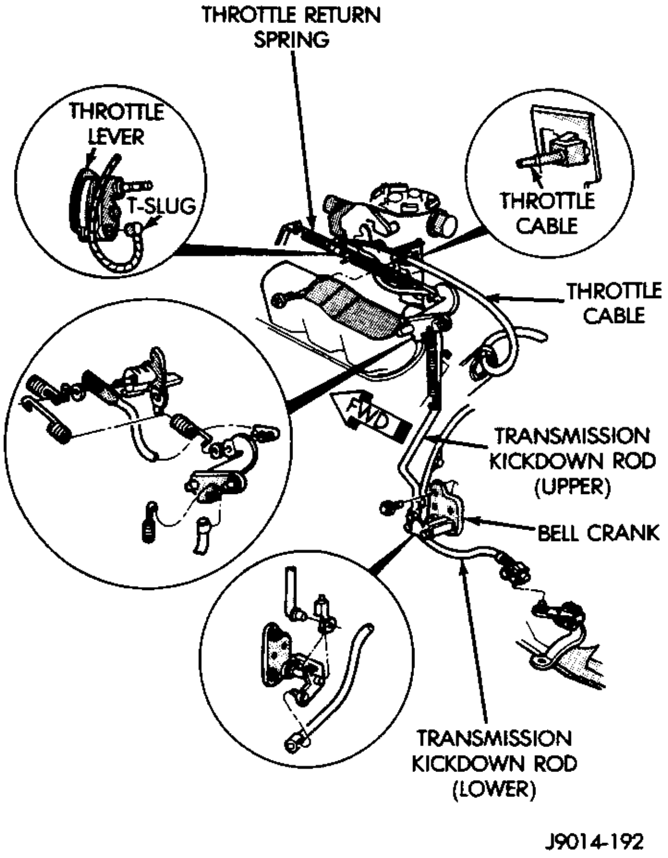

Fig. 2 Throttle Cable Attachment—3.9L Engine

INSTALLATION

(1) Install the cable housing into the cable mounting bracket on the throttle body and attach the cable slug with the retaining clip onto the throttle body cam.

(2) Install the remaining cable housing end-fitting into the dash panel grommet and attach the housing retainer clip from inside the vehicle.

(3) Install the ball end of the cable through the hole in the pedal shaft and install the plastic cable retainer.

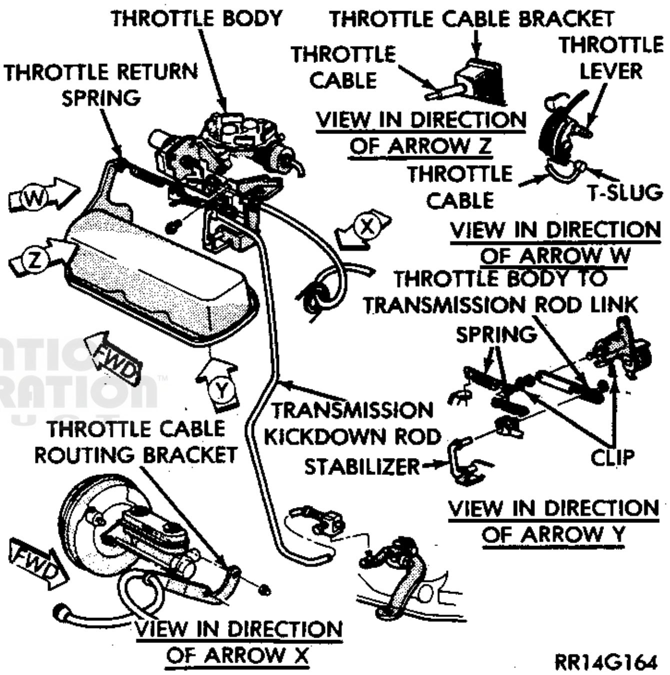

Fig. 3 Throttle Cable Attachment—5.2L and 5.9L Engine

DUAL POINT FUEL INJECTION

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GENERAL INFORMATION

The Dual-Point Electronic Fuel Injection System (Fig. 1) is a computer regulated system that provides a precise air/fuel ratio for all driving conditions. Fuel is supplied to the engine through two fuel injectors in the throttle body.

At the center of the system is the Single Board Engine Controller (SBEC). The SBEC is a preprogrammed, digital computer that regulates ignition timing, air-fuel ratio, emission control devices, charging system, speed control and idle speed. The SBEC can adapt its programming to meet changing operating conditions.

Various sensors provide the inputs necessary for the SBEC to correctly regulate fuel flow at the injector. These include the Manifold Absolute Pressure sensor, Throttle Position sensor, Oxygen Sensor, Coolant Temperature sensor, and Vehicle Distance sensor. In addition to the sensors, certain switches and relays provide important inputs. These include the Neutral-Safety Switch and Air Conditioning Clutch Relay.

All inputs to the Single Board Engine Controller are converted into signals. Air-fuel ratio, ignition timing and other controlled outputs are adjusted based on these inputs. The SBEC adjust the air-fuel ratio by changing injector pulse width. Injector pulse width is the period of time that an injector is energized by the SBEC.

The fuel injection system is a "Speed-Density" system. In this type of system engine RPM and manifold absolute pressure are the primary computer inputs that determine fuel injector pulse width. The SBEC maintains desired air/fuel (14.7 to 1) ratio by determining mass air flow and adjusts fuel injector pulse width to obtain the correct mass fuel flow.

The combination of engine RPM and throttle angle (throttle position input) indicates engine air flow. The MAP sensor input indicates air density. The product of engine air flow and air density is mass air flow. The product of fuel pressure and injector pulse width is mass fuel flow.

SYSTEM DIAGNOSIS

The Single Board Module Engine Controller (SBEC) tests many of its own input and output circuits. If a fault is found in a major system, this information is stored in memory. Information about this fault can be displayed to a technician by means of the instrument panel Check Engine lamp or by connecting the Diagnostic Readout Box II (DRBII) and reading descriptions of any faults which have been stored in memory. Refer to the Service Diagnostic Tester and accompanying manuals. The Service Diagnostic Tester plugs into a diagnostic connector inside the engine compartment.

SINGLE BOARD ENGINE CONTROLLER (SBEC)

The Single Board Engine Controller (SBEC— Fig. 2) is a digital computer containing a microprocessor. It receives input signals from various switches and sensors. Based on these inputs, the SBEC regulates various engine and vehicle operations through different system components that are referred to as "SBEC Outputs".

The SBEC controls fuel injector pulse width (air-fuel ratio) based on inputs received from sensors that react to exhaust gas oxygen content, coolant temperature, manifold absolute pressure, battery voltage, engine speed, throttle position, throttle body temperature (5.2L and 5.9L engines) battery voltage, and inputs from switches that are triggered by air condi

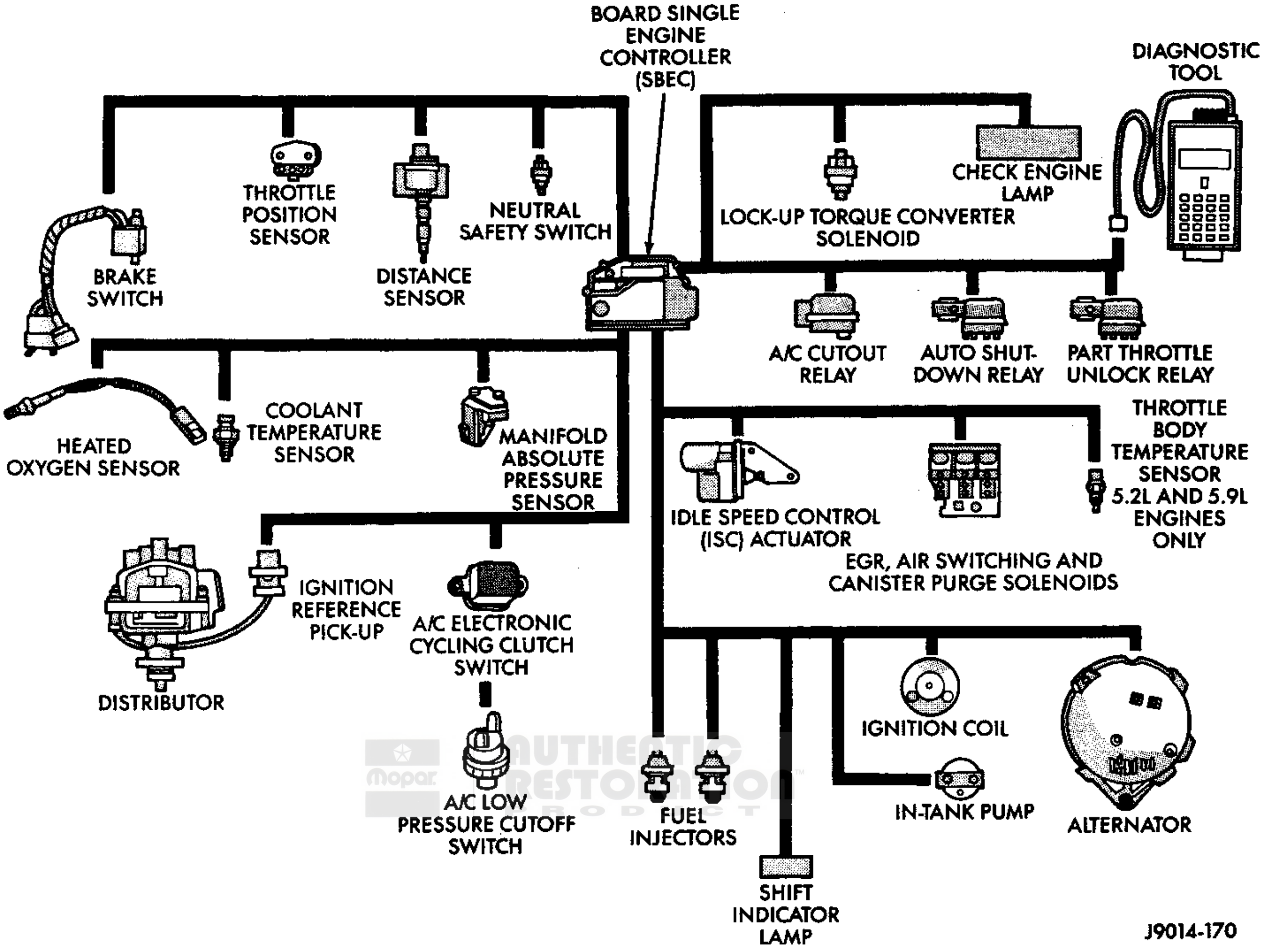

Fig. 1 Dual-Point Injection Components

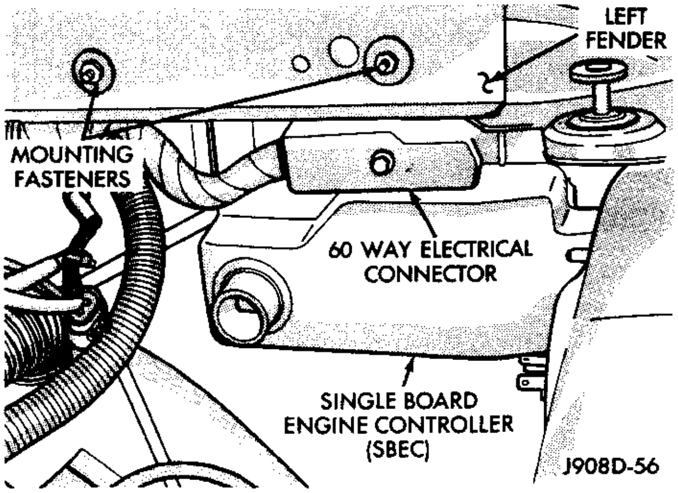

Fig. 2 Single Board Engine Controller (SBEC)

tioning selection, transmission gear selection (automatic transmissions only), and speed control. These sensors and switches are considered "SBEC Inputs".

The SBEC adjusts ignition timing based upon inputs it receives from sensors that react to: engine RPM (the distributor pick-up), manifold absolute pressure, coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed, and the idle contact switch. These sensors are considered "SBEC Inputs"

The SBEC adjusts idle speed based on inputs it receives from sensors that react to: throttle position, vehicle speed, transmission gear selection, coolant temperature and from inputs it receives from the air conditioning clutch switch, brake light switch, and idle contact switch.

Based on inputs that it receives, the SBEC also controls ignition coil dwell and evaporative canister purge operation. The SBEC also adjusts the alternator charge rate through control of the alternator field and provides speed control operation.

SBEC Inputs:

- Air Conditioning Switch
- Battery Voltage
- Brake Light Switch
- Coolant Temperature Sensor
- Engine Speed (Distributor Pick-up)
- Idle contact switch

- Manifold Absolute Pressure (MAP) Sensor
- Neutral Safety Switch
- Oxygen Sensor
- Throttle Position Sensor
- Throttle Body Temperature Sensor (5.2L and 5.9L engines)
- Vehicle Distance Sensor

SBEC Outputs

- A/C Clutch Relay
- Air Switching Solenoid
- Alternator
- Auto Shutdown (ASD) Relay
- Canister Purge Solenoid
- Check Engine Lamp
- Diagnostic Connector
- EGR Solenoid
- EMR Lamp
- Fuel Injectors
- Idle Speed Control (ISC) Actuator
- Ignition Coil
- Overdrive and Lock-up Torque Convertor Solenoids
- Shift Indicator Lamp

The Automatic Shut Down (ASD) relay is mounted externally, but is switched on and off by the SBEC. The relay provides voltage for the electric fuel pump, fuel injector, ignition coil and exhaust gas oxygen sensor heater element. The SBEC monitors the distributor pick-up signal to determine engine speed and compute injector synchronization. If the SBEC does not receive a distributor signal when the ignition switch is in the "RUN" position, it will not energize the ASD relay, stopping the battery voltage supply to the fuel injector, fuel pump, ignition coil, and oxygen sensor heater element.

The SBEC contains a voltage convertor which converts battery voltage to a regulated 8.0 volts to power the distributor pick-up. The SBEC also provides a five (5) volt supply for the Manifold Absolute Pressure (MAP) sensor and Throttle Position Sensor (TPS).

A/C SWITCH—SBEC INPUT

When the A/C switch is in the ON position, the SBEC receives an input indicating that the air conditioning has been selected. After receiving this input the SBEC activates the A/C compressor clutch by grounding the A/C clutch relay, and maintains idle speed to a scheduled RPM through control of the Idle Speed Control Actuator.

The SBEC will de-energize the A/C clutch relay if it receives input from either the A/C low pressure switch indicating a low refrigerant level, or from the electric clutch cycling switching indicating evaporator freezing.

BATTERY VOLTAGE—SBEC INPUT

The SBEC monitors the battery voltage input to determine fuel injector pulse width and alternator field control.

If battery voltage is low the SBEC will increase injector pulse width (period of time that the injector is energized) to compensate for the reduced flow through the injector caused by the lowered voltage.

BRAKE LIGHT SWITCH—SBEC INPUT

When the brake light switch is activated, the SBEC receives an input indicating that the brakes are being applied. After receiving this input the SBEC maintains idle speed to a scheduled RPM through control of the Idle Speed Control Actuator.

COOLANT TEMPERATURE SENSOR—SBEC INPUT

The Coolant Temperature Sensor is installed next to the thermostat housing in the intake manifold water jacket passage and provides an input voltage to the SBEC (Fig. 3). As coolant temperature varies the Coolant Temperature Sensors resistance changes resulting in a different input voltage to the SBEC.

When the engine is cold, the SBEC will demand slightly richer air-fuel mixtures and higher idle speeds until normal operating temperatures are reached.

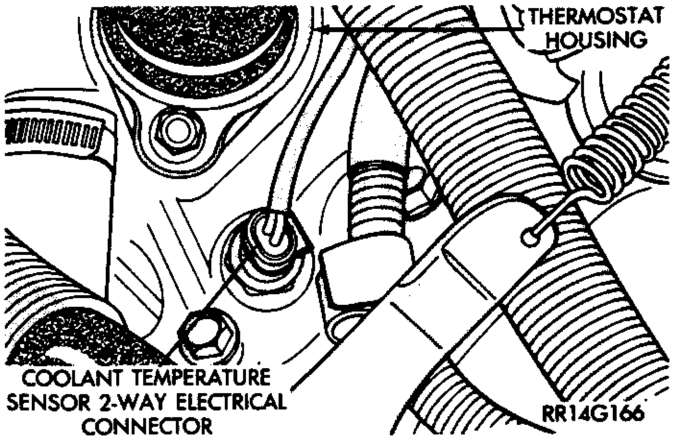

Fig. 3 Coolant Temperature Sensor

ENGINE SPEED—SBEC INPUT

The engine speed input is supplied to the SBEC by the distributor pick-up. The distributor pick-up is a Hall Effect device (Fig. 4).

A shutter (sometimes referred to as an interrupter) is attached to the distributor shaft. The shutter contains one blade per engine cylinder (six blades for the 3.9L engine or eight blades for the 5.2L and 5.9L engines). A switch plate is mounted to the distributor housing above the shutter. The switch plate contains the distributor pick-up (a Hall Effect device and magnet) through which the shutter blades rotate. As the shutter blades pass through the pick-up, they interrupt the magnetic field. The Hall effect device in the pick-up senses the change in the magnetic field and switches on and off (creating pulses), generating the input signal to the SBEC. The SBEC calculates engine speed through the number of pulses generated.

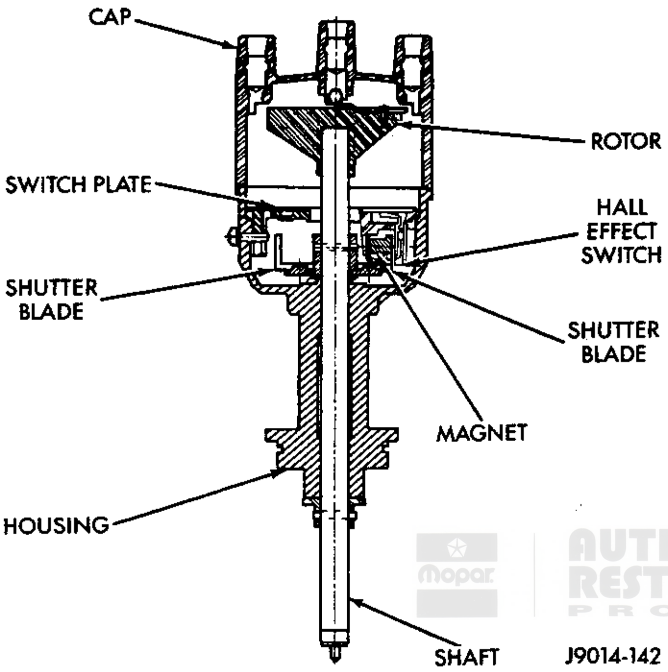

Fig. 4 Distributor Pick-Up—Typical

IDLE CONTACT SWITCH—SBEC INPUT

The idle contact switch is integral with the idle speed (ISC) actuator and provides an input signal to the SBEC (Fig. 5). This input enables the SBEC to increase or decrease the throttle stop angle (by extending or retracting the ISC actuator) in response to engine operating conditions.

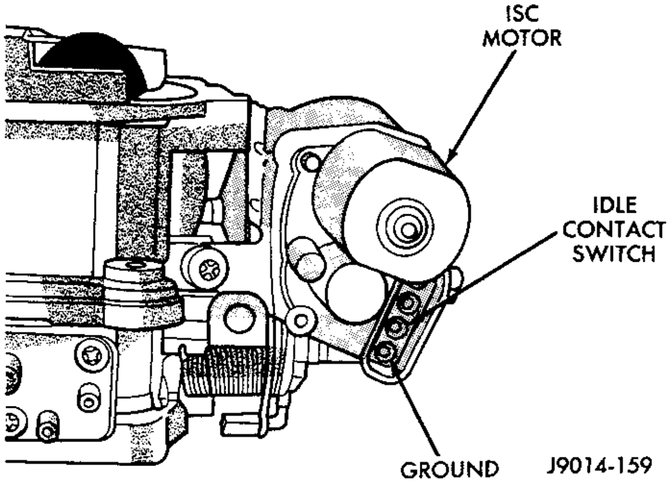

Fig. 5 Idle Contact Switch

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—SBEC INPUT

The MAP sensor reacts to absolute pressure in the intake manifold and provides an input voltage to the Single Board Engine Controller (SBEC). As engine load changes manifold pressure varies, causing the MAP sensors resistance to change. The change in MAP sensor resistance results in a different input voltage to the SBEC. The input voltage level supplies the SBEC with information relating to ambient barometric pressure during engine start-up (cranking) and to engine load while the engine is running. The SBEC uses this input along with inputs from other sensors to adjust air-fuel mixture.

The MAP sensor is mounted on the throttle body (Fig. 6) and is connected to the throttle body with a vacuum hose and to the SBEC electrically.

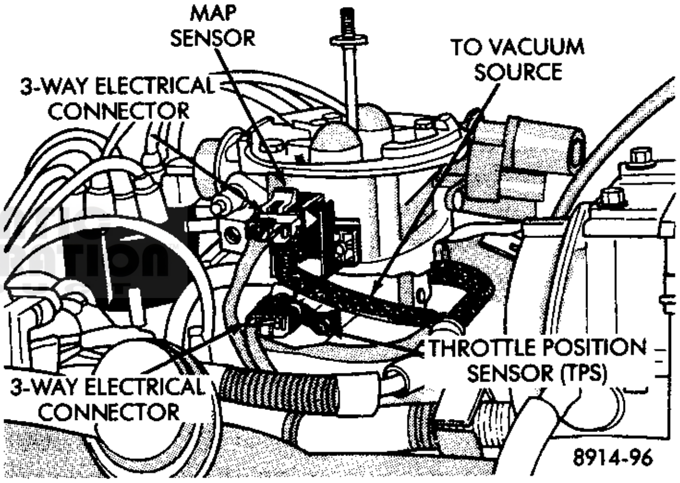

Fig. 6 Manifold Absolute Pressure (MAP) Sensor Location

OXYGEN SENSOR (O_2 SENSOR)—SBEC INPUT

The O_2 sensor is located in the exhaust down pipe on 3.9L engines (Fig. 7) and on 5.2L and 5.9L engines above the left exhaust manifold outlet (Fig. 8). The O_2 sensor provides an input voltage to the Single Board Engine Controller (SBEC) relating the oxygen content of the exhaust gas. The SBEC uses this information to fine tune the air-fuel ratio by adjusting injector pulse width.

The O_2 sensor produces voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air-fuel mixture), the sensor produces a low voltage. When there is a lesser amount present (rich air-fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensor acts as a rich-lean switch.

The oxygen sensor is equipped with a heating element that keeps the sensor at proper operating temperature during all operating modes. Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner.

In "Closed Loop" operation the SBEC monitors the O_2 sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During "Open Loop" operation the SBEC ignores the O_2 sensor input and adjusts injector pulse width to a preprogrammed value (based on other sensor inputs).

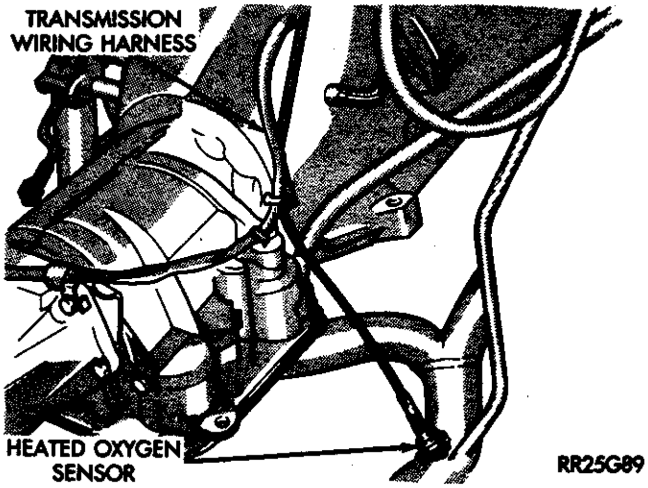

Fig. 7 Heated Oxygen Sensor Location—3.9L Engine

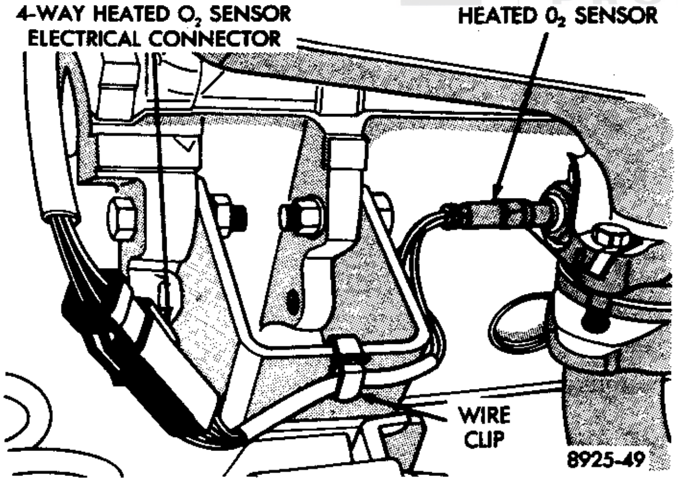

Fig. 8 Heated Oxygen Sensor Location—5.2L and 5.9L Engines

THROTTLE BODY TEMPERATURE SENSOR—SBEC INPUT (5.2L and 5.9L Engines)

Vehicles equipped with a 5.2L or 5.9L engine have a throttle body temperature sensor. The sensor (Fig. 9) monitors throttle body temperature which is the same as fuel temperature. It is mounted in the throttle body. This sensor provides information on fuel temperature which allows the SBEC to enrichen the air fuel mixture for a hot restart condition.

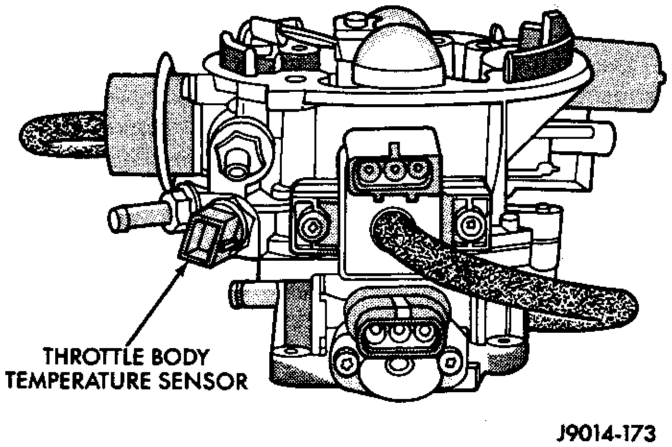

Fig. 9 Throttle Body Temperature Sensor

THROTTLE POSITION SENSOR (TPS)—SBEC INPUT

The Throttle Position Sensor (TPS) is mounted on the throttle body below the MAP sensor and connected to the throttle blade shaft (Fig. 10). The TPS is a variable resistor that provides the Single Board Engine Controller (SBEC) with an input signal (voltage) that represents throttle blade position. As the position of the throttle blade changes, the resistance of the TPS changes.

The SBEC supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the SBEC) represents the throttle blade position. The SBEC receives an input signal voltage from the TPS varying in an approximate range of from 1 volt at minimum throttle opening (idle) to 4 volts at wide open throttle. Along with inputs from other sensors, the SBEC uses the TPS input to determine current engine operating conditions and adjust fuel injector pulse width and ignition timing.

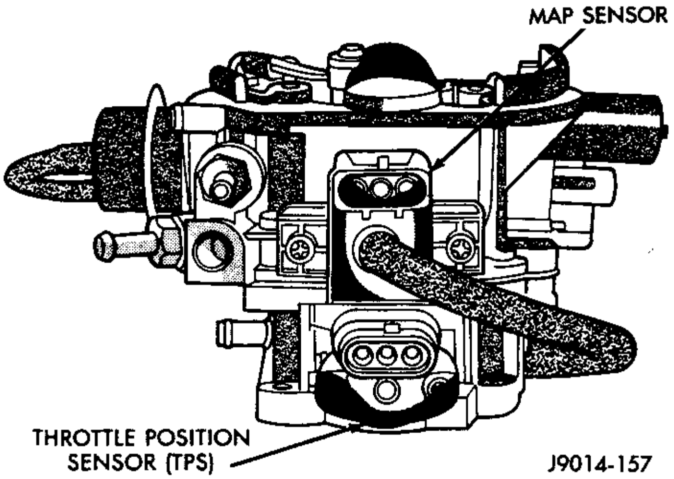

Fig. 10 Throttle Position Sensor

TRANSMISSION GEAR SELECTION—SBEC INPUT

The neutral safety switch (Fig. 11) is located on the transmission housing and provides an input to the SBEC that indicates the automatic transmission is in Park, Neutral or a drive gear selection. This input is used to determine idle speed (varying with gear selection), fuel injector pulse width, and ignition timing advance. Refer to group 21 Transmissions, for testing, replacement, and adjustment information.

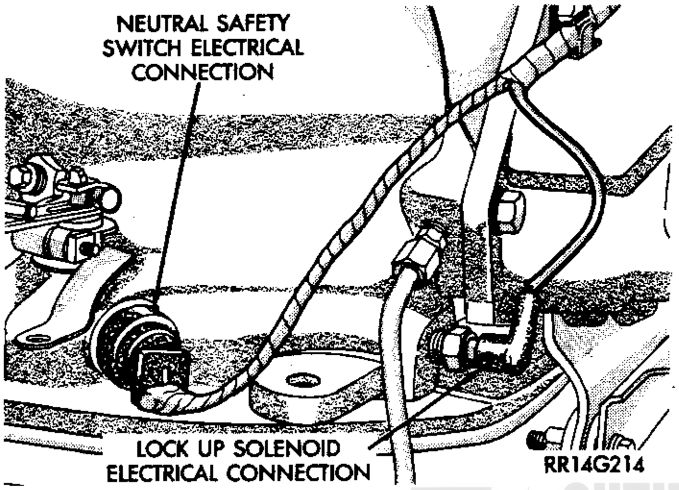

Fig. 11 Neutral Safety Switch

VEHICLE DISTANCE (SPEED) SENSOR—SBEC INPUT

The distance sensor (Fig. 12) is located in the extension housing of the transmission. The sensor input is used by the Single Board Engine Controller (SBEC) to determine vehicle speed and distance traveled.

The distance sensor generates 8 pulses per sensor revolution. These signals are interpreted, in conjunction with a closed throttle signal from the throttle position sensor, by the engine controller to differentiate between a closed throttle deceleration and a normal idle (vehicle stopped) condition. Under deceleration conditions, the engine controller controls the ISC motor to maintain a desired MAP value. Under idle conditions, the engine controller adjusts the AIS motor to maintain a desired engine speed.

AIR CONDITIONING CLUTCH RELAY—SBEC OUTPUT

The Single Board Engine Controller (SBEC) controls the air conditioning compressor through the A/C clutch relay (Fig. 13). By switching the ground path for relay on and off, the SBEC is able to cycle the air conditioning compressor clutch based on changes in engine operating conditions.

The relay is energized when the A/C switch is closed (A/C has been selected) and the blower motor switch is in the on position. If, during A/C operation, the SBEC senses low idle speeds or a wide open throttle condition, it will de-energize the relay preventing air conditioning clutch engagement until the idle speed increases or wide open throttle condition no longer exists.

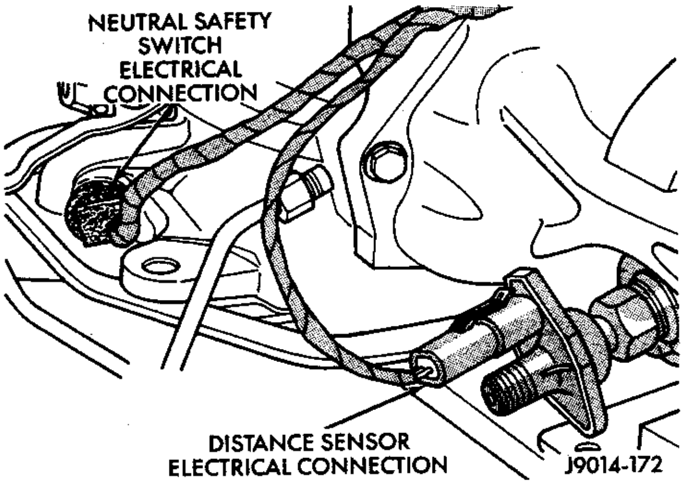

Fig. 12 Vehicle Distance Sensor

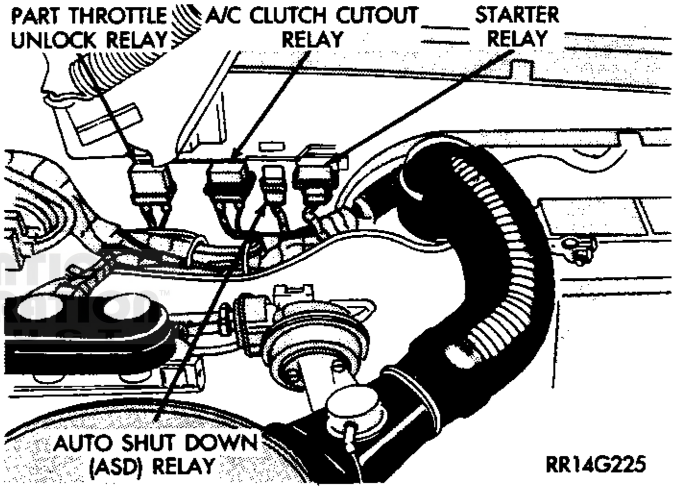

Fig. 13 A/C Clutch, ASD, Starter and Part Throttle Un-lock Relays

AIR SWITCHING SOLENOID—SBEC OUTPUT

The SBEC controls the upstream or downstream discharge of air from the air pump through the air switching solenoid (Fig. 14). The solenoid controls the flow of vacuum to the air switching/relief valve of the air pump system.

When the air switching system is in the downstream mode of operation the solenoid is not energized and vacuum is not supplied to the air switching/relief valve. During downstream operation air pump output is directed to the catalytic convertor.

When the air switching system is in the upstream mode of operation, the solenoid is energized and vacuum is supplied to the air switching/relief valve.

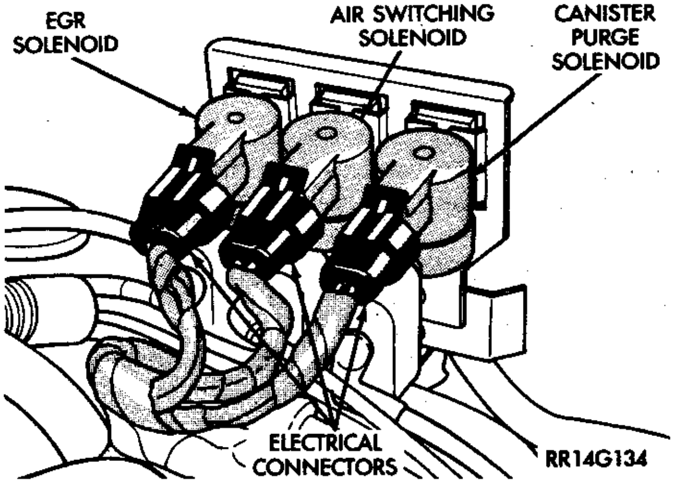

Fig. 14 Air Switching, Canister Purge and EGR Solenoids

During upstream operation air pump output is directed to the exhaust manifolds.

ALTERNATOR—SBEC OUTPUT

The SBEC regulates the charging system voltage within a range of 12.9 to 15.0 volts. Refer to Group 8A for charging system information.

AUTO SHUTDOWN (ASD) RELAY—SBEC OUTPUT

The Auto Shutdown Relay (ASD—Fig. 13) is mounted on the left inner fender well and supplies battery voltage to the fuel pump, fuel injector, ignition coil, and O_2 sensor heating element. The ground circuit for the ASD relay is controlled by the Single Board Engine Controller (SBEC). The SBEC controls the relay operation by switching the ground circuit on and off.

The SBEC monitors the distributor pick-up signal to determine engine speed and compute injector synchronization. If the SBEC does not receive a distributor signal when the ignition switch is in the “Run” position it will not energize (not provide a ground) the ASD relay, stopping the battery voltage supply to the fuel pump, fuel injectors, ignition coil, and 0_2 sensor heater element.

CANISTER PURGE SOLENOID—SBEC OUTPUT

Vacuum for the Evaporative Canister is controlled by the Canister Purge Solenoid (Fig. 14). The solenoid is controlled by the Single Board Engine Controller (SBEC). The SBEC controls the solenoid by switching the ground circuit on and off based on engine operating conditions. When energized, the solenoid prevents vacuum from reaching the evaporative canister. When not energized the solenoid allows vacuum to flow to the canister.

During warm-up and for a specified time period after hot starts the engine controller grounds the purge solenoid causing it to energize, preventing vacuum from reaching the canister valve. When the engine reaches a specified operating temperature and the time delay interval has occurred the SBEC removes the ground to the solenoid, de-energizing it which allows vacuum to flow to the canister purge valve and purge fuel vapors through the throttle body. The Purge Solenoid will also be energized during certain idle conditions, in order to update the fuel delivery calibration.

CHECK ENGINE LAMP—SBEC OUTPUT

The Check Engine Lamp illuminates at the bottom of the instrument panel each time the ignition key is turned on and stays on for three seconds as a bulb test.

If the Single Board Engine Controller (SBEC) receives an incorrect signal or no signal from certain sensors or emission related systems (California vehicles only) the lamp is turned on. This is a warning that the SBEC has gone into a limp-in mode in an attempt to keep the system operating. It signals an immediate need for service.

The lamp can also be used to display fault codes. Cycle the ignition switch on, off, on, off, on within five seconds and any fault codes stored in the SBEC memory will be displayed in a series of flashes representing digits.

EGR SOLENOID—SBEC OUTPUT

Vacuum for the exhaust gas recirculation (EGR) valve function is switched on and off by the EGR solenoid. The solenoid is controlled by the Single Board Engine Controller (SBEC). The solenoid is located on the engine right valve cover (Fig. 14).

When the solenoid is energized by the SBEC, it prevents vacuum from reaching the EGR valve transducer and EGR valve. The solenoid is energized during engine warm-up, closed throttle (idle), wide open throttle and rapid acceleration/deceleration. **If the solenoid wire connector is disconnected, the EGR valve function will be operational at all times.**

On California vehicles, there is an On-Board Diagnostics test that is performed by the SBEC. The test will check the EGR system for failures. The SBEC monitors EGR system performance and registers a fault code if the system has failed or is degraded. The dash-mounted check engine light is turned on indicating immediate service is required.

EMR LAMP—SBEC OUTPUT

The emission maintenance reminder (EMR) lamp informs the vehicle owner that scheduled maintenance is required for certain emission system components. The SBEC determines vehicle milage by monitoring the vehicle distance sensor. The EMR lamp illuminates at 96,600, 132,000, 192,000 km (60,000, 82,500, and 120,000 miles). Refer to Group 0, Lubrication and Maintenance for the scheduled maintenance.

FUEL INJECTORS—SBEC OUTPUT

The Fuel injectors (Fig. 15) are electro-mechanical solenoids that are driven by the Single Board Engine Controller (SBEC). The SBEC switches the ground circuit for the injectors on and off while battery voltage is supplied to the injectors through the ASD Relay.

Based on sensor inputs the SBEC determines injector pulse width (how long the injector is energized) and when the fuel injector should operate. When electrical current is supplied to the injector, a spring loaded pintle is lifted from its seat. This allows fuel to flow through past the pintle and orifice. This action causes the fuel to form a 30° cone shaped spray pattern before entering the air stream in the throttle body.

Fuel is supplied to the injector constantly at regulated 14.5 psi, the unused fuel is returned to the fuel tank.

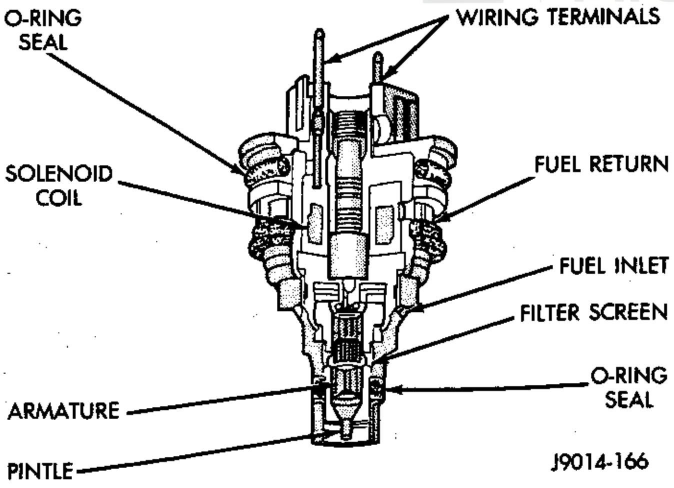

Fig. 15 Fuel Injector

FUEL PUMP—SBEC OUTPUT

The SBEC controls fuel pump operation through the auto shutdown (ASD) relay. When the relay is energized by the SBEC, battery voltage is supplied to the fuel pump. Refer to "Auto Shutdown (ASD) Relay—SBEC Output" in this section for relay operation.

IDLE SPEED CONTROL (ISC) ACTUATOR—SBEC OUTPUT

The Idle Speed Control Actuator (ISC) motor is mounted to the throttle body and controlled by the SBEC (Fig. 16). The throttle lever rests against an adjustment screw at the end of the actuator (plunger). The actuator extends or retracts to control engine idle speed and to set throttle stop angle during deceleration. Based on inputs from the various engine control system sensors and switches the SBEC supplies current and a ground path to the ISC motor to adjust the actuator position for the particular operating conditions.

Do not attempt to correct a high idle speed condition by changing the adjustment screw position. When the engine is shut off, the SBEC extends the ISC actuator to its maximum position to preset a "fast idle" for the next start-up. Turning the adjustment screw inward will not change the idle speed of a warm engine, but can cause cold start problems due to restricted air flow. Only change the adjustment screw position as outlined in the Service Procedures section.

The ISC actuator also contains the idle contact switch.

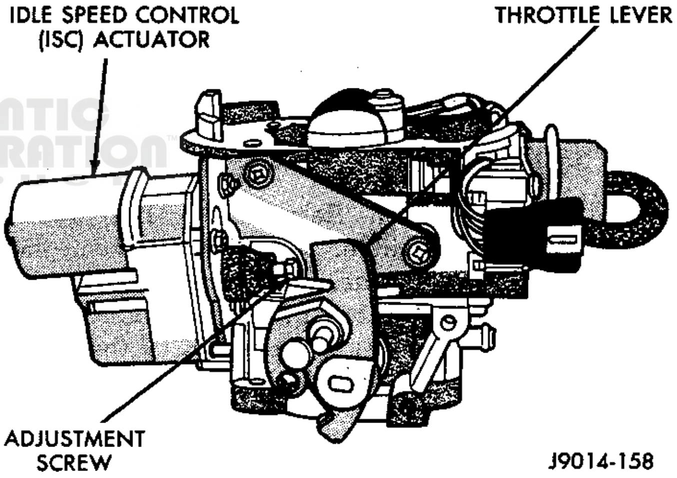

Fig. 16 Idle Speed Control Actuator

IGNITION COIL—SBEC OUTPUT

The SBEC controls ignition coil firing through the auto shutdown (ASD) relay. When the relay is energized by the SBEC, battery voltage is supplied to the ignition coil positive terminal (Fig. 17). The SBEC will not energize the ASD relay until it receives input from the distributor pick-up. Refer to "Auto Shutdown (ASD) Relay—SBEC Output" in this section for relay operation.

OVERDRIVE SOLENOID—SBEC OUTPUTS

On vehicles equipped with overdrive, the SBEC controls the 3-4 overdrive upshift and downshift through the Overdrive solenoid (Fig. 18). Refer to Group 21 for solenoid information.

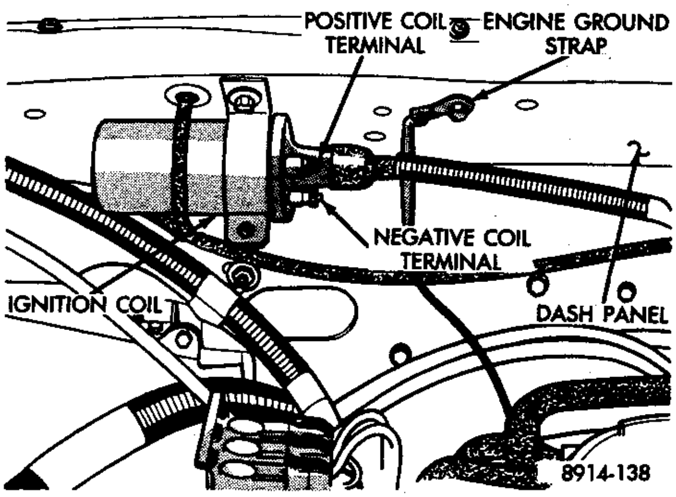

Fig. 17 Ignition Coil

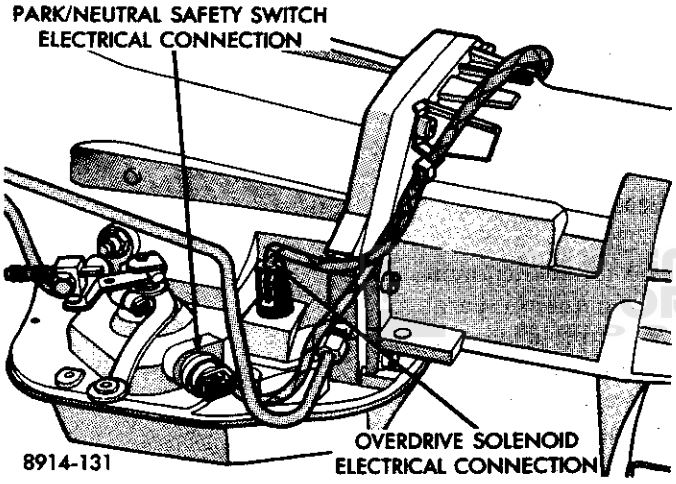

Fig. 18 Overdrive Solenoid

LOCK-UP TORQUE CONVERTOR SOLENOIDS—SBEC OUTPUTS

On vehicles equipped with an A-999 transmission (except california) the SBEC controls torque converter lock-up through the Lock-up solenoid (Fig. 19). Refer to Group 21 for solenoid information.

MODES OF OPERATION

As input signals to the SBEC change, the SBEC adjusts its response to the output devices. For example, the SBEC must calculate different injector pulse width and ignition timing for idle than it does for wide open throttle (WOT). There are several different modes of operation that determine how the SBEC responds to the various input signals.

Modes of operation are of two different types. OPEN LOOP and CLOSED LOOP.

During OPEN LOOP modes the SBEC receives input signals and responds only according to preset SBEC programming. Input from the oxygen (O_2) sensor is not monitored during OPEN LOOP modes.

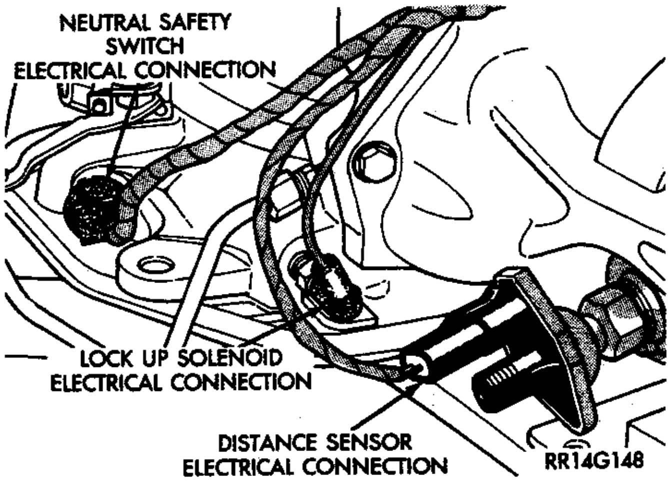

Fig. 19 Lock-Up Solenoid

During CLOSED LOOP modes the SBEC does monitor the oxygen (O_2) sensor input. This input indicates to the SBEC whether or not the calculated injector pulse width results in the ideal air-fuel ratio of 14.7 parts air to 1 part fuel. By monitoring the exhaust oxygen content through the O_2 sensor, the SBEC can “fine tune” the injector pulse width to achieve optimum fuel economy combined with low emission engine performance.

The dual point fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up
- Engine warm-up
- Cruise
- Acceleration
- Deceleration
- Wide Open Throttle
- Ignition switch OFF

The ignition switch on, engine start-up (crank), engine warm-up, acceleration, deceleration and wide throttle modes are OPEN LOOP modes. The cruise mode, **with the engine at operating temperature** is a CLOSED LOOP mode.

Ignition Switch ON Mode

This is an OPEN LOOP mode. When the dual point fuel injection System is activated by the ignition switch, the following actions occur:

- SBEC determines ambient atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The SBEC monitors the coolant temperature sensor input. The SBEC modifies fuel strategy based on this input.
- The SBEC monitors throttle body temperature sensor input (5.2L and 5.9L engines only).

When the key is in the ON position, the auto shutdown (ASD) relay is not energized. Therefore battery voltage is not supplied to the fuel pump, ignition coil, fuel injector or oxygen sensor heating relay.

Engine Start-Up Mode

This is an OPEN LOOP mode. The following actions occur when the starter motor is engaged.

If the SBEC receives a distributor signal it will energize the auto shutdown (ASD) relay to supply battery voltage to the fuel pump, fuel injector ignition coil, and oxygen sensor heating element. If the SBEC does not receive a distributor input, the ASD relay will not be energized.

When the engine is operating and idling within ±64 RPM of the target RPM, the SBEC compares the current MAP value with the atmospheric pressure value it received during the Key-On mode. If a minimum difference between the two is not detected, a pneumatic fault code is set into memory.

Once the ASD relay has been energized the SBEC:

- Supplies a ground path to the injector and the injector is pulsed six times per engine revolution instead of the normal three pulses per revolution.
- determines injector pulse width based on coolant temperature, barometric pressure (MAP sensor), and the number of engine revolutions since cranking was initiated.
- Monitors the coolant temperature sensor, distributor pick-up, MAP sensor, and throttle position sensor to determine correct ignition timing.

Engine Warm-Up Mode

This is a OPEN LOOP mode. The following inputs are received by the SBEC:

- coolant temperature
- idle contact switch
- manifold absolute pressure
- engine speed (distributor pick-up)
- throttle position
- gear position (automatic transmission)
- A/C switch
- battery voltage

The SBEC provides a ground path for the injector to precisely control injector pulse width (by switching the ground on and off) and fires the injector three times per engine revolution. The SBEC controls engine idle speed, throttle stop angle, and ignition timing.

The SBEC controls engine idle speed and throttle stop angle. For vehicles equipped with a manual transmission, the up-shift indicator lamp is controlled by the SBEC according to engine speed and load.

Cruise Mode

When the engine is at operating temperature this is a CLOSED LOOP mode. During cruising speed the following inputs are received by the SBEC:

- coolant temperature
- manifold absolute pressure
- engine speed
- throttle position
- exhaust gas oxygen content
- gear position (automatic transmission)
- A/C control positions

The SBEC provides a ground path for the injector to precisely control injector pulse width and fires the injector three times per engine revolution. The SBEC controls engine idle speed, throttle stop angle, and ignition timing. The SBEC controls the air/fuel mixture ratio according to the oxygen content in the exhaust gas.

For vehicles equipped with a manual transmission, the up-shift indicator lamp is controlled by the SBEC according to engine speed and load.

Acceleration Mode

This is an OPEN LOOP mode. The SBEC recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The SBEC increases injector pulse width in response to increased fuel demand.

Deceleration Mode

This is a OPEN LOOP mode. During deceleration the following inputs are received by the SBEC:

- coolant temperature
- manifold absolute pressure
- idle contact switch
- engine speed
- throttle position
- exhaust gas oxygen content
- gear position (automatic transmission)
- A/C control positions

When the SBEC receives a closed throttle input at the same time it senses an abrupt decrease in manifold pressure from the MAP sensor (indicating a hard deceleration) it may reduce injector firing to once per engine revolution to lean the air-fuel mixture as sensed through the O_2 sensor.

The SBEC grounds the EGR and evaporative purge solenoids stopping EGR and canister purge functions. The SBEC may cycle air switching solenoid for short periods of time in response to the MAP sensor sending a high vacuum signal.

Wide Open Throttle Mode

This is an OPEN LOOP mode. During wide-open-throttle operation, the following inputs are received by the SBEC:

- coolant temperature
- manifold absolute pressure
- engine speed
- throttle position

When the SBEC senses wide open throttle condition through the TPS it will provide a ground for the EGR solenoid and evaporative canister purge solenoid preventing EGR and canister purge functions.

The exhaust gas oxygen content input is not accepted by the SBEC and it will adjust injector pulse width to supply a predetermined amount of additional fuel.

Ignition Switch OFF Mode

This is an OPEN LOOP mode. When the ignition switch is turned to the OFF position, the SBEC ceases to provide a ground for the auto shutdown (ASD) relay and extends the ISC actuator in anticipation of the next start up. When the ASD relay is not energized, battery voltage is shut off from the fuel pump, fuel injector, ignition coil, and oxygen sensor heating element. All fuel injection stops.

THROTTLE BODY

The throttle body assembly (Fig. 20 or 21) is mounted on top of the intake manifold and contains the fuel injectors, fuel pressure regulator, idle speed control actuator, throttle position sensor, and manifold absolute pressure sensor. Air flow through the throttle body is controlled by the throttle blade. The throttle blade is connected to the accelerator pedal by the accelerator cable. The fuel inlet and return lines are connected to the throttle body.

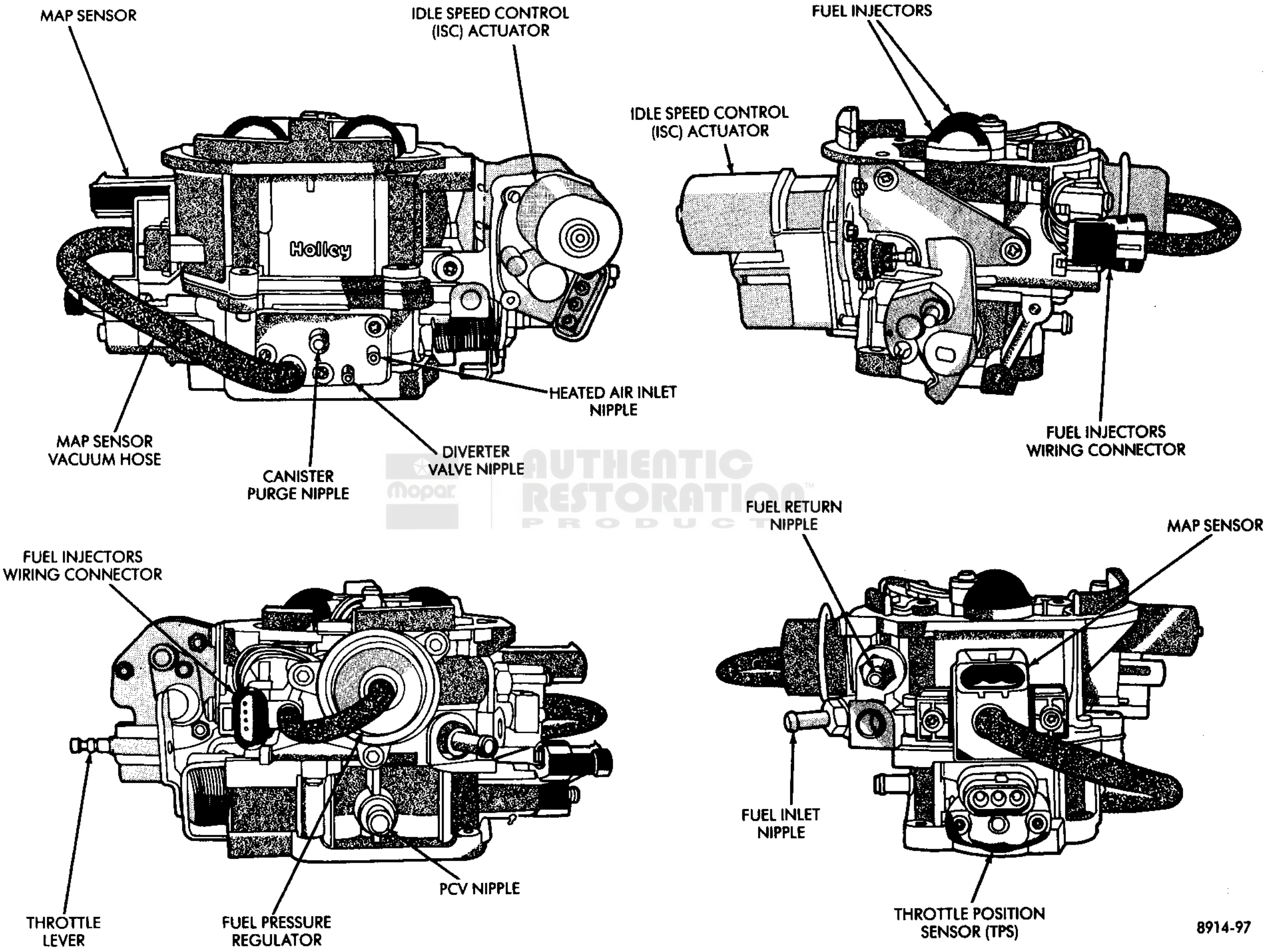

Fig. 20 Throttle Body Assembly—3.9L Engine

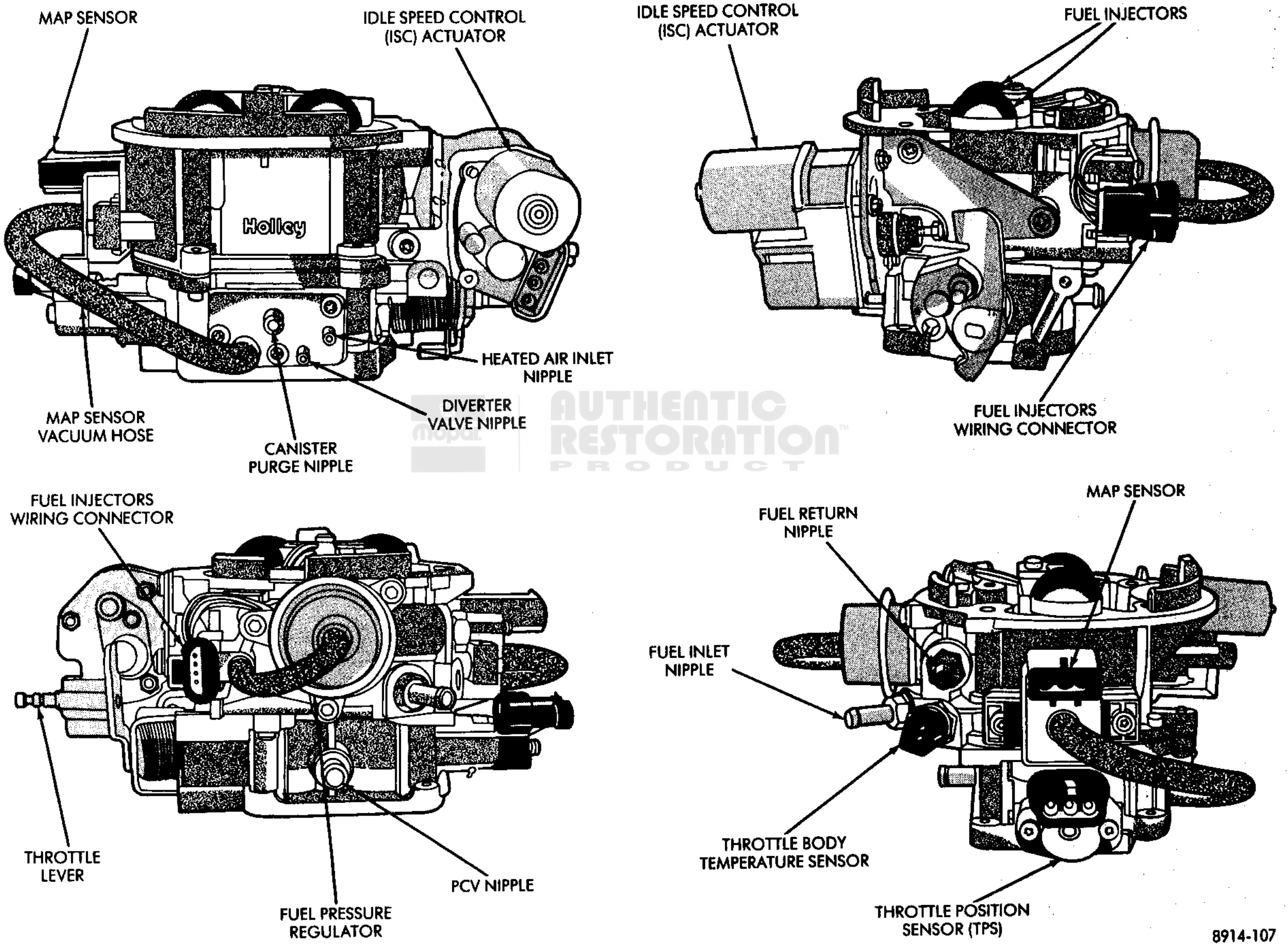

Fig. 21 Throttle Body Assembly—5.2L and 5.9L Engines

FUEL PRESSURE REGULATOR

The pressure regulator is located at the back of the throttle body. The regulator maintains fuel pressure at constant 100 kPa (14.5 psi) across the fuel injector tip. When the fuel pump is operational, fuel flows past the injectors into the pressure regulator. The fuel return port is blocked by the a spring loaded rubber diaphragm (Fig. 22). When fuel pressure reaches 100 kPa (14.5 psi) it pushes the diaphragm away from the fuel return port and fuel flows through the return line to the fuel tank. The diaphragm is constantly moving from the open to closed position to keep fuel pressure constant.

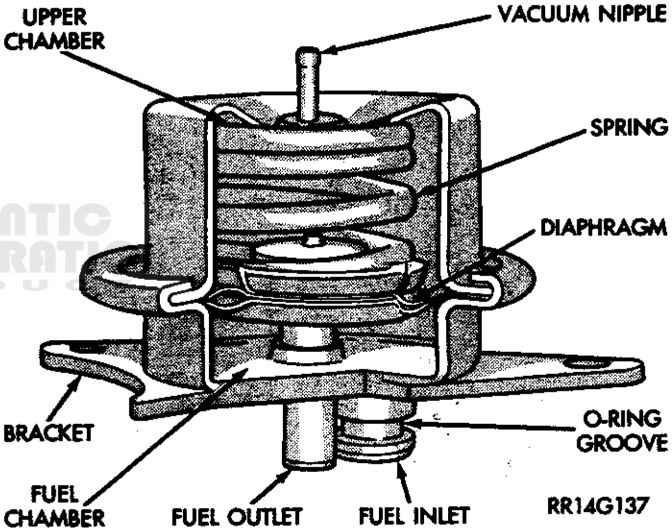

Fig. 22 Fuel Pressure Regulator Operation

GENERAL DIAGNOSIS

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VISUAL INSPECTION

A visual inspection for loose, disconnected, or incorrectly routed wires and hoses should be made 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 of the Fuel Injection System (Fig. 1) will include the following checks:

(1) Verify that the 60-way connector is fully inserted into the socket on the Single Board Engine Controller (SBEC) (Fig. 2).

(2) Verify that hoses are securely attached to vapor canister (Fig. 3).

(3) Verify that alternator electrical wiring and the drive belt are correctly installed.

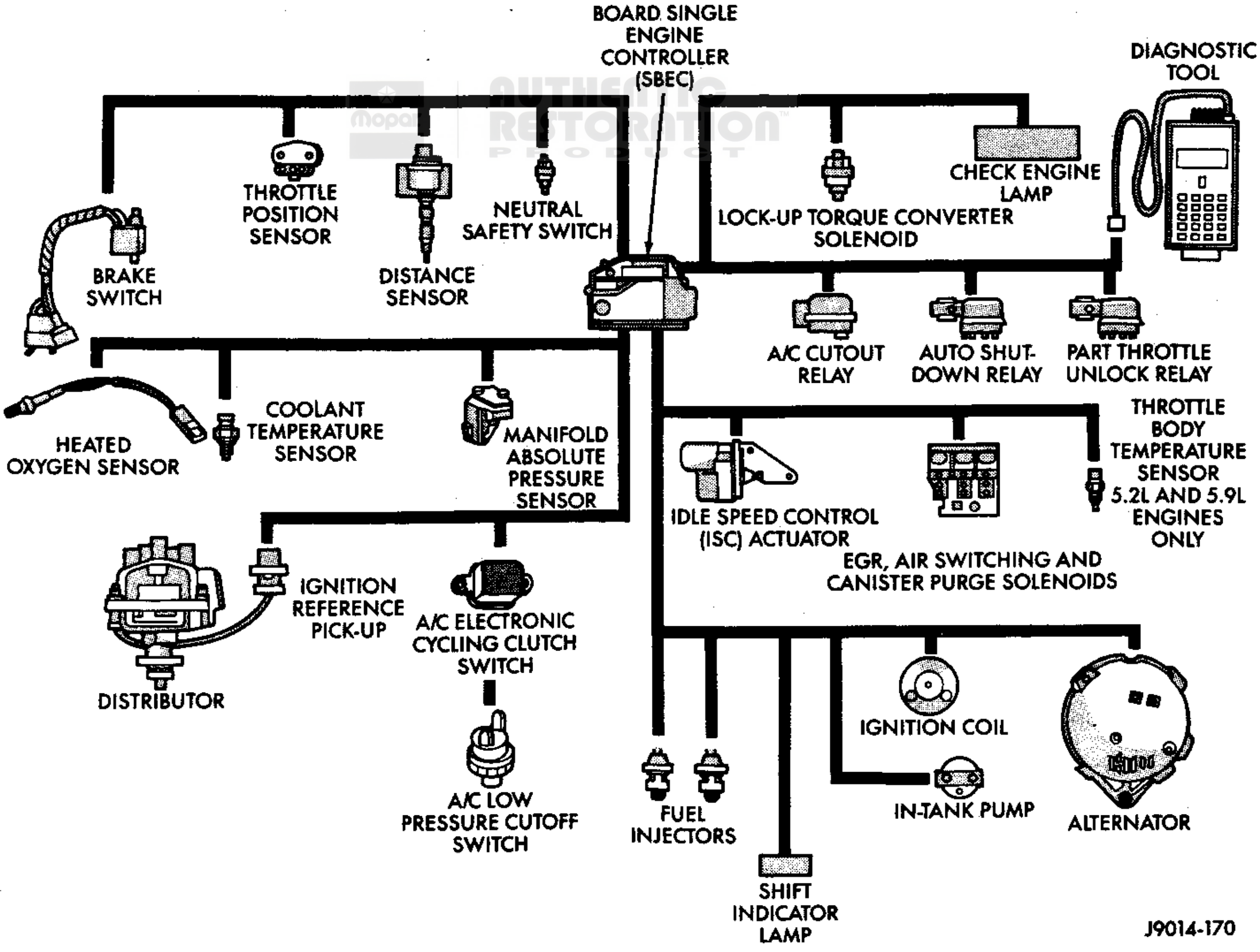

Fig. 1 Dual-Point Fuel Injection Components

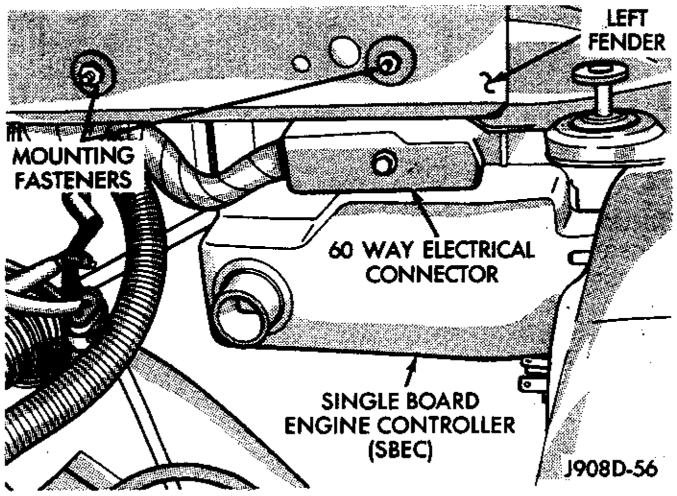

Fig. 2 Single Board Engine Controller

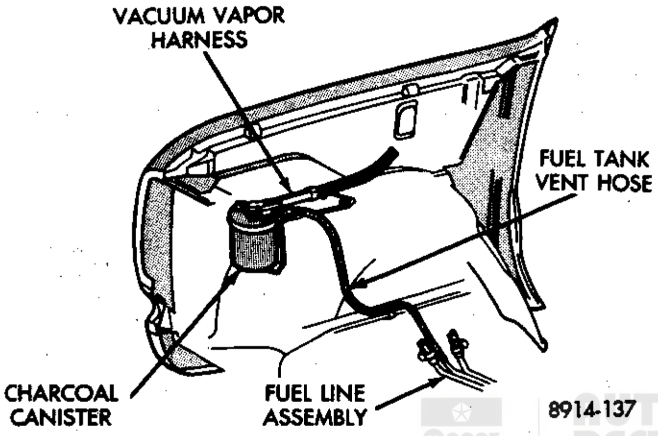

Fig. 3 Vapor Canister

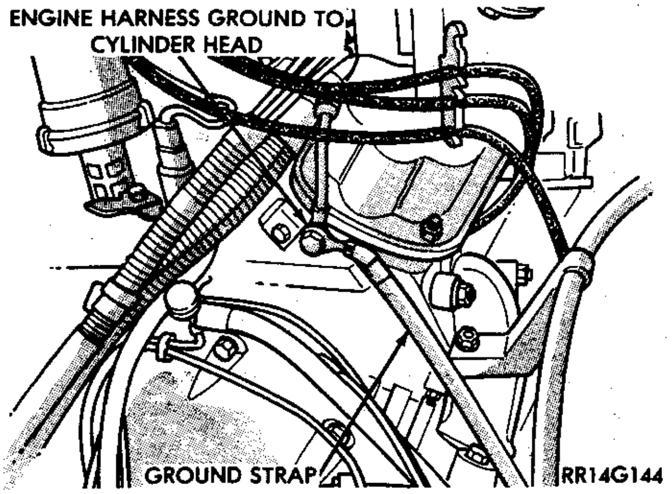

Fig. 4 Engine Ground Strap Connection

(4) Verify that engine ground strap is attached at the engine dash panel (Fig. 4).

(5) Check Ignition Coil Electrical Connections (Fig. 5).

(6) Verify that 3-way connector is attached to distributor (Fig. 6).

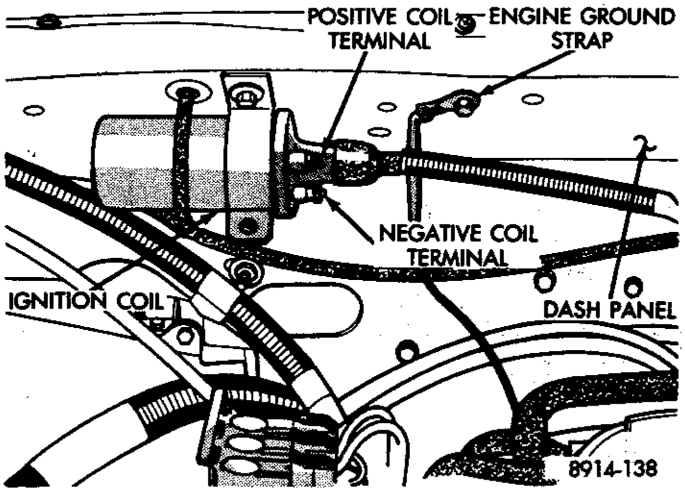

Fig. 5 Ignition Coil Connections

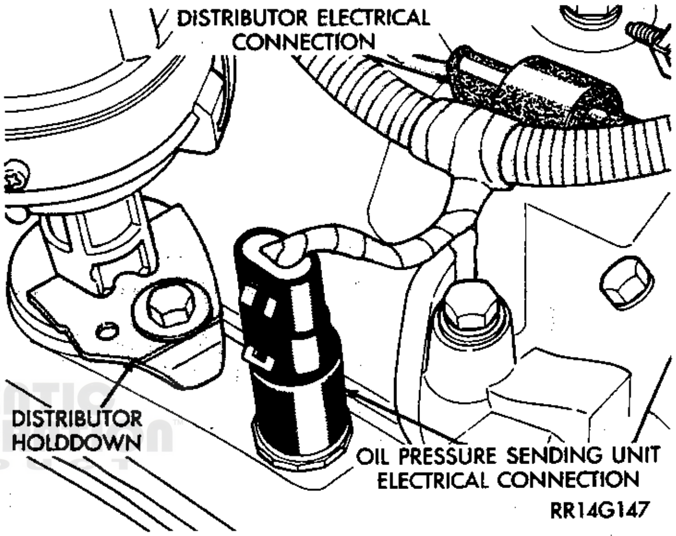

Fig. 6 Distributor and Oil Pressure Switch Electrical Connections

(7) Verify oil pressure sending unit electrical connections is fully inserted (Fig. 6).

(8) Verify that 4-way connector is attached for Heated Oxygen Sensor (3.9L Engine—Fig. 7).

(9) Verify that 4-way connector is attached for Heated Oxygen Sensor (5.2L and 5.9L Engines—Fig. 8).

(10) Verify that the 2-way connector is attached to the Air Switching Solenoid (Fig. 9).

(11) Verify that the 2-way connector is attached to the Canister Purge Solenoid (Fig. 9).

(12) Verify that the 2-way connector is attached to the EGR Solenoid (Fig. 9).

(13) Verify that vacuum connection at Air Switch Solenoid is secure and not leaking (Fig. 10).

(14) Verify that vacuum connection at Canister Purge Solenoid is secure and not leaking (Fig. 10).

(15) Verify that vacuum connection at EGR Solenoid is secure and not leaking (Fig. 10).

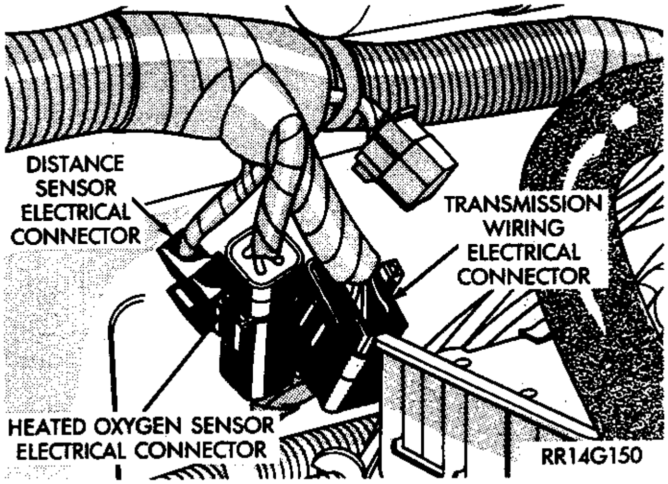

Fig. 7 Heated Oxygen Sensor Electrical Connection—3.9L Engine

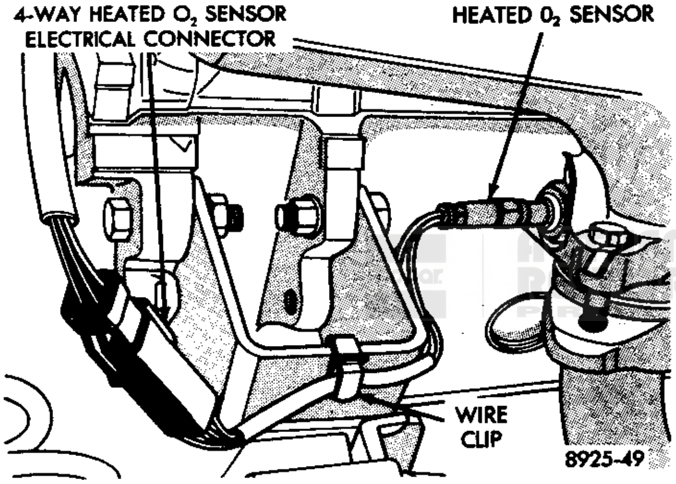

Fig. 8 Heated Oxygen Sensor Electrical Connection—5.2L and 5.9L Engines

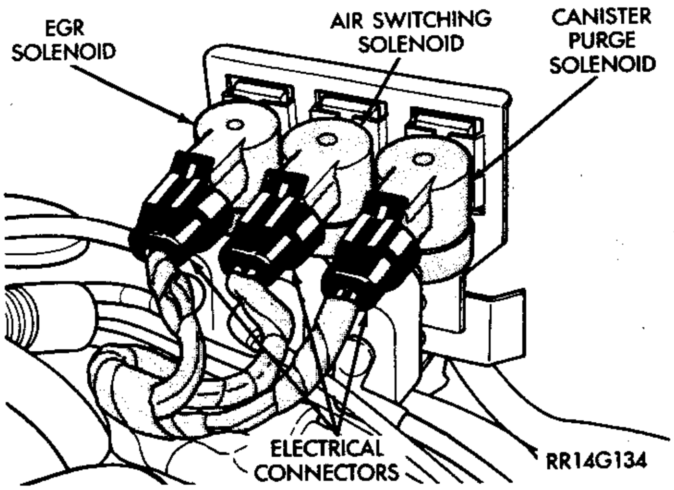

Fig. 9 EGR, Air Switching, and Canister Purge Solenoids

(16) Verify engine harness to main harness connections are fully inserted (Fig. 11).

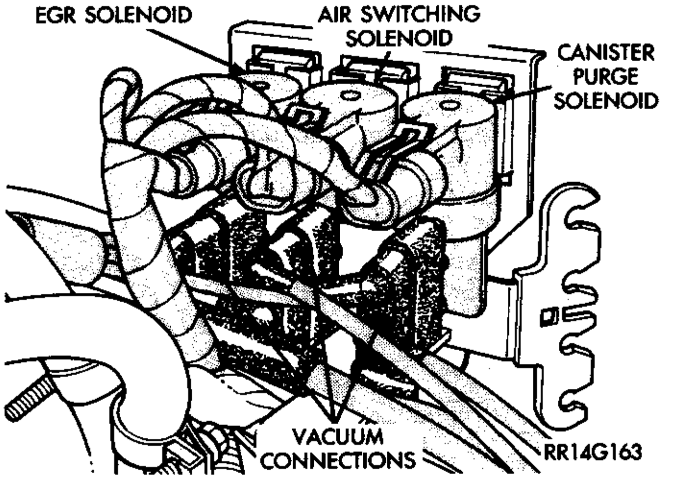

Fig. 10 EGR, Air Switching, and Canister Purge Solenoids Vacuum Connections

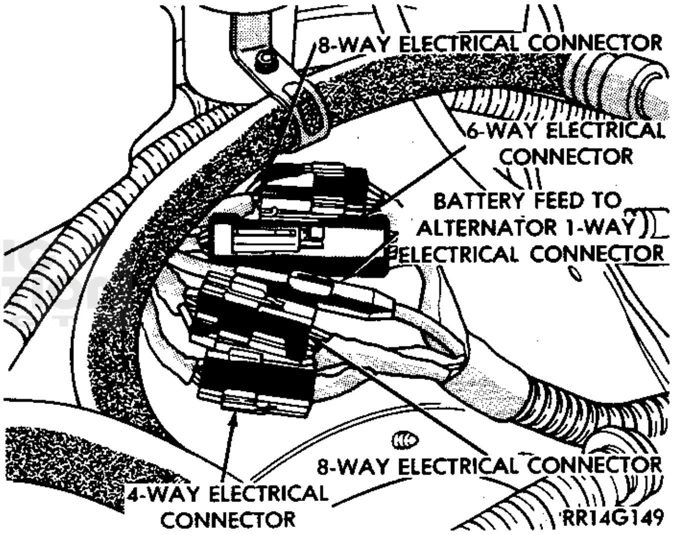

Fig. 11 Engine Harness to Main Harness Connection

(17) On 5.2L or 5.9L engines, verify that the 2-way connector is attached to the throttle body temperature sensor (Fig. 12).

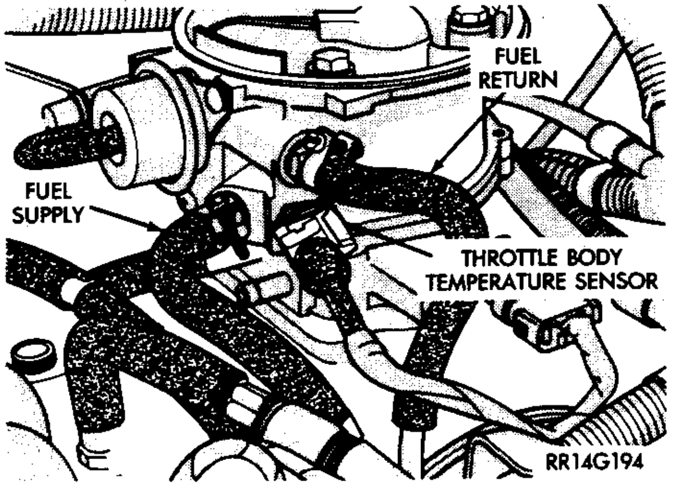

Fig. 12 Throttle Body Temperature Sensor—5.2L and 5.9L Engines

(18) Verify that the 3-way connector is attached to the throttle position sensor (Fig. 13).

(19) Verify that the 3-way connector is attached to the MAP sensor (Fig. 13).

(20) Verify MAP Sensor Vacuum Hose is attached at MAP sensor. (Fig. 13).

(21) Verify that 4-way connector is attached to Idle Speed Control (ISC) actuator (Fig. 14).

(22) Verify that the 4-way connector is attached to the harness for the fuel injectors (Fig. 14).

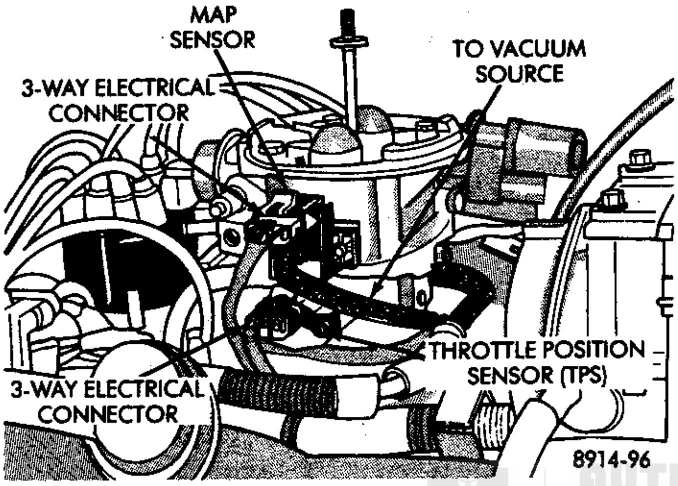

Fig. 13 Throttle Position Sensor and Map Sensor

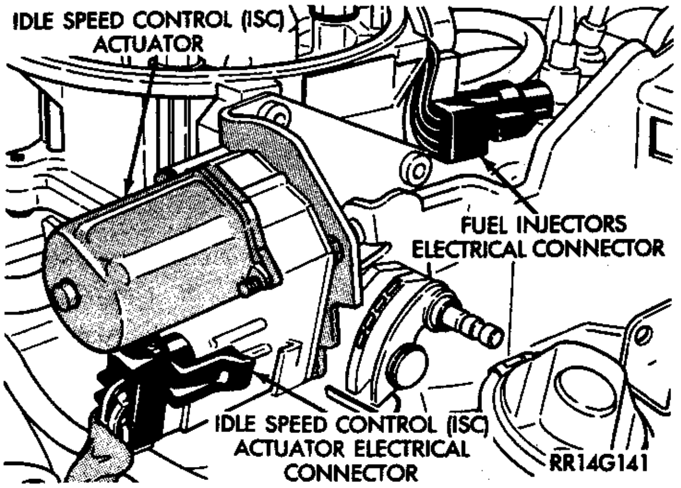

Fig. 14 Throttle Body Electrical Connections

(23) Verify that vacuum connections on the front and rear of Throttle Body are secure and not leaking (Figs. 15 and 16).

(24) Verify that heated air door and MAP sensor vacuum connections are connected and not leaking (Fig. 15).

(25) Verify that hose from PCV valve is securely attached to the manifold vacuum port (Fig. 16).

(26) Verify that the MAP sensor vacuum connector is attached to the vacuum port at the rear of the throttle body (Fig. 15).

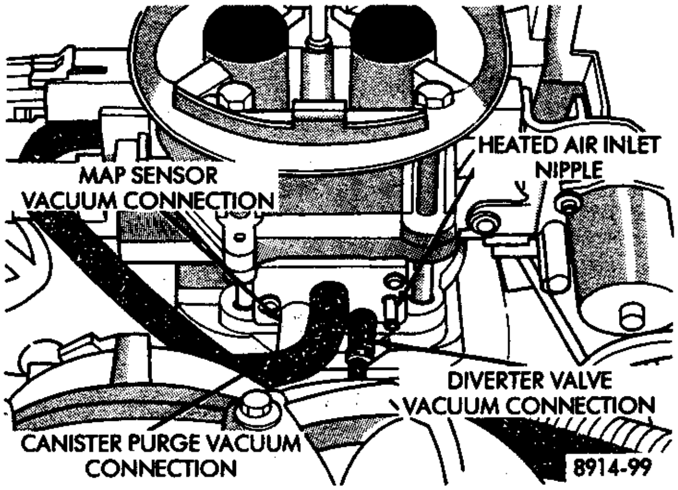

Fig. 15 Throttle Body Vacuum Connections—Front

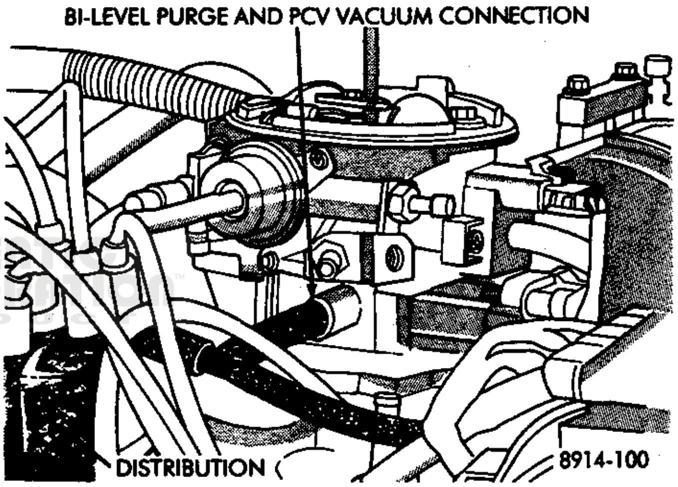

Fig. 16 Throttle Body Vacuum Connections—Rear

(27) Verify that hoses are attached to the EGR valve back pressure transducer (Fig. 17).

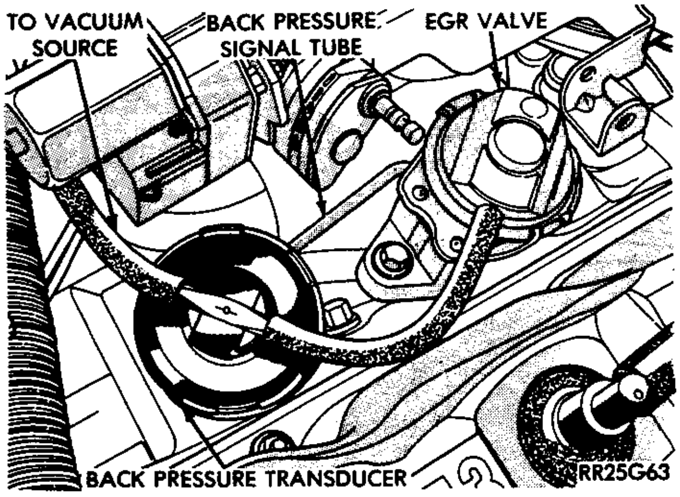

Fig. 17 EGR Valve and Transducer

(28) Verify that 2-way connector is attached to Coolant Temperature Sensor (Fig. 18).

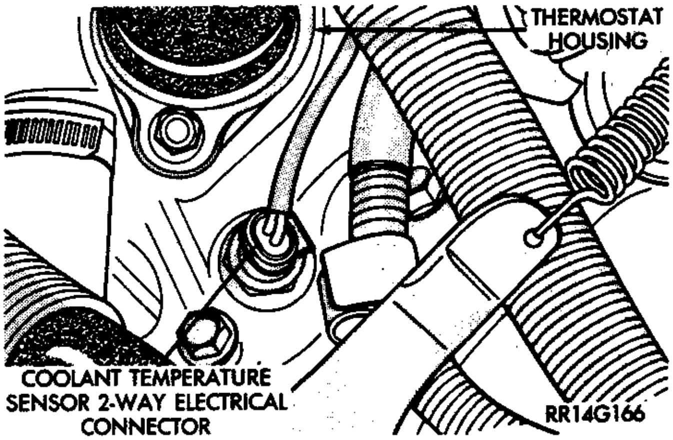

Fig. 18 Coolant Temperature Sensor

(29) Verify power brake and speed control vacuum connectors are tight (Fig. 19).

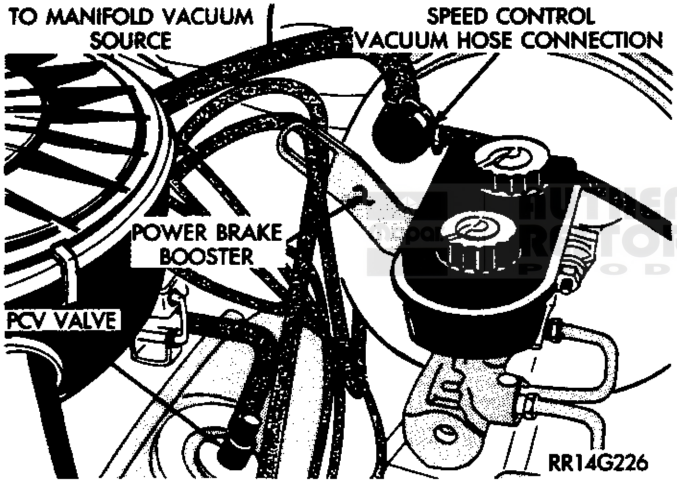

Fig. 19 Power Brake and Speed Control Vacuum Connections

(30) Verify that all ignition cables are in correct order and seated into place.

(31) Verify that all electrical connectors are fully inserted into relays (Fig. 20) and that battery connections are clean and tight.

(32) Check two way Distance Sensor Electrical Connector (Fig. 21).

(33) On automatic transmission equipped vehicles, verify that the neutral safety switch electrical connector is in place (Fig. 22).

(34) If vehicle is equipped with a lock-up torque convertor, check Torque Converter Lockup Solenoid Electrical Connection (Fig. 22).

(35) If vehicle has overdrive (A-500 automatic transmission), check Overdrive Solenoid Electrical Connection (Fig. 23).

(36) Check Hose and Wiring Connections at Fuel Pump. Ensure that wiring connector is making contact with terminals on pump.

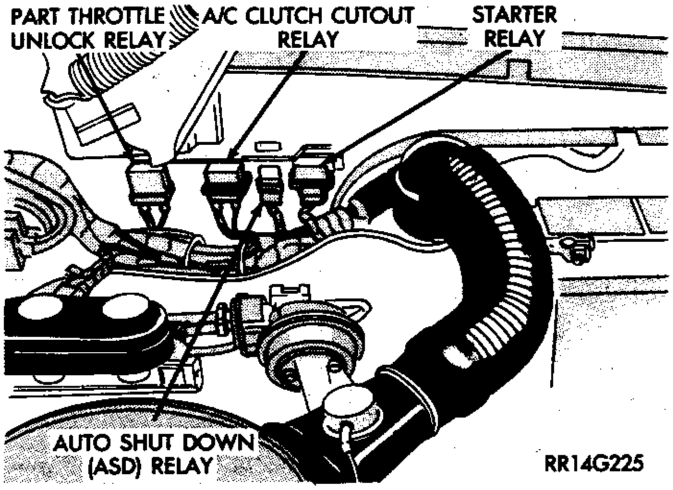

Fig. 20 Engine Compartment Relays

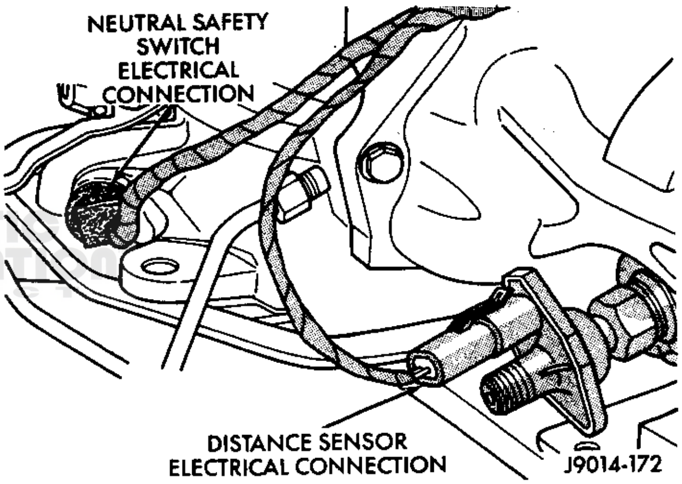

Fig. 21 Distance Sensor

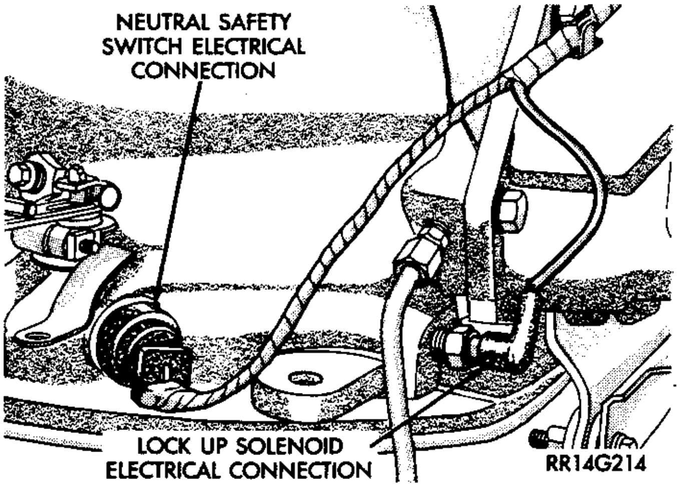

Fig. 22 Transmission Electrical Connections

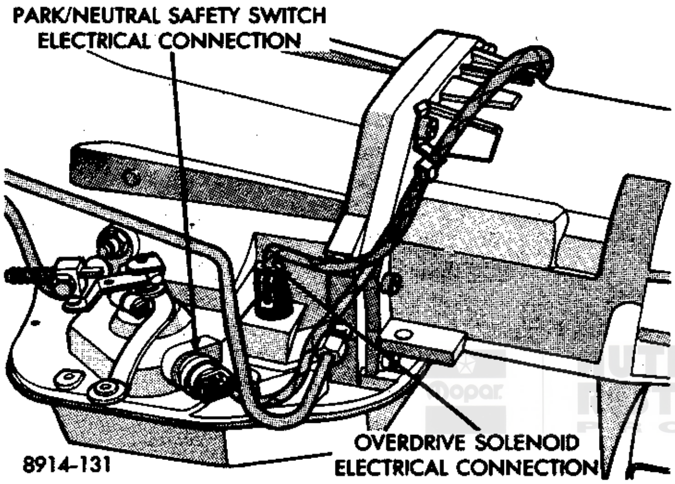

Fig. 23 Transmission Electrical Connections

ON BOARD DIAGNOSTICS

The Single Board Engine Controller (SBEC) has been programmed to monitor several different circuits of the fuel injection system. This monitoring is called On Board Diagnosis. If a problem in a monitored circuit is sensed often enough to indicate an actual problem, its fault code is stored in the SBEC for eventual display to the service technician. If the problem is repaired or ceases to exist, the SBEC cancels the Fault Code after 50 to 100 vehicle key on/off cycles.

FAULT CODE DESCRIPTION

When a fault code appears (either by flashes of the check engine lamp or by watching the Diagnostic Tool), it indicates that the SBEC has recognized an abnormal signal in the system. Fault codes indicate the results of a failure but never identify the failed component directly.

To obtain fault codes from the Check Engine Light, cycle the ignition key on-off-on-off-on within a five second period. Count the flashes to determine the code. The light will flash the first digit of the code, pause, then flash the second digit of the code. For example Fault Code 24 would be displayed by two flashes a pause and four flashes.

FAULT CODE DESCRIPTION

Fault Code	DRBII Display	Description of Fault Condition
11	Ign Reference Signal	No distributor reference signal detected during engine cranking.
12	N/A (See Key-On Info)	Direct battery input to controller disconnected within the last 50 ignition key on cycles.
13	MAP Pneumatic Signal or MAP Voltage Too Low	No variation in MAP sensor signal is detected. No difference is recognized between the engine MAP reading and the stored barometric pressure reading.
14	MAP Voltage Too Low or MAP Voltage Too High	MAP sensor input below minimum acceptable voltage. MAP sensor input above maximum acceptable voltage.
15	Vehicle Speed Signal	No distance sensor signal detected during road load conditions.
17	Low Engine Temp	Engine coolant temperature remains below normal operating temperatures during vehicle travel (thermostat).
21	Oxygen Sensor Signal or O_2 Sensor Shorted High	Neither rich or lean condition is detected from the oxygen sensor input. Oxygen sensor input voltage maintained above normal operating range.
22	Coolant Voltage Low or Coolant Voltage High	Coolant temperature sensor input below the minimum acceptable voltage. Coolant temperature sensor input above the maximum acceptable voltage.
23	T/B Temp Voltage Low or T/B Temp Voltage High	Throttle body temperature sensor input below the minimum acceptable voltage (5.2L and 5.9L engines). Throttle body temperature sensor input above the maximum acceptable voltage (5.2L and 5.9L Engines).

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FAULT CODE DESCRIPTION

FAULT CODE	DRBII DISPLAY	DESCRIPTION OF FAULT CONDITION
24	TPS Voltage Low or TPS Voltage High	Throttle position sensor input below the minimum acceptable voltage. Throttle position sensor input above the maximum acceptable voltage.
25	AIS Motor Circuits	A shorted condition detected in one or more of the AIS control circuits.
27	INJ 1 Control Ckt	Injector output driver #1 or #2 does not respond properly to the control signal.
31	Purge Solenoid Ckt	An open or shorted condition detected in the purge solenoid circuit.
32	EGR Solenoid Circuit or EGR System Failure	An open or shorted condition detected in the EGR solenoid circuit. Required change in air-fuel ratio not detected during diagnostic test (California emission packages only).
33	A/C Clutch Relay Ckt	An open or shorted condition detected in the A/C clutch relay circuit.
34	S/C Servo Solenoids	An open or shorted condition detected in the speed control vacuum or vent solenoid circuits.
35	Idle Switch Shorted or Idle Switch Opened	Idle contact switch input circuit shorted to ground. Idle contact switch input circuit opened.
36	Air Switch Solenoid	An open or shorted condition detected in the air switching solenoid circuit.
37	PTU Solenoid Circuit	An open or shorted condition detected in the torque convertor part throttle unlock circuit (Engine packages with A-999 or A-500 automatic transmissions only).

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FAULT CODE DESCRIPTION

FAULT CODE	DRBII DISPLAY	DESCRIPTION OF FAULT CONDITION
41	Alternator Field Ckt	An open or shorted condition detected in the alternator control circuit.
42	ASD Relay Circuit or Z1 Voltage Sense	An open or shorted condition detected in the auto shutdown relay circuit. No Z1 voltage sensed when the auto shutdown relay circuit.
45	Overdrive Solenoid	An open or shorted condition detected in the overdrive solenoid circuit (engine packages with A-500 or A-518 automatic transmissions only).
46	Battery Voltage High	Battery voltage sensor input above target charging voltage during engine operation.
47	Charging Output Low	Battery voltage sense input below target charging voltage during engine operation and no significant change in voltage detected during active test of alternator output.
51	Lean F/A Condition	Oxygen sensor signal input indicates lean fuel/air ratio condition during engine operation.
52	Rich F/A Condition or Excessive Leaning	Oxygen sensor signal input indicates rich fuel/air ratio condition during engine operation. Adaptive fuel valve leaned excessively due to a sustained rich condition.
53	Internal Self Test	Internal engine controller fault condition detected.
62	EMR Miles Not Stored	Unsuccessful attempt to update EMR mileage in the controller EEPROM.
63	EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the controller.
55	N/A	Completion of fault code display on the CHECK ENGINE lamp.

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SYSTEMS TEST

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING IDLE CHECK OR ADJUSTMENT, OR ANY ENGINE RUNNING TESTS.

OBTAINING FAULT CODES

(1) Connect DRBII to the diagnostic connector located in the engine compartment near the SBEC (Fig. 24).

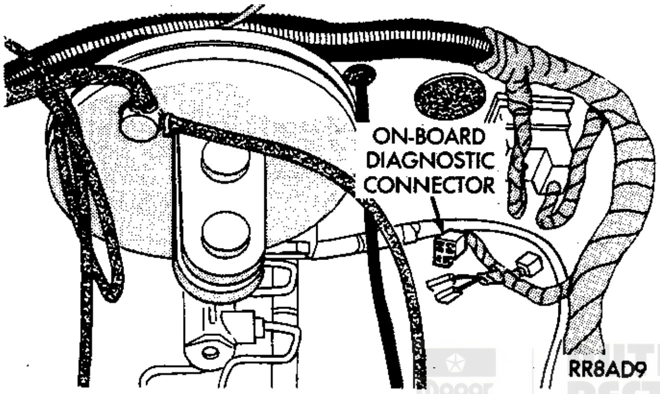


Fig. 24 Diagnostic Connector

(2) Start the engine if possible, set the parking brake and then cycle the transmission selector and the **A/C** switch if applicable. Shut off the engine.

(3) Turn the ignition switch on, access "Read Fault Code Data". Record all fault messages shown on the DRBII. Observe the check engine lamp on the instrument panel. The lamp should light for 3 seconds then go out (bulb check).

Fault code erasure; access erase fault code data

SWITCH TEST MODE

The switch inputs used by the SBEC have only two recognized states, HI and LO. For this reason, the SBEC cannot recognize the difference between a selected switch position versus an open circuit, a short circuit, or a defective switch. However, if any one of these subject switches is toggled, the controller does have the capability to respond, indicating that it has recognized a state change. If the change is displayed, it can be assumed that the entire switch circuit to the SBEC is functional.

OBTAINING SWITCH TEST MODE

Access "Read Input States"

SWITCH TEST MODE

Z1 Voltage Sense
Brake Switch
Park/Neutral Switch
A/C Switch Sense
Speed Control On/Off
Speed Control Set
Speed Control Resume
Overdrive Override
Close Throttle Switch

CIRCUIT ACTUATION TEST MODE

The purpose of the circuit actuation test mode is to check for the proper operation of output circuits of devices which the SBEC cannot internally recognize. The SBEC can attempt to activate these outputs and allow an observer to verify proper operation. Most of the tests available in this mode provide an audible or visual indication of device operation (click of relay contacts, spray of fuel, etc.) With the exception of an intermittent condition, if a device functions properly during its test, it can be assumed that the device, its associated wiring, and its driver circuit are in working order.

OBTAINING CIRCUIT ACTUATION TEST

Access "Actuate Solenoid/Rly" or "Actuate Outputs"

CIRCUIT ACTUATE TEST DISPLAY

ACTUATE SOLENOID/RLY

Stop All Tests
Auto Shutdown Relay
Air Switch Solenoid
Purge Solenoid
EGR Solenoid
A/C Clutch Relay
S/C Servo Solenoids
PTU Solenoid
Overdrive Solenoid
All Solenoids/Relays

ACTUATE OUTPUTS

Ignition Coil No.1
Fuel Injector(s) #1
Fuel Injector(s) #2
AIS Motor Open/Close
Alternator Field
Tachometer Output
Shift Indicator Lamp (Manual Trans Only)

SENSOR TEST MODE

The sensor test mode allows the output of seven sensors and the state of three switches to be displayed on the DRBII while the engine is not operating. This provides a means by which the entire circuit for each individual sensor and switch can be checked, including the wiring and Single Board Engine Controller (SBEC) circuitry.

OBTAINING SENSOR READ TEST MODE

Access "Read Sensor Voltage" or "Read Sensor Values"

SENSOR READ TEST MODE

READ SENSOR VOLTAGE

MAP Sensor Voltage
Throttle Position
Minimum Throttle
Oxygen Sensor Signal
Coolant Temp Sensor
T/Body Temp Sensor (5.2L and 5.9L Engines)
Battery Temp Sensor

READ SENSOR VALUES

MAP Sensor Reading
Throttle Opening
Oxygen Sensor State
Coolant Temperature
T/Body Temperature (5.2L and 5.9L Engines)
Battery Temperature
Vehicle Speed

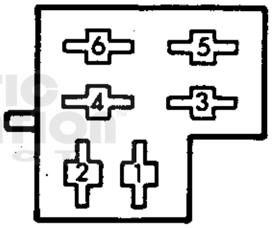
ENGINE PARAMETERS MODE

Engine Speed
Total Spark Advance
MAP Gauge Reading
Barometric Pressure
Battery Voltage

IGNITION TIMING PROCEDURE

Refer to Group 8D "Ignition System"

DIAGNOSTIC CONNECTOR SCHEMATIC



D-1	GROUND
D-2	N/C
D-3	SCI TRANS
D-4	SCI RECEIVE
D-5	J-2 IGNITION
D-6	ASD RELAY

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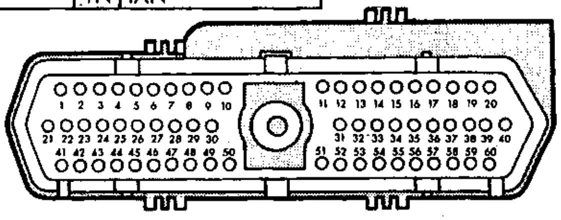
CAV	WIRE COLOR	DESCRIPTION
1	DG/RD*	MAP SENSOR
2	TN/WT*	COOLANT SENSOR
3	RD/WT*	DIRECT BATTERY
4	BK/LB*	SENSOR RETURN
5	BK/WT*	SIGNAL GROUND
6	VT/WT*	5-VOLT OUTPUT (MAP AND TPS)
7	OR	8-VOLT OUTPUT (DISTRIBUTOR PICK-UP)
8	DG/BK*	Z-1 INPUT
9	DB	J2
10		
11	LB/RD*	POWER GROUND
12	LB/RD*	POWER GROUND
13		
14		
15	TN	INJECTOR DRIVER #2
16	WT/DB*	INJECTOR DRIVER #1
17		
18		
19	BK/GY*	IGNITION COIL DRIVER
20	DG	ALTERNATOR FIELD CONTROL
21	BK/RD*	THROTTLE BODY TEMPERATURE SENSOR (5.2L AND 5.9L)
22	OR/LB*	THROTTLE POSITION SENSOR (TPS)
23		
24	GY/BK*	IGNITION (DISTRIBUTOR) REFERENCE PICK-UP
25	PK	SCI TRANSMIT
26		
27	BR	A/C SWITCH SENSE
28	VT	IDLE CONTACT SWITCH
29	WT/PK*	BRAKE SWITCH
30	BR/YL*	PARK NEUTRAL SWITCH
31		
32	BK/PK*	CHECK ENGINE LAMP
33	TN/RD*	SPEED CONTROL VACUUM SOLENOID
34	DB/OR*	A/C CLUTCH RELAY
35	GY/YL*	EGR SOLENOID
36	BK/OR*	AIR SWITCHING SOLENOID
37		
38		
39		
40	BR/WT*	ISC MOTOR CLOSED
41	BK/DG*	OXYGEN SENSOR SIGNAL
42		
43	GY/LB*	TACHOMETER SIGNAL OUTPUT (VEHICLES WITH TACHOMETER)
44		
45	LG	SCI RECEIVE
46		
47	WT/OR*	DISTANCE SENSOR SIGNAL
48	BR/RD*	SPEED CONTROL SET SWITCH
49	YL/RD*	SPEED CONTROL ON/OFF SWITCH
50	WT/LG*	SPEED CONTROL RESUME SWITCH
51	DB/YL*	AUTO SHUTDOWN (ASD) RELAY
52	PK/BK*	PURGE SOLENOID
53	LG/RD*	SPEED CONTROL VENT SOLENOID
54	OR/BK*	SHIFT INDICATOR LIGHT (MANUAL TRANSMISSION ONLY)
54	OR/BK*	PART THROTTLE UNLOCK SOLENOID (AUTO TRANSMISSION)
55	OR/WT*	OVERDRIVE SOLENOID (AUTO TRANSMISSION ONLY)
56	GY/PK*	EMISSION MAINTENANCE REMINDER (EMR) LIGHT
57		
58		
59		
60	GY/RD*	ISC MOTOR OPEN

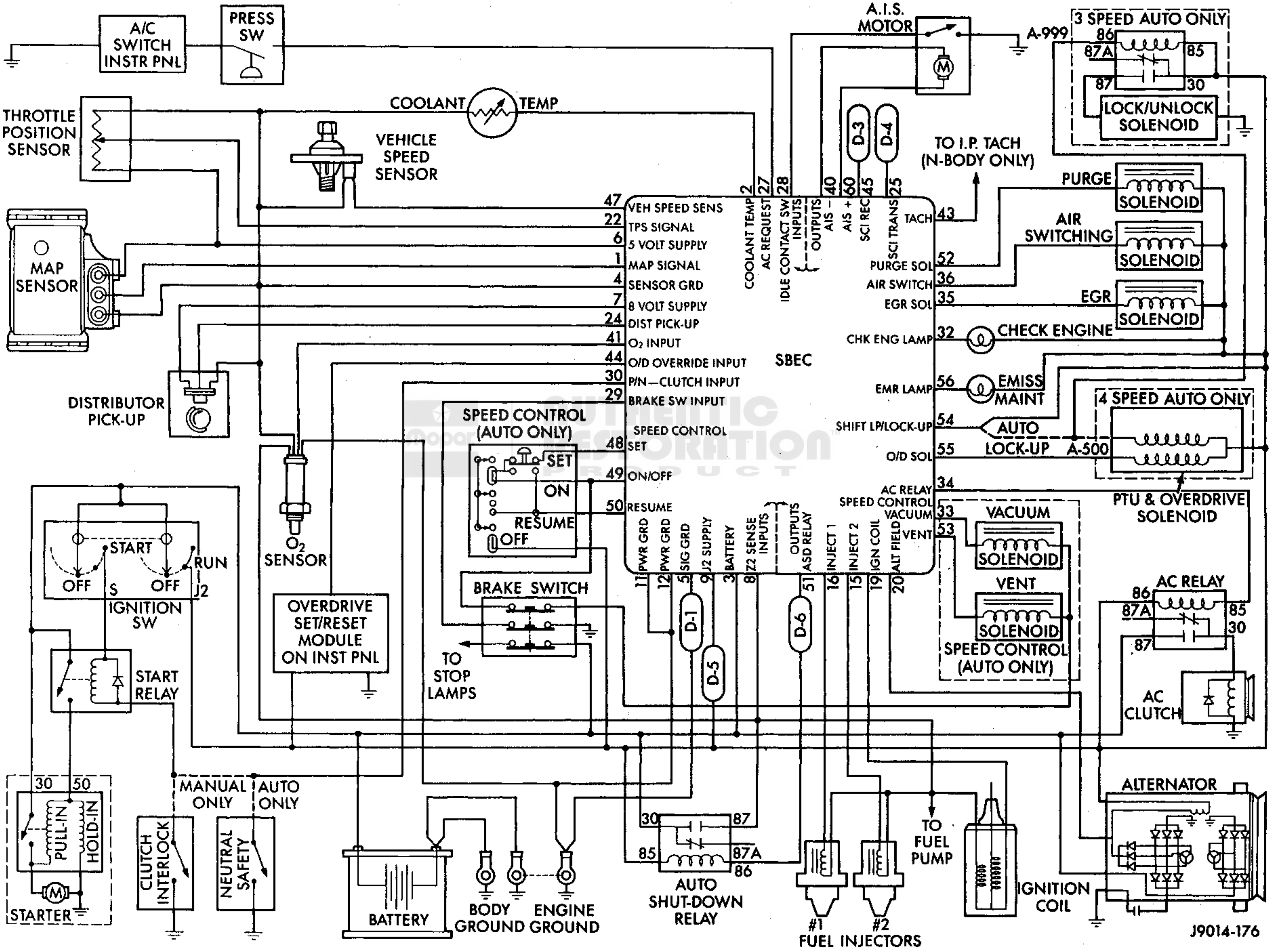
WIRE COLOR CODES					
		LB	LIGHT BLUE	VT	VIOLET
BK	BLACK	LG	LIGHT GREEN	WT	WHITE
BR	BROWN	OR	ORANGE	YL	YELLOW
DB	DARK BLUE	PK	PINK	*	WITH TRACER
DG	DARK GREEN	RD	RED		
GY	GRAY	TN	TAN		

CONNECTOR TERMINAL SIDE SHOWN

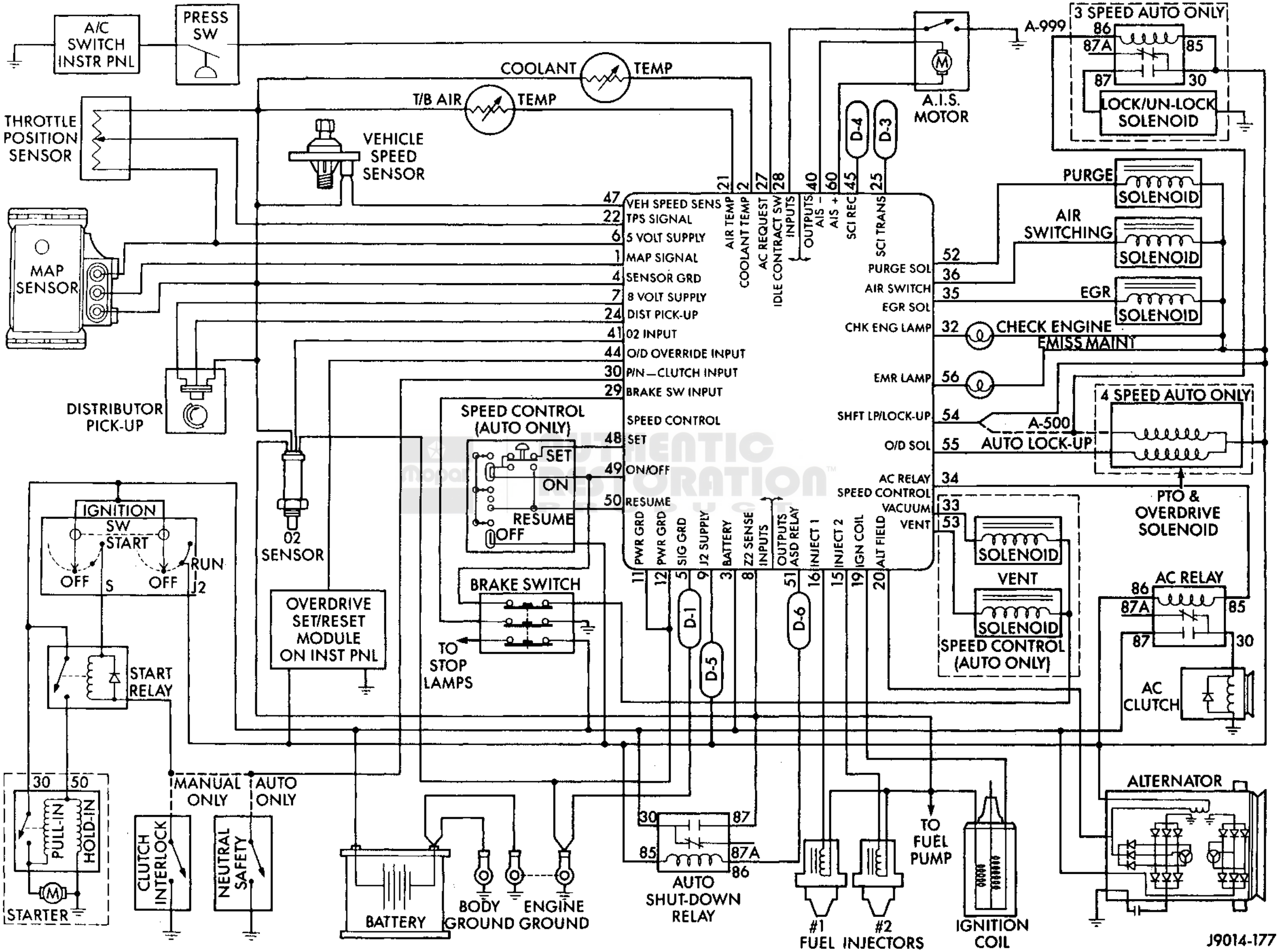


J9014-175

60-Way Single Board Engine Controller (SBEC) Wiring Connector Cavity Description—3.9L, 5.2L and 5.9L Engines

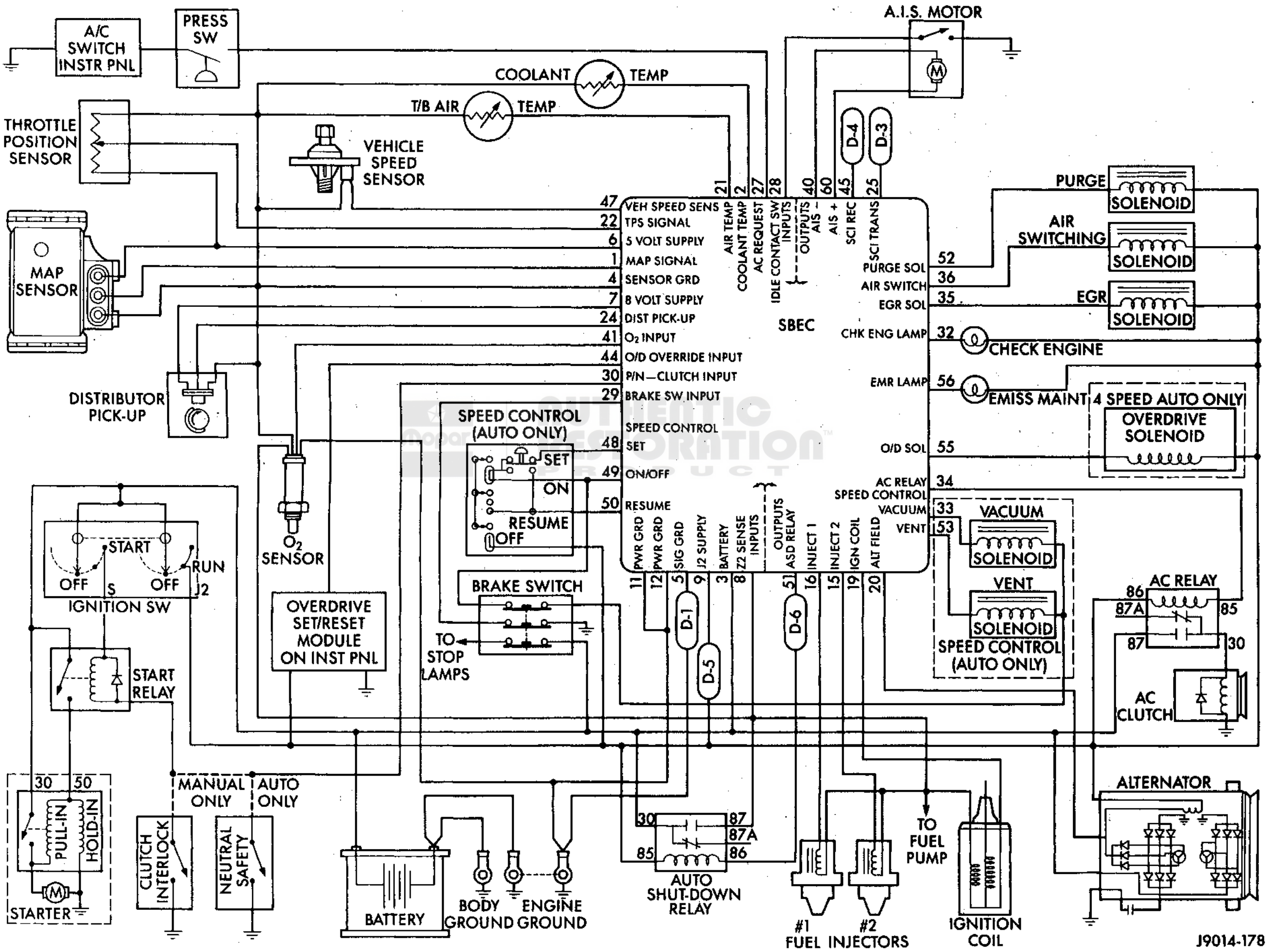


Single Board Engine Controller System Schematic—3.9L Engine

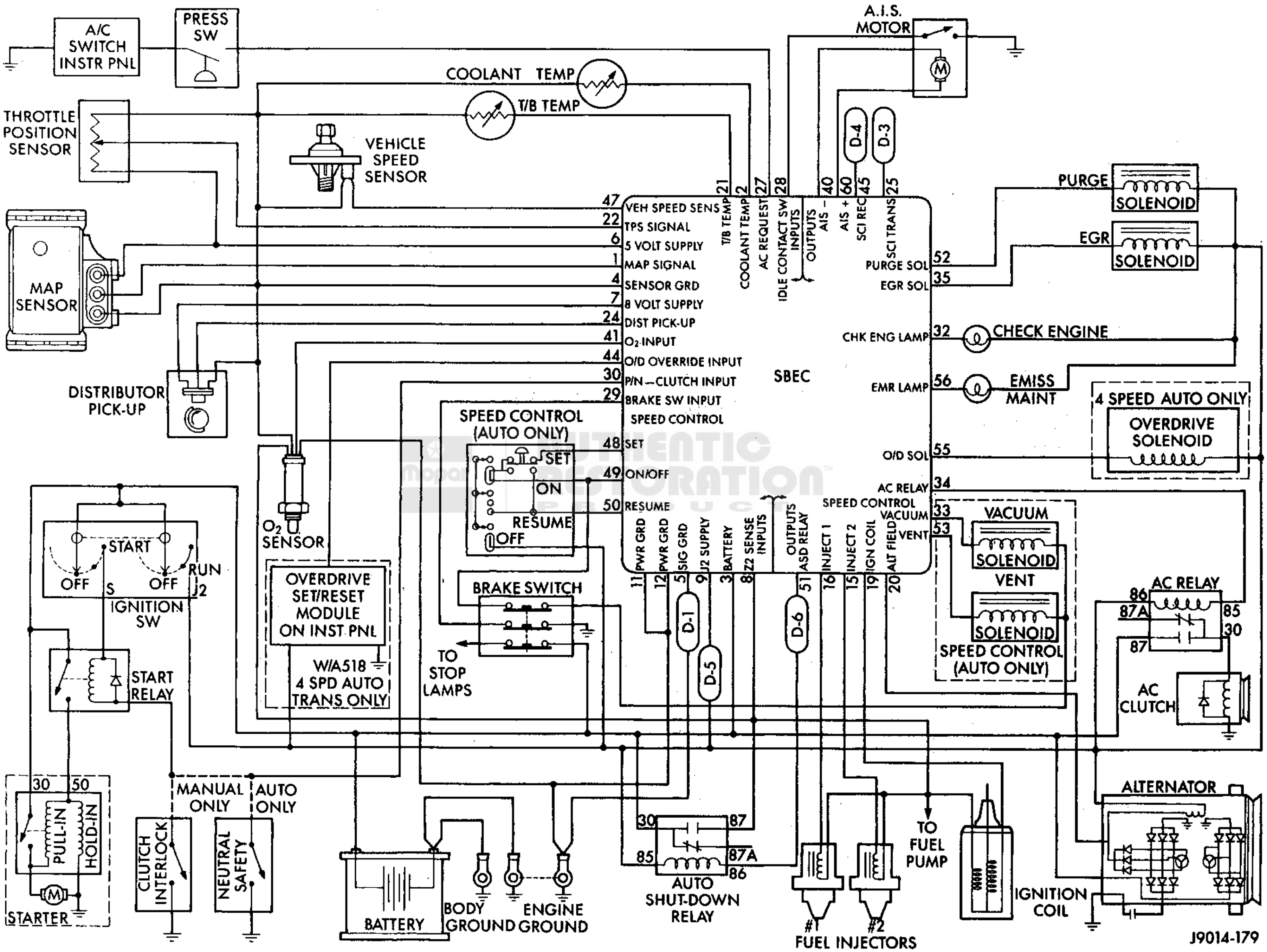


Single Board Engine Controller System Schematic—5.2L Engine

◆



Single Board Engine Controller System Schematic—5.9L Engine, Normal Duty



Single Board Engine Controller System Schematic—5.9L Engine, Heavy Duty

SERVICE PROCEDURES

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FUEL LINES AND HOSES

When servicing the fuel portion of the system, it will be necessary to preform the "Fuel System Pressure Relief Procedure" to bleed fuel pressure from the system before removing any clamps or hoses. Use care when removing fuel hoses to prevent damage to hose or hose nipple. During assembly always use new hose clamps of the correct type. Tighten hose clamps to 1 N•m (10 in. lbs.) torque. **Do not use aviation style clamps on this system or hose damage may result.**

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

WARNING: THE TBI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 100 KPA (14.5 PSI). BEFORE SERVICING THE FUEL PUMP, FUEL LINES, FUEL FILTER, THROTTLE BODY OR FUEL INJECTOR, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(1) Loosen fuel filler cap to release fuel tank pressure.

(2) Disconnect injector wiring harness from engine harness.

(3) Connect a jumper wire to ground terminal Number 1 of the injector harness (Fig. 1) to engine ground.

(4) Connect a jumper wire to the positive terminal Number 2 of the injector harness (Fig. 1) and touch the battery positive post for no longer than 5 seconds. This releases system pressure.

(5) Remove jumper wires.

(6) Continue fuel system service.

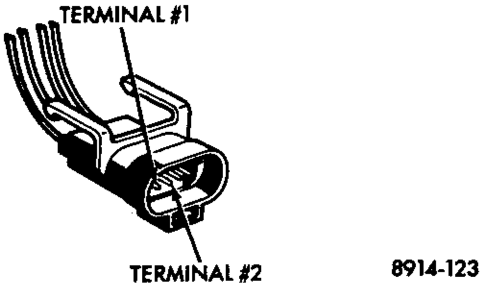

Fig. 1 Injector Harness Connectors

THROTTLE BODY

REMOVAL

(1) Remove air cleaner.

(2) Perform fuel system pressure release.

(3) Disconnect battery negative cable.

(4) Disconnect vacuum hoses and electrical connectors.

(5) Remove throttle cable. If equipped, remove speed control and transmission kick down cables.

(6) Remove throttle return spring.

(7) Remove fuel intake and return hoses (Fig. 2).

(8) Remove throttle body mounting screws and lift throttle body from vehicle. Remove throttle body gasket from intake manifold.

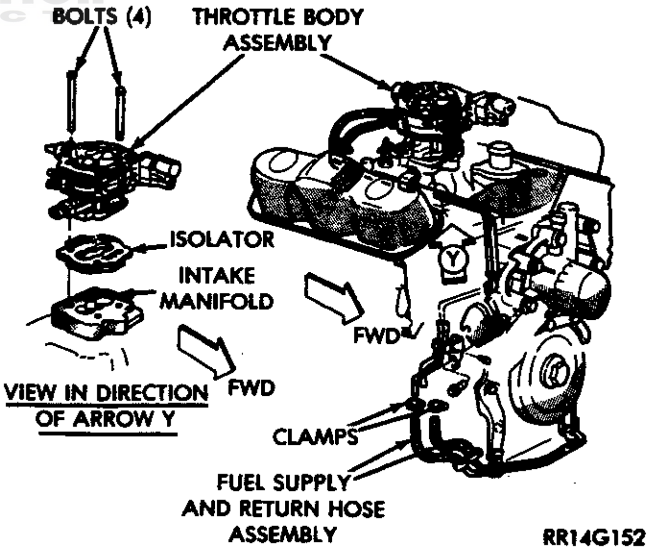

Fig. 2 Throttle Body Removal and Installation

INSTALLATION

(1) Using a new gasket, install throttle body and tighten mounting screws to 20 N•m (175 in-lbs) torque.

(2) Install fuel intake and return hoses using new original equipment type clamps.

(3) Install return spring.

(4) Install throttle cable. If equipped, install transmission kick-down and speed control cables.

(5) Install wiring connectors and vacuum hoses.

(6) Install air cleaner.

(7) Reconnect negative battery cable.

THROTTLE BODY COMPONENTS

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 100 KPA (14.5 PSI). BEFORE SERVICING THE THROTTLE BODY OR FUEL INJECTOR THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

Perform the Fuel System Pressure Release procedure prior to servicing fuel delivery system components or opening fuel hoses on the throttle body.

Always reassemble throttle body components with new O-rings and seals where applicable. Never use silicone lubricants on O-rings or seals, damage may result.

Use care when removing fuel hoses to prevent damage to hose or hose nipple. **If fuel system hoses are to be replaced, only hoses marked EFI/EFM may be used.** Always use new hose clamps of the correct type when reassembling and tighten hose clamps to 1 N•m (10 in.lbs.) torque. Do not use Aviation style clamps on this system or hose damage may result.

It is not necessary to remove the throttle body from the intake manifold when removing or replacing throttle body components (Fig. 3 or Fig. 4).

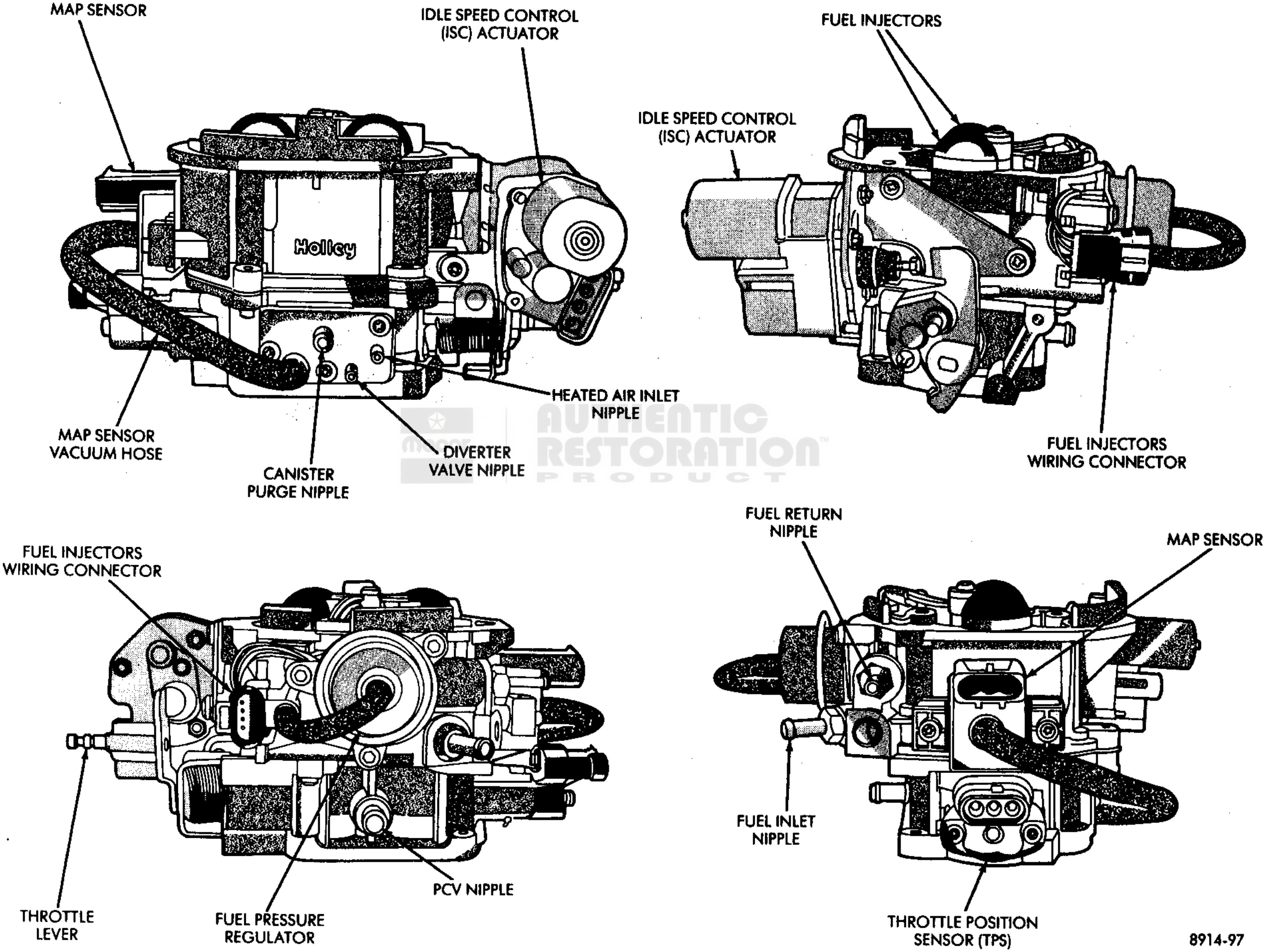

Fig. 3 Throttle Body Components—3.9L Engine

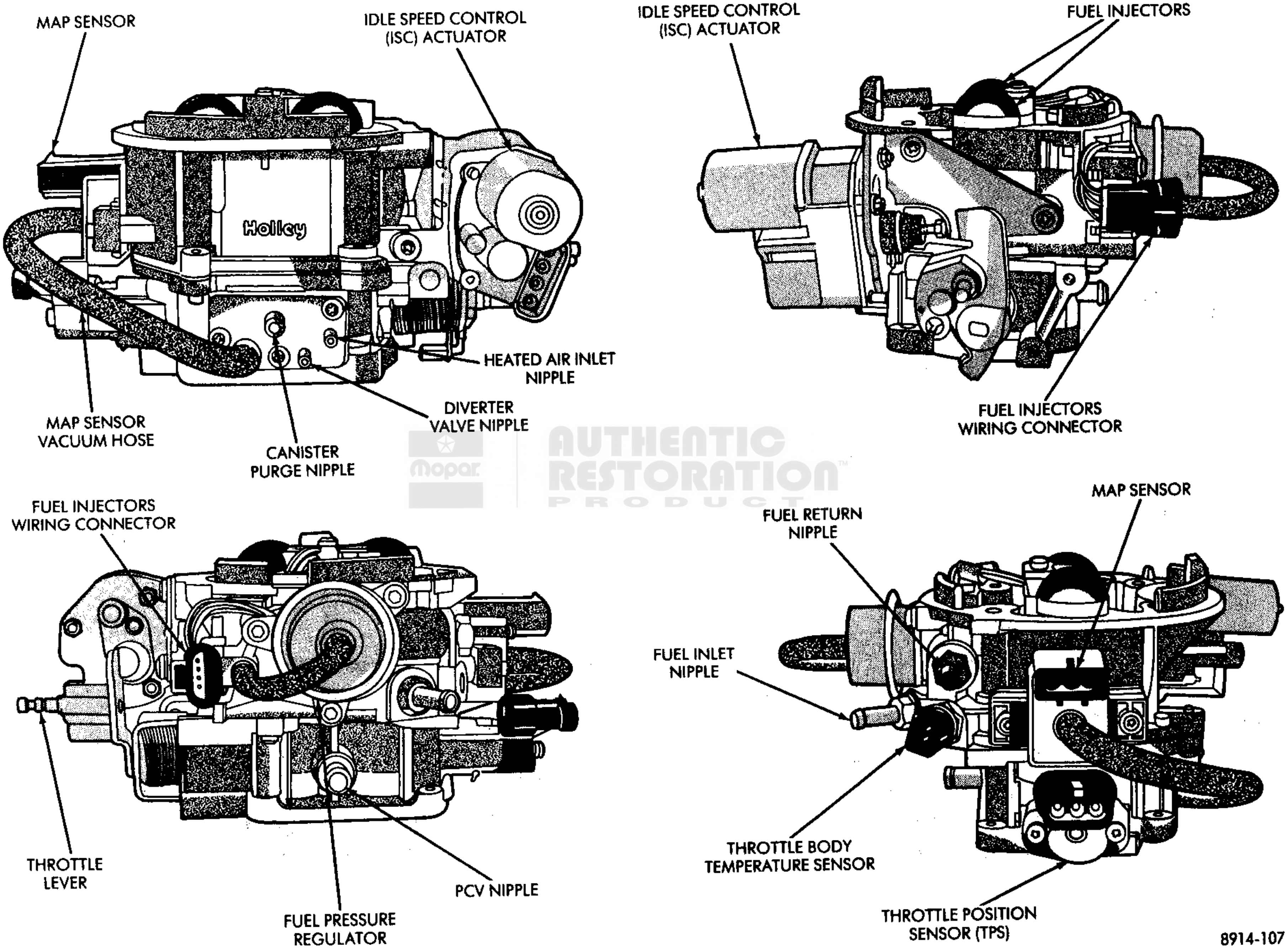

Fig. 4 Throttle Body Components—5.2L and 5.9L Engines

FUEL FITTINGS

Removal

(1) Remove air cleaner assembly.

(2) Perform Fuel System Pressure Release.

(3) Disconnect battery negative cable.

(4) Loosen fuel intake and return hose clamps. Wrap a shop towel around each hose, twist and pull of each hose.

(5) Remove each fitting and note inlet diameter (Fig. 5). Remove copper washers.

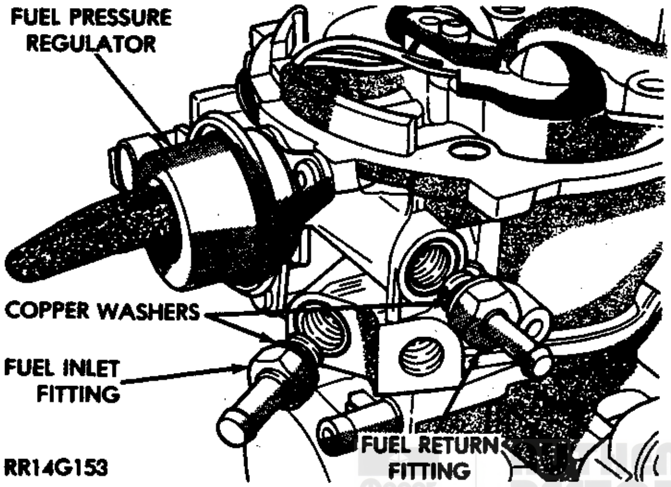

Fig. 5 Servicing Fuel Fitting

Installation

(1) Replace copper washers with new washers.

(2) Install fuel fittings in proper ports and tighten to 20 N•m (175 in. lbs.) torque.

(3) Using new original equipment type hose clamps, install fuel return and supply hoses. Tighten hose clamps to 1 N•m (10 in. lbs.) torque.

(4) Reconnect battery negative cable.

(5) Using DRBII diagnostic tester, with the key in the "Run" position, use Special Functions "ASD Fuel System Test", to activate the fuel pump and pressurize the system. Check for leaks.

(6) Reinstall air cleaner assembly.

THROTTLE BODY TEMPERATURE SENSOR

Removal

(1) Remove air cleaner from engine.

(2) Disconnect throttle body temperature sensor electrical connector.

(3) Remove sensor (Fig. 6).

Installation

(1) Apply heat transfer compound (provided with new sensor) to tip of new sensor.

(2) Install sensor and tighten to 12 N•m (110 in. lbs.) torque.

(3) Connect electrical connector to sensor.

(4) Install air cleaner.

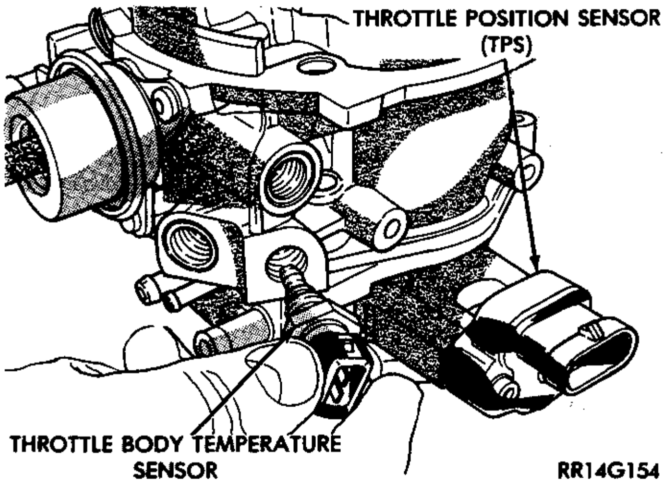

Fig. 6 Throttle Body Temperature Sensor—5.2L and 5.9L Engines

FUEL PRESSURE REGULATOR

Removal

(1) Remove air cleaner assembly.

(2) Perform fuel system pressure release.

(3) Disconnect battery negative cable.

(4) Remove vacuum hose from throttle body.

(5) Remove screws attaching pressure regulator to throttle body.

WARNING: PLACE A SHOP TOWEL AROUND FUEL INLET OF THE PRESSURE REGULATOR TO ABSORB ANY RESIDUAL FUEL REMAINING IN THE SYSTEM.

(6) Remove pressure regulator from throttle body (Fig. 7).

(7) Carefully remove O-ring from pressure regulator (Fig. 7). Remove gasket.

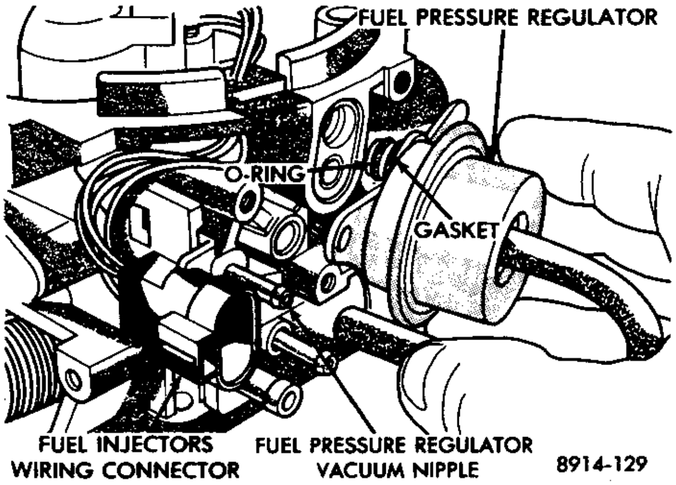

Fig. 7 Servicing Fuel Pressure Regulator

Installation

(1) Place new gasket on pressure regulator and carefully install new O-ring.

(2) Position pressure regulator on throttle body press into place, install mounting screws and tighten to 5 N•m (40 in. lbs.) torque.

(3) Install vacuum hose to throttle body.

(4) Using DRBII diagnostic tester, with the key in the "Run" position, use Special Functions "ASD Fuel System Test", to activate the fuel pump and pressurize the system. Check for leaks.

(5) Reinstall air cleaner assembly.

FUEL INJECTORS

Removal

(1) Remove air cleaner assembly.

(2) Perform fuel system pressure release.

(3) Disconnect battery negative cable.

(4) Remove injector hold-down clamp Torx screw (Fig. 8). **Be careful not to damage the spacer under the clamp.**

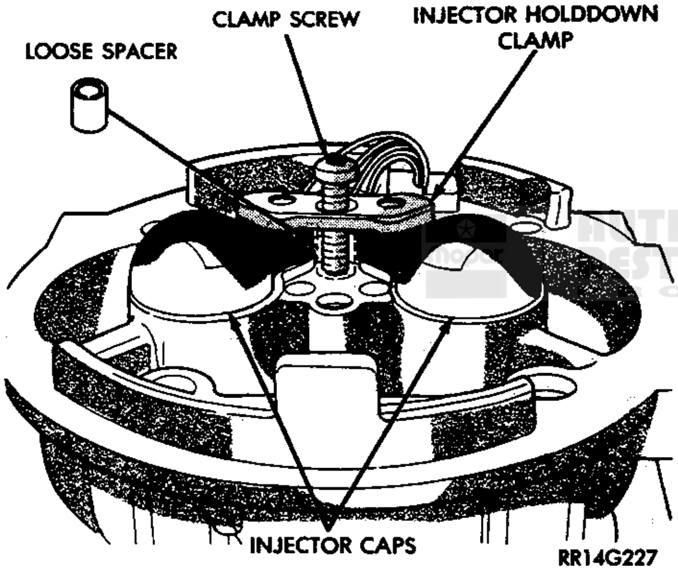

Fig. 8 Removing Injector Cap Hold-Down

(5) Using a small screwdriver and the area in front of the hold-down clamp for leverage, lift the caps off the injectors.

(6) Using a small screw driver placed in the hole in the front of the electrical connector gently pry the injectors from the pod (Fig. 9).

(7) Make sure the injector lower O-ring has been removed from the pod (Fig. 10)

Installation

(1) Install lower O-ring on injector. O-ring should butt against plastic filter assembly. Inspect both O-rings for cuts or tears and replace if necessary. (Fig. 10).

(2) Align the injector terminal housing with the locating socket in the injector cap. (Fig. 11).

(3) Press injector into cap so that upper O-ring flange is flush with lower surface of cap. (Fig. 12).

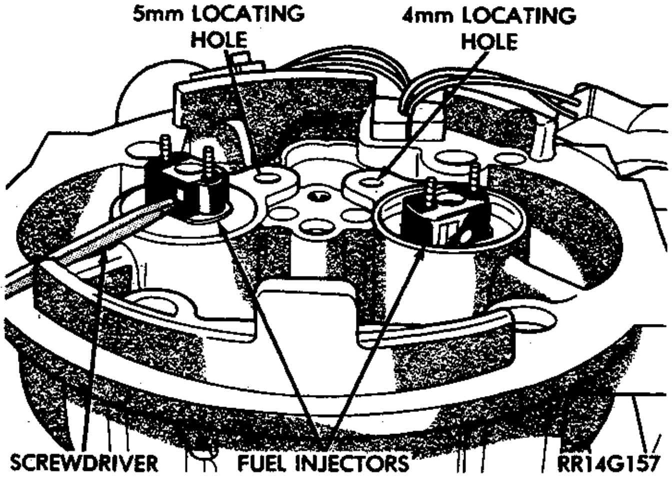

Fig. 9 Removing Fuel Injector

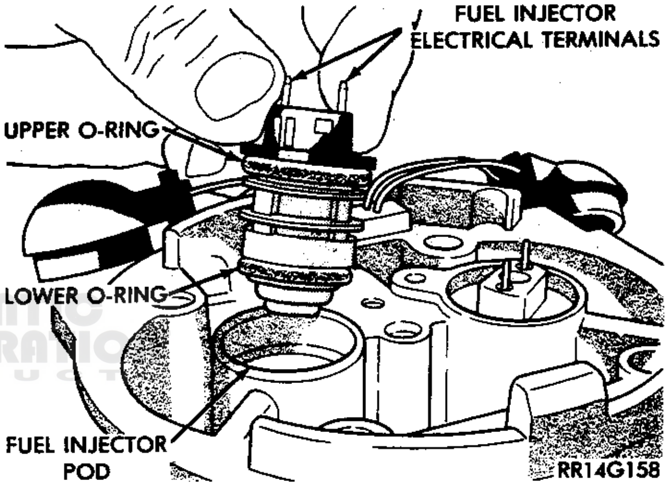

Fig. 10 Servicing Fuel Injector

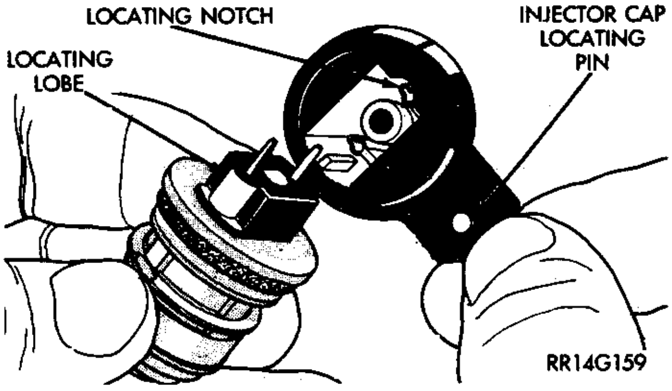

Fig. 11 Fuel Injector and Injector Cap

(4) Spray inner surfaces of both injector pods with Mopar Brake and Carburetor Parts Cleaner to remove residual gasoline.

(5) Lightly lubricate the upper and lower O-rings with Petroleum Jelly.

(6) Place injector and cap in injector pod and align cap locating pin with locating hole in the casting.

Passenger side cap locating pin is 5 mm in diameter and will only fit in passenger side locat-

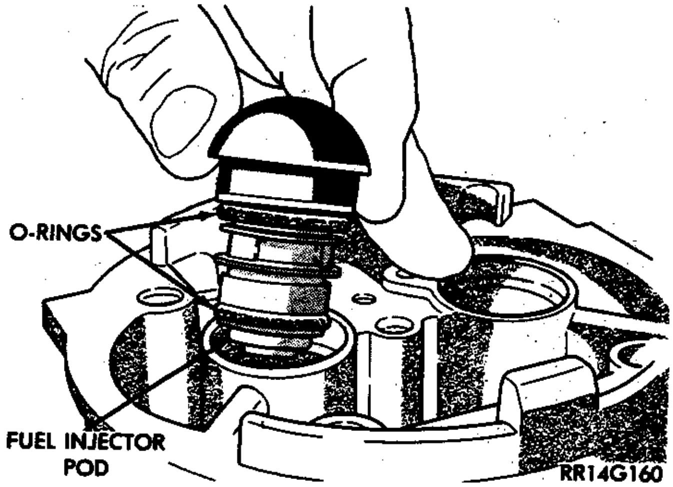

Fig. 12 Installing Fuel Injector Assembly

ing hole. Driver's side locating pin is 4 mm in diameter (Fig. 9).

(7) Repeat steps 1-6 with other injector and cap.

(8) Press firmly on injector caps until flush with casting surface.

(9) Place injector hold-down clamp with spacer on rear portion of caps, aligning the holes in clamp with pins on caps. (Fig. 8).

(10) Install clamp screw. Be sure spacer is in place (Fig. 8). **Because O-ring squeeze may cause caps to lift up, press firmly on both caps with one hand to ensure caps are flush while installing clamp screw.** Tighten screw until snug. Tighten screw to 4 N•m (35 in-lbs) torque.

(11) Connect negative cable to battery. Test for leaks using DRBII diagnostic tester. With the key in the "Run" position, use Special Functions "ASD Fuel System Test", to activate the fuel pump and pressurize the system.

(12) Reinstall Air Cleaner Assembly.

MANIFOLD ABSOLUTE PRESSURE SENSOR SERVICE

(1) Remove vacuum hose and electrical connector from sensor (Fig. 13).

(2) Remove sensor mounting screws and remove sensor (Fig. 13).

(3) Reverse the above procedure for installation. Check the vacuum hose and electrical connections to the sensor.

THROTTLE POSITION SENSOR (TPS)

Removal

(1) Disconnect battery negative cable.

(2) Remove air cleaner.

(3) Disconnect 3 way connector at throttle position sensor.

(4) Remove throttle position sensor mounting screws.

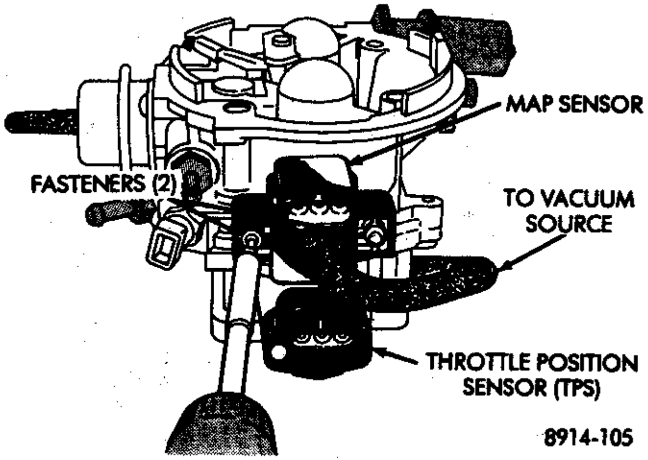

Fig. 13 Servicing the MAP Sensor

(5) Lift throttle position sensor off the throttle shaft (Fig. 14).

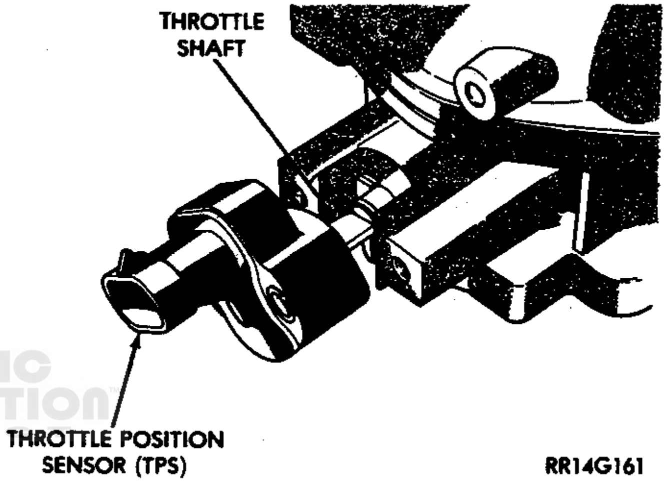

Fig. 14 Servicing Throttle Position Sensor

Installation

(1) Install throttle position sensor to throttle body with the electrical connector positioned upward away from the engine. Tighten mounting screws to 3 N•m (27 in-lbs) torque.

(2) Connect 3 way connector at throttle position sensor.

(3) Install air cleaner.

(4) Connect battery cable.

IDLE SPEED CONTROL (ISC) ACTUATOR

Removal

(1) Remove air cleaner.

(2) Disconnect battery negative cable.

(3) Disconnect electrical connector.

(4) Remove ISC motor attaching nuts (Fig. 15).

(5) Remove the idle speed control actuator from the bracket.

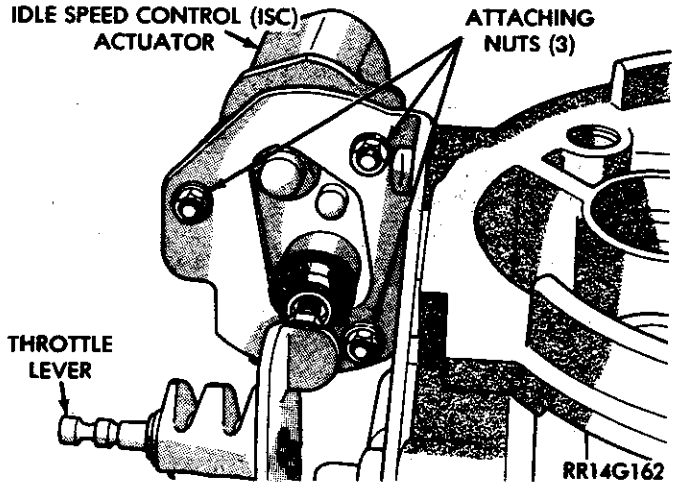

Fig. 15 Idle Speed Control (ISC) Actuator Service

Installation and Adjustment

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING IDLE CHECK OR ADJUSTMENT.

(1) Install the idle speed control actuator to the support bracket with washers and mounting nuts.

(2) Attach electrical connector.

(3) Start the vehicle and allow to run for two minutes.

(4) Shut vehicle off. Allow 60 seconds for the actuator shaft to fully extend.

(5) Disconnect the wiring connector to the idle speed control actuator.

(6) Disconnect the wiring connector to the coolant temperature sensor.

(7) Hook up a tachometer to the engine.

(8) Start the vehicle.

(9) Adjust the extension screw on the actuator shaft (Fig. 16) until the rpm is within the specifications shown:

3.9L Engine:

- If vehicle mileage is less than 1000 miles, set to 2400-2500 rpm
- If vehicle mileage is greater than 1000 miles, set to 2500-2600 rpm

5.2L and 5.9L Engine:

- If vehicle mileage is less than 1000 miles, set to 2650-2750 rpm
- If vehicle mileage is greater than 1000 miles, set to 2750-2850 rpm

(10) Shut off vehicle.

(11) Reconnect the ISC actuator motor electrical connector.

(12) Reconnect the Coolant Temperature Sensor.

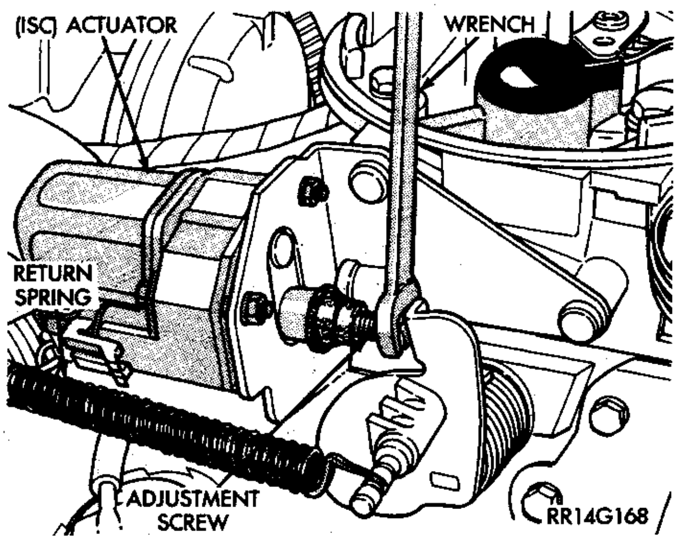

Fig. 16 Adjusting the Idle Speed Control (ISC) Actuator

VACUUM MANIFOLD

Removal

(1) Remove the air cleaner.

(2) Disconnect battery negative cable.

(3) Remove the throttle body. Refer to "Throttle Body Removal" in this section.

(4) Remove vacuum manifold mounting screw (Fig. 17).

(5) Remove manifold and any gasket material on surface of throttle body.

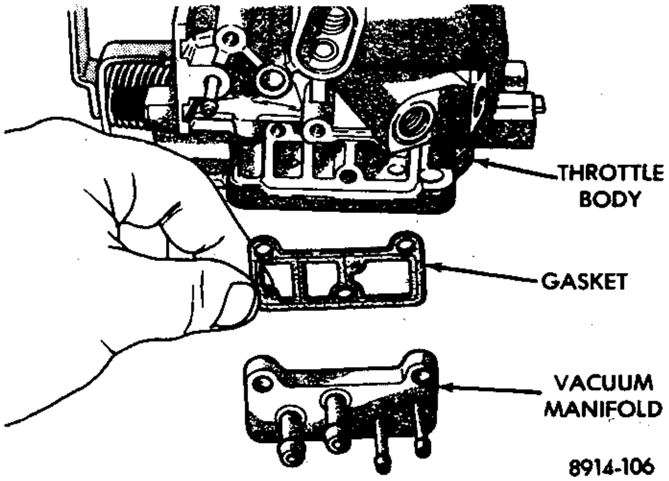

Fig. 17 Servicing Vacuum Manifold

Installation

(1) Install vacuum manifold with a new gasket.

(2) Tighten attaching screws to 4 N•m (35 in. lbs.) torque.

(3) Install the throttle body. Refer to "Throttle Body Installation" in this section, use a new base gasket when installing the throttle body.

(4) Install the air cleaner.

(5) Connect the battery negative cable.

AIR SWITCHING, CANISTER PURGE AND EGR DIAGNOSTIC SOLENOID SERVICE

The solenoids are mounted to a bracket at the rear of the engine on the right side cylinder head cover (Fig. 18).

(1) Remove vacuum hose and electrical connector from solenoids.

(2) Remove mounting bracket fastener.

(3) Depress tab on top of solenoid to be replaced and slide the solenoid downward out of mounting bracket.

(4) Reverse above procedure to install.

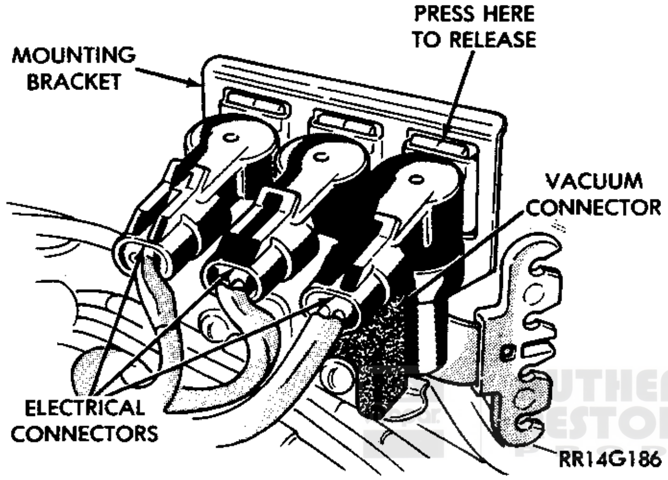

Fig. 18 Air Switching, Canister Purge and EGR Solenoids

SINGLE BOARD ENGINE CONTROLLER (SBEC) SERVICE

(1) Remove air cleaner duct from SBEC.

(2) Remove SBEC mounting screws (Fig. 19).

(3) Remove wiring connectors from SBEC. Remove module.

(4) Reverse above procedure for installation.

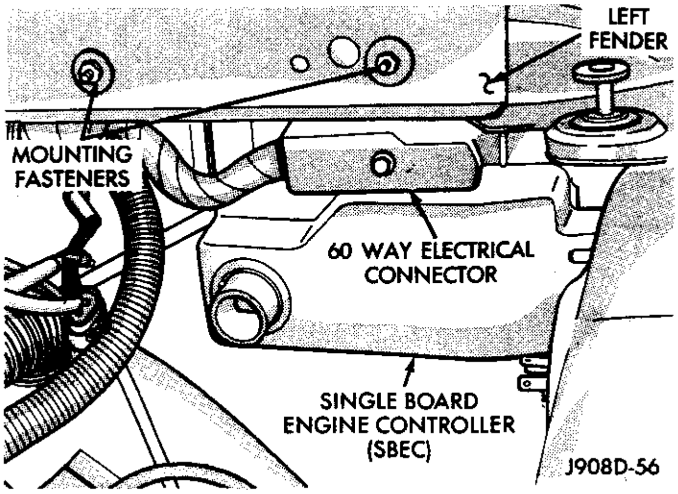

Fig. 19 Single Board Engine Controller (SBEC)

HEATED OXYGEN SENSOR (O_2 SENSOR) SERVICE

On 3.9L engines the oxygen sensor is located in the exhaust systems Y-pipe (Fig. 20). On 5.2L and 5.9L engines the oxygen sensor is located above the outlet of the left exhaust manifold (Fig. 21).

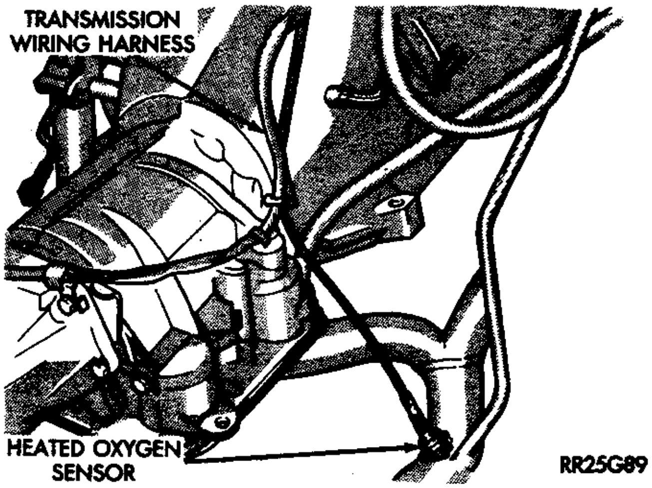

Fig. 20 Heated Oxygen Sensor Location—3.9L Engine

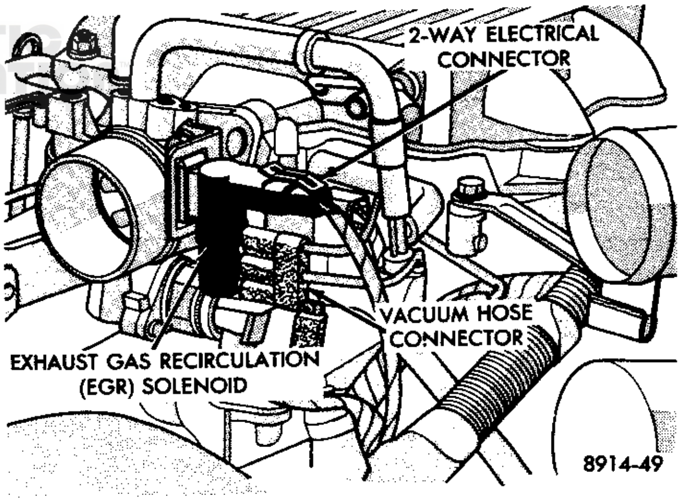

Fig. 21 Heated Oxygen Sensor Location—5.2L and 5.9L Engine

(1) Disconnect engine harness from Oxygen Sensor Connector (Fig. 22).

CAUTION: Take care not to pull on oxygen sensor wires when servicing the O_2 sensor.

WARNING: THE EXHAUST PIPE MAY BE EXTREMELY HOT. AVOID CONTACT WITH THE EXHAUST PIPE WHEN SERVICING THE OXYGEN SENSOR.

(2) Remove O_2 sensor with Tool C-4907.

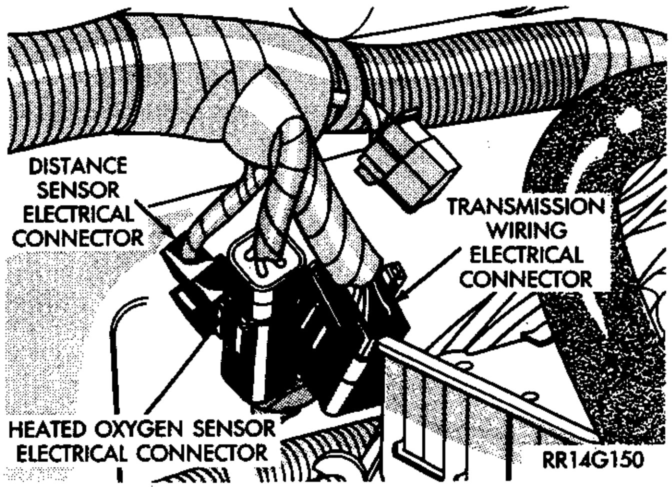

Fig. 22 Heated Oxygen Sensor Electrical Connector—3.9L Engine

The original O_2 sensor threads were coated with an anti-seize compound. The compound must be removed from the threads in the exhaust manifold prior to sensor installation.

(3) Clean the threads in the exhaust manifold with an 18 mm X 1.5 + 6E tap.

(4) If the original sensor is to be reinstalled, the sensor threads must be coated with an anti-seize compound (Loctite 771-64 or equivalent). New O_2 sensors are packaged with compound on the threads and no additional compound is required.

(5) Tighten sensor to 27 N•m (20 ft. lbs.) torque. **For more information refer to Group 25.**

SENSOR SPECIFICATIONS

Component	Number of Terminals	Resistance at °F	Thread Compound	Thread Size	Torque
Coolant Temperature Sensor	2	7,000 to 13,000 Ohms About 21°C, 70°F	Preapplied (Nonrequired)	3/8–18 NPTF	27 N·m (20 ft.-lbs.)
		700 to 1,000 Ohms About 93°C, 200°F			
Throttle Body Temperature Sensor (5.2L and 5.9L Engines)	2	5,600 to 14,600 Ohms About 21°C, 70°F	Silicone Heat Transfer Compound	M12 × 1.5 (Metric)	11 N·m (100 in.-lbs.)
		400 to 1,500 Ohms About 93°C, 200°F			

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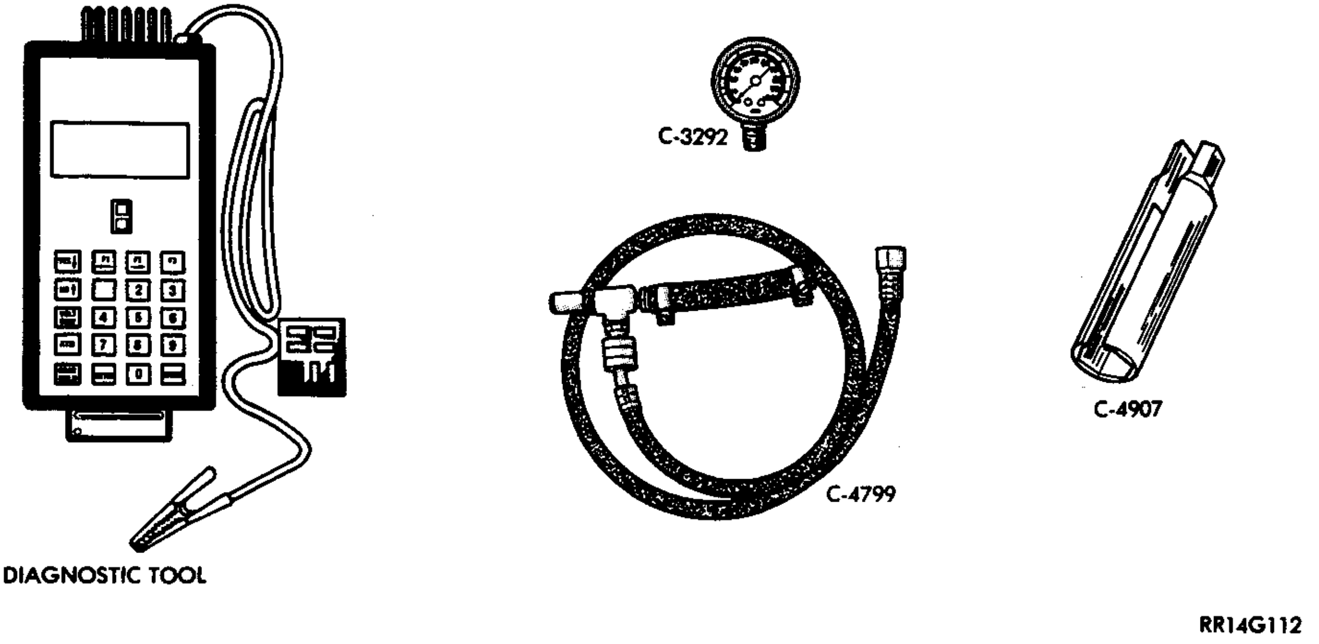
SPECIAL TOOLS



DRIVE SHAFTS AND UNIVERSAL JOINTS

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GENERAL INFORMATION

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DESCRIPTION

DRIVE SHAFTS

Ram Truck and Ramcharger vehicles use tubular steel drive shafts (Figs. 1 and 2) to transfer engine torque from the transmission to the rear axle (2WD vehicles) and to transfer engine torque from the transfer case to the front and rear axles (4WD vehicles). Universal joints are used to connect each drive shaft to the transmission (or the transfer case) output shaft and to the drive pinion gear shaft (axle) yoke.

An internally-splined, sliding type (slip) yoke (with a shaft) is located at the front end of rear drive shafts (Fig. 1) to compensate for variations in the distance to the rear axle caused by rear suspension spring and axle movement. The internally splined slip yoke shaft slides fore and aft on the externally-splined drive shaft to compensate for rear axle "up-and-down" movement with the road surface (i.e., to shorten and lengthen the effective drive shaft length). A rubber boot protects the drive shaft splines from road splash.

A sliding type (slip) yoke (Figs. 1 and 2) is also located at the front end of front drive shafts (4WD) to compensate for variations in the distance between the transfer case and the front axle differential case caused by front suspension spring and axle movement. The internally-splined slip yoke shaft slides fore and aft on the externally-splined drive shaft to compensate for distance variation (i.e., to shorten and lengthen the effective drive shaft length) between the front axle differential housing and transfer case. A rubber boot protects the drive shaft splines from road splash.

Vehicles with an extended wheelbase are equipped with a two-piece rear drive shaft. The two-piece drive shafts have a center support bearing and a U-joint coupler between the two shaft-halves. The ball-type, center support bearing is enclosed in a rubber-cushioned (insulator) support and bracket that is attached to the frame crossmember.

U-JOINTS

Two different types of U-joint couplers are used with the drive shafts:

- single cardan U-joint (Fig. 3) and
- double cardan U-joint (Fig. 4).

A single cardan type U-joint (Fig. 3) is used for most drive shaft applications and is comprised of:

- a single spider,
- four sets of spider needle bearings,
- four bearing seals,
- four needle bearing caps, and
- four bearing cap retaining clips.

Strap clamps and screws are used to attach the U-joint spider to the drive pinion gear shaft (axle) yoke.

The double cardan type U-joint (Fig. 4), also referred to as a constant velocity (CV) joint, is comprised of:

- two spiders,
- one socket ball and "seats",
- one link yoke,
- one socket spring,
- one socket yoke,
- one socket yoke needle bearing,
- two thrust washers,

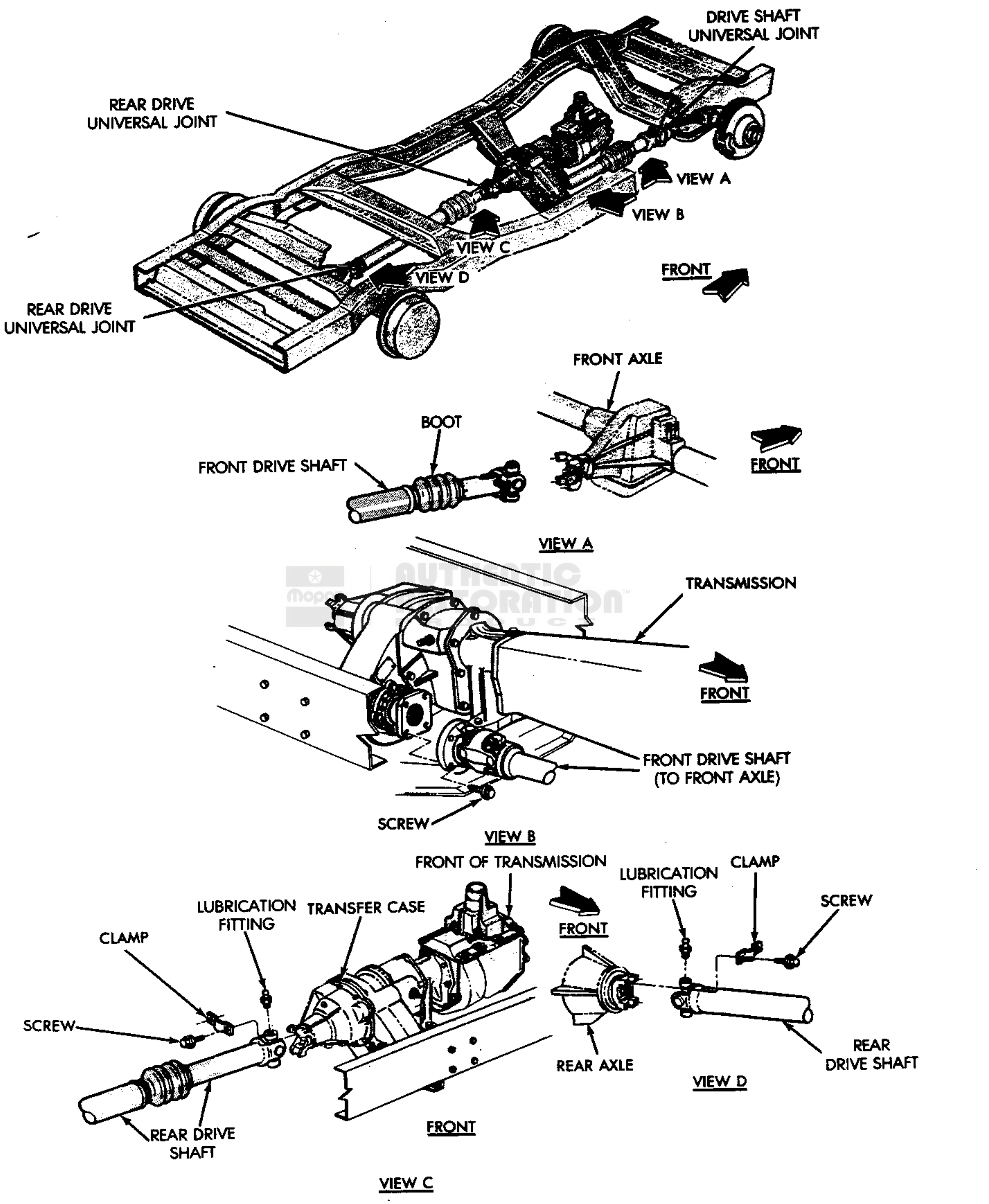

Fig. 1 Drive Shafts

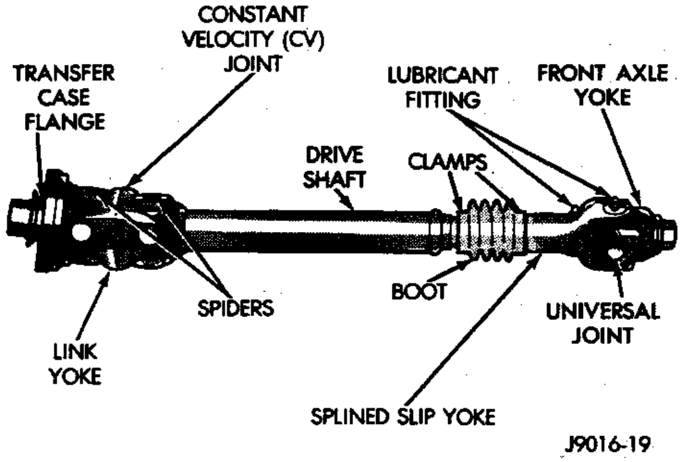

Fig. 2 Front Drive Shaft (4WD)

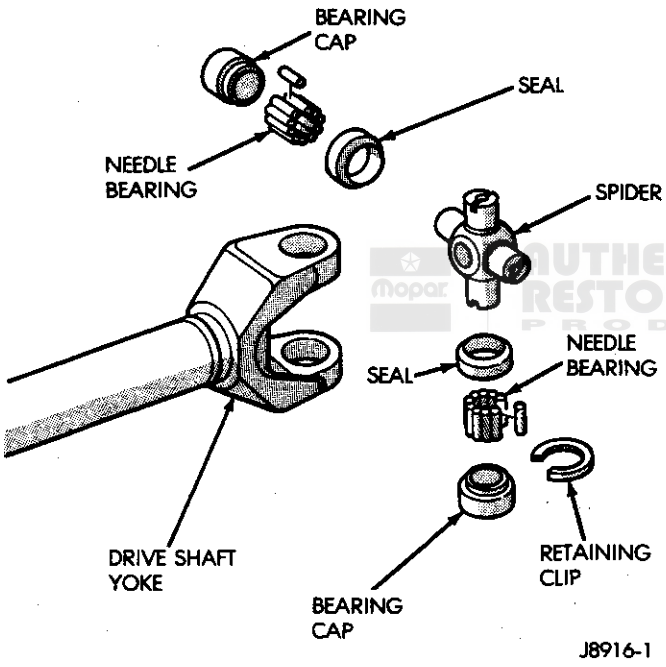

Fig. 3 Single Cardan U-Joint

- eight sets of spider needle bearings,
- sixteen bearing seals,
- eight bearing caps and retaining clips, and
- one drive shaft yoke.

Capscrews are used to attach the socket yoke to the transfer case output shaft flange.

VEHICLE CONFIGURATION

The rear drive shaft (Fig. 1) is connected to both the drive pinion gear shaft (axle) yoke and the transmission (or the transfer case) output shaft via a single cardan U-joint coupler (Fig. 3). An internally-splined, slip-yoke type U-joint coupler is also located at the transmission (or the transfer case) end of the shaft.

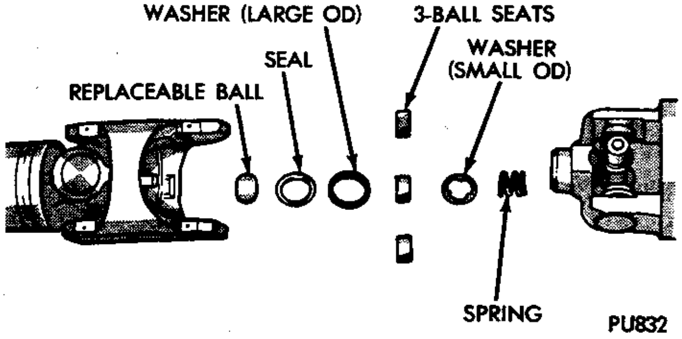

Fig. 4 Double Cardan (CV) Joint

If equipped for 4WD operation, the front drive shaft (Figs. 1 and 2) is connected to the front axle drive pinion gear shaft yoke via an internally-splined slip yoke and a single cardan U-joint coupler (Fig. 3), and to the transfer case output shaft yoke with a double cardan (CV) joint coupler (Fig. 4).

VIBRATION

VIBRATION SOURCES

Objectional vibration, while traveling on roads/streets with a "good" surface, can originate at the following locations:

- wheels/tires/brake drums;
- engine/mounts/engine accessories;
- clutch/torque converter/transmission; and
- drive shaft/U-joints/axle yoke.

Tires that are "out-of-round" (i.e., radial "runout") or wheels/tires that are excessively unbalanced will cause a low frequency vibration that will induce prominent mirror and door "shake". Tire and/or wheel faults must be corrected before proceeding with the diagnosis. If necessary, refer to Group 22—Tires And Wheels for service information.

Brake drums that are excessively unbalanced will a cause harsh, low frequency vibration. Refer to Group 5—brakes for service information.

Engine vibration faults can be located by accelerating the engine (transmission in "NEUTRAL") through the speed range and noting the speed when (if) the vibration occurs.

Refer to Group 21—Transmissions for service information involving transmissions and transfer cases.

Drive shaft/U-joint (driveline) vibration will increase in intensity as the vehicle speed is increased and it is not sensitive to engine torque. A vibration that occurs within a specific speed range ((e.g., 55 to 65 mph or 88 to 105 km/h) and does not occur above that speed range is **not** caused by drive shaft unbalance. Defective U-joints or an incorrect drive shaft angle are usually the cause of vibration that occurs within a specific speed range.

DRIVELINE VIBRATION CAUSES

Driveline vibration can be caused by the drive shaft, drive pinion gear shaft (axle) yokes, U-joints, or an incorrect U-joint angle.

Vibration caused by the drive shaft(s) can be the result of:

- undercoating material on the drive shaft tube(s),
- missing drive shaft balance weight,
- excessive drive shaft "runout",
- worn or damaged drive shaft yokes or U-joints,
- cracked seam welds at either end of the drive shaft tube, or
- dents or bends in the drive shaft tube.

Vibration from the drive pinion gear shaft (axle) yoke can be the result of:

- excessive yoke "runout",
- loose clamp screws, or
- damaged yoke.

An incorrect U-joint angle can produce an out-of-phase condition within the U-joint that results in vibration at low or high vehicle speeds.

DRIVELINE VIBRATION

Drive Condition	Possible Cause	Correction
DRIVE SHAFT VIBRATION	a. Undercoating or other foreign material on shaft.	a. Clean exterior of shaft and wash with solvent.
	b. Loose U-joint clamp screws.	b. Tighten screws properly.
	c. Loose or bent U-joint yoke or excessive runout.	c. Install replacement yoke.
	d. Incorrect drive line angularity.	d. Correct angularity.
	e. Rear spring center bolt not in seat.	e. Loosen spring U-bolts and seat center bolt.
	f. Worn U-joint bearings.	f. Replace U-joint.
	g. Drive shaft damaged (bent tube) or out of balance.	g. Install replacement drive shaft.
	h. Broken rear spring.	h. Replace rear spring.
	i. Excessive runout or unbalanced condition.	i. Reindex drive shaft 180°, test and correct as necessary.
	j. Excessive drive pinion gear shaft yoke runout.	j. Reindex drive shaft 180° and evaluate.
UNIVERSAL JOINT NOISE	a. U-joint clamp screws loose.	a. Tighten screws with specified torque.
	b. Lack of lubrication.	b. Replace U-joint.

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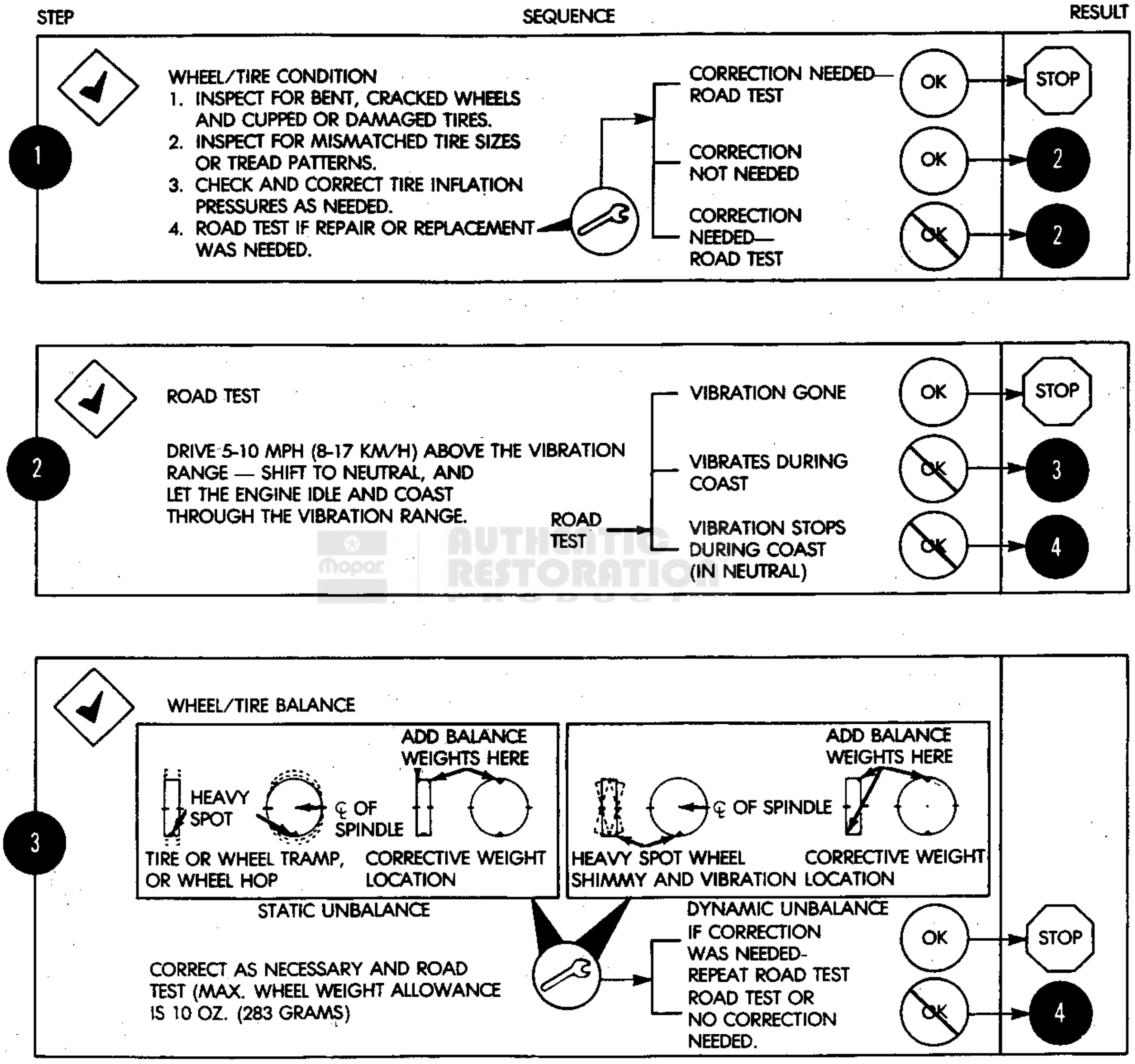
Driveline vibration can also result from loose or damaged crossmembers, support cushions, leaf springs and driveline retaining bolts/nuts. Refer to Group 22—Tires And Wheels for additional information involving vibration diagnosis.

DRIVELINE VIBRATION DIAGNOSIS

When a driveline vibration condition exists, do not initiate corrective action until the actual source of the vibration has been identified. This is very important if unnecessary or ineffective repairs are to be avoided. The following diagnosis charts will help to identify the most common causes of driveline vibration.

DRIVELINE VIBRATION DIAGNOSIS



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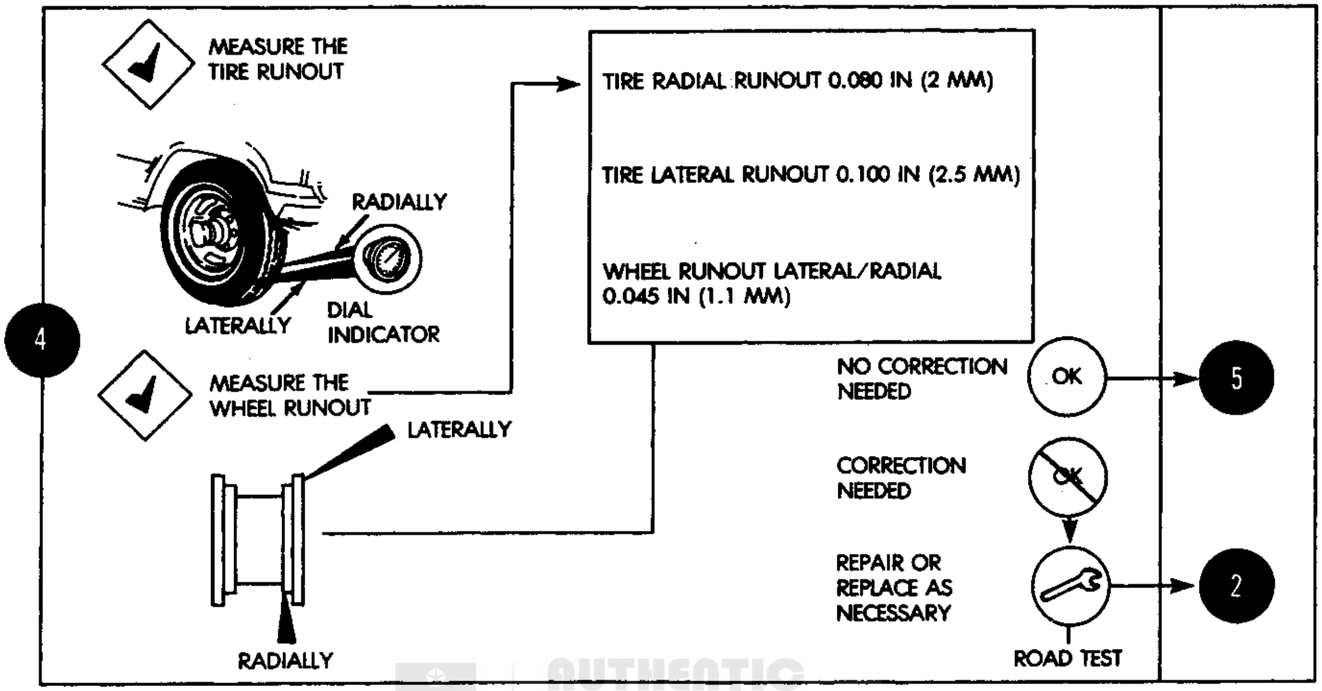
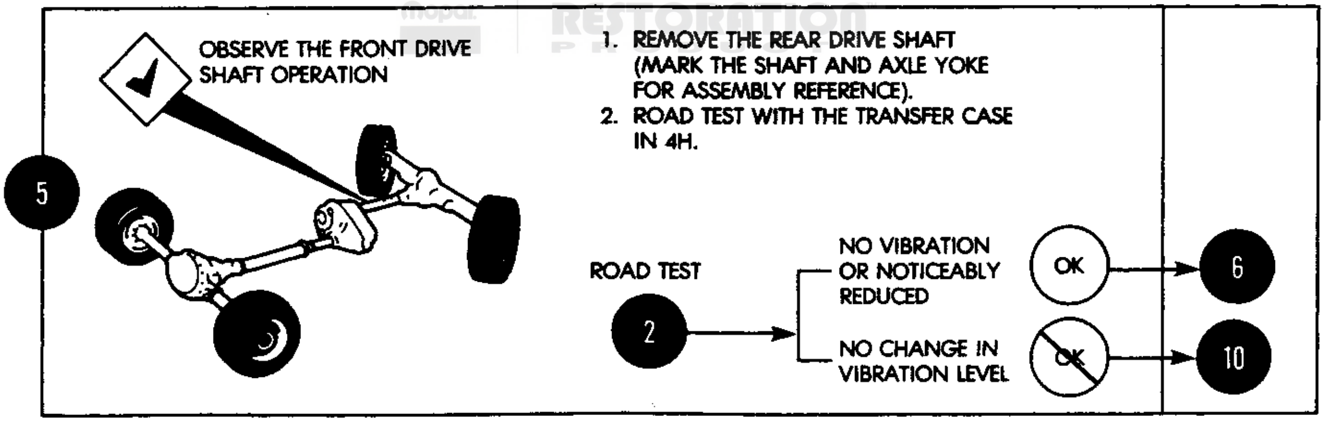
DRIVELINE VIBRATION DIAGNOSIS (CONT'D)



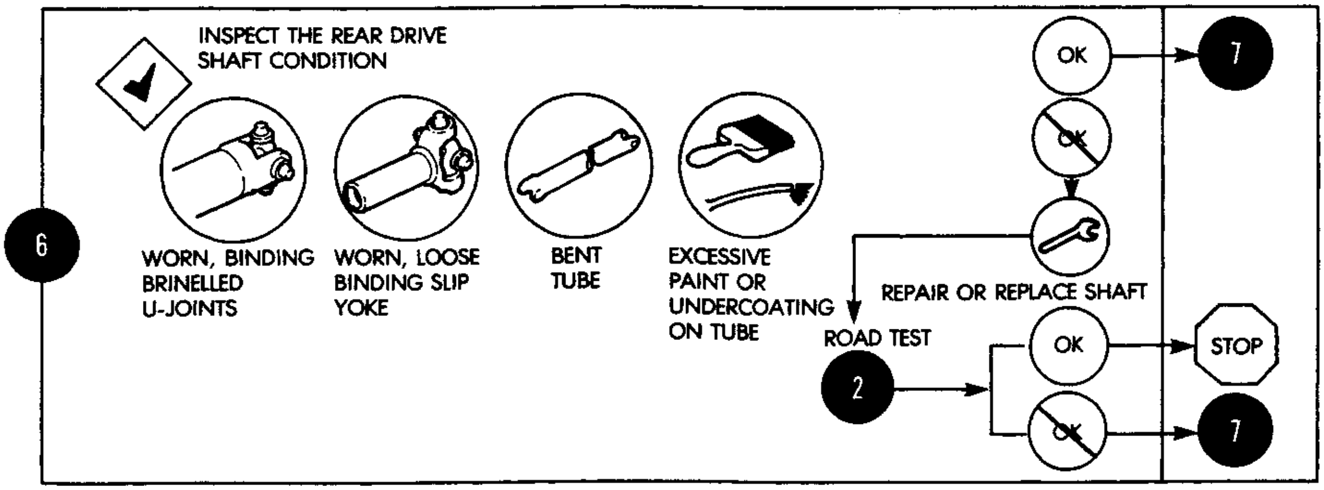
TIRE RADIAL RUNOUT 0.080 IN (2 MM)

TIRE LATERAL RUNOUT 0.100 IN (2.5 MM)

WHEEL RUNOUT LATERAL/RADIAL 0.045 IN (1.1 MM)



1. REMOVE THE REAR DRIVE SHAFT (MARK THE SHAFT AND AXLE YOKE FOR ASSEMBLY REFERENCE).
2. ROAD TEST WITH THE TRANSFER CASE IN 4H.



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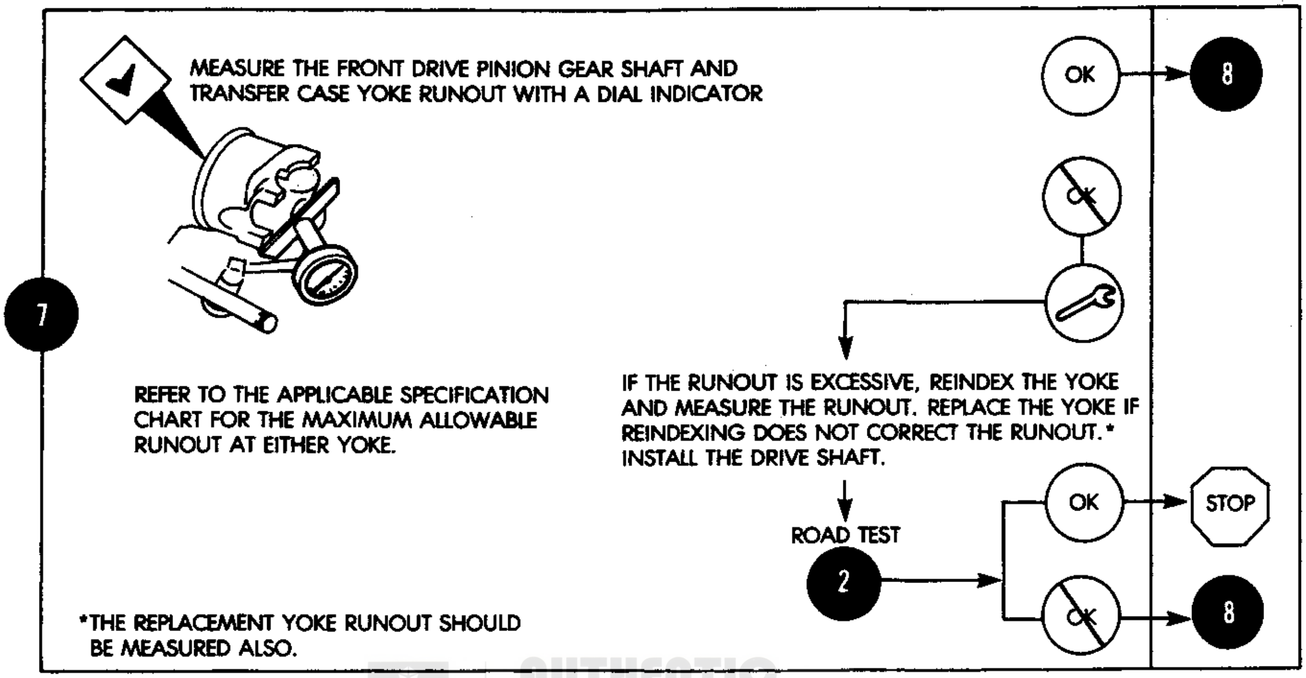
DRIVELINE VIBRATION DIAGNOSIS (CONT'D)

STEP SEQUENCE RESULT



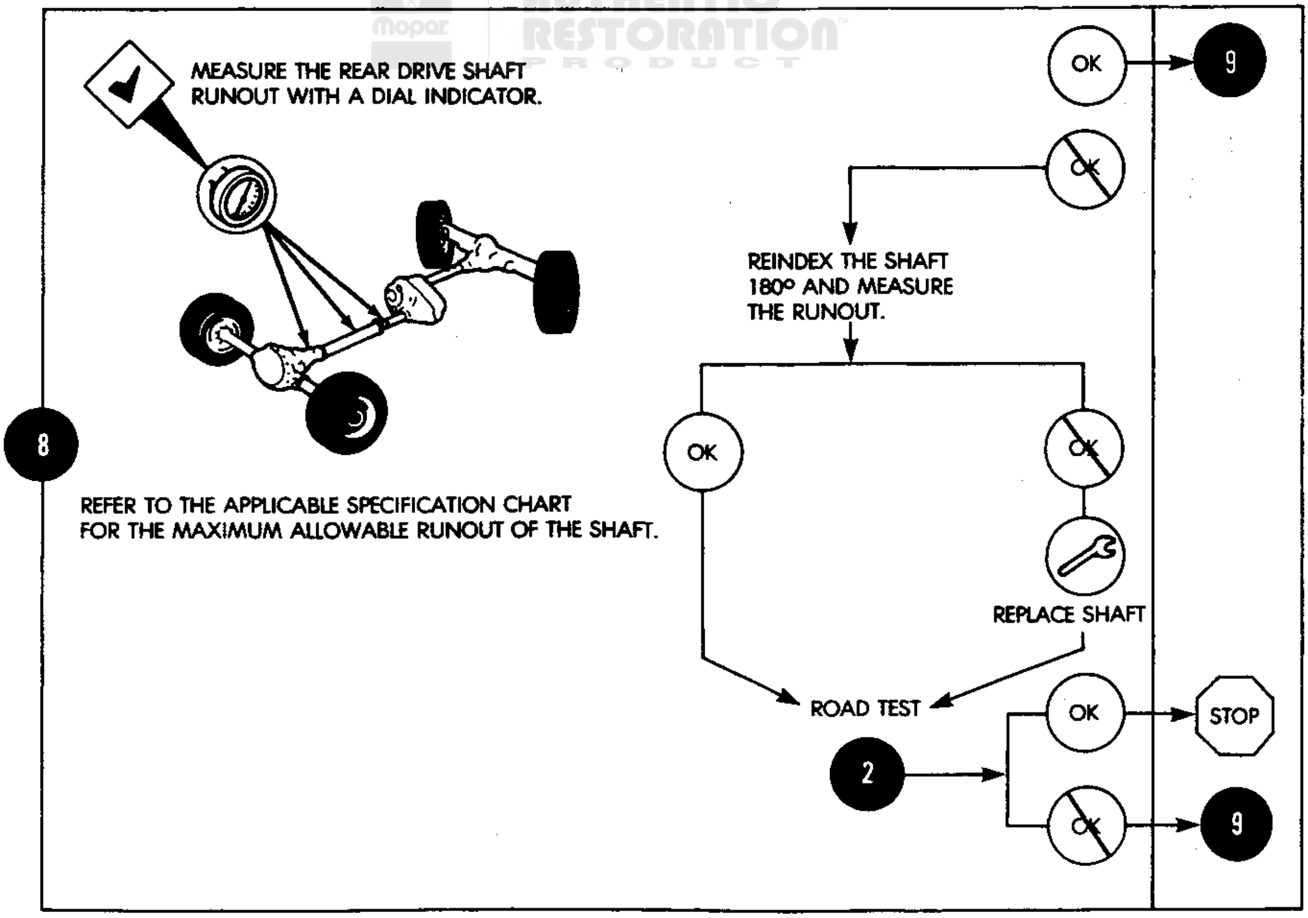
MEASURE THE FRONT DRIVE PINION GEAR SHAFT AND TRANSFER CASE YOKE RUNOUT WITH A DIAL INDICATOR

REFER TO THE APPLICABLE SPECIFICATION CHART FOR THE MAXIMUM ALLOWABLE RUNOUT AT EITHER YOKE.

IF THE RUNOUT IS EXCESSIVE, REINDEX THE YOKE AND MEASURE THE RUNOUT. REPLACE THE YOKE IF REINDEXING DOES NOT CORRECT THE RUNOUT.* INSTALL THE DRIVE SHAFT.

ROAD TEST

*THE REPLACEMENT YOKE RUNOUT SHOULD BE MEASURED ALSO.



MEASURE THE REAR DRIVE SHAFT RUNOUT WITH A DIAL INDICATOR.

REFER TO THE APPLICABLE SPECIFICATION CHART FOR THE MAXIMUM ALLOWABLE RUNOUT OF THE SHAFT.

REINDEX THE SHAFT 180° AND MEASURE THE RUNOUT.

REPLACE SHAFT

ROAD TEST

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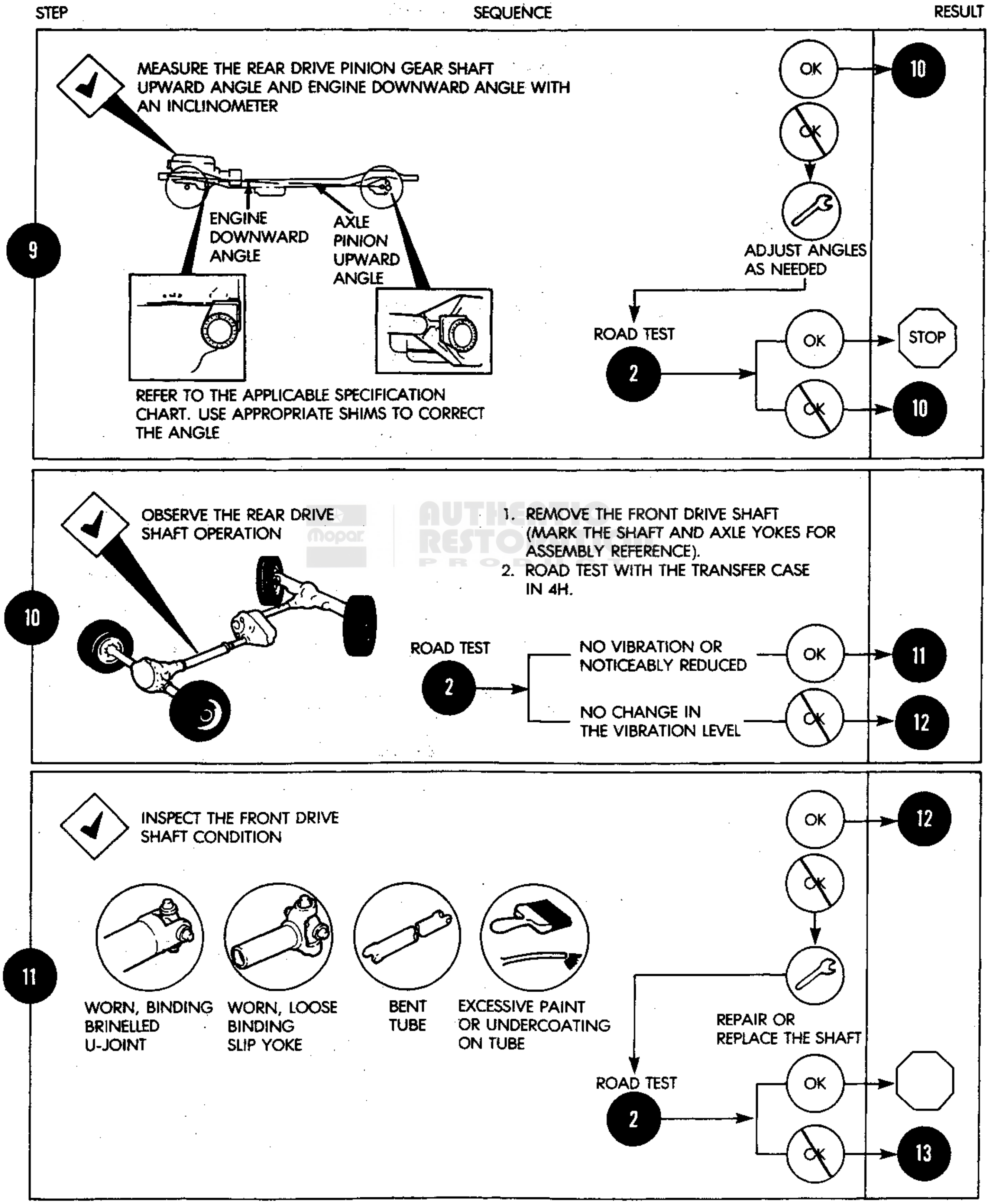
DRIVELINE VIBRATION DIAGNOSIS (CONT'D)



MEASURE THE REAR DRIVE PINION GEAR SHAFT UPWARD ANGLE AND ENGINE DOWNWARD ANGLE WITH AN INCLINOMETER

REFER TO THE APPLICABLE SPECIFICATION CHART. USE APPROPRIATE SHIMS TO CORRECT THE ANGLE

ADJUST ANGLES AS NEEDED

OBSERVE THE REAR DRIVE SHAFT OPERATION

1. REMOVE THE FRONT DRIVE SHAFT (MARK THE SHAFT AND AXLE YOKES FOR ASSEMBLY REFERENCE).
2. ROAD TEST WITH THE TRANSFER CASE IN 4H.

NO VIBRATION OR NOTICEABLY REDUCED

NO CHANGE IN THE VIBRATION LEVEL

INSPECT THE FRONT DRIVE SHAFT CONDITION

REPAIR OR REPLACE THE SHAFT

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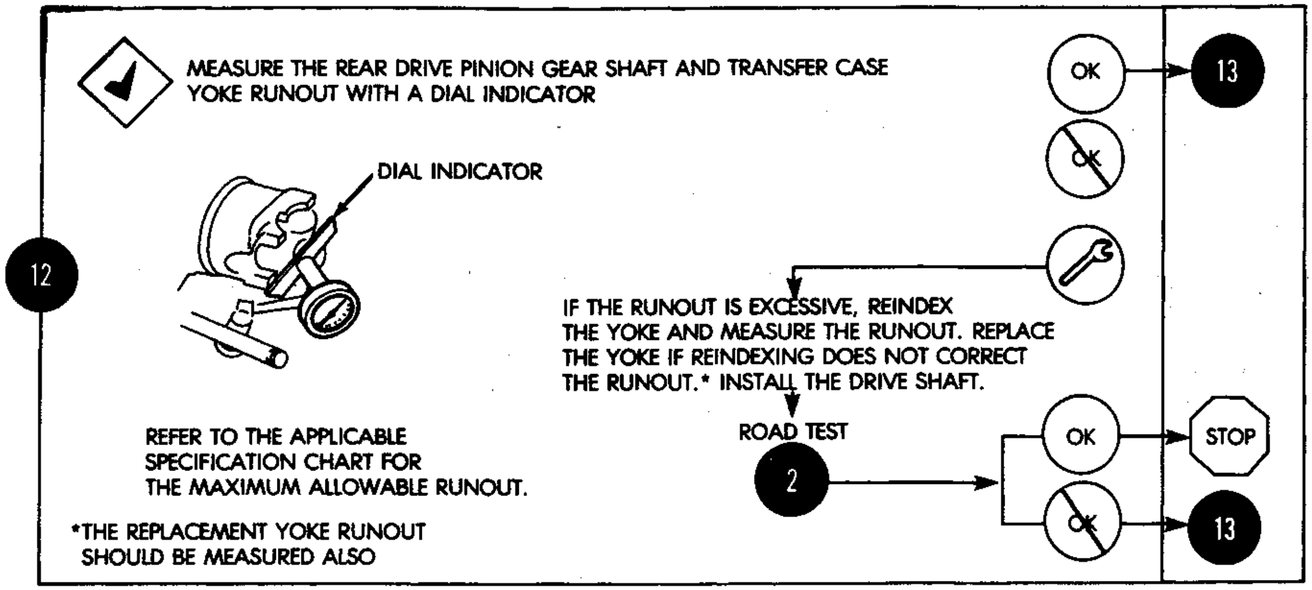
DRIVELINE VIBRATION DIAGNOSIS (CONT'D)

STEP SEQUENCE RESULT

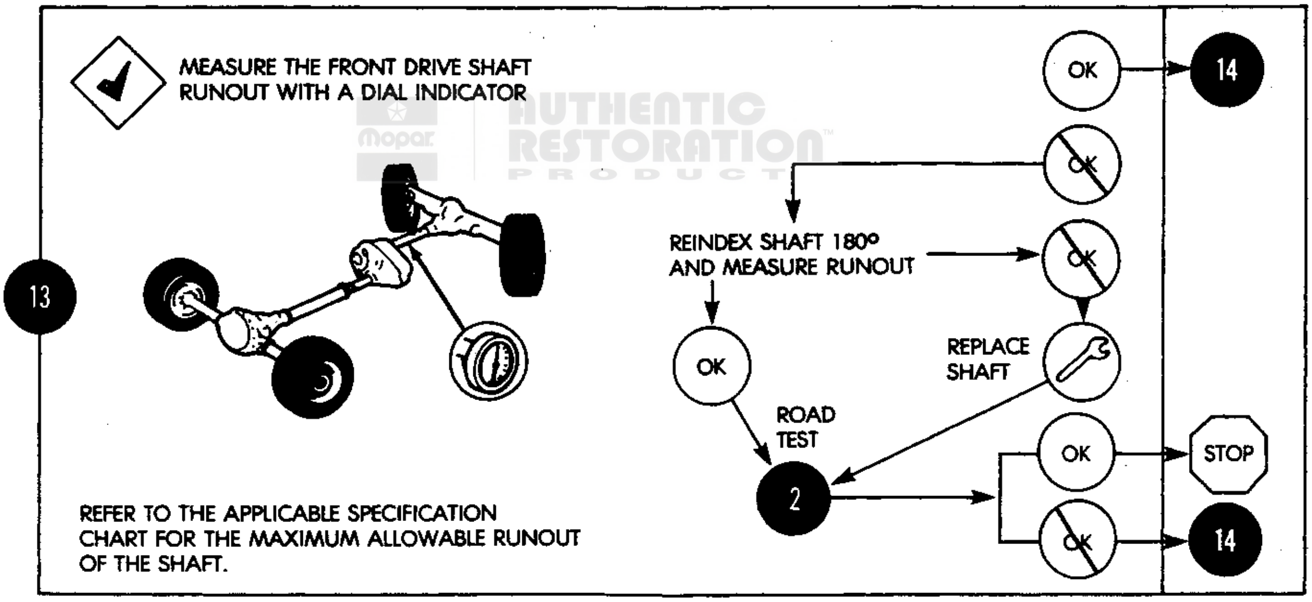


MEASURE THE REAR DRIVE PINION GEAR SHAFT AND TRANSFER CASE YOKE RUNOUT WITH A DIAL INDICATOR

IF THE RUNOUT IS EXCESSIVE, REINDEX THE YOKE AND MEASURE THE RUNOUT. REPLACE THE YOKE IF REINDEXING DOES NOT CORRECT THE RUNOUT.* INSTALL THE DRIVE SHAFT.

REFER TO THE APPLICABLE SPECIFICATION CHART FOR THE MAXIMUM ALLOWABLE RUNOUT.

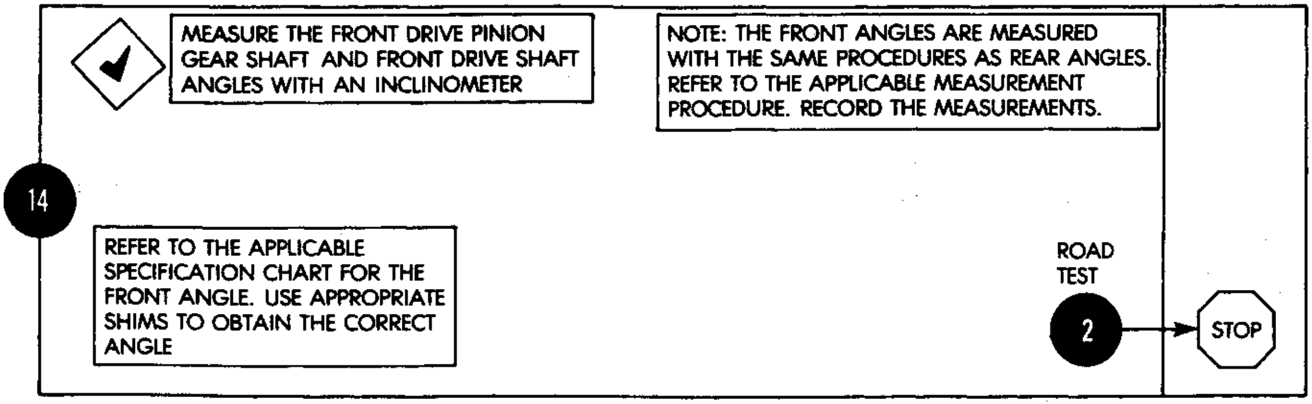
*THE REPLACEMENT YOKE RUNOUT SHOULD BE MEASURED ALSO



MEASURE THE FRONT DRIVE SHAFT RUNOUT WITH A DIAL INDICATOR

REINDEX SHAFT 180° AND MEASURE RUNOUT

REFER TO THE APPLICABLE SPECIFICATION CHART FOR THE MAXIMUM ALLOWABLE RUNOUT OF THE SHAFT.



MEASURE THE FRONT DRIVE PINION GEAR SHAFT AND FRONT DRIVE SHAFT ANGLES WITH AN INCLINOMETER

NOTE: THE FRONT ANGLES ARE MEASURED WITH THE SAME PROCEDURES AS REAR ANGLES. REFER TO THE APPLICABLE MEASUREMENT PROCEDURE. RECORD THE MEASUREMENTS.

REFER TO THE APPLICABLE SPECIFICATION CHART FOR THE FRONT ANGLE. USE APPROPRIATE SHIMS TO OBTAIN THE CORRECT ANGLE

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SERVICE PROCEDURES

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SERVICE INFORMATION

PRECAUTIONS

Drive shafts are balanced by the manufacturer to prevent vibration, therefore, before undercoating a vehicle, the drive shaft and the U-joints should be covered to prevent the undercoating material from attaching to the shaft and the U-joints and causing an unbalanced condition (and vibration).

Replacement of the drive shaft attaching fasteners (e.g., screws, bolts, nuts and clamps) with exact replacements is essential for safe vehicle operation. Always replace the attaching fasteners with those that have identical part numbers (or with equivalent attaching fasteners) when replacement is necessary. In addition, the specified torque must always be applied when tightening the fasteners during drive shaft installation.

LUBRICATION

The rear and front drive shaft single cardan U-joints require periodic lubrication. The single cardan U-joints have a “Zerk” type lubrication fitting located on one bearing cap (Figs. 1 and 2). The front drive shaft slip yoke has a “Zerk” type lubrication fitting located on the tube rearward of the yoke.

The double cardan (CV) joint (Figs. 1 and 2) attached to the front drive shaft (4WD vehicles) is permanently lubricated when assembled during manufacture and does not require additional lubrication during its service life, but it can be lubricated when disassembled (if necessary). The CV joint should be inspected for seal external leakage and damage each time the vehicle is serviced. If seal external leakage or damage exists, the CV joint should be replaced to avoid eventual failure.

For vehicles with an extended wheelbase, the ball-type, center support bearing is permanently lubricated when assembled during manufacture and does not require additional lubrication during its service life.

All CV/U-joints should be inspected for seal external leakage and damage each time the vehicle is serviced. If seal external leakage or damage exists, the U-joint should be repaired/replaced (as applicable) to avoid eventual failure.

An extreme-pressure (EP), lithium-base type lubricant should be used to lubricate all areas that are designated to be lubricated at specified time/distance intervals. Refer to Group 0—Lubrication And Maintenance for additional information involving lubrication.

No adjustments are provided to compensate for wear of the U-joint components. When excessive “play” exists between the spider and the needle bearings, the U-joint or components should be repaired/replaced to avoid eventual failure.

DRIVE SHAFT MEASUREMENTS

UNBALANCE

If drive shaft unbalance is suspected, it can be verified (and the drive shaft balanced) with the following procedure.

(1) Raise and support the vehicle.

(2) Clean all the foreign material from the drive shaft and the U-joints (e.g., mud, road spray, undercoating, etc.).

(3) Inspect the drive shaft for:

- missing balance weights,
- broken welds,
- bent areas, and
- dents.

If the drive shaft tube or yoke is bent, it must be replaced.

(4) Ensure that the U-joint spiders and needle bearings are not worn, that the U-joint bearing caps are properly installed, and that each U-joint is correctly aligned with the shaft (i.e., the yoke is not bent or distorted).

(5) Measure the torque and, if necessary, re-tighten the U-joint clamp screws.

(6) Remove the wheel covers and the wheels/tires. Install the wheel lug nuts to retain the brake drums in place.

(7) Mark the drive shaft tube at four positions spaced at 90° intervals around the circumference of the tube (approximately six inches inward from the

yoke weld at the axle end of the drive shaft tube). Number the marked positions 1 through 4.

(8) Connect a tachometer to the engine ignition. Start the engine, shift the transmission into forward gear and accelerate the engine until vibration occurs. Note the amount (intensity) of vibration, observe the tachometer and note the engine speed (rpm) at which the vibration occurred. Stop the engine.

(9) Install and tighten a "worm-drive screw" type hose clamp on the drive shaft with the screw located at **position "1"** (Fig. 5).

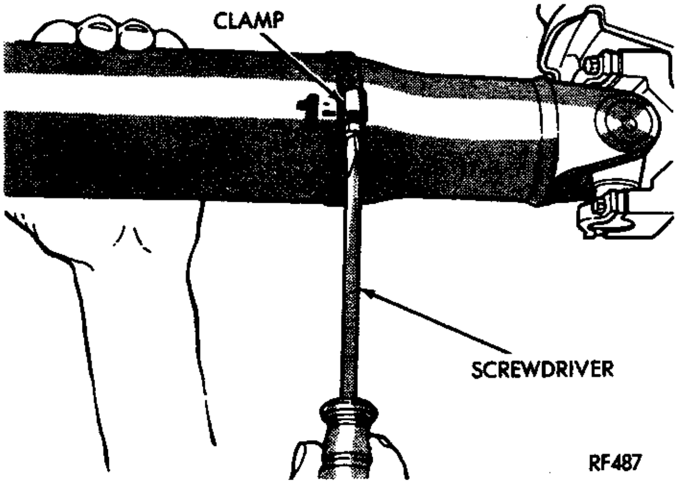

Fig. 5 Clamp Screw At Position "1"

(10) Start the engine, shift the transmission into forward gear and accelerate the engine to the speed (rpm) at which the vibration occurred (above).

(11) Compare the amount (intensity) of vibration to the initial amount (intensity) of vibration. If there is little or no change in the vibration, move the clamp screw to one of the other three marked positions and repeat the vibration test.

(12) If no difference in the amount (intensity) of vibration is detected with the clamp screw located at all four positions, the vibration possibly is not be caused by drive shaft unbalance.

(13) If the amount (intensity) of vibration decreased (but was not completely eliminated) with the clamp screw located at one of the marked positions, install a second clamp on the drive shaft tube with the screw adjacent to the first clamp screw (Fig. 6) and repeat the vibration test.

(14) The combined weight of two clamp screws at the same position could cause an additional unbalanced condition. If so, separate the clamp screws approximately 1/2 inch (1/4 inch above and 1/4 inch below the marked position) and repeat the vibration test (Fig. 7).

(15) Continue to increase the separation distance between the clamp screws and repeat the vibration test until the amount (intensity) of vibration is at the lowest level. Bend the loose end of the clamps so that the clamp screws will not loosen.

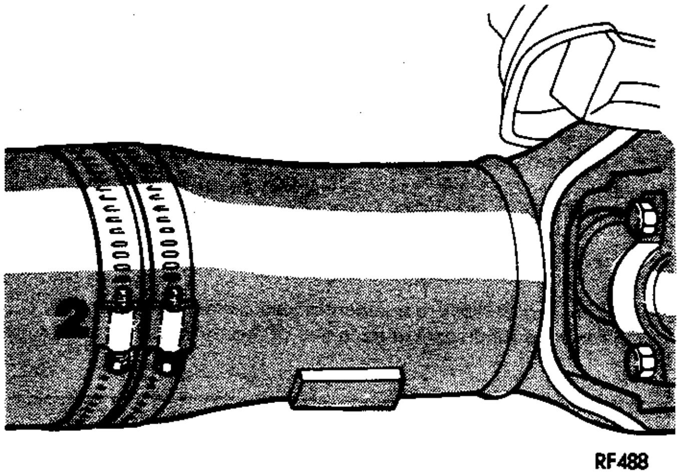

Fig. 6 Two Clamp Screws At The Same Position

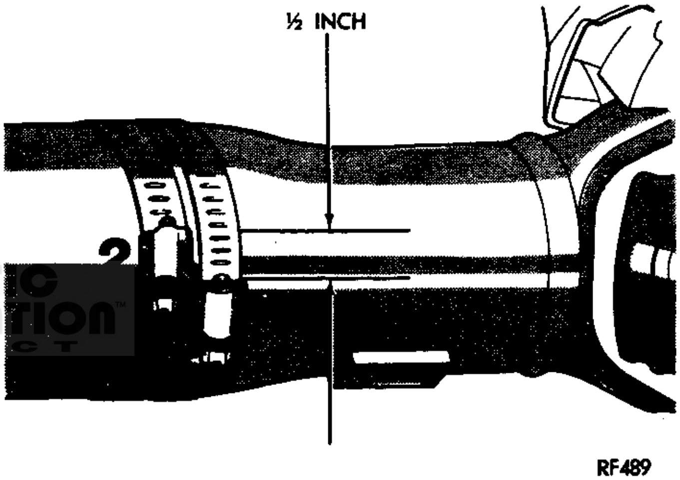

Fig. 7 Clamp Screws Separated

(16) Install the wheels/tires and the wheel covers. Remove the supports, lower the vehicle and road test.

(17) If the amount (intensity) of vibration remains unacceptable, apply the same instructions (above) at the front end of the drive shaft.

RUNOUT

(1) Remove all dirt, rust, paint, and undercoating from the drive shaft tube surface areas where the dial indicator plunger will contact the surface of the drive shaft tube.

(2) The dial indicator must be installed perpendicular to the shaft tube surface and must be firmly attached to a fixed surface to prevent inaccurate measurements.

(3) Measure the drive shaft runout at the center and at both ends of the shaft tube with the dial indicator.

(4) Refer to the Drive Shaft Runout Specifications chart.

(5) Replace the drive shaft if the runout exceeds the specified limit at either the front, center or rear of the shaft tube.

DRIVE SHAFT RUNOUT SPECIFICATIONS
RAM TRUCK AND RAMCHARGER VEHICLES

Front of shaft	0.015 in. (0.38 mm)
Center of shaft	0.015 in. (0.38 mm)
Rear of shaft	0.015 in. (0.38 mm)

NOTE: Measure front/rear runout approximately 3 inches (76 mm) from the weld seam at each end of the shaft tube.

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U-JOINT YOKE BORE ALIGNMENT MEASUREMENT

SERVICE INFORMATION

Correct cross-alignment of the front U-joint slip yoke bores, both shaft yoke bores and the drive pinion gear shaft yoke "saddles" is very important to prevent drive shaft vibration, U-joint wear and other vehicle performance problems. Before measuring the drive shaft vertical and horizontal angles for possible mis-alignment, it is necessary to determine that all the individual yoke bores are correctly cross-aligned (i.e., "true" from bore-to-bore). **Also, ensure that the axle drive pinion gear shaft yoke nut is tightened correctly (i.e., the bearing "preload" torque is correct).**

The center lines of the U-joint spider bearing bores in both yoke arms (for drive shafts tubes that have welded yokes at each end) are permanently aligned (i.e., the bores are fixed in the same plane) during manufacture.

When a drive shaft has external splines at one end (instead of a yoke) that mate with an internally-splined slip yoke, the slip yoke must be installed so that the center line of its spider bearing bores in the yoke arms is aligned (i.e., in the same plane) with the center line of the welded yoke arm bores at the opposite end of the drive shaft tube. The yoke arm bore alignment is accomplished by having a double-width master spline (tooth) within the drive shaft external splines that mates (indexes) with a double-width space within the slip yoke internal splines.

A drive shaft with a slip yoke is correctly aligned when the yoke arms (and bores) at each end of the shaft are in the same plane (Fig. 8).

MEASUREMENT WITH A GAUGE BAR

Use a straight piece of round, stock metal with the same outside diameter (OD) as the yoke bore diameter for a "slip fit" gauge bar.

(1) Remove the bearing caps and the spider from the yoke. If necessary, refer to **U-Joint Service** for the procedure.

(2) Insert the gauge bar into one yoke arm bore (or "saddle") and continue it to the other yoke arm bore (or "saddle").

(3) If the gauge bar will "slip fit" through both yoke bores (or "saddles") simultaneously, the bores are properly cross-aligned (i.e., "true") and the yoke arms are not distorted, twisted or otherwise misaligned.

(4) When the gauge bar passes through one yoke arm bore (or "saddle"), but then contacts the inner face of the opposite yoke arm, the yoke arms are misaligned (i.e., distorted or twisted) and the yoke (or drive shaft) must be replaced.

MEASUREMENT WITH A PROTRACTOR

In the event a gauge bar with the correct diameter is not available, yoke mis-alignment can be measurement with a level protractor according to the following instructions.

(1) Remove the burrs or nicks from the yoke arm outer surfaces and the machined surface of the needle bearing caps.

(2) Rotate the yoke so that the bores in the arms are horizontal.

(3) Position the level protractor vertically on one yoke arm outer surface (or on the machined surface of a bearing cap) and adjust the protractor so that the scale indicates zero or 90 degrees when the bubble is centered between the two marks on the tube.

(4) Position the level protractor at same location on the opposite yoke arm (or bearing cap) and note the position of the bubble.

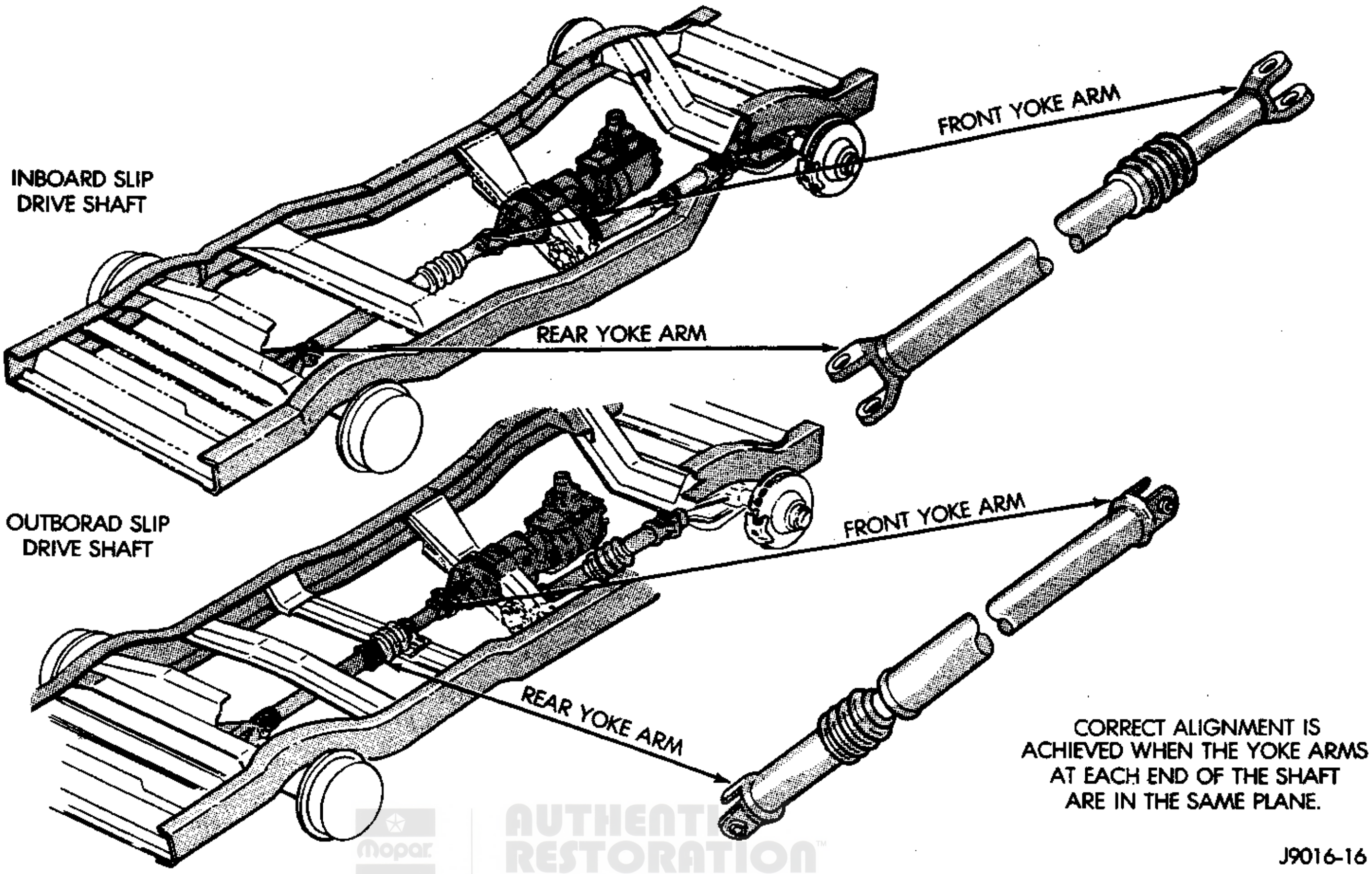
(5) If necessary, adjust the scale so that the bubble is exactly between the marks on the tube, and, if the bubble moves more than 1/2 of-a-degree, the yoke is likely to be distorted and should be replaced.

DRIVE SHAFT OPERATING ANGLE MEASUREMENT AND ADJUSTMENT

VERTICAL ANGLES (ONE-PIECE DRIVE SHAFT)

MEASUREMENT

(1) Shift the transmission into NEUTRAL position.



CORRECT ALIGNMENT IS ACHIEVED WHEN THE YOKE ARMS AT EACH END OF THE SHAFT ARE IN THE SAME PLANE.

Fig. 8 Drive Shaft Yoke Arm Bores Aligned In Same Plane

(2) Raise the vehicle on a twin post or a similar type hoist that will support the vehicle at the axles and allow the wheels to be rotated.

If a drive-on type (platform) hoist is used, place support stands under each axle shaft tube and lower the hoist until the wheels will rotate freely.

(3) Rotate the rear drive shaft until one of the drive pinion gear shaft (axle) yoke bearing caps is facing downward.

(4) Attach the magnet of an inclinometer on the bearing cap and note the angle (Fig. 9). This is the axle drive pinion gear shaft angle.

(5) Rotate the rear drive shaft until one of the shaft rear yoke bearing caps is facing downward.

(6) Attach the inclinometer magnet to the bearing cap and note the angle.

The inclinometer frame and degree scale must face the same direction (i.e., either vehicle-left or vehicle-right) for both measurements.

(7) The difference between the two angles is the drive shaft rear angle "B" (Fig. 10).

(8) Rotate the drive shaft until one of the slip yoke bearing caps is facing downward.

(9) Attach the inclinometer magnet to the bearing cap and note the angle (Fig. 11). This is the transmission output shaft angle.

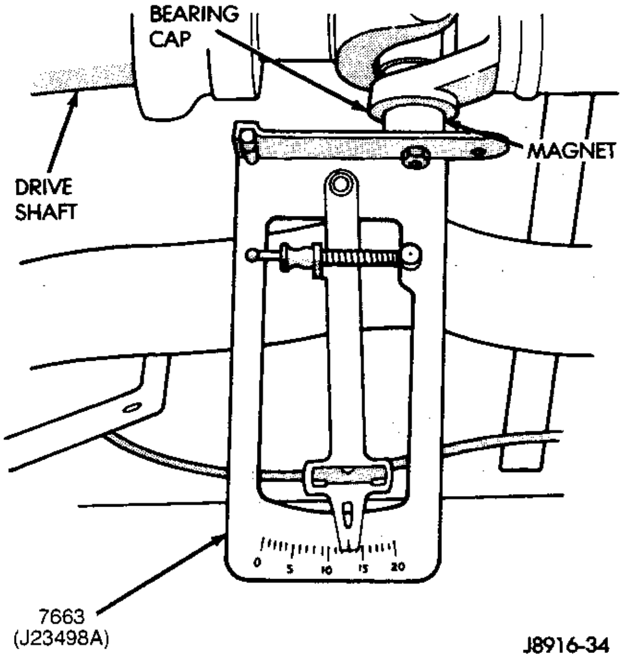


Fig. 9 Drive Pinion Gear Shaft Angle Measurement

(10) Rotate the rear drive shaft until one of the shaft front yoke bearing caps is facing downward.

(11) Attach the inclinometer magnet to the bearing cap and note the angle.

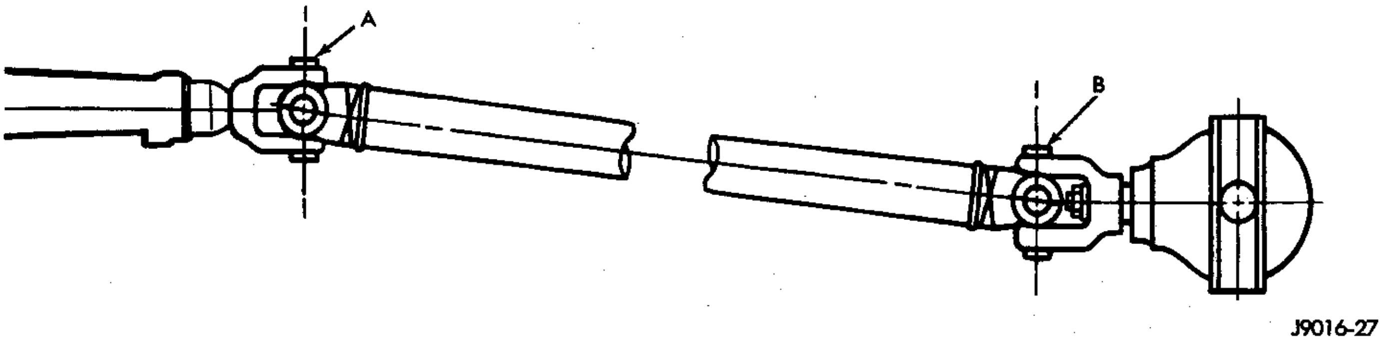


Fig. 10 Drive Shaft Front & Rear Angles

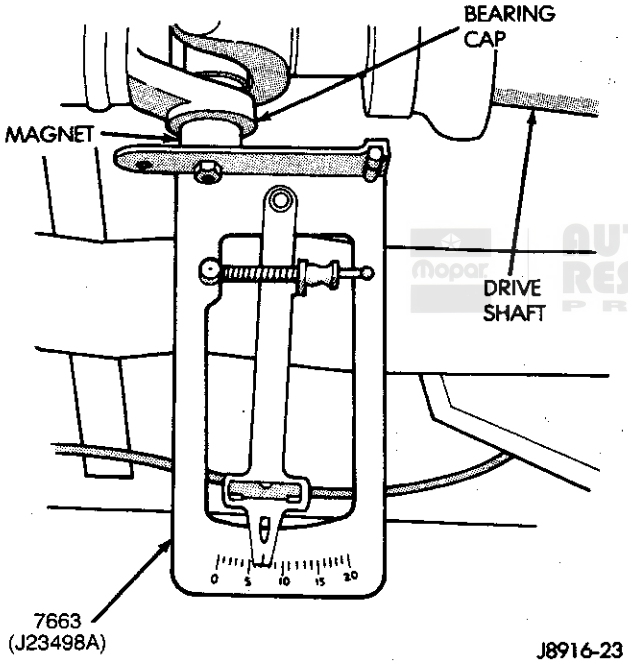


Fig. 11 Transmission/Transfer Case Output Shaft Angle Measurement

The inclinometer frame and degree scale must face the same direction (i.e., either vehicle-left or vehicle-right) for both measurements.

(12) The difference between the two angles is the drive shaft front angle "A" (Fig. 10).

(13) Compare the drive shaft rear angle "B" and the front angle "A" (Fig. 10). The difference between the two angles is the drive shaft vertical angle (i.e., angle "A" minus angle "B").

(14) The drive shaft vertical angle should be a maximum of plus or minus one degree (±1°); otherwise, the drive shaft is vertically misaligned. If necessary, adjustment of the axle drive pinion gear shaft vertical angle will normally correct the misalignment. The adjustment is accomplished by installing tapered shims between the rear springs and the axle spring pads.

(15) If the drive shaft vertical angle is correct, the axle drive pinion gear shaft angle should also be correct.

(16) An incorrect drive shaft vertical angle is generally caused by rear axle drive pinion gear shaft yoke mis-alignment. If the drive pinion gear shaft yoke is mis-aligned, inspect for loose spring-to-axle U-bolts, which would allow the axle tubes to rotate on the springs. Also, inspect for broken springs, and worn spring shackles, brackets and bushings. Repair or replace as necessary to correct the mis-alignment.

VERTICAL OPERATING ANGLES (TWO-PIECE DRIVE SHAFT)

All of the drive shaft U-joints must operate at the correct angle to prolong the life of the bearings. The U-joint operating angles will differ according to the half-shaft length. Also, the front half-shaft must be parallel to the rear axle drive pinion gear shaft.

The front half-shaft and the rear half-shaft must be offset by a minimum of 1/2 of-a-degree from the transmission/transfer case output shaft and from each other.

The center U-joint operating angle can be adjusted by replacing the center bearing support. Adjusting the rear U-joint operating angle is accomplished by installing tapered shims between the rear springs and the of rear axle spring pads.

MEASUREMENT

(1) Shift the transmission to the NEUTRAL position.

(2) Raise the vehicle on a twin post or a similar type hoist that will support the vehicle at the axles and allow the wheels to be rotated.

If a drive-on type (platform) hoist is used, place support stands under each axle shaft tube and lower the hoist until the wheels will rotate freely.

(3) Rotate the rear drive shaft until the transmission/transfer case yoke is in the vertical position (Fig. 12).

(4) Place a level protractor on the front yoke and bearing cap "A" (parallel to the drive shaft). Adjust the protractor so the bubble in spirit level is centered. Note the angle on the protractor scale.

(5) Repeat the same measurement procedure (above) for the center yoke and bearing cap "B", and for the rear yoke and bearing cap "C". Note both angles on the protractor scale.

(6) Excessive variation in measured angles "A", "B" and "C" indicates drive shaft vertical mis-alignment. The vertical alignment of two-piece drive shafts at the yokes should be greater than one-half degree (1/2°) and retained as close to one degree (1°) as possible.

(7) Drive shaft vibration that is not associated with unbalance or "runout" (e.g., decreasing or increasing as engine speed increases) is highly responsive to rear axle drive pinion gear shaft yoke angle adjustment. This includes the center bearing support length adjustment for two-piece drive shafts.

(8) Adjustment of the drive pinion gear shaft yoke vertical angle is accomplished by installing tapered shims between the rear springs and the rear axle spring pad, and/or correcting the center bearing support bracket length.

VERTICAL ANGLE ADJUSTMENT

The drive shaft vertical angle (i.e., angle "A" minus angle "B", Fig. 10) is controlled by the axle drive pinion gear shaft angle. The axle drive pinion gear shaft angle is adjusted between the rear springs and the axle with tapered shims. Tapered shims are commercially available from automotive parts supply sources.

If the vertical angle is not correct at the transmission (or transfer case) and the vehicle is equipped with a two-piece drive shaft, the center bearing support should be inspected for the correct length. Shims can be inserted between the support bracket and frame crossmember to correct mis-alignment, if necessary.

If angle "A" minus angle "B" is greater than one degree positive (>+1°), angle "B" (Fig. 10) is too small and must be increased.

When angle "B" (Fig. 10) is too small, it can be increased by decreasing the axle drive pinion gear shaft angle.

If angle "A" minus angle "B" is greater than one degree negative (>-1°); angle "B" (Fig. 10) is too large and must be decreased.

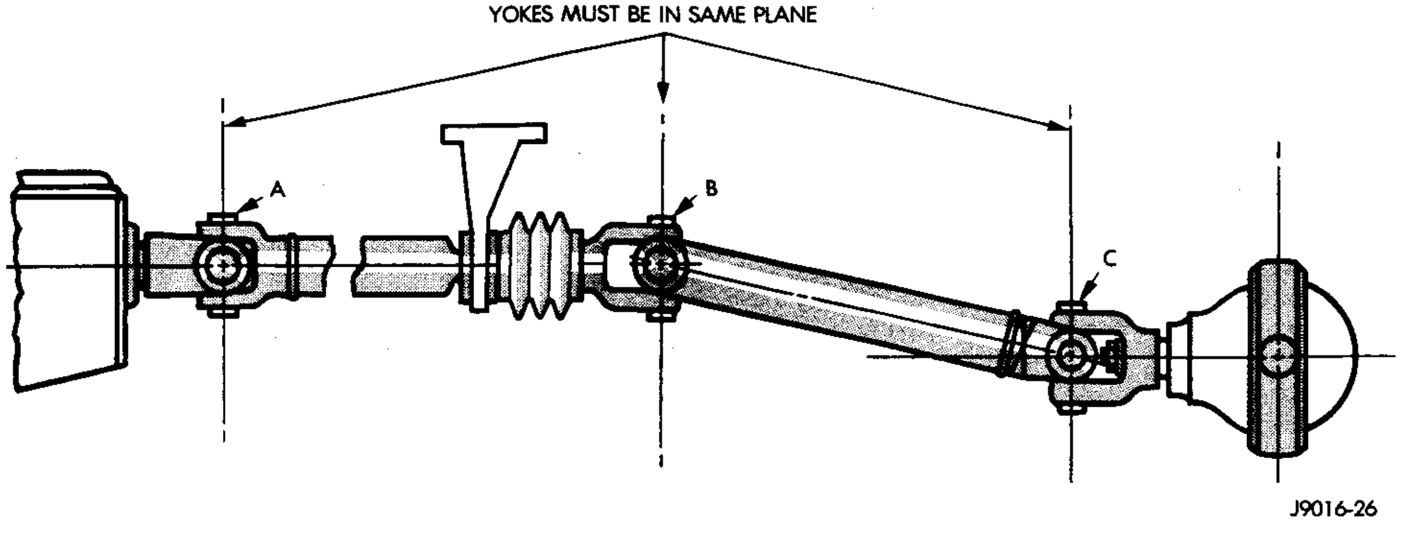


Fig. 12 Vertical Angle Measurement—Two-Piece Drive Shaft

When angle "B" (Fig. 10) is too large, it can be decreased by increasing the axle drive pinion gear shaft angle.

(1) Raise the rear of the vehicle and place support stands under the frame.

(2) Position a hydraulic jack under the differential housing and raise the jack just enough to support the weight of the axle.

(3) Remove the rear wheels/tires.

(4) Loosen the spring U-bolt nuts.

(5) Install tapered shims (with the required degree of taper) between the springs and the axle spring pads according to the following instructions:

- if angle "B" (Fig. 10) must be increased (i.e., the axle drive pinion gear shaft angle decreased), install the adjustment shims so that the thick end of each shim is facing the front of the vehicle; and
- if angle "B" (Fig. 10) must be decreased (i.e., the axle drive pinion gear shaft angle increased), install the adjustment shims so that the thick end of each shim is facing the rear of the vehicle.

(6) Tighten the spring U-bolt nuts:

- Model 150 and 250 vehicles — 61 N•m (45 ft-lbs) torque; and
- Model 350 vehicles — 149 N•m (110 ft-lbs) torque.

(7) Remove the hydraulic jack, install the wheels/tires, remove the support stands and lower the vehicle.

(8) Tighten the wheel lug nuts with the specified torque. Refer to the Torque Specifications chart at the end of Group 22—Tires And Wheels for the correct torque value.

HORIZONTAL ANGLES

If the drive shaft horizontal angle is not zero degrees (i.e., the front and rear U-joints are not in perfect longitudinal alignment), the fault is normally caused by rear axle misalignment. Drive shaft vibration can also result from rear axle misalignment.

FRONT YOKE MEASUREMENT

Horizontal drive shaft alignment is as important as vertical alignment. The required tools are:

- straightedge that is 20 to 40 inches (508 to 1016 mm) longer than the rear wheel track (i.e., the vehicle width);
- short straightedge;
- two large and two small C-clamps;
- rigid tape measure; and
- large carpenter's square.

(1) Inspect the condition of the engine rear mounts. Worn/loose engine or transmission/transfer case mounts could cause misalignment and cause an erroneous measurement.

(2) Position the vehicle on level surface or level the vehicle (to eliminate the possibility of an incorrect measurement).

(3) Clamp the long straightedge at right (90°) angles to the frame rails (Fig. 13). To verify, measure the 90 degree angle with the large carpenter's square.

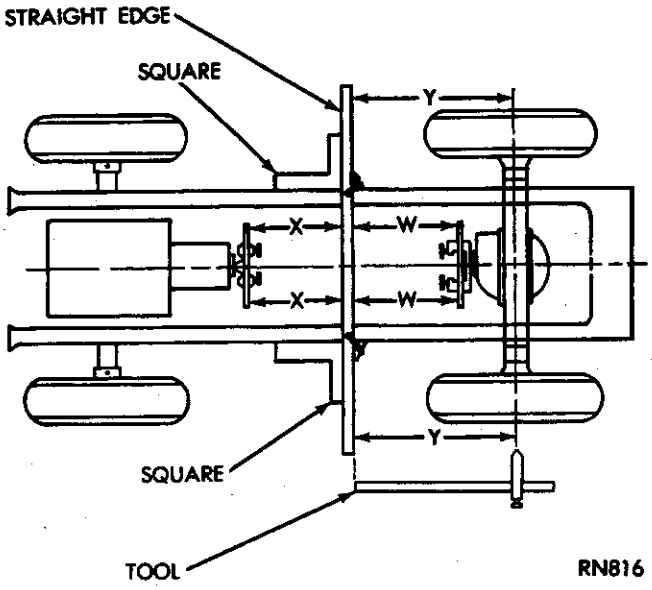


Fig. 13 Horizontal Alignment Measurement

(4) Clamp a short straightedge to the front yoke arms so that it is parallel to the surface (Fig. 13). Verify that the straightedge is level with a spirit level. It must be exactly level for accurate measurements.

(5) Measure the distance "X" between the two straightedges from both ends of the short straightedge with the tape measure (Fig. 13). The tape must be held parallel to the sides of vehicle frame rail.

(6) The two lengths should be within 1/16 of-an-inch (1.58 mm) of each other. If they are not, the drive shaft front yoke is not properly aligned.

(7) The Horizontal alignment of the transmission/transfer case yoke can be measured in same manner as described above, however, substitute a straight piece of round bar stock for the short straightedge. Ensure that the bar fits "snug" in yoke arm bores. Otherwise, drive a wooden wedge between the bar and the yoke shaft.

REAR AXLE AND AXLE YOKE HORIZONTAL MEASUREMENT

When a vehicle does not track straight (i.e., "dog-tracks"), rear axle mis-alignment is a common cause. The mis-alignment usually results from loose spring U-bolt nuts, which allows the spring center bolt to be "sheared-off" and the axle spring pad to shift forward or rearward on the adjacent spring leaf. The existence of rear axle mis-alignment can be determined by accurately measuring the distance from a fixed point on the frame rail to the center line of the axle shaft tube on each side of the vehicle. If the measured distances are not the same (or nearly the same), the axle is mis-aligned. Axle alignment requires repair or replacement of the spring and tightening the U-bolt nuts with the correct torque.

Three causes of axle horizontal mis-alignment are possible:

- loose or sheared spring center bolt,
- loose spring clips, and
- loose spring shackle brackets.

(1) Before inspecting the drive pinion gear shaft (axle) yoke for horizontal mis-alignment, measure the rear wheel axle horizontal alignment. A measurement tool can be fabricated from a drill rod.

(2) Fabricate the tool from a long piece of 1/2-inch (12.7-mm) diameter drill rod and a short piece of 3/4-inch (19-mm) diameter rod with one end ground to a point (Fig. 13.)

(3) Drill a 1/2-inch (12.7-mm) diameter hole through the 3/4 -inch (19-mm) diameter rod near the end opposite the point to accommodate the 1/2-inch (12.7-mm) diameter rod. Drill and tap with threads an intersecting hole at the same end of the rod to allow the use of a small set screw (Fig. 13).

(4) Measure the distance "Y" from the straightedge to the center of the rear axle tube at each side of the vehicle with the fabricated measuring tool (Fig. 13). If the distances vary more than approximately 1/8 of-an-inch (3 mm), inspect for one or more of the three possible causes of axle horizontal mis-alignment.

(5) Clamp the short straightedge to the drive pinion gear shaft (or use a round bar and a wedge if the pinion gear shaft is equipped with a yoke), so that the straightedge/bar is parallel to the surface (Fig. 13). Verify that the straightedge/bar is level with a spirit level.

(6) Measure the distance "W" between the two straightedges (or straightedge and bar) at each end of the short straightedge/bar with the tape measure (Fig. 13). Ensure that the tape is held parallel to the frame rail.

(7) The two distances should be within 1/16 of-an-inch (1.58 mm) of each other. In the event that they are not, the yoke is mis-aligned and should be replaced.

DRIVE SHAFT—REMOVAL/INSTALLATION

ONE-PIECE REAR DRIVE SHAFT—REMOVAL

There are two types of one-piece drive shafts:

- outboard slip yoke type—used with Model D-150, D-250 and D-350 vehicles equipped with a transmission extension housing; and
- inboard slip yoke type—used with Model W-150, W-250 and W-350 vehicles (i.e., vehicles equipped with a transfer case).

(1) Raise and support the vehicle.

(2) Mark the drive shaft and the rear axle drive pinion gear shaft yoke (Fig. 14) for installation alignment reference.

CAUTION: Do not allow the drive shaft to drop or hang from either U-joint during removal. Either attach it to the vehicle underside with wire or otherwise support the loose end of the drive shaft to prevent damage to the U-joints.

(3) Remove the rear U-joint attaching screws and both strap clamps from the rear axle drive pinion gear shaft yoke (Fig. 14).

(4) Before removing the drive shaft slip yoke from the transmission/transfer case output shaft (Fig. 14), the vehicle front end should be lowered slightly to prevent loss of transmission/transfer case fluid.

(5) Remove the drive shaft slip yoke from the transmission/transfer case output shaft yoke (Fig. 14) and remove the drive shaft from the vehicle. **Use care to prevent damage to the protective boot (and the drive shaft and slip yoke splines).**

(6) Examine the protective boot for evidence of damage. If no damage is apparent, do not disturb the boot.

CAUTION: It is very important to protect the machined, external boot contact sealing surface on the slip yoke and the drive shaft (Fig. 14)) from damage after the drive shaft has been removed from the vehicle. Otherwise the boot possibly will not seal properly on a rough, scored/scratched surface.

ONE-PIECE REAR DRIVE SHAFT—INSTALLATION

(1) Raise and support the vehicle.

CAUTION: Do not allow the drive shaft to drop or hang from either U-joint during installation. Either attach it to the vehicle underside with wire or otherwise support the loose end of the drive shaft to prevent damage to the U-joints.

(2) Visually align the drive shaft and drive pinion gear shaft (axle) yoke installation reference marks and connect the drive shaft slip yoke to the transmission/transfer case output shaft yoke (Fig. 14).

(3) Position the drive shaft rear U-joint spider and bearing caps in the rear axle drive pinion gear shaft yoke "saddles" (Fig. 14). Install the strap clamps and screws. Tighten the clamp screws with 19 N•m (14 ft-lbs/170 in-lbs) torque.

(4) Remove the supports and lower the vehicle.

TWO-PIECE REAR DRIVE SHAFT—REMOVAL

(1) Raise and support the vehicle.

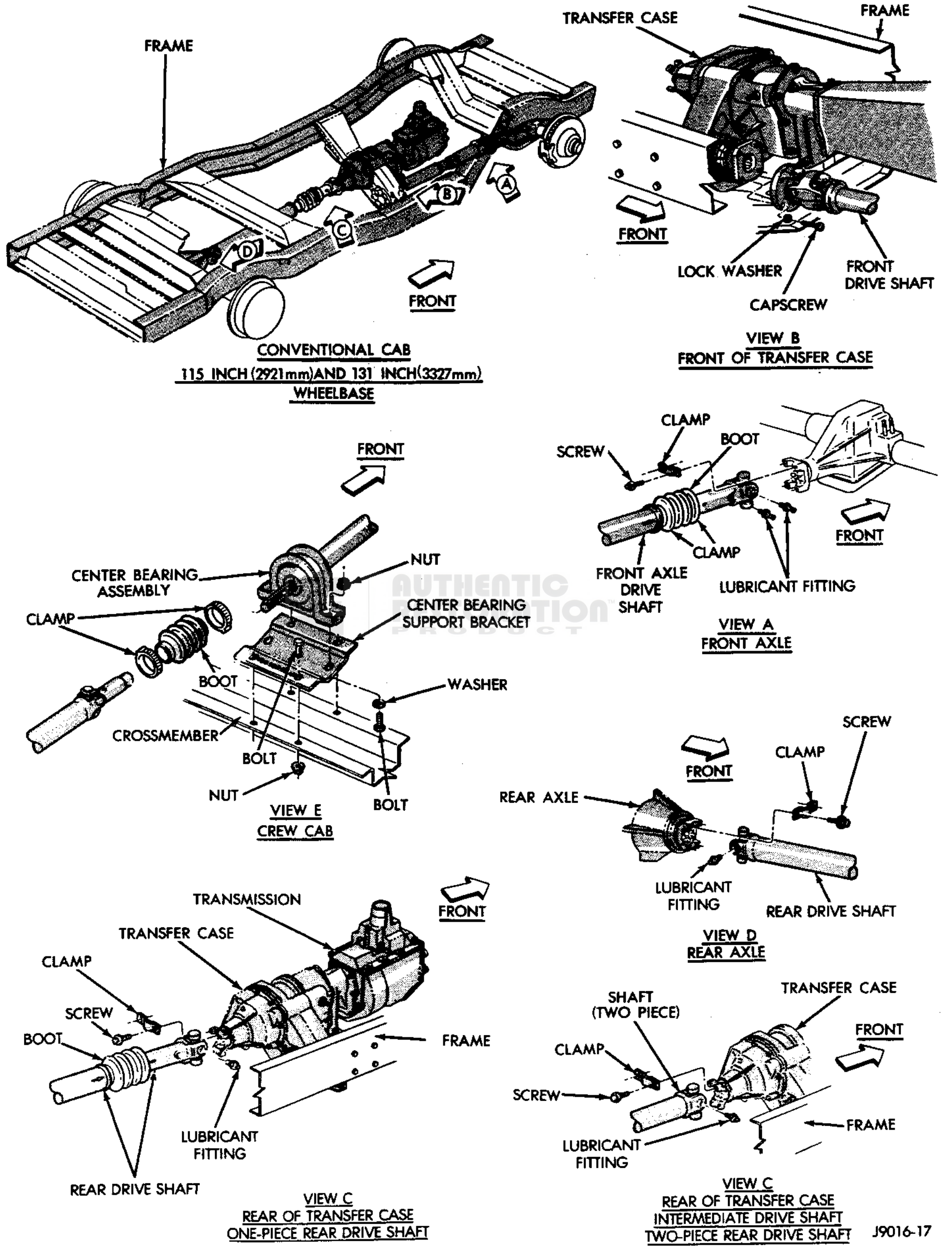


Fig. 14 Drive Shaft Components

(2) Mark the drive shaft and the rear axle drive pinion gear shaft yoke for installation alignment reference.

CAUTION: Do not allow the drive shaft to drop or hang from either U-joint during removal. Either attach it to the vehicle underside with wire or otherwise support the loose end of the drive shaft to prevent damage to the U-joints.

CAUTION: Do not disturb the retaining strap used to retain bearing caps on the rear U-joint spider, if equipped.

(3) Remove the rear U-joint clamp screws and both strap clamps from the rear axle drive pinion gear shaft yoke (Fig. 14).

(4) Detach the protective boot clamp from the front half-shaft splines and slide the rear half-shaft slip yoke from the front half-shaft at the center bearing. Remove the rear half-shaft from the vehicle (Fig. 15).

(5) Examine the protective boot (Fig. 15) for evidence of damage. If no damage is apparent, do not disturb the clamp or boot.

(6) If necessary, detach the protective boot clamp and remove the boot from the rear half-shaft slip yoke tube (Fig. 15).

(7) Mark the yokes at the transmission/transfer case (Fig. 14) for installation alignment reference and remove the clamp retaining screws and strap clamps (or flange nuts if equipped with a brake).

(8) Remove the two center bearing support-to-bracket retaining nuts and bolts (Fig. 15) and remove the front half-shaft (with the center bearing) from the vehicle.

TWO-PIECE REAR DRIVE SHAFT—INSTALLATION

(1) Clean and lubricate the front half-shaft and rear half-shaft slip yoke splines.

(2) Position the front end of the front half-shaft at the transmission/transfer case (Fig. 14) and start the clamp screws at the front yoke and the retaining bolts and nuts at the center bearing support and bracket (Fig. 14).

(3) As applicable, tighten 1/4-inch diameter clamp screws with 19 N•m (170 in-lbs) torque or tighten 5/16-inch diameter clamp screws with 34 N•m (25 ft-lbs/300 in-lbs) torque. If equipped with a brake, tighten the universal flange nuts with 47 N•m (35 ft-lbs) torque. "Finger-tighten" the center bearing support-to-bracket nuts and bolts.

(4) If removed/replaced, slide the protective boot over the rear half-shaft slip yoke tube. Install and crimp the clamp around the yoke tube. Align the master spline with the corresponding wide space and slide the rear half-shaft slip yoke internal splines over the front half-shaft external splines (Fig. 15). Slide the boot forward over the front half-shaft splines and crimp the clamp around the splines.

Because of the master spline in the front half-shaft splines and the corresponding wide space in the slip yoke splines, the externally splined front half-shaft and the internally splined rear

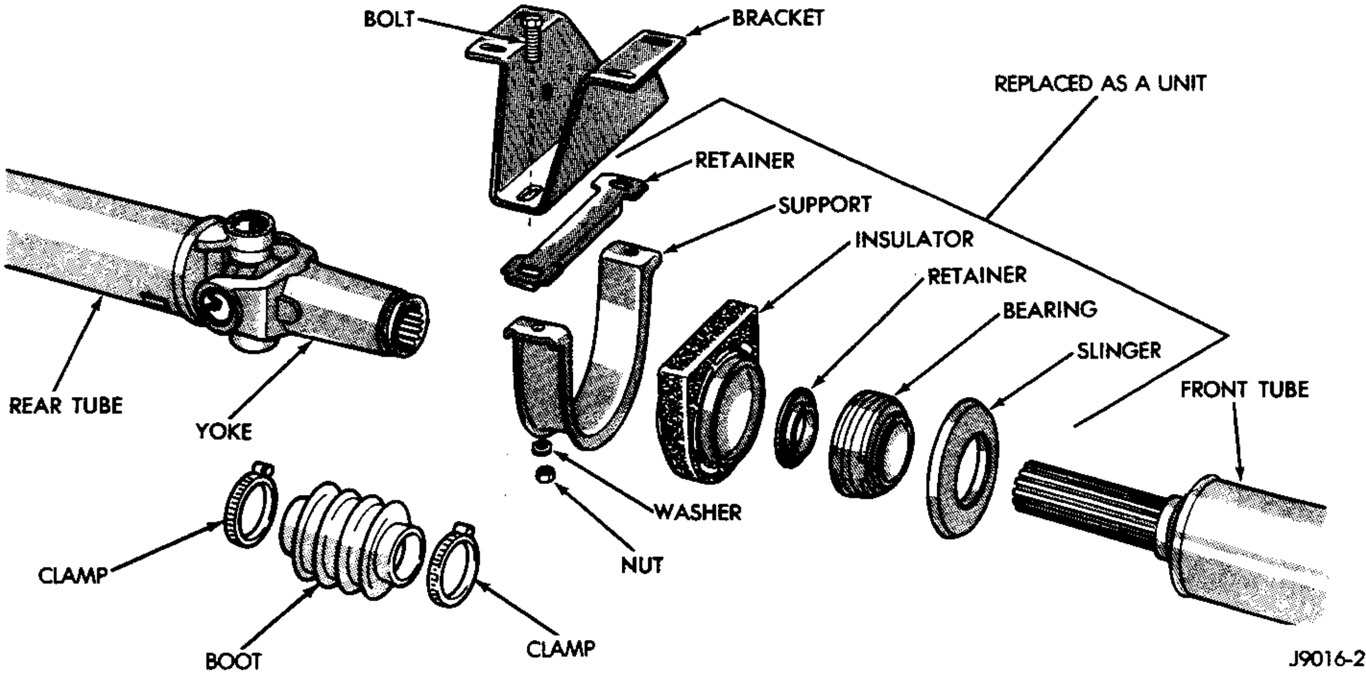


Fig. 15 Half-Shafts & Center Bearing

half-shaft slip yoke can be mated only at one correctly aligned position (Fig. 15).

(5) Align the installation reference marks and position the rear U-joint spider in the axle yoke saddles (Fig. 14).

(6) Install the U-joint strap clamps and screws (Fig. 14).

(7) As applicable, tighten 1/4-inch diameter clamp screws with 19 N•m (170 in-lbs) torque or tighten 5/16-inch diameter clamp screws with 34 N•m (25 ft-lbs/300 in-lbs) torque.

(8) Raise the rear wheels from the surface and rotate the drive shaft via the engine. This will allow the center bearing to self-align in the bearing support (Fig. 15). After the bearing is aligned in the support, tighten the support-to-bracket retaining nuts and bolts with 68 N•m (50 ft-lbs) torque.

(9) Remove the supports and lower the vehicle.

FRONT DRIVE SHAFT (4WD)—REMOVAL

(1) Raise and support the vehicle.

(2) Remove the skid plate, if equipped.

(3) Mark the drive shaft front yoke and the front axle drive pinion gear shaft yoke (Fig. 14) for installation alignment reference.

CAUTION: Do not allow the drive shaft to drop or hang from the CV joint or the U-joint during removal. Either attach it to the vehicle underside with wire or otherwise support the loose end of the drive shaft to prevent damage to the CV/U-joints.

(4) Remove the CV joint-to-transfer case flange capscrews and lockwashers.

If necessary, utilize a press bar to prevent the CV joint from rotating while removing the four capscrews.

(5) Remove the front U-joint clamp screws and both strap clamps from the front axle drive pinion gear shaft yoke (Fig. 14). **Do not disturb the retaining strap used to retain bearing caps on the U-joint spider, if equipped.**

(6) Remove the front drive shaft from the vehicle.

FRONT DRIVE SHAFT (4WD)—INSTALLATION

The drive shaft yoke arms at each end of the shaft, with the U-joint spider and bearings installed, must be in the same plane.

(1) Before installing the drive shaft, wipe the slip yoke clean, inspect the machined surface for scratches, nicks and burrs. Do not damage the splines when engaging the yoke.

(2) Provide a support for the drive shaft during installation to prevent damage to the CV/U-joints.

(3) Visually align the drive shaft front U-joint and drive the drive pinion gear shaft (axle) yoke installation reference marks and correctly mate the drive shaft CV-joint yoke with the transfer case output shaft yoke (Fig. 14).

(4) Install the CV-joint yoke-to-transfer case output shaft yoke capscrews (Fig. 14) and tighten them with 34 N•m (25 ft-lbs) torque.

(5) Position the drive shaft front U-joint spider and bearing caps in the front axle drive pinion gear shaft yoke "saddles" (Fig. 14). Install the strap clamps and screws. Tighten the clamp screws with 19 N•m (14 ft-lbs/170 in-lbs) torque.

(6) Remove the supports and lower the vehicle.

SLIP YOKE SERVICE

REMOVAL

(1) Remove the drive shaft from the vehicle. If necessary, refer to the removal procedure.

(2) Remove the clamps and the protective boot from the drive shaft.

(3) Separate the slip yoke from the drive shaft.

CLEANING AND INSPECTION

(1) Clean all foreign material and lubricant from the slip yoke shaft, the slip yoke shaft splines and the drive shaft splines with an appropriate cleaning fluid and brush.

(2) Inspect the slip yoke splines for excessive wear and evidence of being "twisted".

(3) Inspect the clearance ("backlash") between the slip yoke shaft splines and drive shaft splines.

(4) The slip yoke must be replaced if the spline "backlash" is excessive.

(5) Inspect the protective boot for excessive wear, punctures and rips/tears. Replace if not satisfactory for reuse.

INSTALLATION

(1) Apply a coat of lubricant to the shaft splines as specified in Group 0—Lubrication And Maintenance.

(2) Position the boot and the clamp over the drive shaft splines. Crimp the clamp on the drive shaft.

(3) Engage the slip yoke and the drive shaft splines.

(4) Position the boot over the slip yoke and crimp the clamp on the slip yoke.

REAR DRIVE SHAFT CENTER BEARING SERVICE

When a two-piece rear drive shaft is required (vehicles with an extended wheelbase), a rubber insulated center bearing is used to support the area where the half-shafts are joined. The bearing is supported by a support and a bracket that is attached to the frame crossmember (Fig. 15).

REMOVAL/DISASSEMBLY

(1) Mark the drive shaft, rear axle and transmission/transfer case yokes for installation alignment reference and remove the half-shafts from the vehicle. If necessary, refer to the removal procedure.

CAUTION: Do not clamp the drive shaft tube in a vise. Clamp only the forged portion of the welded (fixed) drive shaft yoke in the vise. Also, to avoid distorting the yoke, do not over-tighten the vise jaws.

(2) Clamp the front half-shaft in a vise and remove the bearing support and rubber insulator from the center bearing (Fig. 15). Discard both components.

(3) Bend the slinger away from the center bearing (Fig. 15) with a hammer to provide sufficient clearance for installing a bearing puller tool.

(4) Remove the bearing from the front half-shaft with a puller tool and remove the slinger. Discard the bearing, the retainer and the slinger (the replacement package includes the bearing plus the slinger and retainer).

ASSEMBLY/INSTALLATION

(1) Place the replacement slinger, bearing and retainer on the front half-shaft splines (Fig. 15). Each component is "press-fitted" on the splined half-shaft.

(2) Use a rigid tube or pipe with an ID larger than the OD of the splines to force the components forward onto the shaft splines until they are "seated" at the shaft shoulder.

(3) Clean and lubricate the front half-shaft and rear half-shaft slip yoke splines.

(4) Slide the protective boot onto the rear half-shaft slip yoke tube (Fig. 15). Install and crimp the clamp around the yoke tube.

(5) Install the front and rear half-shafts. If necessary, refer to the installation procedure.

(6) Slide the protective boot forward over the front half-shaft splines and crimp the clamp around the splines.

U-JOINT SERVICE

SINGLE CARDAN U-JOINT—REMOVAL/DISASSEMBLY

Single cardan U-joints are serviceable and, if defective, damaged or excessively worn, the needle bearings, seals, spider and bearing caps should all be replaced as a unit (Fig. 16).

(1) If not removed from the vehicle, remove the drive shaft. If necessary, refer to the applicable removal procedure.

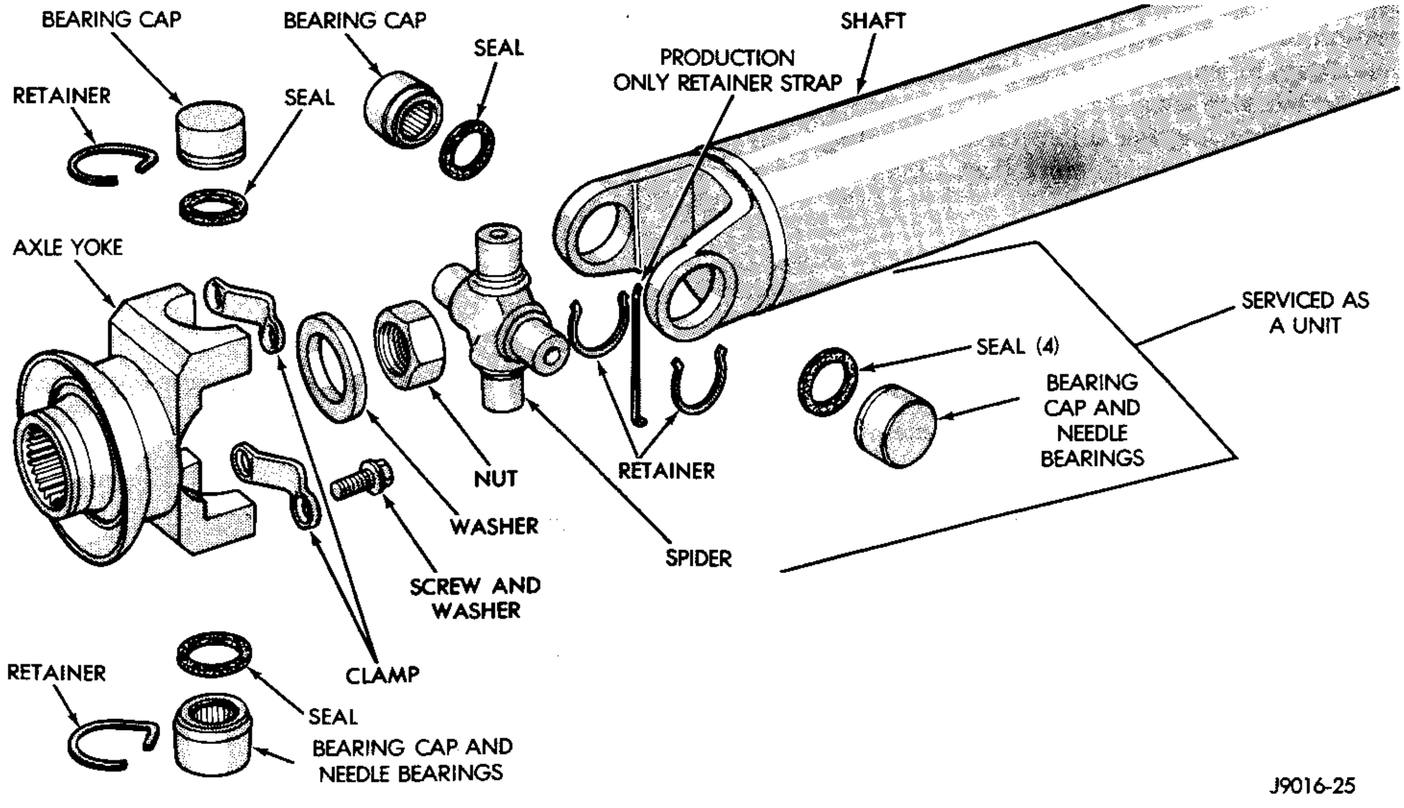


Fig. 16 Single Cardan U-Joint At Fixed Yoke—Disassembled

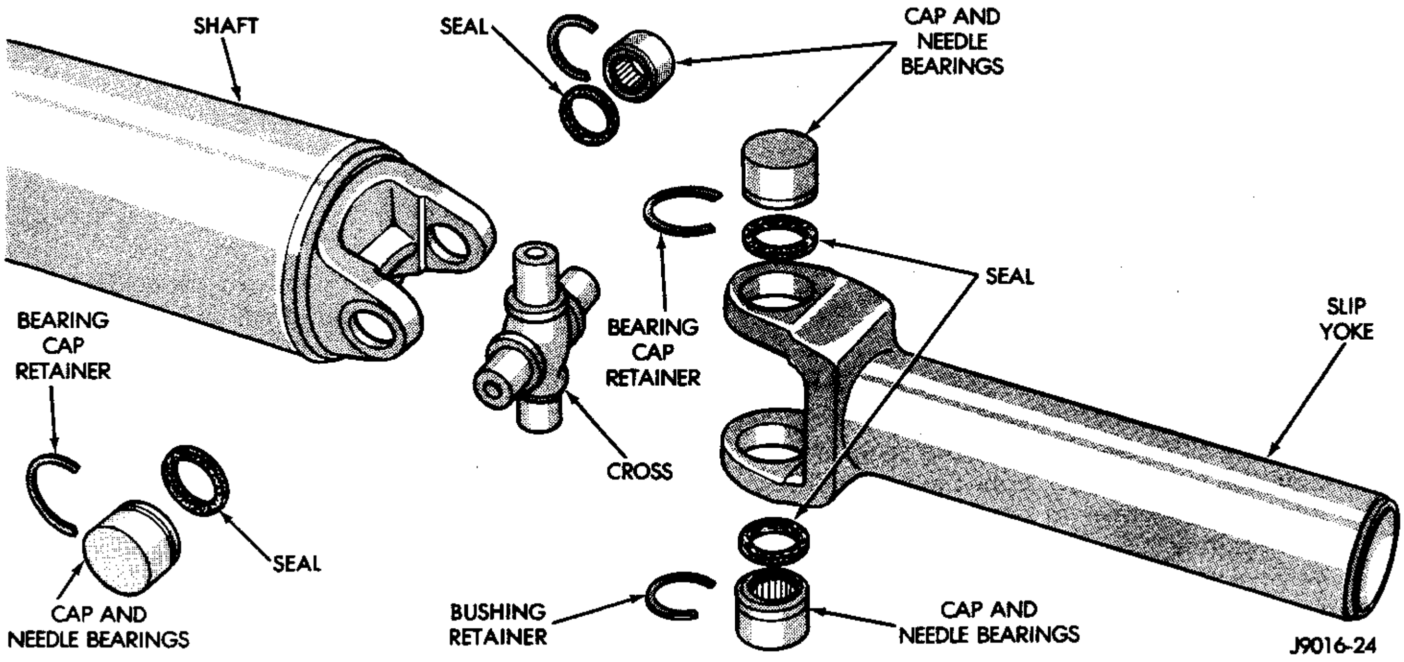


Fig. 17 Single Cardan U-Joint At Slip Yoke—Disassembled

(2) As applicable, remove the U-joint from the drive shaft fixed (welded) yoke or from the slip yoke (Figs. 16 and 17) according to the following instructions.

CAUTION: Do not clamp the slip yoke tube or the drive shaft tube in a vise. Clamp only the forged portion of the fixed (welded) or the slip yoke in the vise. Also, to avoid distorting the yoke, do not overtighten the vise jaws.

Before removing the U-joint and separating a slip yoke from a fixed yoke, mark both tubes for installation alignment reference.

(3) Clamp the fixed/slip yoke in a vise and remove the bearing cap retainers (Fig. 18). Remove the drive shaft from the vise.

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

(4) Place a suitable size socket wrench (larger ID than the bearing cap OD) against the yoke and around the perimeter of the first bearing cap to be removed. This will be the bearing cap receiver. Place a socket wrench (slightly smaller OD than the yoke bore) against the opposite bearing cap. This will be the bearing cap driver. Position the yoke (with the socket wrenches) in a vise (Fig. 19).

(5) Compress the vise jaws (Fig. 19) until the smaller socket wrench (driver) partially forces the opposite bearing cap out of the yoke bore and into the larger socket wrench (receiver).

(6) Release the vise jaws, remove the socket wrenches and remove the bearing cap that was partially forced out of the yoke bore.

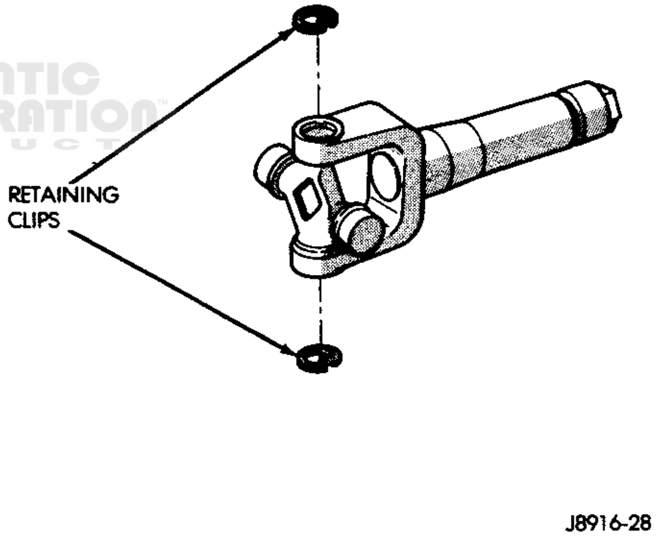


Fig. 18 Bearing Cap Retainers

(7) Place the larger ID socket wrench (receiver) against the yoke and around the perimeter of the remaining bearing cap. Place the smaller OD socket wrench (driver) against the end of the spider and position the yoke with the socket wrenches in a vise (Fig. 19).

(8) Compress the vise jaws (Fig. 19) until the remaining bearing cap is partially forced out of the yoke bore and into the larger diameter socket wrench (receiver).

(9) Remove the yoke and socket wrenches from the vise.

(10) Remove the remaining bearing cap and the bearings, seals and spider from the yoke bore (Figs. 16 and 17).

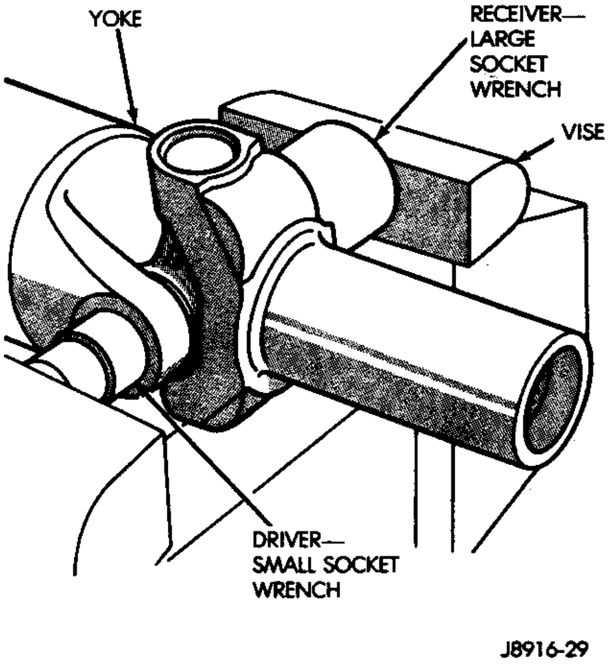


Fig. 19 Bearing Cap Removal

(11) If applicable, follow the instructions listed above to remove the U-joint bearing caps from the slip yoke (Fig. 19).

SINGLE CARDAN U-JOINT—CLEANING AND INSPECTION

CLEANING

(1) Clean the drive shaft fixed yoke/slip yoke arm bores with an appropriate cleaning solvent and a wire brush. Ensure that all the corrosion (rust) and foreign matter are removed from the bores.

(2) Clean the bearing caps and bearings, seals and spider (Figs. 16 and 17) in an appropriate cleaning solvent and wipe them dry with a shop cloth.

Do not disassemble the needle bearings. Clean the bearings with a short, stiff brush inserted into the bearing cap and "blow out" with compressed air. Lubricate the needle bearings with SAE 140w oil for inspection.

INSPECTION

(1) Inspect the bearing caps, the needle bearings, and the bearing contact surfaces on the spider cylinders for evidence of "Brinelling" (i.e., concave, spherical areas), excessive wear, flat spots, scoring and cracks.

(2) Replace all of the U-joint components if any one of the components is excessively worn or otherwise defective.

SINGLE CARDAN U-JOINT—ASSEMBLY/INSTALLATION

(1) Apply extreme pressure (EP), lithium-base type lubricant to the yoke bores, the bearing caps, the needle bearings, the seals and the bearing contact surfaces on the spider cylinders.

(2) Position the spider cylinders in the yoke bores; insert the seals into the yoke bores and against the spider cylinders; and tap the bearing caps (with the needle bearings) into the yoke bores far enough to retain the spider in-place.

CAUTION: Do not clamp the drive shaft tube or the slip yoke tube in a vise. Clamp only the forged portion of each yoke in the vise. Also, to avoid distorting the yoke, do not over-tighten the vise jaws.

(3) For a driver, place a socket wrench (slightly smaller OD than the yoke bore) against one bearing cap and position the yoke (with the socket wrench) in a vise (Fig. 20).

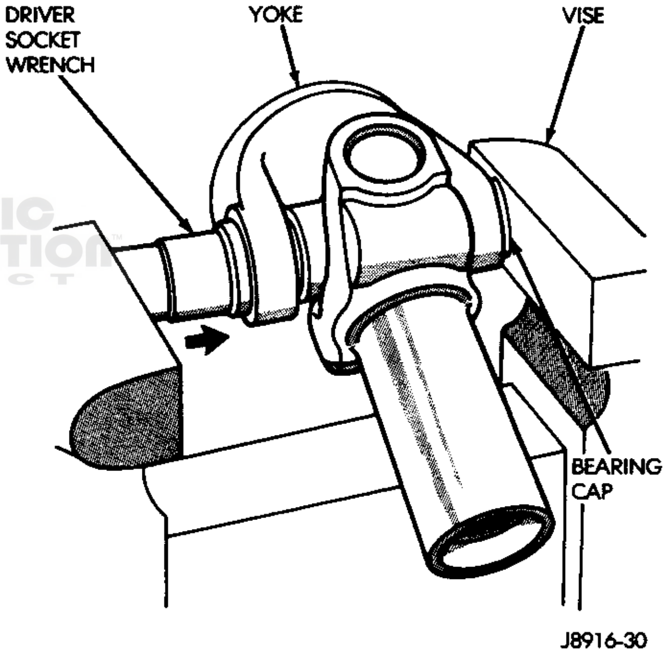


Fig. 20 Bearing Cap Installation

(4) Compress the vise jaws (Fig. 20) and force the bearing caps into the yoke bores with the socket wrench (driver). **Ensure that the caps are forced into the yoke bores far enough to expose the bearing cap retainer grooves.**

(5) Install the bearing cap retainers (Fig. 18) after the bearing caps are correctly installed (i.e., completely seated).

(6) If applicable, attach the slip yoke to the fixed yoke (with the installation reference marks aligned) according to the instructions listed above.

(7) Install the drive shaft. If necessary, refer to the applicable installation procedure.

(8) Remove the supports and lower the vehicle.

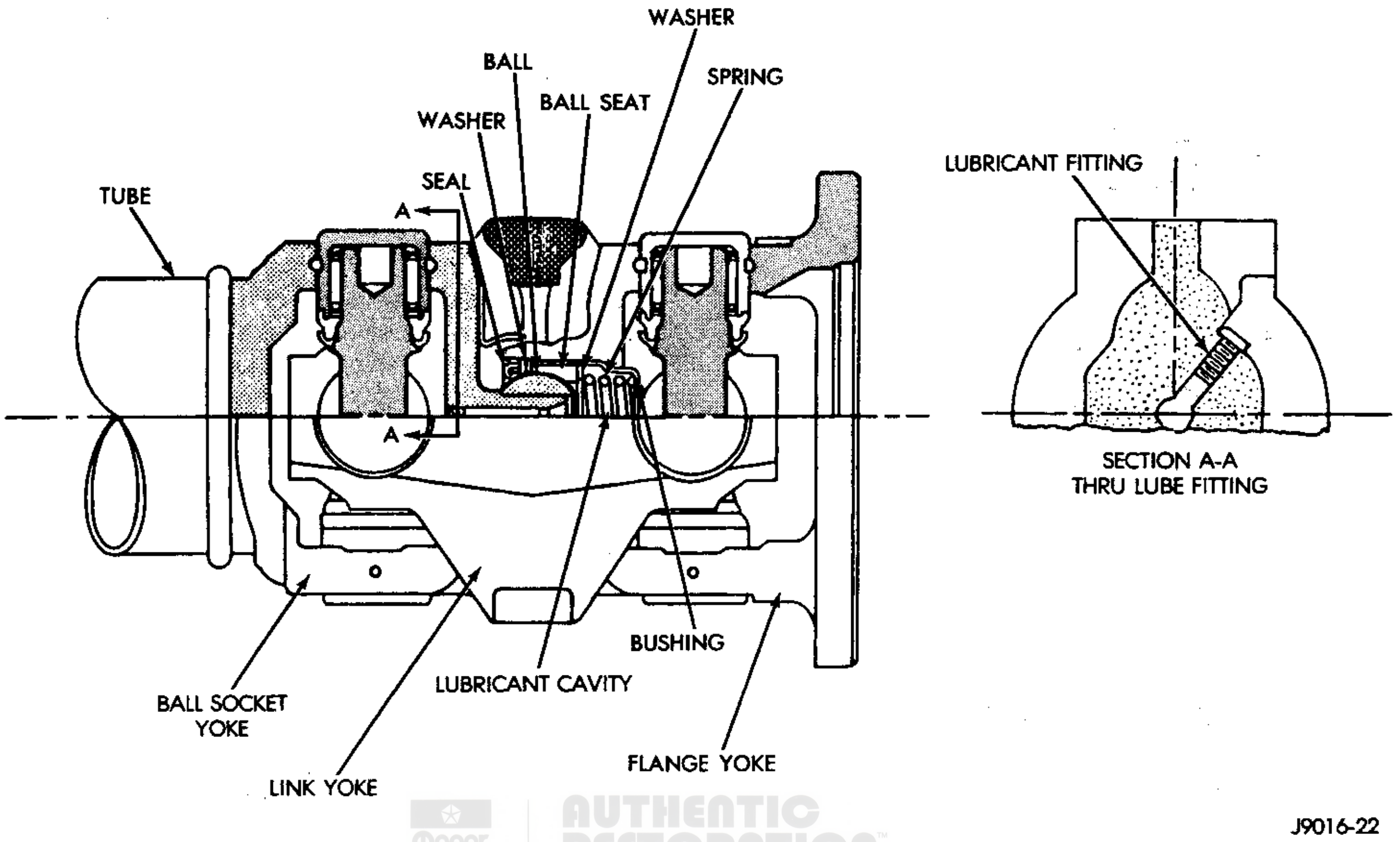


Fig. 21 Constant Velocity (CV) Joint

DOUBLE CARDAN (CV) JOINT (4WD VEHICLES)

Double cardan (CV) joints are serviceable. If the ball socket yoke, ball, spring, bushings, seals, thrust washers, spiders or bearing caps (Fig. 21) are either damaged or excessively worn, disassemble and repair the CV joint according to the following instructions.

REMOVAL/DISASSEMBLY

(1) If not removed from the vehicle, remove the front drive shaft. If necessary, refer to the removal procedure.

(2) Punch reference marks or otherwise identify, as applicable, the yokes before disassembly so that they can be assembled at their original locations to retain the drive shaft balance (Fig. 22).

CAUTION: Do not clamp a drive shaft tube in a vise. Clamp only the forged portion of a yoke in the vise. Also, to avoid distorting a yoke, do not over-tighten the vise jaws.

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

(3) Each bearing cap should be removed in the sequence indicated in Figure 23. This sequence requires the least amount of disassembly time.

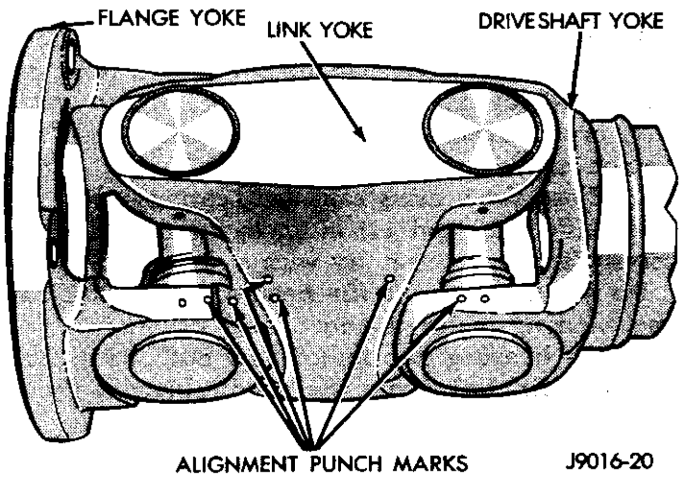


Fig. 22 Yoke Assembly Reference Marks

If the flange yoke is removed, it is necessary to remove only the two bearing caps at location 1 (Fig. 23). This can be determined by observing the trunnions at location 1.

(4) Support the drive shaft horizontally and aligned with the base plate of a press. Shear the bearing cap plastic retaining ring and position the first link yoke rear arm over a 1 1/8-inch (30-mm) ID socket wrench. Place Spider Press Tool C-4365-1 on the

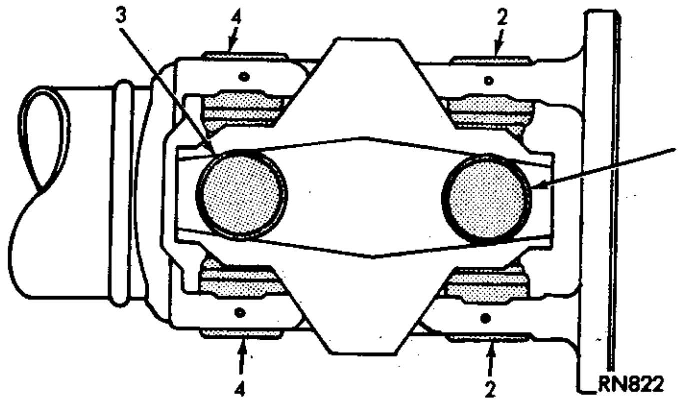


Fig. 23 Bearing Cap Removal Sequence

bearing caps located in the flange yoke arms (Fig. 24). Force the bearing cap out of the link yoke arm with a press.

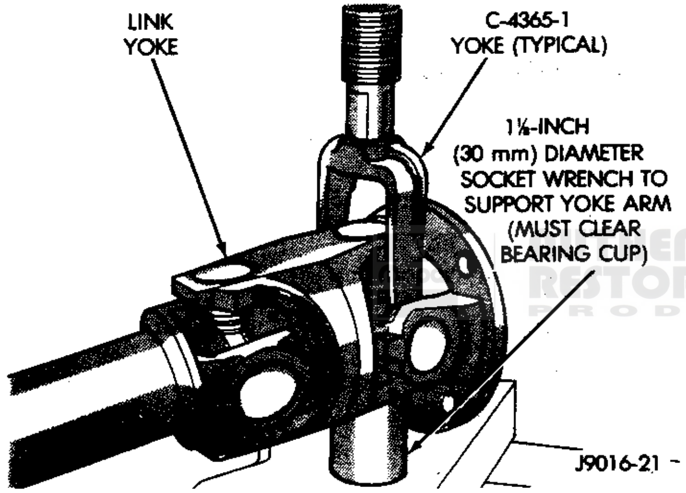


Fig. 24 Bearing Cap Removal With Tool C-4365-1

(5) If the bearing cap is not completely removed, insert Spacer Tool C-4365-4 between the spider and the bearing cap (Fig. 25) and complete the removal of the bearing cap.

(6) Rotate the drive shaft 180 degrees. Shear the opposite bearing cap plastic retaining ring and force the bearing cap out of the link yoke with Spacer Tool C-4365-4 (Fig. 25) and a press.

(7) Disengage the spider trunnions from the link yoke. Pull the flange yoke and the spider from the centering ball on the ball support tube yoke. The ball socket is part of the flange yoke.

(8) Pry the seal from the ball socket and remove the washers, the spring, and the three ball "seats" from the ball socket (Fig. 26).

BALL SOCKET INSPECTION/REPLACEMENT

(1) For ball removal, separate the CV joint between the link yoke and the flange yoke by forcing the spider trunnion bushing from the link yoke. Pull the flange yoke and the spider with the ball socket from the centering ball as a unit.

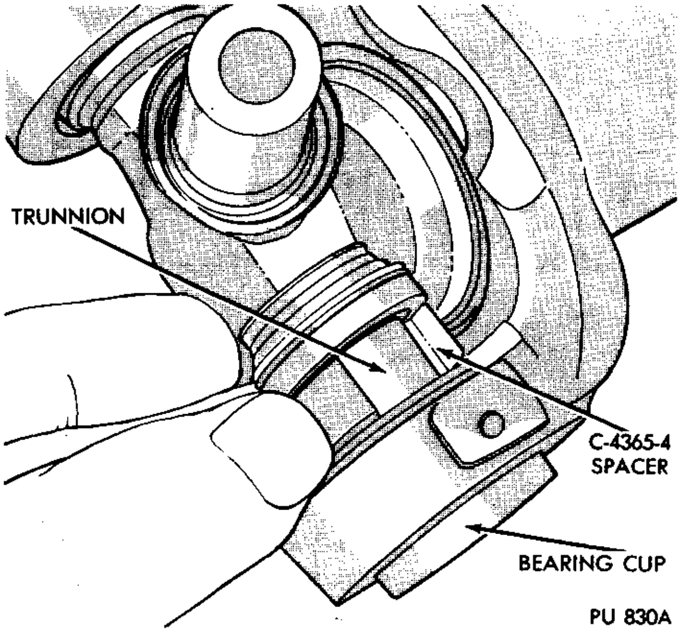


Fig. 25 Bearing Cap Removal With Tool C-4365-4

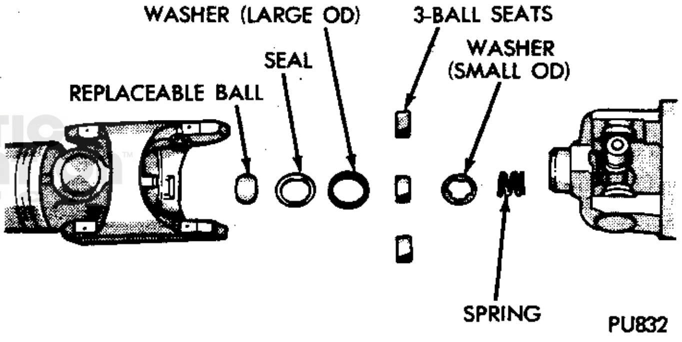


Fig. 26 CV Joint Components

(2) Clean and inspect the ball socket bushing for wear. If the bushing is worn, replace both the flange yoke and the spider.

(3) Pry the seal from ball socket and remove the washers, the spring and the three ball "seat"s.

(4) Clean and inspect the centering ball surface, the seal, the ball "seats", the spring and the washer. If the components are worn or otherwise defective, replacement is recommended.

(5) Remove the centering ball from the ball socket with Tool Set C-4365: Screw Tool C-4365-5, Sleeve Tool C-4365-6, Washer Tool C-4365-7, Nut Tool C-4365-7, and Jaw Tool C-4365-8 (Fig. 27).

(6) Use Tool C-4365-3 to install the centering ball in the ball socket. Force the ball into the socket until it is "seated" firmly against the shoulder at the base of the socket (Fig. 28).

(7) To install the spider, insert one bearing cap partially into one of the yoke bores and then rotate the yoke 180 degrees. Insert the spider into the yoke bore and "seat" the spider trunnion in the bearing cap. Partially insert the opposite bearing cap in the

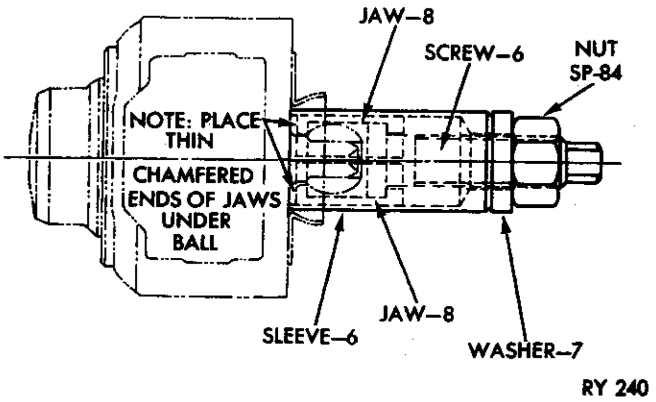


Fig. 27 Centering Ball Removal With Tool Set C-4365

remaining yoke bore. Force the bearing caps inward while pivoting the spider back-and-forth to ensure "free" movement of the trunnions in the bearings.

(8) When one of the retainer grooves becomes visible in the yoke bore, stop forcing the bearing caps inward and install a retainer in the groove.

(9) Continue to force the bearing caps inward until the opposite retainer can be installed in the groove.

If difficulty is encountered in "seating" the retainers in the grooves, strike the yoke arms firmly with a hammer to "seat" the retainers.

(10) Lubricate the centering ball and socket and assemble the remaining half of the CV joint according to the same instructions (above).

LUBRICATION

(1) Use the lubricant provided with the ball "seat" service kit to lubricate all the components and then insert them in the ball "seat" in the following sequence:

- spring,
- small OD washer,
- three ball "seat"s with the large opening facing outward, and
- large OD washer.

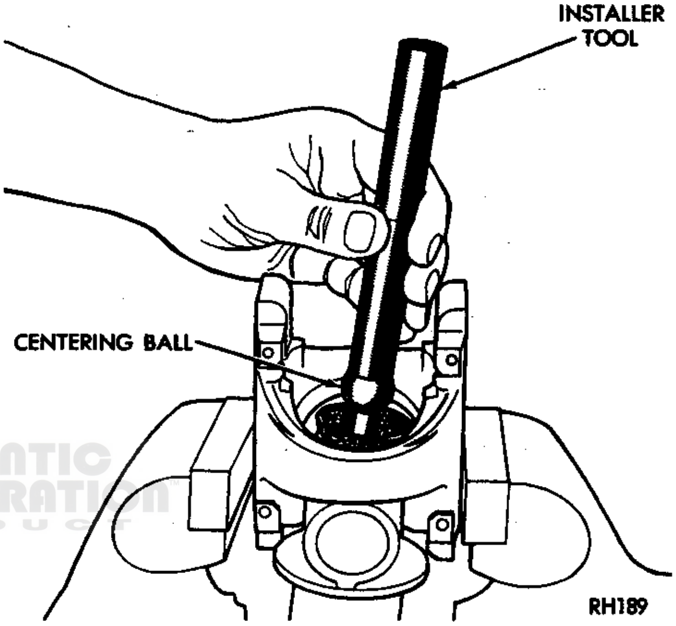


Fig. 28 Centering Ball Installation With Tool C-4365-3

(2) Lubricate the seal lip and press it inward and flush with an appropriate tool. The seal lip should tip inward.

(3) Fill the lubricant cavity with the lubricant provided in the service kit.

SPECIFICATIONS

TORQUE SPECIFICATIONS

COMPONENT	SET-TO-TORQUE	RECHECK TORQUE
Center Bearing Bracket-to-Frame Bolt	68 N•m (50 ft-lbs)	
Center Bearing Support-to-Bracket Bolt	68 N•m (50 ft-lbs)	
Yoke (Axle)	406 N•m (300 ft-lbs)	
Yoke (Transmission)	237 N•m (175 ft-lbs)	
Roller Bushing Clamp Bolt 1/4-28	19 N•m (14 ft-lbs)	
Roller Bushing Clamp Bolt 5/16-24	34 N•m (25 ft-lbs)	
Parking Brake-to-Flange Yoke Nut	47 N•m (35 ft-lbs)	
Front Axle U-Bolt Nut	17 N•m (150 in-lbs)	
CV Joint Screw	88 N•m (65 ft-lbs)	
Rear Axle Clamp Screw	19 N•m (14 ft-lbs)	
Transfer Case Clamp Screw	19 N•m (14 ft-lbs)	
Lubricant Fitting	3 N•m (30 in-lbs)	

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SPRINGS/SHOCK ABSORBERS

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GENERAL INFORMATION

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SPRING DESCRIPTIONS

FRONT SPRINGS

2WD VEHICLES

All two-wheel drive (2WD) Ram Truck and Ramcharger vehicles are equipped with a coil-spring operated (independent) front suspension system at each side of the vehicle (Fig. 1). The coil springs are located between the frame side rail bracket and the lower suspension arm. A 0.3 inch (7.6 mm) ozone-resistant, rubber noise isolation pad is located between the upper end of the coil spring and the frame bracket. This pad dampens noise that would otherwise be transmitted via the metal-to-metal contact of the spring and the frame bracket. A shock absorber is located inside each spring coil and it is attached to the frame side rail bracket and to the lower suspension arm.

4WD VEHICLES

All four-wheel drive (4WD) Ram Truck and Ramcharger vehicles are equipped with a leaf-spring operated front suspension system (Fig. 2). The leaf springs are the fixed-rate type and are attached to the frame side rail brackets and the front axle.

The front leaf springs are attached to the axle shaft tubes at the spring pads by U-bolts and nuts.

REAR SPRINGS

All Ram Truck and Ramcharger vehicles are equipped with leaf-type rear springs. The springs have a one-piece, rubber bushing “pressed” into their main leaf front “eye”. Model 150 and Ramcharger vehicles are equipped with a fixed-rate type leaf spring (Fig. 2). Progressive-rate type rear leaf springs (Fig. 3) are standard equipment for all model 250 and 350 vehicles.

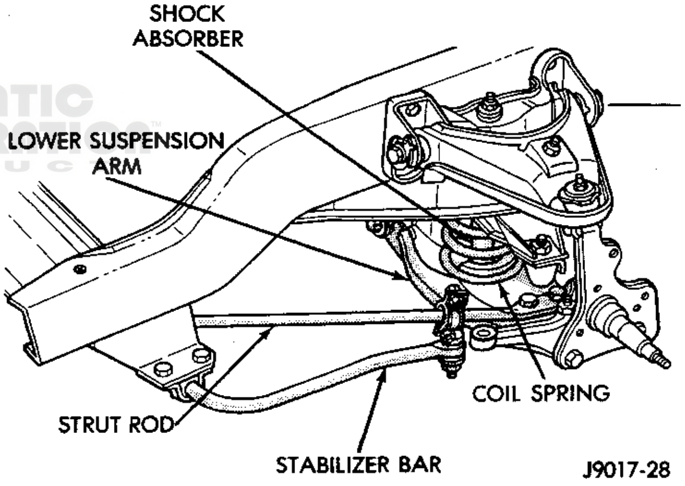

Fig. 1 Front Coil Spring

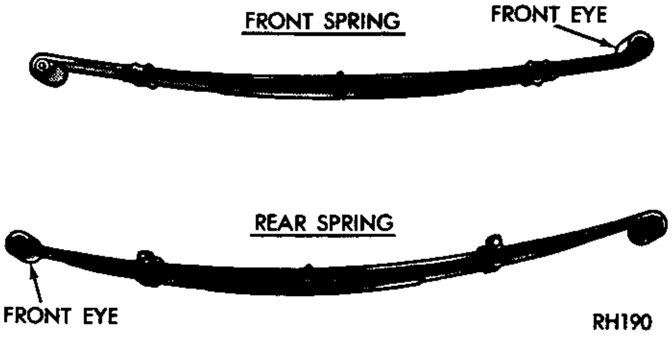

Fig. 2 Front & Rear Leaf Springs

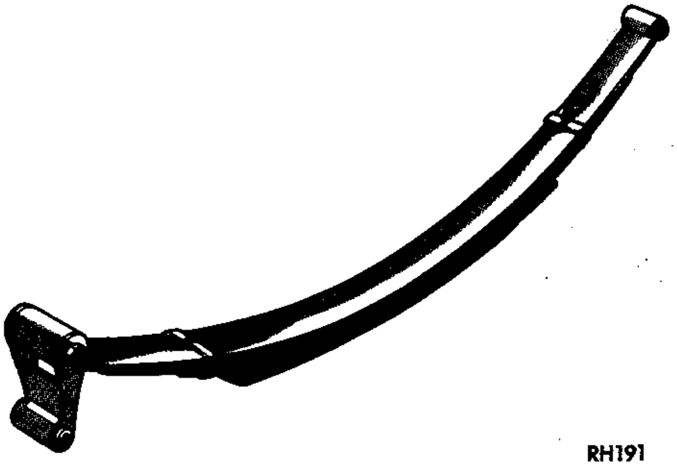

Fig. 3 Progressive-Type Rear Leaf Spring

A progressive-rate type leaf spring has two stages. The first stage, comprised of the upper leaves, provides a low spring rate with a light cargo load. The lower leaves (second stage) gradually interact with the upper leaves and provide an increased spring rate for medium-to-heavy cargo loads. **This type of spring (progressive) is not the same as a fixed-rate with auxiliary spring type of two-stage leaf spring (with the auxiliary spring located above the main leaf).**

VEHICLE CONFIGURATION

The front "eye" of each leaf spring is attached to a bracket that is riveted to the frame side rail. The rear "eye" of each standard equipment leaf spring is attached to the frame side rail via a one-piece spring shackle with a one-piece, "pressed-in" rubber bushing.

The rear leaf springs are attached to the axle shaft tubes at the spring pads by U-bolts and nuts.

SHOCK ABSORBER DESCRIPTION

Dual-action, gas-charged, hydraulic shock absorbers are used with both the front and rear suspension systems for Ram Truck and Ramcharger vehicles. The shock absorbers are designed to dampen the vehicle body (i.e., spring) "up-down" movement. In addition, rubber bushings are inserted into the shock absorber "eyes" to dampen out road/street surface "shock" and noise.

The front and rear springs allow the wheels to move up and down with the road/street surface semi-independent of the vehicle chassis and body. However, the springs alone cannot provide a completely smooth ride because of the energy that is stored in the springs during compression and then released during rebound. If a spring is unrestrained, the energy will be alternately stored and released and the spring will continue to oscillate in this manner until the vehicle weight dampens the oscillations (movements). A shock absorber is designed to immediately dampen the spring movements by dissipating most of the spring energy, which would otherwise continue to be alternately stored and then released.

A shock absorber converts mechanical spring energy into heat energy via the friction caused by the hydraulic fluid (in the shock absorber) when it is forced through restricted passages. This causes the spring to return smoothly to its normal position (i.e., the spring movement is dampened).

VEHICLE CONFIGURATION

For 2WD vehicles, a front shock absorber is located inside each front spring coil. It is attached to the frame side rail bracket and to the lower suspension arm (Fig. 1).

For 4WD vehicles, the front shock absorber upper ends are attached to brackets located on the frame side rail. The lower ends are attached to the front axle shaft tube brackets.

The rear shock absorber upper ends are attached to the frame crossmember aft of the rear axle. The lower ends are attached to the spring brackets (at the axle shaft tubes).

Ram Truck and Ramcharger vehicles are also equipped with jounce bumpers located at the front of the vehicle. The bumpers are attached to the shock absorber brackets in-line with the axle shaft tubes.

VEHICLE LOADING AND WEIGHT DISTRIBUTION

A Ram Truck or Ramcharger vehicle should always be loaded so that the vehicle weight **center-line** is located immediately forward of the rear axle. Correct vehicle loading provides proper "front tire-to-road" contact and this results in maximum vehicle handling stability and safety. Incorrect vehicle weight distribution can cause excessive tire tread wear, spring fatigue or failure, and/or erratic steering (with extremely incorrect weight distribution).

Incorrect vehicle weight distribution should be considered as a possible cause during diagnosis for erratic steering, spring failure, and/or excessive tire tread wear complaints.

SERVICE PROCEDURES

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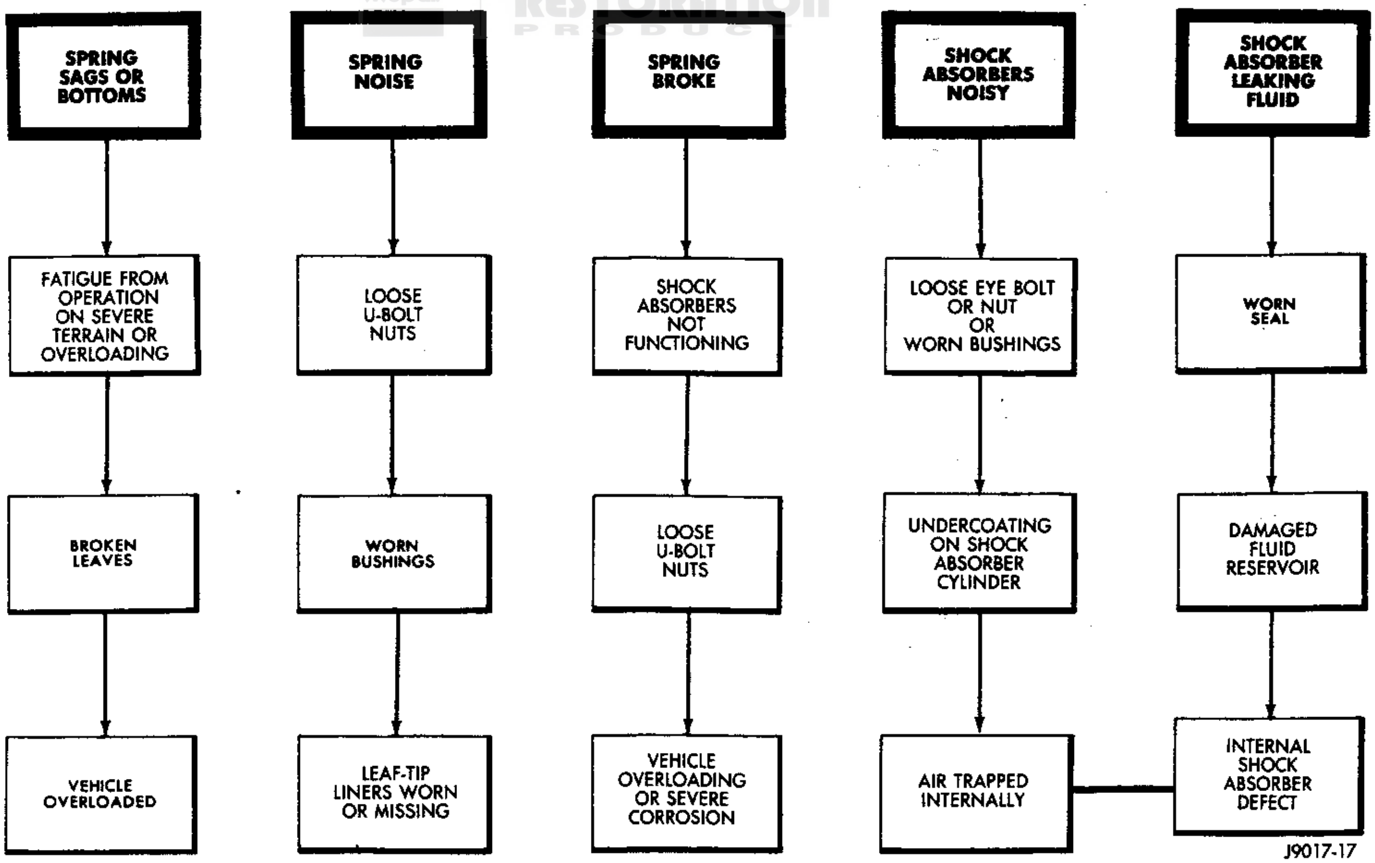
SERVICE DIAGNOSIS

To use the **Spring And Shock Absorber Diagnosis** chart:

- select the uppermost square containing the description that describes the condition requiring correction, and
- follow the connecting arrows to the square(s) that describe(s) the possible cause(s).

SPRING AND SHOCK ABSORBER DIAGNOSIS



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SHOCK ABSORBER REMOVAL/INSTALLATION

SERVICE INFORMATION

The front and rear shock absorbers cannot be refilled or disassembled. When service is required, remove the shock absorber and install a replacement unit.

A shock absorber should be replaced only if it has lost its resistance to spring movement (i.e., does not dampen) or if there is a fluid leak. **Existence of a thin fluid coating on the outside of the shock absorber cylinder is not cause to replace the shock absorber.**

FRONT/2WD VEHICLES—REMOVAL

(1) Raise the vehicle. Position supports at the extreme front ends of the frame rails and then lower the front of the vehicle onto the supports.

(2) Turn the wheels in the direction necessary to provide the best possible access to the shock absorber upper bracket.

(3) Remove the shock absorber stud (upper) nut and the upper retainer (Fig. 4).

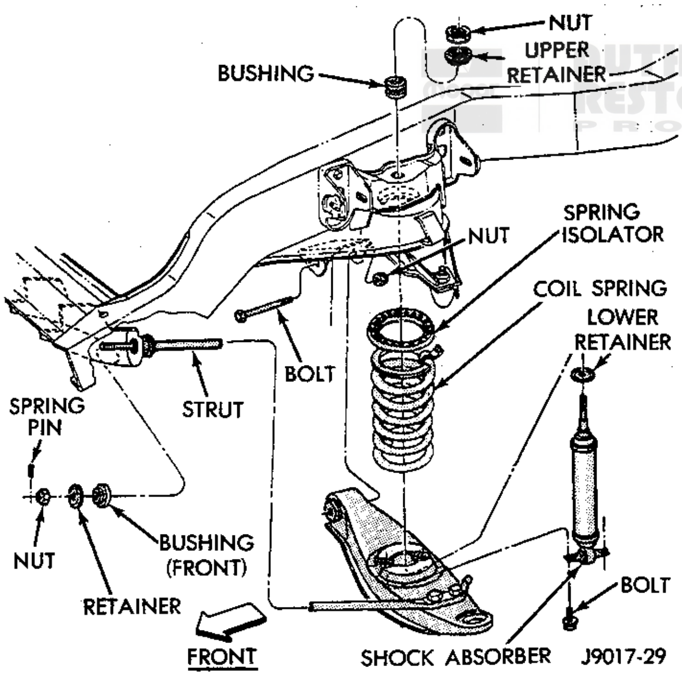

Fig. 4 Front Shock Absorber & Coil Spring (2WD)

(4) Remove the two lower retaining bolts, guide the shock absorber down through the coil spring and remove it from the vehicle through the lower suspension arm (Fig. 4).

FRONT/2WD VEHICLES—INSTALLATION

(1) Extend the shock absorber completely, install the lower retainer on the shock absorber stud (Fig. 4). Inspect the bushing and the sleeve to ensure they are in proper position and not excessively worn or broken (Fig. 4).

(2) Carefully guide the shock absorber up through the lower suspension arm and the coil spring, and insert the stud through the bushing (Fig. 4).

(3) Install the upper retainer and the nut (Fig. 4). Tighten the nut with 34 N•m (25 ft-lbs) torque.

(4) Align the lower end of the shock absorber with the holes in the lower suspension arm and install the retaining bolts. Tighten the bolts "finger-tight".

(5) Raise the vehicle, remove the supports and lower the vehicle to the surface. Tighten the retaining bolts with 23 N•m (17 ft-lbs/200 in-lbs) torque.

FRONT/4WD VEHICLES—REMOVAL

(1) Raise the vehicle. Position supports at the extreme front ends of the frame rails and then lower the front of the vehicle onto the supports.

(2) Turn the wheels in the direction necessary to provide the best possible access to the shock absorber upper bracket (Fig. 5).

(3) Remove the two nuts and bolts that attach the shock absorber upper bracket to the frame rail (Fig. 5). **Remove the bracket lower nut and bolt, remove the upper nut, rotate the bracket until there is sufficient clearance between the shock absorber and the upper bolt for removal, and remove the upper bolt.**

(4) Remove the shock absorber lower attaching nut and the outer retainer. Remove the shock absorber and the inner retainer from the stud (Fig. 5).

(5) After removing the shock absorber with the upper bracket from the vehicle, remove the bracket from the shock absorber if the shock absorber is being replaced (Fig. 5).

FRONT/4WD VEHICLES—INSTALLATION

(1) If applicable, before installing a replacement shock absorber on the vehicle, attach the upper bracket to the shock absorber (Fig. 5).

(2) Before installing the shock absorber, ensure that the bushing is inserted in the shock absorber "eye".

Ensure that the shock absorber is positioned on the stud with the retainers correctly located on either side of the bushing (Fig. 5).

(3) Position the large ID retainer and the shock absorber "eye" on the stud. Position the small ID retainer on the stud and install the attaching nut (Fig. 5). Tighten the nut "finger-tight".

(4) Position the shock absorber and the upper bracket at the frame rail and install the bracket upper bolt and nut. Rotate the bracket until the lower bolt hole is aligned with the frame rail bolt hole and install the lower bolt and nut (Fig. 5). Tighten the nuts "finger-tight".

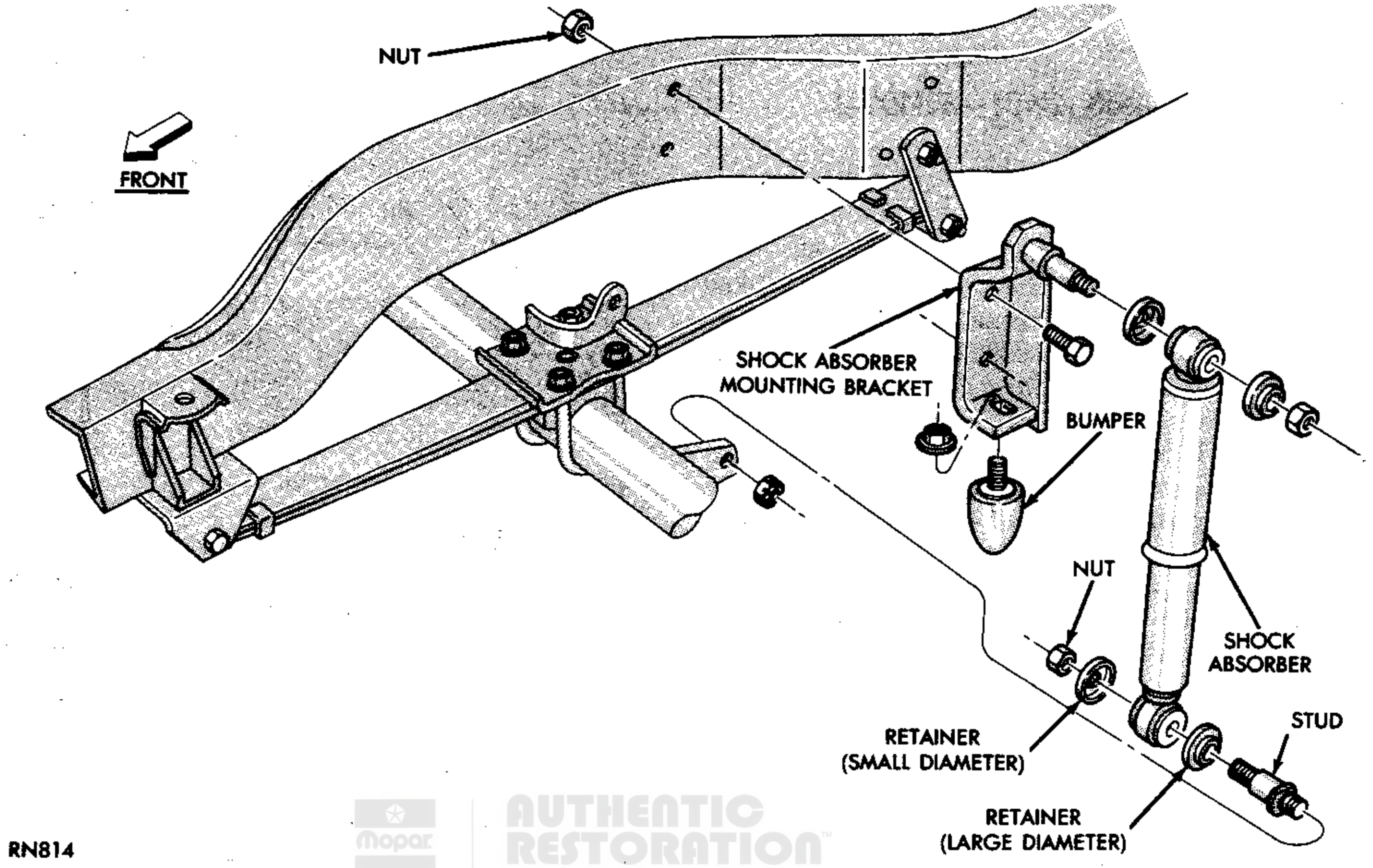

Fig. 5 Front Shock Absorber & Leaf Spring (4WD)

(5) Raise the vehicle, remove the supports and lower the vehicle to the surface. Tighten the shock absorber upper bracket attaching nuts and the lower stud nut with 75 N•m (55 ft-lbs) torque.

REAR—REMOVAL

(1) Raise and support the vehicle.

(2) Remove the retaining locknut and bolt from the frame crossmember at the upper end of the shock absorber (Fig. 6).

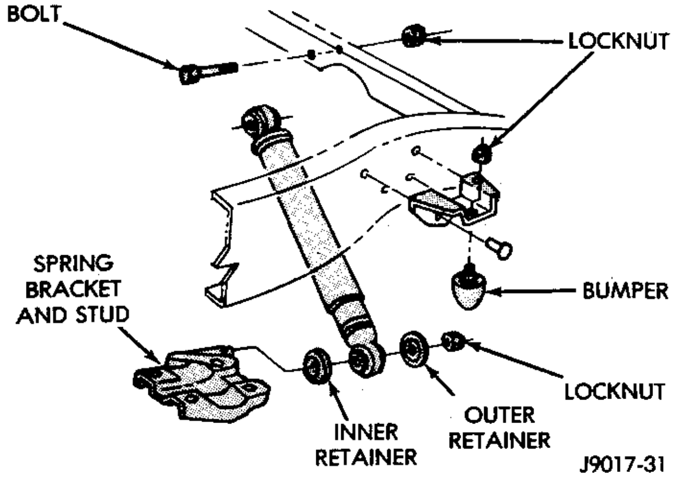

Fig. 6 Rear Shock Absorber Removal/Installation

(3) Remove the locknut and the outer retainer from the spring bracket stud (Fig. 6).

(4) Remove the rear shock absorber and the inner retainer from the vehicle (Fig. 6).

REAR—INSTALLATION

(1) Before installing the shock absorber, ensure that the bushings is inserted in the shock absorber “eyes”.

Ensure that the shock absorber is positioned on the spring bracket stud with retainers located on either side of the bushing (Fig. 6).

(2) Position the inner retainer and shock absorber “eye” on the spring bracket stud. Install the outer retainer and the locknut (Fig. 6). Tighten the locknut “finger-tight”.

(3) Rotate the shock absorber upward by pivoting it on the lower stud and position the upper end of the shock absorber at the frame crossmember.

(4) Align the upper bushing bore with the frame crossmember hole and insert the bolt through the upper shock absorber “eye” and the crossmember (Fig. 6).

(5) Install the locknut on the upper bolt and tighten it “finger-tight”.

(6) Raise the vehicle, remove the supports and lower the vehicle to the surface.

(7) Tighten the shock absorber locknuts with 82 N•m (60 ft-lbs) torque.

FRONT COIL SPRINGS (2WD)—REMOVAL/ INSTALLATION

REMOVAL

(1) Block the brake pedal in the "up" (non-depressed) position. Raise the vehicle on a hoist. Position supports at the extreme front ends of the frame rails and lower the hoist. Remove the applicable wheel cover and wheel/tire.

(2) Remove the brake caliper retainer and the anti-rattle spring. Remove the brake caliper from the disc rotor by sliding it out and then away from the rotor. If necessary, refer to Group 5—Brakes for removal information. Support the brake caliper out-of-the-way. **Do not allow the caliper hang from or be supported by the brake fluid hose.** Remove the inboard brake pad.

(3) Remove the dust cap, the cotter pin, the nut lock, the adjustment nut, the washer, and the outer wheel bearing.

(4) Carefully slide the hub/rotor from the steering knuckle spindle. **Do not allow the seal or the inner wheel bearing to contact the steering knuckle spindle threads, otherwise the threads, the bearing, and the seal could be damaged.**

(5) Remove the attaching screws and the brake splash shield.

(6) Remove the shock absorber from the vehicle and the shock absorber upper bushing from the bracket (Fig. 7). If necessary, refer to the removal procedure.

(7) Remove the strut bar (Fig. 7). If necessary, refer to the removal procedure.

(8) Install Spring Compressor Tool DD-1278 in the spring (Fig. 8) and tighten the nut "finger-tight", and then loosen the nut 1/2 of-a-turn.

(9) Remove the cotter pins and the lower and upper ball stud nuts at the steering knuckle.

(10) Install Ball Stud Loosening Tool C-3564-A on the lower ball stud. Turn the threaded portion of the tool and "lock" the tool securely against the lower stud (Fig. 8).

(11) Expand the tool sufficiently enough to place force on the lower ball stud and then strike the steering knuckle sharply with a hammer to loosen the stud. **Do not attempt to force the stud out of the steering knuckle with the loosening tool.**

(12) Remove the loosening tool and remove the ball stud with an appropriate tool.

(13) Slowly loosen the coil spring compressor tool until all tension is relieved from the spring.

(14) Remove the spring compressor tool and the spring with the rubber isolation pad (Fig. 7).

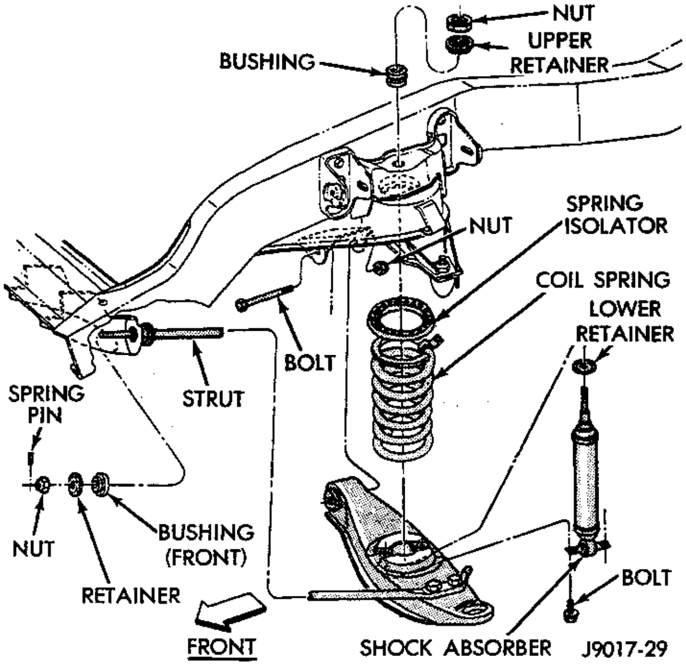

Fig. 7 Coil Spring Suspension

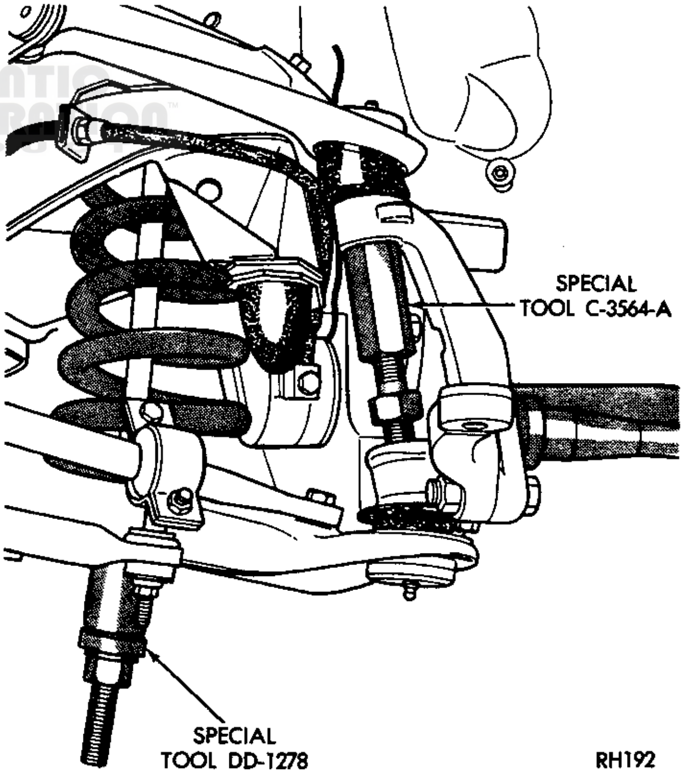

Fig. 8 Spring Compressor & Ball Stud Loosening Tools Installed

INSTALLATION

(1) Position the spring (with the rubber isolation pad) on the suspension arm (Fig. 7) and install the spring compressor tool. Compress the spring until the lower suspension arm ball stud can be properly positioned in the steering knuckle bore.

(2) Install the retaining nuts on the ball studs and tighten the upper nut with 142 N•m (105 ft-lbs) torque and the lower nut, if a 11/16-16 bolt, with 183 N•m (135 ft-lbs) torque or, if a 3/4-16 bolt, with 237 N•m (175 ft-lbs) torque. Install replacement cotter pins.

(3) Install the strut (Fig. 7). Tighten the strut-to-lower suspension arm bolts with 136 N•m (100 ft-lbs) torque. Tighten the strut front nut with 70 N•m (50 ft-lbs) torque. Install the spring pin.

(4) Connect the stabilizer bar (if equipped) and tighten the link with 11 N•m (100 in-lbs) torque. Remove the spring compressor tool.

(5) Install the shock absorber bushing in the bracket. Place the lower retainer on the stud and position the shock absorber within the coil spring (Fig. 7). Install and tighten the upper stud nut and the lower retaining bolts "finger-tight".

After the vehicle has been lowered to the surface, tighten the upper stud nut with 34 N•m (25 ft-lbs) torque and the lower retaining bolts with 23 N•m (17 ft-lbs/200 in-lbs).

(6) Position the brake splash shield on the steering knuckle, install and tighten the attaching screws with 23 N•m (200 in-lbs) torque.

(7) Carefully install the hub/rotor on the steering knuckle spindle, followed by the outer wheel bearing, the washer and the adjustment nut. Tighten the adjustment nut with 48 N•m (35 ft-lbs) torque while rotating hub/rotor. Stop the hub/rotor rotation and loosen the adjustment nut to completely release the wheel bearing "preload". Next, tighten the adjustment nut "finger-tight", and install nut lock and cotter pin. The result of the adjustment should be 0.0001 to 0.003 inch (0.0025 to 0.76 mm) "end play". Clean the dust cap, apply a light coat of wheel bearing lubricant to the inside surface and install it on the hub.

(8) Position the inboard brake pad on the brake caliper adapter with the pad flanges engaged with the adapter rails. Slowly slide the caliper into position in the adapter and over the brake rotor. Align the caliper on the adapter rails. Use care to avoid pulling the protective dust boot from the grooves as the caliper piston and boot slide over the inboard brake pad.

If necessary, refer to Group 5—Brakes for additional installation information.

(9) Install the anti-rattle springs and the retainer clips, and tighten with 20 N•m (15 ft-lbs/180 in-lbs) torque.

The inboard shoe anti-rattle spring must always be installed on top of the retainer spring plate.

(10) Install the wheel/tire and the wheel cover. Raise the vehicle, remove the supports, lower the vehicle and remove the block from the brake pedal.

(11) Tighten the shock absorber nut and bolts with the specified torque.

(12) Test the vehicle brakes and the suspension for proper operation.

FRONT LEAF SPRINGS (4WD)—REMOVAL/ INSTALLATION

REMOVAL

(1) Use a chain hoist or a hydraulic crane connected to tow hooks or to the frame to raise the vehicle until all weight is removed from the front springs.

(2) With the front tires in contact with the surface, position support stands under the frame side rails.

(3) Remove the nuts, the lockwashers, and the U-bolts that attach the spring to the axle shaft tubes (Figs. 9 and 10).

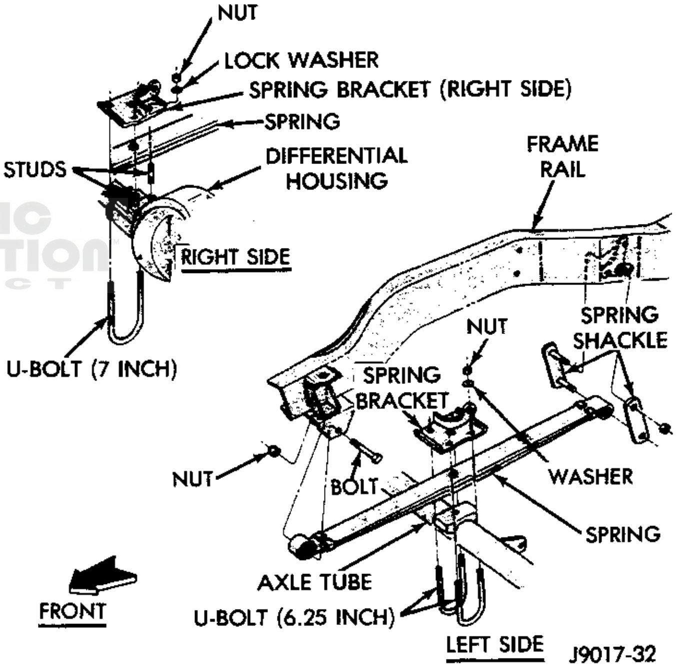

Fig. 9 Front Suspension W/Model 44 Axle—W-150, W-250, W-350 & AW-150 Vehicles

(4) Remove the spring front "eye" pivot nut and bolt, the rear spring shackle nuts, the spring shackle plates, and remove the spring from the vehicle (Figs. 9 and 10).

INSPECTION

(1) Inspect the spring and shackle "eye" bushings, the shackle bolts, the shackle plates, the shackle bracket and the spring "eye" (pivot) bolts for excessive wear and damage. Replace all excessively worn and damaged components (Figs. 9 and 10).

(2) Examine the condition of the spring center bolt (Figs. 9 and 10) and ensure that the nut is correctly tightened. If necessary, tighten the center bolt nut with 20 N•m (15 ft-lbs) torque.

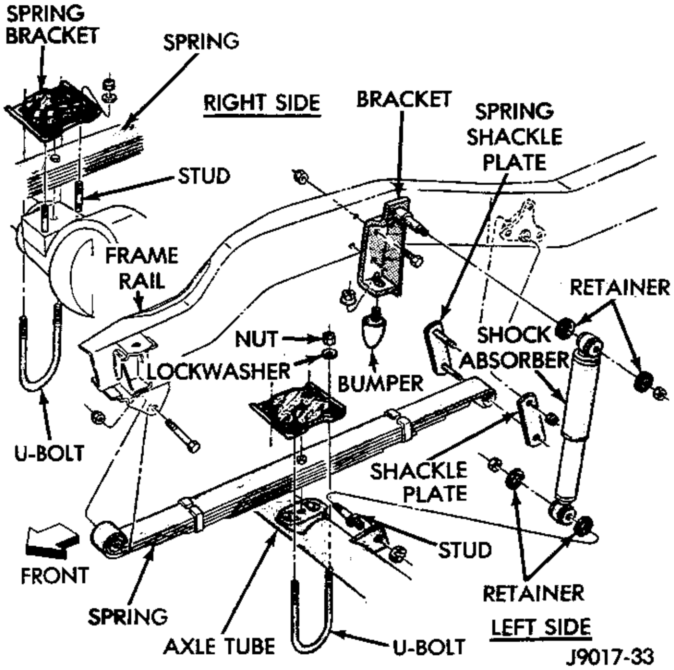

Fig. 10 Front Suspension W/Model 60 Axle—W-350 Vehicles

(3) Inspect the spring leaf alignment clips. The clips must not be damaged or bent. The clips should be tight around the spring leaves, but not tight enough to "bind" the spring leaves. Replace damaged clips.

(4) Inspect for broken spring leaves and replace as necessary.

The rear springs are designed to function satisfactorily without lubricant added between the leaves; however, for abnormal operating conditions, a slight application of lubricant between the leaves will improve the spring action.

Front leaf springs do not have plastic-tip liners.

INSTALLATION

(1) Align the spring front "eye" with the bolt hole in the front bracket and install the "eye" pivot bolt and nut (Figs. 9 and 10).

(2) Position the shackle plates at the spring rear "eye" and the frame rail bracket, and install the retaining nuts (Figs. 9 and 10).

(3) Tighten the shackle plate nuts and the front "eye" pivot bolt nut until all separation between the metal is removed.

(4) Position the spring on the axle shaft tube so that the spring center bolt is inserted into the locating hole in the axle tube spring pad (Figs. 9 and 10).

(5) Install the U-bolts, replacement lockwashers and the retaining nuts (Figs. 9 and 10).

(6) Tighten the nuts until they force the lockwashers flush against the spring bracket.

(7) Remove the supports and lower the vehicle so that the weight is being supported by the tires (i.e., the springs).

(8) Tighten the spring retaining nuts according to the following specifications:

- U-bolt nuts — 129 N•m (95 ft-lbs) torque;
- axle spring pad stud nuts (9/16-18 stud) — 129 N•m (95 ft-lbs) torque;
- axle spring pad stud nuts (Model 44 Axle) — 142 N•m (105 ft-lbs) torque;
- axle spring pad stud nuts (Model 60 Axle) — 156 N•m (115 ft-lbs) torque;
- spring front "eye" pivot bolt nut — 108 N•m (80 ft-lbs) torque; and
- shackle plate nuts — 108 N•m (80 ft-lbs) torque.

REAR SPRINGS—REMOVAL/INSTALLATION

REMOVAL

(1) Use a chain hoist/crane or a hydraulic lift positioned at the frame aft of the rear axle to raise the vehicle until all weight is removed from the rear springs.

The vehicle must be raised either by a hoist/crane or a lift positioned under the frame side rail at the crossmember aft of the axle. Use care to avoid bending the side rail flange.

(2) With the front tires in contact with the surface, position support stands under the frame side rails.

(3) Remove the nuts, the lockwashers, and the U-bolts that attach the spring to the axle shaft tubes (Figs. 11, 12 and 13).

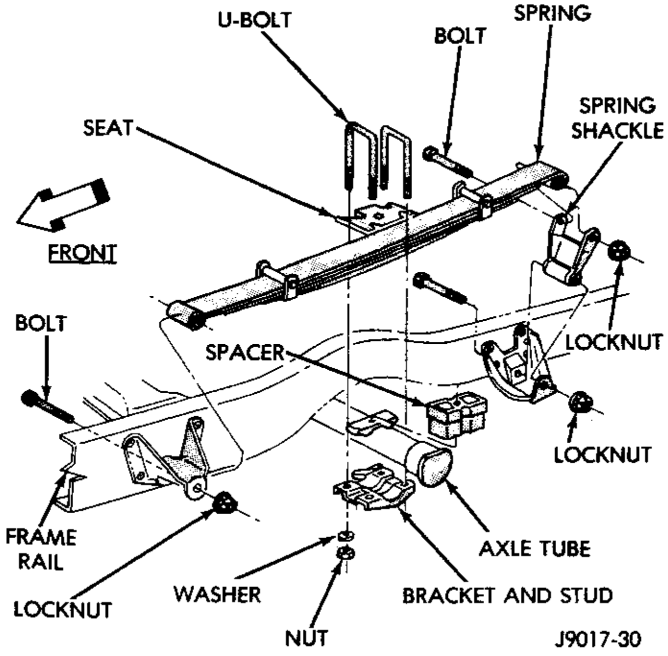

Fig. 11 Rear Spring—Model 150 Vehicles

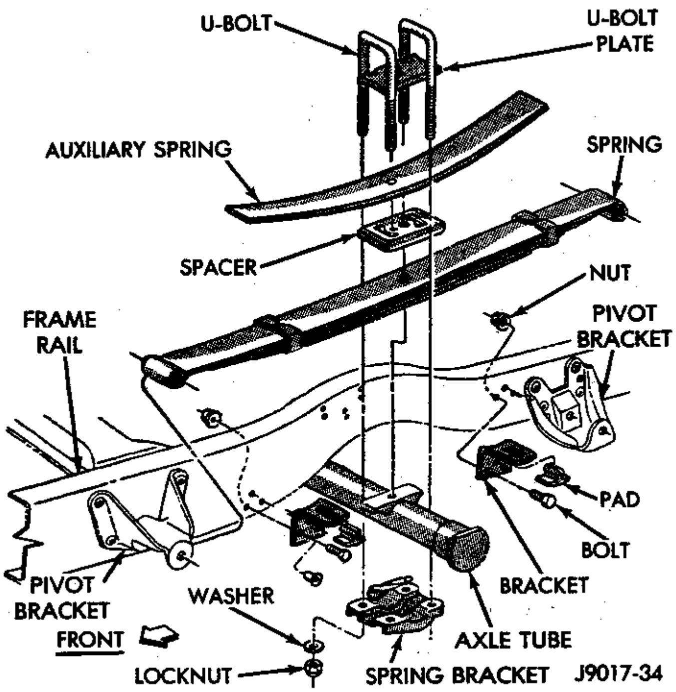

Fig. 12 Rear Spring & Auxiliary Spring—D-150 Vehicles

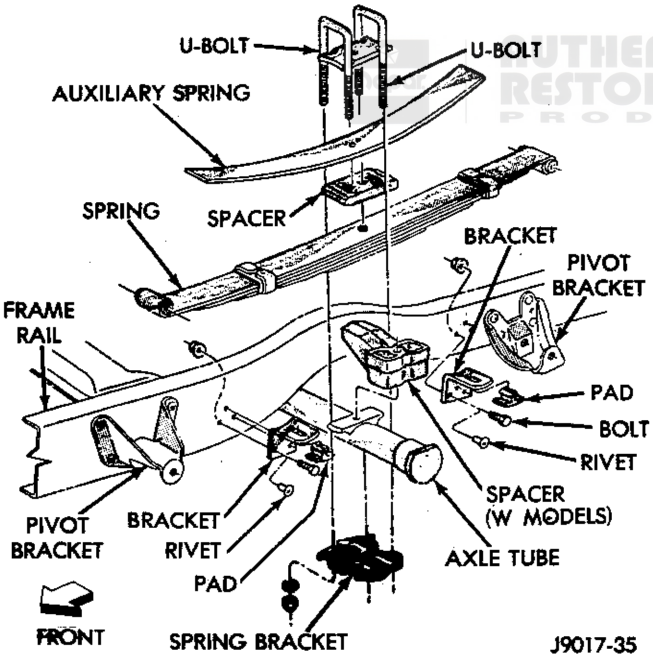

Fig. 13 Rear Spring & Auxiliary Spring—D/W-250 & D/W-350 Vehicles

(4) Remove the nuts and bolts from the spring front and rear "eyes", and remove the spring from the vehicle (Figs. 11, 12 and 13).

INSPECTION

(1) Inspect the spring and shackle "eye" bushings, the shackle bolts, the shackle, the shackle bracket and the spring "eye" (pivot) bolts for excessive wear and damage. Replace all excessively worn and damaged components (Figs. 11, 12 and 13).

(2) Examine the condition of the spring center bolt (Figs. 11, 12 and 13) and ensure that the nut is correctly tightened. If necessary, tighten the center bolt nut with 20 N•m (15 ft-lbs) torque.

(3) Inspect the spring leaf alignment clips. The clips must not be damaged or bent. The clips should be tight around the spring leaves, but not tight enough to "bind" the spring leaves. Replace damaged clips.

(4) Inspect for broken spring leaves and replace as necessary.

The rear springs are designed to function satisfactorily without lubricant added between the leaves; however, for abnormal operating conditions, a slight application of lubricant between the leaves will improve the spring action.

Light-duty, 2WD vehicle springs are equipped with plastic-tip liners. These tips should not be lubricated, but may be replaced if excessively worn or missing. Vehicles with heavy-duty suspensions do not have plastic-tip liners.

INSTALLATION

(1) Position the spring on the axle shaft tube so that the spring center bolt is inserted into the locating hole in the axle tube spring pad (Figs. 11, 12 and 13).

(2) Align the spring front "eye" with the bolt hole in the front bracket and install the "eye" pivot bolt and nut (Figs. 11, 12 and 13).

(3) Align the spring rear "eye" with the bolt hole in the spring shackle or the rear bracket (as applicable) and install the spring "eye" pivot bolt and nut (Figs. 11, 12 and 13).

(4) Tighten the spring front and rear "eye" pivot bolt nuts until all separation between the metal is removed.

(5) Install the U-bolts, replacement lockwashers and the retaining nuts (Figs. 11, 12 and 13).

(6) Tighten the nuts until they force the lockwashers flush against the spring bracket.

(7) Align the auxiliary spring with the primary spring (Figs. 11, 12 and 13).

(8) Remove the supports and lower the vehicle so that the weight is being supported by the tires (i.e., the springs).

(9) Tighten the spring retaining nuts according to the following specifications:

- U-bolt nuts (1/2-20) — 88 N•m (65 ft-lbs) torque;
- U-bolt nuts (9/16-18) — 149 N•m (110 ft-lbs) torque;
- spring front and rear "eye" pivot bolt nut (1/2-20) — 88 N•m (65 ft-lbs) torque;
- spring front and rear "eye" pivot bolt nut (5/8-18) — 135 N•m (100 ft-lbs) torque; and

- spring front and rear "eye" pivot bolt nut (3/4-16) — 183 N•m (135 ft-lbs) torque.

SPRING LEAF—REPLACEMENT

Spring leaves (if broken) can be replaced with replacement leaves, however, if a spring has taken a "set" (i.e., has lost significant height), it should be replaced.

(1) Remove the spring from the vehicle. If necessary, refer to the removal procedure.

(2) Remove the spring leaf alignment clips.

(3) Clamp the spring in a vise and remove the nut and the center bolt (Fig. 14).

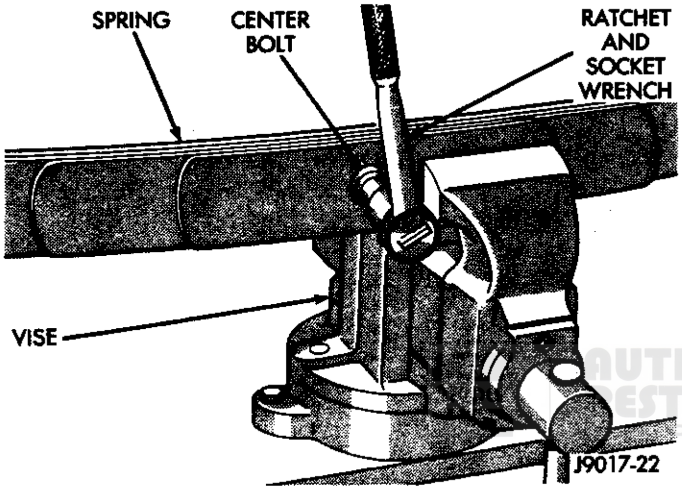

Fig. 14 Leaf Spring Disassembly

(4) Insert a long drift or punch into the center bolt hole and slowly release the vise jaws.

(5) Remove the spring from the vise and replace the broken/defective leaf. Insert a long drift or punch into the spring center bolt hole.

(6) Position the spring between vise jaws and slowly tighten the vise jaws while retaining the spring leaves aligned with the long drift or punch.

(7) Remove the drift/punch from the spring center bolt hole and install a replacement center bolt and nut (Fig. 14).

(8) Tighten the nut with 20 N•m (15 ft-lbs) torque or until the center of the spring has no "gaps" between the leaves (maximum of 54 N•m/40 ft-lbs torque).

(9) Install the alignment clips.

(10) Install the spring in the vehicle. If necessary refer to the installation procedure.

FRONT AND REAR SPRING "EYE" ROUND BUSHING

The spring front/rear "eye" round (one-piece) bushing can be replaced with the spring installed on the vehicle according to the following instructions.

(1) Raise and support the vehicle so that the spring is relaxed and the tires slightly contacting the surface.

(2) As applicable, remove the spring front or rear "eye" pivot bolt and remove the front or rear of the spring from the frame rail bracket or the spring shackle.

(3) Use an appropriate driver tool and force the original bushing out of the spring "eye".

(4) Install the replacement bushing with an appropriate tool.

(5) As applicable, insert the end of the spring in the frame rail bracket or the spring shackle, install the pivot bolt and the retaining nut. Do not tighten the pivot bolt retaining nut until the full weight of the vehicle is supported by the springs.

(6) Remove the supports and lower the vehicle to the surface.

(7) Tighten the spring "eye" pivot bolt nut with the specified torque. Refer to the Torque Specifications chart.

STABILIZER BAR—REMOVAL/INSTALLATION

REMOVAL

(1) Remove the link rod retaining nut at each end of the stabilizer bar (Figs. 15 and 16).

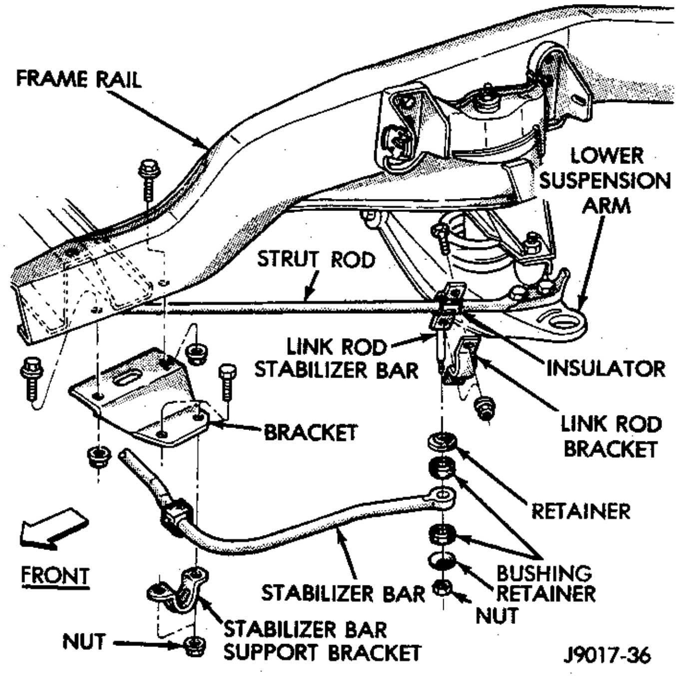

Fig. 15 Stabilizer Bar—2WD Vehicles

(2) Remove the outer retainers and rubber bushings from the link rods (Figs. 15 and 16).

(3) As applicable, remove the bolts or nuts from the U-shaped stabilizer bar support brackets and remove the stabilizer bar from the vehicle (Figs. 15 and 16).

INSTALLATION

(1) Position the stabilizer bar ends over the link rods and install the U-shaped support brackets and bolts/nuts (Figs. 15 and 16). Tighten the bolts/nuts with 23 N•m (17 ft-lbs/200 in-lbs) torque.

(2) Install the outer retainers and rubber bushings on the link rods (Figs. 15 and 16).

(3) Install the link rod nuts (Figs. 15 and 16). Tighten the nuts with 11 N•m (100 in-lbs).

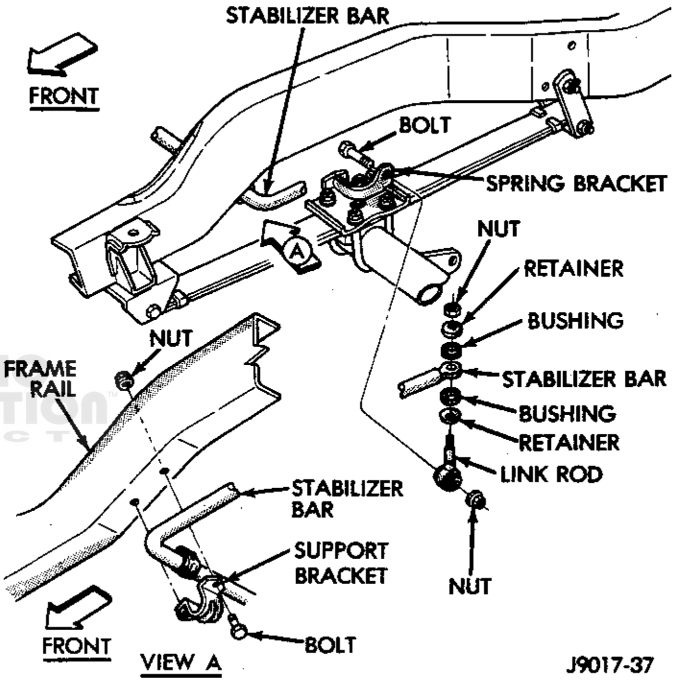

Fig. 16 Stabilizer Bar—4WD Vehicles

SPECIFICATIONS

TORQUE SPECIFICATIONS

COMPONENT	SET-TO-TORQUE	RECHECK TORQUE
SPRINGS (FRONT)		
Shackle Bolt Nut and Front Eye Bolt (1/2-20)	108 N•m (80 ft-lbs)	
Axle Spring Plate Stud (Model 60 Axle)	156 N•m (115 ft-lbs)	
Axle Spring Plate Stud (Model 44 Axle)	142 N•m (105 ft-lbs)	
Axle Spring Plate Stud Nut (9/16-18)	129 N•m (95 ft-lbs)	
U-Bolt Nut (9/16-18)	129 N•m (95 ft-lbs)	
SPRINGS (REAR)		
Shackle Bolt Nut and Front Eye Bolt (1/2-20)	88 N•m (65 ft-lbs)	
Shackle Bolt Nut and Front Eye Bolt (5/8-18)	135 N•m (100 ft-lbs)	
Shackle Bolt Nut and Front Eye Bolt (3/4-16)	183 N•m (135 ft-lbs)	
U-Bolt Nut (1/2-20)	88 N•m (65 ft-lbs)	
U-Bolt Nut (9/16-18)	149 N•m (110 ft-lbs)	
Aux. Spring Pad Bracket-to-Frame Nut (3/8-16)	41 N•m (30 ft-lbs)	
SHOCK ABSORBERS (FRONT) 2WD VEHICLES		
Upper Bushing Retaining Nut (3/8-24)	34 N•m (25 ft-lbs)	
Lower Nut (5/16-18)	23 N•m (200 in-lbs)	
Shock Absorber Lower Stud-to-Axle Nut (3/4-16)	156 N•m (115 ft-lbs)	
Shock Absorber Lower Nut (1/2-20)	75 N•m (55 ft-lbs)	
Shock Absorber Upper Nut (1/2-20)	75 N•m (55 ft-lbs)	
SHOCK ABSORBERS (REAR)		
Lower Nut (1/2-20)	82 N•m (60 ft-lbs)	
Upper Nut (1/2-20)	82 N•m (60 ft-lbs)	
JOUNCE BUMPERS		
Front Jounce Bumper Retaining Nut	20 N•m (180 in-lbs)	
Front Jounce Bumper Bracket-to-Frame Nut (1/2-13) (4WD)	102 N•m (75 ft-lbs)	
D-150, W-150, and Sport Utility		
Rear Jounce Bumper Retaining Nut	20 N•m (180 in-lbs)	
Rear Jounce Bumper Mounting Bracket-to-Frame Nut (3/8-16)	41 N•m (30 ft-lbs)	
D and W250 and 350 Models		
Rear Jounce Bumper Retaining Nut	23 N•m (200 in-lbs)	
STABILIZER BAR		
2WD Vehicles		
Link Rod-to-Front Strut Rod Nuts (5/16-18)	23 N•m (200 in-lbs)	
Stabilizer Bar Bracket-to-Frame Nuts (7/16-14)	68 N•m (50 ft-lbs)	
U-Shaped Bracket-to-Mounting Bracket Nut (5/16-18)	23 N•m (200 in-lbs)	
Stabilizer Bar-to-Link Rod Nut (5/16-18)	11 N•m (100 in-lbs)	
4WD Vehicles		
U-Shaped Bracket-to-Frame Nuts (5/16-18)	23 N•m (200 in-lbs)	
Link Rod-to-Spring Bracket Nut (1/2-13)	102 N•m (75 ft-lbs)	
Stabilizer Bar to Link Rod Nut (5/16-18)	11 N•m (100 in-lbs)	
UPPER SUSPENSION ARM (2WD)		
Camber/Caster Adjustment Cam Nut	95 N•m (70 ft-lbs)	
Upper Ball Joint-to-Steering Knuckle Nut	142 N•m (105 ft-lbs)	
LOWER SUSPENSION ARM (2WD)		
Arm-to-Frame Pivot Bolt Nut (5/8-18 & 3/4-16)	237 N•m (175 ft-lbs)	
Lower Ball Joint-to-Steering Arm Nut HD	237 N•m (175 ft-lbs)	
SD	183 N•m (135 ft-lbs)	
Strut Rod-to-Lower Arm Nut (1/2-13)	136 N•m (100 ft-lbs)	
Strut Rod Front Nut	70 N•m (52 ft-lbs)	
STEERING KNUCKLE		
Steering Knuckle-to-Steering Arm Nut Heavy Duty Suspension	305 N•m (225 ft-lbs)	
Standard Suspension	294 N•m (217 ft-lbs)	

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STEERING

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STEERING SYSTEM DESCRIPTION

Ram Truck and Ramcharger vehicles can be equipped with either manual steering or a power (assisted) steering system. A recirculating-ball type steering gear is used for both systems (Fig. 1).

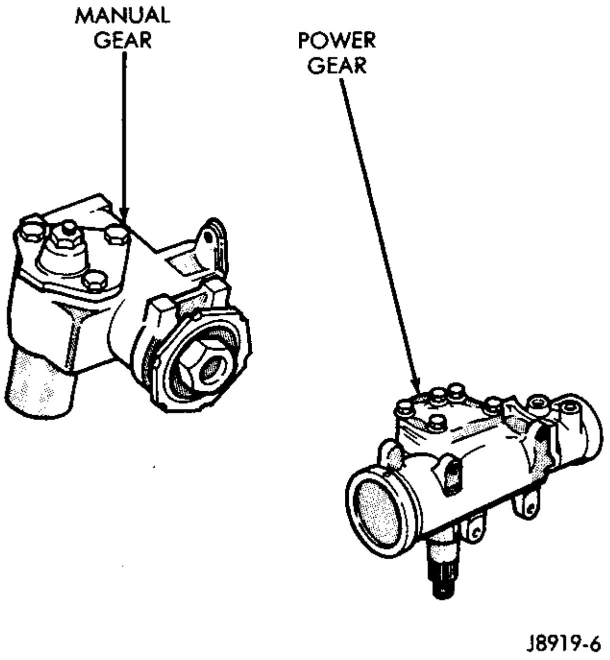

Fig. 1 Steering Gears

A manual steering system consists of a steering gear and the steering linkage.

A power (assisted) steering system consists of a steering gear; the interconnecting hoses and fittings; a belt-driven power steering pump with an integral fluid reservoir (Fig. 2); and the steering linkage. The power steering gear and pump can be adjusted and internally serviced.

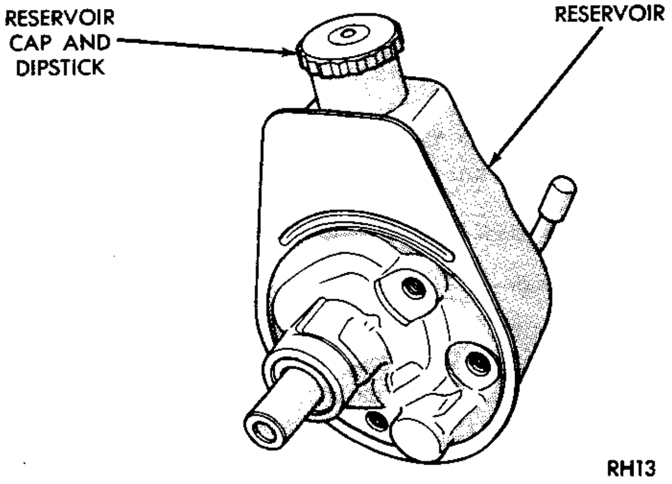

Fig. 2 Power Steering Pump

Steering wheel movement is transferred by the steering column shaft to the steering gear via a universal joint coupler. The steering gear converts the rotational movement of the steering column shaft to transverse movement for the tie rods. The tie rods and the tie-rod ends transfer this movement to the steering knuckle arms and the wheels/tires while simultaneously accommodating movement of the vehicle front suspension.

If the front tire tread becomes worn, the steering effort will increase because of the decrease in surface friction.

STEERING LINKAGE

DESCRIPTION—2WD VEHICLES

The steering linkage for 2WD vehicles (Fig. 3) consists of a steering gear pitman arm, a center link, two tie rods (with removal and adjustable ends), and an idler arm. The adjustment sleeves at the tie-rod ends provide for "toe" position adjustment. The tie rod threaded-ends have right-hand threads to accept the adjustment sleeve.

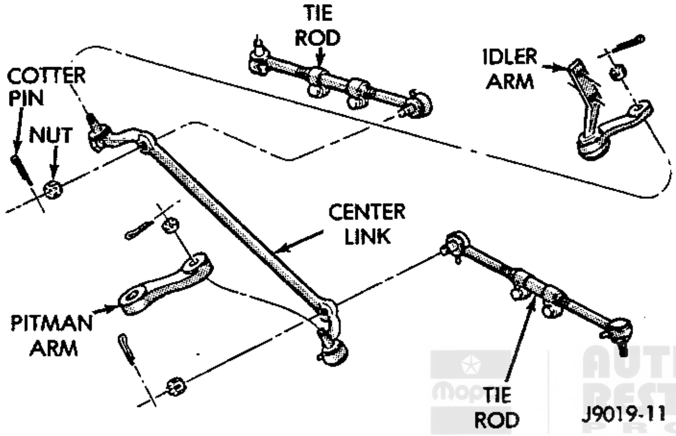

Fig. 3 Steering Linkage—2WD Vehicles

The center link is connected to the pitman arm at one end and to the idler arm at the opposite end. The inner tie-rod ends are connected to the center link and the outer tie-rod ends are connected to the steering knuckle arms (Fig. 3).

MANUAL STEERING GEAR

DESCRIPTION

The manual steering gears (Fig. 4) installed in Ram Truck and Ramcharger vehicles are designed to provide easy steering with minimum friction within the steering gear. A recirculating ball nut travels up and down on a wormshaft that is supported by recirculating balls, which function as the worm (screw) thread. The wormshaft and ball nut are supported in the steering gear housing by an adjustable, ball-thrust type upper and lower bearing.

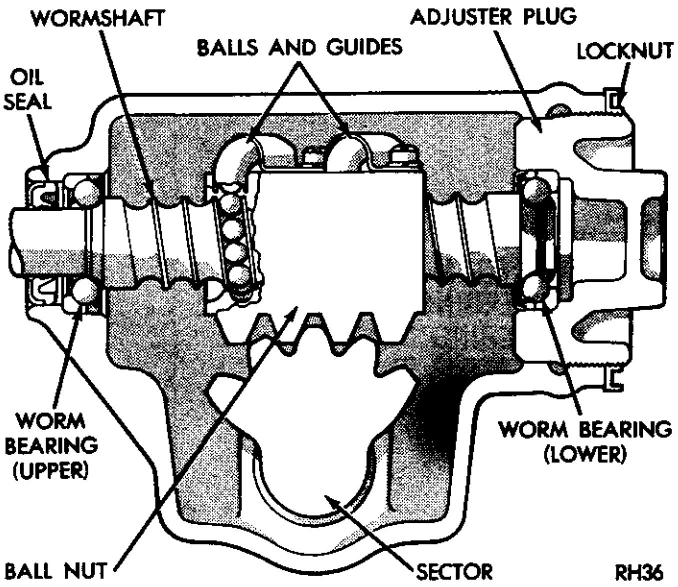

Fig. 4 Manual Steering Gear

POWER STEERING GEAR

DESCRIPTION

The power steering gear is comprised of a gear housing that contains a pitman (sector) shaft with sector gear, a power piston with gear teeth that are "broached" into the side of the piston (which are in constant mesh with the pitman/sector shaft gear teeth), and a wormshaft that connects the steering column shaft to the power piston via a fabric and rubber coupler.

The steering valve, located on top of the steering gear, directs the flow of fluid in the steering gear. Fluid is supplied to the steering gear by a belt (engine) driven, constant displacement, vane-type pump via a high pressure hose. Fluid is returned to the pump reservoir from the steering gear via a low pressure, return hose.

BUILD DATE

The steering gear build date code is stamped into the pitman (sector) shaft adjustment screw combination aluminum gasket and date tag with a four digit number. The first three digits represent the day of the year. The fourth digit represents the year. For example, build date code 2908 means the 290th day (i.e., Oct. 16) of 1989.

POWER STEERING PUMP

DESCRIPTION

Hydraulic fluid pressure is provided for operation of the power steering gear by a belt driven power steering pump (Fig. 2). The power steering pump is a constant displacement, vane-type pump. The pump housing and the internal components are combined with the reservoir to form a one-piece mechanism. The "ham can" shaped, integral reservoir has a pressure hose attachment located at the rear of the pump. The power steering pump is connected to the steering gear via a high pressure hose and a low pressure, return hose. The pump shaft has a "pressed-on" pulley that is belt driven by the crankshaft pulley.

Because of the unique shaft bearings, the different flow control levels and the different pump displacements, Ram Truck and Ramcharger power steering pumps are not interchangeable with pumps installed in other vehicles.

STEERING COLUMNS

DESCRIPTION

Two general types of steering columns are installed on Ram Truck and Ramcharger vehicles: a fixed, non-tiltable column and a tiltable column. The multi-position, tiltable column is optionally available.

The tiltable steering column has a "spring-loaded", movable upper housing that provides multi-steering wheel positions in a vertical plane.

The ignition key/lock cylinder and the ignition switch are located in the steering column. When the key/lock cylinder is turned to the LOCK position, the ignition switch and the steering shaft cannot be operated. For vehicles with an automatic transmission, the lock mechanism also prevents operation of the column-mounted gear shift/selector mechanism.

The center, slip-type (telescoping) intermediate shaft is attached to the steering gear shaft with a flexible coupler and to the steering column shaft with a universal joint.

Both types of steering columns have anti-theft provisions, plus they are energy-absorbing (i.e., collapse from impact in the event of a front-end collision).

SERVICE PRECAUTIONS

Periodic lubrication of the steering linkage ball studs is a requirement, refer to Group 0—Lubrication and Maintenance for the correct lubricant specification and the recommended time interval/distance schedule.

The tie-rod end "boot" seals can be replaced separately and should always be inspected for damage when the vehicle chassis is lubricated.

All front suspension components that contain rubber should be tightened only when the suspension system is at the normal height above the surface and with the complete weight of the vehicle on the wheels/tires. Rubber bushings should never be lubricated with a petroleum-based lubricant.

Safety goggles should be worn at all times when involved with power steering service.

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TIE-ROD END—REMOVAL/INSTALLATION

SERVICE INFORMATION

Before removing a tie-rod end, the "boot" seal should be closely inspected for excessive wear and damage. If a seal is damaged (i.e., the ball stud exposed), it should be removed and the tie-rod end ball stud inspected. If the ball stud is not excessively worn or corroded (i.e., "rusted") and the lubricant is in-tact (and is not contaminated), install a replacement seal; otherwise, a complete replacement tie-rod end should be installed. Lubricate the tie-rod end ball stud with "long-life" chassis lubricant (e.g., MOPAR Multi-Mileage Lubricant, or an equivalent product).

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the cotter pin and the retaining nut from the applicable tie-rod end ball stud (i.e., either at the steering knuckle or at the center link).

Removal of a tie-rod end ball stud from a steering knuckle arm bore or from a center link bore by methods other than using an appropriate puller tool (e.g., Tool C-3894-A) will damage the tie-rod end ball stud seal.

(3) As applicable, install Puller Tool C-3894-A on the tie-rod end ball stud at the steering knuckle (Fig. 1) or at the center link.

(4) Apply sufficient force with the puller tool (Fig. 1) to loosen the tie-rod end ball stud from the steering knuckle arm bore or from the center link bore.

(5) Loosen the applicable tie-rod sleeve clamp nut and bolt and un-thread the tie-rod end from the sleeve.

INSTALLATION

(1) Thread the replacement tie-rod end into the tie rod sleeve.

(2) As applicable, insert the tie-rod end ball stud into the steering knuckle arm bore or the center link bore (Fig. 2). Install the stud retaining nut and tighten it with 61 N•m (45 ft-lbs) torque. Install a replacement cotter pin in the ball stud.

(3) Remove the supports and lower the vehicle to the surface. Adjust the wheel "toe" position (refer to the Alignment Specifications chart within **Group 2—Front Suspension**).

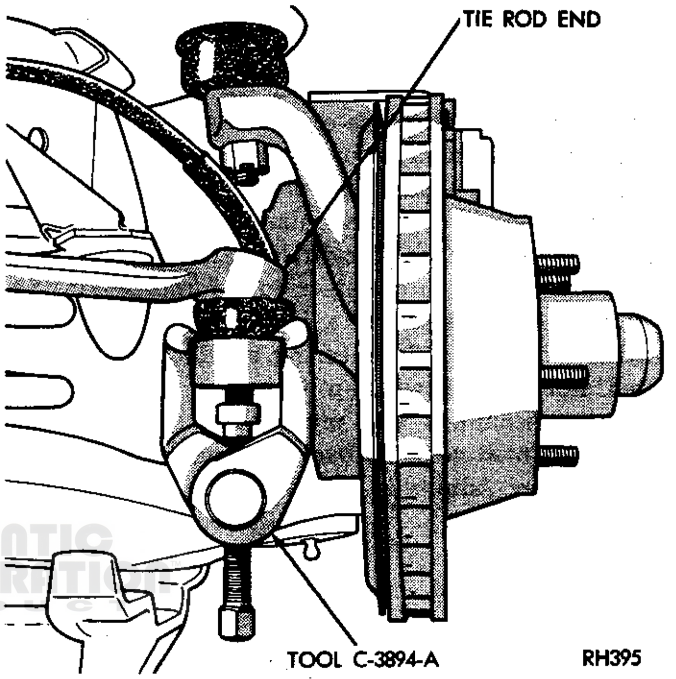

Fig. 1 Tie-Rod End Removal

Position the clamp on the sleeve (Fig. 2) so that the retaining bolt is located on the bottom side of the sleeve and the clamp slot is aligned with the sleeve slot.

(4) After adjustment, tighten the sleeve clamp bolt with 20 N•m (177 in-lbs) torque.

STEERING LINKAGE—REMOVAL/INSTALLATION

SERVICE INFORMATION

Before removing a tie-rod end, idler arm, pitman (steering) arm or center link (Fig. 2), all the ball stud "boot" seals should be closely inspected for excessive wear and damage. If a seal is damaged (i.e., the ball stud is exposed), it should be removed and the ball stud inspected. If the ball stud is not excessively worn or corroded (i.e., "rusted") and the lubricant is in-tact (and is not contaminated), install a replacement seal; otherwise, a complete replacement component should be installed. Lubricate the ball stud with "extended-life" chassis lubricant (e.g., MOPAR MultiMileage Lubricant, or an equivalent multi-purpose, NLGI Grade 2 EP lubricant).

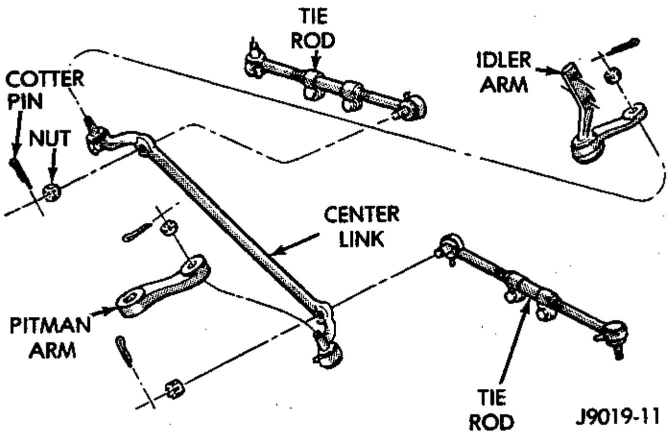

Fig. 2 Steering Linkage

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the cotter pins and retaining nuts from the tie-rod ends and center link ball studs.

Removal of a ball stud (Fig. 1) from a steering knuckle arm bore, from a center link bore or a pitman (steering) arm bore (Fig. 2) by methods other than using an appropriate puller tool (e.g., Tool C-3894-A) will damage the ball stud seal.

(3) Remove the outer tie-rod end ball studs from the steering knuckle arm bores (Fig. 2). Use care to avoid damaging the seals.

(4) Remove the inner tie-rod end ball studs from the center link bores (Fig. 2). Use care to avoid damaging the seals.

(5) Remove the center link ball stud from the idler arm bore (Fig. 2). Use care to avoid damaging the seal.

(6) Remove the center link ball stud from the pitman (steering) arm bore (Fig. 2). Use care to avoid damaging the seal. Remove the steering linkage from the vehicle.

(7) Remove the idler arm bracket retaining nuts from the frame bolts (Fig. 2).

(8) Remove the retaining nut and the pitman (steering) arm from the steering gear pitman (sector) shaft with Removal Tool C-4150.

INSTALLATION

(1) Replace all steering linkage components (Fig. 2) that are either damaged or excessively worn.

(2) Position the idler arm bracket at the frame and install the retaining nuts on the bolts (Fig. 2). Tighten the retaining nuts with 54 N•m (40 ft-lbs) torque.

(3) Install the pitman (steering) arm on the steering gear pitman (sector) shaft. Tighten the retaining nut with 237 N•m (175 ft-lbs) torque.

CAUTION: Care must be exercised when installing a center link. It is possible to install it back to front (i.e., reversed position), which will result in incorrect geometry and tie rod-to-center link and tie rod-to-strut interferences during vehicle jounce. Viewed from the front of the vehicle, the center link ends should turn upward. Viewed from the side of the vehicle, the ends should turn toward the front of the vehicle. The tie-rod ball studs enter the center link bores from the rear.

(4) Position the center link ball studs at the idler arm and at the pitman (steering) arm (Fig. 2). Install and tighten the ball stud retaining nuts with 54 N•m (40 ft-lbs) torque. Install replacement cotter pins in the ball studs.

(5) Connect the tie-rod end ball studs to the steering knuckle arms and to the center link (Fig. 2). Tighten the retaining nuts with 61 N•m (45 ft-lbs) torque and install replacement cotter pins in the ball studs.

(6) Remove the supports and lower the vehicle to the surface. Adjust the wheel "toe" position (refer to the Alignment Specifications chart within **Group 2—Front Suspension**).

Position the clamp on the tie-rod adjustment sleeve (Fig. 2) so that the retaining bolt is located on the bottom side of the sleeve and the clamp slot is aligned with the sleeve slot.

(7) After adjustment, tighten the sleeve tie-rod adjustment sleeve clamp bolt with 20 N•m (177 in-lbs) torque.

MANUAL STEERING GEAR SERVICE

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SERVICE INFORMATION

Manual steering gears (Fig. 1) are designed to provide easy steering with minimum friction within the steering gear. A recirculating ball nut travels up and down on a wormshaft that is supported by recirculating balls, which function as the worm (screw) thread. The wormshaft and ball nut are supported in the steering gear housing by an adjustable, ball-thrust type upper and lower bearing.

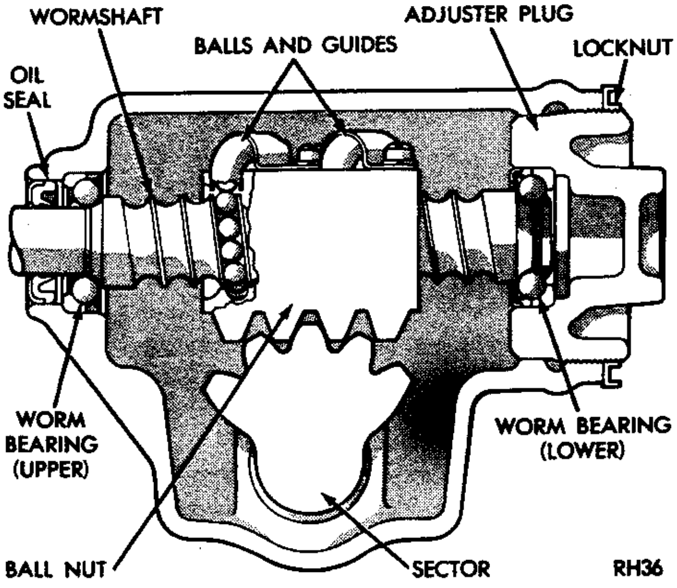


Fig. 1 Manual Steering Gear

The sector shaft and the sector gear are integral. The sector shaft gear teeth mesh with the rack teeth on the recirculating ball nut. The teeth mesh (lash) adjustment is provided by the sector shaft gear adjustment screw, which extends through the housing cover.

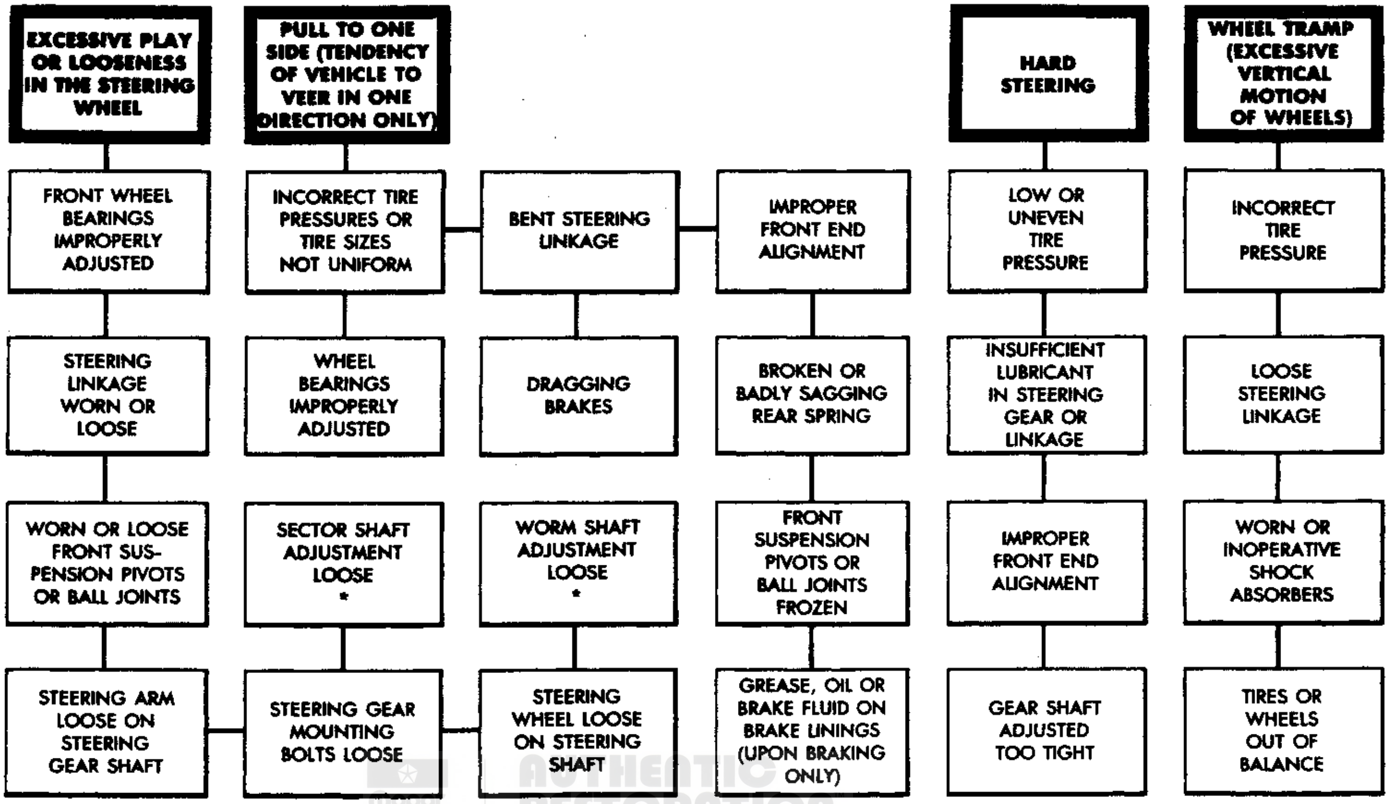
The sector shaft gear teeth and the ball nut rack teeth are designed so that a tighter meshing exists between the two when the front wheels are straight ahead. Correct meshing between the sector shaft gear and ball nut rack teeth is obtained by adjusting an adjustment screw, which moves the sector shaft gear endwise and produces the desired meshing of the tapered sector shaft gear and ball nut rack teeth.

The wormshaft bearing adjustment plug is adjusted to provide the correct "preloading" of the upper and lower wormshaft thrust bearings.

DIAGNOSIS

To use the Manual Steering Gear Diagnosis chart: read the conditions described within the upper, bold-outlined squares and select the condition that requires correction and follow the connecting lines into the squares describe the possible causes. In most instances, the required corrective action is obvious, however, an asterisk (*) indicates an existing service procedure that is located within an applicable group of this manual.

MANUAL STEERING GEAR DIAGNOSIS



* TESTS, ADJUSTMENTS AND PROCEDURES ARE DESCRIBED IN THIS MANUAL

ON-VEHICLE ADJUSTMENTS

Two adjustments are provided for manual steering gears (Figs. 2 and 3). The wormshaft bearing “preload” torque adjustment and the ball nut rack/sector shaft gear teeth mesh (lash) adjustment.

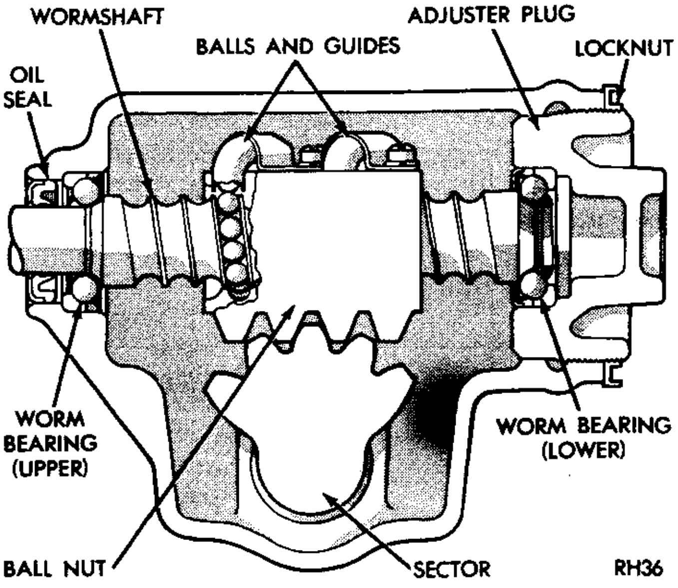


Fig. 2 Wormshaft “Preload” Torque Adjustment

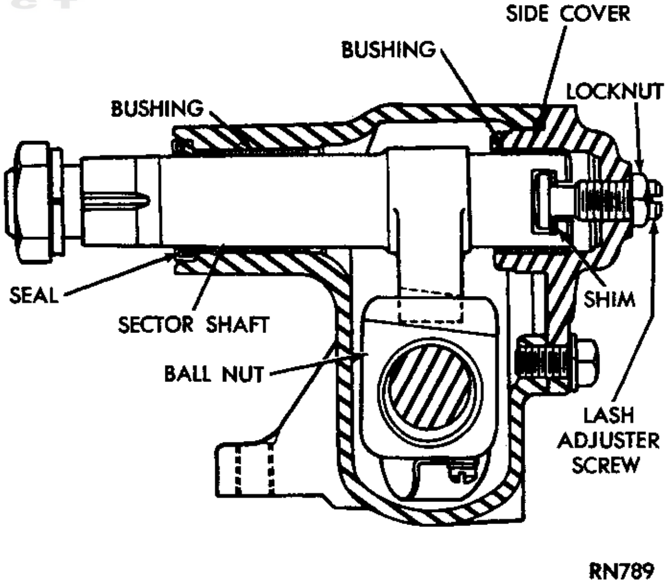


Fig. 3 Ball Nut Rack/Sector Shaft Gear Teeth Mesh (Lash) Adjustment

Before an adjustment can be initiated for the ball nut rack/sector shaft gear teeth mesh (lash), it must be determined that the wormshaft bearing “preload” torque is properly adjusted.

The wormshaft bearing “preload” torque adjustment is provided by the wormshaft thrust bearing plug adjuster that threads into the housing at the lower end of the wormshaft.

Safety goggles should be worn at all times when involved with steering gear service.

WORMSHAFT BEARING "PRELOAD" TORQUE ADJUSTMENT

(1) Disconnect and remove the pitman (steering) arm from the pitman (sector) shaft with Tool C-4150 (Fig. 4).

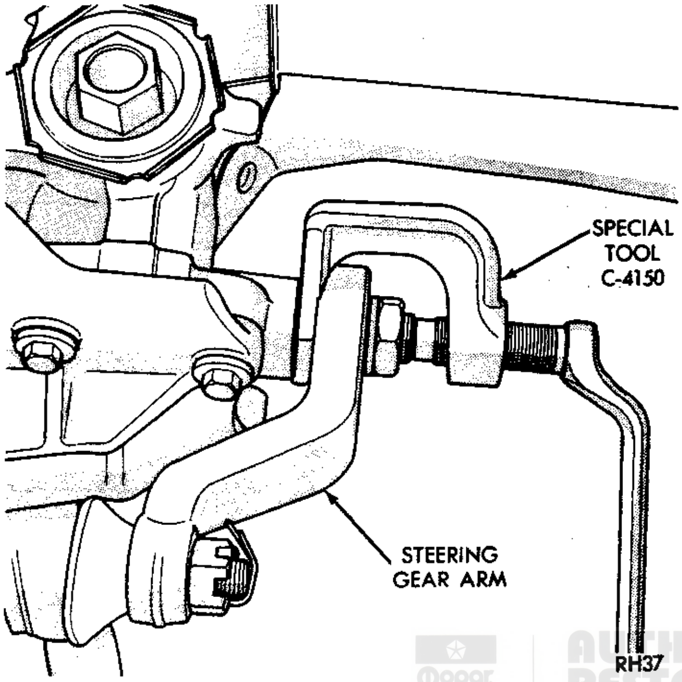


Fig. 4 Pitman (Steering) Arm Removal

(2) Remove the horn contact cover.

(3) Loosen the sector shaft adjustment screw locknut and un-thread the adjustment screw 1/2 to 2 turns (Fig. 3). This will relieve any friction load that could exist between the closely meshed ball nut rack and sector shaft gear teeth.

(4) Turn the steering wheel to the right "stop" and then back 1/2 turn. Position Tool C-3380 (or an appropriate torque wrench) on steering shaft nut.

(5) Rotate the steering shaft from the right "stop" toward the straight ahead position with Tool C-3380 while noting the indicated "preload" torque.

(6) The torque required to rotate the steering shaft should be between 0.56 and 0.68 N•m (4 and 6 in-lbs). If the torque is not within this range, a "preload" torque adjustment is necessary.

(7) Loosen the plug adjuster locknut (Fig. 2).

(8) Turn the plug adjuster clockwise to increase the "preload" torque and counterclockwise to decrease the torque.

(9) While preventing the plug adjuster from rotating, tighten the locknut securely, and then measure the wormshaft bearing "preload" torque.

BALL NUT RACK/SECTOR SHAFT GEAR TEETH MESH (LASH) ADJUSTMENT

The sector shaft gear adjustment screw (located in housing cover) raises or lowers the position of the shaft to provide the correct mesh between the tapered sector shaft gear teeth and the tapered ball nut rack teeth. This adjustment can be accurately completed only after the wormshaft bearing "preload" torque has been correctly adjusted.

(1) Rotate the steering wheel gently from one "stop" to the other and accurately count the number of rotations. Turn the steering wheel back exactly half way to the center position.

(2) Turn the sector shaft adjustment screw clockwise to remove all the lash that exists between the ball nut rack and sector shaft gear teeth, and then tighten the adjustment screw locknut with 47 N•m (35 ft-lbs) torque.

(3) Rotate the steering wheel approximately 1/4 turn away from the overcenter position. Then, with a torque wrench on the steering wheel nut, measure the torque required to rotate the steering wheel through the overcenter position. The indicated overcenter drag torque should be 1.6 N•m (14 in-lbs). The measured (drag) torque represents the total of the wormshaft bearing "preload" torque and the ball nut rack/sector shaft gear teeth mesh friction load. Readjust the sector shaft adjustment screw (if necessary) to obtain the correct drag torque.

(4) After the adjustment have been completed, place the front wheels in a straight ahead position, and, with the steering gear and steering wheel centered, install the pitman (steering) arm lockwasher and nut on the pitman shaft.

(5) Tighten pitman (steering) arm retaining nut with 237 N•m (175 ft-lbs) torque. Install a replacement cotter pin.

(6) Install the horn contact cover.

REMOVAL/DISASSEMBLY

REMOVAL

(1) Remove the two bolts from the wormshaft-to-steering shaft coupler.

(2) Remove the pitman (steering) arm from the pitman shaft with Tool C-4150 (Fig. 4).

(3) Remove the steering gear-to-frame bolts and remove the gear from the vehicle.

PITMAN SHAFT SEAL—REPLACEMENT

(1) Raise and support the vehicle. Place the front wheels in the straight-ahead position.

(2) Disconnect the center link from the pitman (steering) arm.

(3) Mark the pitman (steering) arm and the pitman shaft positions for installation reference and remove the pitman arm from the pitman shaft with a puller tool (Fig. 4).

(4) Remove the pitman shaft seal with a pointed tool or a screw driver with a small blade.

(5) Inspect the condition of the steering gear lubricant. If it is contaminated (e.g., contains metal particles), remove and recondition the steering gear.

CAUTION: A protective wrap must be used to enclose the shaft threads/splines during the shaft seal installation. If the shaft seal is installed over exposed shaft threads or splines, the seal lip could be cut or distorted and result in leakage after installation.

(6) Wrap the pitman shaft threads/splines with 0.1-mm (0.005-in) thick shimstock (or a single layer of the thinnest plastic tape available) to protect the replacement seal during installation.

(7) Lubricate the lip of the replacement seal with chassis lubricant. Slide the seal over the shimstock/tape and shaft and into the steering gear housing recess. Remove the shimstock/tape from the shaft. Complete the seal installation by tapping the seal with a small plastic mallet to “seat” it in the housing recess.

(8) With the arm and the shaft installation reference marks aligned, position the pitman (steering) arm on the pitman shaft.

(9) Install the washers and the retaining nut on the pitman shaft and tighten the nut with 237 N•m (175 ft-lbs) torque. Install a replacement cotter pin.

(10) Connect the center link to the pitman (steering) arm. Tighten the retaining nut with 54 N•m (40 ft-lbs) torque. Install a replacement cotter pin.

(11) Remove the supports and lower the vehicle.

DISASSEMBLY

(1) Remove the flexible coupling.

(2) Position the steering gear in a vise and clamp it in-place at the mounting bosses only.

(3) Rotate the wormshaft from stop-to-stop and count the total number of rotations. Rotate the wormshaft in the reverse direction 1/2 of the total number of rotations to center it and the ball nut.

(4) Remove the pitman (sector) shaft adjustment screw locknut. Remove the cover retaining bolts, cover, and gasket (Fig. 5).

(5) Slide the adjustment screw head (Fig. 6) out of the pitman (sector) shaft T-slot and remove it and the shim(s).

(6) Retain the shim(s) for “end-play” measurement during assembly.

(7) Remove the pitman (sector) shaft, the wormshaft bearing “preload” torque adjustment plug locknut, and the adjustment plug (Fig. 6).

(8) Remove the wormshaft and the ball nut (Fig. 7).

(9) Remove (pry) the pitman (sector) shaft and the wormshaft seals from the steering gear housing (Fig. 8).

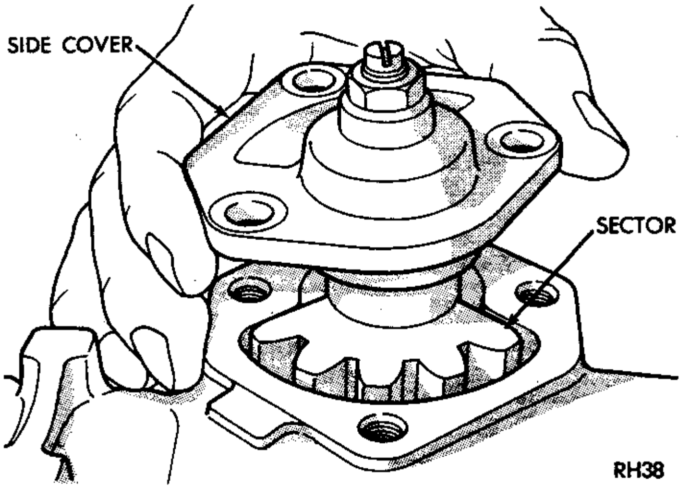


Fig. 5 Pitman (Sector) Shaft Removal

WORMSHAFT AND BALL NUT—DISASSEMBLY

(1) Remove the upper bearing from the wormshaft (Fig. 6).

CAUTION: Do not allow the ball nut to rotate freely and travel to either extreme end of the wormshaft. This could damage the tangs at the ends of the recirculating ball guides (Fig. 6).

(2) Remove the recirculating ball guide clamp retaining screws, the clamp and the guides (Fig. 6). Separate the half-guides and place the recirculating balls aside in a container.

(3) Hold the ball nut over a cloth and remove the remaining recirculating balls from the ball nut circuits by rotating the wormshaft back and forth until the balls drop out on the cloth.

There are a total of 50 recirculating balls within the ball nut and the guides (25 in each circuit).

(4) Remove the wormshaft from the ball nut (Fig. 6).

WORMSHAFT AND BALL NUT—CLEANING AND INSPECTION

(1) Clean all the components in a cleaning solvent and dry them with a clean cloth and/or compressed air.

(2) Inspect each component for wear, scoring, cracks, nicks and surface pitting. Replace as necessary.

WORMSHAFT AND BALL NUT—ASSEMBLY

CAUTION: The ball nut teeth are wider and deeper on one side than on the other. When assembling the wormshaft and ball nut, position the ball nut so that the wider/deeper side of the teeth is closer to the housing cover opening after installation.

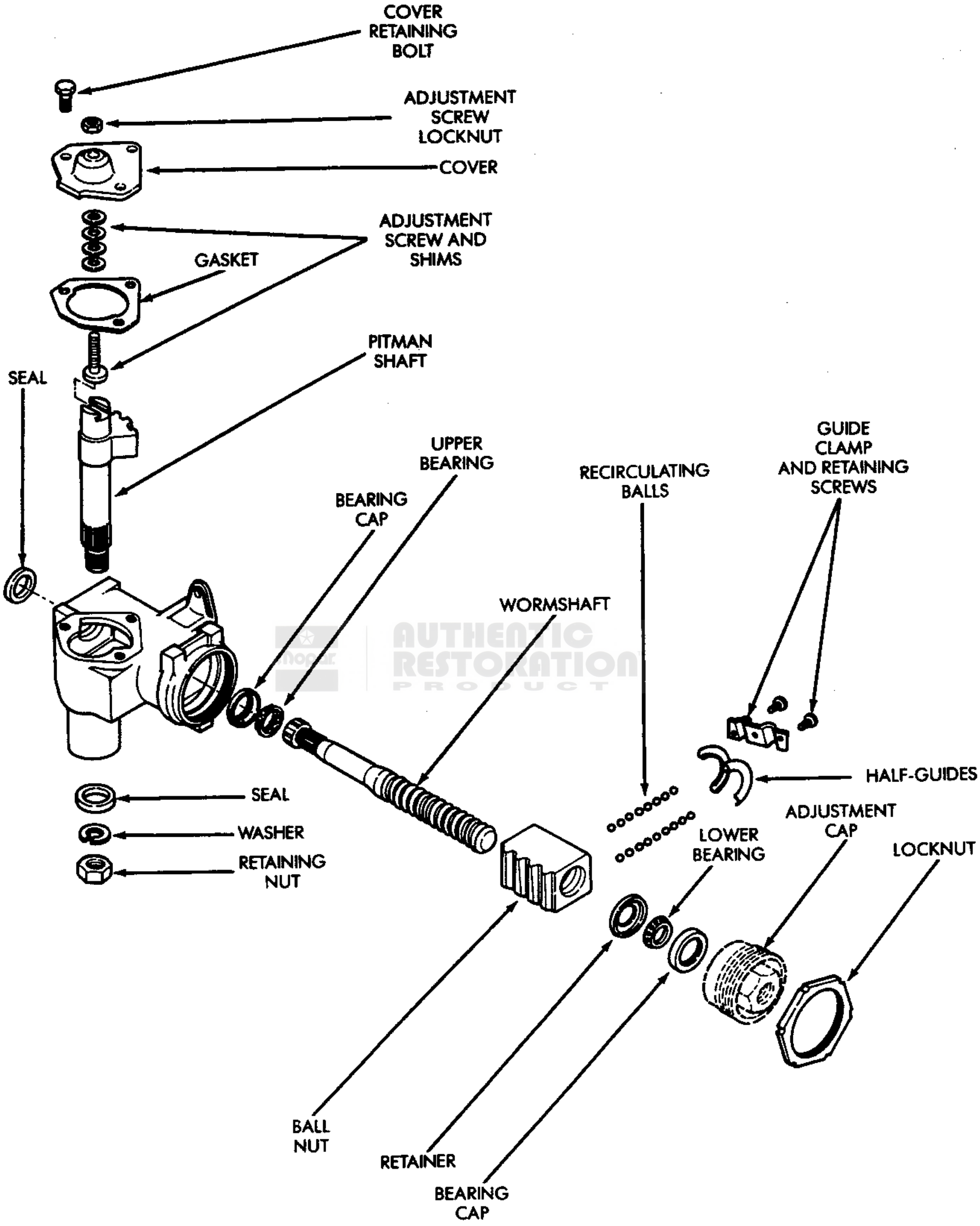


Fig. 6 Manual Steering Gear—Exploded View

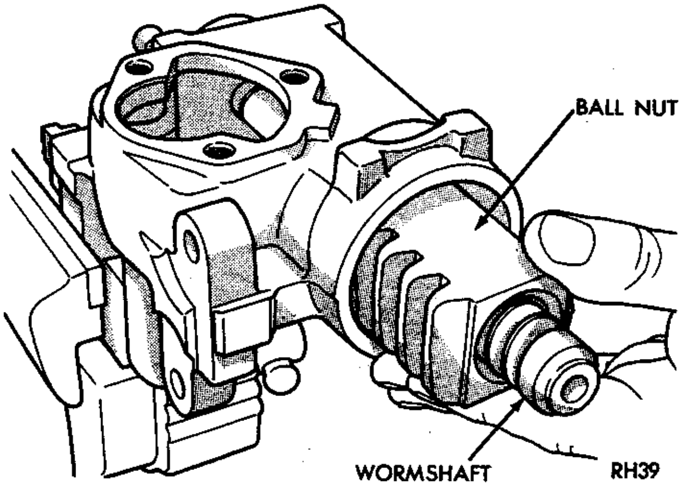


Fig. 7 Wormshaft & Ball Nut Removal

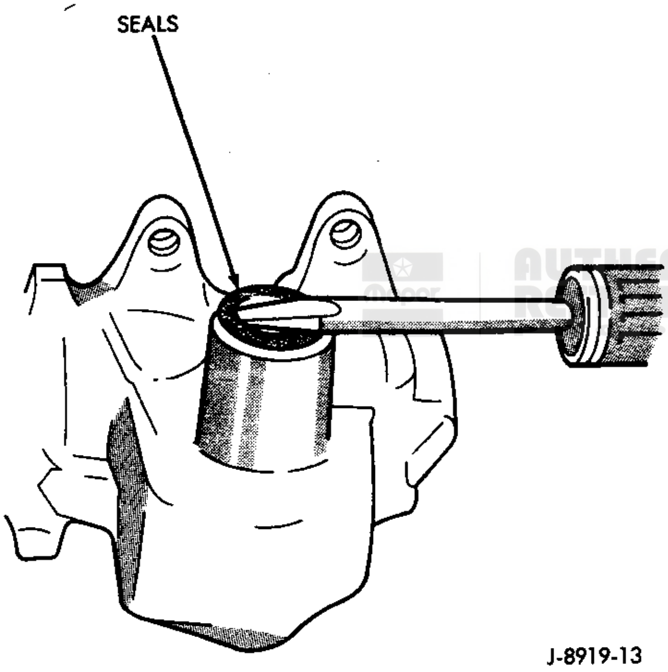


Fig. 8 Shaft Seal Removal

(1) Position the ball nut with the recirculating ball guide holes facing upward and the ball nut teeth facing downward. Install the wormshaft in the ball nut. Rotate the shaft and thread it into the nut until an equal number of shaft threads are visible at each end of the nut (Fig. 9).

(2) Install one recirculating ball in each ball guide hole. Move the wormshaft up/down and side-to-side until the balls roll into the ball nut threads at the bottom of wormshaft and support the wormshaft.

(3) Assemble and install the ball guides in the ball nut (Fig. 10).

(4) Divide the remaining 48 recirculating balls into two groups and install 24 balls in each ball nut circuit. Insert the balls in the ball nut circuits through the holes in the ball guides (Fig. 10).

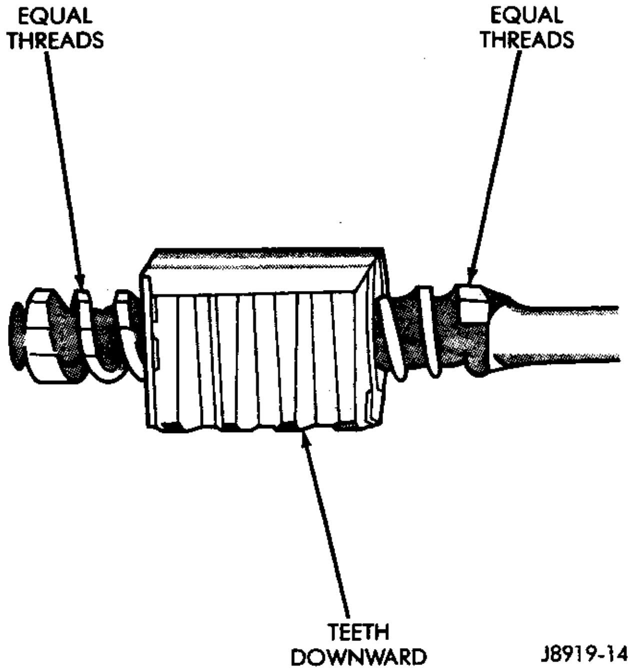


Fig. 9 Wormshaft & Ball Nut

To aid the recirculating ball installation, rotate wormshaft back and forth slightly while inserting the balls.

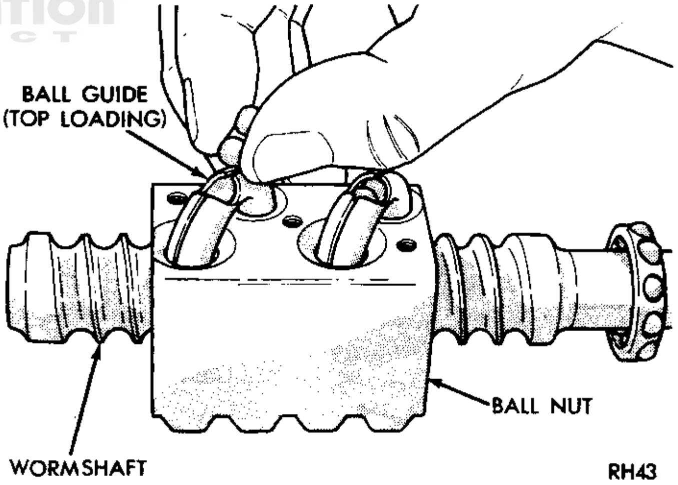


Fig. 10 Recirculating Ball Installation

(5) Place the ball guide clamp on the ball nut and install the clamp retaining screws (Fig. 6). Tighten the screws with 14 N•m (10 ft-lbs) torque.

CAUTION: To avoid damaging the tangs on the ball guide ends, do not allow the wormshaft to travel to the end of the thread in either direction.

(6) Lubricate the wormshaft threads with chassis lubricant and rotate the shaft to move it in-and-out of the ball nut and distribute the lubricant.

(7) Lubricate the wormshaft upper bearing with chassis lubricant and install it on the wormshaft.

WORMSHAFT BEARING ADJUSTMENT PLUG—DISASSEMBLY

(1) Pry out and remove the wormshaft lower bearing retainer from the adjustment plug (Fig. 11).

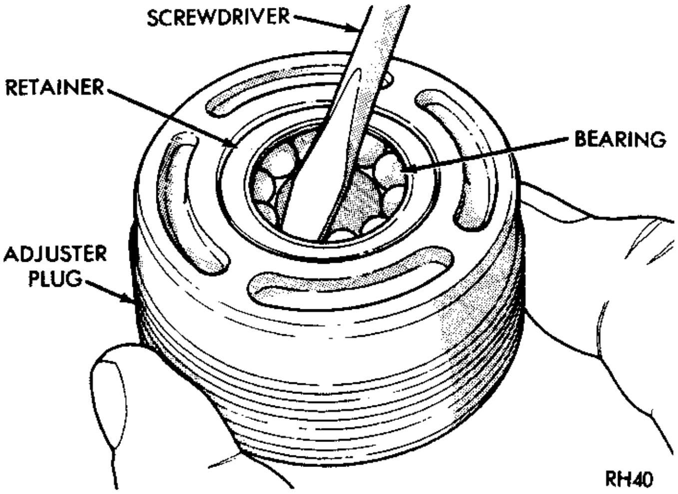


Fig. 11 Wormshaft Lower Bearing Retainer Removal

(2) Remove the wormshaft lower bearing from the adjustment plug.

WORMSHAFT BEARING ADJUSTMENT PLUG—CLEANING/INSPECTION

(1) Clean all the components in cleaning solvent and dry with a clean cloth only.

(2) Inspect each component for wear and damage. Replace as necessary.

WORMSHAFT BEARING ADJUSTMENT PLUG—ASSEMBLY

(1) If the lower bearing cup must be replaced, remove the original cup (Fig. 12) and install a replacement cup (Fig. 14) according to the following instructions:

- install a spare locknut on the adjustment plug (Fig. 12) and clamp the cap in a vise **(clamp the vise jaws on the locknut only)**;
- assemble a puller tool and a slide hammer;
- position the puller tool legs between the bearing cup and the inside of the adjustment plug (Fig. 12);
- tighten the puller tool screw (Fig. 12) to expand and hold the legs in position;
- move the slide hammer weight outward to remove the bearing cup from the adjustment plug (Fig. 12);
- remove the adjustment plug from the vise and remove the spare locknut; and
- install a replacement bearing cup in the adjustment plug with an appropriate installation tool (Fig. 13).

(2) Lubricate the wormshaft lower bearing and place it in the bearing cup.

(3) Install the lower bearing retainer on the adjustment plug. If necessary, tap the retainer lightly with a plastic mallet to "seat" it.

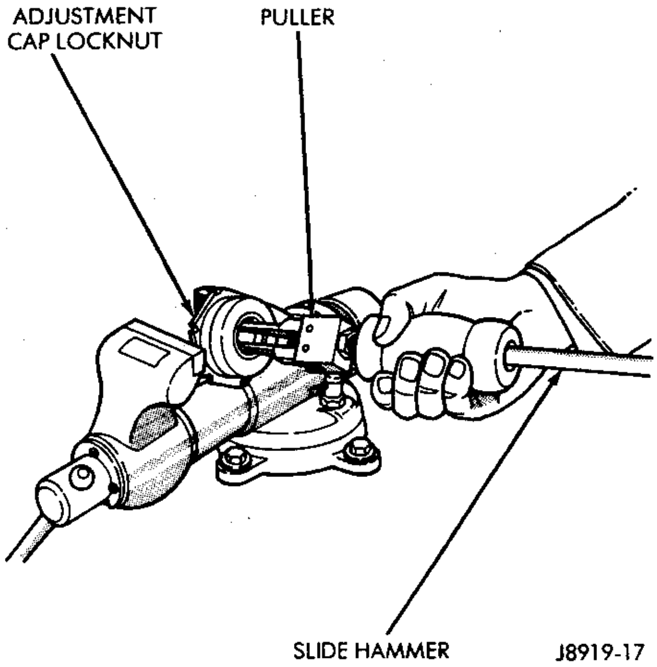


Fig. 12 Bearing Cup Removal

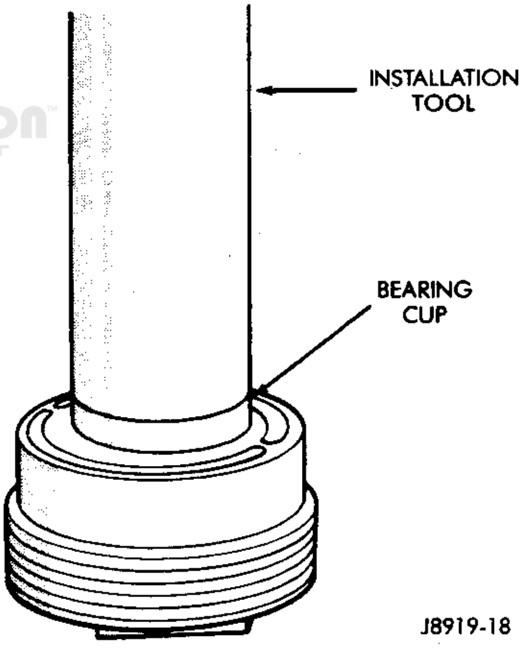


Fig. 13 Bearing Cup Installation

CLEANING AND INSPECTION

(1) Clean the housing and the pitman shaft with cleaning solvent and dry them with a clean cloth and/or compressed air.

(2) Inspect the housing for cracks, porosity, damaged threads and scoring/distortion of the gasket surface area. Repair or replace as necessary.

(3) Inspect the pitman shaft contact surface and the pitman (sector) shaft gear teeth for wear, pitting, and other damage. Replace as necessary.

(4) Insert the pitman (sector) shaft in the steering gear housing shaft bore and inspect for excessive shaft or housing shaft bore wear. The shaft should have a smooth, "bind-free" fit with no visible side play when installed in the shaft bore.

(5) If the shaft fit is loose but it is not visibly worn, trail fit a replacement pitman (sector) shaft in the housing shaft bore. If the replacement shaft also has a loose fit, replace the housing. However, if the replacement pitman fits properly, replace the original pitman (sector) shaft.

(6) Measure the pitman shaft adjustment screw fit and "end-play" in the T-slot (Fig. 14). When installed, the adjustment screw must rotate freely and not bind in any position. Measure the "end-play" by inserting a feeler gauge between the screw head and the T-slot surface. **The "end-play" must not exceed 0.05 mm (0.002 in). If the "end-play" exceeds the specified limit, select and install a replacement shim that reduces the "end-play" to below the specified limit.**

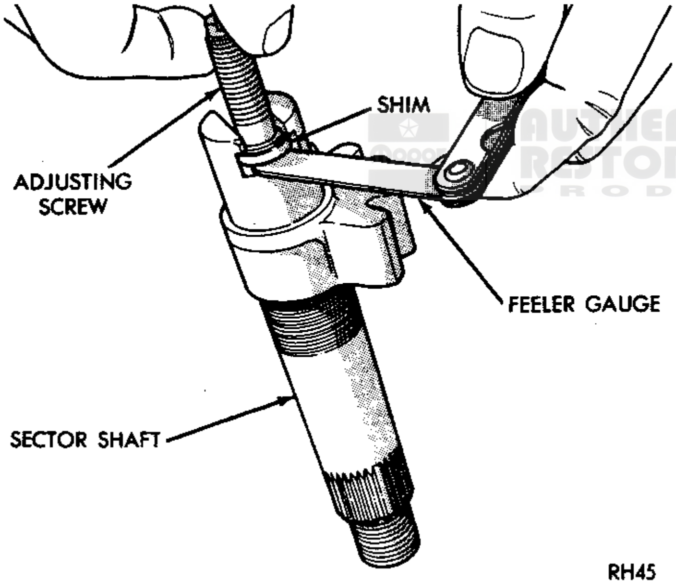


Fig. 14 Adjustment Screw End-Play Measurement

(7) Inspect the wormshaft shaft upper bearing and bearing cup for wear, looseness, flat spots, pitting, cracks, and other damage. If either the bearing or the bearing cup is damaged, both components must be replaced.

(8) If the cup fits loosely in the housing, trial fit a replacement cup. If the replacement cup also fits loosely, replace the housing. If the replacement cup fits properly, replace only the original bearing cup.

ASSEMBLY

(1) If the original wormshaft upper bearing cup must be replaced because of damage, remove it with a hammer and a brass punch (Fig. 15).

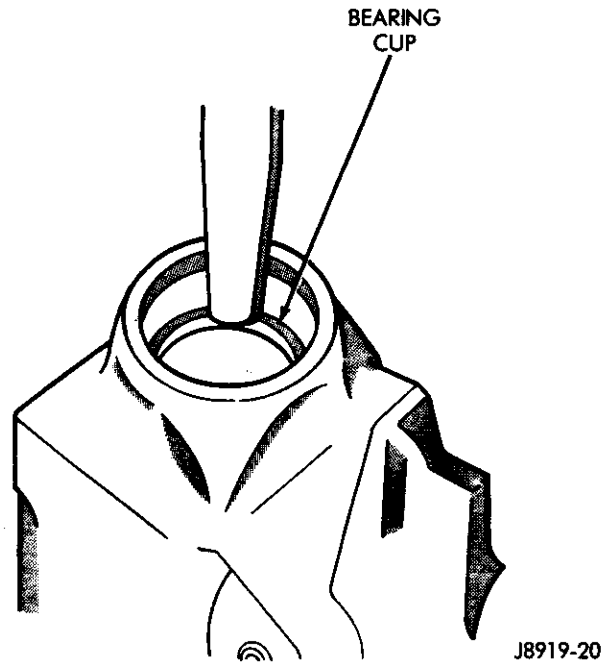


Fig. 15 Wormshaft Upper Bearing Cup Removal

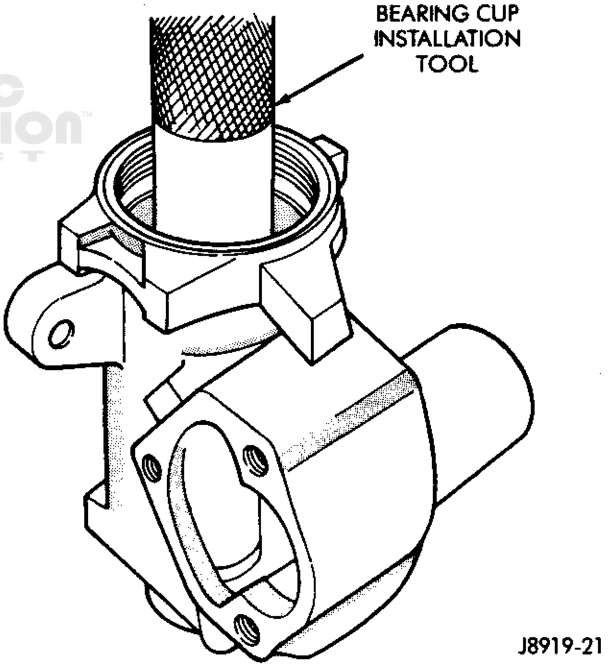


Fig. 16 Wormshaft Upper Bearing Cup Installation

(2) Install a replacement bearing cup with an appropriate installation tool (Fig. 16).

Do not install the wormshaft or the pitman shaft seals at this time.

(3) Lubricate all the components with chassis lubricant.

(4) Place the steering gear housing in a vise. Clamp the vise jaws on the housing mounting bosses only.

(5) Install the wormshaft and ball nut in the steering gear housing.

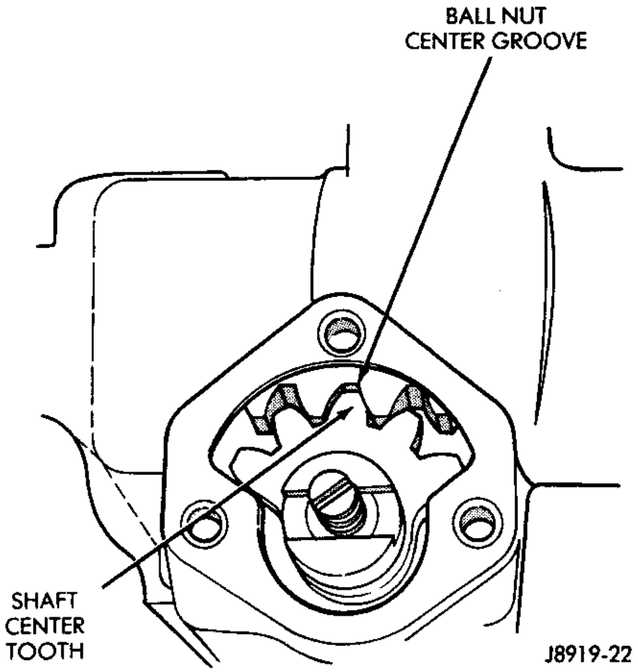


Fig. 17 Pitman Shaft & Ball Nut Engagement

CAUTION: Ensure that the ball nut is installed with the wide/deep side of the ball nut teeth facing toward the cover opening.

(6) Install the wormshaft bearing adjustment cap in the housing and tighten it only enough to remove the wormshaft "end-play".

(7) Install the locknut on the wormshaft bearing adjustment cap but do not tighten it at this time.

(8) Pack the steering gear housing with as much chassis lubricant as possible.

To be able to pack the maximum amount of lubricant into the housing, the ball nut must be moved back and forth for better access to the housing interior. Rotate the wormshaft in one direction until the ball nut ceases. Pack the unobstructed end of the housing full of lubricant, rotate the shaft in the opposite direction and repeat the packing procedure.

(9) Place the ball nut (Fig. 17) in the centered position (i.e., rotate the wormshaft from "stop-to-stop" and count the total number rotations, and then rotate wormshaft in the reverse direction 1/2 of the total number of rotations to center the ball nut).

(10) Lubricate the pitman shaft with chassis lubricant and insert it in the steering gear housing. Engage the center tooth on the shaft with the center groove on the ball nut.

(11) Apply chassis lubricant to the replacement housing cover gasket and position it so that it surrounds the housing cover opening.

(12) Place the shim(s) on the adjustment screw and thread the screw into the cover to a depth of 2 to 3 threads.

(13) Slide the head of the adjustment screw into the pitman shaft T-slot and, with the cover in place, rotate the screw counterclockwise to thread it into the cover. Rotate the screw until the cover almost comes in contact with the gasket.

(14) Install the cover retaining bolts and "finger-tighten" them only. Continue tightening the adjustment screw counterclockwise until the cover is tight against the gasket and then loosen the screw 1/2 rotation.

(15) Tighten the cover bolts with 61 N•m (45 ft-lbs) torque.

CAUTION: A protective wrap must be used to enclose the shaft threads/splines during the shaft seal installation. If the shaft seals are installed over exposed shaft splines or threads, the seal lips could be cut or distorted and result in leakage after assembly.

(16) Install the pitman shaft and wormshaft seals according to the following procedure:

- wrap the pitman shaft threads/splines with 0.1-mm (0.005-in) thick shimstock (or a single layer of the thinnest plastic tape available) to protect the replacement seals during installation;
- lubricate the lips of the replacement seals with chassis lubricant;
- slide the seals over the shimstock/tape and shaft and into the steering gear housing recess;
- remove the shimstock/tape from the shaft;
- complete the seal installation by tapping the seals into the recesses with a small plastic mallet; and
- ensure that each seal is fully "seated" in the housing recess.

(17) Rotate the wormshaft and observe the steering gear operation. With the adjustment screw and the cap loose, the wormshaft should rotate freely and not "bind" in either direction of rotation. If the steering gear "binds", repair as necessary.

(18) Inspect for lubricant leakage from the shaft seals. If there is a leak at either seal, replace the defective seal(s).

ADJUSTMENTS ON-BENCH

A recirculating-ball type steering gear requires two adjustments after assembly:

- wormshaft bearing "preload" torque, and
- pitman (sector) shaft overcenter drag torque.

CAUTION: Adjust the steering gear in the following order only. Always adjust the wormshaft bearing "preload" torque first, and then adjust the pitman shaft overcenter drag torque last. Failure to do so could result in damage to the gear or improper steering response.

(1) Tighten the wormshaft bearing adjustment plug until it is "snug" tight against the bearing, then loosen the adjustment cap 1/4 of-a-turn.

(2) Install a low calibration (e.g., inch-pounds) torque bar with a socket wrench on the splined end of the wormshaft.

The "preload" torque adjustment must be accomplished with the wormshaft rotated away a maximum of 1/2 of-a-turn from either the full-right or the full-left turn stop positions.

(3) Rotate the wormshaft clockwise or counterclockwise to the stop position and then away 1/2 of-a-turn from the stop position.

(4) Tighten the wormshaft bearing adjustment plug (Fig. 18) until the torque required to rotate the wormshaft is 0.6 to 1.0 N•m (5 to 8 in-lbs) torque.

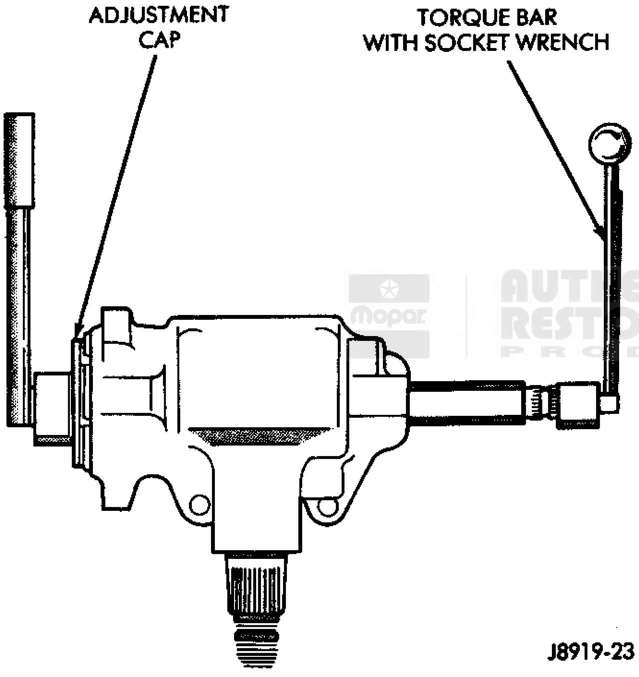


Fig. 18 Wormshaft Bearing "Preload" Torque Adjustment

(5) Tighten the adjustment cap locknut with 68 N•m (50 ft-lbs) torque and measure the "preload" torque. If necessary, adjust the "preload" torque again. Record the "preload" torque for later reference.

CAUTION: Do not attempt to adjust the pitman shaft overcenter drag torque before the wormshaft bearing "preload" torque has been adjusted.

(6) Adjust the pitman shaft overcenter drag torque:
- rotate the wormshaft from stop-to-stop, count the total number of rotations, and rotate the wormshaft in the reverse direction 1/2 of the total number of rotations to center the ball nut/pitman shaft;
- place a low calibration (e.g., inch-pounds) torque bar with a socket wrench on the wormshaft splines (Fig. 19) and, while rotating the wormshaft back and forth overcenter, tighten the pitman shaft adjustment screw until the torque required to rotate the shaft is 1.6 N•m (14 in-lbs);

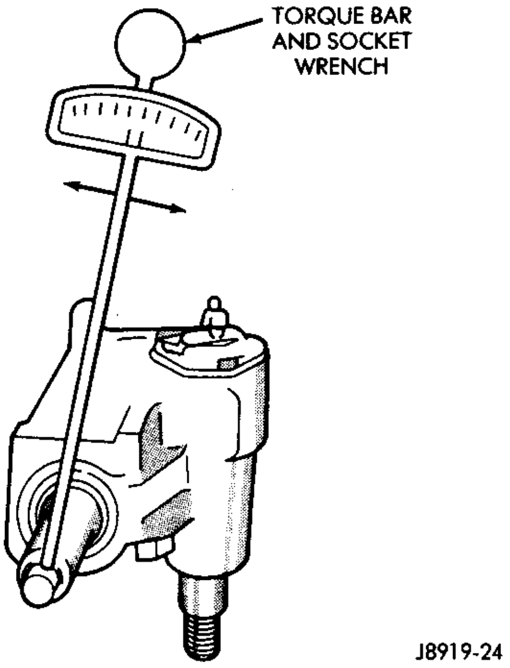


Fig. 19 Overcenter Drag Torque Adjustment

- the overcenter drag torque represents the total of the wormshaft bearing "preload" torque and the ball nut rack/sector shaft gear teeth mesh friction load (re-adjust the sector shaft adjustment screw, if necessary to obtain the correct drag torque);
- hold the pitman shaft adjustment screw and tighten the locknut with 47 N•m (35 ft-lbs) torque; and
- after tightening the locknut, measure the overcenter drag torque again and re-adjust the torque, if necessary.

If the adjustment screw is allowed to rotate while tightening the locknut, the complete overcenter drag torque adjustment procedure must be repeated.

INSTALLATION

(1) Position the steering gear at the frame rail and install the attaching bolts. Tighten the attaching bolts with 136 N•m (100 ft-lbs) torque.

(2) Connect the steering intermediate shaft to the steering gear.

(3) With the pitman arm and the shaft installation reference marks aligned, position the pitman (steering) arm on the pitman shaft.

(4) Install the washers and the retaining nut on the pitman shaft and tighten the nut with 237 N•m (175 ft-lbs) torque. Install a replacement cotter pin.

(5) Connect the center link to the pitman (steering) arm. Tighten the retaining nut with 54 N•m (40 ft-lbs) torque. Install a replacement cotter pin.

(6) Remove the supports and lower the vehicle.

POWER STEERING GEAR SERVICE

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SERVICE INFORMATION

Ram Truck and Ramcharger vehicles are equipped with a recirculating ball, variable ratio power steering gear. Steel balls riding in helical grooves function as a rolling thread between the wormshaft and the rack piston. Teeth on the side of the rack piston mesh with the sector shaft gear teeth. The control valve is housed inside the steering gear housing, negating the need for an externally located valve.

If the hydraulic fluid pressure in the steering system should fail, the driver, by using more effort to turn the steering wheel, can control the vehicle steering manually (i.e., without power assist).

Safety goggles should be worn at all times when involved with power steering gear or pump service.

POWER STEERING GEAR—REMOVAL/INSTALLATION

REMOVAL

(1) Place the front wheels in a straight-ahead position.

(2) Place a drain pan under the steering gear.

(3) Disconnect the fluid hoses from the steering gear. Raise and secure the hoses above the reservoir fluid level to prevent excessive fluid loss. Cap the ends of the hoses to prevent any entry of foreign material.

(4) Disconnect the steering column shaft from the stub shaft.

(5) Raise and support the vehicle.

(6) Disconnect the center link from the pitman (steering) arm.

(7) Remove the pitman (steering) arm retaining nut and washer, mark the pitman (steering) arm and the pitman shaft positions for installation reference and remove the pitman (steering) arm from the pitman shaft with an appropriate puller tool (Fig. 1).

(8) Remove the steering gear retaining bolts at the frame rail and remove the steering gear from the vehicle.

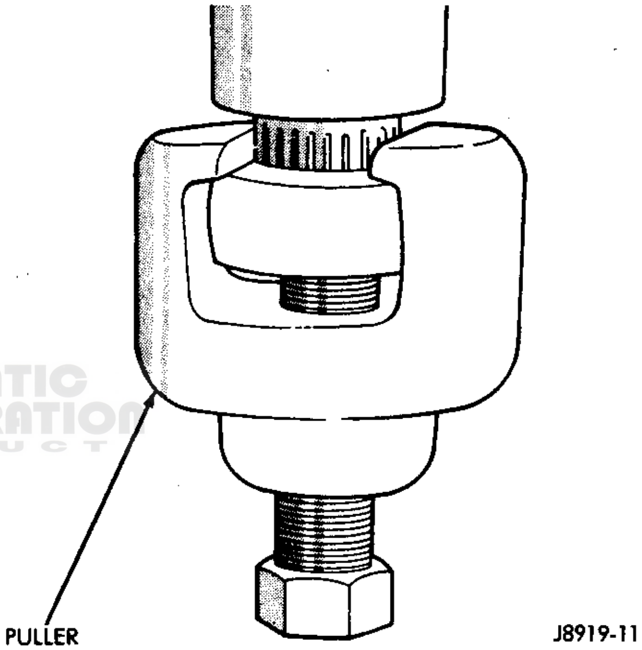

Fig. 1 Pitman (Steering) Arm Removal

INSTALLATION

(1) Position the steering gear at the frame rail, install and tighten the attaching bolts “finger-tight”. Center the steering gear and align the steering column shaft and the stub shaft.

(2) Install the bolts in the steering column shaft-to-stub shaft coupling and tighten with 45 N•m (33 ft-lbs) torque.

(3) If necessary, re-position the steering gear at the frame to eliminate any binding and tighten the attaching bolts with 136 N•m (100 ft-lbs) torque.

(4) With the pitman (steering) arm and shaft installation reference marks aligned, position the pitman (steering) arm on the pitman shaft.

The pitman (steering) arm nut and lock washer must be replaced with either exact replacements (same part numbers), or with equivalent replacements, if replacement is necessary.

(5) Install the lockwasher and the retaining nut on the pitman shaft and tighten the nut with 237 N•m (175 ft-lbs) torque.

(6) Connect the center link to the pitman (steering) arm. Tighten the retaining nut with 54 N•m (40 ft-lbs) torque. Install a replacement cotter pin.

(7) Remove the supports and lower the vehicle.

POWER STEERING GEAR REPAIR SERVICE

SERVICE INFORMATION

The recirculating-ball type power steering gear installed on Ram Truck and Ramcharger vehicles (Fig. 2) has a "variable steering ratio".

Safety goggles should be worn at all times when involved with power steering gear or pump service.

POWER STEERING SYSTEM SERVICE DIAGNOSIS

To use the System Service Diagnosis charts, look for the "condition" that describes the malfunction that requires correction, then move to the right to the "possible cause" of the malfunction and then further to the right for the "correction". In most instances the corrective action involves routine repair. However, a service procedure for the corrective action is normally available within a Service Group in this manual.

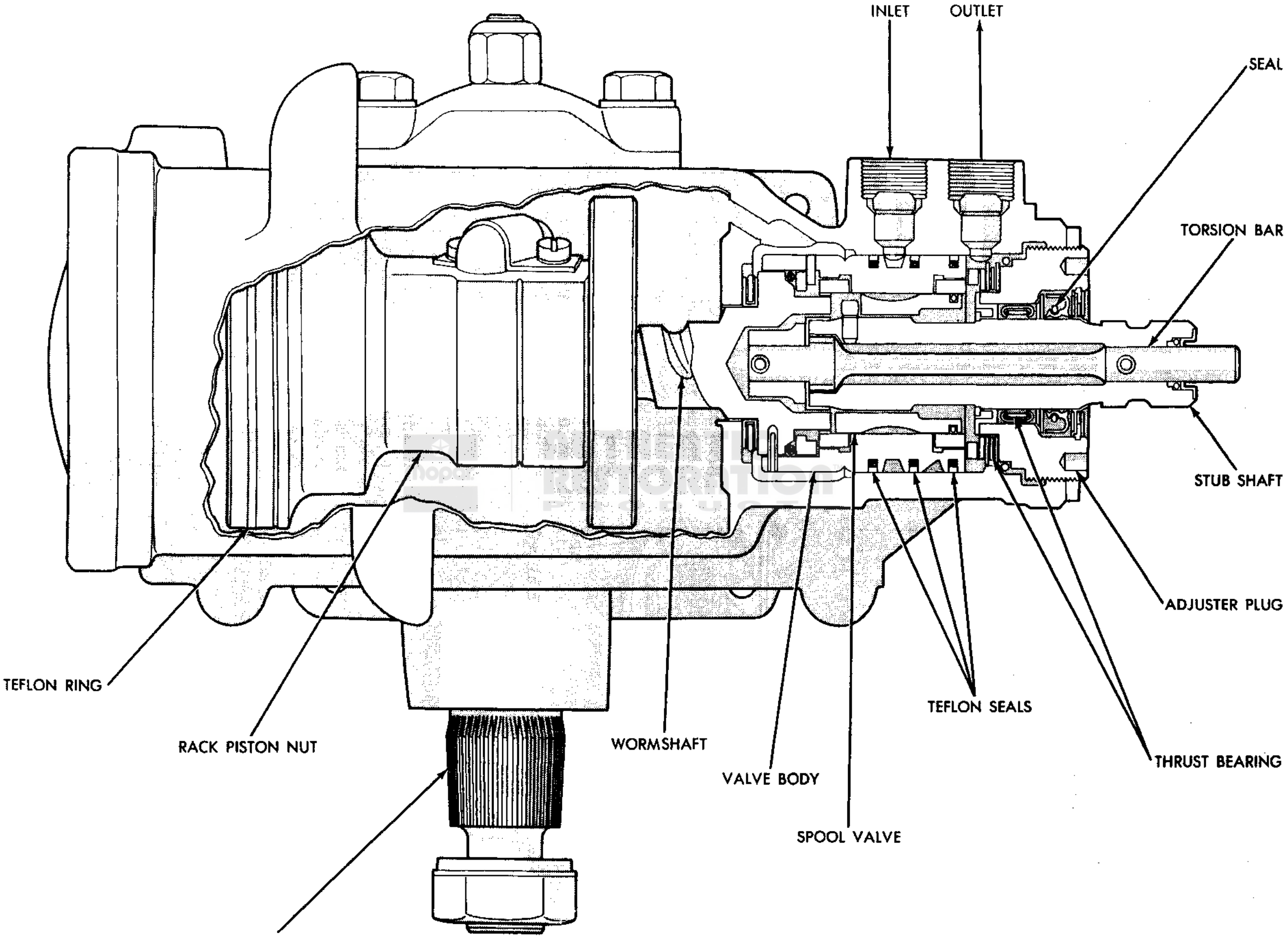

Fig. 2 Power Steering Gear

SYSTEM SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
HISSING NOISE IN STEERING GEAR	(1) There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and performance of the steering. Hiss may be expected when steering wheel is at end of travel or when slowly turning at standstill.	(1) Slight hiss is normal and in no way affects steering. Do not replace valve unless hiss is extremely objectionable. A replacement valve will also exhibit slight noise and is not always a cure. Investigate clearance around flexible coupling rivets. Be sure steering shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates. Any metal-to-metal contacts through flexible coupling will transmit valve hiss into passenger compartment through the steering column.
RATTLE OR CHUCKLE NOISE IN STEERING GEAR	(1) Gear loose on frame.	(1) Check gear-to-frame mounting screws. Tighten screws to 88 N·m (65 foot pounds) torque.
	(2) Steering linkage looseness.	(2) Check linkage pivot points for wear. Replace if necessary.
	(3) Pressure hose touching other parts of car.	(3) Adjust hose position. Do not bend tubing by hand.
	(4) Loose pitman shaft over center adjustment. **NOTE:** A slight rattle may occur on turns because of increased clearance off the "high point." This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.	(4) Adjust to specifications.
	(5) Loose pitman arm.	(5) Tighten pitman arm nut to specifications.
SQUAWK NOISE IN STEERING GEAR WHEN TURNING OR RECOVERING FROM A TURN	(1) Damper O-ring on valve spool cut.	(1) Replace damper O-ring.
POOR RETURN OF STEERING WHEEL TO CENTER	(1) Tires not properly inflated.	(1) Inflate tires to specified pressure.
	(2) Lack of lubrication in linkage and ball joints.	(2) Lube linkage and ball joints.
	(3) Lower coupling flange rubbing against steering gear adjuster plug.	(3) Loosen pinch bolt and assemble properly.
	(4) Steering gear to column misalignment.	(4) Align steering column.

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SYSTEM SERVICE DIAGNOSIS (CONT'D)

CONDITION	POSSIBLE CAUSE	CORRECTION
POOR RETURN OF STEERING WHEEL TO CENTER (Continued)	(5) Improper front wheel alignment.	(5) Check and adjust as necessary. With front wheels still on alignment pads of front-end machine, disconnect pitman arm of linkage from pitman shaft of gear. Turn front wheels by hand. If wheels will not turn or turn with considerable effort, determine if linkage or ball joints are binding.
	(6) Steering linkage binding.	(6) Replace pivots.
	(7) Ball joints binding.	(7) Replace ball joints.
	(8) Steering wheel rubbing against housing.	(8) Align housing.
	(9) Tight or frozen steering shaft bearings.	(9) Replace bearings.
	(10) Sticking or plugged valve spool.	(10) Remove and clean or replace valve.
	(11) Steering gear adjustments over specifications.	(11) Check adjustment with gear out of car. Adjust as required.
	(12) Kink in return hose.	(12) Replace hose.
CAR LEADS TO ONE SIDE OR THE OTHER (KEEP IN MIND ROAD CONDITION AND WIND. TEST CAR IN BOTH DIRECTIONS ON FLAT ROAD)	(1) Front end misaligned.	(1) Adjust to specifications.
	(2) Unbalanced steering gear valve. **NOTE:** If this is cause, steering effort will be very light in direction of lead and normal or heavier in opposite direction.	(2) Replace valve.
MOMENTARY INCREASE IN EFFORT WHEN TURNING WHEEL FAST TO RIGHT OR LEFT	(1) Low oil level.	(1) Add power steering fluid as required.
	(2) Pump belt slipping.	(2) Tighten or replace belt.
	(3) High internal leakage.	(3) Check pump pressure. (See pressure test)
STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING ESPECIALLY DURING PARKING	(1) Low oil level.	(1) Fill as required.
	(2) Loose pump belt.	(2) Adjust tension to specification.
	(3) Steering linkage hitting engine oil pan at full turn.	(3) Correct clearance.
	(4) Insufficient pump pressure.	(4) Check pump pressure. (See pressure test.) Replace relief valve if defective.

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SYSTEM SERVICE DIAGNOSIS (CONT'D)

CONDITION	POSSIBLE CAUSE	CORRECTION
	(5) Pump flow control valve sticking.	(5) Inspect for varnish or damage, replace if necessary.
EXCESSIVE WHEEL KICKBACK OR LOOSE STEERING	(1) Air in system.	(1) Add oil to pump reservoir and bleed by operating steering. Check hose connectors for proper torque and adjust as required.
	(2) Steering gear loose on frame.	(2) Tighten attaching screws to specified torque.
	(3) Steering linkage joints worn enough to be loose.	(3) Replace loose pivots.
	(4) Worn poppet valve.	(4) Replace poppet valve.
	(5) Loose thrust bearing preload adjustment.	(5) Adjust to specification with gear out of vehicle.
	(6) Excessive overcenter lash.	(6) Adjust to specification with gear out of car.
HARD STEERING OR LACK OF ASSIST	(1) Loose pump belt.	(1) Adjust belt tension to specification.
	(2) Low oil level. **NOTE:** Low oil level will also result in excessive pump noise.	(2) Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage. Tighten loose connectors.
	(3) Steering gear to column misalignment.	(3) Align steering column.
NOTE: IF CHECKS (1) THROUGH (5) DO NOT REVEAL CAUSE OF HARD STEERING, REFER TO PRESSURE TEST	(4) Lower coupling flange rubbing against steering gear adjuster plug.	(4) Loosen pinch bolt and assemble properly.
	(5) Tires not properly inflated.	(5) Inflate to recommended pressure.
	Further possible causes could be:	
	(6) Sticky flow control valve.	In order to diagnose conditions such as listed in (6), (7), (8), (9) a test of the entire power steering system is required.
	(7) Insufficient pump pressure output.	
	(8) Excessive internal pump leakage.	
	(9) Excessive internal gear leakage.	

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SYSTEM SERVICE DIAGNOSIS (CONT'D)

CONDITION	POSSIBLE CAUSE	CORRECTION
FOAMING MILKY POWER STEERING FLUID, LOW FLUID LEVEL AND POSSIBLE LOW PRESSURE	(1) Air in the fluid, and loss of fluid due to internal pump leakage causing overflow.	(1) Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeriation should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.
LOW PRESSURE DUE TO STEERING PUMP	(1) Flow control valve stuck or inoperative.	(1) Remove burrs or dirt or replace. Flush system.
	(2) Pressure plate not flat against cam ring.	(2) Correct.
LOW PRESSURE DUE TO STEERING GEAR	(1) Pressure loss in cylinder due to worn piston ring or badly worn housing bore.	(1) Remove gear from car for disassembly and inspection of ring and housing bore.
	(2) Leakage at valve rings, valve body-to-worm seal.	(2) Remove gear from car for disassembly and replace seals.

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FLUID LEAKAGE—DETECTION

In addition to the following procedure, a "black light" detection device can be used to locate power steering fluid leakage. The dye must be installed and mixed with the power steering fluid for this purpose.

CAUTION: If the fluid reservoir cap is not properly tightened after a fluid level check, the result can be fluid leakage and possible loss of the cap. Ensure that the cap is securely tightened when installing it.

(1) Power steering fluid leakage is possible from the following steering gear areas:

- hoses and fittings;
- "preload" torque adjustment cap seal;
- stub shaft seals;
- housing ball plug;
- pitman shaft cover, gasket, adjustment screw and locknut;
- pitman shaft seals;
- housing end-plug seal; and
- cracked or porous housing.

(2) Raise and support the front of the vehicle. Clean the exterior surfaces of the steering gear, the pump and reservoir, the hoses and the fittings thoroughly.

(3) Check and correct the fluid level in the reservoir. If the reservoir is overfilled, drain the excess fluid down to the correct level before proceeding.

(4) Inspect for aerated (milky color) fluid, which can cause an overflow from the reservoir and be mistaken for an actual fluid leak.

(5) Inspect and tighten all the hose connections at the steering gear and at the pump.

(6) Start the engine. Have a helper turn the steering wheel to the left and to the right several times while you search for the source of the fluid leak. Contact the stops momentarily in each direction. Stop the engine when the source of the fluid leak is located.

PITMAN SHAFT SEAL—REPLACEMENT

(1) Raise and support the vehicle. Place the front wheels in a straight-ahead position.

(2) Disconnect the center link from the pitman (steering) arm.

(3) Mark the pitman (steering) arm and the pitman shaft positions for installation reference and remove the pitman (steering) arm from the pitman shaft with an appropriate puller tool (Fig. 23).

(4) Place a drain pan under the steering gear.

(5) Remove the pitman shaft seal retaining ring with "snap" ring pliers and remove the outer backup washer from the shaft bore.

CAUTION: To prevent excessive fluid loss and pump wear, do not hold the steering wheel in an extreme left-turn position for more than one or two seconds at a time.

(6) Start the engine and momentarily hold the steering wheel in an extreme left-turn position to actuate the spool valve. This should develop enough pressure on the upper side of the rack piston and in the pitman shaft chamber to force the pitman shaft seals and the remaining backup washer out of the shaft bore (Fig. 3).

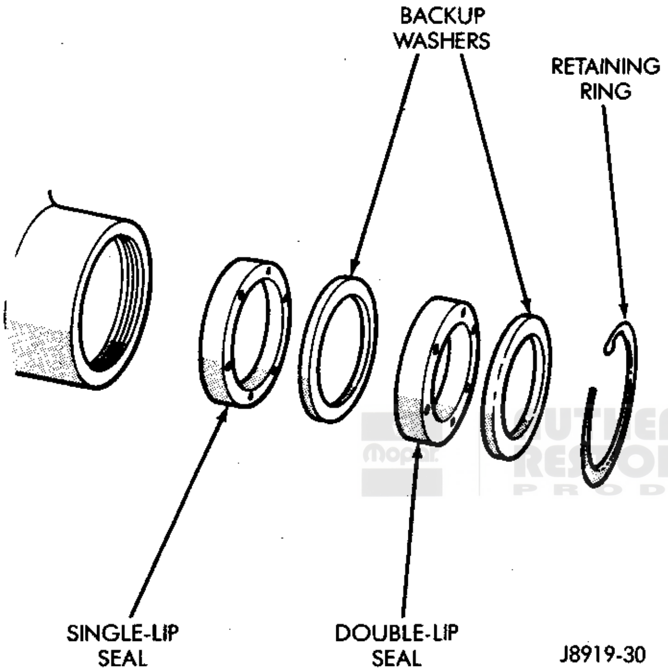


Fig. 3 Seals, Backup Washers & Retaining Ring

(7) Stop the engine and remove the seals and backup washer from the pitman shaft. Discard the seals.

(8) Inspect the outer circumference surface area of the seals for damage to the rubber covers. If the outer circumference surface area is scored, inspect the shaft bore in the housing for burrs. If present, remove the burrs from the bore before installing the replacement seals.

(9) Inspect the seal contact surface area on the pitman shaft for pitting and roughness. If pitted, replace the shaft.

(10) Remove all rust, foreign material and rough areas from the seal contact surface area on the pitman shaft with a crocus cloth.

(11) Lubricate the replacement seals and the backup washers with power steering fluid.

CAUTION: A protective wrap must be used to enclose the shaft threads/splines during seal installation. If the shaft seals are installed over exposed shaft threads or splines, the seal lips could be cut or distorted and result in leakage after installation.

(12) Wrap the pitman shaft threads/splines with 0.1-mm (0.005-in) thick shimstock (or a single layer of the thinnest plastic tape available) to protect the replacement seals during installation.

(13) Install the single-lip seal first, and then the inner backup washer (Fig. 3) with a seal installation tool. Position the seal and the washer only far enough in the shaft bore to provide sufficient clearance for the second seal, the outer backup washer and the retaining ring. **Do not force the seal against the inner bore surface.**

CAUTION: For proper sealing, ensure that the seals are spaced so that they are separately "seated" in the shaft bore.

(14) Install the "double-lip" seal and the outer backup washer (Fig. 3) with a seal installation tool. Position the seal and the backup washer only far enough in the shaft bore to provide sufficient clearance for the retaining ring.

(15) Remove the shimstock/tape from the shaft. Install the retaining ring (Fig. 3). Ensure that the ring is "seated" correctly in the housing bore groove.

(16) With the pitman (steering) arm and shaft installation reference marks aligned, position the pitman (steering) arm on the pitman shaft.

The pitman (steering) arm nut and lock washer must be replaced with either exact replacements (same part numbers), or with equivalent replacements, if replacement is necessary.

(17) Install the lockwasher and the retaining nut on the pitman shaft and tighten the nut with 237 N•m (175 ft-lbs) torque.

Install a replacement cotter pin.

(18) Connect the center link to the pitman (steering) arm. Tighten the retaining nut with 54 N•m (40 ft-lbs) torque. Install a replacement cotter pin.

(19) Remove the supports and lower the vehicle.

(20) Fill the reservoir with power steering fluid.

(21) Start the engine and allow it to operate at idle speed for at least three minutes. **Do not turn the steering wheel during this time.**

(22) Turn the steering wheel to the left and to the right and inspect for fluid leakage. Add power steering fluid as required.

(23) Remove the drain pan.

END-PLUG SEAL—REPLACEMENT

(1) Raise and support the vehicle. Place the front wheels in a straight-ahead position.

(2) Place a drain pan under the steering gear.

(3) Rotate the end-plug retaining ring until one end of the ring is positioned under the adjacent hole located in the side of the gear housing. "Unseat" and

force the ring from the groove by inserting a punch through the hole in the housing (Fig. 4).

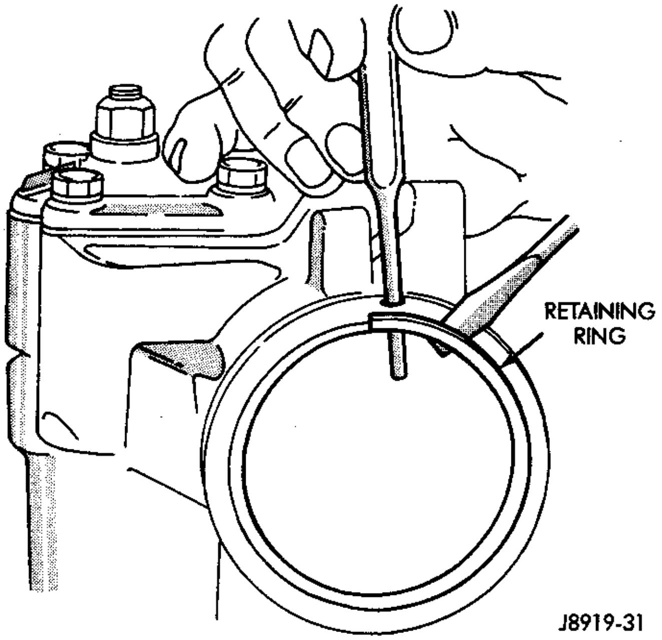


Fig. 4 End-Plug Retaining Ring Removal

CAUTION: Do not turn the wheel any farther than necessary because, otherwise, the recirculating balls will drop out of the rack piston circuit and fall inside the rack piston chamber.

(4) Turn the steering wheel slowly to the left until the rack piston forces the end-plug out of the housing and then turn the steering wheel back to the center position.

(5) Remove and discard the end-plug O-ring seal.

(6) Lubricate the replacement O-ring seal with power steering fluid and install it on the end plug.

(7) Install the end plug and the retaining ring.

(8) Lower the vehicle.

(9) Fill the fluid reservoir with power steering fluid.

(10) Start the engine and allow it to operate at idle speed for at least three minutes. **Do not turn the steering wheel during this time.**

(11) Turn the steering wheel to the left and to the right and inspect for fluid leakage. Add power steering fluid as required.

(12) Remove the drain pan.

POWER STEERING GEAR—DISASSEMBLY

CAUTION: Cleanliness is extremely important when repairing a power steering gear. Maintain the bench, the tools and the components clean at all times. Thoroughly clean the exterior of the gear with cleaning solvent before disassembly and drain as much of the fluid as possible. Use protective vise jaws at all times when clamping components in a vise. During assembly, lubricate all the components with power steering fluid except when instructed otherwise.

(1) Drain the fluid, position the steering gear in a vise and clamp it in-place with the pitman shaft downward. Use the un-machined bosses for clamping pads (Fig. 5).

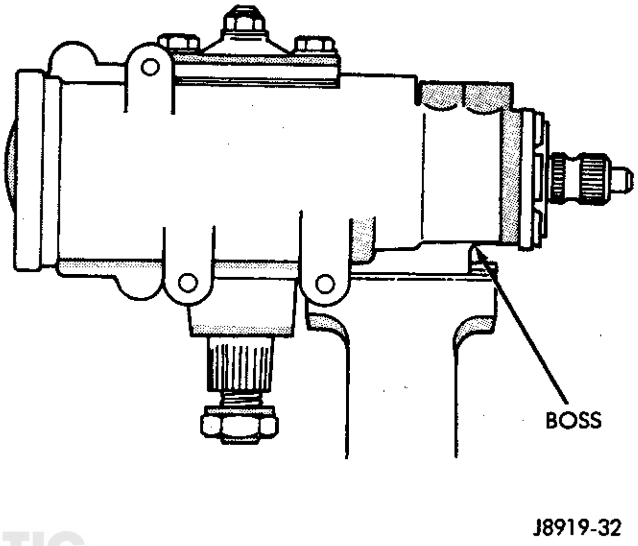


Fig. 5 Steering Gear Clamped In A Vise

(2) Rotate the housing end-plug retaining ring until one end of the ring is positioned under the adjacent hole located in the side of the gear housing. "Unseat" and force the ring from the groove by inserting a punch through the hole in the housing (Fig. 6).

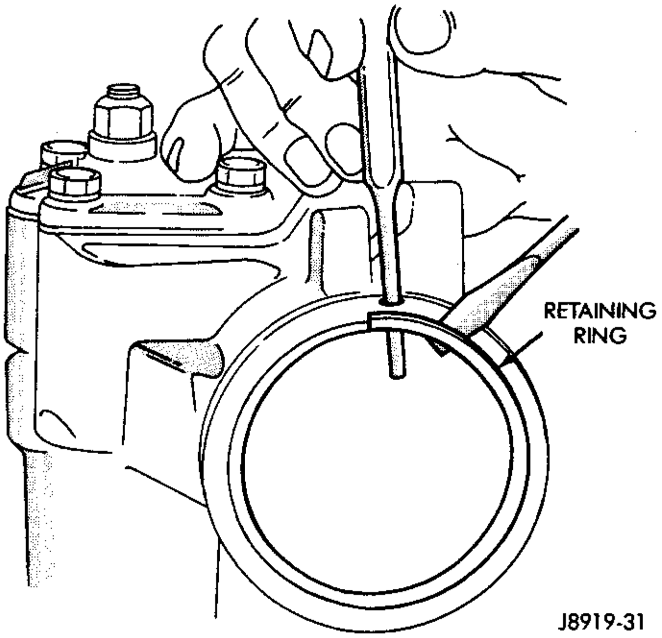
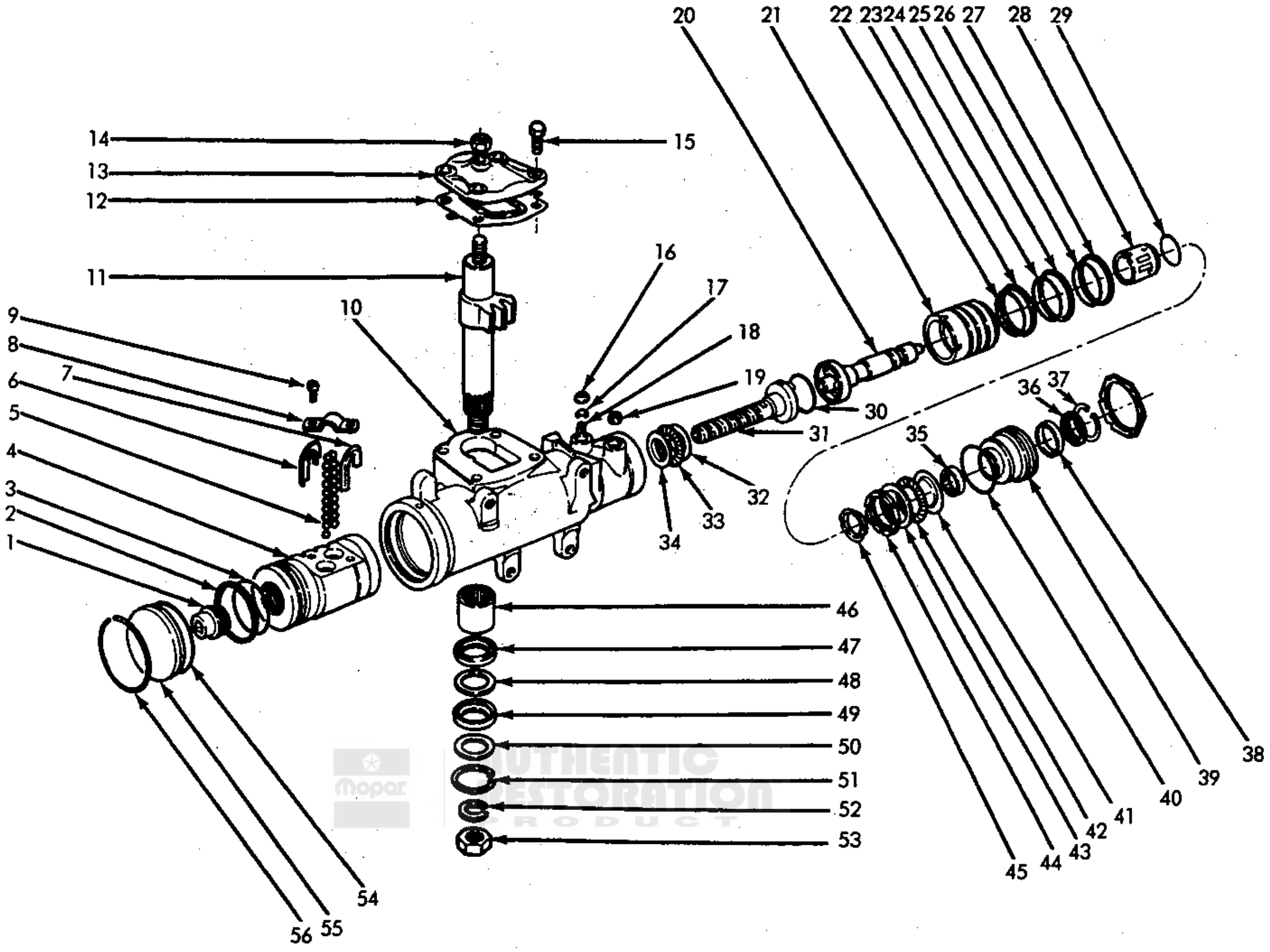


Fig. 6 End-Plug Retaining Ring Removal



1. PISTON END-PLUG
2. TEFLON RING
3. O-RING SEAL
4. RACK PISTON
5. BLACK & SILVER BALLS
6. BALL HALF-GUIDE
7. BALL HALF-GUIDE
8. CLAMP
9. CLAMP BOLT
10. GEAR HOUSING
11. PITMAN SHAFT
12. COVER GASKET
13. COVER
14. LOCKNUT
15. BOLT
16. HOSE CONNECTOR SEAT
17. CHECK VALVE
18. CHECK VALVE SPRING
19. HOSE CONNECTOR SEAT
20. STUB SHAFT
21. VALVE BODY
22. O-RING SEAL
23. TEFLON RING
24. O-RING SEAL
25. TEFLON RING
26. O-RING SEAL
27. TEFLON RING
28. SPOOL VALVE
29. O-RING SEAL
30. O-RING SEAL
31. WORMSHAFT
32. BEARING RACE
33. THRUST BEARING
34. BEARING RACE
35. NEEDLE BEARING
36. DUST SEAL
37. RETAINING SNAP RING
38. SEAL
39. ADJUSTMENT CAP
40. O-RING SEAL
41. LARGE THRUST WASHER
42. THRUST BEARING
43. SMALL THRUST WASHER
44. SPACER
45. RETAINING RING
46. NEEDLE BEARING
47. SINGLE-LIP SEAL
48. BACK-UP WASHER
49. DOUBLE-LIP SEAL
50. BACK-UP WASHER
51. RETAINING SNAP RING
52. SPRING WASHER
53. RETAINING NUT
54. O-RING SEAL
55. HOUSING END-PLUG
56. RETAINING RING

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Fig. 7 Power Steering Gear—Exploded View

CAUTION: Do not rotate the stub shaft any farther than necessary because, otherwise, the recirculating balls will drop out of the circuits and cause the pitman shaft and rack piston teeth to disengage. If the teeth become disengaged, remove the cover and the pitman shaft and engage the teeth.

(3) Rotate the stub shaft counterclockwise (with a 12-point deep wrench and a ratchet handle) until the rack piston forces the end plug out of the housing.

(4) Remove and discard the end-plug O-ring seal.

(5) Rotate the stub shaft clockwise 180 degrees to remove the rack piston end plug (Fig. 7).

CAUTION: The rack piston end plug could break during removal if it is not initially "unseated" by striking it with a plastic-tipped hammer.

(6) Strike the rack piston end plug sharply with a plastic-tipped hammer and use a 13-mm (1/2-in) square drive ratchet to remove the end plug. **Do not use a ratchet with a worn drive lug or with a drive lug that is rounded on the bottom corners.**

(7) Hold the pitman shaft adjustment screw with an Allen wrench to prevent the screw from turning and remove the locknut (Fig. 7). Discard the locknut.

(8) Remove the pitman shaft cover attaching bolts and lockwashers from the housing (Fig. 7).

(9) Thread the pitman shaft adjustment screw into the cover with and Allen wrench until the cover can be removed from the screw. Remove the cover from the housing and discard the gasket (Fig. 7).

(10) Rotate the stub shaft until the pitman shaft teeth are centered in the housing. Tap the end of the pitman shaft with a plastic-tipped hammer and remove it from the housing (Fig. 7). **Do not disassemble the pitman shaft, it is serviced and replaced as a unit only.**

(11) Insert an arbor tool in the rack piston until it stops at the end of the wormshaft (Fig. 8).

(12) Grip the tool firmly and turn the stub shaft counterclockwise to force the rack piston on the arbor tool (Fig. 8). Remove the tool and the rack piston as a unit from the steering gear housing.

(13) Loosen the wormshaft bearing "preload" torque adjustment cap locknut with a brass drift and remove it from the cap. Remove the adjustment cap from the housing with a spanner wrench (Fig. 9).

(14) Remove the complete valve body from the housing by pulling outward on the splined end of the stub shaft.

(15) Remove the wormshaft lower thrust bearing and the conical bearing races from the wormshaft. Note the relative position of each race for assembly reference (Fig. 10).

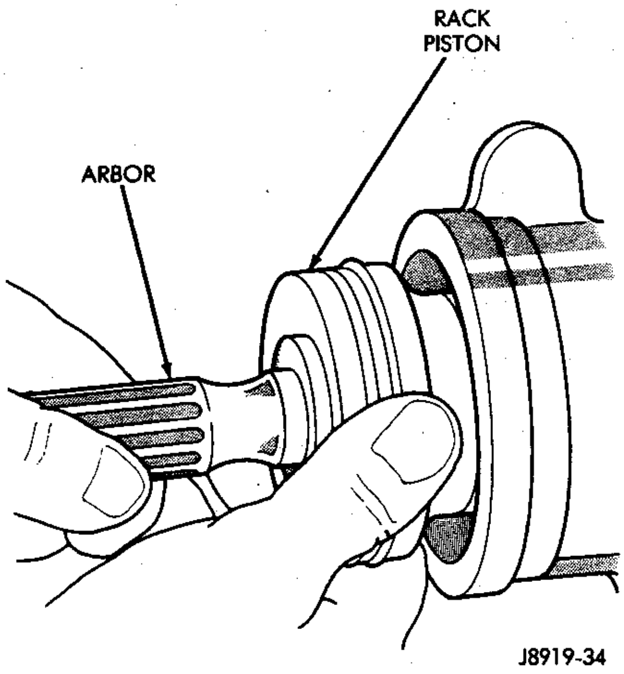

Fig. 8 Rack Piston Removal

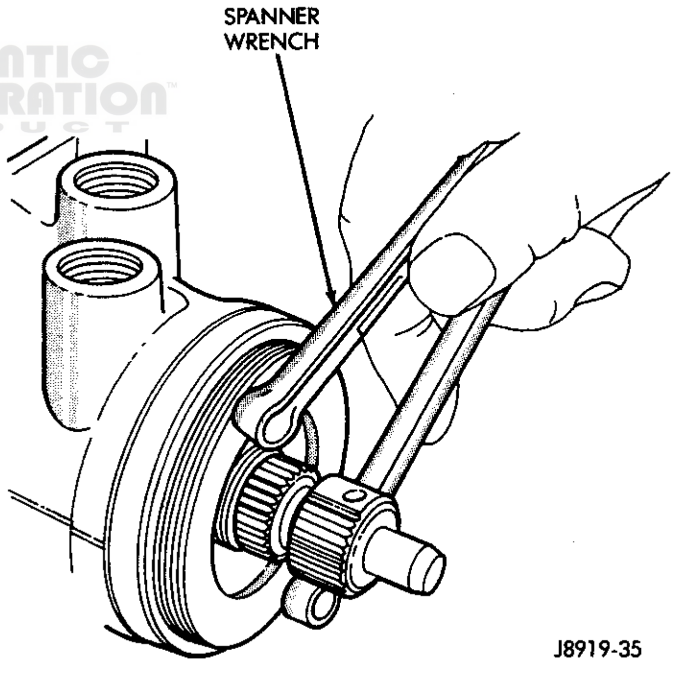

Fig. 9 Wormshaft "Preload" Adjustment Cap Removal

STEERING GEAR HOUSING—DISASSEMBLY

(1) Remove the pitman shaft seal retaining ring from the shaft bore groove with "snap" ring pliers. Remove the outer backup washer from the shaft bore (Fig. 11).

If the upper seal is difficult to remove, force it out of the shaft bore from the top of the housing. In extreme situations, it may be necessary to force out both the needle bearing and the upper

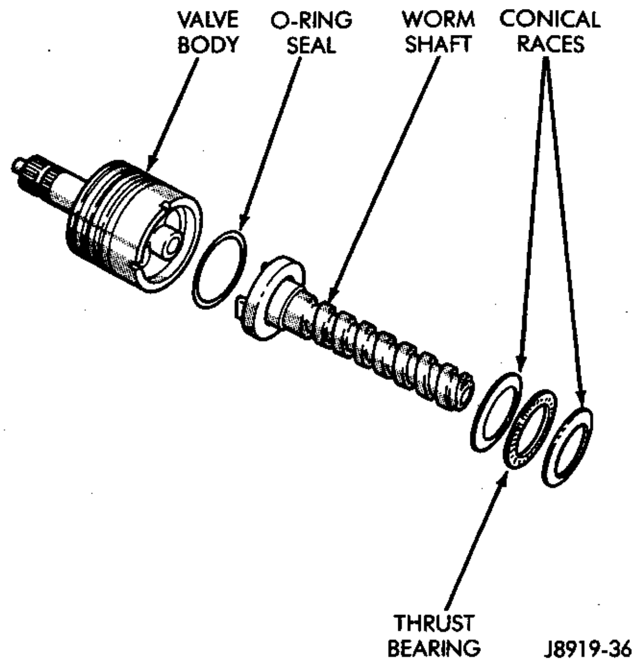

Fig. 10 Valve Body & Wormshaft

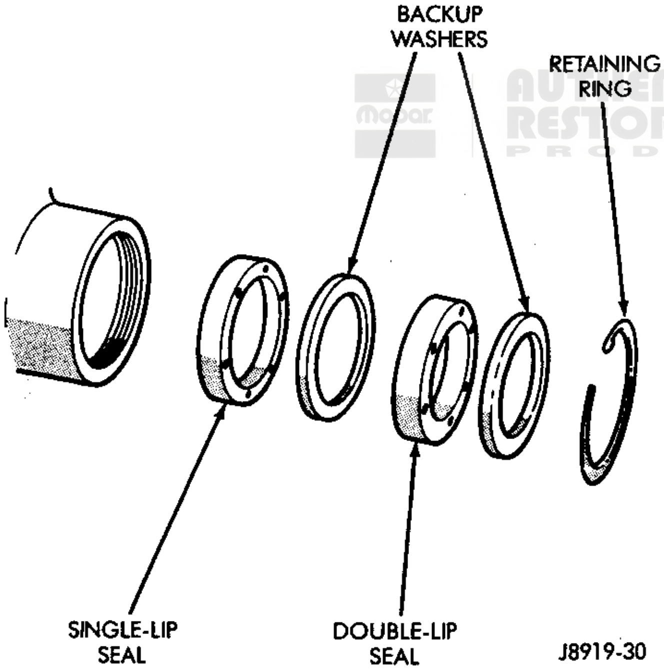

Fig. 11 Seals, Backup Washers & Retaining Ring

seal simultaneously. Discard the seal and the needle bearing if they are removed by this method.

(2) Remove the pitman shaft needle bearing from the housing inner bore with the appropriate removal tools (Fig. 12).

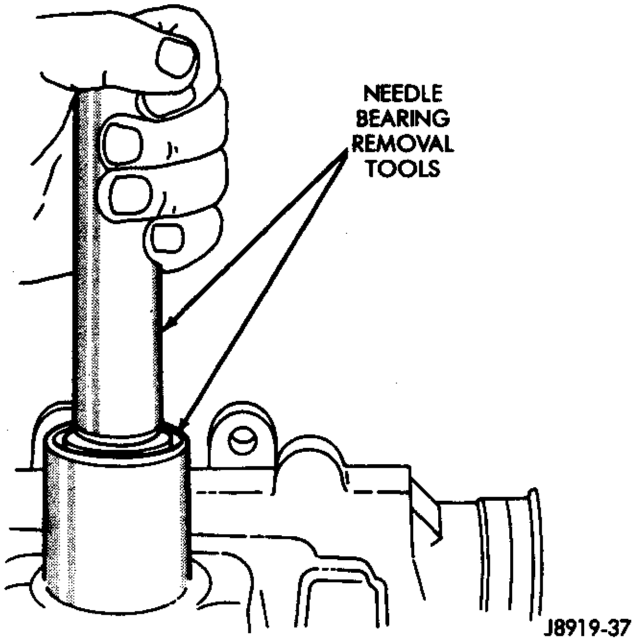

Fig. 12 Pitman Shaft Needle Bearing Removal

STEERING GEAR HOUSING—INSPECTION

(1) Clean the steering gear housing thoroughly with cleaning solvent.

(2) Inspect the pitman shaft bore. If it is badly scored or worn, replace the housing. However, slight scratches in the bore are usually acceptable.

(3) Inspect the hose connector "seats" and the poppet check valve. If they are deeply scored, cracked or worn, they must be replaced.

(4) Inspect the ball plug in the housing (Fig. 13). If fluid leakage past the ball plug occurred before disassembly or if it is raised above the housing surface, the housing must be replaced.

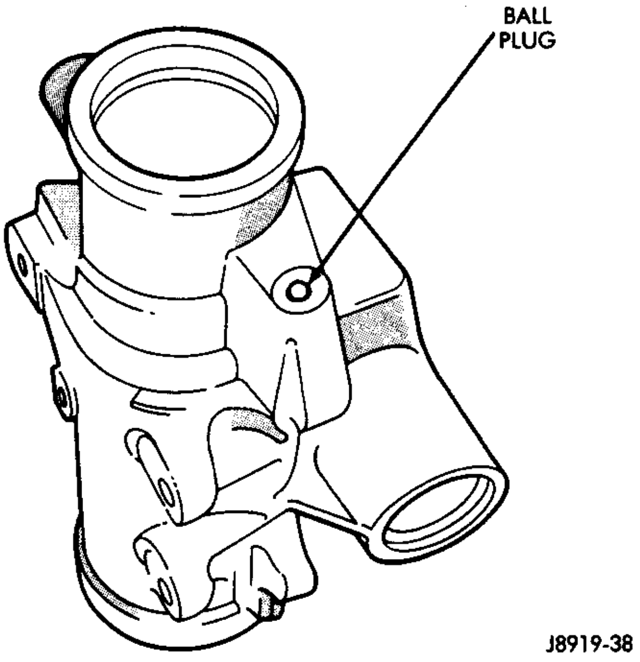

Fig. 13 Steering Gear Housing & Ball Plug

(5) Inspect all the retaining ring grooves and O-ring seal mating surfaces. If any are chipped, scored,

cracked or otherwise worn, replace the housing.

STEERING GEAR HOUSING—ASSEMBLY

(1) Lubricate the pitman shaft bore in the housing, the replacement needle bearing, the lip seals and the backup washers with power steering fluid (Fig. 14).

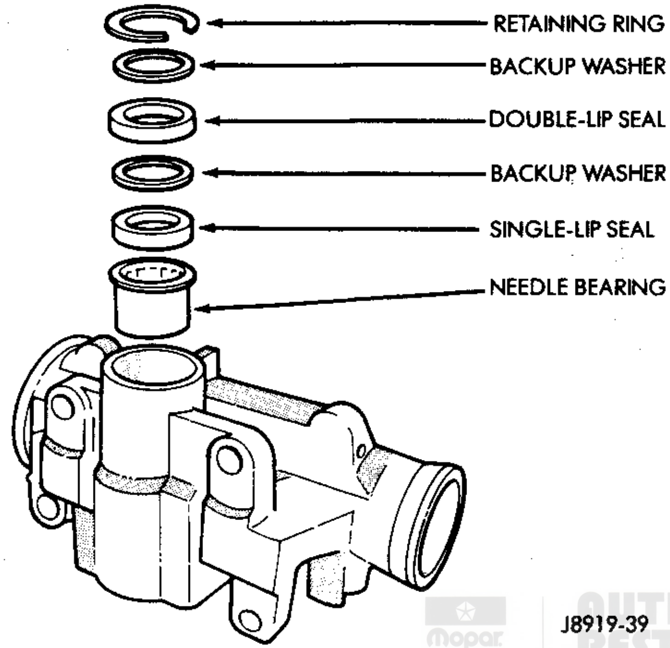

Fig. 14 Pitman Shaft Bearing, Seals & Washers

(2) Install the replacement needle bearing with the appropriate installation tools (Fig. 15).

(3) Insert the bearing in the pitman shaft inner bore until it is approximately 0.76 mm (0.03 in) below the shoulder of the inner bore.

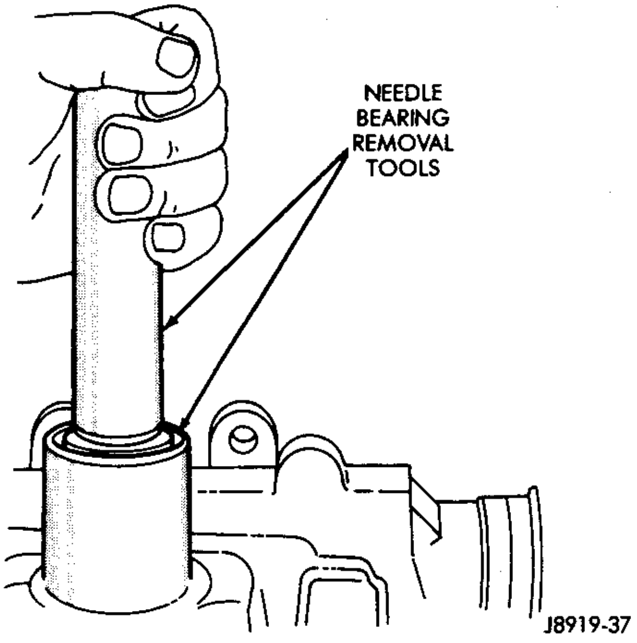

Fig. 15 Pitman Shaft Needle Bearing Installation

(4) Install the single-lip seal first, and then the inner backup washer with a seal installation tool. Position the seal and washer only far enough in the shaft bore to provide sufficient clearance for the second seal, the outer backup washer and the retaining ring (Fig. 14). **Do not force the seal against the inner bore surface.**

CAUTION: For proper sealing, ensure that the seals are spaced so that they are separately "seated" in the shaft bore.

(5) Install the double-lip seal and the outer backup washer (Fig. 16) with a seal installation tool. Position the seal and the backup washer only far enough in the shaft bore to provide sufficient clearance for the retaining ring.

(6) Install the retaining ring (Fig. 14). Ensure that the ring is "seated" correctly in the bore groove.

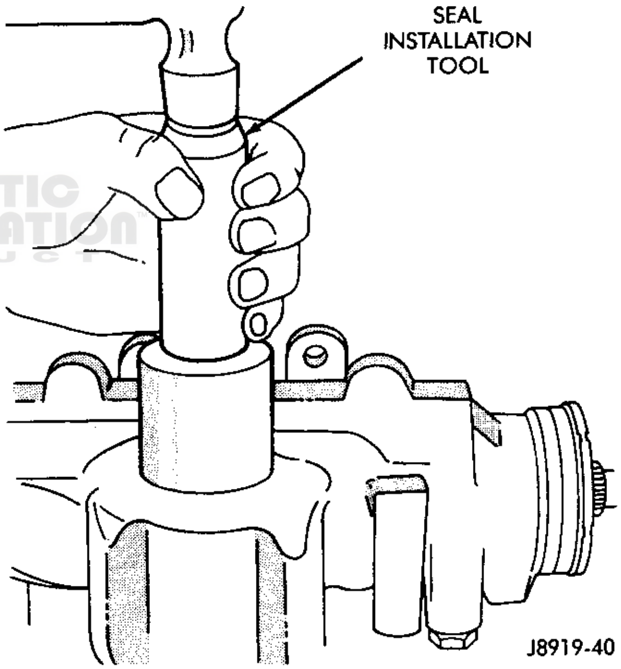

Fig. 16 Pitman Shaft Seal Installation

PRELOAD TORQUE ADJUSTMENT CAP—DISASSEMBLY

(1) Remove the thrust bearing retaining ring from the adjustment cap with a small pry bar (Fig. 17). Discard the retaining ring. **Use care to prevent damaging the needle bearing bore.**

(2) Remove the thrust bearing spacer, the thrust bearing washers, the thrust bearing and the O-ring seal from the adjustment cap (Fig. 18). Discard the seal.

(3) Remove the stub shaft seal retaining "snap" ring from the adjustment cap with "snap" ring pliers (Fig. 18).

(4) Remove (and discard) the stub shaft dust seal and the oil seal from the adjustment cap (Fig. 18).

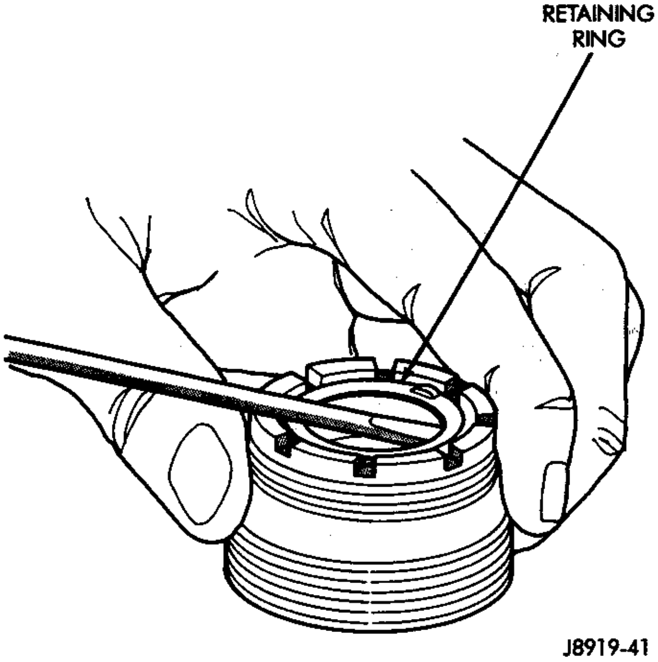

Fig. 17 Thrust Bearing Retaining Ring Removal

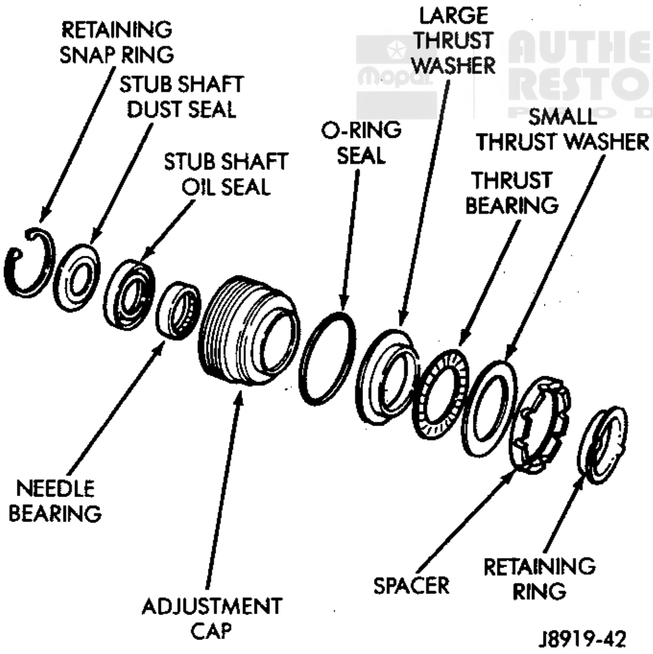

Fig. 18 "Preload" Torque Adjustment Cap

(5) Remove the stub shaft needle bearing from the adjustment cap with an appropriate removal tool (Fig. 19).

PRELOAD TORQUE ADJUSTMENT CAP—INSPECTION

(1) Clean the adjustment cap and its components thoroughly with cleaning solvent.

(2) Inspect the adjustment cap and all the components for wear, scoring, nicks, cuts and distortion.

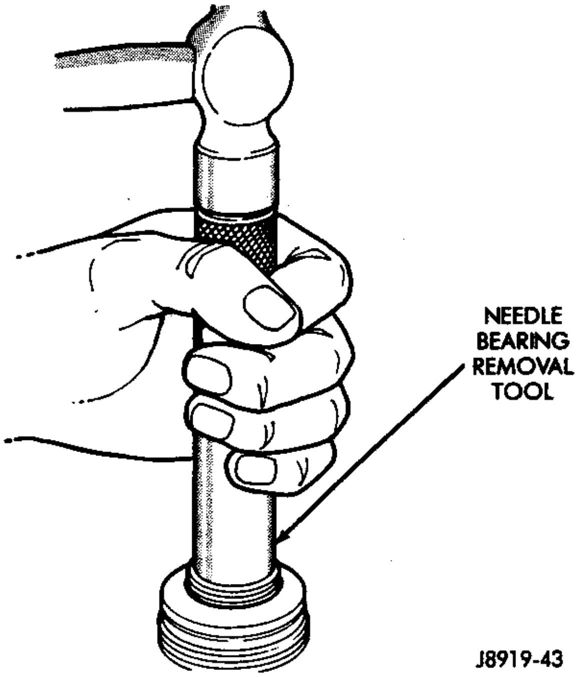

Fig. 19 Stub Shaft Needle Bearing Removal

(3) Replace all defective components.

PRELOAD TORQUE ADJUSTMENT CAP—ASSEMBLY

(1) Lubricate the adjustment cap and the components with power steering fluid.

(2) Place the stub shaft needle bearing on the installation tool with the bearing manufacturer's identification number facing toward the tool.

(3) Position the bearing and the tool over the inner bore and press the bearing into the bore until it is flush with the bottom surface of the outer bore.

(4) Insert the stub shaft oil seal far enough into the seal bore to provide sufficient clearance for the dust seal and the retaining ring (Fig. 18).

(5) Lubricate the dust seal with petroleum jelly and install it in the seal bore with the rubber side facing outward (Fig. 18).

(6) Install the retaining "snap" ring. Ensure that the ring is properly "seated" in the cap groove.

(7) Lubricate the O-ring seal with petroleum jelly and install it in the cap seal groove (Fig. 18).

(8) Position the large thrust washer, the thrust bearing, the small thrust washer and the spacer on the adjustment cap (Fig. 18).

The radial locations of the spacer notches are not important. However, do not damage the notches during installation.

(9) Press the replacement retaining ring into the stub shaft needle bearing bore with a brass or wooden drift.

VALVE BODY AND STUB SHAFT—DISASSEMBLY

CAUTION: The valve body is a precisely manufactured unit with components selectively fitted to conform to tolerances as close as 0.00082 mm (0.0004 in). The unit is hydraulically and mechanically balanced during manufacture. If replacement is necessary, the complete valve body must be replaced. To avoid possible damage, the valve body should not be disassembled unless absolutely necessary. If the valve spool damper O-ring seal requires replacement, remove the valve spool only as instructed in the following procedure.

(1) Hold the valve body in both hands with the stub shaft downward and tap the end of the stub shaft lightly against the workbench until the stub shaft cap disengages from the valve body (Fig. 20).

(2) Remove and discard the stub shaft cap-to-wormshaft O-ring seal.

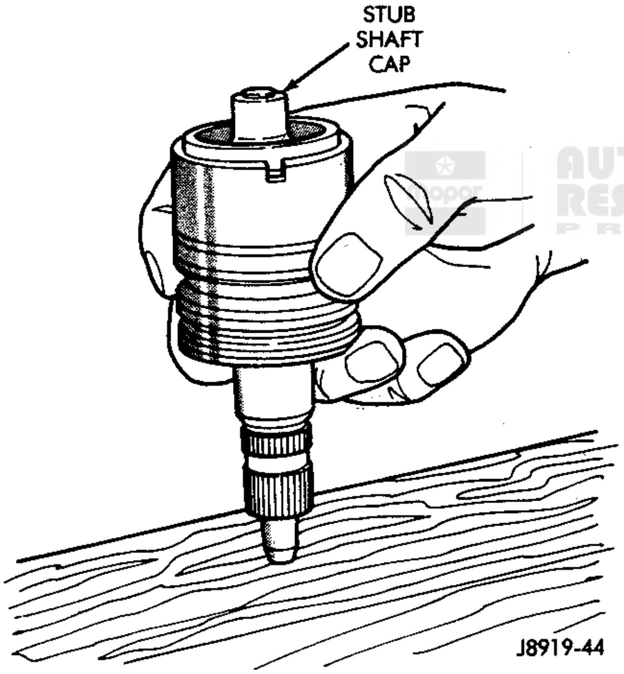

Fig. 20 Stub Shaft Cap Disengagement

CAUTION: Do not pull the stub shaft out too far beyond the specified distance because the spool valve could become cocked in the valve body.

(3) Pull outward on the cap end of the stub shaft until it clears the valve body by approximately 6.35 mm (1/4 in).

(4) Carefully disengage the stub shaft locating pin from the hole in the spool valve and remove the stub shaft from the valve body (Fig. 21).

(5) Rotate the spool valve and remove it from the valve body (Fig. 22). If the spool valve becomes cocked, carefully realign it and then remove it.

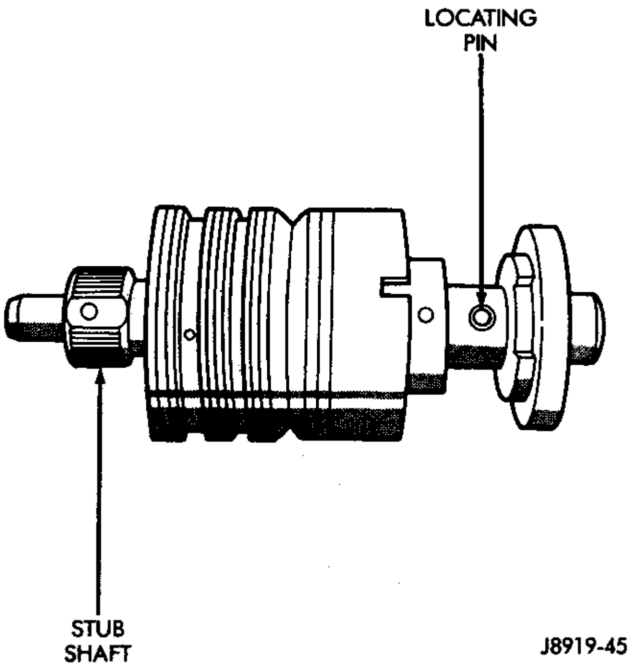

Fig. 21 Stub Shaft Removal

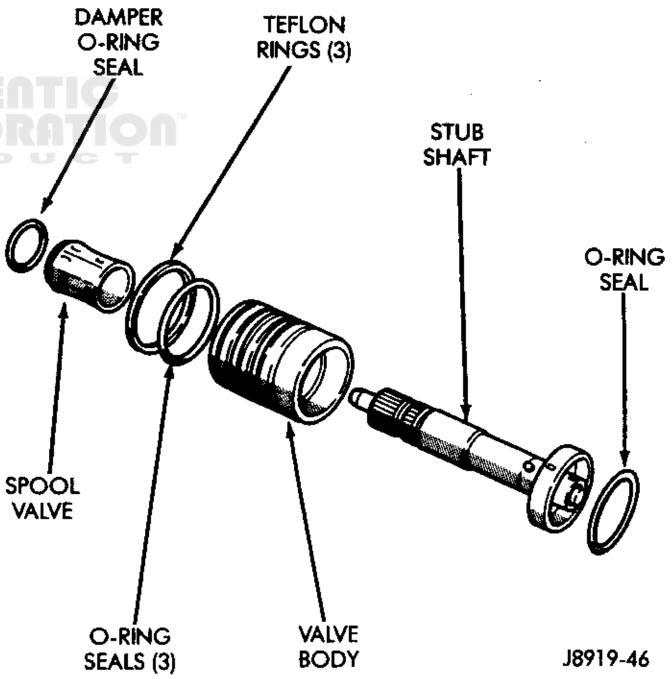

Fig. 22 Valve Body & Stub Shaft Disassembly

(6) Remove the damper O-ring seal from the spool valve (Fig. 22). Discard the O-ring seal.

(7) Cut the teflon rings and the inner O-ring seals (located between the teflon rings and the valve body) and remove them from the valve body. Carefully cut the rings with either a knife or diagonal pliers.

VALVE BODY AND STUB SHAFT—INSPECTION

(1) Clean all the components in cleaning solvent and open all of the fluid passages by blowing with compressed air. If the stub shaft locating pin or the

spool valve locating hole is either cracked, excessively worn or broken, replace the complete valve body. **Small flat spots on either side of the stub shaft locating pin head are normal and acceptable.**

(2) If the stub shaft ground surfaces has scores, nicks or burrs that cannot be removed with crocus cloth, replace the complete valve body. Inspect the outside surface area of the spool valve and the inside surface area of the valve body for nicks, burrs and wear. Slight wear is normal on the valve mating surfaces. **If any serious defects cannot be removed with crocus cloth, replace the complete valve body.**

(3) If the small notch in the skirt of the valve body is excessively worn, replace the complete valve body (Fig. 23).

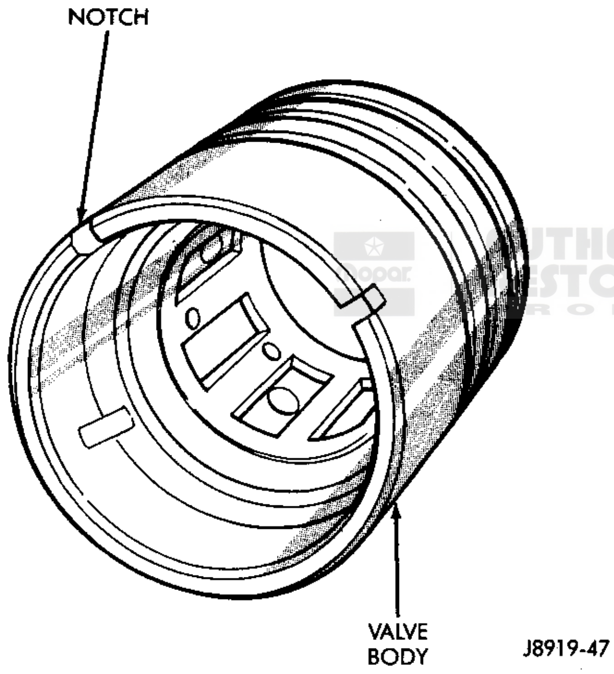

Fig. 23 Valve Body Inspection

(4) Lubricate the spool valve with power steering fluid and check the fit of the spool valve in the valve body without the spool valve dampener O-ring seal installed. If the spool valve does not rotate easily within the valve body, replace the complete valve body.

VALVE BODY AND STUB SHAFT—ASSEMBLY

(1) Lubricate the replacement inner O-ring seals and the teflon rings (Fig. 24) with power steering fluid.

(2) Install the inner O-ring seals in the valve body ring grooves (Fig. 25) and install the teflon rings on top of the O-ring seals. **Use care to avoid damaging the teflon rings during installation.**

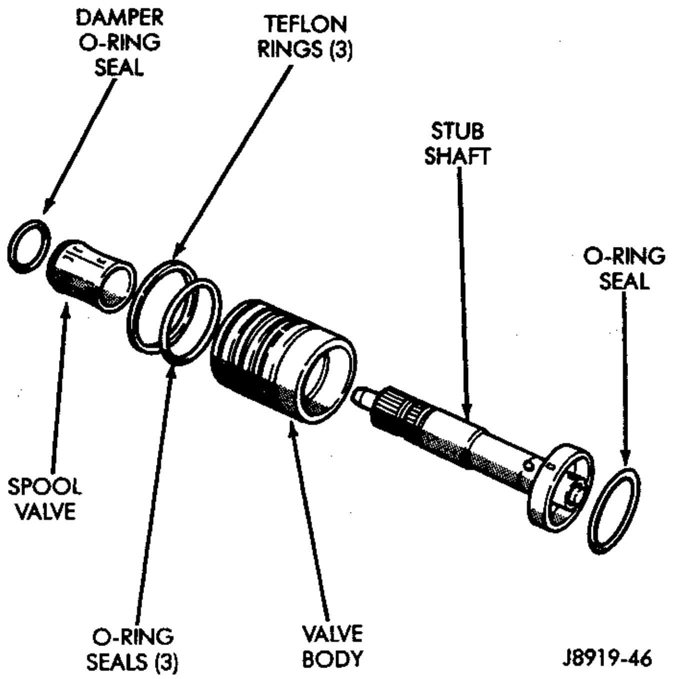

Fig. 24 Valve Body & Stub Shaft Assembly

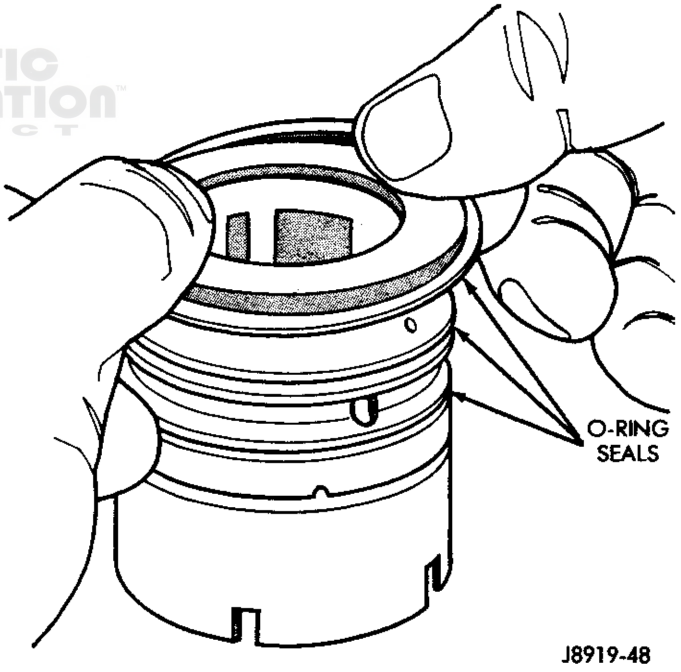

Fig. 25 O-Ring Seal Installation

The teflon rings can appear slightly distorted when first installed; however, during operation, hot power steering fluid will cause them to straighten out.

(3) Lubricate the spool valve dampener O-ring seal with petroleum jelly and install it in the spool valve groove (Fig. 24).

(4) Lubricate the spool valve and valve body with power steering fluid and carefully insert the spool valve in the valve body (Fig. 24).

(5) Move the spool valve through the valve body until the stub shaft locating pin hole in the spool valve is visible and the spool valve is flush with the notched end of the valve body.

(6) Carefully insert the stub shaft into the spool valve until the stub shaft locating pin is aligned with the locating pin hole in the spool valve (Fig. 25).

CAUTION: Ensure that the stub shaft cap notch is aligned with the valve body pin before installing the valve body in the steering gear housing.

(7) Align the notch in the stub shaft cap with the locating pin in the valve body and press the spool valve and the stub shaft in the valve body (Fig. 26).

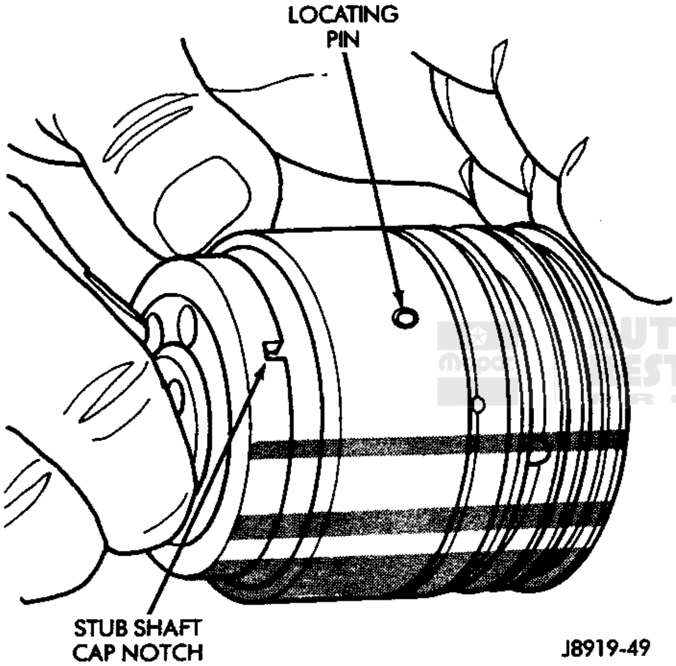

Fig. 26 Stub Shaft Installation

(8) Lubricate the stub shaft cap-to-wormshaft O-ring seal with power steering fluid and position it in the cap groove.

PITMAN SHAFT AND COVER—INSPECTION

(1) Inspect the cover-to-housing contact surface.

(2) Inspect the pitman shaft sector teeth, upper contact surface and bearing/seal contact surface (Fig. 27).

(3) Replace the cover and the shaft if they are severely worn, scored or pitted. If the pitman shaft adjustment screw head fits loose in the T-slot, replace the pitman shaft.

RACK PISTON/WORMSHAFT—DISASSEMBLY

(1) Remove the ball return guide clamp.

(2) Place the complete assembly on clean paper and remove the ball return guides, the wormshaft with an arbor tool, and the recirculating balls. **Ensure that all 24 balls are removed and retained.**

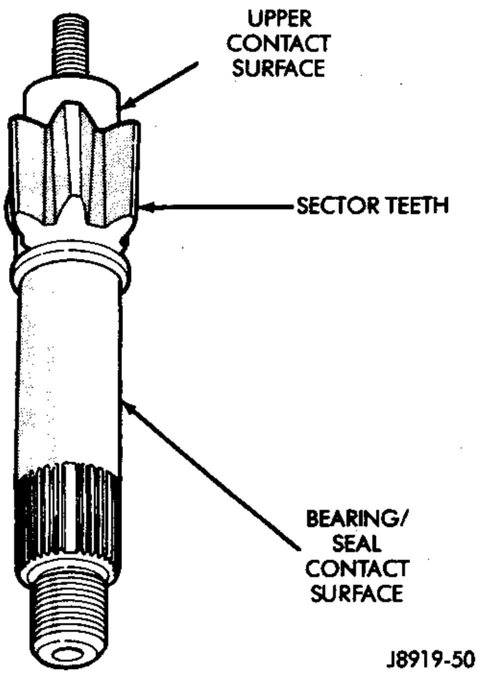

Fig. 27 Pitman Shaft Inspection

(3) Remove the arbor tool from the wormshaft.

(4) Remove the teflon piston ring and the O-ring seal from the rack piston (Fig. 28).

RACK PISTON/WORMSHAFT—ASSEMBLY

(1) Lubricate all of the components with power steering fluid.

(2) Install the O-ring seal in the rack piston groove (Fig. 50). **Do not allow the O-ring seal to become twisted during installation.**

(3) Install the teflon piston ring over the O-ring seal.

(4) Insert the wormshaft completely into the rack piston.

(5) Install the recirculating balls in the rack piston by alternately installing one black ball followed by one silver ball until a total of 18 balls have been installed in the inner return guide hole (Fig. 29). After installing each ball, press it downward to provide space for the next ball.

(6) Rotate the wormshaft counterclockwise (viewed from the steering shaft end) to route the balls into the circuit. **The wormshaft will spiral out of the rack piston as it is rotated and the balls are circulated.**

(7) Fill one ball return half-guide with petroleum jelly and install the six remaining balls in the ball return half-guide (Fig. 30). Ensure that the balls in the half-guide are installed alternately by color (i.e., a black ball followed by a silver ball) and are in alternating color sequence with the balls previously installed in the rack piston.

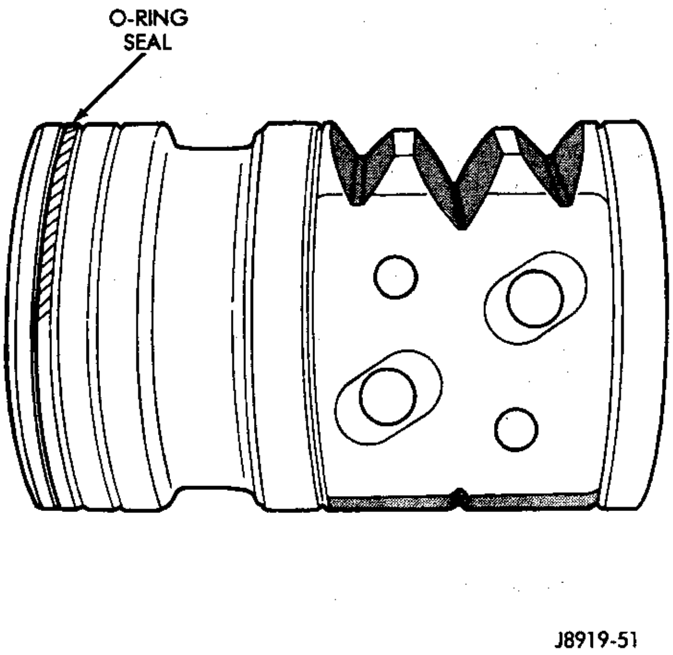

Fig. 28 Rack Piston

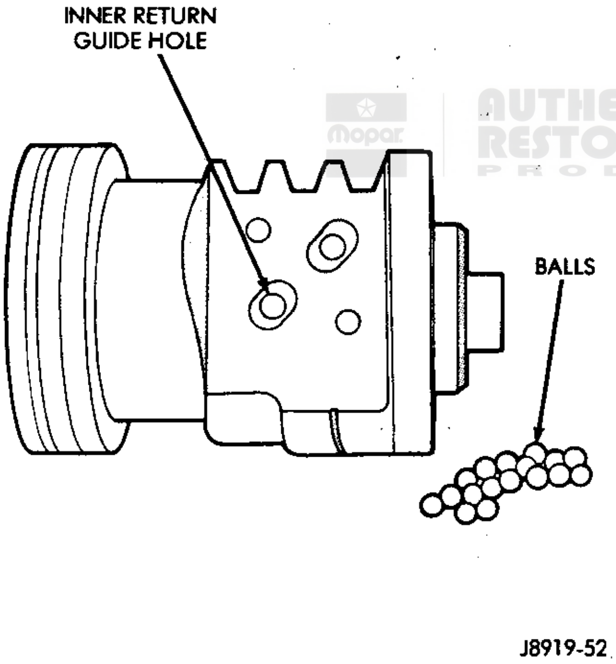

Fig. 29 Recirculating Ball Installation

(8) Mate the two half-guides and insert the assembled ball return guide into the guide holes in the rack piston.

(9) Install the ball return guide clamp, the lockwashers and the retaining screws. Tighten the screws with 14 N•m (10 ft-lbs) torque.

(10) Insert an arbor tool (Fig. 31) into the wormshaft and position the end of the assembled rack piston (with tool) on wooden blocks. Ensure that the rack piston is supported with wooden blocks after it is inverted (Fig. 31).

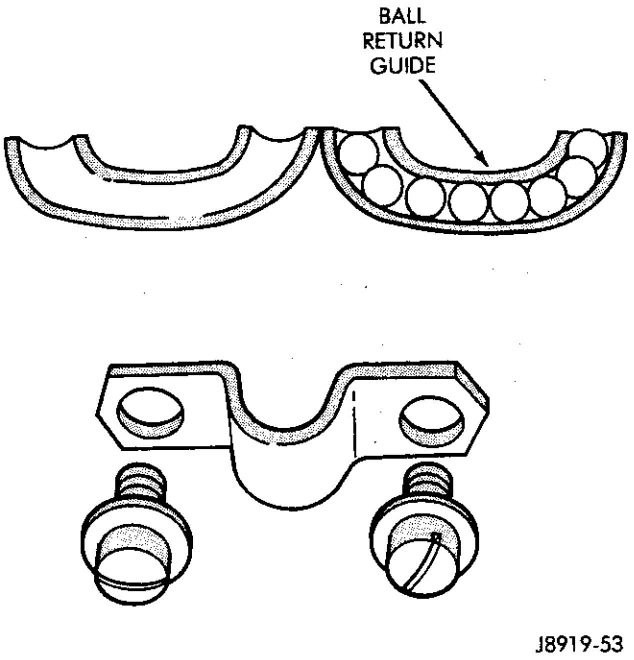

Fig. 30 Ball Return Guide

(11) Do not permit the tool to separate from the wormshaft until the rack piston is completely installed on the wormshaft.

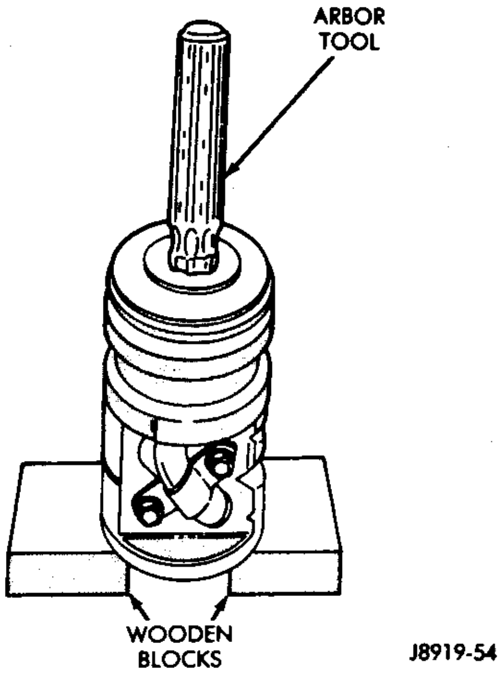

Fig. 31 Rack Piston Assembled

POWER STEERING GEAR—ASSEMBLY

All components must be clean and lubricated with power steering fluid (except as stated otherwise) before assembly.

(1) Clamp the steering gear housing in a vise with the pitman shaft bore facing downward. Use the unmachined housing bosses for the clamping pads (Fig. 32).

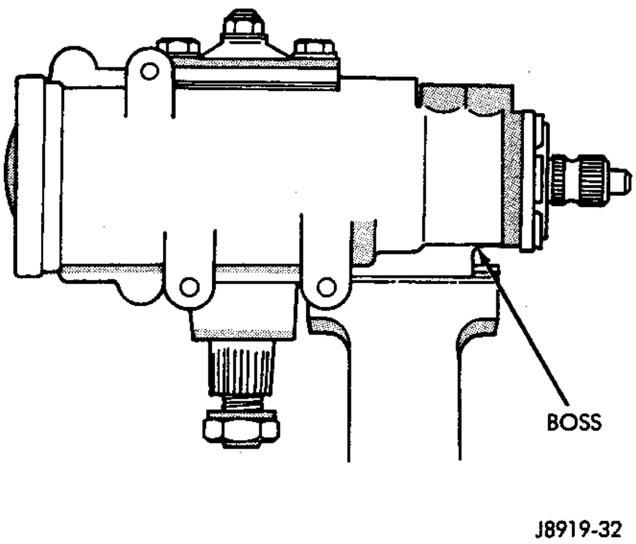

Fig. 32 Steering Gear Housing

(2) Install the wormshaft conical bearing races and the lower thrust bearing. Install the first conical bearing race followed by the thrust bearing, and then the second conical bearing race (Fig. 33). **Both of the conical bearing races must be installed so that the top of each cone faces the bottom of the gear housing.**

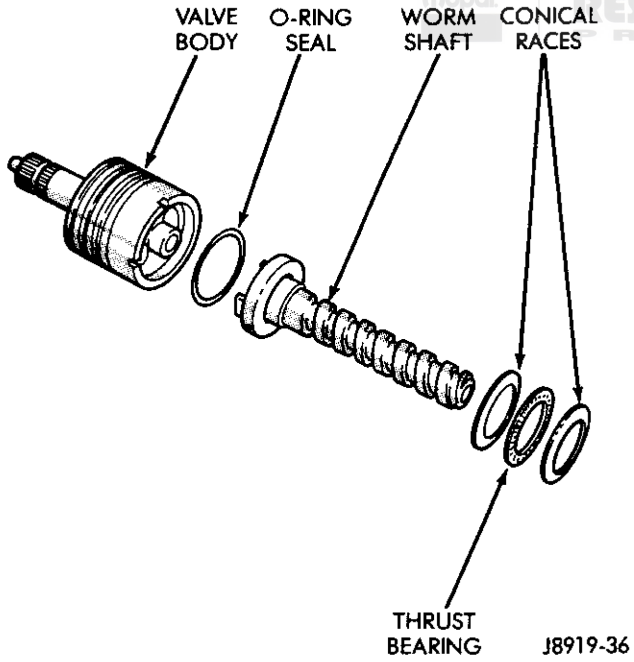

Fig. 33 Lower Thrust Bearing & Race Installation

(3) Install the stub shaft cap-to-valve body O-ring seal in the valve body so that it is "seated" against the inner edge of the stub shaft cap (Fig. 34).

CAUTION: Do not press against the stub shaft to "seat" the valve body. This could cause the stub shaft and cap to separate from the valve body and allow the spool valve dampener O-ring seal to slip into the valve body fluid grooves. "seat" the valve body only by pushing on the outer diameter surface of the valve body with your fingertips (Fig. 34). Ensure that the teflon rings do not bind inside the housing. The valve body is correctly "seated" when all or most of the fluid return hole in the steering gear housing is visible.

(4) Align the narrow slot in the valve body with the locating pin in the wormshaft (Fig. 34) and insert the valve body into the steering gear housing. "seat" the valve body in the housing (Fig. 34).

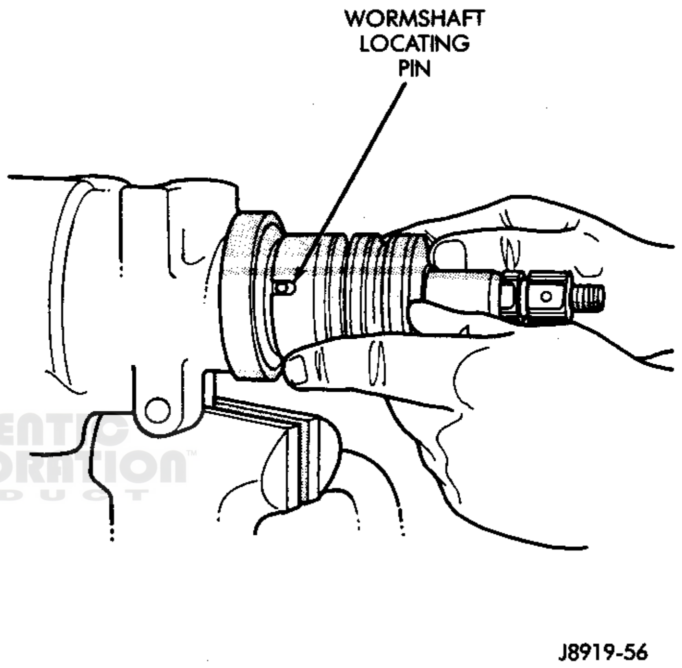

Fig. 34 Valve Body Installation

(5) Install a seal protector tool over the end of the stub shaft (Fig. 35).

(6) Install the adjustment cap over the end of the stub shaft (Fig. 35).

(7) Tighten the adjustment cap with a spanner wrench until it "seats" against the valve body. Approximately 27 N•m (20 ft-lbs) torque is required to "seat" the cap.

(8) Remove the seal protector tool after installing the adjustment cap.

(9) Insert the rack piston into the steering gear housing until the wormshaft engages with the valve body and the stub shaft.

Use care to prevent damage to the piston ring during installation.

(10) Rotate the stub shaft clockwise to force the rack piston into the steering gear housing. Do not remove the arbor tool until the valve body piston ring has entered the housing bore.

(11) Rotate the stub shaft until the rack piston center groove is aligned with the center of the pitman shaft bearing bore.

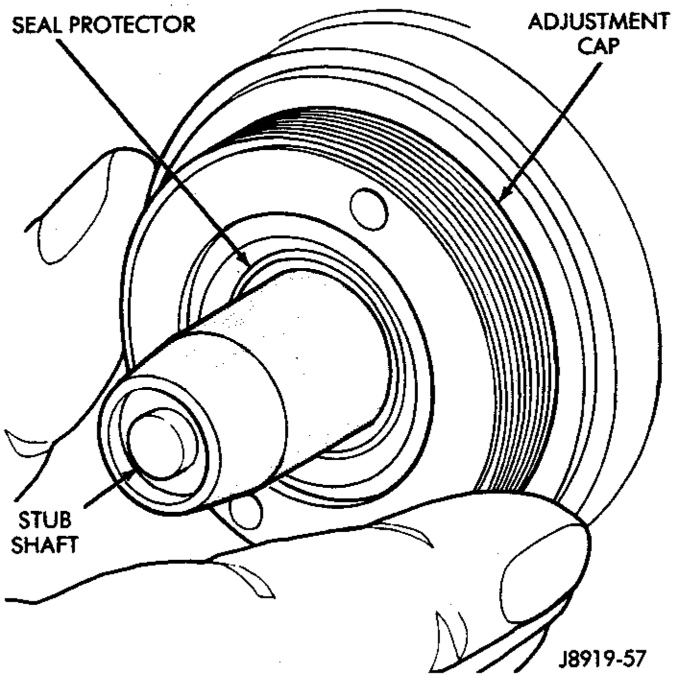

Fig. 35 Adjustment Cap Installation

(12) Lubricate the pitman shaft adjustment screw cover gasket with petroleum jelly and place it on the cover. Ensure that the rubber seal in the gasket is properly "seated" in the cover groove.

(13) Position the cover over the pitman shaft and thread the cover onto the adjustment screw until it contacts the pitman shaft.

(14) Install the pitman shaft with the long, center sector tooth meshing with the rack piston center groove.

(15) Ensure that the adjustment screw cover gasket is correctly in place before attaching the cover to the steering gear housing. Install the cover lockwashers and bolts. Tighten the bolts with 61 N•m (45 ft-lbs) torque.

(16) Thread the adjustment screw locknut half-way on the adjustment screw. If necessary, insert an Allen wrench into the adjustment screw head to prevent it from turning while threading the nut on it.

(17) Install the end plug in the rack piston. Tighten the plug with 68 N•m (50 ft-lbs) torque.

(18) Lubricate the steering gear housing end-plug O-ring seal with power steering fluid and position it on the end plug.

(19) Install and "seat" the end plug in the steering gear housing. If necessary, tap the end plug lightly with a plastic mallet to "seat" it properly.

(20) Install the end-plug retaining ring with the ring end gap **not aligned** with the hole inside the steering gear housing. Tap lightly on the plug to ensure that the ring is "seated" properly.

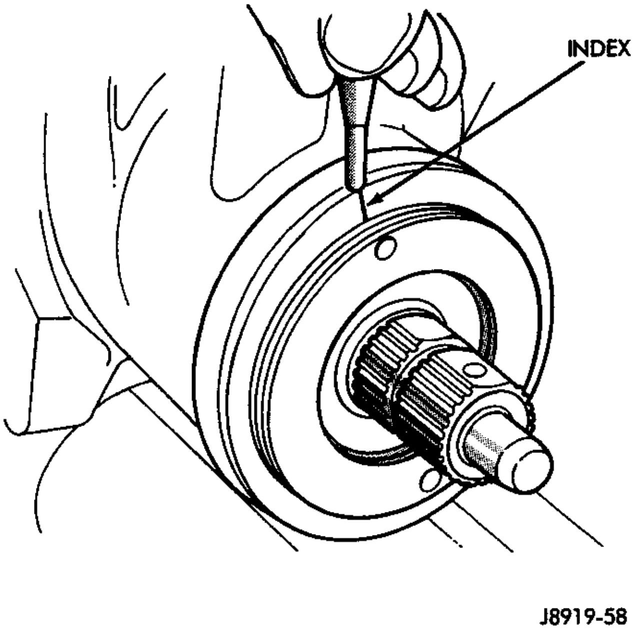

Fig. 36 Adjustment Cap Index Mark

(21) Adjust the wormshaft bearing "preload" torque and the pitman shaft overcenter drag torque according to the procedures listed within **Power Steering Gear—Adjustments On Bench.**

POWER STEERING GEAR—ADJUSTMENTS ON BENCH

After assembly, the steering gear requires two adjustments:

- wormshaft bearing "preload" torque, and
- pitman shaft overcenter drag torque.

CAUTION: Adjust the steering gear in the following order only. Always adjust the wormshaft bearing "preload" torque first, and then adjust the pitman shaft overcenter drag torque last. Failure to do so could result in damage to the gear or improper steering response.

WORMSHAFT BEARING PRELOAD TORQUE—ADJUSTMENT

(1) Tighten the wormshaft bearing adjustment cap with a spanner wrench until it is "seated" in the steering gear housing. Approximately 27 N•m (20 ft-lbs) torque is required to "seat" the cap in the housing.

(2) Score an index mark on the steering gear housing adjacent to one of the spanner wrench tightening holes in the adjustment cap (Fig. 36).

(3) Measure counterclockwise 4.7 to 6.3 mm (3/16 to 1/4 in) from the index mark and score an adjustment reference mark on the housing (Fig. 37).

(4) Rotate the adjustment cap counterclockwise until the spanner wrench tightening hole in the cap (adjacent to the index mark) is aligned with the adjustment reference mark on the housing.

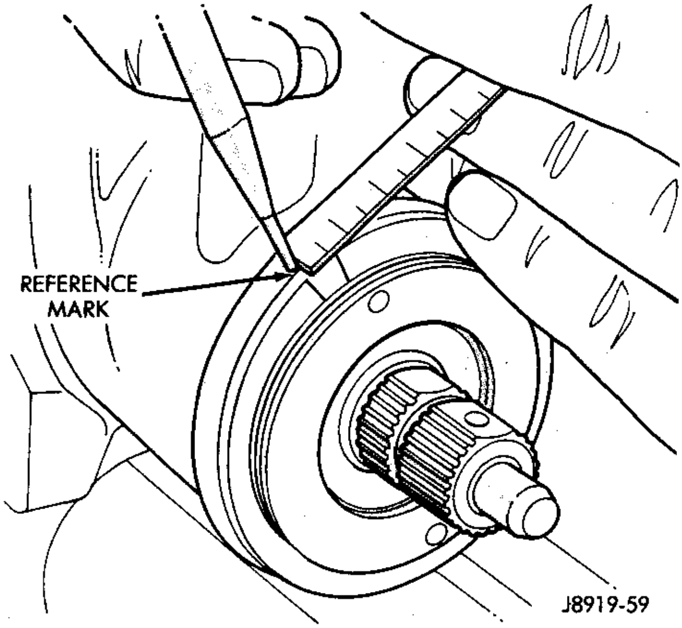

Fig. 37 Adjustment Reference Mark

(5) Install the adjustment cap locknut and tighten it with 115 N•m (85 ft-lbs) torque. Ensure that the adjustment cap does not rotate while tightening the locknut.

(6) Rotate the stub shaft clockwise to the stop, then rotate it counterclockwise 1/4 of-a-turn.

(7) Use a low calibration (e.g., inch-pounds) torque bar with a maximum capacity of 6 N•m/50 in-lbs torque and a 12-point deep socket wrench to measure the "preload" torque required to rotate the stub shaft (and wormshaft). Rotate the stub shaft at a constant speed (rpm) and measure the wormshaft "preload" torque with the beam of the torque bar at or near the vertical position (Fig. 38).

(8) Record the wormshaft bearing "preload" torque measurement. The "preload" torque required to rotate the stub shaft (and wormshaft) should be 0.45 to 1.13 N•m (4 to 10 in-lbs). If the torque measurement is not within the specified torque range:

- the adjustment cap could be not tightened correctly or it could have rotated while the locknut was being tightened;
- the steering gear could be assembled incorrectly; or
- the thrust bearings and the races could be defective.

(9) If necessary, correct the cause for the incorrect "preload" torque and readjust the adjustment cap.

PITMAN SHAFT OVERCENTER DRAG TORQUE—ADJUSTMENT

CAUTION: Do not attempt to adjust the pitman shaft overcenter drag torque before the wormshaft bearing "preload" torque has been adjusted.

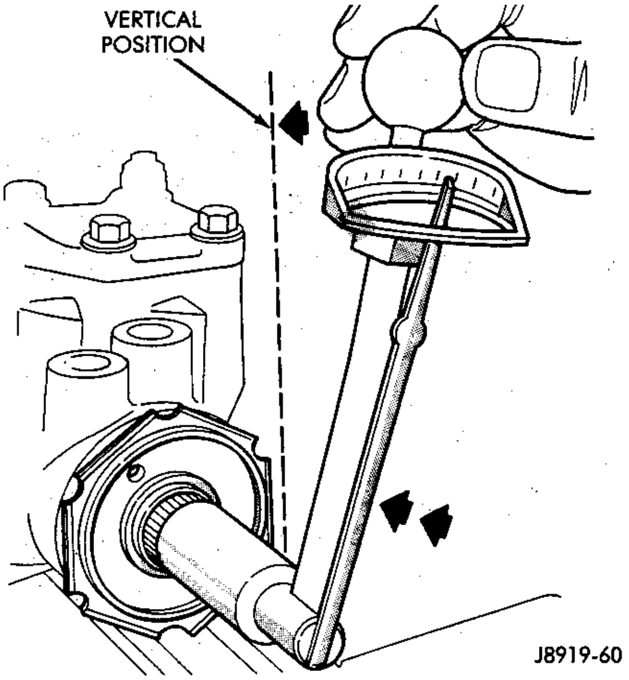

Fig. 38 Wormshaft Bearing "Preload" Torque Measurement

(1) Rotate the pitman shaft adjustment screw counterclockwise until it is fully extended, then rotate it 180 degrees clockwise.

(2) Rotate the stub shaft from stop-to-stop, count the total number of rotations, and rotate the stub shaft in the reverse direction 1/2 of the total number of rotations to center the steering gear.

When the steering gear is centered, the flat area on the stub shaft should face upward and be parallel with the adjustment screw cover (Fig. 39) and the pitman shaft master spline should be aligned with the adjustment screw as illustrated in Figure 40.

(3) Place a low calibration (e.g., inch-pounds) torque bar with a maximum capacity of 6 N•m/50 in-lbs torque and a 12-point deep socket wrench on the stub shaft. Place the torque bar in a vertical position for the measurement. Rotate the torque bar 45 degrees each side of vertical position)center) and record the highest overcenter drag torque measured at or near the steering gear center position (Fig. 41).

(4) The overcenter drag torque must conform (as applicable) to the following specifications:

- for new steering gears (less than 400 miles/640 km)—the overcenter drag torque should be equal to the previously measured wormshaft bearing "preload" torque plus an additional 0.45 to 0.90 N•m (4 to 8 in-lbs) torque but must not exceed a maximum of 2 N•m (18 in-lbs) torque; and
- for used steering gears (400 miles/640 km or more-)—the overcenter drag torque should be equal to the previously measured wormshaft bearing torque plus

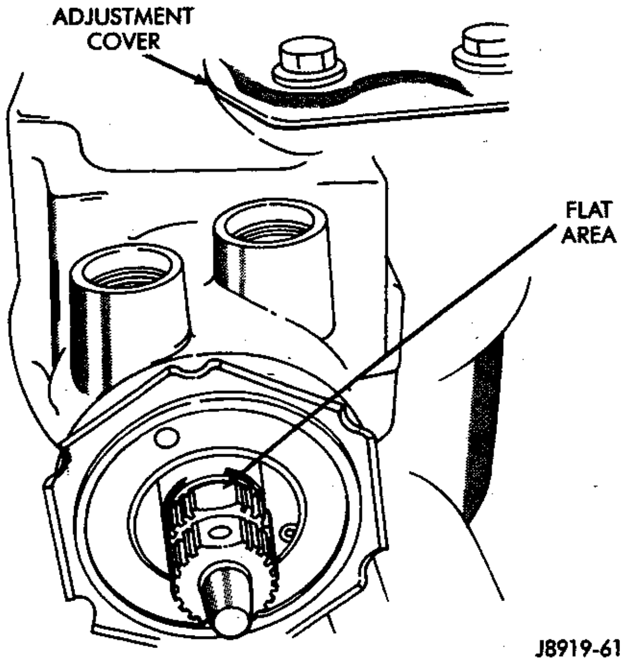

Fig. 39 Steering Gear Centered (Reference)

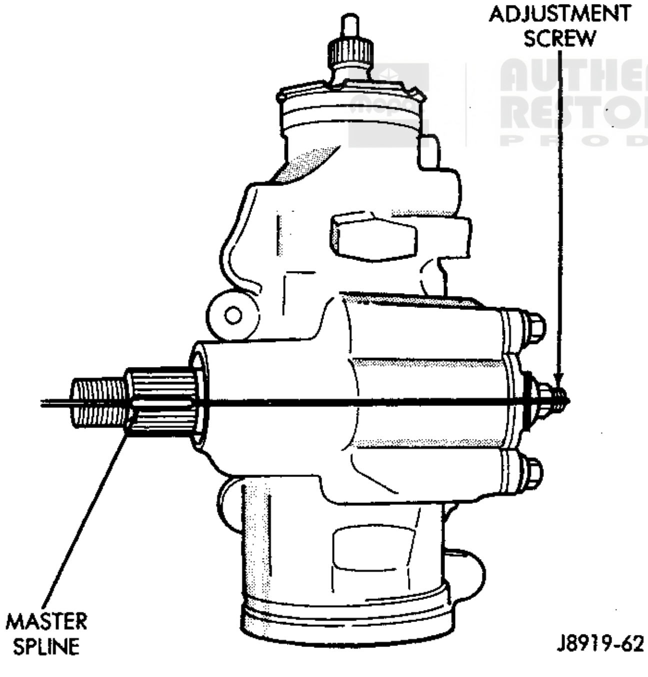

Fig. 40 Steering Gear Centered (Reference)

an additional 0.5 to 0.6 N•m (4 to 5 in-lbs) torque but do not exceed a maximum of 2 N•m (18 in-lbs) torque.

(5) if necessary, adjust the overcenter drag torque by rotating the pitman shaft adjustment screw clockwise until the specified overcenter drag torque is obtained. Hold the pitman shaft adjustment screw and tighten the locknut with 27 N•m (20 ft-lbs) torque after the adjustment is completed (Fig. 42). **If the adjustment screw is allowed to rotate while tightening the locknut, the complete overcenter drag torque adjustment procedure must be repeated.**

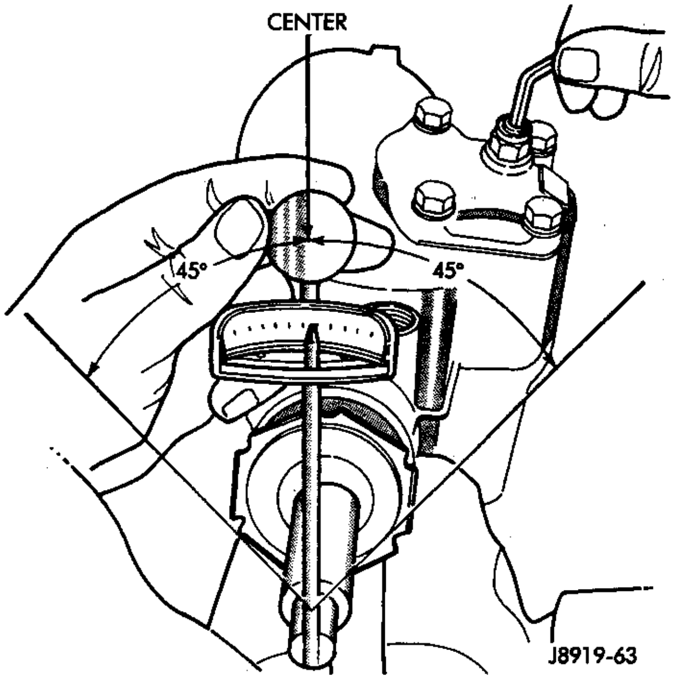

Fig. 41 Pitman Shaft Overcenter Drag Torque Measurement

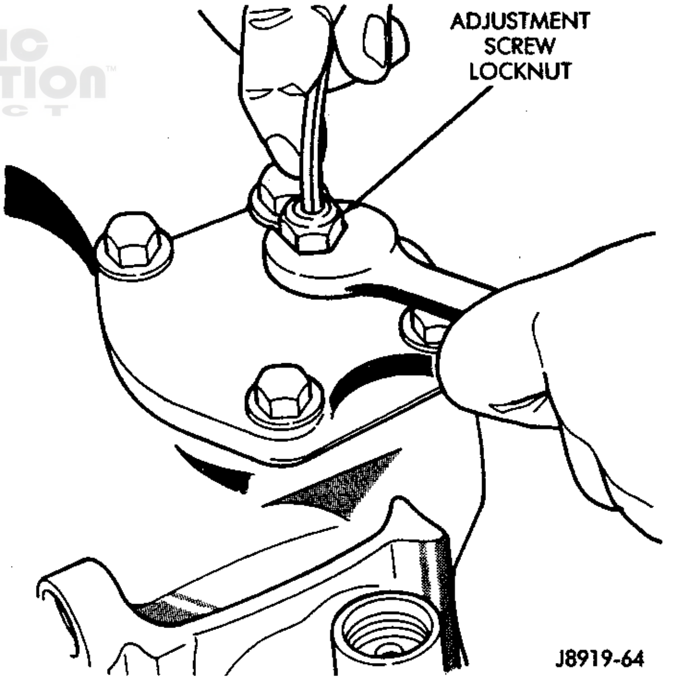

Fig. 42 Tightening Adjustment Screw Locknut

(6) Install the steering gear according to the installation procedure.

(7) Fill the pump reservoir with power steering fluid and purge the system according to the procedure listed within **Power Steering Gear—Initial Operation.**

INITIAL OPERATION

(1) Fill the pump reservoir and operate the engine until the power steering fluid reaches the normal operating temperature of approximately 77°C (170°F), then stop the engine.

(2) Turn the wheels to a full-left-turn position and add power steering fluid until the reservoir is full.

(3) Start the engine. Operate it at high idle speed and then observe the fluid level on the dipstick. Add fluid, if necessary.

(4) Purge the system of air by turning the wheels from side-to-side without contacting the stops. Fluid with air in it will have a "milky-red" color. Maintain the reservoir full of fluid.

Because air is compressible, it must be eliminated from the fluid before normal steering action can be obtained.

(5) Return the wheels to the straight-ahead position and operate the engine for an additional 2 to 3 minutes, then stop the engine.

(6) Road test the vehicle to ensure that the steering system functions normally and has no noise.

(7) Observe the fluid level. Add fluid as necessary to fill the reservoir with the system stabilized at the normal operating temperature.

CAUTION: If the fluid reservoir cap is not properly tightened after a fluid level check, the result can be fluid leakage and possible loss of the cap. Ensure that the cap is securely tightened when installing it.

POWER STEERING HOSE—REMOVAL/INSTALLATION

Cap the hose open ends and the pump/steering gear fittings to prevent entry of foreign material.

WARNING: POWER STEERING FLUID (AND PUMP COMPONENTS) AND THE EXHAUST SYSTEM CAN BE EXTREMELY HOT IF THE ENGINE HAS BEEN RECENTLY OPERATING. DO NOT START THE ENGINE WITH ANY LOOSE OR DISCONNECTED HOSES. DO NOT ALLOW THE HOSES TO TOUCH A HOT EXHAUST MANIFOLD OR THE CATALYTIC CONVERTER.

REMOVAL

(1) If applicable, remove the fasteners from the hose retaining brackets at all locations.

(2) Disconnect the hose from the steering gear valve body fitting and drain the fluid from the pump and reservoir via the open end of the hose.

(3) Disconnect the opposite end of the hose from the pump fitting and remove the hose from the vehicle.

INSTALLATION

When an original power steering fluid hose is being installed or a replacement hose is being installed, it is essential that the following precautions be employed:

- avoid sharp bends in the hose (a 5-inch approximate radius minimum is recommended);
- hose must remain at least one inch away from all pulleys, battery, and brake tubing, and two inches away from the exhaust manifold; and
- protective plastic foam sleeves must be installed where the hose contacts other components or vehicle body metal.

(1) Wipe the hose open ends and the pump/steering gear fittings clean.

(2) Connect the hose at the steering gear valve body fitting and at the pump fitting. If applicable, route the hose to the retaining brackets while avoiding extreme bends or "kinking" the hose. The hose must remain away from the exhaust system components. Do not distort the hose tube ends.

(3) If applicable, install and properly tighten all bracket fasteners.

(4) Where used, the protective plastic foam sleeves must be properly positioned on the hose to prevent chafing caused by contact with other components.

(5) Tighten the fittings at the pump and at the steering gear with 30 N•m (22 ft-lbs) torque.

(6) After the hose is installed, inspect and test for fluid leaks.

POWER STEERING GEAR—INITIAL OPERATION

(1) Fill the pump reservoir and operate the engine until the power steering fluid reaches the normal operating temperature of approximately 77°C (170°F), then stop the engine.

(2) Turn the wheels to a full-left-turn position and add power steering fluid until the reservoir is full.

(3) Start the engine. Operate it at high idle speed and then observe the fluid level on the dipstick. Add fluid, if necessary.

(4) Purge the system of air by turning the wheels from side-to-side without contacting the stops. Fluid with air in it will have a "milky-red" color. Maintain the reservoir full of fluid.

Because air is compressible, it must be eliminated from the fluid before normal steering action can be obtained.

(5) Return the wheels to the straight-ahead position and operate the engine for an additional 2 to 3 minutes, then stop the engine.

(6) Road test the vehicle to ensure that the steering system functions normally and has no noise.

(7) Observe the fluid level. Add fluid as necessary to fill the reservoir with the system stabilized at the normal operating temperature.

CAUTION: If the fluid reservoir cap is not properly tightened after a fluid level check, the result can be fluid leakage and possible loss of the cap. Ensure that the cap is securely tightened when installing it.

POWER STEERING PUMP SERVICE

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OPERATION

Rectangular pump vanes rotated by the shaft driven rotor move the fluid from the intake to the cam ring pressure cavities. As the rotor begins to turn, centrifugal force moves the vanes against the inside surface of the cam ring to pickup residual fluid. This fluid is then forced into the high pressure area. As more fluid is picked up by the vanes, fluid is forced into the cavities of the thrust plate through two crossover holes in the cam ring and pressure plate. The crossover holes empty into the high pressure area between the pressure plate and the housing end cover.

When the high pressure area is filled, fluid flows under the vanes in the rotor slots, forcing the vanes to follow the inside oval surface of the cam ring. As the vanes reach the restricted area of the cam ring, fluid is forced out from between the vanes. When excess fluid flow is generated during high-speed operation, a regulated amount of fluid returns to the pump intake side through the flow control valve. The flow control valve reduces the power required to drive the pump and reduces temperature "build-up".

When steering conditions cause the maximum allowable safe pressure to be exceeded (e.g., turning the wheels against the steering "stops") the pressure built up in the steering gear also exerts pressure on the spring end of the flow control valve. This end of the valve houses the pressure relief valve. High pressure lifts the relief valve ball from its "seat" and allows fluid to flow through a trigger orifice located in the outlet fitting. This reduces the pressure on the spring end of the flow control valve, which then opens and allows the fluid to return to the intake side of the pump. This action limits the maximum pressure output of the pump to a safe level.

With normal operating conditions, the pressure requirements of the pump are below maximum, causing the pressure relief valve to remain closed.

Safety goggles should be worn at all times when involved with power steering pump service.

A power steering pump can be identified by its "ham can" shaped reservoir (Fig. 1).

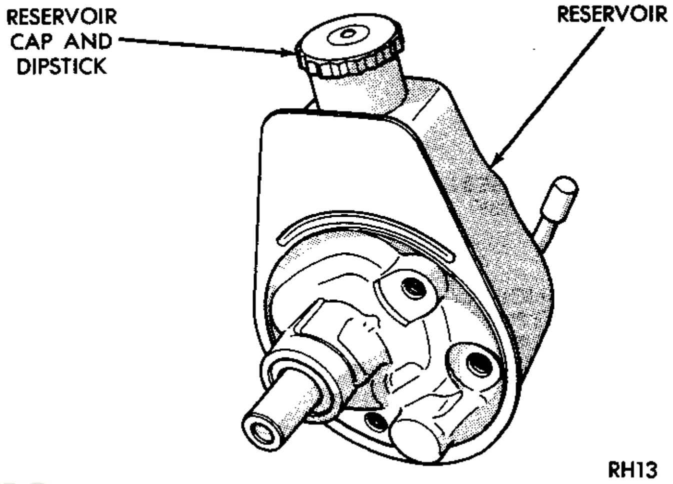

Fig. 1 Power Steering Pump

FLUID LEVEL

CAUTION: The fluid level should be "checked" with engine off to prevent injury from moving components. Do not use automatic transmission fluid to supplement the fluid in the reservoir. Do not overfill the reservoir.

Wipe the reservoir filler cap clean of foreign material, then check the fluid level (Fig. 1). The dipstick should indicate **FULL COLD** when the fluid is at normal ambient temperature (approximately 21°C to 27°C/70°F to 80°F). Replenish the fluid, if necessary, with **MOPAR Power Steering Fluid, Part No. 4318056, or an equivalent fluid.**

SERVICE DIAGNOSIS

There is some noise in all power steering systems. One of the most common is a hissing sound most evident at vehicle standstill or parking. Hiss is a high frequency noise similar to that experienced while slowly closing a water tap. The noise is present in every valve and results from high velocity fluid passing the valve orifice edges. There is no relationship between this noise and performance of the steering pump. "Hiss" can be expected when the steering wheel is at the end of travel or when slowly turning the wheels at vehicle standstill.

PUMP SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
CHIRP NOISE IN STEERING PUMP	(1) Loose belt.	(1) Adjust belt tension to specification.
BELT SQUEAL (PARTICULARLY NOTICEABLE AT FULL WHEEL TRAVEL AND STAND STILL PARKING)	(1) Loose belt.	(1) Adjust belt tension to specification.
GROWL NOISE IN STEERING PUMP	(1) Excessive back pressure in hoses or steering gear caused by restriction.	(1) Locate restriction and correct. Replace part if necessary.
GROWL NOISE IN STEERING PUMP (PARTICULARLY NOTICEABLE AT STAND STILL PARKING	(1) Scored pressure plates, thrust plate or rotor.	(1) Replace parts and flush system.
	(2) Extreme wear of cam ring.	(2) Replace parts.
GROAN NOISE IN STEERING PUMP	(1) Low oil level.	(1) Fill reservoir to proper level.
	(2) Air in the oil. Poor pressure hose connection.	(2) Tighten connector to specified torque. Bleed system by operating steering from right to left - full turn.
RATTLE NOISE IN STEERING PUMP	(1) Vanes not installed properly.	(1) Install properly.
	(2) Vanes sticking in rotor slots.	(2) Free up by removing burrs, varnish, or dirt.
SWISH NOISE IN STEERING PUMP	(1) Defective flow control valve.	(1) Replace part.
WHINE NOISE IN STEERING PUMP	(1) Pump shaft bearing scored.	(1) Replace housing and shaft. Flush system.
HARD STEERING OR LACK OF ASSIST	(1) Loose pump belt.	(1) Adjust belt tension to specification.
	(2) Low oil in reservoir. **NOTE:** Low oil level will also result in excessive pump noise.	(2) Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage. Tighten loose connectors.
	(3) Steering gear to column misalignment.	(3) Align steering column.
	(4) Lower coupling flange rubbing against steering gear adjuster.	(4) Loosen pinch bolt and assemble properly.
	(5) Tires not properly inflated.	(5) Inflate to recommended pressure.

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PUMP SERVICE DIAGNOSIS (CONT'D)

CONDITION	POSSIBLE CAUSE	CORRECTION
	Further possible causes could be:	
	(6) Sticking flow control valve.	In order to diagnose conditions such as listed in (6), (7), (8), (9) a pressure test of the entire power steering system is required.
	(7) Insufficient pump pressure output.	
	(8) Excessive internal pump leakage.	
	(9) Excessive internal gear leakage.	
FOAMING MILKY POWER STEERING FLUID, LOW FLUID LEVEL AND POSSIBLE LOW PRESSURE	(1) Air in the fluid, and loss of fluid due to internal pump leakage causing overflow.	(1) Check for leaks and correct. Bleed system. Extremely cold temperatures will cause system aeriation should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from body. Check welsh plug and body for cracks. If plug is loose or body is cracked, replace body.
LOW PUMP PRESSURE	(1) Flow control valve stuck or inoperative.	(1) Remove burrs or dirt or replace. Flush system.
	(2) Pressure plate not flat against cam ring.	(2) Correct.
MOMENTARY INCREASE IN EFFORT WHEN TURNING WHEEL FAST TO RIGHT OR LEFT	(1) Low oil level in pump.	(1) Add power steering fluid as required.
	(2) Pump belt slipping.	(2) Tighten or replace belt.
	(3) High internal leakage.	(3) Check pump pressure. (See pressure test.)
STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING ESPECIALLY DURING PARKING	(1) Low oil level.	(1) Fill as required.
	(2) Loose pump belt.	(2) Adjust tension to specification.
	(3) Steering linkage hitting engine oil pan at full turn.	(3) Correct clearance.
	(4) Insufficient pump pressure.	(4) Check pump pressure. (See pressure test.) Replace flow control valve if defective.
	(5) Sticking flow control valve.	(5) Inspect for varnish or damage, replace if necessary.
EXCESSIVE WHEEL KICKBACK OR LOOSE STEERING	(1) Air in system.	(1) Add oil to pump reservoir and bleed by operating steering. Check hose connectors for proper torque and adjust as required.

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PUMP SERVICE DIAGNOSIS (CONT'D)

CONDITION	POSSIBLE CAUSE	CORRECTION
LOW PUMP PRESSURE	(1) Flow control valve stuck or inoperative.	(1) Remove burrs or dirt. Replace valve if damaged.
	(2) Pump pressure plate not seating (flat) against cam ring.	(2) Disassemble pump and correct.
	(3) Extreme wear of cam ring.	(3) Replace parts. Flush system.
	(4) Scored pressure plate, thrust plate, or rotor.	(4) Replace parts. Flush system.
	(5) Vanes not installed properly.	(5) Install properly.
	(6) Vanes sticking in rotor slots.	(6) Freeup by removing burrs, varnish, or dirt.
	(7) Cracked or broken thrust or pressure plate.	(7) Replace part.

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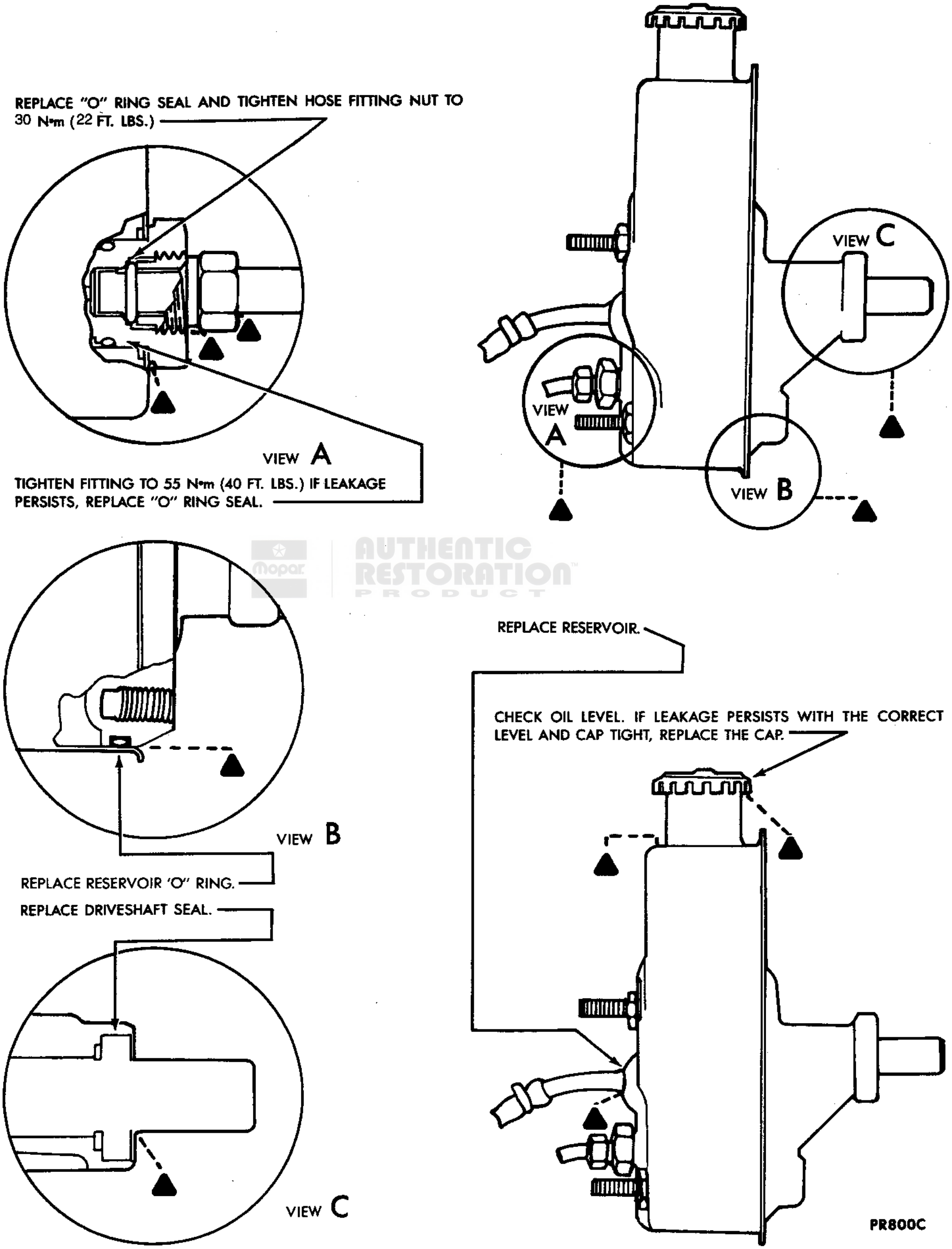
PUMP LEAKAGE DIAGNOSIS



REPLACE "O" RING SEAL AND TIGHTEN HOSE FITTING NUT TO 30 N•m (22 FT. LBS.)

TIGHTEN FITTING TO 55 N•m (40 FT. LBS.) IF LEAKAGE PERSISTS, REPLACE "O" RING SEAL.

REPLACE RESERVOIR 'O" RING.

REPLACE DRIVESHAFT SEAL.

REPLACE RESERVOIR.

CHECK OIL LEVEL. IF LEAKAGE PERSISTS WITH THE CORRECT LEVEL AND CAP TIGHT, REPLACE THE CAP.

PRESSURE TEST

The following procedure can be used to test the operation of the power steering system while installed on the vehicle.

Safety goggles should be worn at all times when involved with power steering pump pressure testing.

(1) Check and adjust the power steering pump belt tension as necessary. If necessary, refer to the procedure.

(2) Place a drip pan under the engine and disconnect the power steering pump high pressure hose either at the pump or at the steering gear (whichever is the most convenient). Maintain the hose end raised above the reservoir to prevent fluid loss.

(3) Connect Pressure Test Gauge Tool C-3909E to the pump pressure hose and to an adapter hose (use an additional adapter hose if necessary). Connect the test gauge between the power steering pump and the steering gear (Fig. 2).

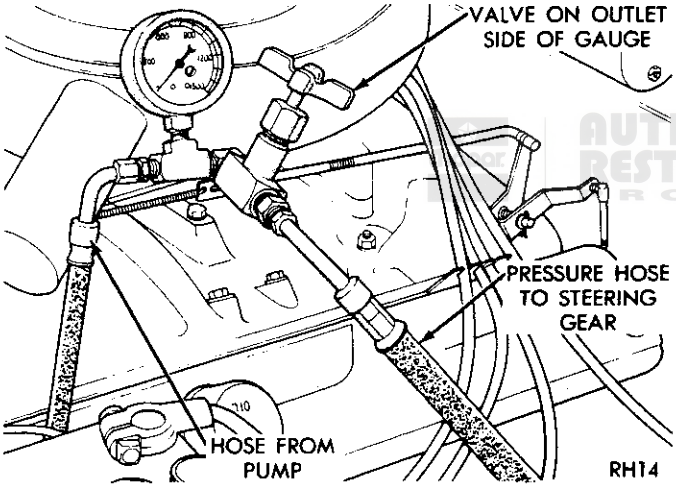


Fig. 2 Pressure Test Gauge

CAUTION: Ensure that the test gauge is connected in the fluid pressure circuit between the pump and the steering gear.

(4) Open the test valve completely. Rotate the valve counterclockwise to open it.

(5) Fill the fluid reservoir with power steering fluid as necessary.

(6) Insert a thermometer in the fluid reservoir. Operate the engine until the power steering fluid reaches the normal operating temperature of 66°C to 77°C (150°F to 170°F).

Turning the wheels from "stop-to-stop" will aid with heating the fluid. Do not hold the steering wheel against the "stop" for an extended period of time because this will cause the pump to over-heat and damage internal components.

(7) With the engine at a speed of approximately 600 to 800 rpm and the gauge valve open, the initial pressure should be in the range of 207-345 kPa (30-50 psi) and should definitely be less than 690 kPa (100 psi). If the pressure is 690 kPa (100 psi) or more, inspect the hoses for restrictions and repair as necessary.

CAUTION: The following test procedure involves testing the maximum pump pressure output and the flow control valve operation. Do not close the test gauge valve for more than five seconds at a time because this could damage the pump.

(8) Close the test gauge valve fully, then immediately open it. Repeat this procedure three times and record the highest pressure indicated on the test gauge each time the test gauge valve is closed.

(9) Compare the highest indicated pressures. If the pressure indications are at least 8 900 kPa (1,300 psi) and the variance of the three pressure indications is within the 345 kPa (50 psi) allowable variance, the pump is functioning normally.

For example: if the highest indicated pressures are 8 930 kPa, 8 990 kPa and 9 050 kPa (1,305 psi, 1,315 psi and 1,325 psi), they are acceptable and, because the pressure variance is within the 345 kPa (50 psi) allowable variance, the pump operation is normal.

(10) If the highest indicated pressures are more than the acceptable limit of 9 930 kPa (1,450 psi) for pressure relief or the pressures are not within the 345 kPa (50 psi) allowable variance, the flow control valve is not functioning correctly. Remove and clean the valve (Fig. 3). Remove burrs with a crocus cloth or a fine grit hone. If the system is contaminated, flush it.

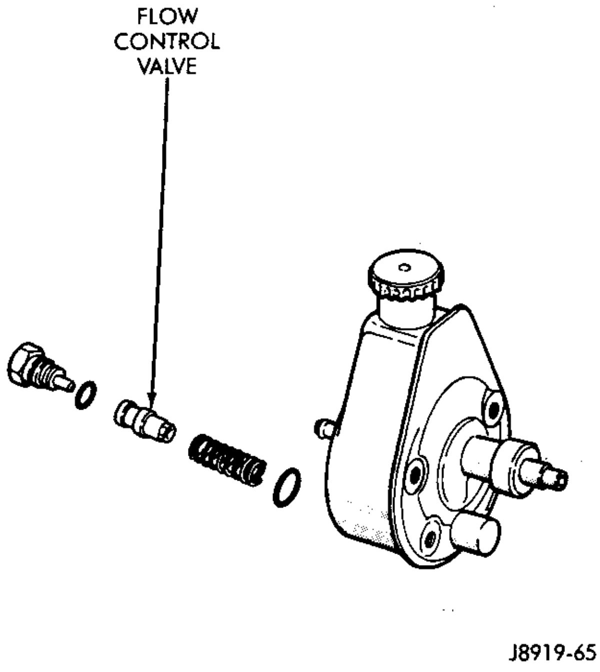


Fig. 3 Flow Control Valve

CAUTION: The power steering system is a closed system. Contaminated fluid in either the pump or in the steering gear is circulated to the other unit. If the system is exceptionally contaminated, the pump and the steering gear must be disassembled and cleaned, and all the hoses removed and flushed.

CAUTION: Do not force the pump to operate against a "stop" for more than 2 to 4 seconds at a time because, otherwise, pump damage will result.

CAUTION: To prevent causing flat spots on the front tires, do not turn the steering wheel more than five times without moving the vehicle to change the tire-to-floor contact surface area.

(11) If the pump operation is acceptable (i.e., the highest indicated pressures are within the specified pressure relief range and variance), continue with the test. With the gauge valve open, turn the steering wheel to the extreme left and right positions to force the pump to operate against the stops (Fig. 4). Record the highest indicated pressure at each steering wheel position.

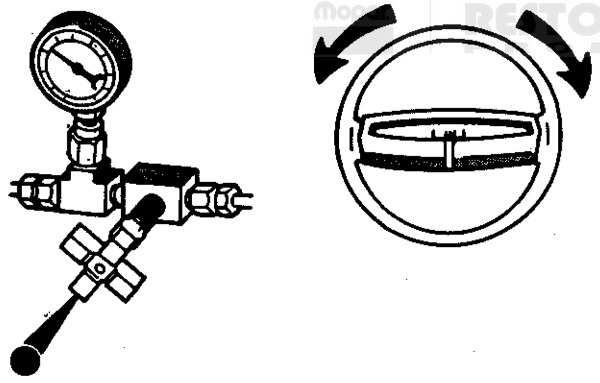


Fig. 4 Pressure Test

(12) Compare the extreme left and the right turn pressures with the previously noted pump highest output pressures. If the pump highest output pressures are not duplicated when the pump is forced to operate against either stop, the steering gear is leaking internally and must be disassembled and repaired.

(13) Stop the engine and remove the test equipment. Connect the pressure hose to the pump (or steering gear).

(14) Repair the system as necessary and correct the fluid level. Remove the drip pan.

HOSE—REMOVAL/INSTALLATION

Remove/install power steering hoses with vehicle raised on a hoist. Cap the hose open ends and the pump and steering gear ports to prevent entry of foreign material.

WARNING: POWER STEERING FLUID (AND PUMP COMPONENTS) AND THE EXHAUST SYSTEM CAN BE EXTREMELY HOT IF THE ENGINE HAS BEEN RECENTLY OPERATING. DO NOT START THE ENGINE WITH ANY LOOSE OR DISCONNECTED HOSES. DO NOT ALLOW THE HOSES TO TOUCH A HOT EXHAUST MANIFOLD OR THE CATALYTIC CONVERTER.

HOSE REMOVAL

(1) If applicable, remove the fasteners from the hose retaining brackets at all locations.

(2) Disconnect the hose from the steering gear union and drain the fluid from the pump and reservoir via the open end of the hose.

(3) Disconnect the opposite end of the hose from the pump union and remove the hose from the vehicle.

HOSE INSTALLATION

When either the original hose or a replacement hose is being installed, the following instructions are essential:

- route the hose(s) and install them in the same location(s) as originally installed before removal;
- route the hose(s) with smooth curves (i.e., avoid sharp bends and kinks);
- tighten the both hose fittings with 30 N•m (22 ft-lbs) torque;
- hose(s) must remain at least one inch away from all pulleys, the battery, and the brake tubing, and at least two inches away from the exhaust manifold;
- when used, the protective sponge sleeves must be properly positioned to prevent hose contact and chafing from other components in engine compartment; and
- after a hose(s) is installed, inspect (and test) for leaks while system is being purged of air (refer to **Pump Installation**).

(1) Wipe the hose open ends, the pump fitting and steering gear fitting clean.

(2) Connect the hose at the steering gear fitting and at the pump fitting. As applicable, route the hose to the retaining brackets while avoiding extreme bends or "kinking" the hose. The hose must re-

main away from the exhaust system components. Do not distort the hose tube ends.

(3) As applicable, install and tighten the bracket fasteners with the correct torque.

(4) When used, the protective foam sleeves must be properly positioned on the hose to prevent chafing caused by contact with other components.

(5) After the hose is installed, inspect and test for leaks. Refer to **Pump Installation** for the procedure.

PUMP—REMOVAL/INSTALLATION

REMOVAL

CAUTION: The drive belt must be loosened before removing the pump. Do not attempt to remove the pump without loosening the belt because, if not loosened, the pulley will be damaged.

(1) Loosen the pump drive belt as instructed in the drive belt adjustment procedure. Refer to **Cooling System—Group 7**. Remove the belt from the pump pulley.

(2) Place a drain pan under the power steering pump.

(3) Clamp the fluid return hose and disconnect the hoses from the power steering pump. Cap the fittings.

(4) Remove the front bracket attaching bolts.

(5) Remove the pump-to-rear bracket bolts/nuts and remove the pump. With the pump removed, remove the front bracket from the pump, if necessary.

PUMP INSTALLATION

(1) If removed, attach the front mounting bracket to the pump.

(2) Position the pump in the rear bracket, install the retaining bolts/nuts and tighten with 28 N•m (21 ft-lbs) torque.

(3) Install the front bracket-to-engine bolts and tighten with 28 N•m (21 ft-lbs) torque.

(4) Connect the fluid hoses to the pump. Tighten the both hose fittings with 30 N•m (22 ft-lbs) torque.

(5) Install the drive belt and adjust the tension according to the adjustment procedure. Refer to **Cooling System—Group 7**. Tighten the adjustment bolts with 41 N•m (30 ft-lbs) torque. **Do not pry on the pump reservoir; use the square hole provided in the bracket.**

CAUTION: Do not use automatic transmission fluid to fill the reservoir.

(6) Fill the reservoir with power steering fluid. If necessary, refer to **Pump Initial Operation** (below) for detailed instructions.

PUMP SHAFT SEAL REPLACEMENT

To service the pump shaft seal, it is necessary to remove the pump from the vehicle, and disassemble and assemble the pump according to the instructions provided in **Pump Repair Service—Pump Disassembly/Assembly**.

Safety goggles should be worn at all times when involved with power steering pump service.

PUMP REPAIR SERVICE

The power steering pump must be removed from the vehicle for the following service procedures.

WARNING: THE POWER STEERING FLUID (AND THE PUMP COMPONENTS) AND THE EXHAUST SYSTEM CAN BE EXTREMELY HOT IF THE ENGINE HAS BEEN RECENTLY OPERATING.

Safety goggles should be worn at all times when involved with power steering pump service.

PULLEY REMOVAL

CAUTION: Do not hammer on pulley because this will damage it and/or the pump.

(1) Remove the pulley from the pump shaft with the removal tools as indicated (Fig. 5).

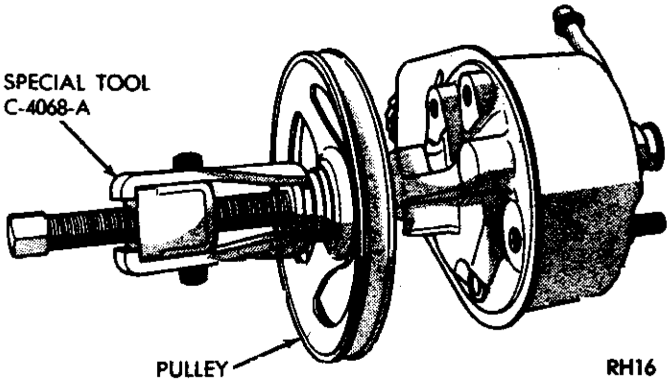


Fig. 5 Pulley Removal

(2) Replace the pulley if it is either bent, cracked, or loose on the shaft.

PULLEY INSTALLATION

(1) Install the pulley on the pump shaft with Installation Tool C-4063 (Fig. 6). Do not use the tool adapters.

(2) Ensure that the tool and the pulley remain aligned with the pump shaft to prevent the pulley from being "cocked" on the shaft.

(3) Force the pulley on the shaft until it is "flush" with the end of the shaft.

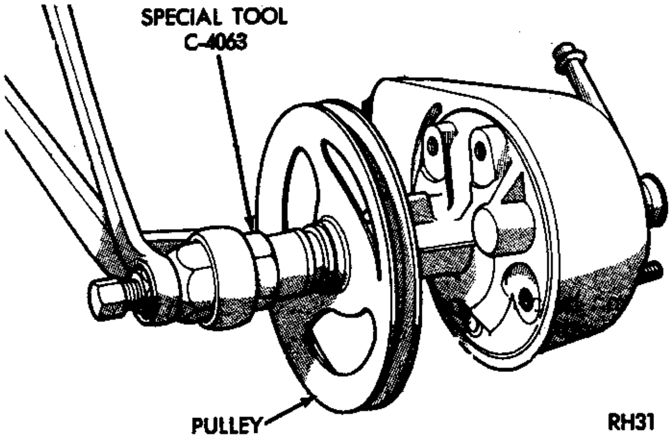


Fig. 6 Pulley Installation

PUMP DISASSEMBLY

The power steering pump installed in Ram Van and Wagon vehicles is a vane-submerged type pump (Fig. 7).

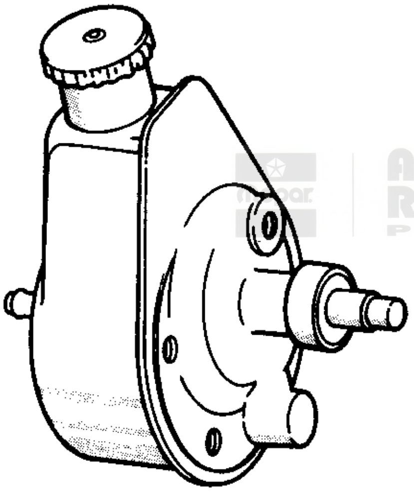


Fig. 7 Vane-Submerged Type Pump

(1) Remove the pump mounting brackets, as necessary.

(2) If applicable, remove the fluid reservoir filler cap and drain the fluid. Install the reservoir filler cap.

(3) Clean the pump exterior with cleaning solvent.

(4) Remove the pump pulley with an appropriate puller tool (Fig. 5).

(5) Clamp the pump housing front hub in a vise with the pump shaft pointing downward (Fig. 8). **Do not over-tighten the vise jaws because this will distort the bearing.**

(6) Remove the pump pressure hose fitting and the mounting studs. Discard the stud seals and the hose fitting O-ring seal (Fig. 9).

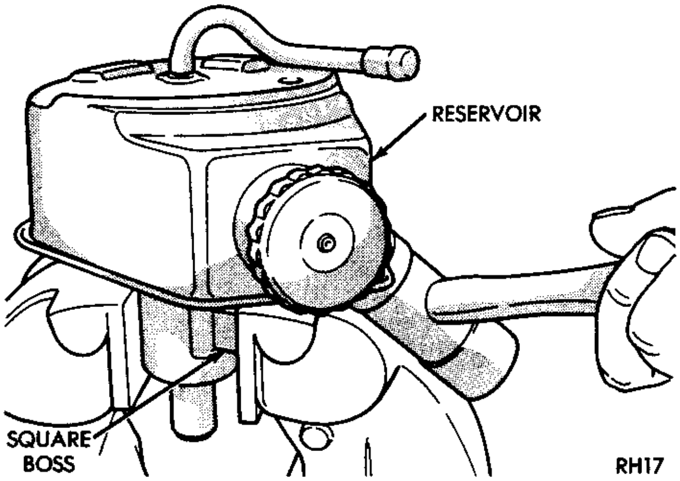


Fig. 8 Pump Clamped In A Vise

(7) Remove the reservoir by gently “tapping” the filler tube back and forth with a plastic hammer (Fig. 8) and then tilting the reservoir slightly back and forth to “unseat” the O-ring seal. Remove and discard the reservoir O-ring seal (Fig. 9).

(8) Remove the mounting stud and the pressure hose fitting seals from the counterbored spaces in the pump housing (Fig. 9). Discard the seals.

(9) Remove the end plate retaining ring (Fig. 10):

- insert a small punch in the 3.1-mm (1/8-in) diameter hole in the pump housing opposite the flow control valve orifice;
- force the retaining ring upward with a punch; and
- remove the retaining ring from the pump housing by inserting a pry tool under the ring and turning it.

(10) Remove the end plate and the spring from the pump housing (Fig. 9). If the end plate is not loose, tilt it slightly or tap it with a plastic hammer to loosen it.

(11) Remove the pump housing from the vise.

(12) Remove the flow control valve and the valve spring from the pump housing (Fig. 9). Invert the pump housing to allow the valve and spring to slide out of the orifice.

CAUTION: Ensure that the outer (exposed) end of the pump shaft has no corrosion before removing it from the pump housing. If corrosion exists, use crocus cloth to remove it. Failure to remove corrosion from the shaft can result in a damaged (nonreusable) shaft seal and bushing.

(13) Tap the outer end of the pump shaft with a plastic hammer (Fig. 11) until the pressure plate, the pump ring and rotor, the thrust plate, and the shaft can be removed as a unit from the pump housing (Fig. 12).

(14) Remove the retaining ring from the pump shaft (Fig. 13). Discard the retaining ring.

(15) Remove the cam (pump) ring and rotor, and the thrust plate from the shaft (Fig. 9). **Use care to avoid dropping the rotor vanes.**

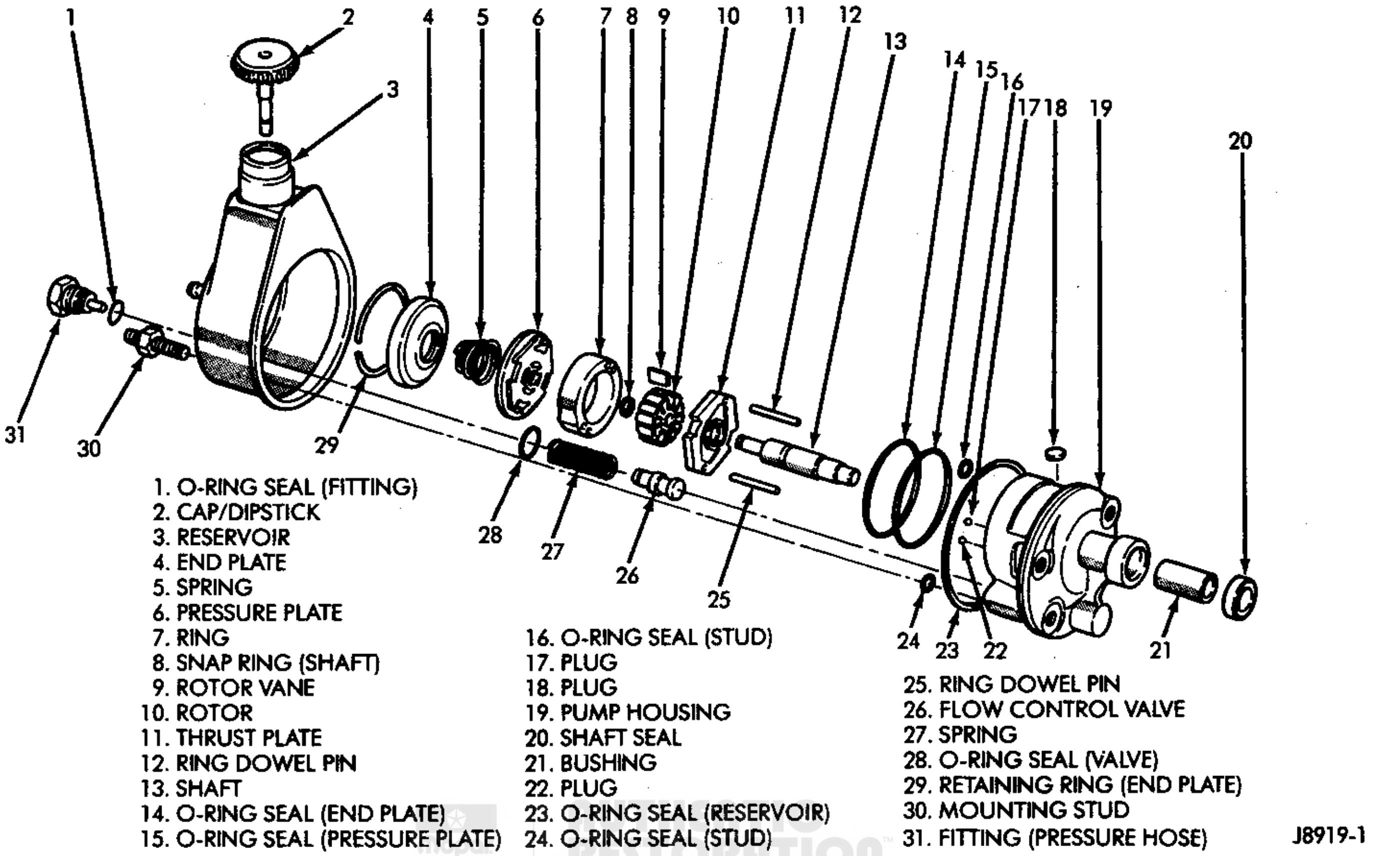


Fig. 9 Vane-Submerged Type Pump—Exploded View

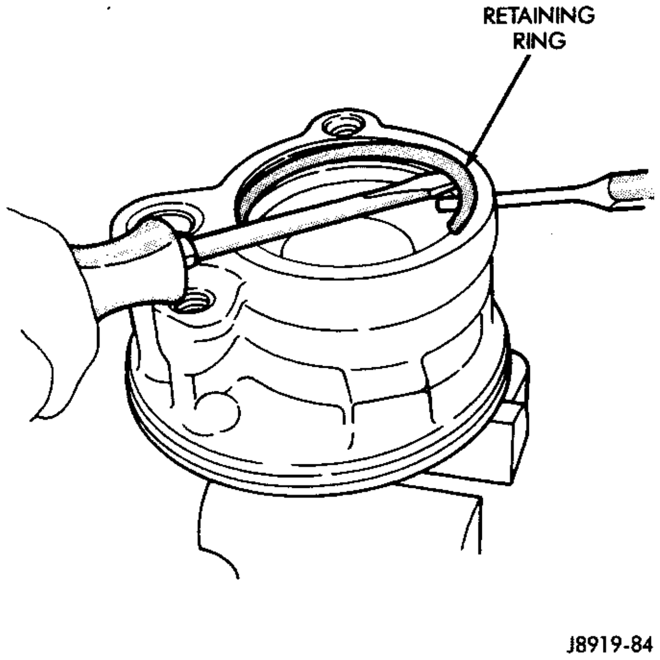


Fig. 10 End Plate Retaining Ring Removal

(16) Remove the end plate O-ring seal and the shaft seal (Fig. 14). **Use care to avoid damaging the pump housing bore.**

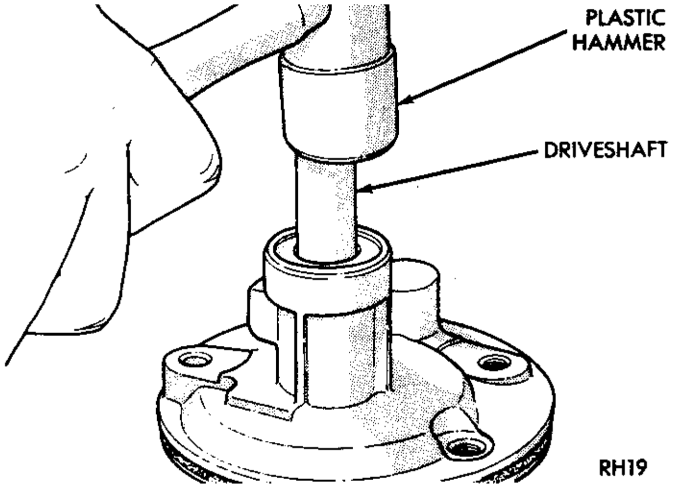


Fig. 11 Pump Shaft Removal

PUMP CLEANING AND INSPECTION

(1) Clean all the metal components with mineral spirits (Fig. 9). Either dry the components with compressed air or wipe them dry with a clean, lint-free cloth.

(2) Inspect the flow control valve and ensure that it slides freely in the pump housing bore (Fig. 9). If it binds, inspect both the valve and the pump housing bore for foreign objects, scratches and burrs. Burrs

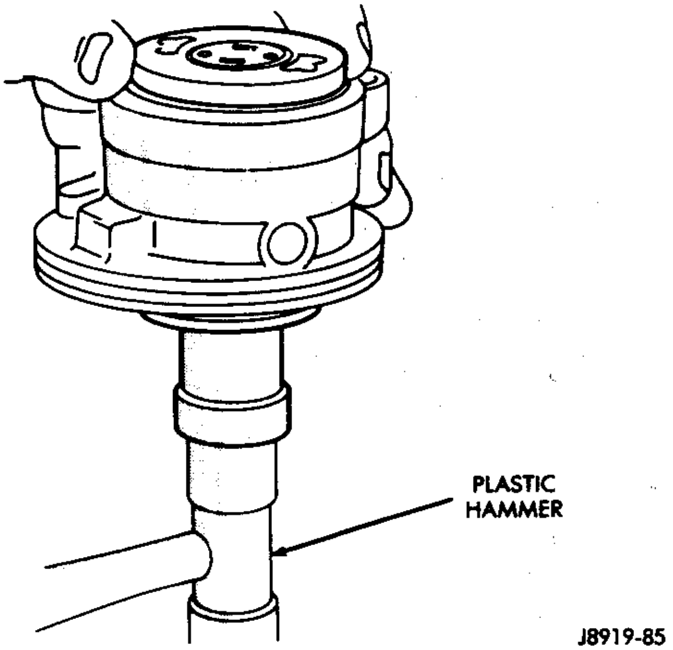


Fig. 12 Pressure/Thrust Plates & Ring/Rotor Removal

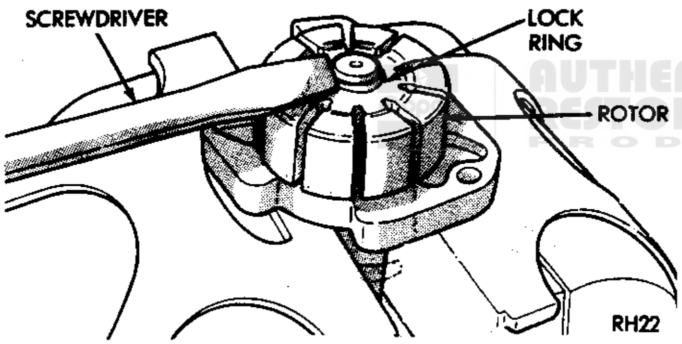


Fig. 13 Pump Shaft Retaining Ring Removal

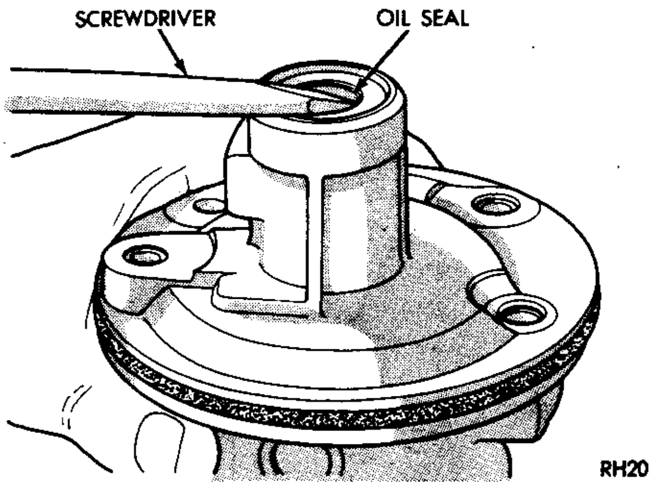


Fig. 14 Pump Seal Removal

can be removed with crocus cloth. Replace the valve or pump housing if either are damaged and not repairable.

The flow control valve is serviced as a unit only and it must not be disassembled.

(3) Inspect the capscrew in the end of the flow control valve for tightness. If loose, tighten it with care to avoid damaging the machined surfaces.

(4) Inspect the pressure plate and the thrust plate surfaces for flatness and, when installed, ensure that they will be parallel with the pump ring. Inspect all the components for cracks and scoring (Fig. 9). Replace any component that is defective or damaged.

A highly polished surface always exists on the pressure plate, the thrust plate and the pump ring as a result of normal friction. Do not confuse this condition with scoring.

(5) Inspect all the rotor vanes for ease of movement in the rotor slots. Inspect the pump shaft for worn splines, cracks, and other defects (Fig. 9). Replace all excessively worn or damaged components. Replace the discarded pump shaft retaining ring (it should not be reused).

(6) Inspect the pump housing for wear, cracks, porosity and damage (Fig. 9). Replace the pump housing if any of the conditions listed exist.

(7) Inspect the pressure hose/flow control valve fitting (Fig. 9). If damaged, replace it.

(8) Inspect the end plate and retaining ring (Fig. 9). If either one is damaged, replace it. Do not reuse the retaining ring if it is bent or distorted. If the condition is uncertain, replace the retaining ring.

(9) Inspect the bushing and the seal (Fig. 9). Replace, if damaged.

(10) Assemble the pump according to the instructions provided within the assembly procedure.

PUMP ASSEMBLY

CAUTION: Do not allow any foreign objects to enter the pump housing during assembly. All components must be clean and lubricated with power steering fluid. Install replacement seals, retaining rings and O-ring seals during assembly. Used, damaged and worn seals will cause leakage, noise and rapid wear after assembly.

(1) Install the pump shaft seal with an appropriate installation tool (Fig. 15).

(2) Lubricate with petroleum jelly and install the replacement seal in the third groove in the pump housing bore (Fig. 16).

(3) Clamp the pump housing in a vise with the large bore side facing downward. **Do not overtighten the vise jaws because this will damage the bearing.**

(4) Insert both dowel pins in the thrust plate.

(5) Insert the splined end of the pump shaft through the thrust plate and the rotor, and install the retaining ring on the end of the shaft (Figs. 17 and 18). **Open the retaining ring only wide**

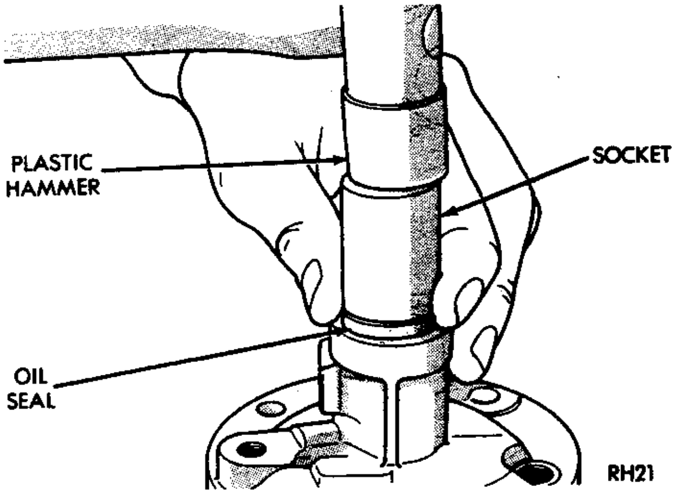


Fig. 15 Pump Shaft Seal Installation

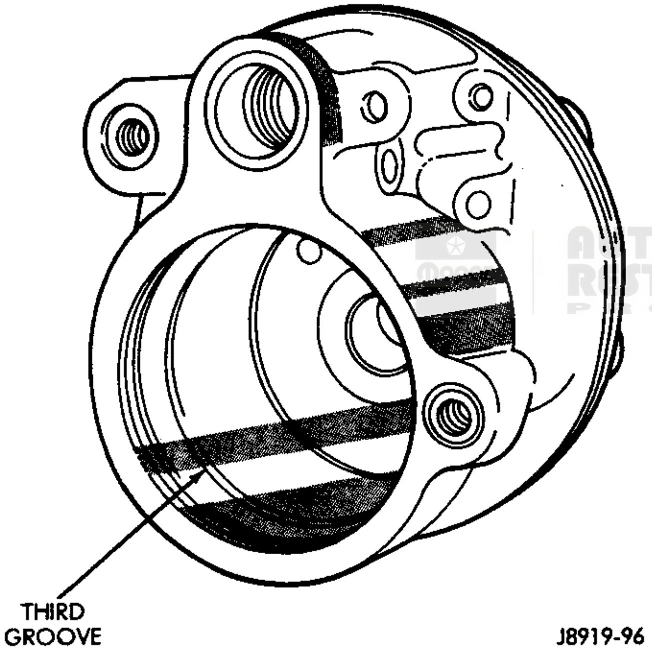


Fig. 16 Pump Housing Bore

enough to slide it over the end of the shaft. The rotor must slide easily on the splines.

(6) Insert the pump shaft in the pump housing (Fig. 19). Ensure that the dowel pins are properly engaged in the thrust plate.

(7) Install the cam (pump) ring (Fig. 19) on the dowel pins with the pump rotation arrow (Fig. 20) facing upward.

(8) Install all 10 rotor vanes in the rotor slots (Figs. 19 and 21) with the rounded edges of the vanes facing outward.

(9) Lubricate the outside diameter surface and the chamfered edge of the pressure plate with petroleum jelly.

(10) Install the pressure plate on the dowel pins (Fig. 19) with the plate spring groove facing upward.

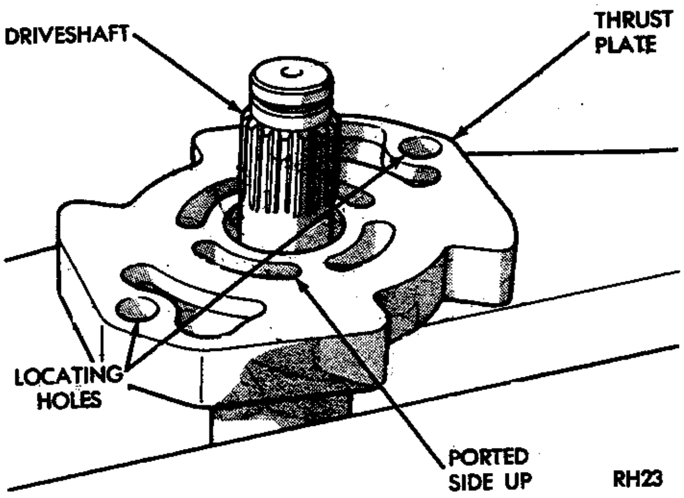


Fig. 17 Thrust Plate & Rotor Assembly

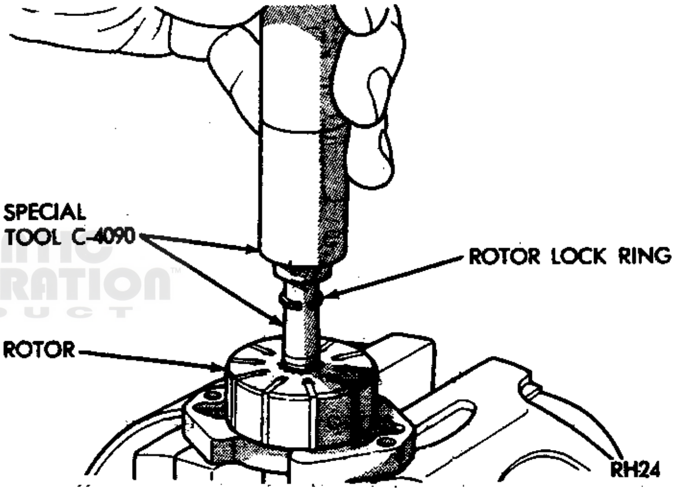


Fig. 18 Rotor Retaining Ring Installation

(11) Place a large socket wrench on top of the pressure plate and force the plate downward approximately 1.5 mm (1/16 in) to “seat” it (Fig. 22).

(12) Lubricate the end plate seal (Fig. 9) with petroleum jelly and install it in the second groove in the pump housing bore.

(13) Install the spring in the center groove in the pressure plate (Fig. 9).

(14) Lubricate the end plate outside diameter surface with petroleum jelly and install the plate in the pump housing (Fig. 23).

(15) Press the end plate downward and install the end plate retaining ring (Fig. 23).

(16) Install the spring over the hex-nut end of the flow control valve (Fig. 9).

(17) Install the flow control valve and spring in the pump housing bore with the hex-nut end of the valve facing the interior of the housing bore (Fig. 24).

(18) Install the mounting stud O-ring seals and the flow control valve O-ring seal in the counterbored holes in the pump housing (Fig. 25).

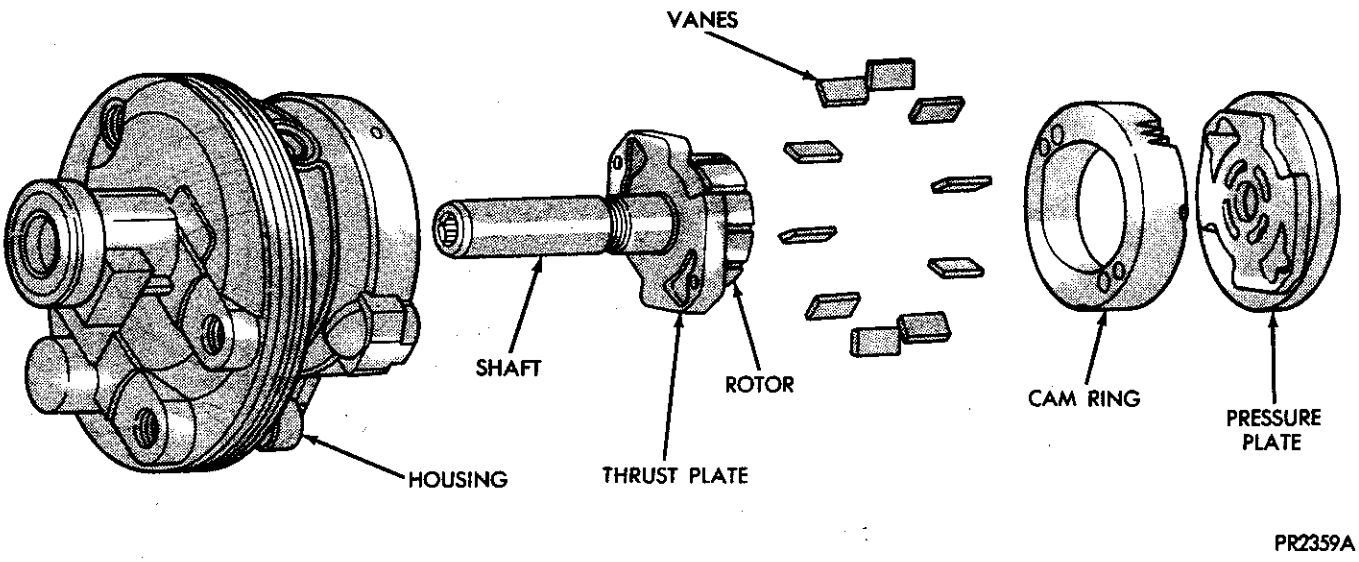


Fig. 19 Pump Shaft, Cam Ring & Pressure Plate Installation

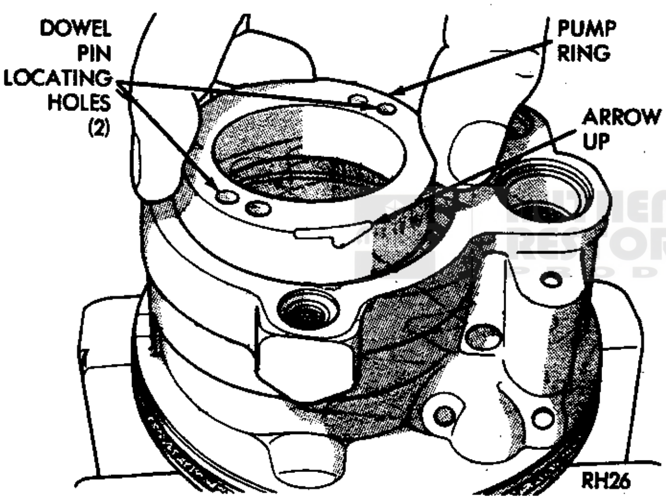


Fig. 20 Cam Ring Installation

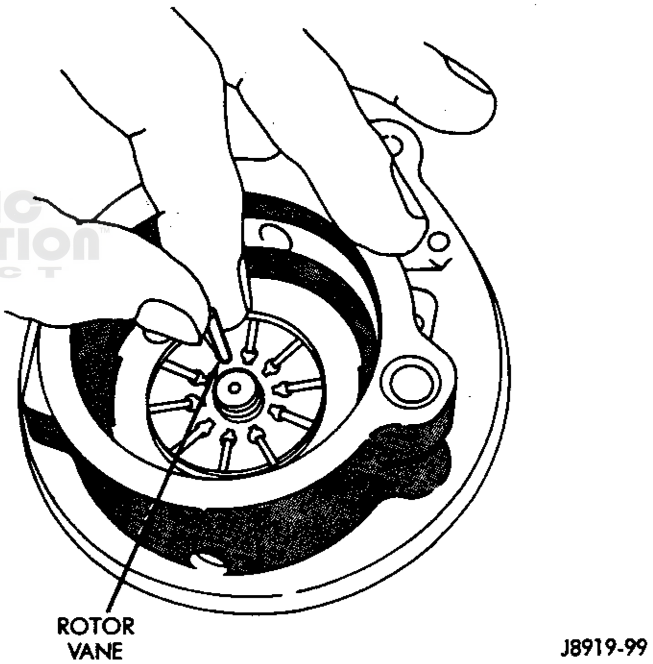


Fig. 21 Rotor Vane Installation

(19) Position the fluid reservoir O-ring seal on the pump housing (Fig. 25).

CAUTION: When installing the fluid reservoir, use care to prevent damaging the O-ring seal. While applying pressure on the reservoir to "seat" it, guide the seal into the seal grooves with a wooden or a plastic tool.

(20) Lubricate the inner edge of the fluid reservoir with petroleum jelly and position the reservoir on the pump housing. Force the reservoir downward to "seat" it on the pump housing.

(21) Inspect the alignment of the mounting stud O-ring seals (Fig. 25) after installing the fluid reservoir. Re-align the seals, if necessary.

(22) Install the mounting studs (Fig. 25) and tighten them with 48 N•m (35 ft-lbs) torque.

(23) Install the O-ring seal on the pressure hose/flow control valve fitting (Fig. 25) and install the fitting in the flow control valve bore. Tighten the fitting with 55 N•m (40 ft-lbs) torque.

(24) Install the pump shaft pulley with the appropriate installation tool (Fig. 26).

(25) Install the pump on the engine. If necessary, refer to the installation procedure.

PUMP INITIAL OPERATION

(1) Fill the pump reservoir and operate the engine until the power steering fluid reaches the normal operating temperature of approximately 77°C (170°F), then stop the engine.

Turning the wheels from "stop-to-stop" will aid with heating the fluid. Do not hold the steering wheel against the "stop" for an extended pe-

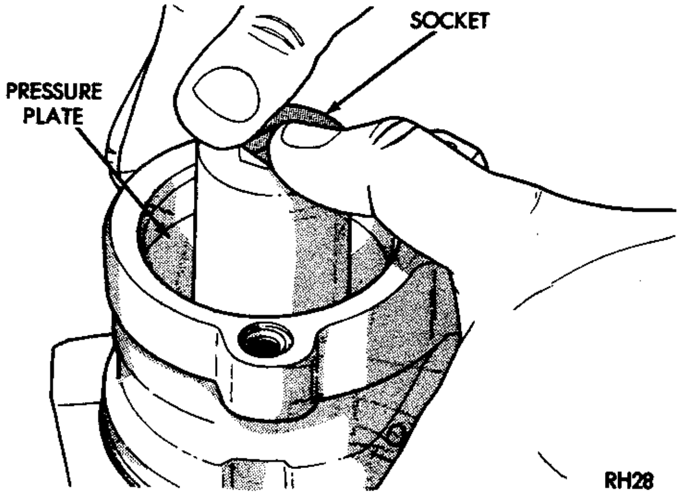


Fig. 22 Seating Pressure Plate

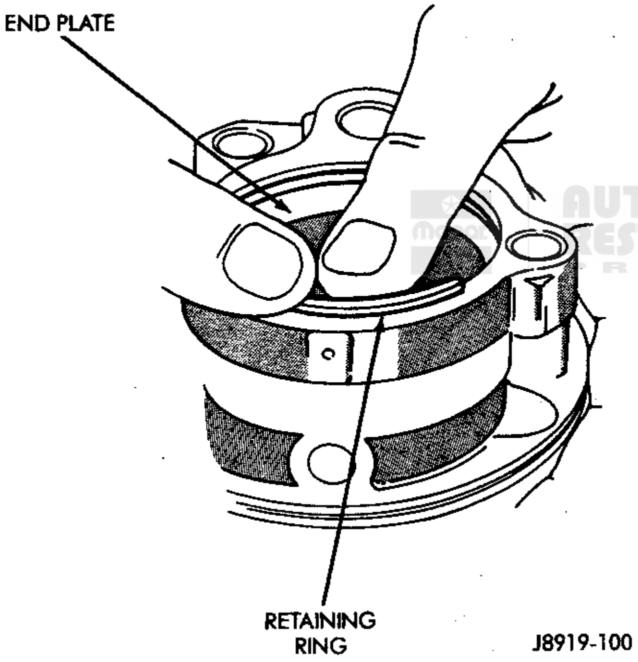


Fig. 23 End Plate Installation

riod of time because this will cause the pump to over-heat and damage internal components.

(2) Turn the wheels to a full-left-turn position and add power steering fluid until the reservoir is full.

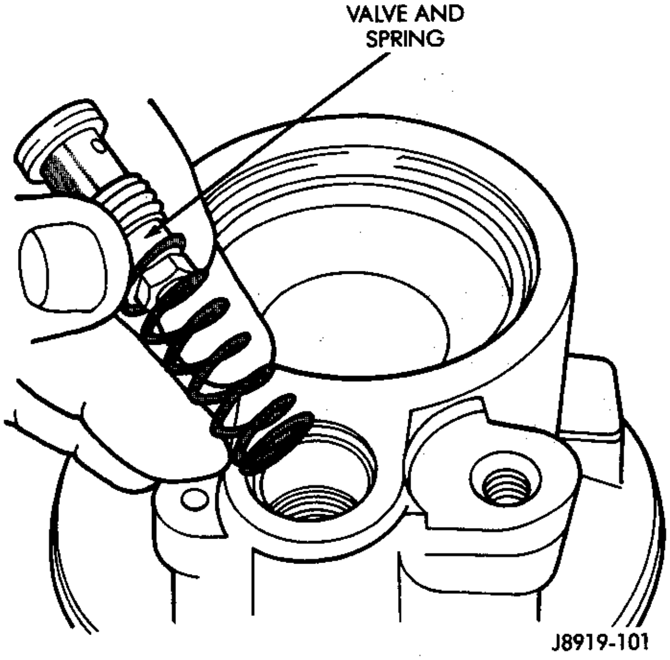


Fig. 24 Flow Control Valve/Spring Installation

(3) Start the engine. Operate it at high idle speed and then observe the fluid level on the dipstick. Add fluid, if necessary.

(4) Purge the system of air by turning the wheels from side-to-side without contacting the stops. Fluid with air in it will have a "milky-red" color. Maintain the reservoir full of fluid.

Because air is compressible, it must be eliminated from the fluid before normal steering action can be obtained.

(5) Return the wheels to the straight-ahead position and operate the engine for an additional 2 to 3 minutes, then stop the engine.

(6) Road test the vehicle to ensure that the steering system functions normally and has no noise.

(7) Observe the fluid level. Add fluid as necessary to fill the reservoir with the system stabilized at the normal operating temperature.

CAUTION: If the fluid reservoir cap is not properly tightened after a fluid level check, the result can be fluid leakage and possible loss of the cap. Ensure that the cap is securely tightened when installing it.

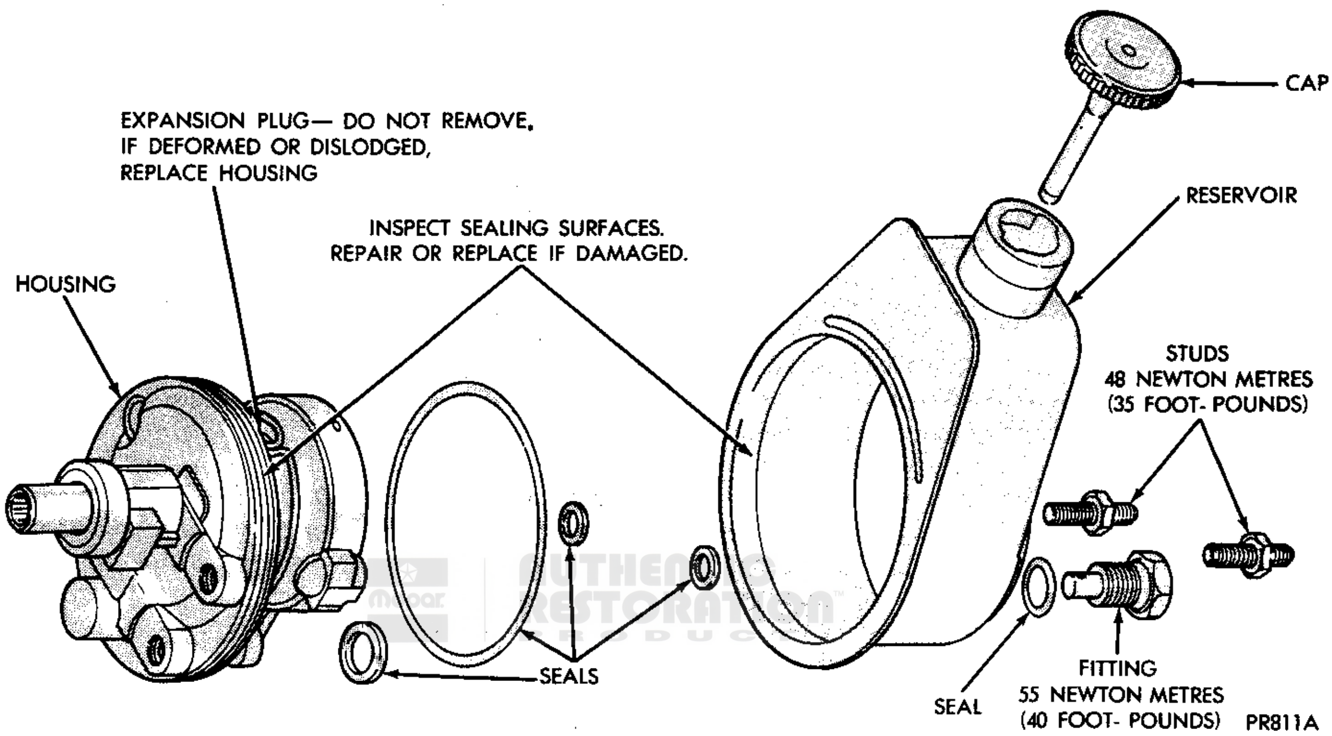


Fig. 25 Pump & Reservoir Seals

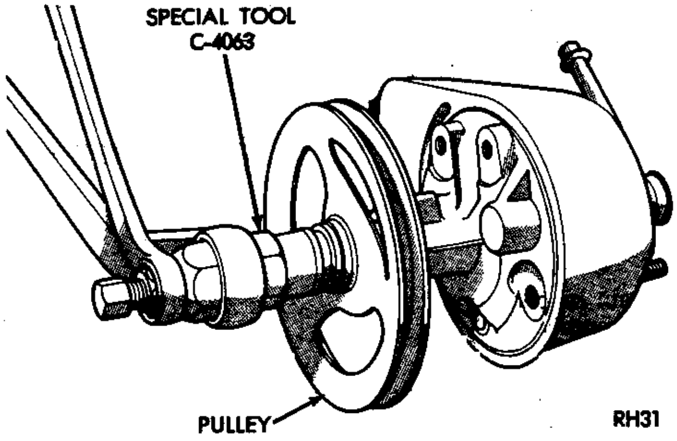


Fig. 26 Pump Shaft Pulley Installation

STEERING COLUMN SERVICE

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SERVICE INFORMATION

The steering columns (i.e., standard/fixed and tiltable) installed in Ram Van and Wagon vehicles have anti-theft provisions, plus they are energy-absorbing (i.e., collapse from impact in the event of a front-end collision). The steering columns are designed to collapse at a **controlled rate** from impact when a front-end collision is encountered. The collapsing action reduces the likelihood of the driver contacting (because of inertia) a "fixed" steering wheel. If the driver continues forward into the wheel, the column will continue collapsing at the same controlled rate and, in so doing, reduce the force of the impact.

The steering columns have four principal components (Figs. 1 and 2):

- a column jacket with a slotted mesh section designed to shorten by "rolling up" at its lower end;
- a two-piece, slip-type (telescoping) transmission gear shift tube interconnected by plastic inserts;
- a two-piece, slip-type (telescoping) steering shaft (upper and lower shafts) connected by plastic friction collars and shear pins; and
- a support bracket that connects the steering column to the instrument panel (the bracket allows the column to slide forward but prevents rearward movement toward the driver).

The center section of the steering column jackets has side-staggered slot perforations and it is riveted to an expansion mandrel. Upon application of a force, the rivets will shear and the column jacket will collapse.

The gear shift tube consists of two sections designed to slip-fit (telescope) together. These sections are interconnected and held together by injections of plastic that form the interconnecting inserts and the shear pins. Under impact, there is a gradual paring

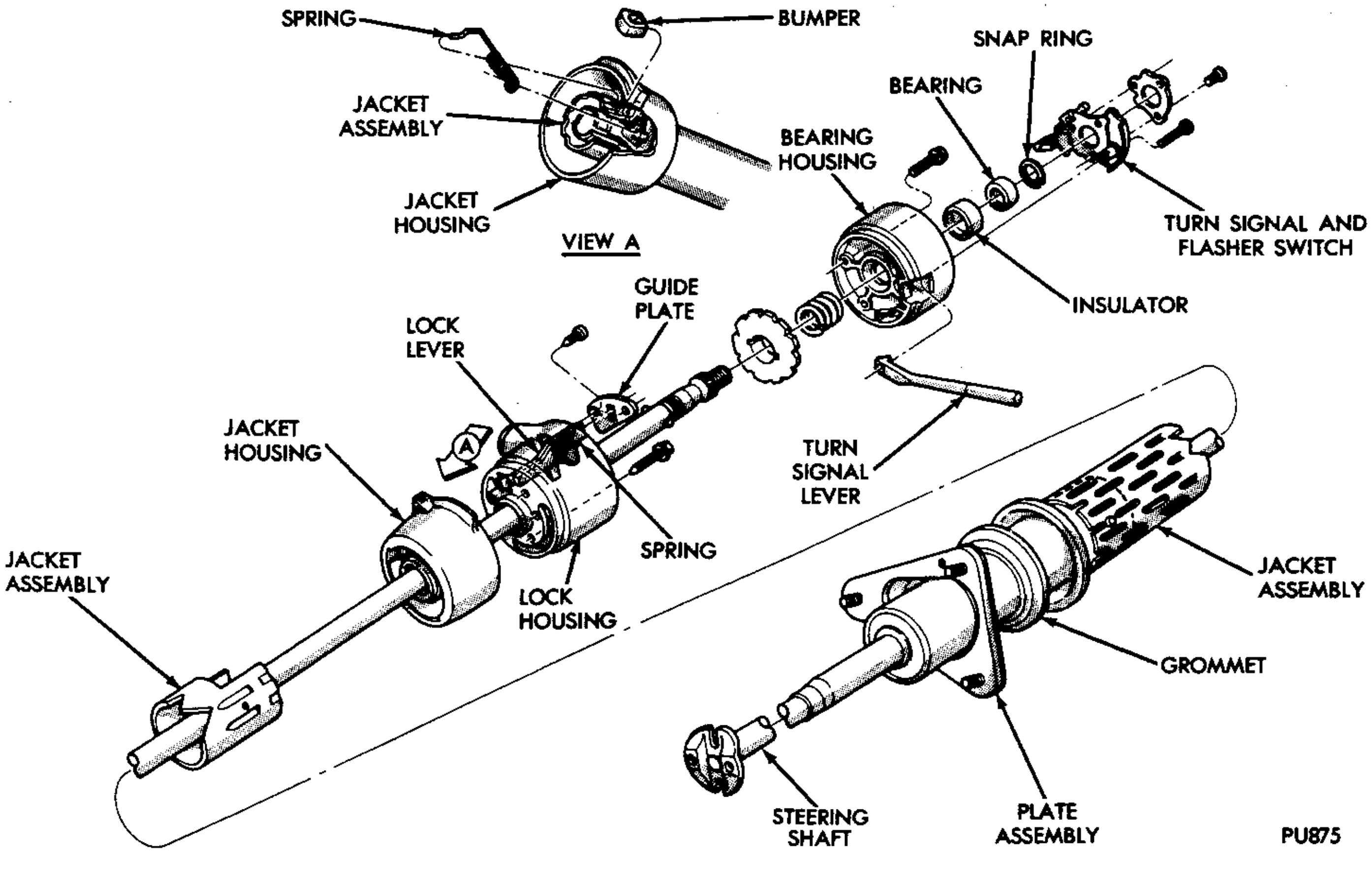

Fig. 1 Steering Column—Console Shift

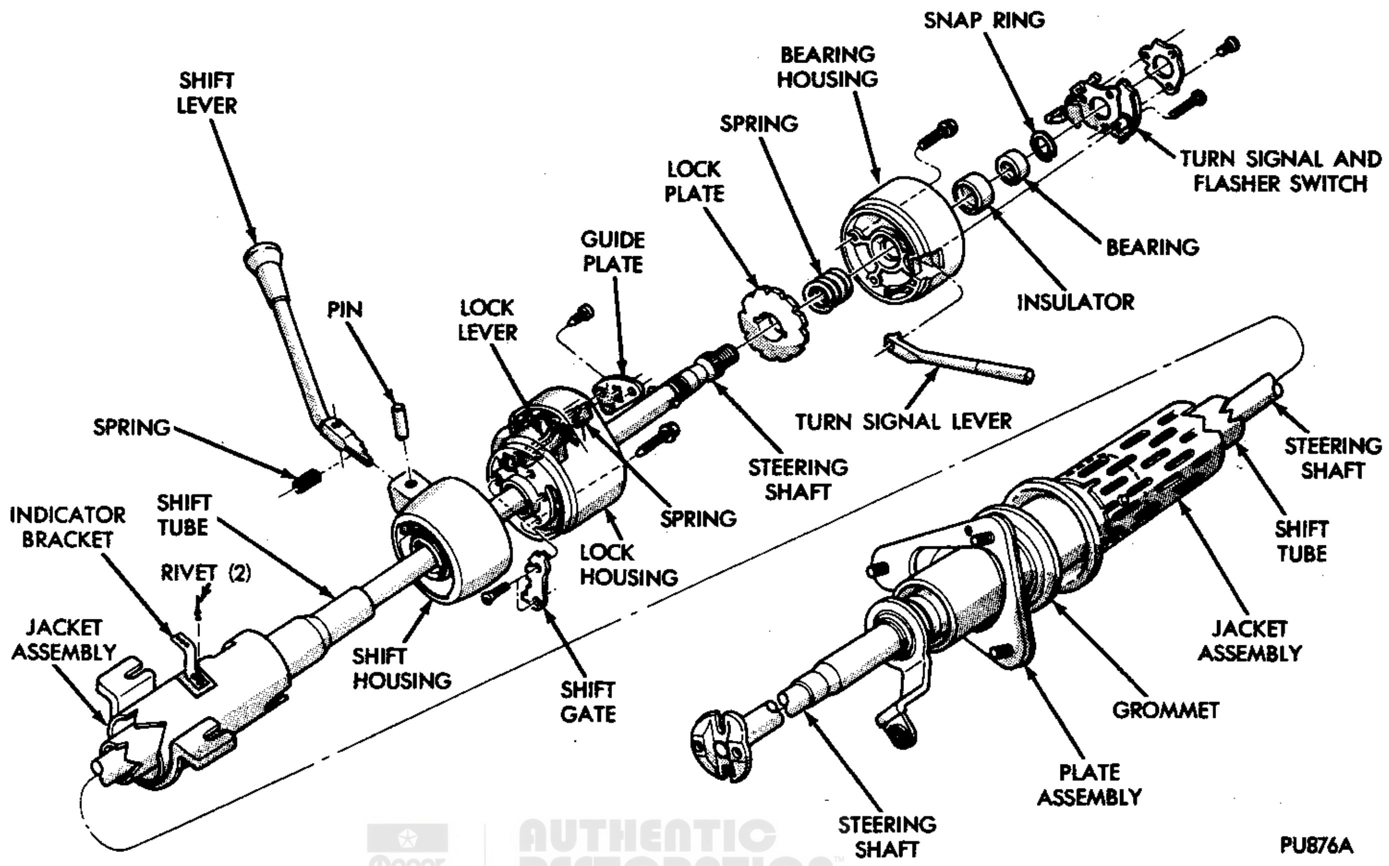

Fig. 2 Steering Column—Column Shift

away of the inserts by the "knife-like" edge in the adjoining tube section.

The steering column shaft is comprised of two sections. The upper shaft (section) is solid and has a double-flatted lower end. The lower shaft (section) is hollow and formed to fit over the double-flatted end of the upper shaft. The purpose of the flatted section is to provide continued steering action even though the column is completely "collapsed". Plastic is injected through four holes in the lower, hollow shaft into a pair of annular grooves on the solid portion of the shaft. The four small holes, when filled with plastic, form the shear pins. Upon impact, the shear pins shear-off and the shaft gradually collapses against a resistance provided by the plastic collars in the annular grooves.

The support bracket is designed to restrain the column from being shifted toward the driver during impact. It incorporates two "break-away capsules" that allow the support bracket to slip off of the attaching points, permitting the steering column to compress or yield in a forward direction under a severe impact at the driver side.

When the column is installed in the vehicle, it is normally not susceptible to damage. However, when it is removed, special care must be taken during handling. When the column is removed from the vehicle, actions such as a sharp blow on the end of the steering shaft or the shift levers, leaning on the column, or dropping the column could shear or loosen the plastic shear pins or rivets that retain the column rigid. It is, therefore, suggested that the removal and installation, and the disassembly and assembly procedures be carefully followed when servicing a steering column.

CAUTION: Bumping, jolting and hammering on the steering column shaft and gear shift tube must be avoided during all service procedures. If the shear pins are broken, the controlled length of the collapsing features will be altered and cause these components to be unfit for additional use. If the steering column shaft or the gear shift tube are damaged, they cannot be repaired, they must be replaced.

The necessary special tools and their usage are also described in the following service procedures.

Safety goggles should be worn at all times when involved with steering column service.

STEERING COLUMN—REMOVAL/INSTALLATION

REMOVAL

(1) Disconnect the negative (ground) cable from the battery.

(2) For vehicles equipped with a column shift, disconnect the link rod by prying it out of the grommet in the shift lever (Fig. 3).

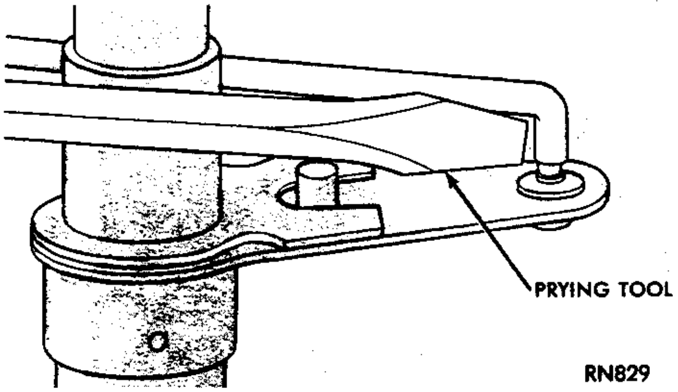

Fig. 3 Link Rod Removal From Grommet

(3) Remove the steering column shaft-to-steering gear shaft coupler clamp bolt.

(4) Disconnect the wire connectors at steering column jacket.

(5) Remove the steering wheel center pad (Fig. 4).

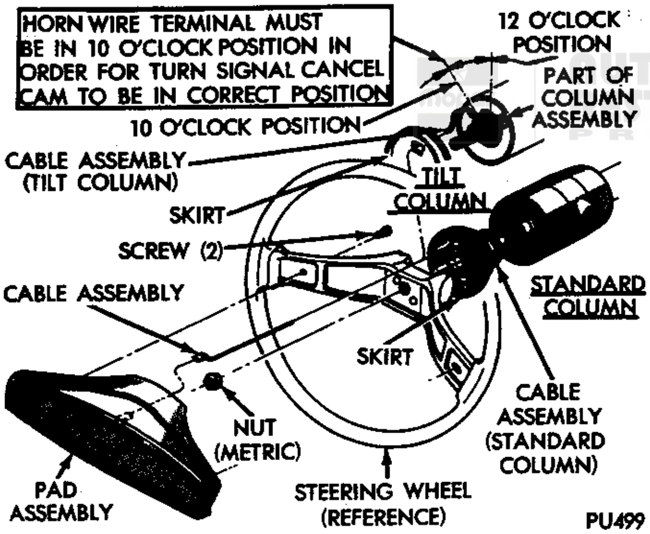

Fig. 4 Steering Wheel (Typical)

(6) Disconnect the horn wire(s) and remove the horn switch (if applicable).

(7) Remove the steering wheel retaining nut. Remove the steering wheel with Tool C-3428B. **Do not bump or hammer on steering column shaft to remove wheel.**

(8) Remove the turn signal lever (Fig. 5).

(9) Remove the floor plate-to-floor pan attaching screws.

(10) To expose the steering column bracket, refer to Electrical—Group 8.

(11) Disconnect the automatic transmission shift indicator pointer cable from the shift housing (if applicable).

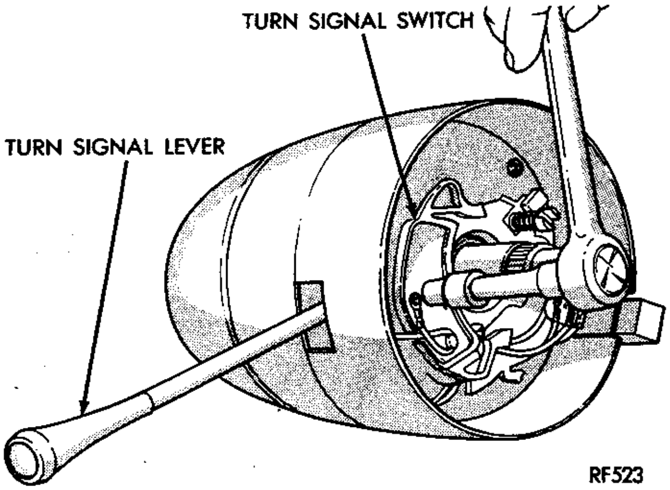

Fig. 5 Turn Signal Lever

(12) Remove the instrument panel steering column cover and the lower reinforcement.

(13) Remove the nuts that attach steering column support bracket to the instrument panel support.

(14) Carefully remove the lower section of the coupler from the steering gear wormshaft, then remove the steering column out through passenger compartment. Use care to avoid damaging the paint or trim.

(15) Install a **replacement** grommet **from the rod side of the lever** with pliers and a back-up washer to "snap" the grommet into place (Fig. 6). Use MOPAR Multipurpose Lubricant (or an equivalent lubricant) to aid installation of the grommet. **A replacement grommet should be used whenever the rod is disconnected from the lever.**

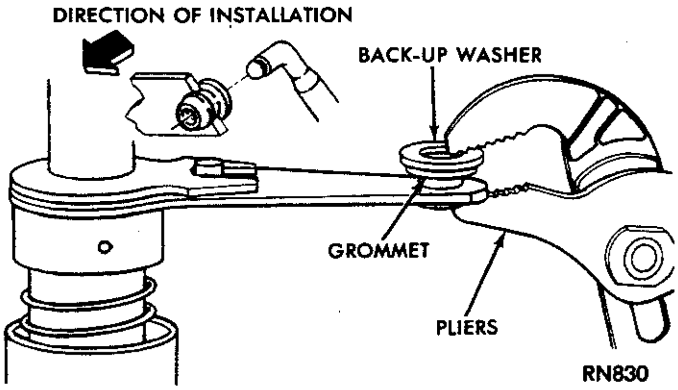

Fig. 6 Replacement Grommet Installation

INSTALLATION

(1) Install the ground clip on the left capsule slot (Fig. 7). The plastic capsules should be pre-assembled in the bracket slots. Insert the column through the floor pan opening while being careful to avoid damaging the paint and the trim.

(2) With the front wheels in the "straight-ahead" position and the master splines on the steering gear shaft and the coupler aligned, engage the coupler

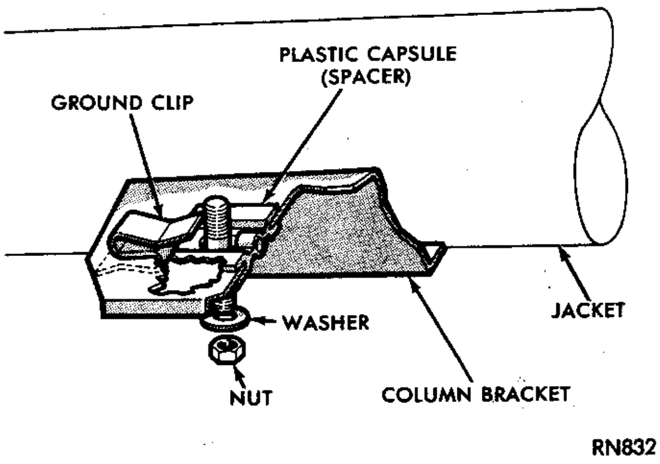

Fig. 7 Ground Clip & Spacer Installation

with the shaft and install the clamp bolt. **Do not apply force at the top of the steering column shaft.**

(3) Position the steering column with the bracket slots on the attaching studs. Install, but **do not tighten**, the two upper bracket washers and nuts.

(4) After ensuring that both breakaway capsules are fully "seated" in the slots in the column support bracket, tighten the two upper bracket nuts with 12 N•m (110 in-lbs) torque.

(5) Position the floor plate over the floor pan opening, center it around the column, then install and tighten the attaching bolts.

(6) Place the steering wheel on the steering column shaft with the master splines aligned. Install the retaining nut and tighten with 61 N•m (45 ft-lbs) torque. **Do not force the steering wheel onto the shaft by "driving" it with a heavy object; force it down onto the shaft with the retaining nut.**

(7) Install the horn switch components on the steering wheel. Connect the horn switch wire connector.

If necessary, refer to Group 8—Electrical for installation of the horn switch.

(8) Connect the wire connectors at the steering column jacket.

(9) Connect the battery ground (negative) cable, test the operation of the lights and horns. If applicable, reset the clock.

(10) If applicable, connect the shift link rod to the transmission shift lever by inserting and "snapping" the rod in-place in the grommet with pliers. **The grommet must be installed in the lever before the rod is inserted into the grommet.** Use MOPAR Multipurpose Lubricant (or an equivalent product) to aid the installation.

(11) If applicable, adjust the transmission shift linkage. **Whenever the steering column is loosened or removed, the shift linkage must be adjusted and tested.** Refer to **Group 21—Transmission** for the shift linkage adjustment.

(12) If applicable, connect the transmission shift selector indicator pointer at its approximate original location.

(13) If applicable, slowly move the transmission shift selector lever from "1" or "L" (low) to "P" (PARK) while pausing briefly at each selector position. The indicator pointer must align with each indicator position (i.e., P,R,N,D, and L or 1,2,3).

(14) Install the lower reinforcement and the instrument panel steering column cover.

STANDARD/FIXED STEERING COLUMN—DISASSEMBLY/ASSEMBLY

Safety goggles should be worn at all times when involved with steering column service.

DISASSEMBLY

(1) Pry the wiring trough retainers outward and lift the wiring trough from the retainers. Replacement retainers could be necessary for assembly.

(2) To remove the transmission shift lever (if applicable), use masking tape to protect the paint and a deep socket wrench to re-enforce the shift housing, then "drive" the retaining roll pin out with a punch.

(3) Remove the breakaway capsules and secure the steering column in a vise by clamping at the column support bracket. Do not distort the bracket.

(4) Remove the two screws that attach the lock housing cover to the lock housing and remove the lock housing cover.

(5) Remove the wash/wipe switch (Fig. 8).

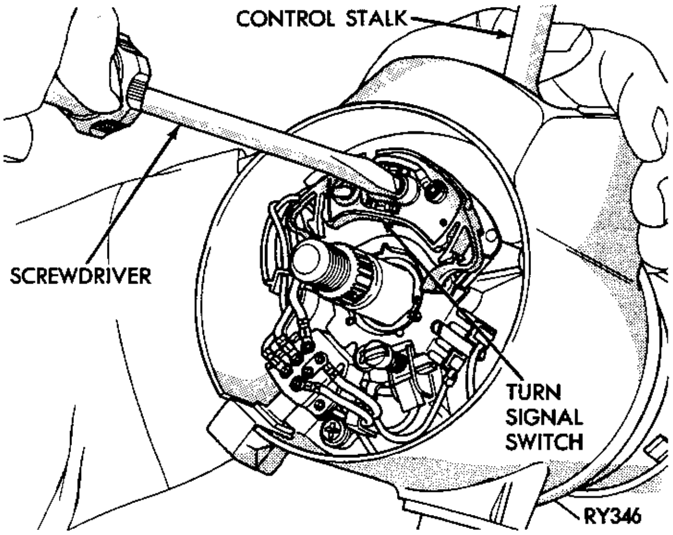

Fig. 8 Wash/Wipe Switch Removal/Installation

(6) If applicable, pull the cover up the speed control stalk and remove the two screws that attach the multi-function control stalk sleeve to the wash/wipe switch.

(7) Rotate the control stalk shaft to the full clockwise position and remove the shaft from the switch by pulling it straight out of the switch (Fig. 9).

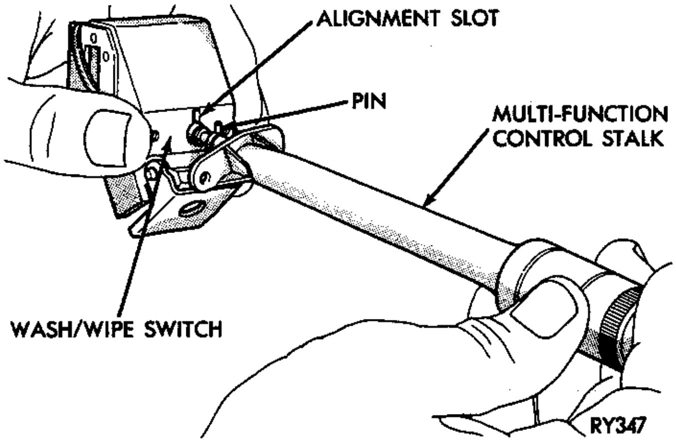

Fig. 9 Multi-Function Control Stalk Removal/ Installation

(8) Remove the turn signal and flasher switch retaining screws and lift the switch upward out of the way (Fig. 10).

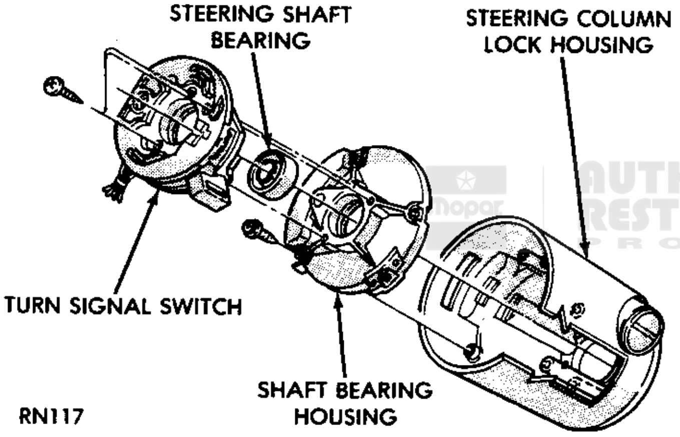

Fig. 10 Turn Signal & Flasher Switch Removal

(9) Detach the horn and the key lamp ground wires.

(10) Remove the retaining screw and lift the ignition key lamp out of the way (Fig. 11).

STEERING SHAFT DISASSEMBLY

(1) Remove the four screws that attach the bearing housing to the lock housing (Fig. 12).

(2) Remove the "snap" retaining ring from the upper end of the steering shaft (Fig. 12).

CAUTION: Do not allow steering shaft to slide out of the jacket.

(3) Remove the bearing housing from the shaft (Fig. 13).

(4) Remove the lock plate spring and the lock plate from the steering shaft (Fig. 13).

(5) Remove the steering column shaft from the lower end of the column.

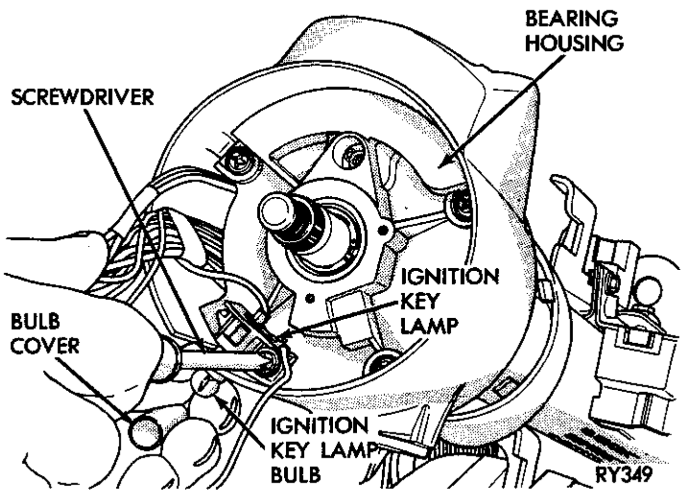

Fig. 11 Ignition Key Lamp

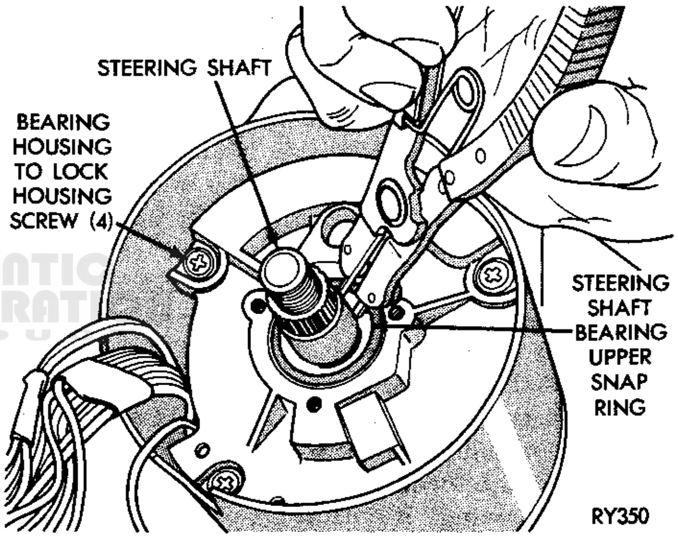

Fig. 12 Bearing Housing Screw & Upper "Snap" Retaining Ring Removal

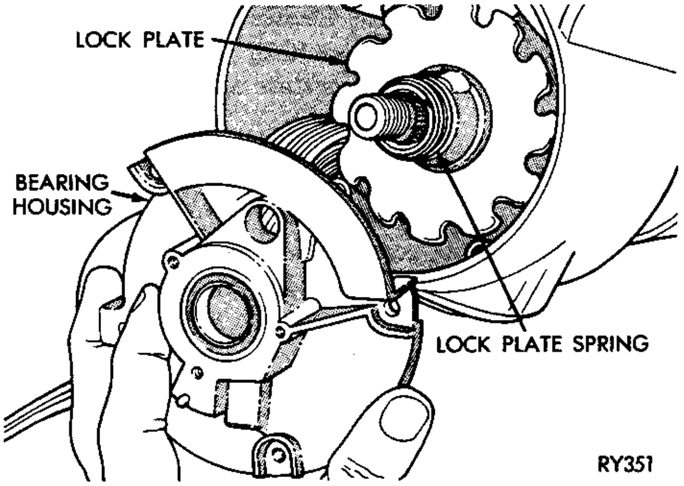

Fig. 13 Bearing Housing & Lock Plate Removal

LOCK HOUSING DISASSEMBLY

(1) Remove the ignition key. Remove the screw and lift out the ignition key buzzer/chime switch from the

lock housing (Fig. 14).

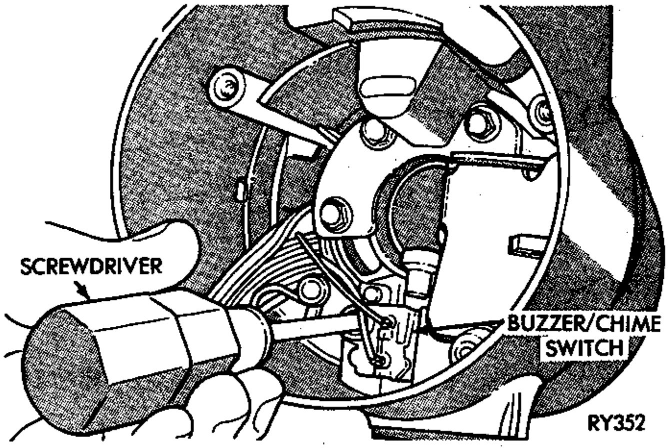

Fig. 14 Ignition Key Buzzer/Chime Switch Removal

(2) Remove the two screws that attach the ignition switch to the lock housing.

(3) Remove the ignition switch from the lock housing by rotating it 90 degrees on the rod and sliding it off the rod.

(4) Remove the two attaching screws from the dimmer switch and disengage the switch from the actuator rod (Fig. 15).

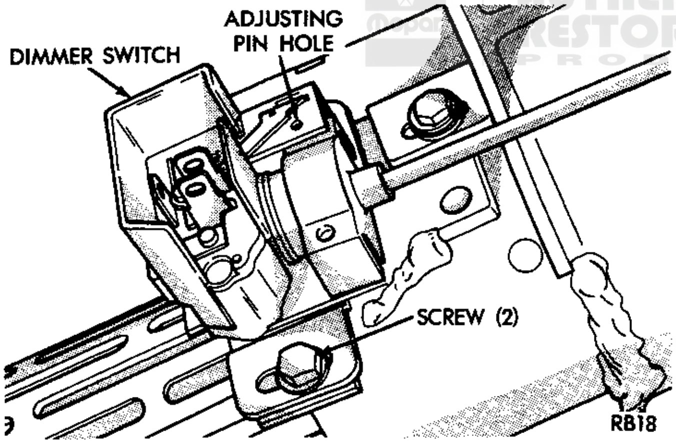

Fig. 15 Dimmer Switch

(5) Remove the two screws that attach the bellcrank and slide the bellcrank up into the lock housing until it can be disconnected from the ignition switch actuator rod.

(6) Place the key/lock cylinder in the LOCK position and remove the key. Insert two small diameter pry bars (or other appropriate tools) into both key/lock cylinder release holes and push inward to release the spring loaded lock retainers. **The key/lock cylinder lower release hole is located immediately above the buzzer/chime switch attaching screw hole.** At the same time, pull the key/lock cylinder out of the lock housing bore (Fig. 16).

(7) Grasp the lock lever and spring and pull them straight out of the lock housing (Fig. 16).

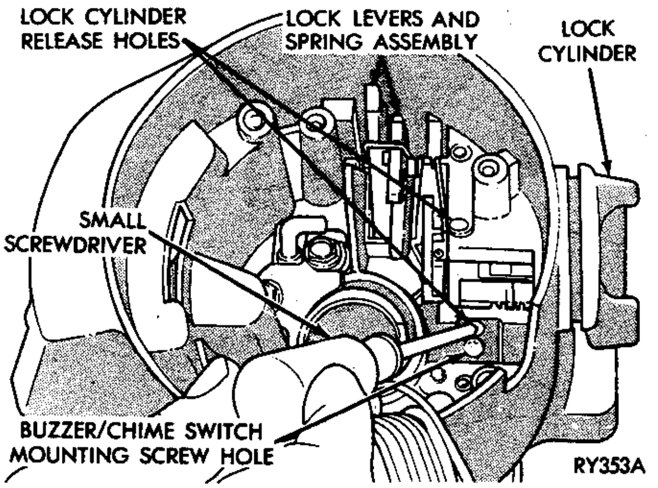

Fig. 16 Key/Lock Cylinder & Lock Levers

(8) Remove the four lock housing-to-column jacket hex-head attaching screws and remove the lock housing plate and housing from jacket (Fig. 17).

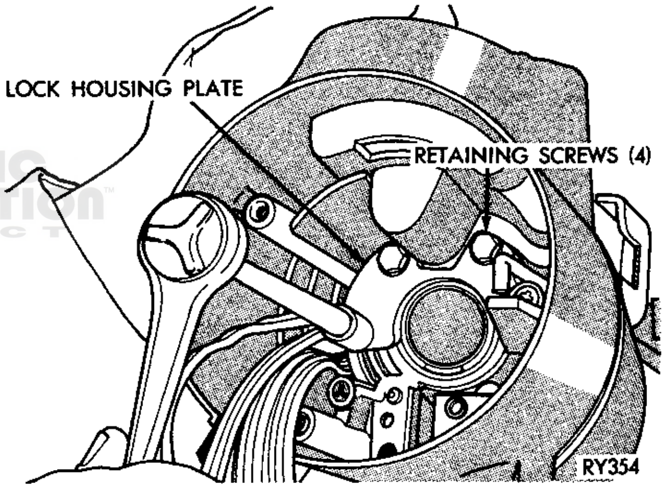

Fig. 17 Lock Housing Screw Removal/Installation

(9) When removing the lock housing from the steering column jacket, rotate it 90 degrees to disengage it from the ignition switch actuator rod.

SHIFT TUBE DISASSEMBLY/ASSEMBLY (COLUMN SHIFT ONLY)

(1) To remove the shift tube, use Tool C-4584 to force the shift tube out of the plastic shift housing (Fig. 18).

(2) To install the shift tube, use Tool C-4584 with Installation Tool C-4584-2. Ensure that the keyway is aligned with the slot in the plastic shift housing (Fig. 19).

INSPECTION

(1) After cleaning, inspect all the components for wear and damage (Fig. 20).

(2) Inspect the turn signal switch for distorted, broken or damaged components (Fig. 20).

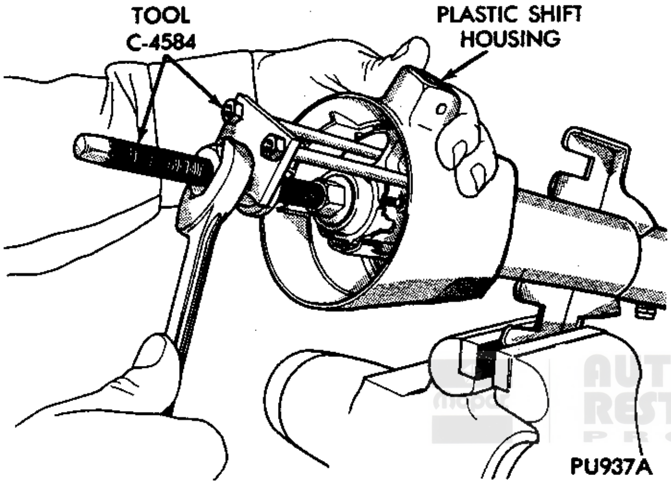

Fig. 18 Shift Tube Removal

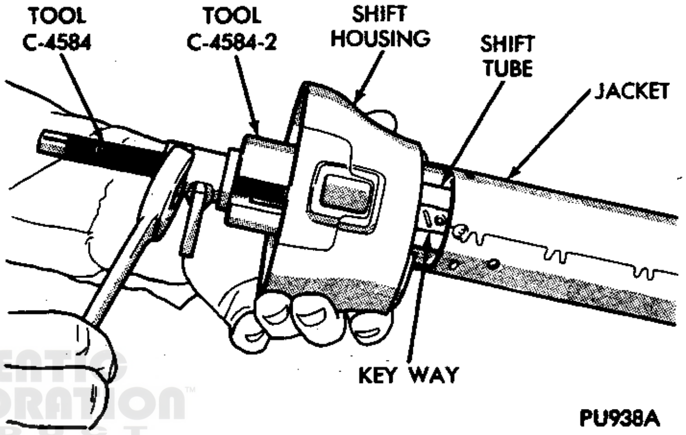

Fig. 19 Shift Tube Installation

(3) Inspect the wire insulation for worn, chafed or bare wire areas.

(4) Inspect the steering shaft bearing (Fig. 20) for smooth operation and lubricate it with multipurpose, NLGI grade 2 EP (extreme pressure) lubricant (e.g., MOPAR Multimileage Lubricant, or an equivalent lubricant). If the bearing has any evidence of roughness or wear, it should be replaced.

LET	TORQUE N·m	TORQUE IN. LBS.
Ⓐ	10	90
Ⓑ	4	35
Ⓒ	3	24
Ⓓ	2	16

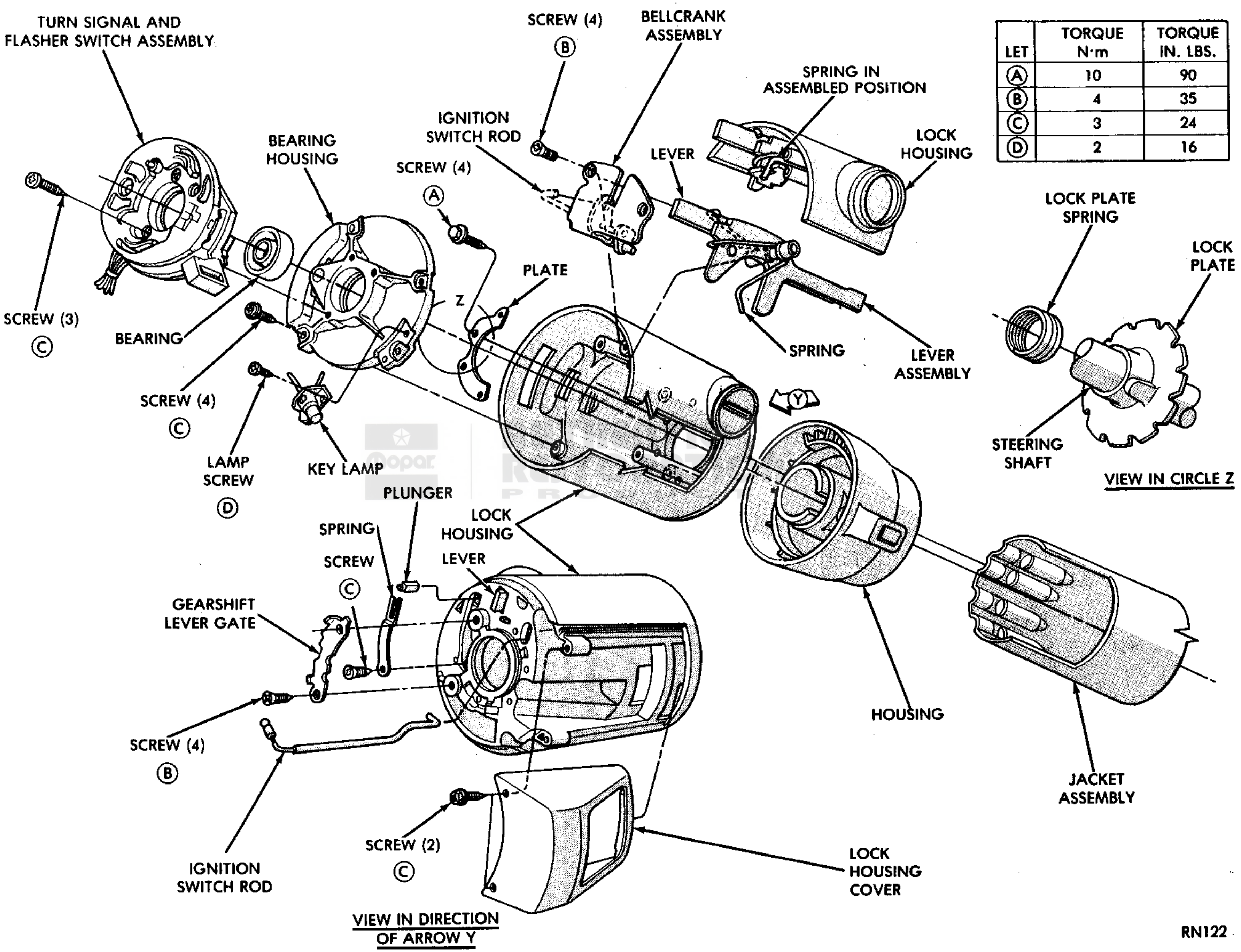

Fig. 20 Upper Part Of Steering Column

(5) Inspect the floor plate grommet and replace it if it is damaged.

(6) Inspect the steering column shaft for spline/thread damage and any defects (Fig. 21).

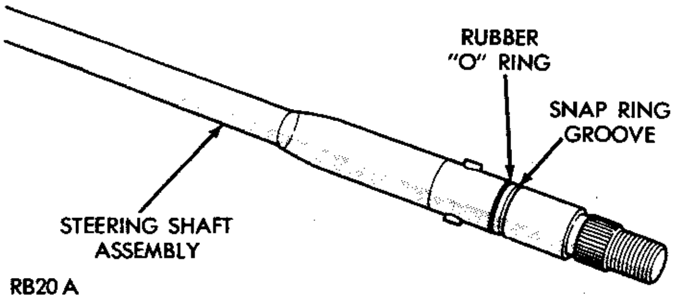

Fig. 21 Steering Column Shaft

ASSEMBLY

During assembly of the components (Fig. 20), apply a thin coat of multi-purpose, NLGI grade 2 EP (extreme pressure) lubricant (e.g., MOPAR Multimileage Lubricant, or an equivalent lubricant) to all contact (friction) surfaces.

(1) Clamp the steering column in a vise (at the column support bracket) so that both ends of the column are accessible.

CAUTION: Never use steel rivets (instead of aluminum) to connect the column tube to the mandrel because this connection must shear upon impact.

(2) Inspect the steering column tube-to-mandrel rivets for tightness. Replace (if necessary) with 1/8-inch diameter by 1/4-inch long (1/8-inch grip) aluminum "blind" rivets.

(3) If applicable, position the crossover load spring and the transmission shift lever in the shift housing and tap the pivot pin into place (Fig. 22).

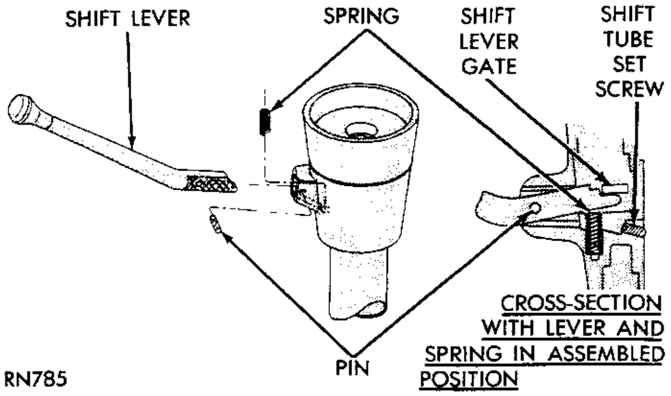

Fig. 22 Transmission Shift Lever Installation

(4) Assemble the key/lock cylinder plunger spring and install it on the lock housing.

(5) Install the shift lever gate on the lock housing (Fig. 23).

(6) Place the shift lever in mid-position (if applicable) and "seat" the lock housing on top of the jacket while aligning the keyway in the housing with the slot in the jacket. Insert all four screws and slowly tighten each screw alternately, and in steps, to ensure proper "seating" of the lock housing on the jacket. Tighten the screws with 10 N•m (90 in-lbs) torque (Fig. 17).

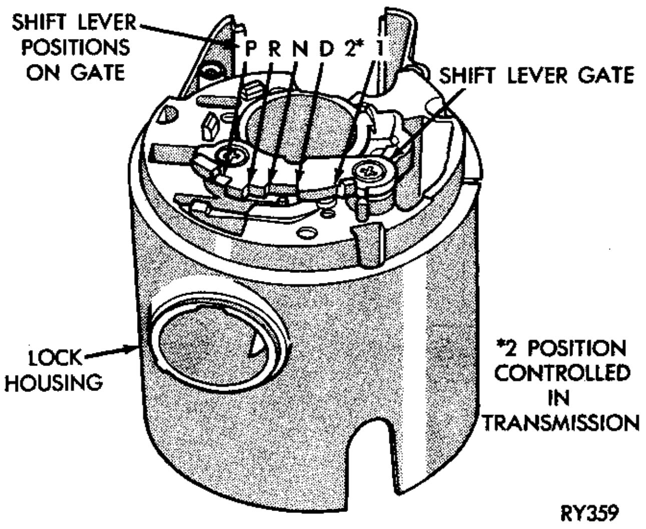

Fig. 23 Lock Housing & Shift Gate

(7) To install the dimmer switch (Fig. 15), firmly "seat" the push rod into the switch. Compress the switch until two 0.093-inch diameter drill bit shanks can be inserted into the alignment holes. Re-position the upper end of the push rod in the pocket of the wash/wipe switch (Fig. 8). This can be accomplished by touch, or if necessary, by removing the column lower cover. With a light rearward force on the switch, install the two retaining screws. Remove the drill bits. The switch should "click" when the lever is lifted; and "click" again, as the lever returns, immediately before it reaches the stop in the down position (Fig. 15).

(8) Lubricate and assemble the two lock levers, the pin and the lock lever spring (Fig. 24).

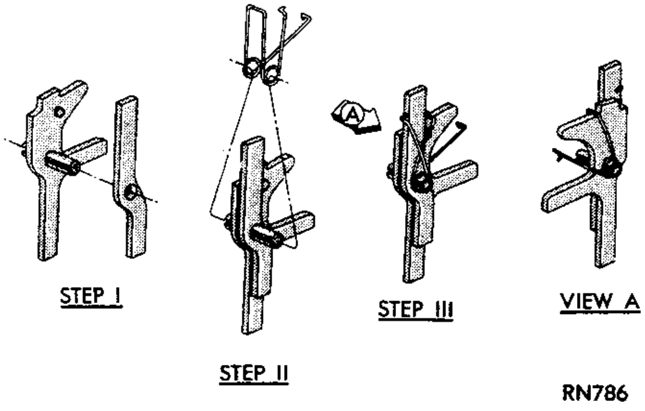

Fig. 24 Lock Levers & Spring Assembly

(9) Install the assembled components in the lock housing. "Seat" the pin firmly in the bottom of the

slots. Ensure that the lock lever spring leg is firmly in-place in the casted notch (Fig. 15).

(10) Install the ignition switch actuator rod from the bottom of the lock housing via the slotted hole in the housing and attach it to the bellcrank. Insert the bellcrank into the lock housing while pulling the ignition switch rod down the column, and then "seat" the bellcrank on the mounting surface (Fig. 20). If applicable, the transmission shift lever should be in the PARK position.

(11) Place the ignition switch on the ignition switch actuator rod and rotate it 90 degrees to lock the rod into position.

(12) To install the ignition lock, turn the key to the LOCK position and remove the key. This will cause the buzzer/chime operating lever to retract into the key/lock cylinder. Now insert the key/lock cylinder into the lock housing far enough to contact the switch actuator. Insert the key, force it inward and rotate the key/lock cylinder. When the components are aligned, the key/lock cylinder will move inward and the spring loaded retainers will "snap" into place and "lock" the cylinder in the housing.

(13) With the key/lock cylinder in the LOCK position and the ignition switch in the LOCK position (the second detent position from the top), tighten the ignition switch retaining screws.

(14) Route the buzzer/chime switch wires behind the wiring post and down through the space between the lock housing and the steering column jacket. Remove the ignition switch key, position the switch in the housing and tighten the retaining screws.

SHAFT INSTALLATION

CAUTION: During installation, do not strike the steering column shaft with a hammer (or other heavy object) because this could damage the collapsible connection.

(1) Install the bearing and the spring on the steering column shaft. Lubricate and install the rubber O-ring seal in the lower groove on the upper end of the shaft (Fig. 21). Insert the shaft completely into the steering column.

(2) Force the upper bearing into the upper bearing housing. The bearing must be fully "seated" in the bearing cavity.

(3) Push upward on the steering column shaft to compress the bearing spring and retain the shaft in this position until the "snap" retaining ring is installed in the shaft groove.

(4) Lubricate the inside of the lock plate (to prevent rattle) and install the lock plate on the steering column shaft (Fig. 13).

(5) Install the upper bearing "snap" retaining ring on the steering shaft (Fig. 12).

(6) Install the four screws that attach the bearing housing to the lock housing (Fig. 12).

KEY LAMP AND TURN SIGNAL SWITCH INSTALLATION

(1) Install the ignition switch key lamp on the bearing housing (Fig. 11).

(2) Install the turn signal switch on the bearing housing (Fig. 10). Route the wires from the turn signal switch and the key lamp through the opening between the bearing housing and the lock housing and down along the bottom of the steering column jacket. Tighten the three attaching screws with 3 N•m (24 in-lbs) torque.

(3) Assemble the wash/wipe switch, the stalk and cover, the multi-function control switch, the cover, and the knob (Fig. 9).

(4) Place the wash/wipe switch in the lock housing, route the wires through the lock housing and the shift housing, and attach them to the turn signal switch.

(5) Route the dimmer switch actuator rod up through the housings and insert it into the "pocket" in the wash/wipe switch.

(6) Compress the dimmer switch until two 0.093-inch diameter drill bit shanks can be inserted into the two alignment holes. With one end of the rod in the wash/wipe switch and the other end of the rod in the dimmer switch, apply a slight upward force and attach the dimmer switch to the bracket. Remove the drill bits. The switch should "click" when the lever is lifted; and "click" again, as the lever returns and immediately before it reaches the "stop" in the "down" position.

(7) Install the turn signal lever cover.

(8) Install the breakaway capsules.

(9) Position the wiring trough in-place over the wires. **Use care to avoid "pinching" the wires between the trough and the steering column jacket.** Install replacement wire retainers, if necessary.

(10) Install the steering column in the vehicle. Refer to the installation procedure.

TILTABLE STEERING COLUMN—DISASSEMBLY/ ASSEMBLY

Safety goggles should be worn at all times when involved with steering column service.

CONSOLE TRANSMISSION SHIFT COLUMN—DISASSEMBLY

This type of steering column is basically the same as a tiltable steering column with a column transmission shift. The service disassembly procedure is the same except as listed below.

(1) After the support is removed from the steering column jacket, it will be evident that there is no transmission shift tube.

(2) The lock inhibiter system, consisting of a plastic housing, an actuator, and a spring, can be lifted out from the top end of the steering column jacket.

DISASSEMBLY

(1) Remove the two bolts that attach the lower bracket to the lower bearing support.

(2) Remove the wire protector from the steering column jacket.

(3) Retain the steering column in a vise by clamping it on the capsule bracket.

(4) Remove the tilt lever. Push the hazard warning knob inward and un-thread it to remove it.

(5) Remove the ignition key lamp dome from the lock housing (Fig. 25).

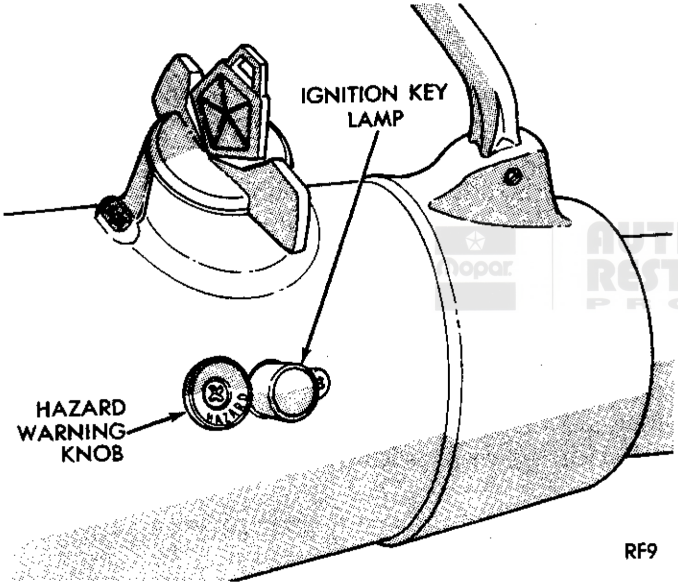

Fig. 25 Upper Part Of Steering Column

(6) Pull the knob off the end of the wash/wipe (multi-function) switch stalk (Fig. 26)

(7) Pull the cover up the stalk and remove the screws that attach the sleeve to the wash/wipe (multi-function) switch. Remove the sleeve (Fig. 26).

(8) Rotate the shaft in the wash/wipe (multi-function) switch to the full clockwise position and remove the shaft by pulling it straight out of the wash/wipe switch (Fig. 26).

(9) Depress the lock plate with Depressing Tool C-4156 and pry the retaining ring out of the steering column shaft groove with a small pry bar (Fig. 27). **The full tension of the upper bearing spring should not be completely relieved with Tool C-4156 because this will allow the retaining ring to slide too easily and cause the removal to be more difficult.** Remove the lock plate, the canceling cam, and the upper bearing spring.

(10) Remove the switch actuator screw and arm.

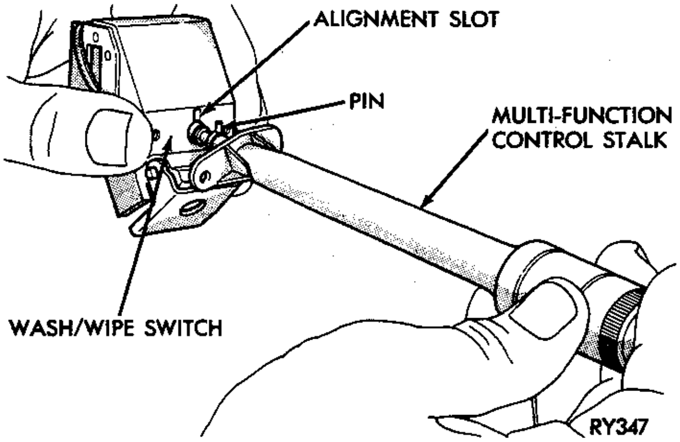

Fig. 26 Multi-Function Control Stalk Removal/ Installation

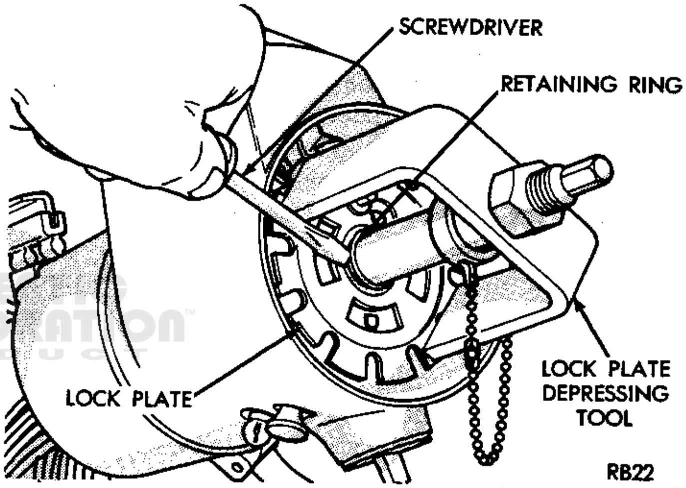

Fig. 27 Lock Plate Retaining Ring Removal/Installation

(11) Remove the three turn signal switch attaching screws and place the shift bowl in the low (1) position. Wrap a piece of tape around the connector and the wires to prevent “snagging” when removing the switch (Fig. 28). Remove the switch and the wire harness.

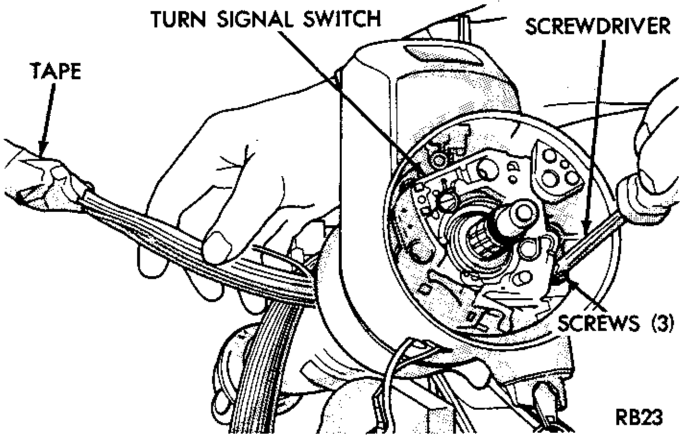

Fig. 28 Connector & Wires Taped

(12) Remove the ignition switch key lamp.

(13) The key/lock cylinder can be removed when in any position ranging from ACCESSORY to ON. However, the LOCK position is recommended because of its accessible location.

(14) Insert a thin tool (small screwdriver or shimstock) into the slot adjacent to the switch attaching screw boss (right-hand slot) and depress the spring latch located at the bottom of the slot, which releases the key/lock cylinder. Remove the key/lock cylinder (Fig. 29).

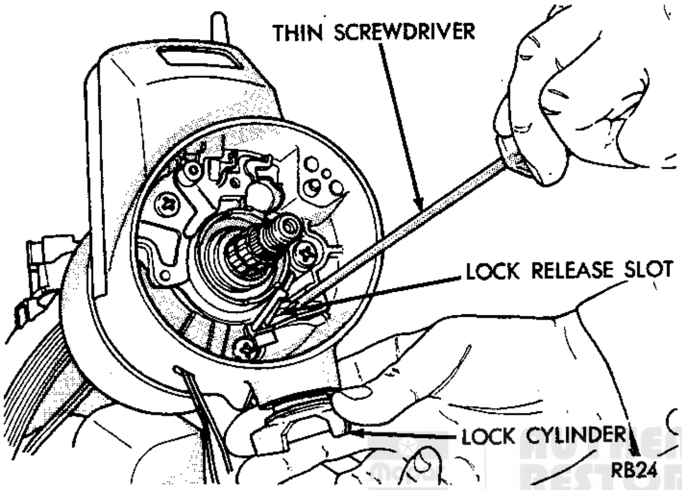

Fig. 29 Key/Lock Cylinder Removal

If the key/lock cylinder is not removed before the switch, it must be in the ON position to remove the buzzer/chime switch.

CAUTION: If the wedge spring (Fig. 30) is dropped during removal, it could fall into the column and this will require complete steering column disassembly to retrieve the spring.

(15) The buzzer/chime switch can be pulled straight out of the housing (Fig. 30). Use a "straightened" paper clip (or a similar section of stiff wire) with a hook bent on one end to "hook" the exposed wedge spring loop, then pull straight out on the wire to remove both the spring and the switch.

(16) Remove the three housing cover screws and remove the housing cover (Fig. 25). With the cover removed, the wash/wipe switch can be removed. If necessary, the wash/wipe switch pivot pin can be forced out with a punch (Fig. 31). Also, if necessary, the tilt-lever slot (opening) shield and the dimmer switch actuator rod can be removed from the cover.

(17) Place the steering column in the complete UP position. Remove the tilt spring retainer with a large Phillips screwdriver. Insert the screwdriver in the opening; force it inward approximately 3/16 of-an-inch; rotate it approximately 1/8 of-a-turn counterclockwise until the "ears" align with the slots in the housing; and remove the retainer, the spring and the guide (Fig. 32).

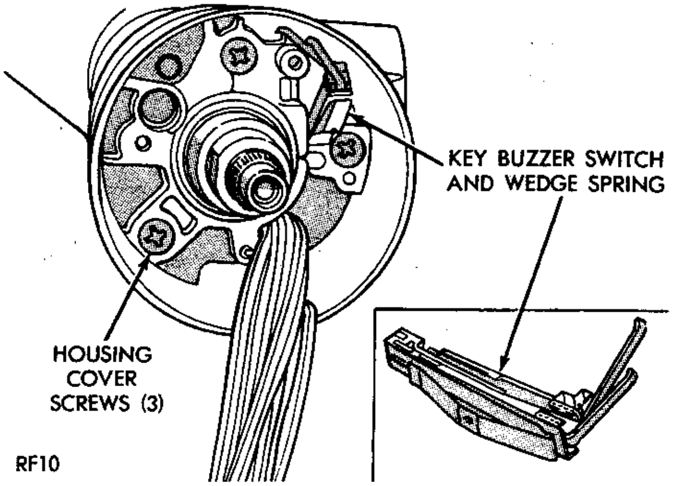

Fig. 30 Key Buzzer/Chime Switch & Wedge Spring

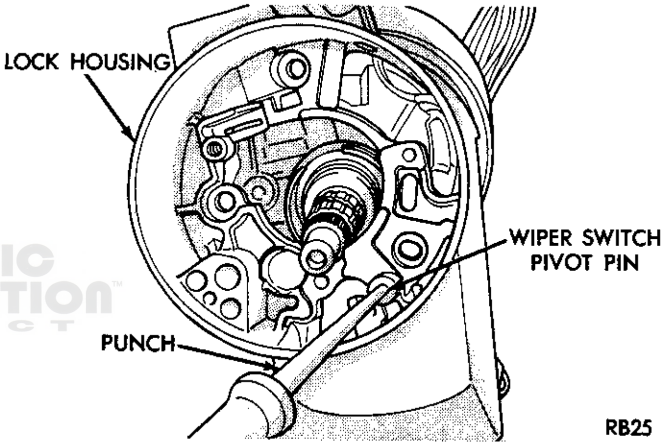

Fig. 31 Wash/Wipe Switch Pivot Pin Removal

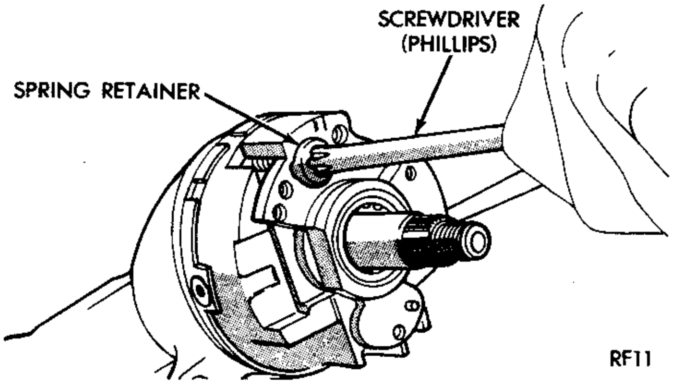

Fig. 32 Tilt Spring Retainer Removal

(18) Remove the dimmer switch attaching screws. Remove the dimmer switch. Separate the dimmer switch from the rod by pulling it away from the rod.

(19) Push the upper steering column shaft inward sufficiently to remove the shaft inner race "seat" and the inner race.

(20) With the ignition switch in the ACCESSORY position, remove the ignition switch attaching screws and the ignition switch (Fig. 33).

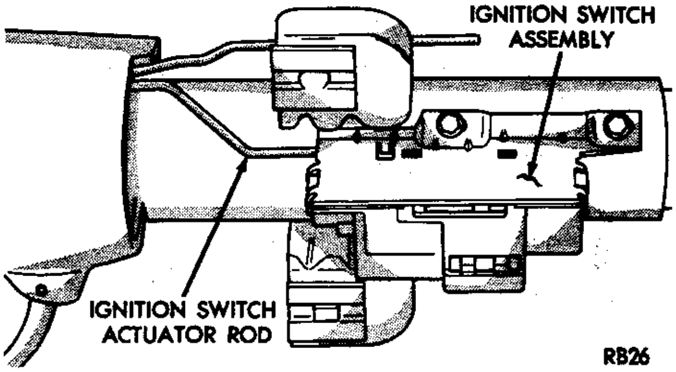

Fig. 33 Ignition Switch Removal

(21) Position Pivot Pin Removal Tool C-4016 over the steering column shaft pivot pin and thread the small portion of the tool screw firmly into the pin. Prevent the screw from turning with a wrench and turn the nut clockwise with a second wrench to withdraw the pivot pin from the support (Fig. 34). Use the same process to remove the opposite pivot pin.

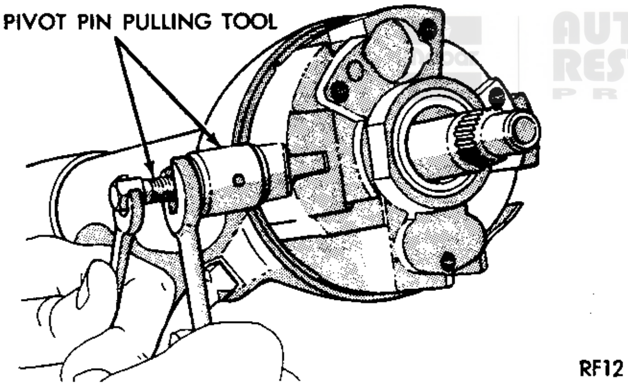

Fig. 34 Pivot Pin Removal

(22) Use the tilt release lever to disengage the lock shoes. Remove the bearing housing by pulling upward and extend the rack completely. Move the housing to the left to disengage the rack from the actuator. Rotate the housing clockwise to detach the dimmer switch actuator rod. Remove the actuator.

(23) Remove the coupler from the lower end of the steering column shaft. The double coupler is attached to the shaft with a roll pin.

(24) Remove the steering column shaft from the upper end of the steering column.

CAUTION: Do not drop or contact the steering shaft with a heavy object because the plastic pins could shear.

(25) Separate the steering shaft by removing the center spheres and the anti-lash spring (Figs. 35 and 36).

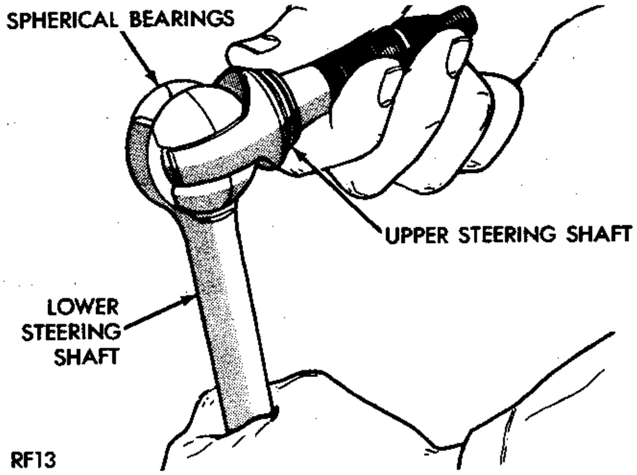

Fig. 35 Steering Column Shaft Separation/Engagement

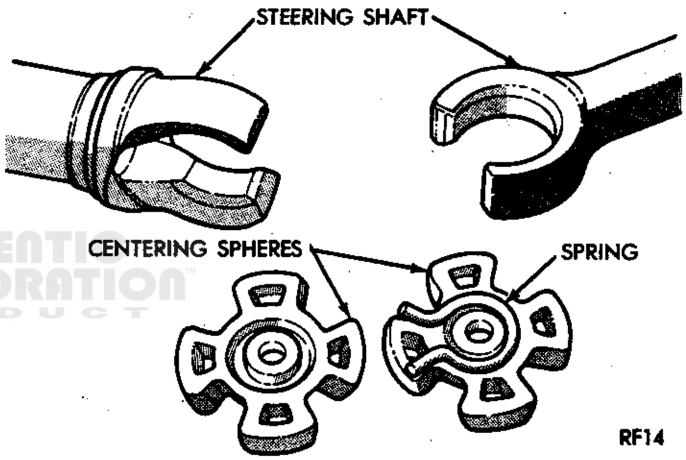

Fig. 36 Steering Column Shaft Centering Spheres

(26) Remove the four bolts that attach the support to the lock plate and remove the support from the end of the steering column jacket. If necessary, remove the two attaching screws and the shift gate from the support. The dimmer switch rod is removed along with the support.

(27) Remove the shift tube retaining ring with a small pry bar. Remove the thrust washer.

(28) Remove the two screws that retain the lower bearing and remove the lower bearing from the steering column jacket.

(29) Remove the shift tube from the bowl with Removal Tool C-4120 (Fig. 37). Insert the bushing on the end of the tool in the shift tube and force the tube out of the bowl with the tool.

CAUTION: Do not strike with a hammer or pull on the lower or the upper shift tube because the plastic connection could be sheared.

(30) Remove the shift tube from the steering column jacket at the lower end.

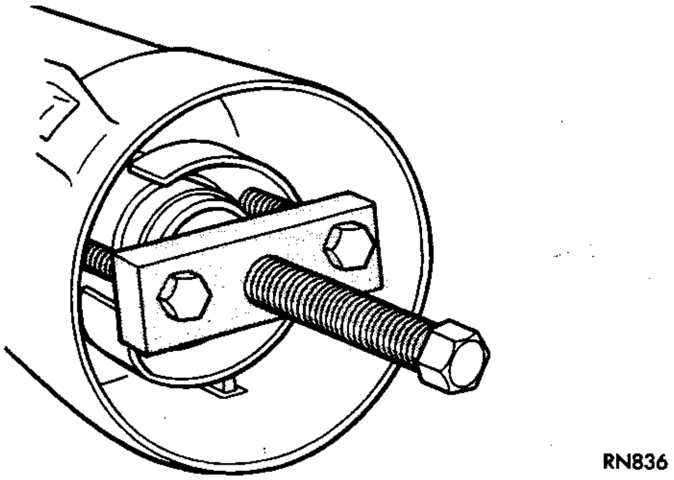

Fig. 37 Shift Tube Removal From Bowl

(31) Remove the steering column jacket attaching plate by sliding it out of the jacket notches and tipping it down toward the bowl hub at the 12 O'clock position and then under the jacket opening. Remove the wave washer.

(32) Remove the bowl from the steering column jacket and the shift lever spring from the bowl by winding the spring up with pliers and pulling outward.

BEARING HOUSING—DISASSEMBLY

(1) Remove the lock bolt spring by removing the spring retaining screw and then moving the spring clockwise to remove it from the bolt (Fig. 38).

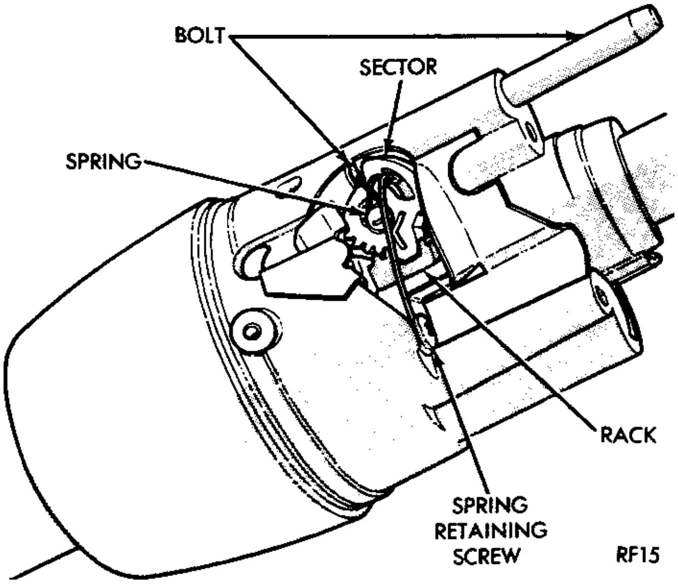

Fig. 38 Sector & Bolt Spring

(2) Lightly tap the drive shaft with a small hammer and small punch to separate it from the sector. Remove the drive shaft, the sector and the bolt. Remove the rack and the rack spring (also the shim, if used).

(3) Remove the tilt release lever pin with a punch and hammer. Remove the lever and the release lever spring. **To relieve the spring tension on the release lever, push the shoes inward and insert/force a block between the top of the shoes (over the slots) and the bearing housing.**

(4) Remove the lock shoe pin with punch and hammer. Remove the lock shoes and the lock shoe springs.

(5) Remove the bearings from the bearing housing **only if they must be replaced.** Remove the separator and the balls from the bearing. Place the housing on a work surface. With a pointed punch against the back surface of the race, carefully drive the race out of the housing with a hammer. Repeat the process for the other race. Do not re-use the bearings.

INSPECTION

(1) Inspect all the bearings and the bearing race "seats" for "brinelling", nicks, scratches and excessive wear.

(2) Inspect the steering column shaft centering spheres (Fig. 36) for nicks, damage and excessive wear. If damage exists, inspect the shaft couplers for nicks, burrs and rough surface areas.

(3) Inspect the actuator housing, the shift lever bowl and the support for cracks and other damage.

(4) Inspect the turn signal switch for distorted, broken and damaged components.

(5) Inspect the horn and turn signal wires for worn and chafed insulation/bare wire areas.

(6) Inspect the steering column shaft and the transmission shift tube for loose and broken plastic shear connections.

ASSEMBLY

The lubricant recommended for use during steering column assembly is multi-purpose, NLGI Grade 2 EP (extreme pressure) lubricant (e.g., MOPAR MultiMileage Lubricant, or an equivalent product).

BEARING HOUSING—ASSEMBLY

(1) Install the bearings in the bearing housing, if removed.

(2) Install the lock shoe springs, the lock shoes, and the shoe pin in the bearing housing. Use an 0.18-inch diameter rod (approximately) to align the shoes for pin installation.

With the tilt lever slot (opening) positioned at the left side of the column and the shoes facing upward, install the four-slot shoe on the left side.

(3) Install the spring, the release lever, and the pin in the bearing housing. **To relieve the spring tension on the release lever, push the shoes inward and insert/force a block between the top of the shoes (over the slots) and the bearing housing.**

(4) Install the shaft in the housing. Lightly tap the sector onto the shaft far enough to "seat" it on the shaft.

(5) Install the lock bolt and engage it with the sector cam surface.

(6) Install the rack and the spring. Engage the block tooth on the rack with the block tooth on the sector. Install the external tilt release lever.

(7) Install the bolt spring and the spring retaining screw (Fig. 38). Tighten the screw with 4 N•m (34 in-lbs) torque.

(8) Install the shift lever spring in the bowl by winding it up with pliers and pushing inward. Slide the bowl into the steering column jacket.

(9) Position the wave washer and the steering column jacket attaching plate in the jacket. Maneuver the jacket attaching plate into the notches in the jacket by tipping the jacket attaching plate toward the bowl hub at the 12 O'clock position and under the jacket opening. Slide the jacket attaching plate into the notches in the jacket.

(10) Carefully install the shift tube in lower end of the jacket. Align the key in the tube with the keyway in the bowl and use Tool C-4119 to pull the shift tube into the bowl (Fig. 39).

CAUTION: Do not push or tap on the end of the transmission shift tube. Install the thrust washer and the retaining ring by pulling the bowl upward to compress the wave washer.

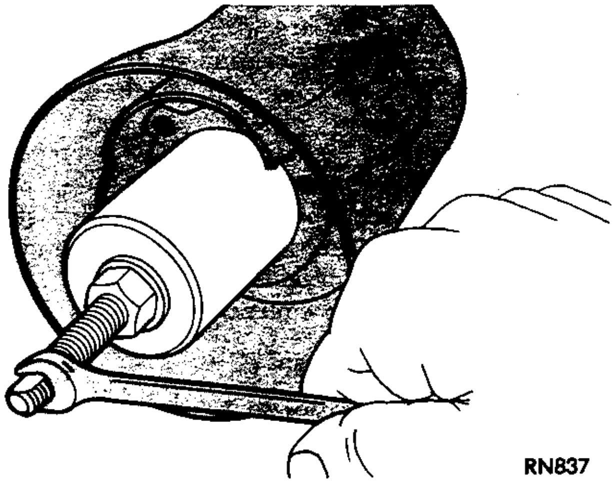

Fig. 39 Shift Tube Installation

(11) Slide the dimmer switch actuator rod through the hole in the support. Route the rod between the bowl and the steering column jacket.

(12) Install the support by aligning the "U" in the support with the "U" notch in the steering column jacket. Insert the four attaching screws through the support and into the jacket attaching plate. Tighten the screws with 7 N•m (60 in-lbs) torque.

(13) Install the lower bearing (if removed) at the lower end of the steering column jacket.

(14) Install the centering spheres and the anti-lash spring in the upper steering column shaft (Figs. 35 and 36). Install the lower steering column shaft at same side of the spheres that the spring ends protrude.

Do a trial engagement of the upper and lower steering column shafts to ensure that the master serration at the upper shaft is on the same side as the master serration at the lower shaft.

(15) Position the shift bowl in the PARK position (turn counterclockwise to the stop). Install the ignition switch actuator rod from the bottom, between the bowl and the steering column jacket. Guide the back of the coupling into the support slot.

(16) Install the bearing housing over the steering column shaft and engage the rack over the end of the ignition switch actuator rod.

(17) Position the access hole of the bearing housing over the end of the dimmer switch actuator rod. Rotate the housing counterclockwise to install it.

(18) Retain the lock shoes in the disengaged position and maneuver the bearing housing over steering column shaft until the pivot holes align with the holes in the support.

(19) Install the pivot pins. Insert them as far as possible with palm pressure from your hand to prevent broaching of the support pivot hole. Once started, complete the installation with a small hammer and punch.

(20) Install the wash/wipe switch stalk pivot and force the pivot pin in the cover (if removed). Test the pivot for ease of movement. If restricted, tap the other end of the pin back to provide clearance.

(21) Install the wash/wipe switch.

(22) Install the tilt lever slot (opening) shield in the cover (if removed). Position the cap over the dimmer switch actuator rod. Guide the end of the actuator rod into the pivot slot during the cover installation. Position the cap so that the cover will slide over it.

(23) Place the lock housing in the complete "up" position, install the guide after ensuring there is sufficient lubricant between the guide and the peg on the support, the tilt spring, and the tilt spring retainer. Then, with a Phillips screwdriver inserted in the retainer slot, turn the retainer clockwise to engage it (Fig. 32).

(24) Install the bearing inner race and the "seat".

(25) Install the lock housing cover and tighten the screws with 11 N•m (100 in-lbs) torque (Fig. 30).

(26) Connect the buzzer/chime switch to the spring clip with the formed end of the clip located under the end of the switch and the spring "bowed" away from the switch on the side opposite the contact. Push the switch and the spring into the hole in the lock housing cover with the contacts facing toward the key/lock cylinder bore (Fig. 30).

(27) Install the ignition switch key lamp.

(28) Insert the turn signal switch wire harness and connector through the cover, the bearing housing and the shift bowl. Push the hazard warning plunger inward. Install the turn signal switch and tighten the screws with 3 N•m (25 in-lbs) torque.

(29) Install the hazard warning knob and screw, and pull the knob outward. Install the cancelling cam spring, the cancelling cam (carrier) and the lock plate.

(30) Use Tool C-4156 to depress the lock plate and install a **replacement** retaining ring on the steering column shaft (Fig. 27).

(31) Install the tilt release lever (if removed) and the turn signal switch lever. Refer to **Electrical—Group 8** for speed control information.

(32) To install ignition switch lock, turn the key to the LOCK position and remove the key. This will cause the buzzer operating lever to retract in the key/lock cylinder. Now insert the key/lock cylinder into the housing far enough to contact the shaft. Force it inward and move the ignition switch actuator rod up and down to align the components. When the components align, the key/lock cylinder will move inward and the spring-loaded retainer will "snap" into place "locking" the key/lock cylinder in the lock housing.

(33) When installing the ignition switch, position the key/lock cylinder in the LOCK detent position and remove the key. Then place the ignition switch in the LOCK position (second detent position from the bottom).

(34) Insert the ignition switch actuator rod into the slider hole and attach it loosely to the steering column jacket with two screws. Push the switch lightly up the column jacket toward the lock housing (to remove the lash in the actuator rod) and tighten the attaching screws. **Caution should be exercised to prevent moving the switch out of the detent position. Use only the correct length screws.** Tighten the screws with 4 N•m (34 in-lbs) torque.

(35) To install the dimmer switch, firmly insert and "seat" the push rod in the switch. Compress the switch until two 0.093-inch diameter drill bit shanks can be inserted into the alignment holes. Re-position the upper end of the push rod in the "pocket" of the wash/wipe switch. This can be accomplished by touch, or if necessary, by removing the lower column cover. Apply a light upward force on the switch and install the attaching screws. Remove the drill bits. The switch should "click" when the lever is lifted, and "click" again, as the lever returns and immediately before it reaches the "stop" in the "down" position (Fig. 40).

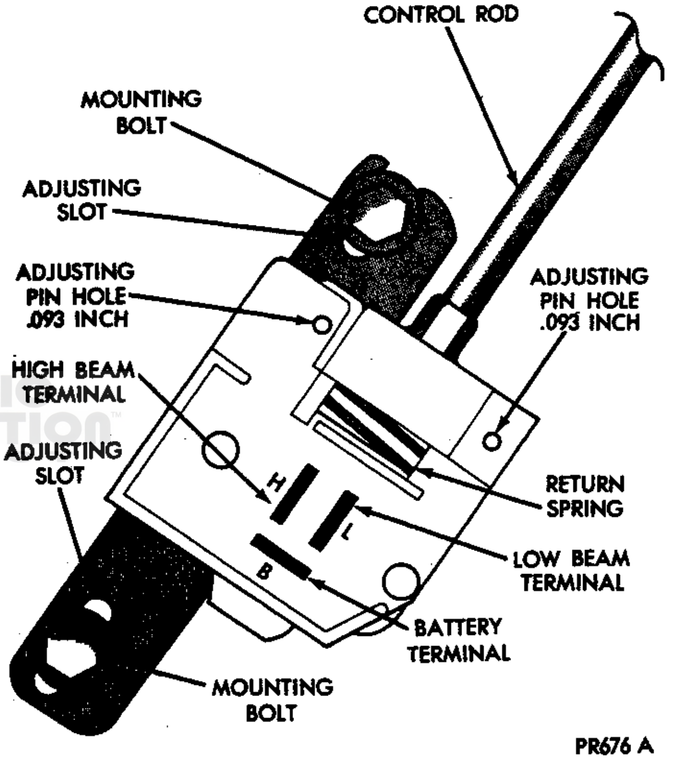

Fig. 40 Dimmer Switch

(36) Install the wire protector over the wire harness on the steering column jacket. Use care to avoid "pinching" the wires.

(37) Remove the steering column from the vise.

(38) Position the lower bracket on the steering column. Install and tighten the two attaching bolts with 12 N•m (105 in-lbs) torque.

(39) Align the steering column shaft and coupler master splines and install the coupler at the lower end of the shaft. Place a support under the coupler at the U-joint and install the clamp bolt.

(40) Install the steering column in the vehicle. Refer to the installation procedure.

SPECIFICATIONS

MANUAL STEERING GEAR SPECIFICATIONS

Wormshaft Bearing Preload Torque	0.6-0.9 N•m (5 to 8 in-lbs)
Pitman Shaft Overcenter Drag Torque	0.5-1 N•m (4 to 10 in-lbs) (in addition to above)
Maximum Steering Gear Torque	2 N•m (18 in-lbs) total (maximum)
Steering Gear Lubricant	Multi-purpose chassis grease
Steering Gear Ratio	24:1
Steering Gear Type	Recirculating Ball

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POWER STEERING GEAR SPECIFICATIONS

Steering Gear Type	Recirculating ball with hydraulic assist.
Steering Gear Ratio	16.2-20:1 (Variable Ratio)
Steering Gear Hydraulic Fluid	Use Mopar Power Steering Fluid, Dexron II, or equivalent.
Steering Gear Lubricants	Lubricate pitman shaft seals, bearings races, and rack piston recirculating balls with petroleum jelly. Lubricate all other parts with power steering fluid.
Steering Gear Adjustments:	
Wormshaft Bearing Preload Torque	0.45-1.13 N•m (4 to 10 in-lbs)
Pitman Shaft Overcenter drag torque	
New Gear (less than 400 miles/640 km)	0.45-0.90 N•m (4 to 8 in-lbs) in addition to wormshaft bearing preload but not to exceed combined total of 2 N•m (18 in-lbs)
Used Gear (over 400 miles/640 km)	0.5-0.6 N•m (4 to 5 in-lbs) in addition to wormshaft bearing preload but not to exceed combined total of 2 N•m (18 in-lbs)

Caution: Gears must be adjusted exactly as outlined in Steering Gear Adjustments-On Bench. Failure to adhere to the recommended procedures may result in gear damage or improper steering response.

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TORQUE SPECIFICATIONS

COMPONENT	SET-TO-TORQUE	RECHECK TORQUE
Sector Shaft Adjustment Screw Locknut (Manual Steering Gear)	47 N•m (35 ft-lbs)	
Sector Shaft Cover Bolt (Manual Steering Gear)	34 N•m (25 ft-lbs)	
Power Steering Gear Housing-to-Frame Bolt/Nut	136 N•m (100 ft-lbs)	
Sector Shaft Adjustment Screw Locknut (Power Steering Gear)	38 N•m (28 ft-lbs)	
Sector Shaft Cover Bolt (Power Steering Gear)	203 N•m (150 ft-lbs)	
High Pressure Hose Fitting (At Pump and Gear)	30 N•m (22 ft-lbs)	
Steering Wheel-to-Shaft Nut Non-Tilt or Tilt Column	61 N•m (45 ft-lbs)	
Steering Column Bracket-to-Support Stud Nut	2 N•m (20 in-lbs)	
Steering Column Bracket-to-Instrument Panel Support Nut	12 N•m (110 in-lbs)	
Steering Column Shaft-to-Steering Gear Coupler Bolt	23 N•m (200 in-lbs)	
Steering Column Support Plate Bolt	7 N•m (60 in-lbs)	

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TRANSMISSION—TRANSFER CASE

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GENERAL INFORMATION

TRANSMISSION COMPONENTS

The A833 is a fully synchronized, four-speed, manual transmission (Fig. 1 and 2). It is used primarily for six cylinder engine applications. Fourth gear is an overdrive range with a ratio of .71:1.

The transmission input shaft is supported by a ball bearing in the front of the transmission case and an by an oilite pilot bushing in the crankshaft pilot bushing bore. The mainshaft front end is supported by roller bearings in the end of the main drive pinion and by a ball bearing in the front of the extension housing. The output end of the mainshaft is splined to the sliding universal joint yoke. The joint is supported by a bushing in the extension housing.

The countershaft gear is supported by a double row of needle type roller bearings at each end. Gear end thrust is controlled by thrust washers between the ends of the gear and the transmission case. The alignment of the needle type roller bearings within the gear is maintained by a tubular spacer and four thrust washers.

The countershaft is not a press fit in the case bores. The shaft has a .12 mm (.005 inch) diameter clearance. An expansion plug is pressed into a counter bore at the front of the case to prevent oil leakage around the countershaft.

The reverse idler gear is supported on a bronze bushing pressed into the gear.

A magnetic disc is attached to the bottom, rear of the case. The magnet collects and prevents circulation of chips in the transmission oil.

Gearshifting is manually operated through shift control rods attached to the transmission shift levers (Fig. 2). Any forward gear may be engaged while the vehicle is in motion through the use of synchronizing clutches.

The transmission synchronizers are serviced as assemblies. Except for the stop rings, synchronizer parts are not interchangeable.

The transmission may be used as an aid to deceleration. Downshifting without double clutching is possible as all forward speeds are synchronized. Refer to Specifications for downshift speed limits.

RECOMMENDED LUBRICANTS

The primary lubricant recommended for the overdrive-4 is ATF PLUS, type 7176 automatic transmission fluid. However, when heavy duty operation is anticipated, SAE gear lubricants meeting API grade GL 5 quality can also be used for quieter operation. These lubricants include 75W-90, 80W-90, 85W-90 and 90W.

TRANSMISSION IDENTIFICATION

Transmission identification information is located on a machined pad at the right side of the transmission case (Fig. 1). Information provided includes the transmission and vehicle identification numbers. Refer to this information when ordering replacement parts.

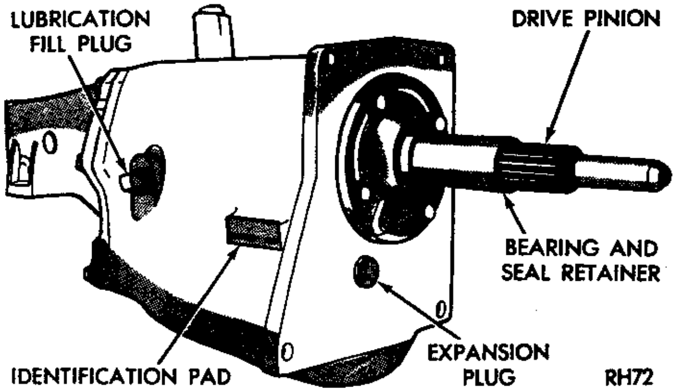

Fig. 1 A833 Overdrive-4 Manual Transmission

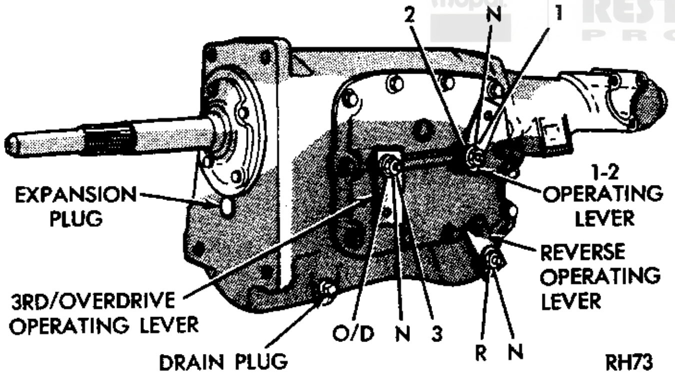

Fig. 2 Transmission Operating Levers

SERVICE DIAGNOSIS

The majority of transmission malfunctions are caused by insufficient lubricant, incorrect lubricant, misadjusted linkage, loose mounting components, or improper operation.

HARD SHIFTING

A low lubricant level, misadjusted linkage, damaged linkage, or worn, damaged internal shift components are the most common causes of hard shifting. If hard shifting is also accompanied by gear clash, synchronizer components may be worn or damaged.

Hard shifting may also be caused by insufficient lubrication of linkage components, or a loose or misaligned gear shift housing. Either fault can result in linkage bind and high shift efforts.

NOISY OPERATION

Transmission noise is most often a result of worn or damaged components. Chipped, broken gear or synchronizer teeth and brinnelled, spalled bearings all cause noise. Abnormal wear and damage to internal components is frequently the end result of insufficient lubricant, non-recommended lubricants, or improper operation.

SLIPS OUT OF GEAR

Transmission disengagement may be caused by misadjusted or damaged linkage, or worn synchronizer clutch teeth on the mainshaft gears. Incorrect assembly will also contribute to gear disengagement.

LOW LUBRICANT LEVEL

Insufficient transmission lubricant is usually the result of leaks, or inaccurate fluid level check or refill method. Leaks will be evident by the presence of gear oil around the leak point. If leakage is not evident, the condition is probably the result of an underfill condition.

If air powered lubrication equipment is used to fill a transmission, be sure the equipment is properly calibrated. Equipment out of calibration can lead to an underfill condition.

CLUTCH PROBLEMS

Worn, damaged, or misaligned clutch components can cause hard shifting, gear clash and noise.

A worn pilot bushing will cause noise and input shaft misalignment. The result is hard shifting and noise.

A worn or damaged clutch disc, pressure plate, or release bearing can cause hard shifting and gear clash.

Damaged or worn clutch hydraulic components, or leaks in the fluid lines or cylinders will cause hard shifting and gear clash. A major failure of one of the clutch hydraulic cylinders will cause incomplete clutch release or engagement.

Be sure that the clutch components are all in good condition before removing the transmission for repair.

SERVICE IN VEHICLE

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SHIFT LINKAGE REMOVAL/INSTALLATION

LINKAGE REMOVAL (FIGS. 3 AND 4)

(1) Disconnect the battery negative cable.

(2) Remove the boot cover retaining screws and slide the boot upward on the shift lever.

(3) Remove the shift lever by disengaging the lever lock with an .010 inch feeler gauge (Fig. 3).

(4) Remove the retaining clips and washers that attach the floor shift assembly to the control rods. Then disengage the rods from the shift assembly levers.

(5) Remove the bolts and washers attaching the floor shift assembly to the extension housing mounting plate and remove the shift assembly.

(6) Remove the shift control rods if necessary.

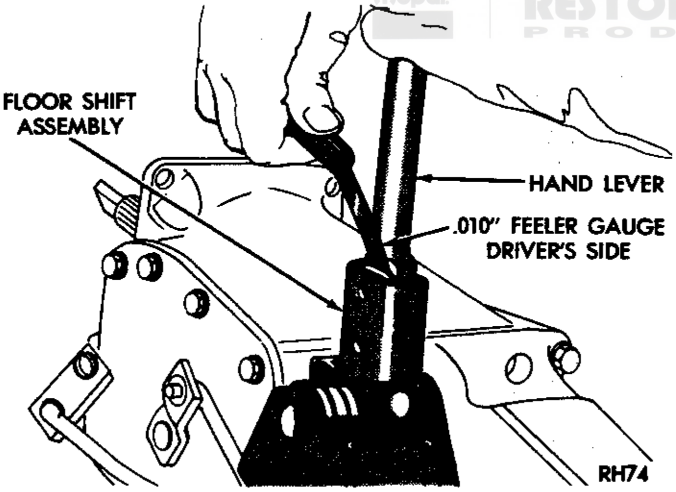

Fig. 3 Hand Lever Removal/Installation

LINKAGE INSTALLATION

(1) Position the floor shift assembly on the extension housing mounting plate and install the assembly attaching bolts and lock washers. Tighten the bolts to 41 N•m (30 ft-lbs) torque.

(2) Connect the shift rods to the lever assembly and install the rod attaching washers and clips.

(3) Install the hand lever in the floor shift assembly (Fig. 3).

(4) Slide the boot and boot cover down the hand lever and position them on the floorpan. Then install and tighten the cover and boot attaching screws.

(5) Reconnect the battery negative cable.

GEARSHIFT LINKAGE ADJUSTMENT

An aligning tool is required to hold the levers in the floor shift assembly in the neutral crossover position for alignment. The tool can be fabricated in the shop from 1/4 inch diameter rod as shown in Figure 4.

ADJUSTMENT PROCEDURE

(1) Install the shift lever aligning tool to hold the levers in neutral crossover position (Fig. 4).

(2) Disconnect the control rods from the levers in the floor shift assembly.

(3) Place the assembly levers in Neutral position (Fig. 4).

(4) Rotate the threaded ends of the shift control rods to adjust rod length. Adjust the rods to a "free pin fit" in the levers. Start with the 1-2 control rod. Then adjust the 3-4 rod followed by the reverse rod. It may be necessary to remove the clip at the lever end of the 1-2 rod to rotate it.

(5) Install the control rod attaching washers and clips.

(6) Remove the alignment tool and check shifting action.

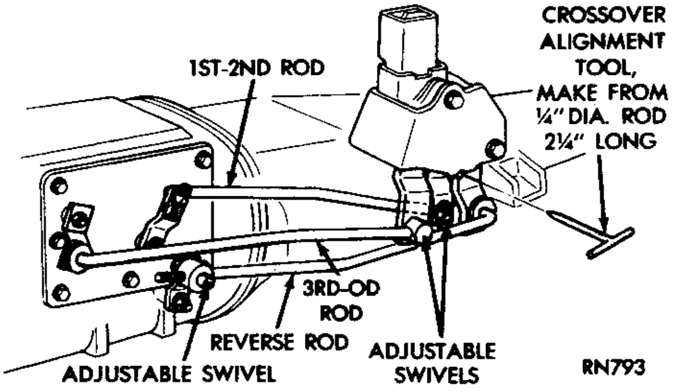

Fig. 4 Linkage Adjustment

SPEEDOMETER PINION AND ADAPTER SERVICE

Rear axle gear ratio and tire size determines speedometer gear usage. If the gear must be replaced, consult the parts catalogue for correct application.

ADAPTER AND PINION REMOVAL

(1) Raise the vehicle and position a drain pan under the speedometer adapter.

(2) Disconnect the wires from the distance sensor (Fig. 5).

(3) Loosen the distance sensor coupling and remove the sensor from the speedometer adapter (Fig. 5).

(4) Remove the bolt and retainer securing the speedometer pinion adapter in the extension housing (Fig. 5).

(5) Carefully work the adapter and pinion out of the extension housing.

(6) Remove and discard the adapter O-ring.

(7) Inspect the adapter. If transmission fluid is found in the coupling section of the adapter housing, the oil seal is leaking and will require replacement. Refer to Adapter Oil Seal Replacement

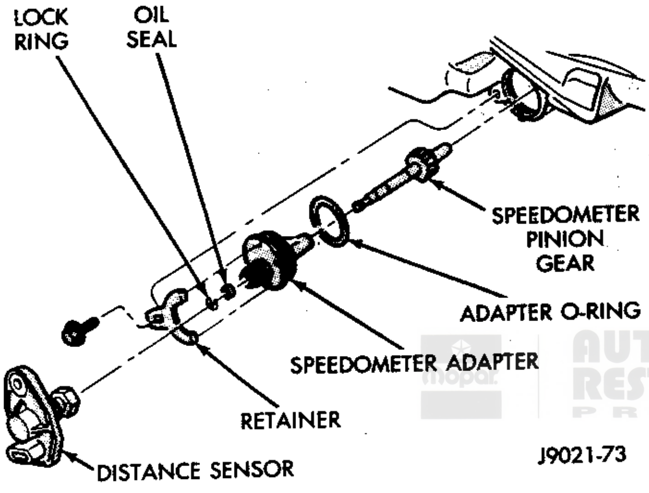

Fig. 5 Speedometer Adapter And Pinion Components

ADAPTER OIL SEAL REPLACEMENT

(1) Remove the C-shaped lock ring securing the seal in the adapter (Fig. 5).

(2) Remove the old seal from the adapter with a small screwdriver or hooked tool.

(3) Start the new seal in the adapter by hand and insert the lock ring in the adapter.

(4) Seat the seal in the adapter with tool C-4004 (Fig. 6). Press the seal and lock ring into place until the installer tool bottoms.

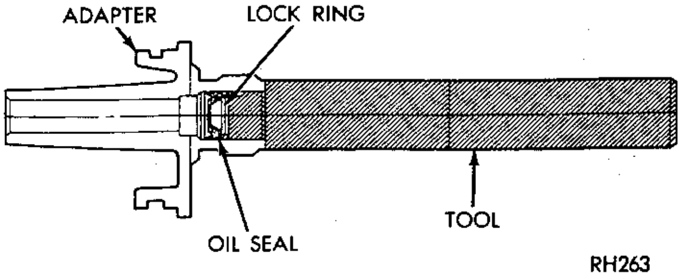

Fig. 6 Installing Adapter Oil Seal And Lock Ring

ADAPTER AND PINION INSTALLATION

CAUTION: Before installing the pinion and adapter assembly make sure the adapter flange and the mating area in the extension housing are perfectly clean. Dirt, sand, or foreign material will cause misalignment resulting in speedometer pinion gear damage.

(1) Thoroughly clean the adapter flange and adapter mounting surface in the extension housing. These surfaces must be clean for proper adapter alignment and speedometer operation.

(2) Install a new O-ring on the adapter.

(3) Lubricate the adapter oil seal and O-ring with transmission fluid.

(4) Count the number of teeth on the pinion gear and install the gear in the adapter. Be sure to count the gear teeth **before** installing the gear.

(5) Note the range numbers on the adapter face (Fig. 7). These numbers correspond to the number of teeth on the speedometer pinion gear.

(6) Insert the adapter in the extension housing.

(7) Rotate the adapter until the required range numbers are at a six o-clock position (Fig. 7). Be sure the adapter range numbers correspond to the number of teeth on the pinion.

(8) Lightly push the adapter all the way into the extension housing.

(9) Install the adapter retainer. Tighten the retainer bolt to 100 in-lbs (11 N•m) torque.

(10) Install the distance sensor on the adapter. Tighten the sensor coupling nut to 150 in-lbs (17 N•m) torque and install the sensor wires.

(11) Check and top off the transmission lubricant level if necessary.

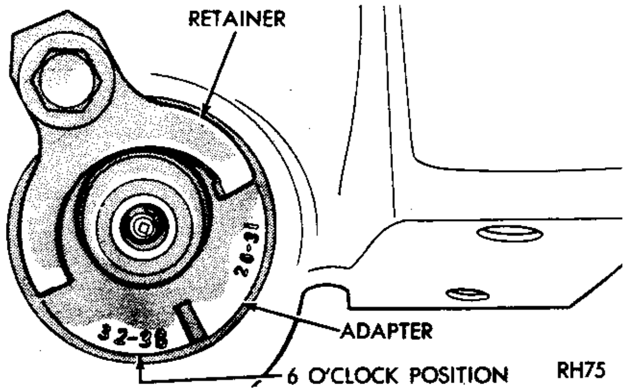

Fig. 7 Indexing Speedometer Adapter

EXTENSION HOUSING YOKE SEAL REPLACEMENT

(1) Raise the vehicle and position a drain pan under the extension housing.

(2) Mark position of the propeller shaft and rear axle yokes for alignment reference.

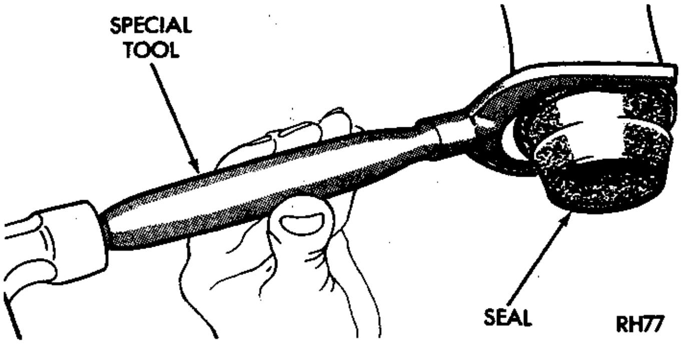

Fig. 8 Removing Yoke Seal

(3) Disconnect the propeller shaft at the axle yoke and remove the shaft.

(4) Remove the oil seal with tool C-3985 (Fig. 8).

(5) Install the new seal with tool C-3972 (Fig. 9). Start the seal in the housing and tap it into place until the tool bottoms against the housing.

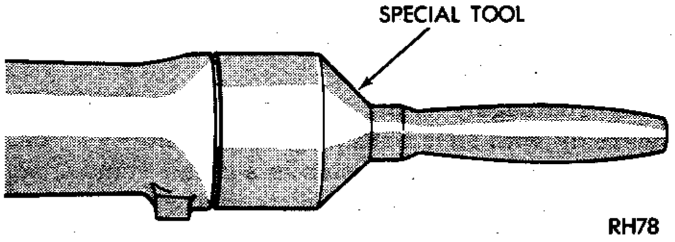

Fig. 9 Installing Yoke Seal

(6) Check condition of the slip yoke surface of the propeller shaft. Reduce minor corrosion, scratches, or nicks with crocus cloth or 400 grit sandpaper. Replace the slip yoke if severely scored or rusted.

(7) Align and install the propeller shaft.

(8) Check and top off the transmission lubricant level if necessary. Correct level is to the edge of the fill plug hole.

(9) Remove the drain pan and lower the vehicle.

SERVICE OUT OF VEHICLE

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TRANSMISSION REMOVAL

(1) Shift the transmission into Neutral. Then remove the shift lever, linkage and control rods.

(2) Raise the vehicle and drain the transmission lubricant.

(3) Mark the propeller shaft and rear axle yokes for assembly alignment.

(4) Disconnect and remove the propeller shaft.

(5) Disconnect the wires from the distance sensor. Then loosen the sensor coupling and remove the sensor from the speedometer adapter.

(6) Remove the speedometer adapter and pinion gear.

(7) Disconnect the backup lamp switch wires.

(8) Install engine support fixture C-3487-A. Be sure the support ends are seated on the underside of the oil pan flange.

(9) Raise the engine slightly with the support fixture.

(10) Disconnect the insulator from the extension housing (Fig. 1).

(11) Support the transmission with a suitable jack and remove the center crossmember (Fig. 1).

(12) Remove the transmission-to-clutch housing bolts.

(13) Slide the transmission rearward until the drive pinion shaft clears the clutch disc.

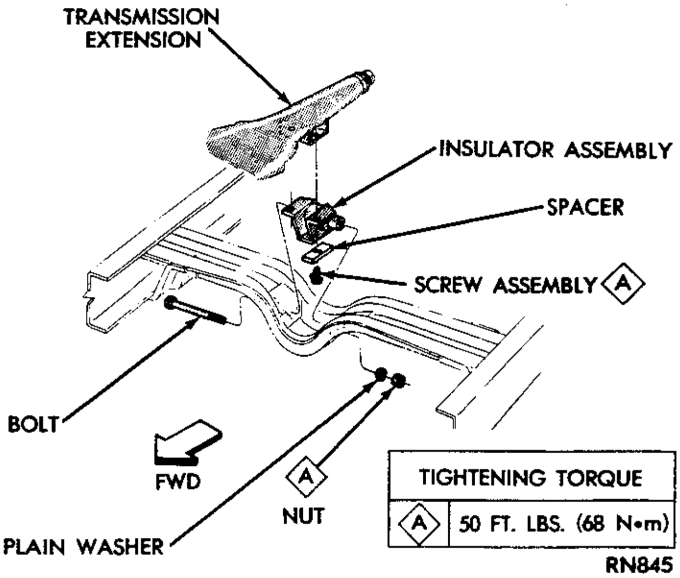

Fig. 1 Crossmember And Insulator

(14) Pull the transmission completely away from the clutch housing and remove the transmission from under the vehicle.

(15) Thoroughly clean the transmission exterior, preferably with steam cleaning equipment.

(16) Mount the transmission in a repair stand (Fig. 2). Use an adapter mounting plate that will use all of the transmission attaching bolts to secure the transmission to the adapter and stand.

remain engaged with synchronizer sleeves, work forks out of sleeves and remove them from case.

(5) Remove operating lever attaching nuts and remove levers from shafts (Fig. 3).

(6) Inspect condition of shift fork and reverse lever shafts. Make sure shaft surfaces are free of burrs before removal. This is necessary to avoid damaging bores in gearshift during removal which could result in leakage after reassembly.

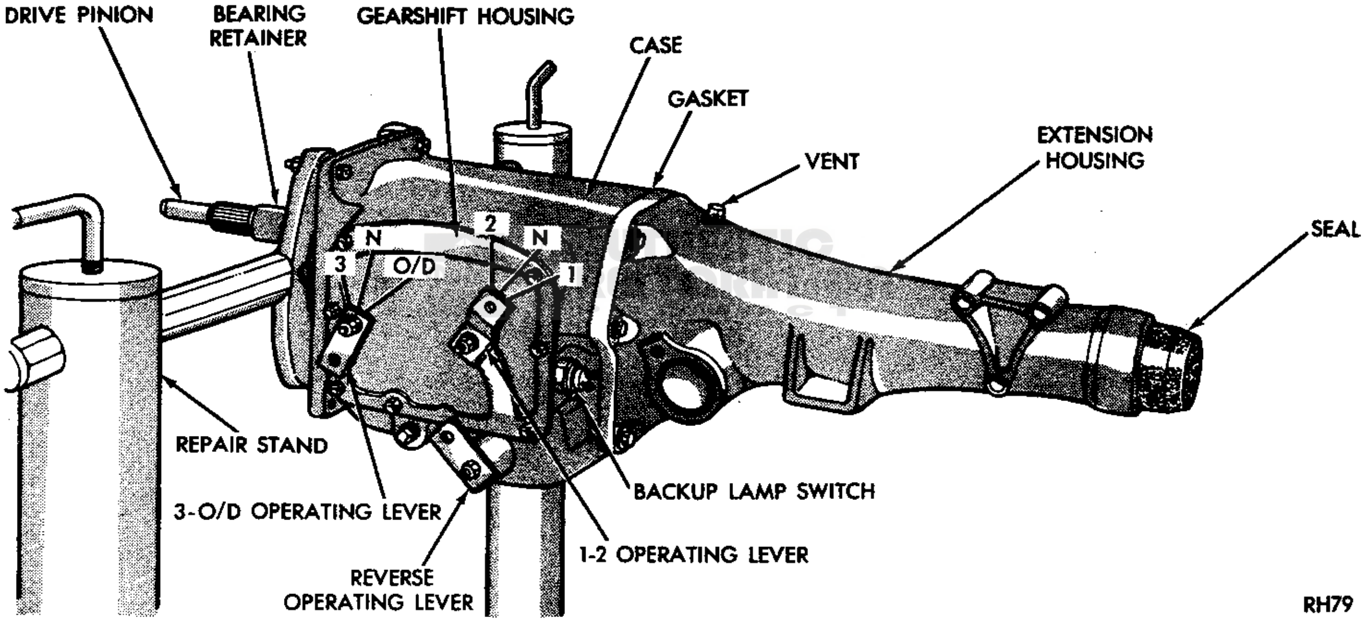

Fig. 2 Transmission Mounted In Repair Stand

TRANSMISSION DISASSEMBLY

GEARSHIFT HOUSING AND SHIFT MECHANISM REMOVAL

(1) Remove reverse operating lever from shaft (Fig. 2).

(2) Remove gearshift housing bolts.

(3) Move operating levers into Neutral (Fig. 2).

(4) Pull gearshift housing out of case. If shift forks

(7) Remove shift fork shafts and reverse lever out of gearshift housing (Fig. 3).

(8) Remove O-ring retainers and O-rings from shaft bores in gearshift housing.

(9) Remove E-ring from interlock lever pivot pin and remove interlock levers and spring (Fig. 3).

(10) Remove reverse detent spring and ball from bore in side of case (Fig. 3).

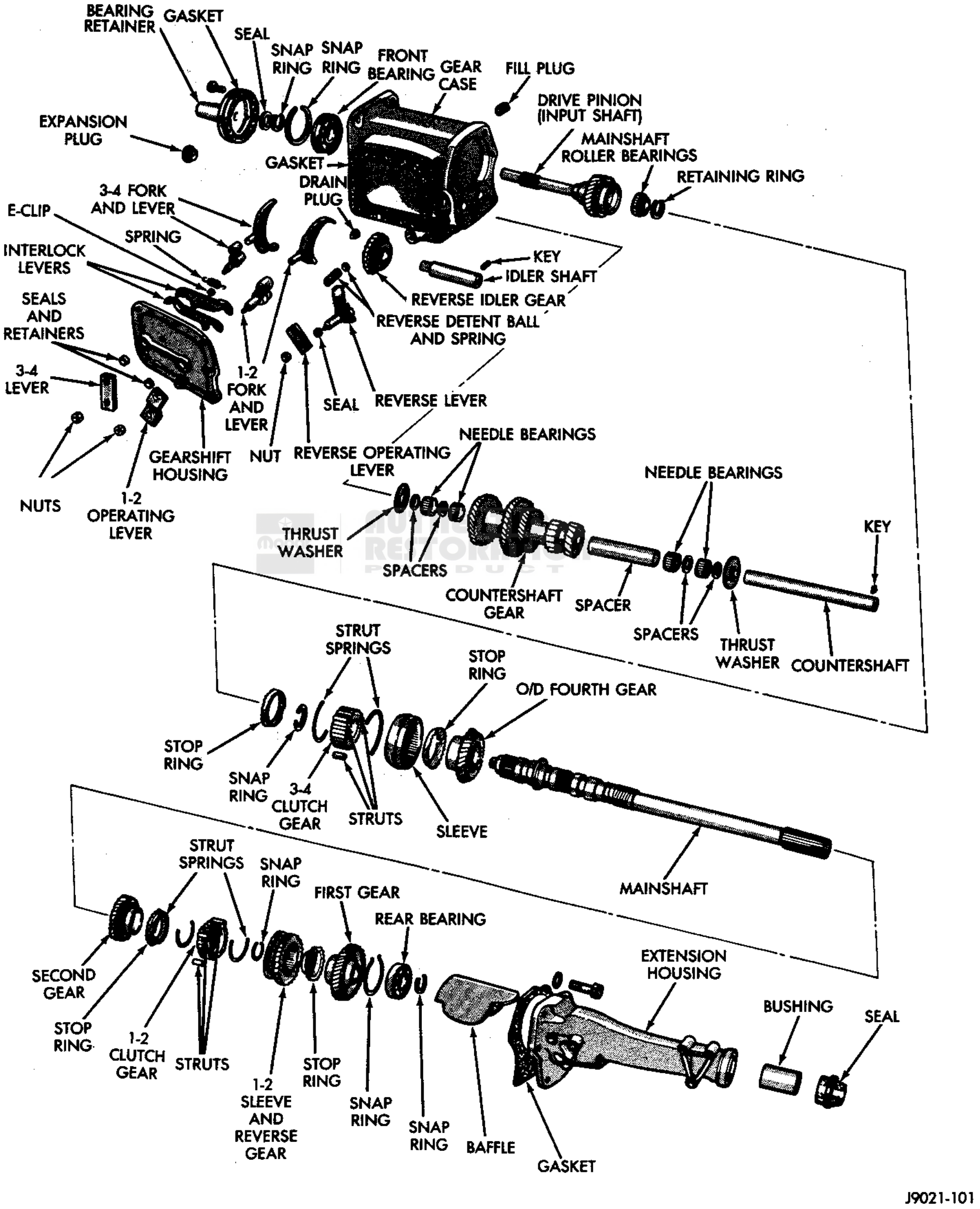

Fig. 3 Overdrive-4 Transmission Components

EXTENSION HOUSING/MAINSHAFT/DRIVE PINION REMOVAL

(1) Remove bolts attaching extension housing to transmission case.

(2) Rotate extension housing to expose rear of countershaft (Fig. 4). Reinstall one of the housing bolts to hold it in position.

(3) Centerpunch or drill a hole in the countershaft expansion plug at front of case.

(4) Reach through hole in expansion plug and push countershaft rearward until the shaft Woodruff key is exposed. Then remove the key.

(5) Push countershaft forward against expansion plug. Then tap shaft forward until it drives expansion plug out front of case.

(6) Insert arbor tool C-3938 through front of case and into countershaft gear. Remove countershaft as arbor tool pushes shaft out rear of case.

(7) Lower countershaft gear to bottom of case. Keep countershaft gear thrust washers in position if possible.

(8) Remove bolt holding extension housing and rotate housing back to normal position.

(9) Remove drive pinion bearing retainer bolts and remove retainer and gasket. Discard the gasket.

(10) Remove oil seal from retainer with pry tool. To avoid leakage around new seal, do not nick or scratch seal bore in retainer or surface on which seal bottoms.

(11) Tap drive pinion and bearing out front of case with brass drift.

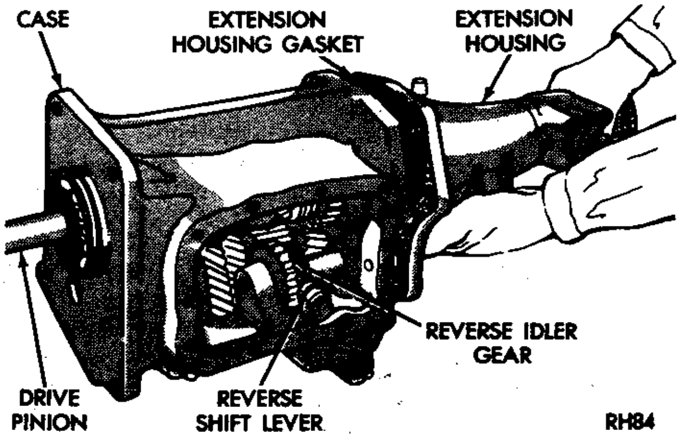

Fig. 5 Removing/Installing Extension Housing And Mainshaft

(12) Slide third and overdrive (O/D) synchronizer sleeve slightly forward.

(13) Slide reverse idler gear to center of gear shaft.

(14) Tap extension housing rearward with plastic mallet until mainshaft rear bearing is free of case.

(15) Remove extension housing and mainshaft as assembly (Fig. 5).

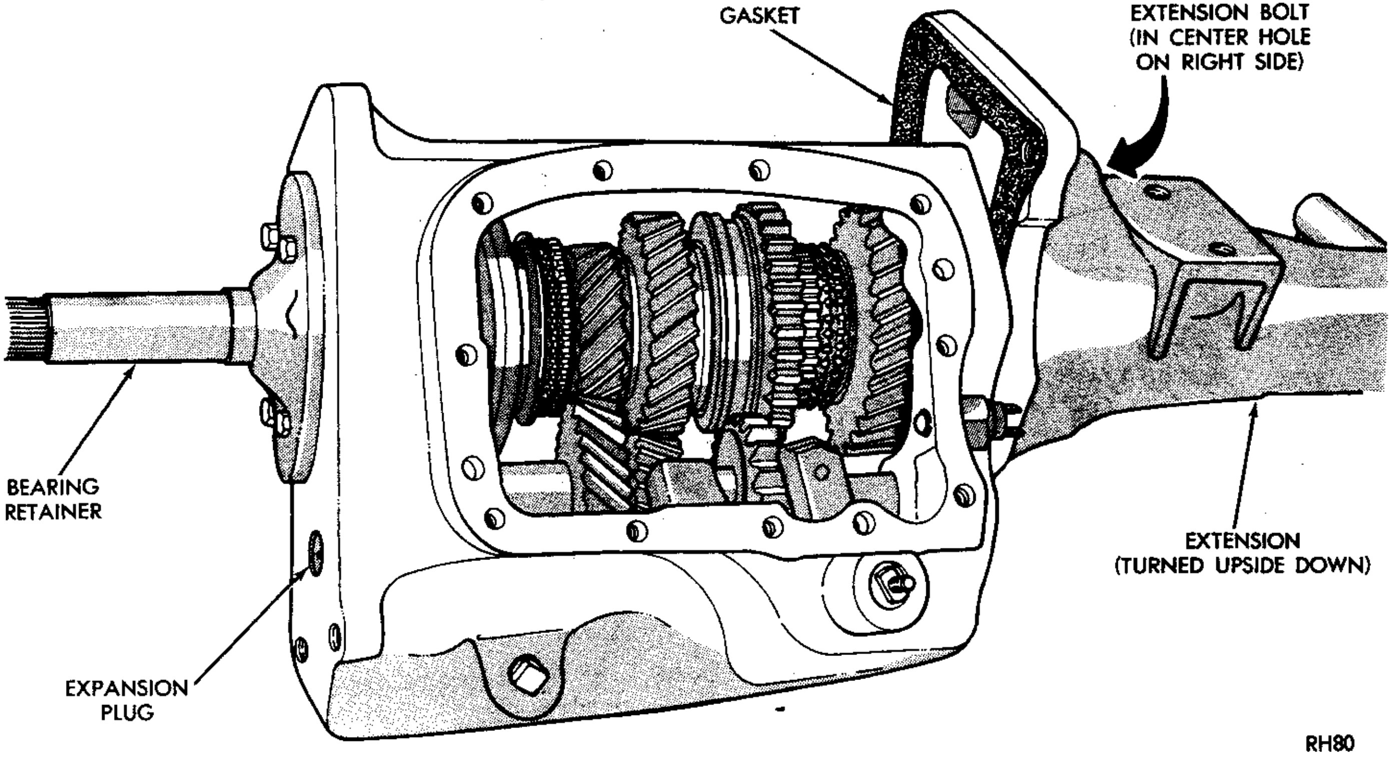

Fig. 4 Rotating Extension Housing For Access To Countershaft

MAINSHAFT DISASSEMBLY

(1) Refer to Figure 6 for location of various gears, synchronizer sleeves and clutches before disassembling mainshaft.

(2) Remove snap ring that retains geartrain on mainshaft (Fig. 7).

(3) Remove O/D stop ring from mainshaft (Fig. 6).

(4) Remove and inspect 3rd and O/D synchronizer clutch gear and sleeve assembly from mainshaft (Fig. 7). **Do not disassemble clutch gear, sleeve, shift struts, or springs unless inspection indicates replacement part is required.**

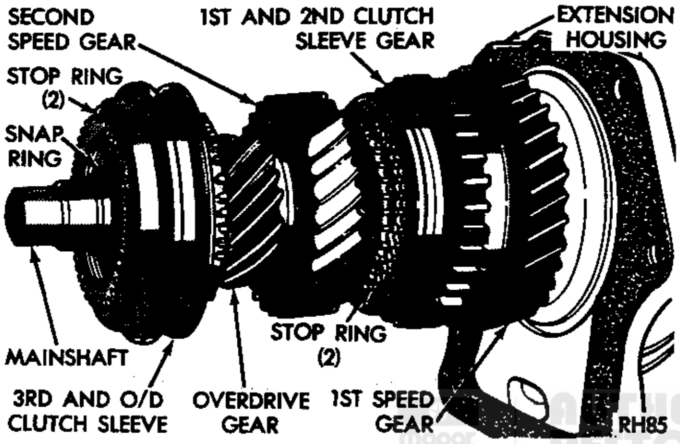

Fig. 6 Mainshaft Gear Identification

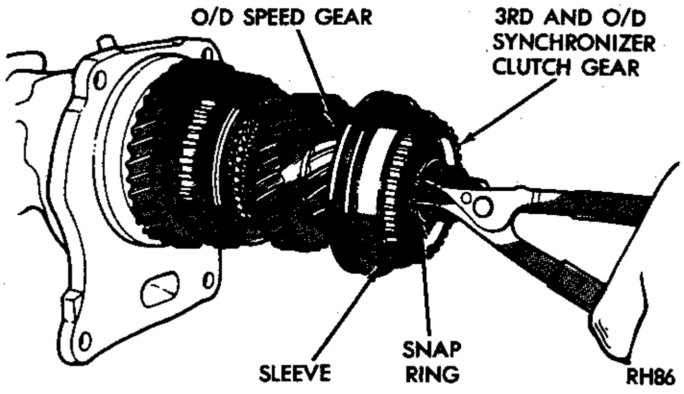

Fig. 7 Removing/Installing Mainshaft Geartrain Snap Ring

(5) Compress mainshaft rear bearing snap ring with long nose pliers (Fig. 8).

(6) Hold rear bearing snap ring in compressed position and pull mainshaft and bearing out of extension housing (Fig. 9).

(7) Remove mainshaft rear bearing snap ring (Fig. 10).

(8) Remove rear bearing from mainshaft with steel plates (or bearing splitter) and shop press. Insert steel plates on front side of 1st speed gear and press mainshaft through and out of rear bearing. Do not damage gear teeth when removing bearing.

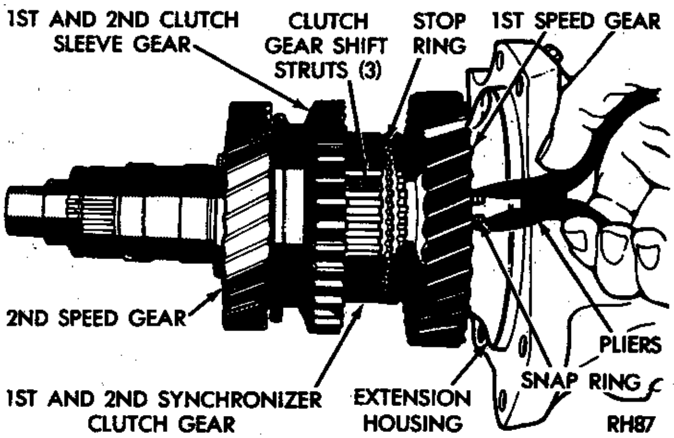

Fig. 8 Compressing Mainshaft Rear Bearing Snap Ring

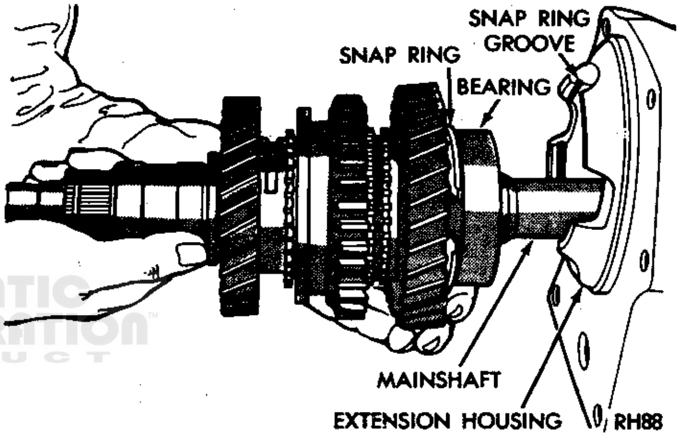

Fig. 9 Removing/Installing Mainshaft

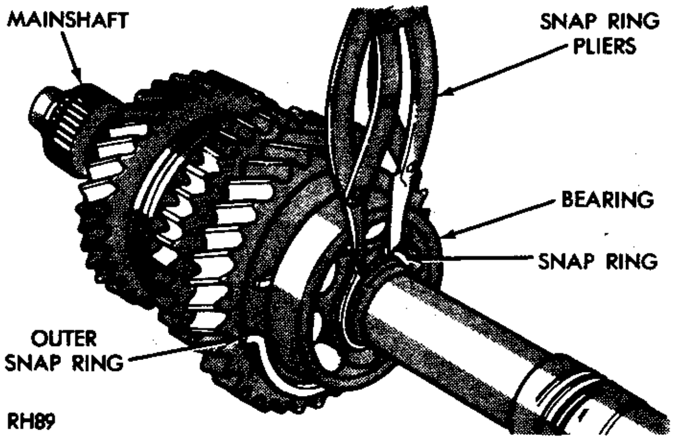

Fig. 10 Removing/Installing Rear Bearing Snap Ring

(9) Remove rear bearing, bearing snap ring, 1st gear and 1st gear stop ring from mainshaft.

(10) Remove snap ring that retains 1st and 2nd clutch gear and sleeve assembly on mainshaft (Fig. 11).

(11) Remove 2nd speed gear (Fig. 11).

(12) Remove and inspect 1st and 2nd clutch gear and sleeve assembly from mainshaft. **Do not disas-**

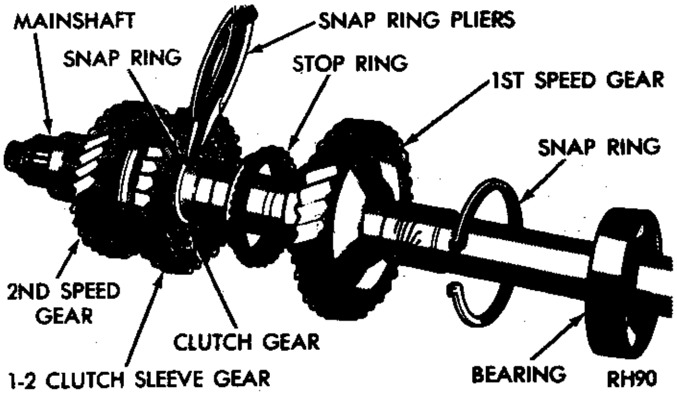

Fig. 11 Removing/Installing 1-2 Clutch Gear And Snap Ring

semble components parts unless inspection indicates replacement part is required.

DRIVE PINION/COUNTERSHAFT GEAR DISASSEMBLY

(1) Remove snap ring that retains drive pinion bearing to pinion shaft.

(2) Remove pinion bearing with shop press and press plates or bearing remover tool.

(3) Remove pilot bearing snap ring and remove 16 bearing rollers from bore in drive pinion.

(4) Remove countershaft gear and thrust washers from bottom of case.

(5) Remove arbor tool from countershaft gear. Then remove needle bearings, thrust washers and spacers from gear. Total of 76 needle bearings are used.

REVERSE GEAR/SHAFT/LEVER/FORK REMOVAL

The reverse idler gear shaft is an extremely tight fit in the case. To avoid damaging the shaft or the case, remove the shaft only as described in the following procedure. Power steering wormshaft seal remover tool C-3638 and a 7/16 socket are required for shaft removal.

(1) Remove backup lamp switch.

(2) Place 7/16 socket (1/4 or 3/8 inch drive) on end of power steering wormshaft seal remover tool C-3638 (Fig. 12).

(3) Position tool in case with 7/16 socket against end of shaft and opposite end of tool against case (Fig. 12).

(4) Turn screw of tool of tool C-3638 to press shaft out of case. If shaft does not come all the way out of case, use a 7/16 deep socket and/or a 3 inch extension to press shaft completely out of case.

(5) Remove reverse idler gear from case and remove woodruff key from idler gear shaft.

(6) Following steps need only be performed if oil leakage around reverse lever shaft was noted (Fig. 12).

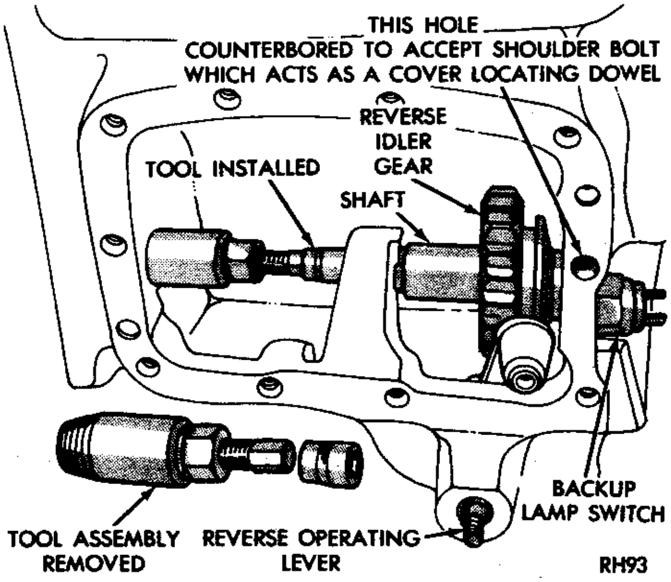

Fig. 12 Removing Reverse Idler Gear Shaft

(7) Remove any burrs from reverse lever shaft to avoid damaging case bore.

(8) Carefully push reverse lever shaft inward and remove it from case.

(9) Remove shaft seal and seal retainer from case bore.

CLEANING AND INSPECTION

Clean the transmission case thoroughly with solvent. Dry the case and gears with compressed air but **do not** use compressed air on any of the bearings. Allow the bearings to air dry or wipe them dry with clean shop towels.

The magnetic disc at the bottom of the case can be removed for cleaning by prying off the magnet retaining clip. After cleaning the magnetic disc with a clean cloth, the disc and retaining clip can be reinstalled by pressing the clip onto the rib in the case.

Transmission Case

Inspect the case for cracks, stripped bolt threads, or damaged gasket mating surfaces. Check the gasket and machined surfaces for severe scoring, cracks, nicks, or any condition that would render the case unfit for further service. The front mating surface should be smooth. Minor scratches, burrs or nicks can be reduced with sandaper or a fine tooth mill file. If any bolt threads are stripped, install Helicoil, or equivalent, thread inserts.

Mainshaft

Inspect the mainshaft gear and bearing surfaces (Fig. 13). Check for signs of wear, scoring, or any condition that would not allow the shaft to be reused. Be sure the snap ring grooves in the shaft are in good condition. if the grooves are worn, or damaged, replace the shaft. Do not attempt to reuse it.

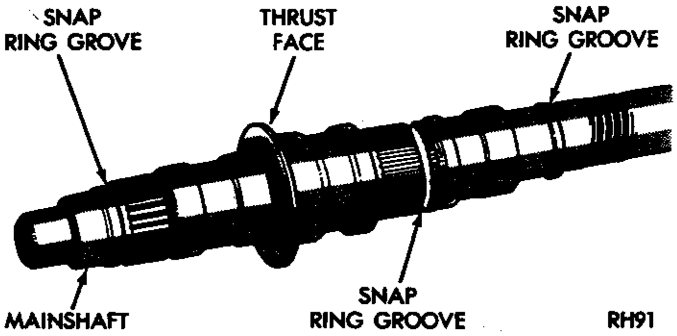

Fig. 13 Mainshaft Snap Ring And Thrust Surfaces

Bearings/Thrust Washers

Inspect the roller, ball and needle bearings. Be sure the bearings are clean and dry before inspection. Replace any bearing that is rough, corroded, brinnelled, galled, worn, or scored. Lubricate the bearings with engine oil after inspection.

Check condition of the countershaft gear thrust washers. replace the washers if cracked, worn, or damaged in any way.

Gears

Inspect all of the transmission gears for worn, broken, chipped teeth. Replace gears as necessary. Minor nicks or burrs on gear teeth can be dressed off with an oilstone.

Inspect the teeth and splines on the drive pinion. If either are excessively worn, or are broken or chipped, a new pinion should be installed. If the oil seal contact area on the pinion is pitted, rusted, or scratched, a new pinion should be installed to preserve the oil seal and prevent clutch contamination.

Levers/Forks/Gearshift Housing

Inspect the interlock levers, shift forks, operating levers and shafts. Be sure these parts are free of distortion, or cracks at the detent and clearance notches and at each end of levers. Check the shift forks for wear on the pads and shafts. Replace components exhibiting damage or excessive wear.

Inspect the shaft bores in the gearshift housing. Be sure the bores are free of burrs. The seal surfaces of the housing must be in good condition and not damaged in any way. Verify that the operating lever shafts fit smoothly and are bind-free.

Synchronizer Components

Inspect the splines and teeth on the synchronizer clutch gears and sleeves. If there is evidence of chipping or excessively worn teeth, install new parts at reassembly. Be sure each clutch sleeve slides easily on the clutch gear.

Synchronizer springs should be in place with the tang inside the cavity of one strut and should not show signs of interference with the polished gear cones or inside diameters of the clutch gears.

Inspect the stop rings for cracks and wear. If rings are cracked or show signs of extreme wear on threaded bore, install new rings at reassembly. Test new rings for good fit on gear cones with minimum wobble. Check synchronizer struts for wear or breakage.

Synchronizers are to be serviced as an assembly. Except for stop rings, synchronizer parts should not be interchanged.

TRANSMISSION ASSEMBLY

REVERSE GEAR/SHAFT/LEVER/FORK INSTALLATION

(1) Install reverse lever in case bore.

(2) Lubricate new lever shaft oil seal with petroleum jelly and install seal in and seal retainer in case bore.

(3) Insert reverse idler gear shaft in end of case. Tap idler shaft into case far enough to permit installation of reverse idler gear on shaft.

(4) Align reverse lever in slot of reverse idler gear and slide gear onto shaft. **Be sure lever slot in gear is toward rear of case.**

(5) Align woodruff key slots in case and idler gear shaft and tap shaft 3/4 of way into case. Then insert woodruff key in shaft and tap shaft inward until shaft is flush with case surface.

(6) Install backup lamp switch and gasket. Tighten switch to 20 N•m (15 ft-lbs) torque.

COUNTERSHAFT GEAR/DRIVE PINION INSTALLATION

(1) Coat bore of countershaft gear at each end with petroleum jelly and install bearing spacer and arbor tool C-3938 in bore. Be sure to center spacer and arbor in gear as shown (Fig. 14).

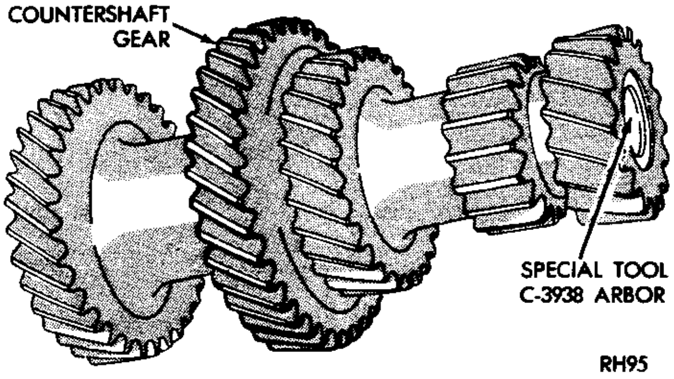

Fig. 14 Arbor Tool Centered In Countershaft Gear

(2) Coat the countershaft needle bearing rollers, spacers and thrust washers with petroleum jelly.

(3) Install first set of 19 bearing rollers on each end of countershaft (Fig. 3). Then install a bearing spacer on each end of shaft. Seat spacers against bearing rollers.

(4) Install second set of 19 bearing rollers on each end of countershaft. Then install remaining bearing spacers on each end of shaft (Fig. 3).

(5) Install thrust washers on ends of countershaft (Fig. 3). Extra petroleum jelly applied to thrust washers will hold them in place during installation.

(6) Position countershaft gear assembly in case (Fig. 15). Allow gear assembly to rest at bottom of case. **Be sure thrust washers stay in position.**

(7) Verify gear alignment (Fig. 16). Be sure reverse idler gear will not interfere with movement of countershaft gear. Also be sure countershaft gear thrust washers are still in place.

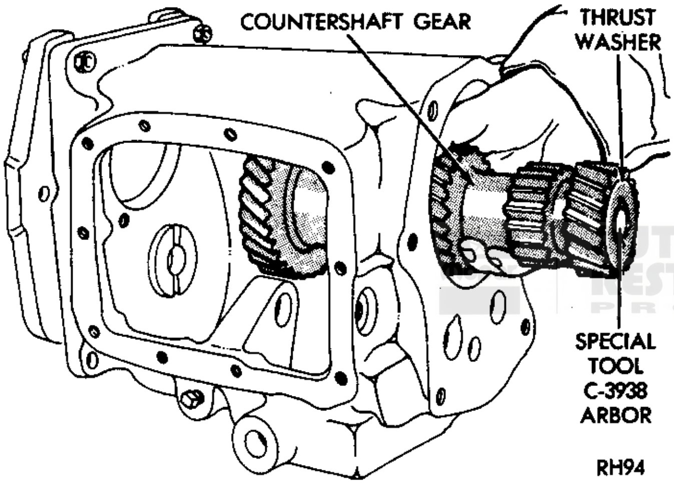

Fig. 15 Positioning Countershaft Gear In Case

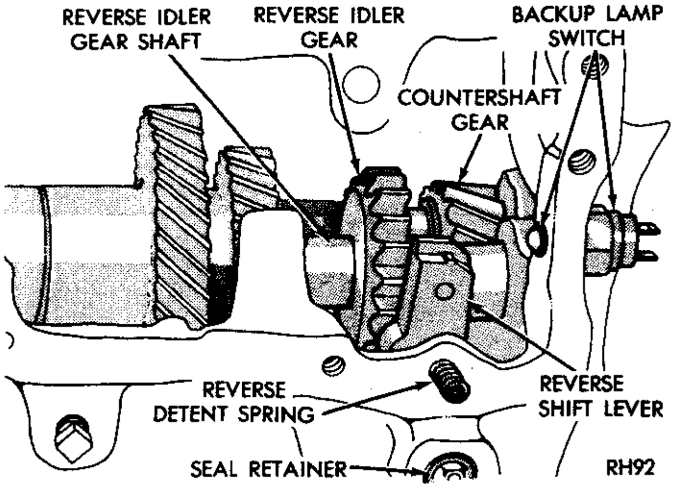

Fig. 16 Gear, Shaft And Lever Placement

(8) Install outer snap ring on drive pinion bearing. Then press bearing onto drive pinion. Be sure snap ring groove in bearing is facing toward front (Fig. 17). Seat bearing fully against shoulder on pinion.

(9) Secure bearing on pinion shaft with new inner snap ring. Be sure snap ring is fully seated. This snap ring is a select fit for minimum end play.

(10) Lubricate mainshaft pilot roller bearings with generous quantity of petroleum jelly and install rollers in drive pinion (Fig. 17).

(11) Secure pilot roller bearings in drive pinion with new snap ring (Fig. 17).

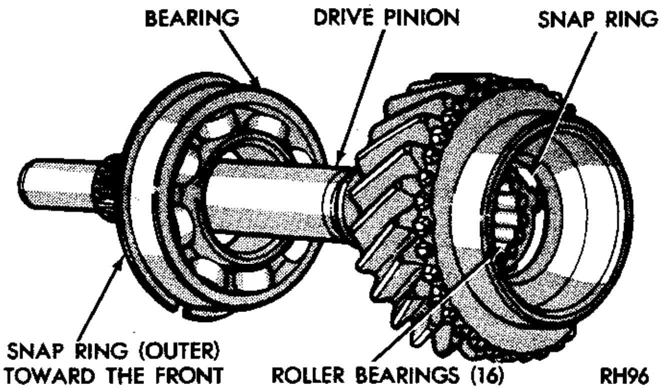

Fig. 17 Installing Drive Pinion Bearings

(12) Install new oil seal in bearing retainer with tool C-3789 (Fig. 18).

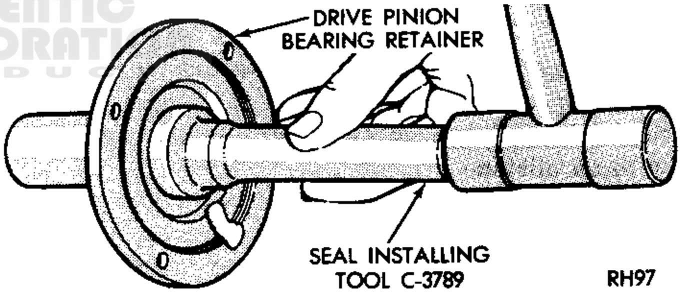

Fig. 18 Installing Bearing Retainer Oil Seal

EXTENSION HOUSING BUSHING REPLACEMENT

(1) Remove extension housing yoke seal.

(2) Drive old bushing out of housing with tool C-3974 (Fig. 19).

(3) Slide new bushing on installing end of tool C-3974.

(4) Align oil hole in bushing with oil slot in extension housing and drive new bushing into place (Fig. 19).

(5) Position new seal in extension housing and drive seal into housing with tool C-3972.

SYNCHRONIZER ASSEMBLY

(1) Assemble 1-2 and 3rd-O/D synchronizer parts in order shown (Figs. 20 and 21):

(2) Place a stop ring flat on bench. Then place clutch gear on ring and install sleeve over clutch gear.

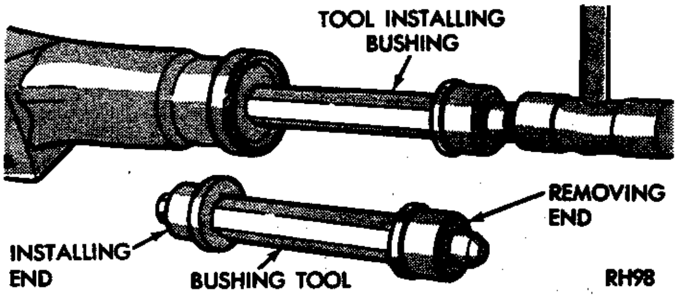

Fig. 19 Replacing Extension Housing Bushing

(3) Drop struts in clutch gear slots and snap in first strut spring. Place one tang of spring inside one of the struts.

(4) Turn assembly over and position it on remaining stop ring.

(5) Install second strut spring. Place one tang of second spring inside a different strut.

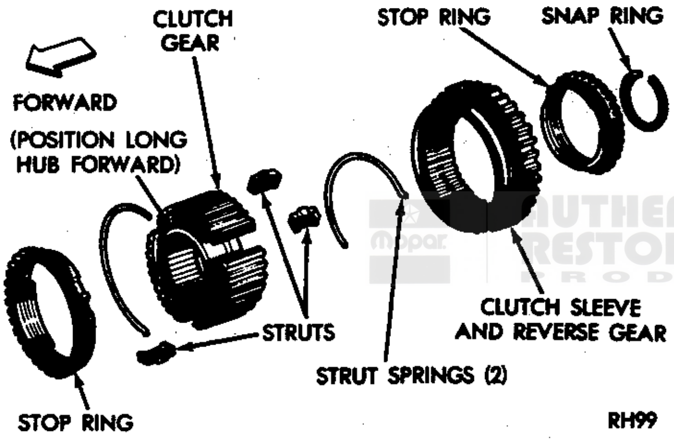

Fig. 20 First-Second Synchronizer Components

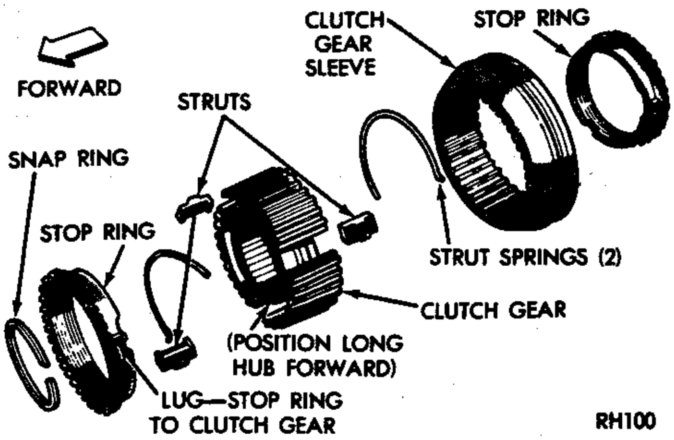

Fig. 21 Third-O/D Synchronizer Components

MAINSHAFT/EXTENSION HOUSING ASSEMBLY AND INSTALLATION

(1) Install second speed gear onto mainshaft (with synchronizer cone toward rear) and against shoulder on shaft (Fig. 11).

(2) Install 1-2 synchronizer assembly onto mainshaft and against second speed gear. Be sure front stop ring lugs are indexed in clutch gear (Fig. 20).

(3) Install new 1-2 clutch gear retaining snap ring (Fig. 11).

(4) Install rear stop ring in 1-2 synchronizer clutch gear. Be sure stop ring lugs are indexed in clutch gear.

(5) Install first speed gear on mainshaft with synchronizer cone of gear facing clutch gear and sleeve (Fig. 11).

(6) Position mainshaft rear bearing outer snap ring on mainshaft (Fig. 10).

(7) Press rear bearing onto mainshaft. Secure bearing on shaft with new snap ring (Fig. 10). This snap ring is a select fit for minimum end play.

(8) Install partially assembled mainshaft into extension housing far enough to engage bearing outer snap ring in slot in housing snap ring groove (Fig. 9).

(9) Compress outer snap ring with pliers (Fig. 8). Then push mainshaft into housing until rear bearing bottoms against thrust shoulder in housing.

(10) Release rear bearing outer snap ring and fully seat it in extension housing groove (Fig. 8).

(11) Install overdrive gear onto front of mainshaft with synchronizer cone facing front.

(12) Install overdrive gear stop ring.

(13) Install third-overdrive synchronizer assembly on mainshaft and against overdrive gear. Be sure shift fork slot in synchronizer sleeve is toward rear and that stop ring lugs are indexed in clutch gear and sleeve.

(14) Install new geartrain retaining snap ring on mainshaft (Fig. 7).

(15) Coat remaining stop ring with petroleum jelly and install it in third-overdrive sleeve and gear. Be sure stop ring is indexed in clutch gear and sleeve.

(16) Coat new extension housing gasket with all purpose chassis grease and position it on housing.

(17) Slide reverse idler gear to center of shaft and move third-overdrive synchronizer sleeve as far forward as possible but do not dislodge the struts. This is necessary to provide installation clearance for the mainshaft.

(18) Insert mainshaft assembly into transmission case (Fig. 5). Tilt assembly as required to clear idler and cluster gears.

(19) Place third-overdrive synchronizer sleeve in neutral position.

(20) Rotate extension housing on mainshaft for access to rear of countershaft (Fig. 4). Install one housing bolt to hold housing in position and prevent it from moving rearward.

DRIVE PINION/COUNTERSHAFT INSTALLATION

(1) Insert drive pinion assembly through front of case.

(2) Align pinion and mainshaft and push or tap pinion into place. If mainshaft is properly seated in pinion roller bearings, pinion bearing outer snap ring will seat flush with front face of transmission case. If components are misaligned, check to see if a strut, pinion roller, or stop ring is out of position.

(3) Hold countershaft gear in place and turn transmission upside down.

(4) Lower countershaft gear until gear teeth mesh with drive pinion gear and mainshaft gears. **Make sure countershaft gear thrust washers and bearing spacers are still in position on arbor tool.**

(5) Rotate countershaft gear thrust washers until washer tangs are aligned with slots in case.

(6) Start countershaft into bore at rear of case. Then push shaft forward until shaft is approximately half way into case and gear.

(7) Install woodruff key in countershaft and push shaft all way into gear and case. Be sure shaft is flush with rear of case face. Remove arbor tool after shaft installation.

(8) Remove holding bolt and rotate extension housing into proper alignment with the case.

(9) Install and tighten extension housing bolts to 68 N•m (50 ft-lbs) torque.

(10) Rotate transmission assembly to normal position.

(11) Install bearing retainer and new gasket. Coat threads of retainer bolts with sealing compound before installation. Then install and tighten bolts to 41 N•m (30 ft-lbs) torque.

(12) Install new expansion plug in countershaft bore at front of case.

GEARSHIFT HOUSING ASSEMBLY AND INSTALLATION (FIGS. 22 AND 23)

(1) Install interlock levers on pivot pin and secure with E-clip (Fig. 22).

(2) Install interlock spring on levers with pliers (Fig. 23).

(3) Lubricate shift lever shafts, reverse lever and new shaft oil seals with petroleum jelly.

(4) Install shift lever shafts and reverse lever in housing bores (Fig. 22).

(5) Install new oil seals and seal retainers over shafts and into housing bores (Fig. 22).

(6) Install operating levers on shift levers and tighten lever retaining nuts to 24 N•m (18 ft-lbs) torque. **Be sure third-overdrive lever points downward.**

(7) Rotate shift levers to Neutral position (straight up).

(8) Install third-overdrive shift fork in shift lever and under both interlock levers.

(9) Check installed position of interlock levers and spring (Fig. 23).

(10) Position 1-2 and third-overdrive synchronizer sleeves and reverse idler gear in Neutral position.

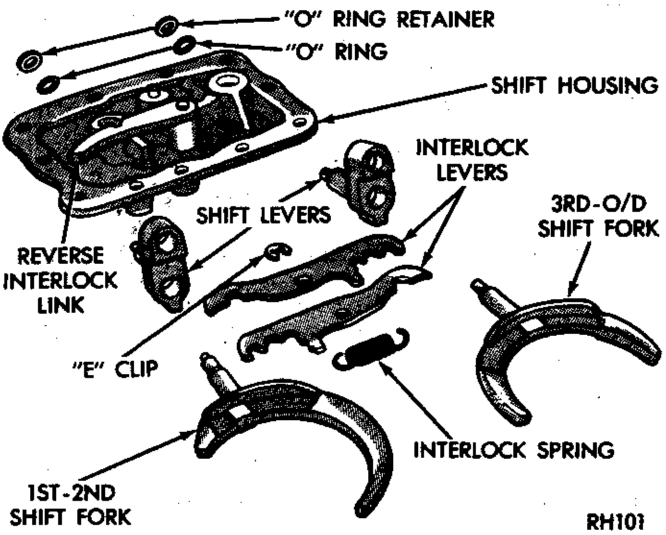

Fig. 22 Gearshift Housing Components

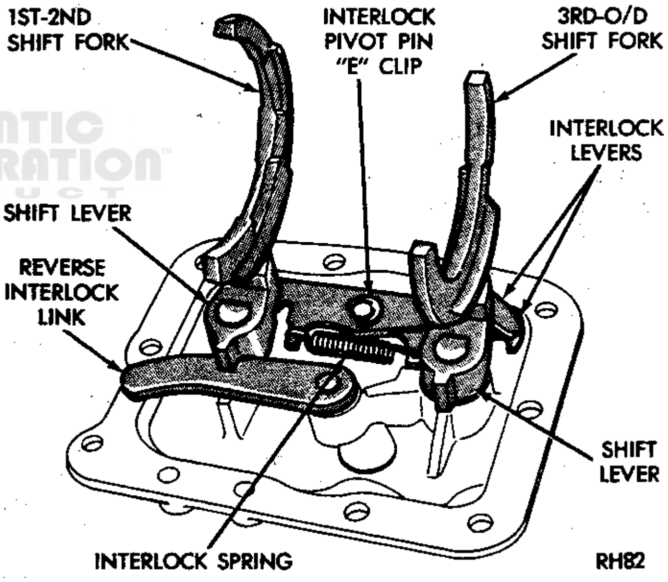

Fig. 23 Gearshift Housing Component Position

(11) Place 1-2 shift fork in groove of 1-2 synchronizer sleeve.

(12) Place transmission on right side.

(13) Coat new gearshift housing gasket with petroleum jelly and position gasket on transmission. Use additional petroleum jelly to hold gasket in position if necessary.

(14) Install reverse detent ball and detent spring in side of case (Fig. 16).

(15) Install gearshift housing assembly. Guide third-overdrive shift fork into groove of synchronizer sleeve and guide shaft of 1-2 shift fork into bore of 1-2 shift lever in housing. Hold reverse interlock link against 1-2 shift lever for clearance as housing is lowered into place.

(16) Before seating housing on transmission, use a screwdriver to lift interlock lever to allow 1-2 shift fork to slip under interlock levers.

(17) Verify that reverse detent spring is positioned in cover bore. Then seat gearshift housing on case gasket.

(18) Install gearshift housing bolts finger tight and shift through all gears to insure proper operation.

(19) Check housing bolt installation before final tightening. Eight housing bolts are shoulder-type bolts for locating housing on transmission; remaining bolts are standard. One bolt has longer shoulder to serve as locating dowel. This bolt passes through cover and into transmission case at center or rear flange. Tighten all bolts evenly to 20 N•m (15 ft-lbs) torque.

(20) Lubricate end of reverse shaft and install operating lever and nut. Tighten lever to 24 N•m (18 ft-lbs) torque.

(21) Shift the transmission into each gear to insure correct shift travel and smooth action.

(22) Install speedometer drive pinion gear and adapter being sure range number (representing number of teeth on pinion gear), is in 6 o-clock position.

TRANSMISSION INSTALLATION

(1) Lubricate pilot bushing in crankshaft with Mopar high temperature grease, or equivalent. Pilot bushing requires grease which will stay in place during high temperature operation. Use recommended grease only.

(2) Apply thin coat of Mopar multipurpose, high temperature grease on drive pinion splines and on release bearing slide surface of front bearing retainer. **Do not lubricate end of pinion shaft, clutch disc splines, or clutch release levers.**

(3) Mount transmission on jack and move it under vehicle.

(4) Raise transmission and center transmission drive pinion with clutch housing bore.

(5) Roll transmission slowly forward until drive pinion enters clutch disc. With transmission in gear, turn output shaft until splines are aligned.

(6) Push transmission forward, seat it against clutch housing and install transmission attaching bolts. Tighten bolts to 68 N•m (50 ft-lbs) torque.

(7) Remove transmission jack.

(8) Align crossmember bolt holes with drift and install attaching bolts. Tighten bolts to 41 N•m (30 ft-lbs) torque.

(9) Remove engine support fixture.

(10) Install and tighten extension housing-to-insulator bolts to 33 N•m (24 ft-lbs) torque.

(11) Install floor gearshift assembly and connect shift rods.

(12) Connect backup lamp switch wires.

(13) Install distance sensor on speedometer adapter and connect sensor wires.

(14) Align and install propeller shaft.

(15) Fill transmission with recommended lubricant.

(16) Lower vehicle.

(17) Install gearshift lever and console, if equipped.

(18) Verify proper transmission shifting. Adjust linkage if necessary.

NP2500 MANUAL TRANSMISSION

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GENERAL INFORMATION

COMPONENT DESCRIPTION AND APPLICATION

The NP2500 (Fig. 1) is a fully-synchronized, five-speed manual transmission. The transmission is designed primarily for light duty applications and incorporates an overdrive fifth gear range for improved highway fuel economy.

The light weight, die cast aluminum case and extension contain a full helical gear set, including reverse. Durability improvement items include: tapered roller bearings on the countershaft gear, caged needle bearings on first and reverse speed gears, and sealed ball bearings on the mainshaft and input shaft.

A new single unit top mounted shifter and three rail shift mechanism optimize shift effort and quality. Reverse gear is a constant mesh design which allows reverse gear to be located directly behind overdrive gear in the shift pattern. A reverse blocker is incorporated to prevent accidental shifts from overdrive to reverse.

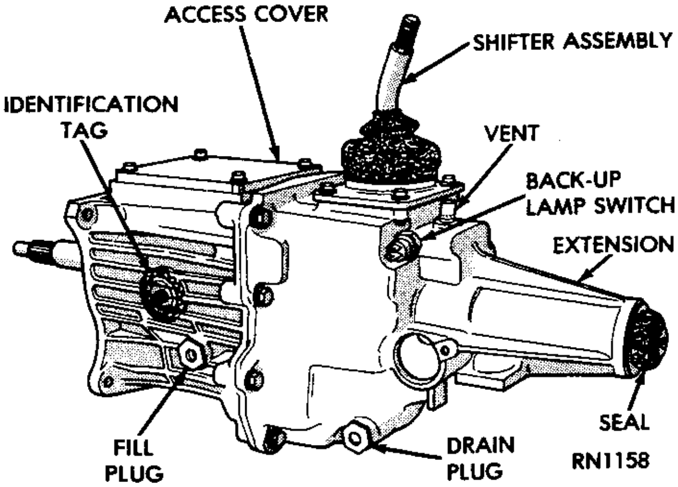

Fig. 1 NP2500 5-Speed Manual Transmission

RECOMMENDED LUBRICANT

Recommended lubricant for the NP2500 is SAE 10W-30 engine oil, API classification SG/CD. This lubricant is used for improved durability and quiet operation.

Lubricant drain and refill intervals are outlined in Group O, Lubrication and Maintenance.

SERVICE DIAGNOSIS

The majority of transmission malfunctions are caused by insufficient lubricant, incorrect lubricant, misadjusted or damaged internal components, loose attaching parts, or improper operation.

HARD SHIFTING

A low lubricant level, damaged linkage, or worn, damaged internal shift components are the most common causes of hard shifting. If hard shifting is also accompanied by gear clash, synchronizer components may be worn or damaged.

Hard shifting may also be caused by a loose, or misaligned shift housing. Either fault can result in component bind and high shift efforts.

NOISY OPERATION

Transmission noise is most often a result of worn or damaged components. Chipped, broken gear or synchronizer teeth and brinnelled, spalled bearings all cause noise. Abnormal wear and damage to internal components is frequently the end result of insufficient lubricant, non-recommended lubricants, or improper operation.

SLIPS OUT OF GEAR

Transmission disengagement may be caused by misaligned or damaged shift components, or worn synchronizer clutch teeth on the mainshaft gears. Incorrect assembly will also contribute to gear disengagement.

LOW LUBRICANT LEVEL

Insufficient transmission lubricant is usually the result of leaks, or inaccurate fluid level check or refill method. Leaks will be evident by the presence of gear oil around the leak point. If leakage is not evident, the condition is probably the result of an underfill condition.

If air powered lubrication equipment is used to fill a transmission, be sure the equipment is properly calibrated. Equipment out of calibration can lead to an underfill condition.

CLUTCH PROBLEMS

Worn, damaged, or misaligned clutch components can cause hard shifting, gear clash and noise.

A worn pilot bushing will cause noise and input shaft misalignment. The result is hard shifting and noise.

A worn or damaged clutch disc, pressure plate, or release bearing can cause hard shifting and gear clash.

Damaged or worn clutch hydraulic components, or leaks in the fluid lines or cylinders will cause hard shifting and gear clash. A major failure of one of the clutch hydraulic cylinders will cause incomplete clutch release or engagement.

Be sure that the clutch components are all in good condition before removing the transmission for repair.

SERVICE IN VEHICLE

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SPEEDOMETER PINION AND ADAPTER SERVICE

Rear axle gear ratio and tire size determines pinion gear usage. If the gear must be replaced, consult the parts catalogue for correct application.

ADAPTER AND PINION REMOVAL

(1) Raise the vehicle and position a drain pan under the speedometer adapter.

(2) Disconnect the wires from the distance sensor (Fig. 2).

(3) Loosen the distance sensor coupling and remove the sensor from the speedometer adapter (Fig. 2).

(4) Remove the bolt and retainer securing the speedometer pinion adapter in the extension housing (Fig. 2).

(5) Carefully work the adapter and pinion out of the extension housing.

(6) Remove and discard the adapter O-ring.

(7) Inspect the adapter. If transmission fluid is found in the coupling section of the adapter housing, the oil seal is leaking and will require replacement. Refer to Adapter Oil Seal Replacement

ADAPTER OIL SEAL REPLACEMENT

(1) Remove the C-shaped lock ring securing the seal in the adapter (Fig. 2).

(2) Remove the old seal from the adapter with a small screwdriver or hooked tool.

(3) Start the new seal in the adapter by hand and insert the lock ring in the adapter.

(4) Seat the seal in the adapter with tool C-4004 (Fig. 3). Press the seal and lock ring into place until the installer tool bottoms.

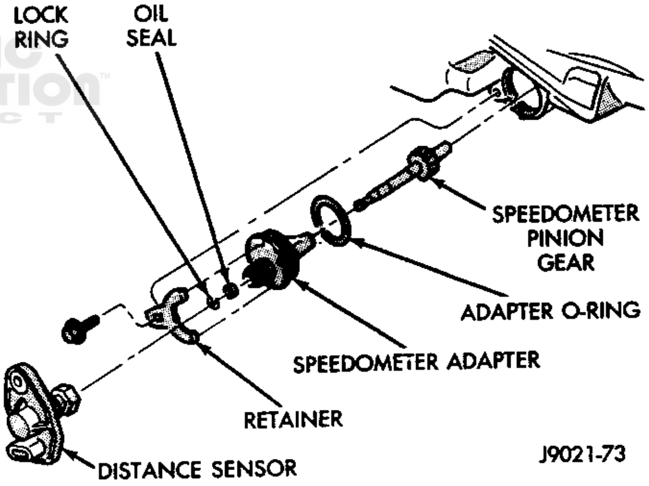

Fig. 2 Speedometer Adapter And Pinion Components

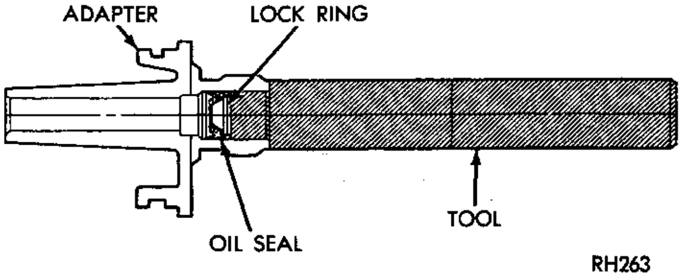

Fig. 3 Installing Adapter Oil Seal And Lock Ring

ADAPTER AND PINION INSTALLATION

CAUTION: Before installing the pinion and adapter assembly make sure the adapter flange and the mating area in the extension housing are perfectly clean. Dirt, sand, or foreign material will cause misalignment resulting in speedometer pinion gear damage.

(1) Thoroughly clean the adapter flange and adapter mounting surface in the extension housing. These surfaces must be clean for proper adapter alignment and speedometer operation.

(2) Install a new O-ring on the adapter.

(3) Lubricate the adapter oil seal and O-ring with transmission fluid.

(4) Count the number of teeth on the pinion gear and install the gear in the adapter. Be sure to count the gear teeth **before** installing the gear.

(5) Note the range numbers on the adapter face (Fig. 4). These numbers correspond to the number of teeth on the speedometer pinion gear.

(6) Insert the adapter in the extension housing.

(7) Rotate the adapter until the required range numbers are at a six o-clock position (Fig. 4). Be sure the adapter range numbers correspond to the number of teeth on the pinion.

(8) Lightly push the adapter all the way into the extension housing.

(9) Install the adapter retainer. Tighten the retainer bolt to 100 in-lbs (11 N•m) torque.

(10) Install the distance sensor on the adapter. Tighten the sensor coupling nut to 150 in-lbs (17 N•m) torque and install the sensor wires.

(11) Check and top off the transmission lubricant level if necessary.

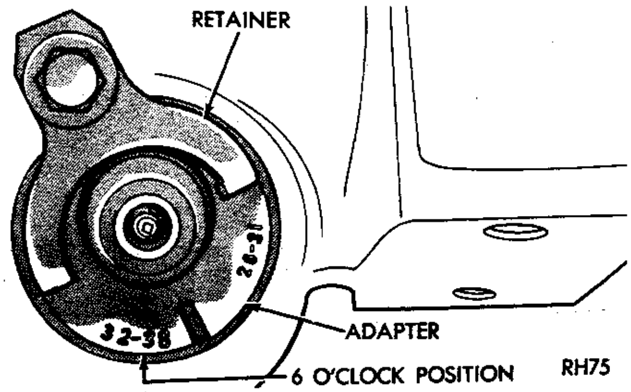

Fig. 4 Indexing Speedometer Adapter

EXTENSION HOUSING YOKE SEAL REPLACEMENT

(1) Raise the vehicle and position a drain pan under the extension housing.

(2) Mark position of the propeller shaft and rear axle yokes for alignment reference.

(3) Disconnect the propeller shaft at the axle yoke and remove the shaft.

(4) Remove the oil seal with tool C-3985 (Fig. 5).

(5) Install the new seal with tool C-3972 (Fig. 6). Start the seal in the housing and tap it into place until the tool bottoms against the housing.

(6) Check condition of the slip yoke surface of the propeller shaft. Reduce minor corrosion, scratches, or nicks with crocus cloth or 400 grit sandpaper. Replace the slip yoke if severely scored or rusted to maintain seal and bushing life.

(7) Align and install the propeller shaft.

(8) Check and top off the transmission lubricant level if necessary. Correct level is to the edge of the fill plug hole. Refer to Group O, Lubrication and Maintenance for lube requirements.

(9) Remove the drain pan and lower the vehicle.

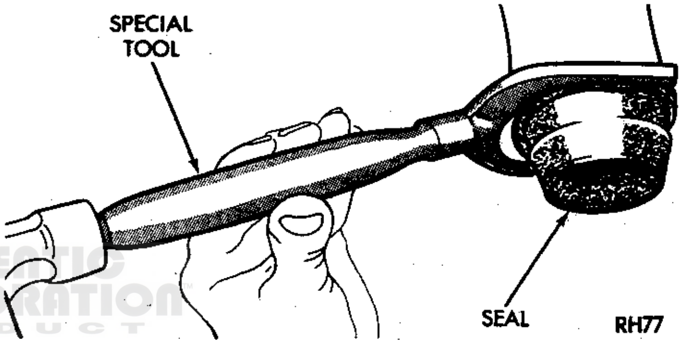

Fig. 5 Removing Yoke Seal

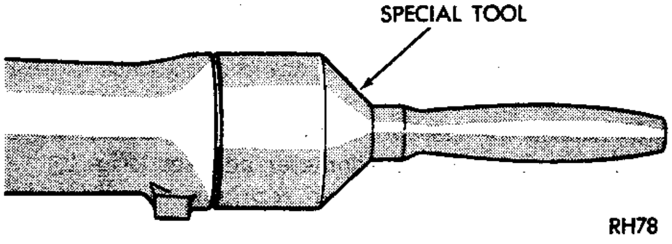

Fig. 6 Installing Yoke Seal

GEARSHIFT LEVER

The gearshift lever is a two-piece design (Fig. 7). The upper part of the lever is threaded to the transmission stub lever. The upper lever can be removed for service without having to remove the entire shift lever assembly or the transmission.

If the upper lever must be serviced, remove the screws attaching the lower boot, support, bezel and insert for access to the lever lower end. Then unthread and remove the upper lever from the stub lever.

TRANSMISSION WIRING HARNESS

The transmission wiring harness is attached to the transmission and clutch housing with clips and tie straps (Fig. 8). If the harness must be replaced, be

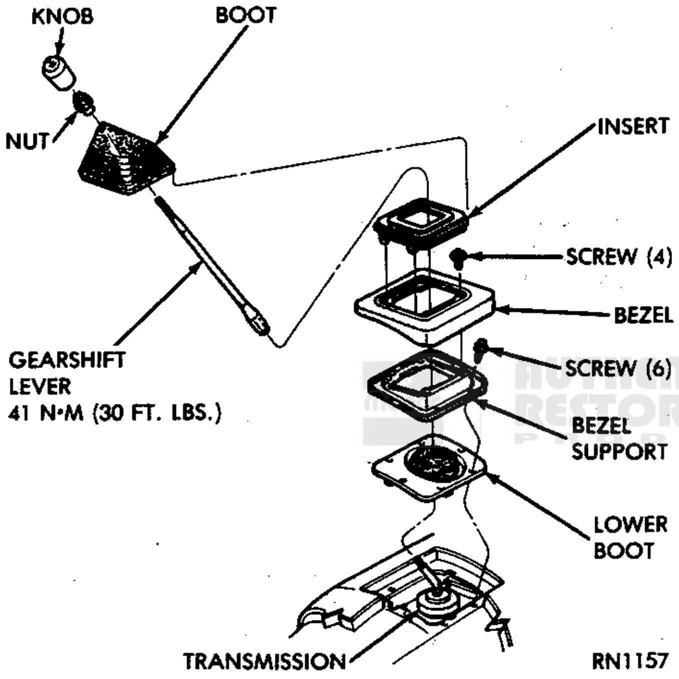

Fig. 7 Gearshift Lever Components

sure to route the harness as shown in the illustration. Do not allow the harness to contact hot or rotating components. Make sure the harness is clear of such components.

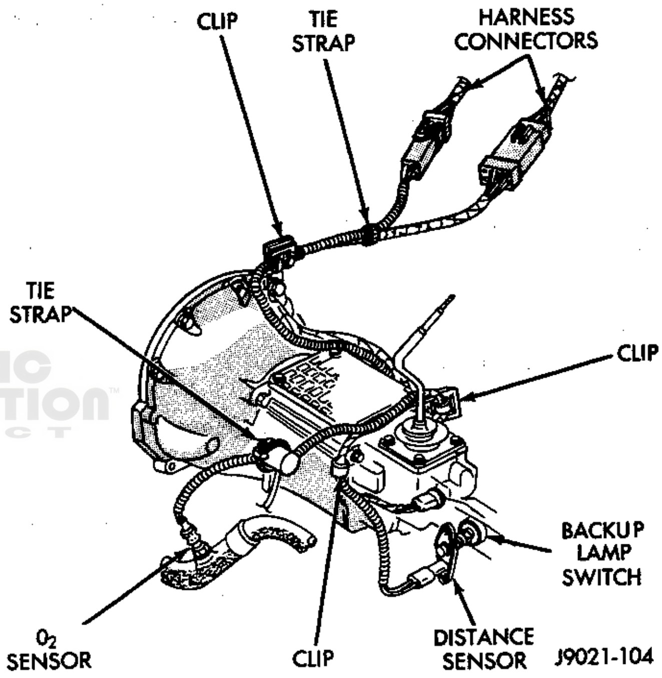

Fig. 8 Transmission Harness Routing

SERVICE OUT OF VEHICLE

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TRANSMISSION REMOVAL

(1) Shift the transmission into Neutral. Then remove the upper shift lever. Refer to procedure in Service In Vehicle section.

(2) Raise the vehicle and drain the transmission lubricant.

(3) Mark the propeller shaft and rear axle yokes for assembly alignment.

(4) Disconnect and remove the propeller shaft.

(5) Disconnect the wires from the distance sensor. Then loosen the sensor coupling and remove the sensor from the speedometer adapter.

(6) Remove the speedometer adapter and pinion gear.

(7) Disconnect the backup lamp switch wires.

(8) Install engine support fixture C-3487-A or a similar device to support the engine. Be sure the support ends are seated on the underside of the oil pan flange.

(9) Raise the engine slightly with the support fixture.

(10) Disconnect the insulator from the extension housing.

(11) Support the transmission with a suitable jack and remove the center crossmember.

(12) Remove the transmission-to-clutch housing bolts.

(13) Slide the transmission rearward until the input shaft clears the clutch disc.

(14) Pull the transmission completely away from the clutch housing and remove the transmission from under the vehicle.

(15) Thoroughly clean the transmission exterior, preferably with steam cleaning equipment.

TRANSMISSION DISASSEMBLY

SHIFTER, EXTENSION HOUSING AND GEAR SET REMOVAL

(1) Remove shifter and stub lever from transmission (Fig. 1).

(2) Pry Shifter plate upward (Fig. 2).

(3) Remove shifter (Fig. 3).

(4) Remove access cover bolts (Fig. 4).

(5) Pry access cover loose (Fig. 5).

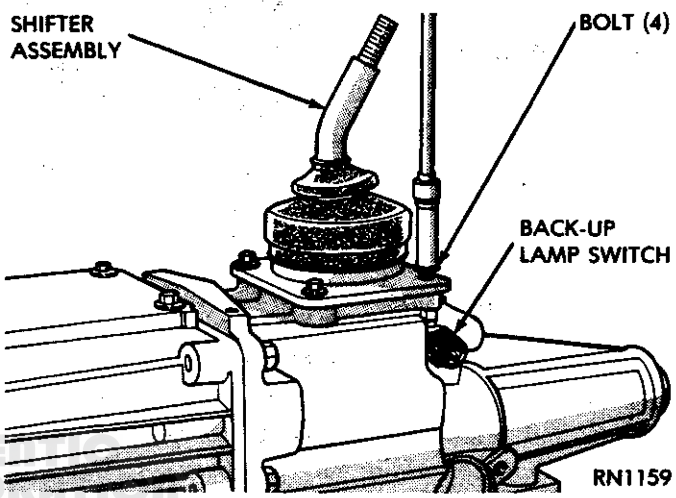

Fig. 1 Removing/Installing Shifter Bolts

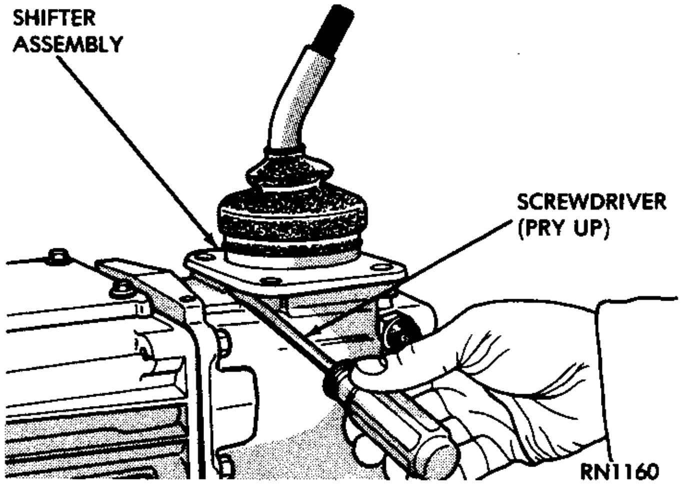

Fig. 2 Prying Shifter Plate loose

(6) Remove access cover (Fig. 6).

(7) Remove detent springs and bullets with magnet (Fig. 7).

(8) Remove extension housing bolts (Fig. 8).

(9) Pry housing loose (Fig. 9).

(10) Remove extension housing (Fig. 10).

(11) Note position of reverse/OD shift rail components (Fig. 11).

(12) Remove shift fork pins (Fig. 12).

(13) Remove interlock plates and 1-2 shift rail (Fig. 13).

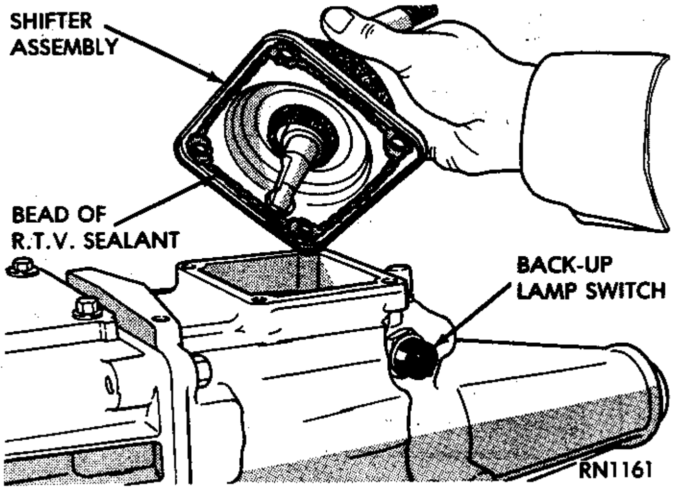

Fig. 3 Removing/Installing Shifter Assembly

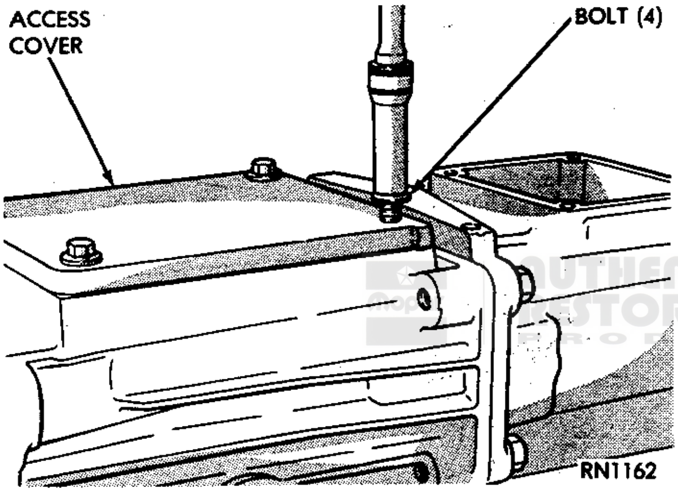

Fig. 4 Removing/Installing Access Cover Bolts

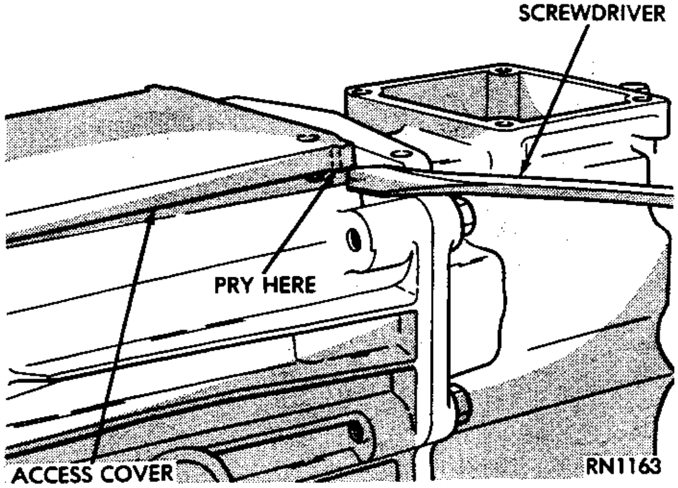

Fig. 5 Prying Access Cover Loose

(14) Remove countershaft OD gear snap ring (Fig. 14).

(15) Note position of OD gear keyway (Fig. 15).

(16) Remove countershaft OD gear with tool C-4982 (Fig. 16).

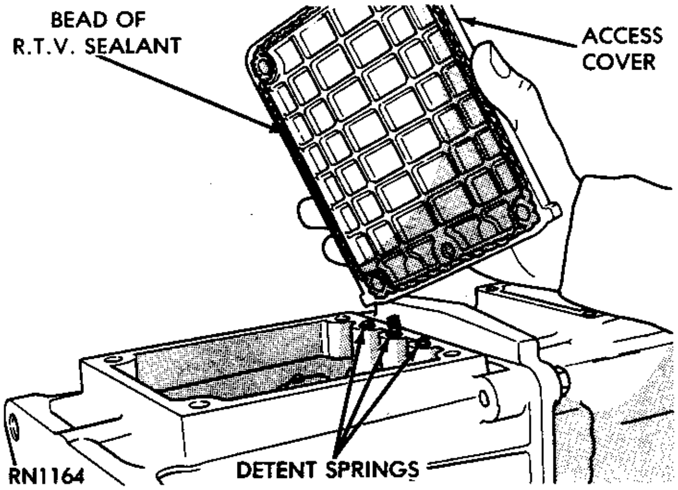

Fig. 6 Removing/Installing Access Cover

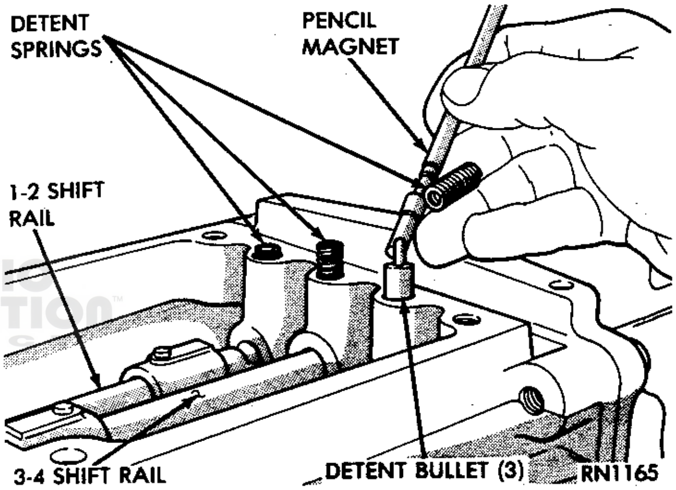

Fig. 7 Removing/Installing Detent Springs And Bullets

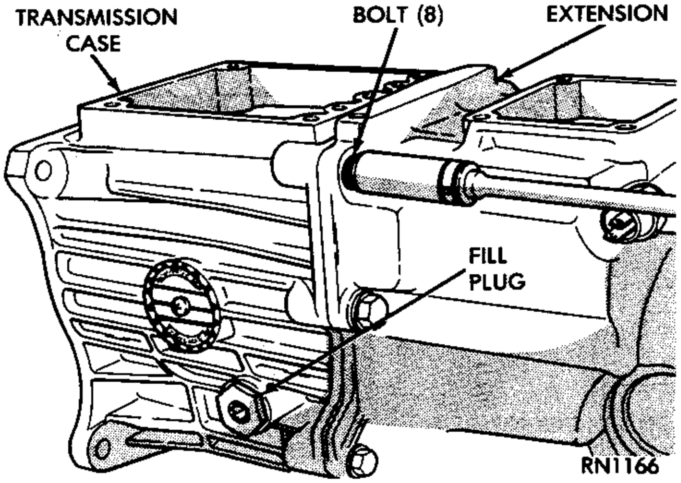

Fig. 8 Removing/Installing Extension Housing Bolts

(17) Note assembly sequence of tool C-4982 (Fig. 17).

(18) Remove mainshaft OD gear snap ring (Fig. 18).

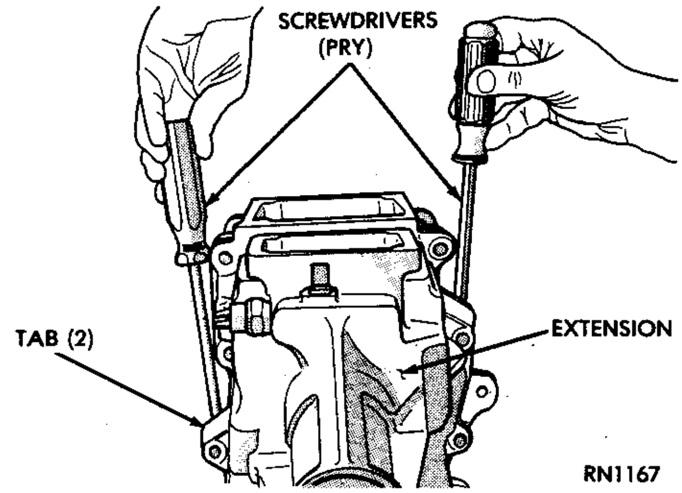

Fig. 9 Loosening Extension Housing

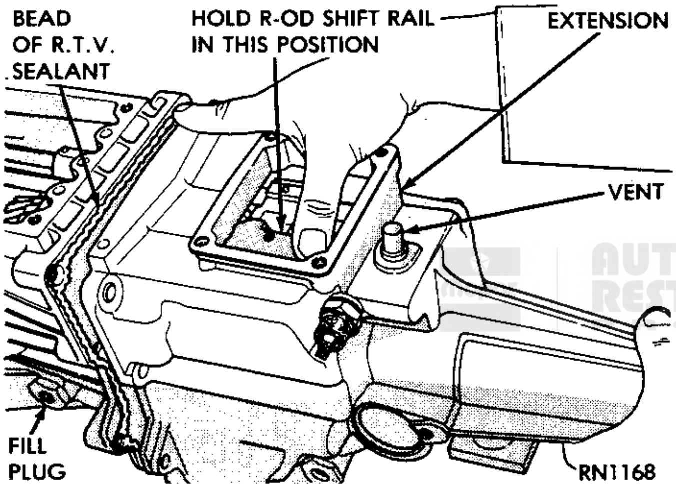

Fig. 10 Removing/Installing Extension Housing

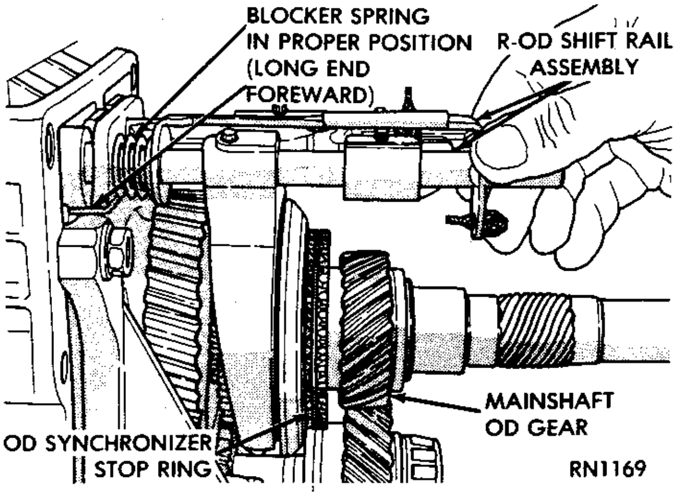

Fig. 11 Reverse/OD Shift Rail And Blocker Spring Position

(19) Remove thrust washer and anti-spin pin (Fig. 19).

(20) Remove mainshaft OD gear (Fig. 20).

(21) Remove reverse/OD hub snap ring (Fig. 21).

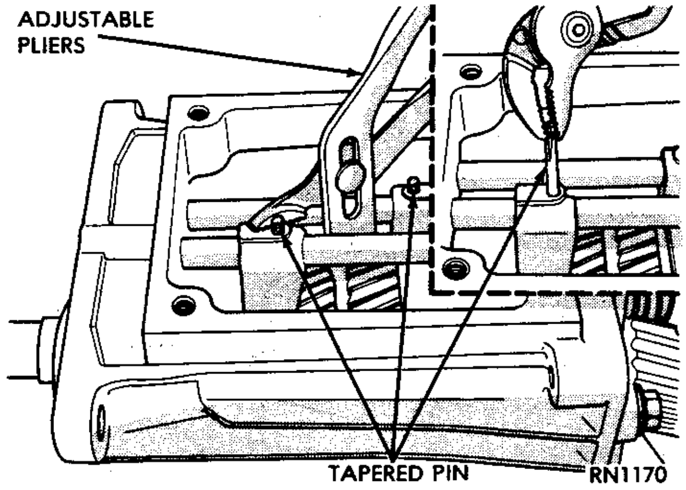

Fig. 12 Removing/Installing Shift Fork Pins

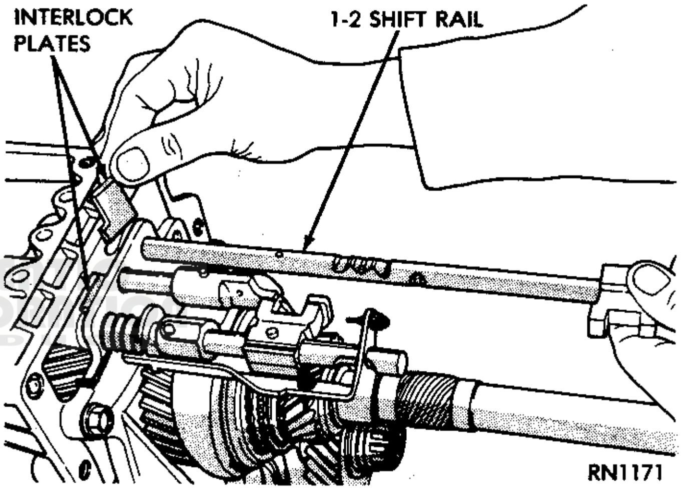

Fig. 13 Removing/Installing 1-2 Shift Rail And Interlock Plates

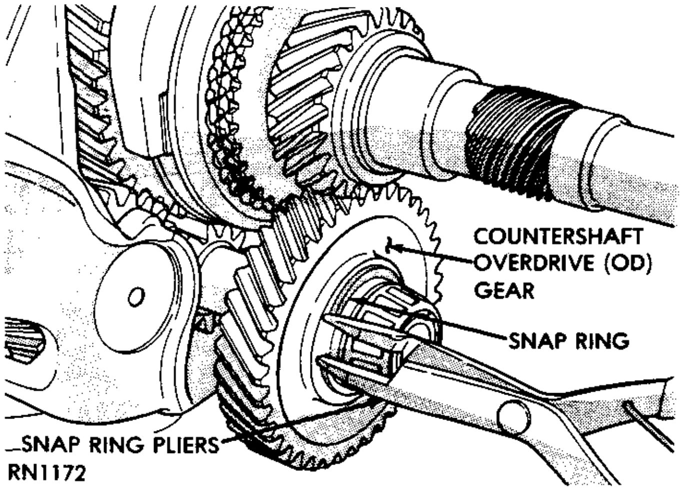

Fig. 14 Removing/Installing Countershaft OD Gear Snap Ring

(22) Remove reverse/OD Synchronizer, fork and rail assembly (Fig. 22).

(23) Remove 3-4 shift rail and interlock plate (Fig. 23).

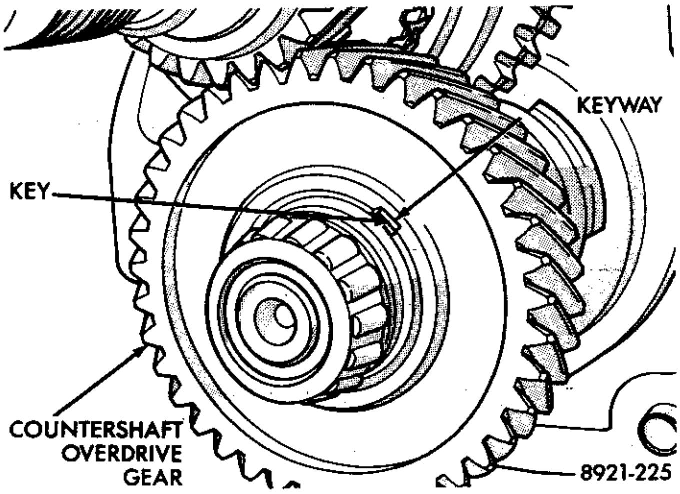

Fig. 15 Overdrive Gear Keyway Position

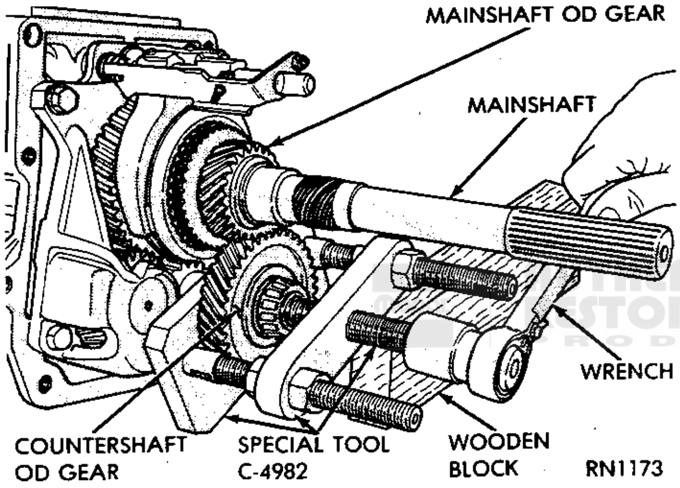

Fig. 16 Removing OD Countershaft Gear

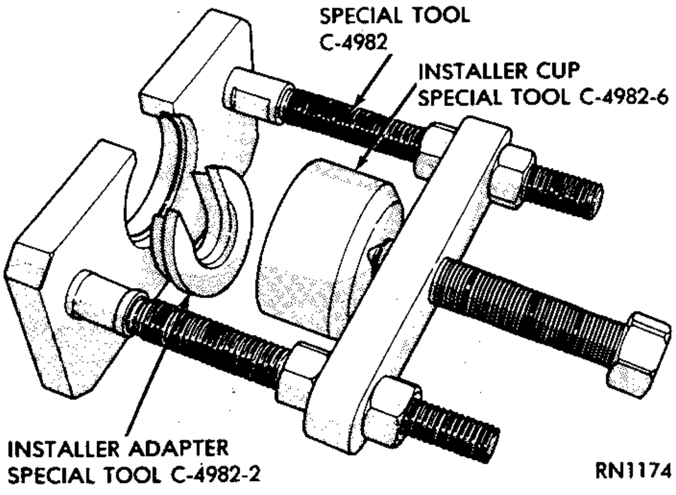

Fig. 17 Tool C-4982 Assembly Sequence

(24) Remove 1-2 and 3-4 shift forks (Fig. 24).

(25) Note shift rail position for assembly reference (Fig. 25).

(26) Remove reverse gear and caged needle bearings (Fig. 26).

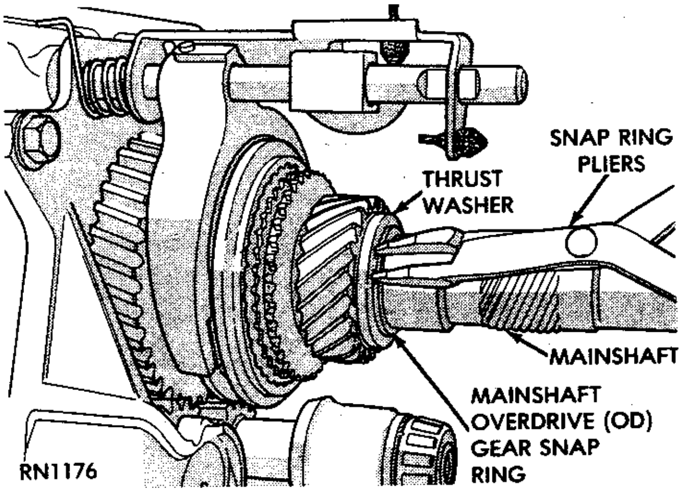

Fig. 18 Removing/Installing Mainshaft OD Gear Snap Ring

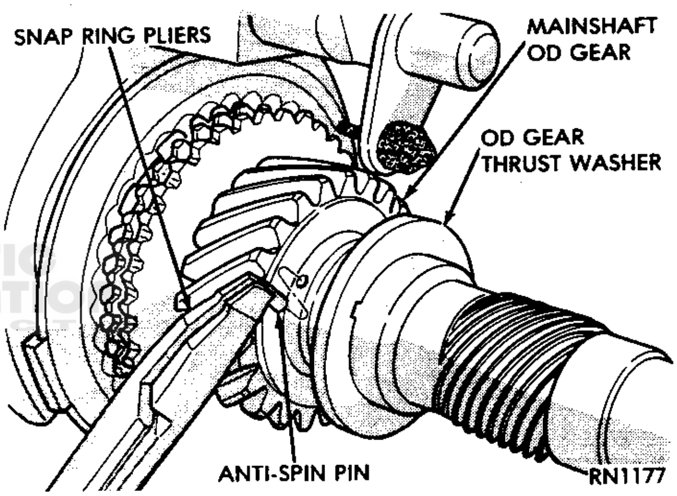

Fig. 19 Removing/Installing Thrust Washer And Anti-Spin Pin

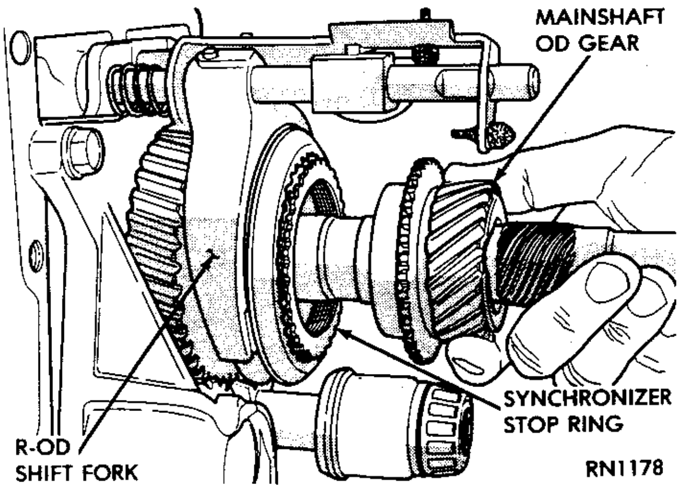

Fig. 20 Removing/Installing Mainshaft OD Gear

(27) Remove reverse gear thrust washer and anti-spin pin (Fig. 27).

(28) Remove center support bolts (Fig. 28).

(29) Note gear position prior to assembly (Fig. 29).

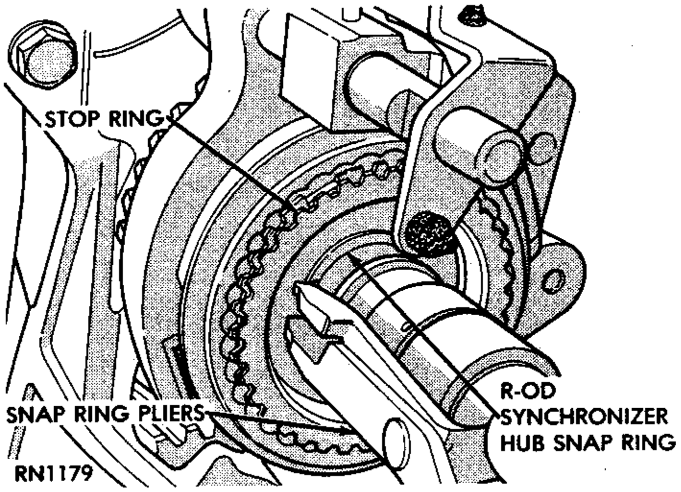

Fig. 21 Removing/Installing Reverse-OD Hub Snap Ring

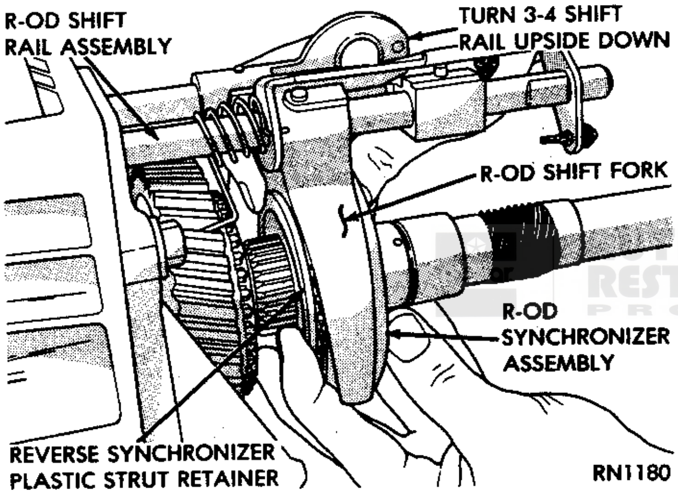

Fig. 22 Removing/Installing Reverse-OD Synchronizer, Fork And Rail

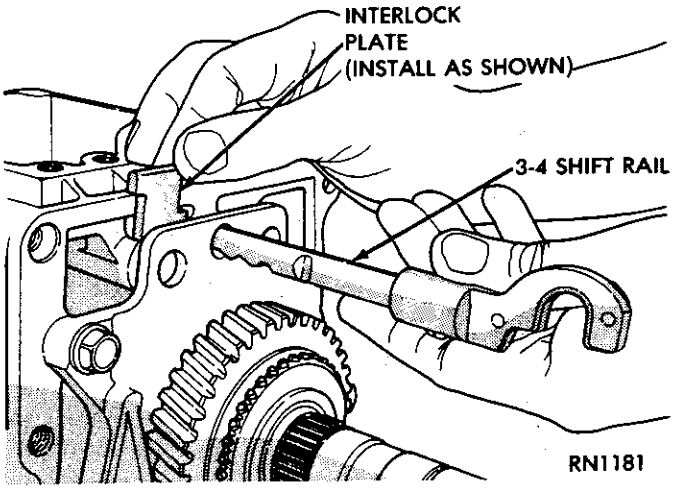

Fig. 23 Removing/Installing 3-4 Shift Rail And Plate

(30) Remove center support and gear set (Fig. 30).

(31) Fabricate alignment studs for reassembly (Fig. 31).

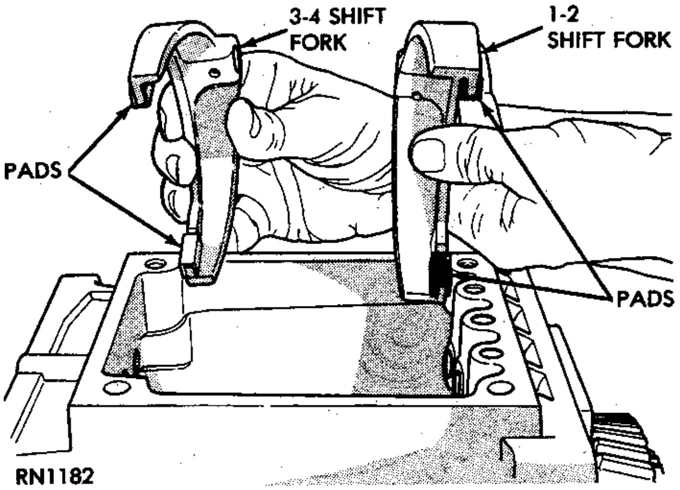

Fig. 24 Removing/Installing Shift Forks

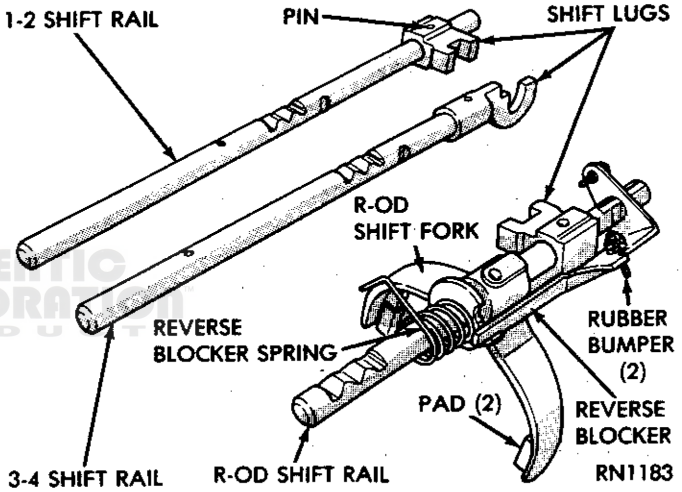

Fig. 25 Position Of Shift Rail Components

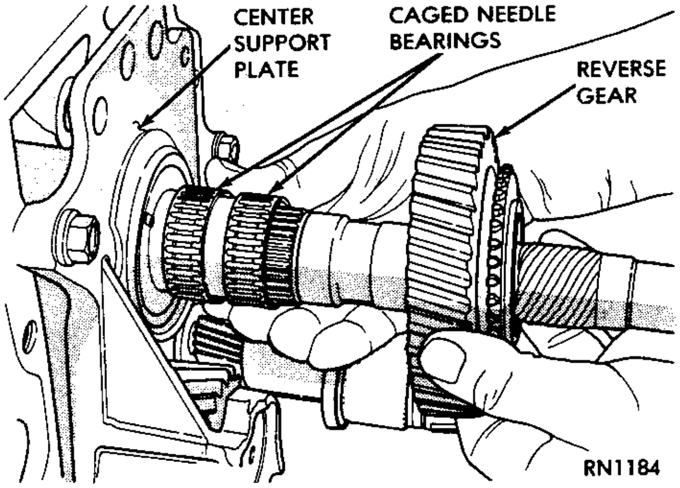

Fig. 26 Removing/Installing Reverse Gear

GEAR SET DISASSEMBLY

(1) Note gear position for assembly reference (Fig. 32).

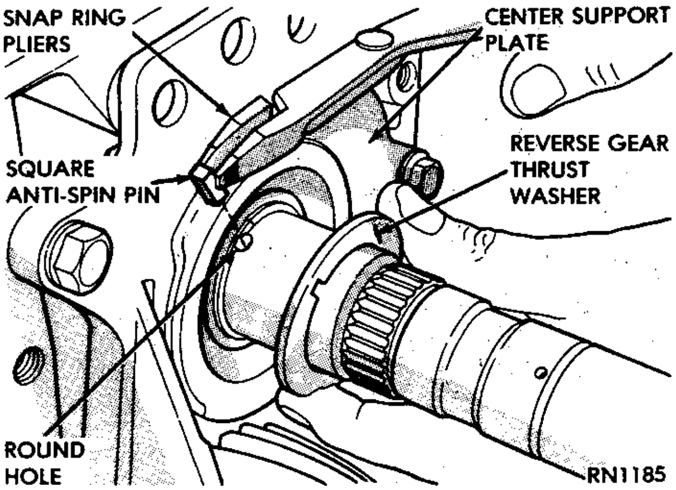

Fig. 27 Removing/Installing Reverse Gear Thrust Washer And Anti-Spin Pin

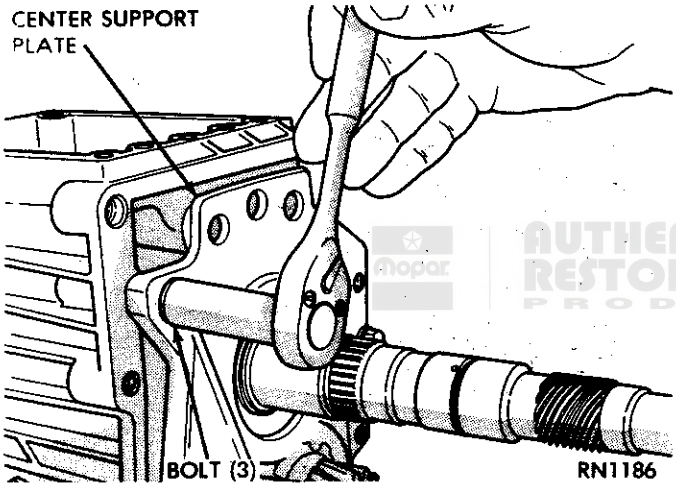

Fig. 28 Removing/Installing Center Support Bolts

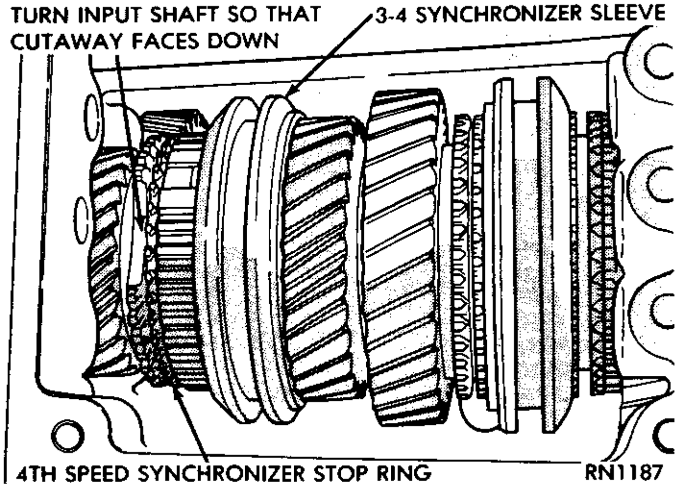

Fig. 29 Gear Set Position

(2) Remove center bearing snap ring and remove mainshaft and gear set from center support plate (Fig. 33).

(3) Remove countershaft (Fig. 34).

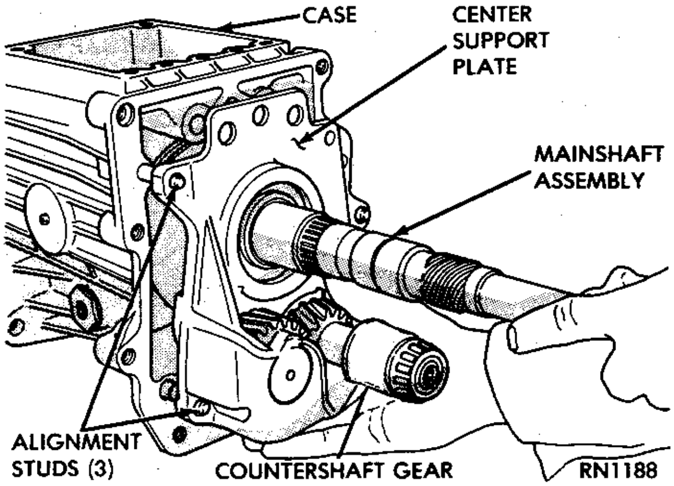

Fig. 30 Removing/Installing Center Support And Gear Set

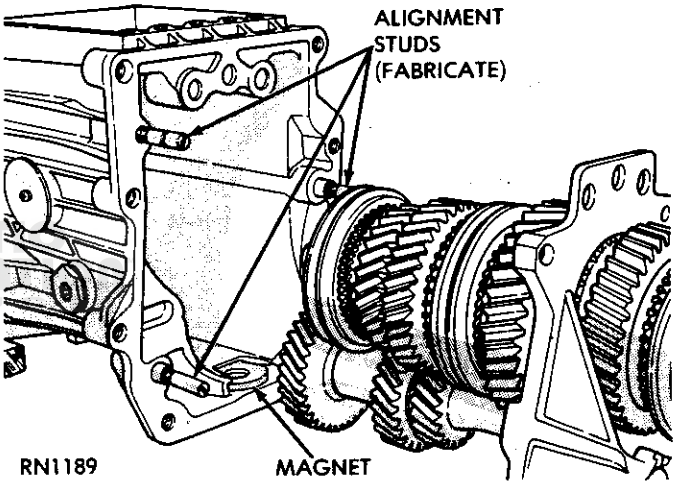

Fig. 31 Gear Case Alignment Studs

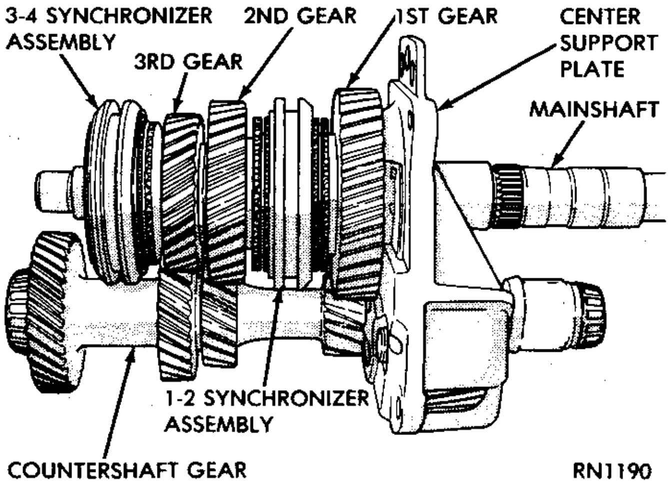

Fig. 32 Gear Set Components

(4) Remove snap ring securing gear set to mainshaft (Fig. 35).

(5) Remove 3-4 synchronizer assembly (Fig. 36).

(6) Remove third gear (Fig. 37).

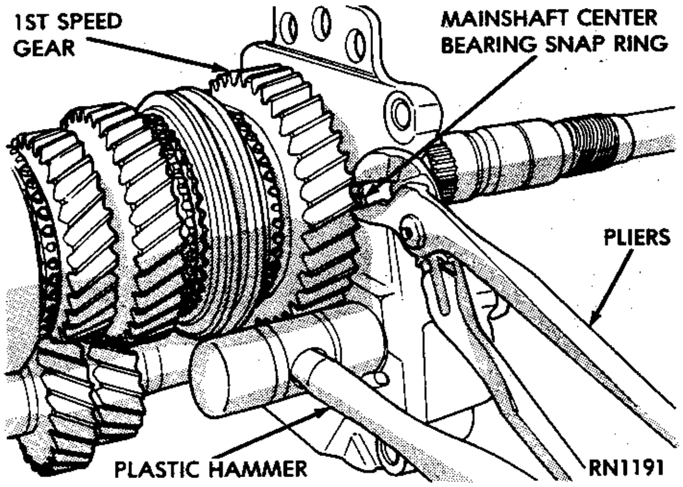

Fig. 33 Removing/Installing Mainshaft And Gear Set

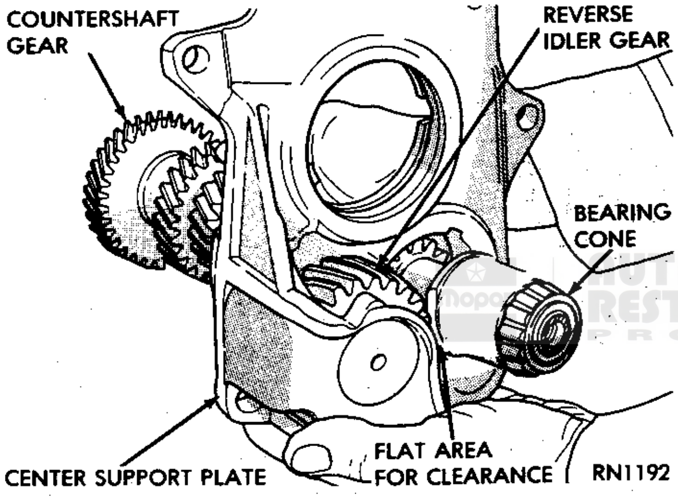

Fig. 34 Removing/Installing Countershaft

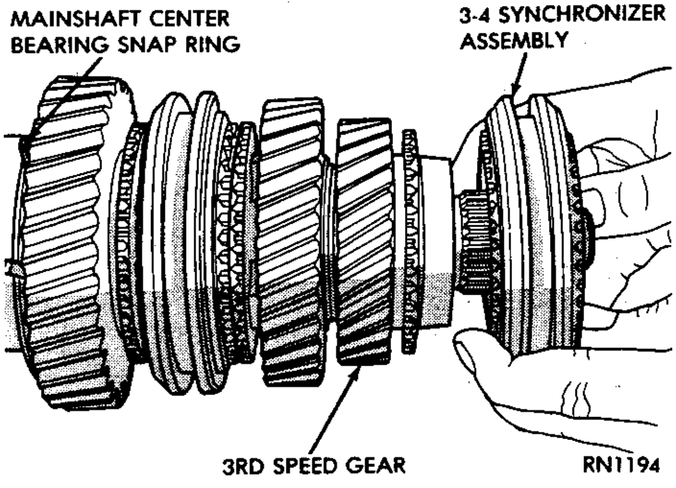

Fig. 35 Removing/Installing Gear Set Retaining Snap Ring

(7) Remove split thrust washer, retaining ring and two anti-spin pins (Fig. 38).

(8) Note washer and retaining ring installation position for reference (Fig. 39).

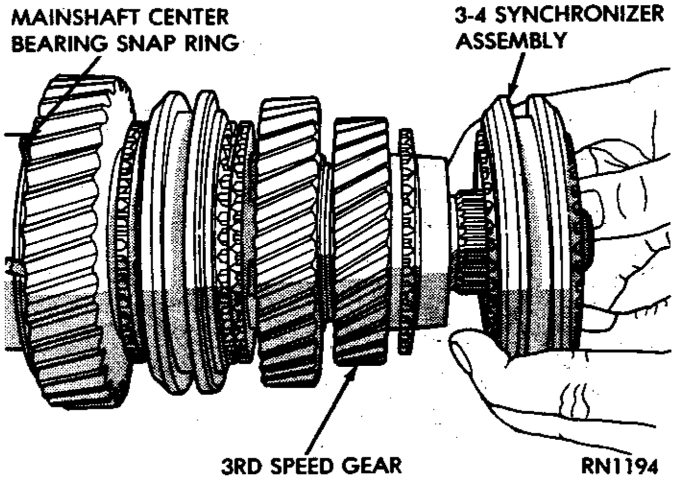

Fig. 36 Removing/Installing 3-4 Synchronizer Assembly

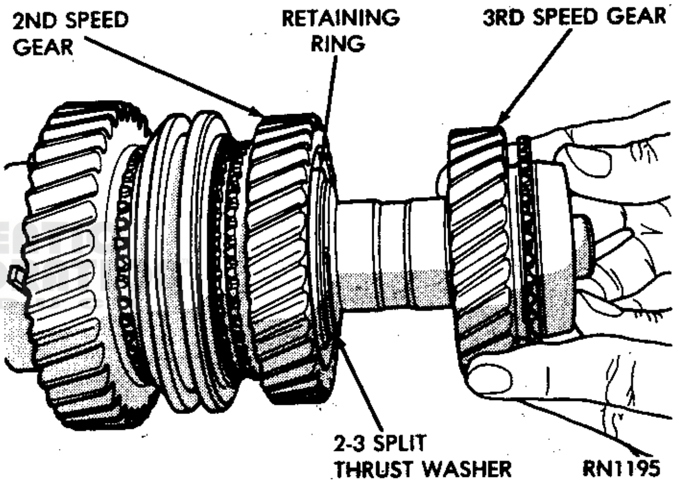

Fig. 37 Removing/Installing Third Gear

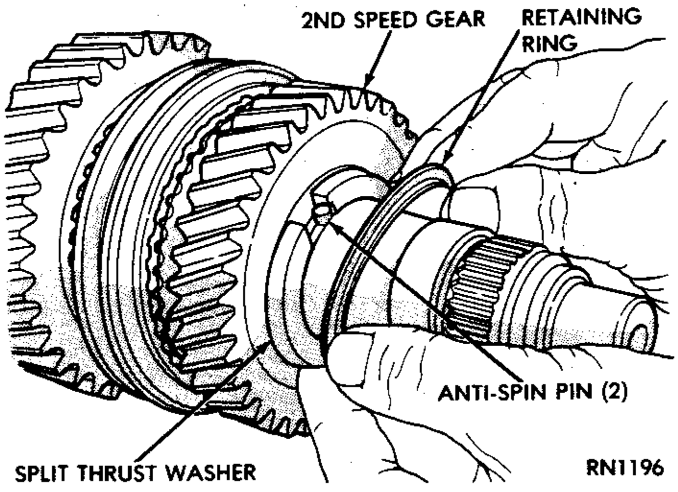

Fig. 38 Removing/Installing Split Thrust Washer, Retaining Ring And Anti-Spin Pins

(9) Remove second speed gear (Fig. 40).

(10) Remove 1-2 synchronizer snap ring (Fig. 41).

(11) Remove 1-2 synchronizer assembly (Fig. 42).

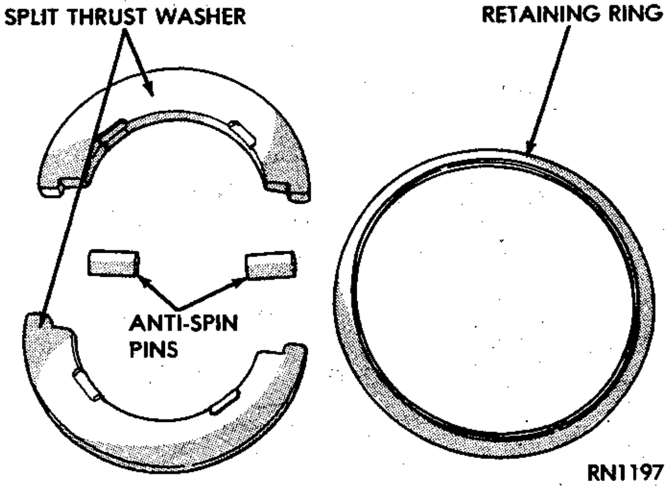

Fig. 39 Thrust Washer And Retaining Installation Position

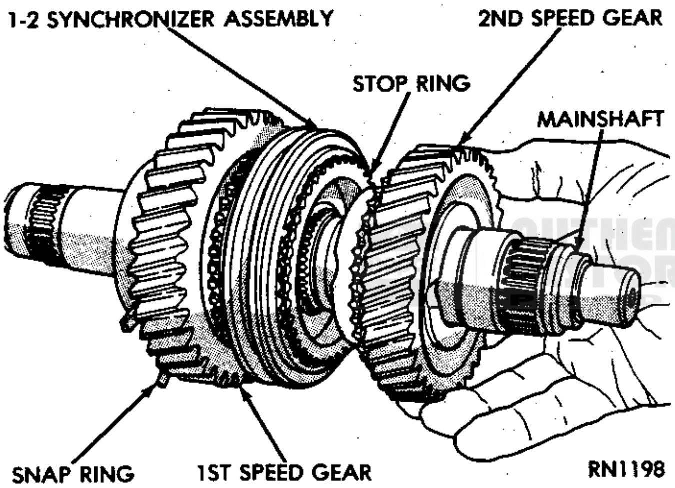

Fig. 40 Removing/Installing Second Speed Gear

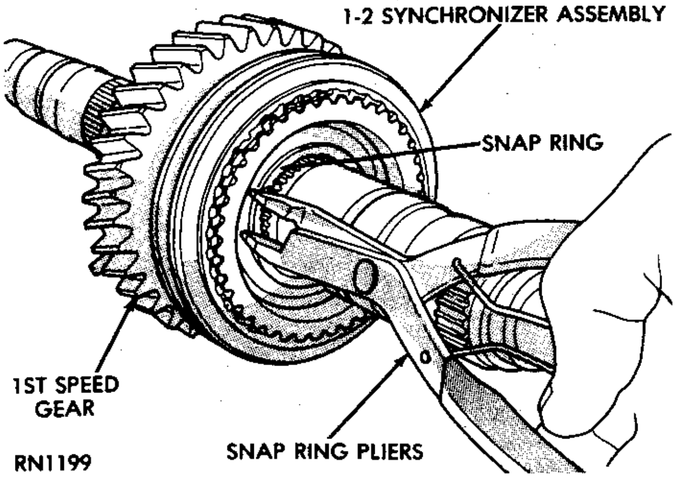

Fig. 41 Removing/Installing 1-2 Synchronizer Snap Ring

(12) Remove first speed gear (Fig. 43).

(13) Remove caged needle bearings and thrust washer (Fig. 43).

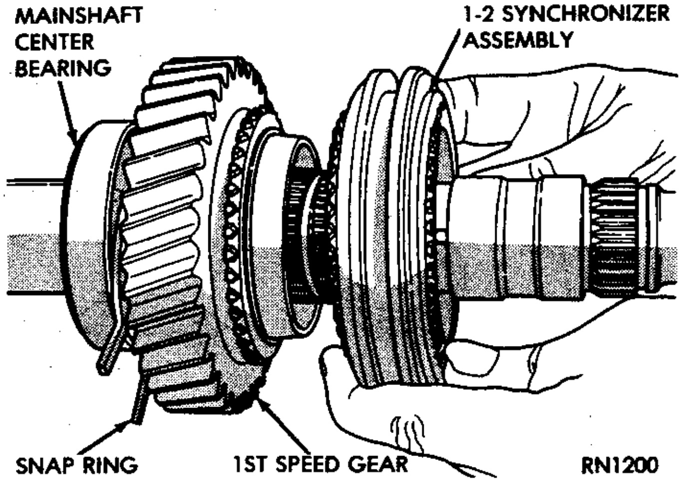

Fig. 42 Removing/Installing 1-2 Synchronizer Assembly

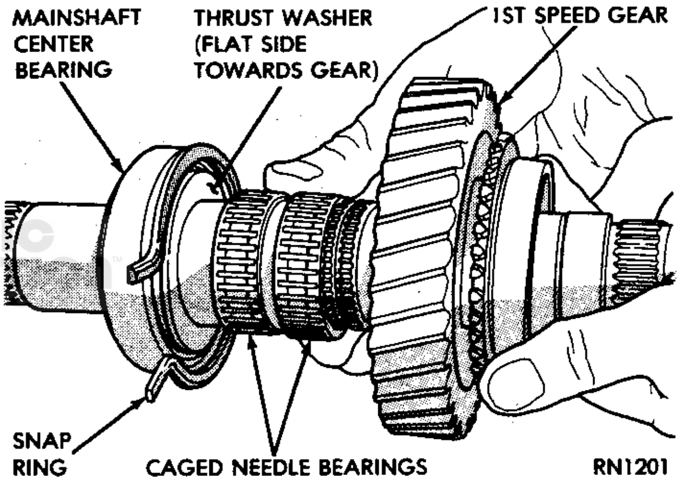

Fig. 43 Removing/Installing First Gear And Needle Bearings

(14) Note synchronizer component layout for assembly identification (Fig. 44).

INPUT SHAFT REMOVAL

(1) Remove retainer bolts (Fig. 45).

(2) Remove retainer and gasket (Fig. 46).

(3) Remove front bearing locating snap ring. This is largest snap ring (Fig. 47).

(4) Remove input shaft (Fig. 48).

(5) Remove mainshaft pilot bearing rollers from input shaft (Fig. 49).

CENTER SUPPORT PLATE/REVERSE IDLER DISASSEMBLY

(1) Remove idler shaft snap ring (Fig. 50).

(2) Remove idler shaft and reverse gear components (Fig. 51).

(3) Remove center bearing snap ring (Fig. 52).

(4) Remove countershaft center bearing with shop press and suitable tool (Fig. 53).

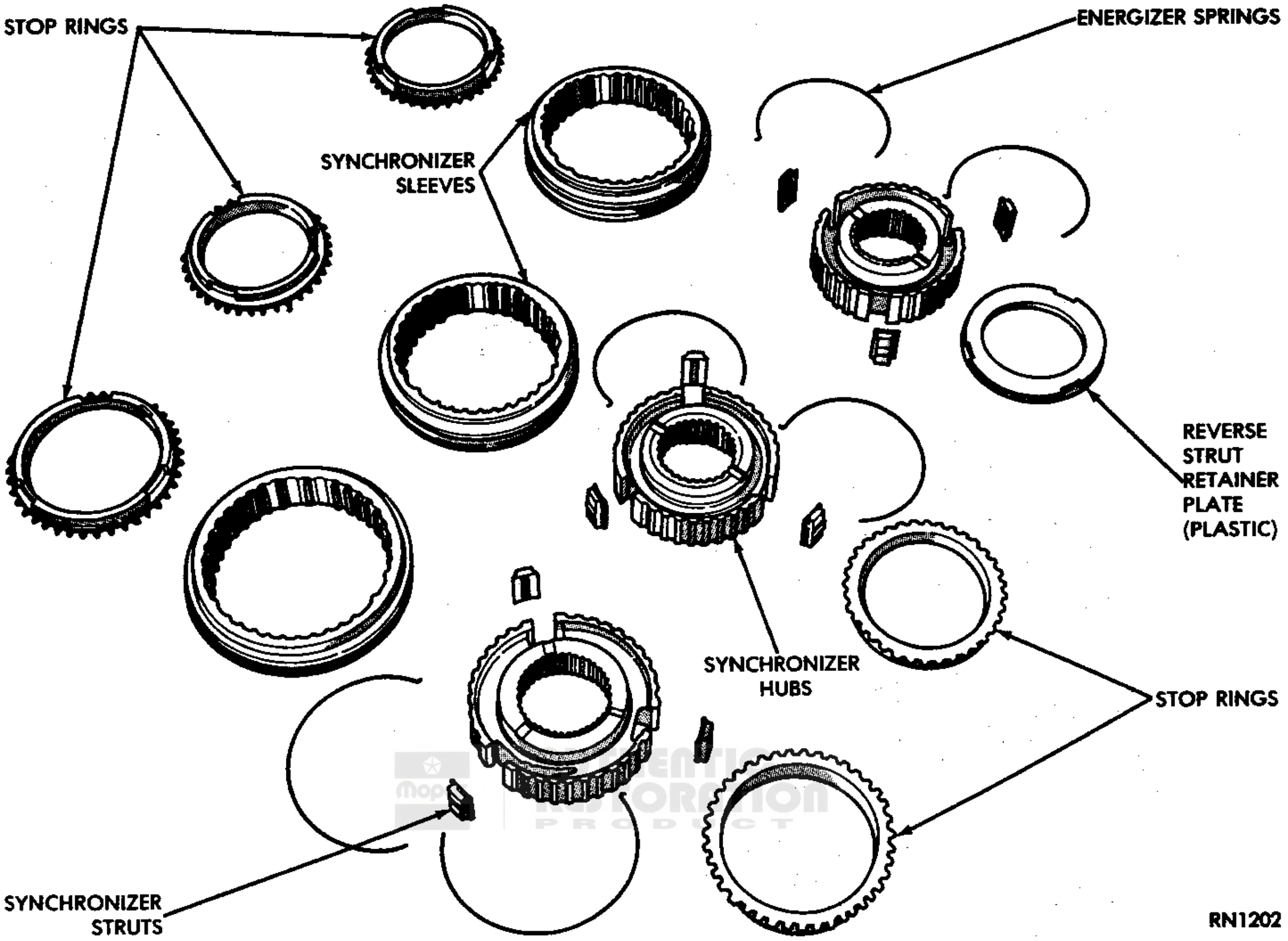

Fig. 44 Synchronizer Component Identification

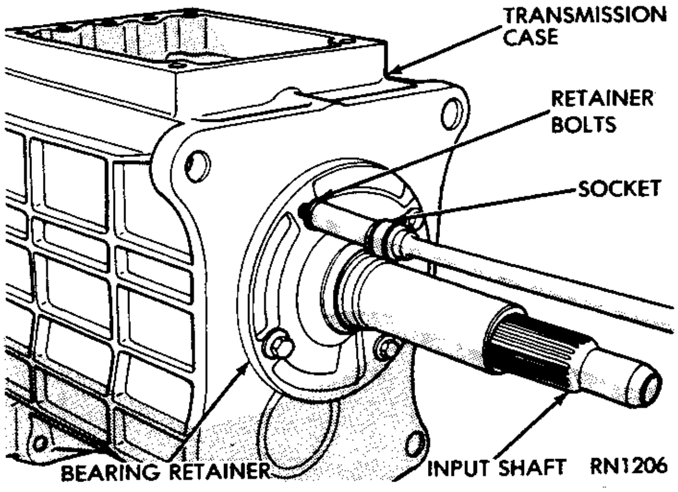

Fig. 45 Removing/Installing Front Bearing Retainer Bolts

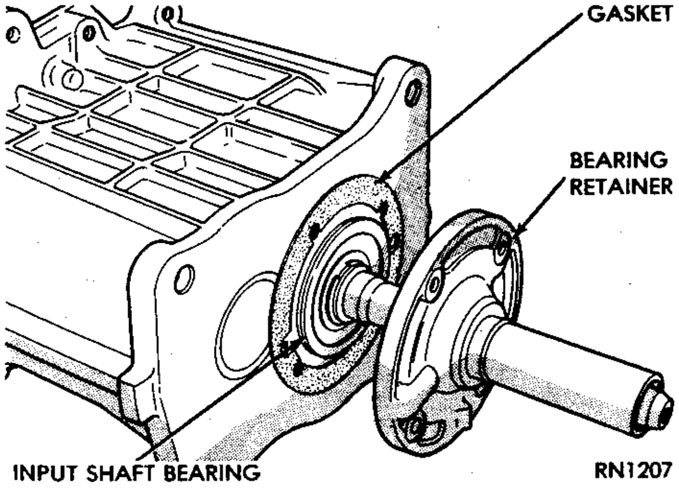

Fig. 46 Removing/Installing Front Bearing Retainer

CLEANING AND INSPECTION

Gear Case

Clean transmission case thoroughly with a suitable solvent and dry with compressed air. The magnetic disc, located on bottom of case, can be removed for cleaning. Wipe the disc clean with a cloth and reinstall the disc.

Inspect the case for cracks and stripped threads in various bolt holes. Inspect the machined surfaces for

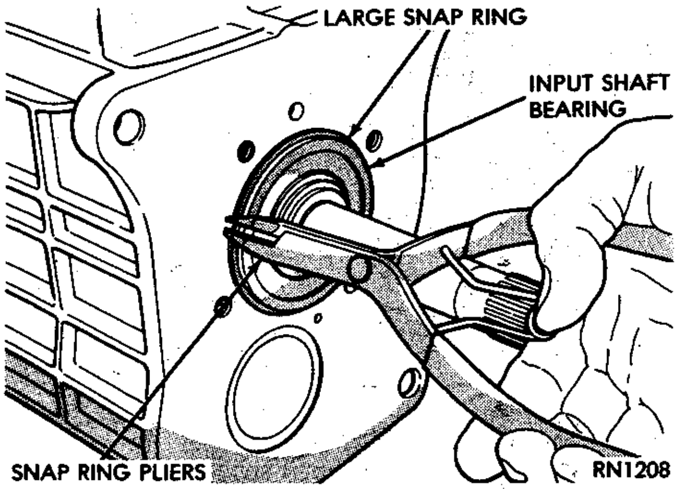

Fig. 47 Removing/Installing Front Bearing Locating Snap Ring

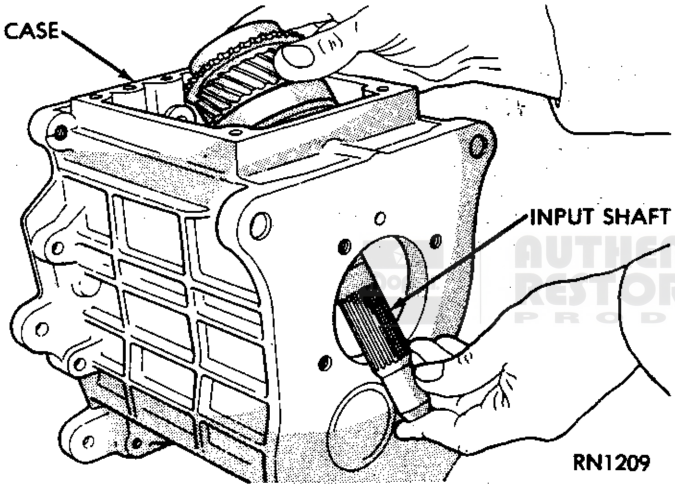

Fig. 48 Removing/Installing Input Shaft

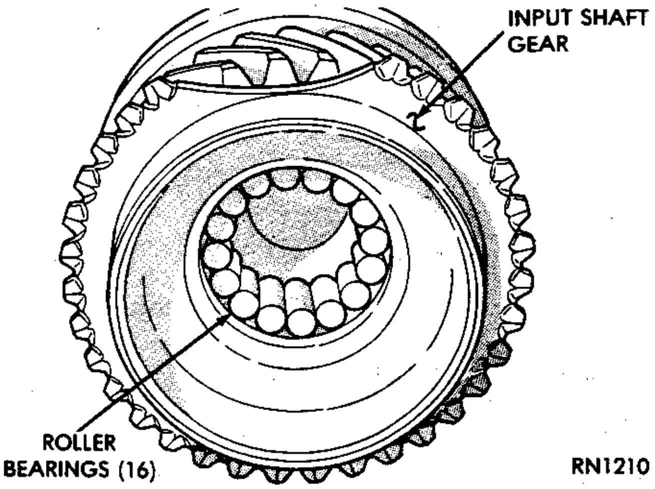

Fig. 49 Removing/Installing Mainshaft Pilot Roller Bearings

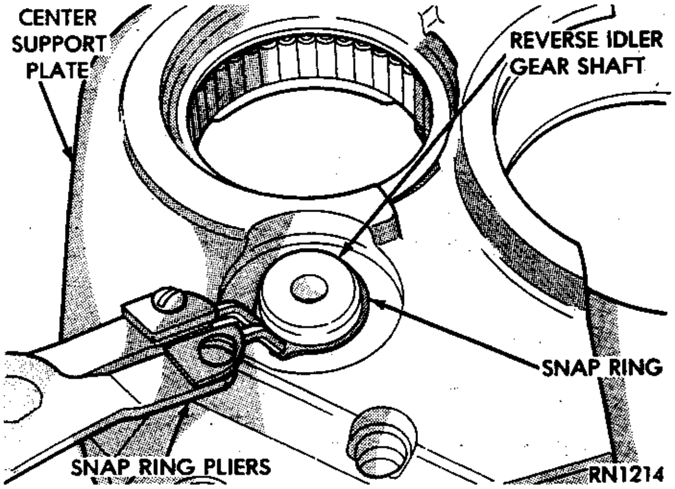

Fig. 50 Removing/Installing Idler Shaft Snap Ring

burrs, nicks, or any condition that would render the case unfit for further service. The front mating surface should be smooth. If any burrs are present, dress them off with a fine mill file. If any case threads are stripped, install Helicoil, or equivalent thread inserts.

Bearings

Wash bearings, using a clean solvent and either air dry them or wipe dry with clean shop towels. **Do not use compressed air to dry the bearings. Compressed air applied to unlubricated bearings may cause damage to the bearing races and balls.**

Be sure bearings are clean. Inspect bearings for roughness. This can best be determined by slowly turning by hand.

Inspect all bearing rollers for flat spots or brinnelling. Inspect all bearing roller spacers for signs of wear or galling. Inspect roller contact surfaces of gear and shaft. Install new parts as required.

Refer to the Bearing/Bushing/Seal Replacement procedure in this section for bearing replacement procedures. Lubricate the bearings with 10W-30 engine oil (API class SG/CD) after cleaning, inspection and/or replacement.

Gears

Inspect countershaft gear and all gear teeth for chipped or broken teeth, or showing signs of excessive wear. Small nicks or burrs must be removed with an oilstone.

Inspect teeth on input shaft. If excessively worn, broken, or chipped, a new pinion should be installed. If the oil seal contact area on drive pinion shaft is pitted, rusted, or scratched, a new pinion is recommended for best seal life.

Inspect shift forks for wear on pads and shafts. Replace the forks if worn or damaged.

Synchronizer Assemblies

Inspect spline teeth on synchronizer clutch gears and stop rings. If there is evidence of chipping or ex-

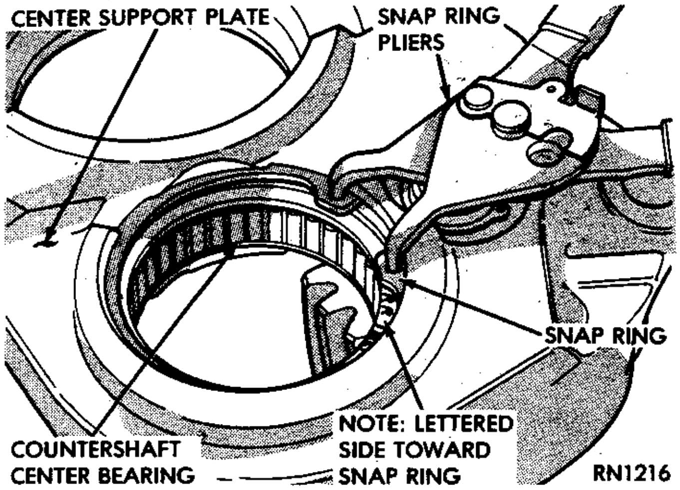

Fig. 52 Removing/Installing Countershaft Center Bearing Snap Ring

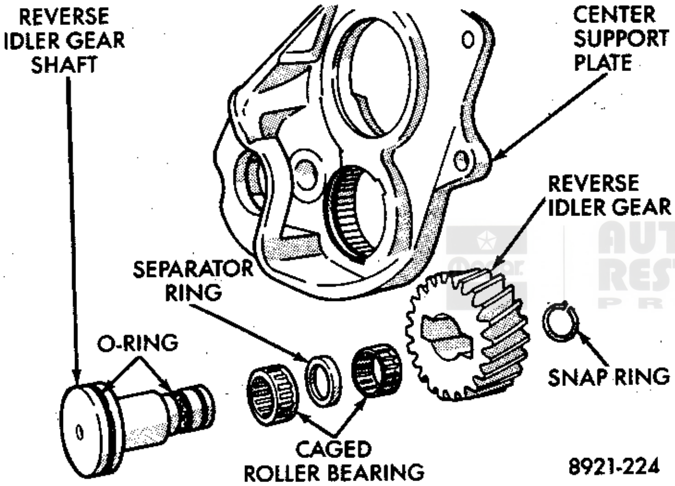

Fig. 51 Removing/Installing Reverse Idler Gear Components

cessively worn teeth, install new parts at reassembly. Be sure synchronizer sleeves slide freely on the hubs.

Inspect the stop rings for cracks and wear. If rings are cracked or show signs of extreme wear on threaded bore, install new stop rings at reassembly. Test new rings for good fit on gear cones with minimum wobble. Check synchronizer struts for wear or breakage.

Synchronizers will be serviced as an assembly. Synchronizer parts should not be interchanged.

Mainshaft

Inspect the mainshaft gear and bearing mating surfaces. If gear contact surfaces show signs of galling or excessive wear, a new mainshaft should be installed.

Inspect the snap ring grooves for burred edges. If rough or burred, remove burrs with a fine file or crocus cloth. Inspect synchronizer hub splines on shaft for burrs also.

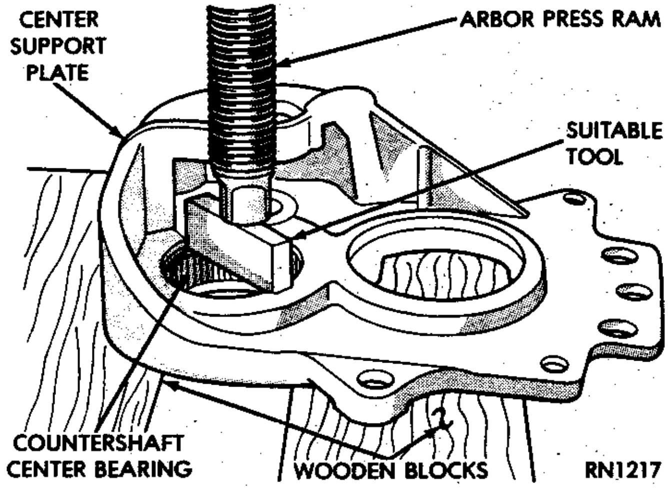

Fig. 53 Removing Countershaft Center Bearing

BEARING/SEAL/BUSHING REPLACEMENT

INPUT SHAFT (FRONT) BEARING REPLACEMENT

(1) Remove front bearing retaining snap ring from input shaft (Fig. 54).

(2) Remove bearing with shop press and universal bearing remover (Fig. 55).

(3) Install bearing with tool C-4965 and shop press (Fig. 56).

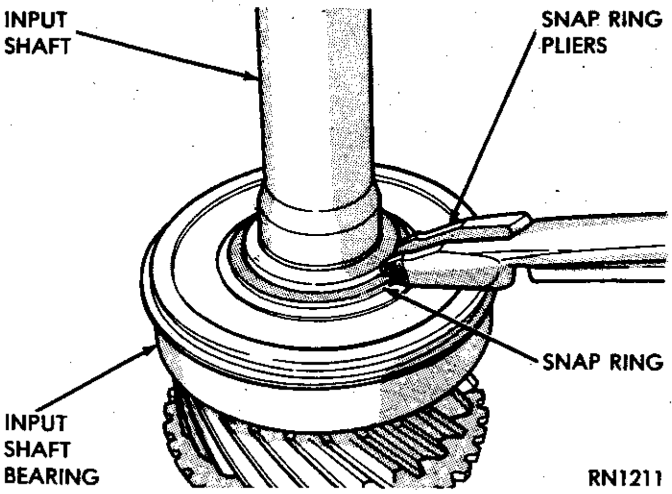

Fig. 54 Removing/Installing Front Bearing Retaining Snap Ring

MAINSHAFT CENTER BEARING REPLACEMENT

(1) Remove bearing snap ring (Fig. 57).

(2) Remove bearing with shop press and plates (Fig. 58).

(3) Install bearing on mainshaft (Fig. 59). **Be sure flat side of first gear thrust washer will face gear after installation.**

(4) Install bearing snap ring (Fig. 57).

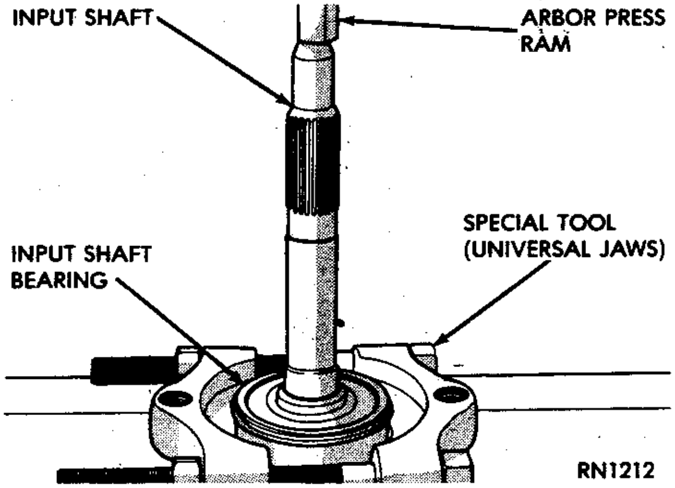

Fig. 55 Removing Front Bearing From Input Shaft

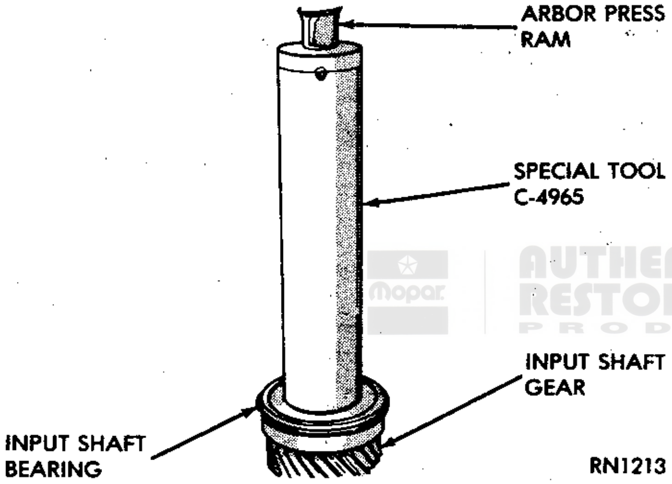

Fig. 56 Installing Front Bearing On Input Shaft

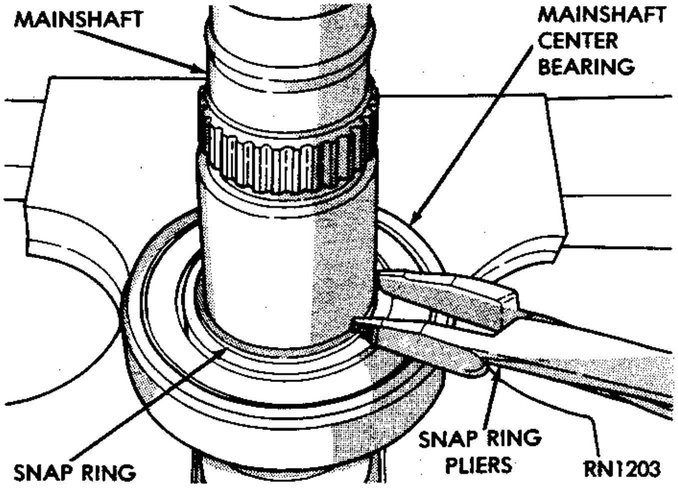

Fig. 57 Removing/Installing Center Bearing Snap Ring

FRONT BEARING RETAINER SEAL REPLACEMENT

(1) Pry seal out of retainer.

(2) Install new seal with tool C-3789 (Fig. 60).

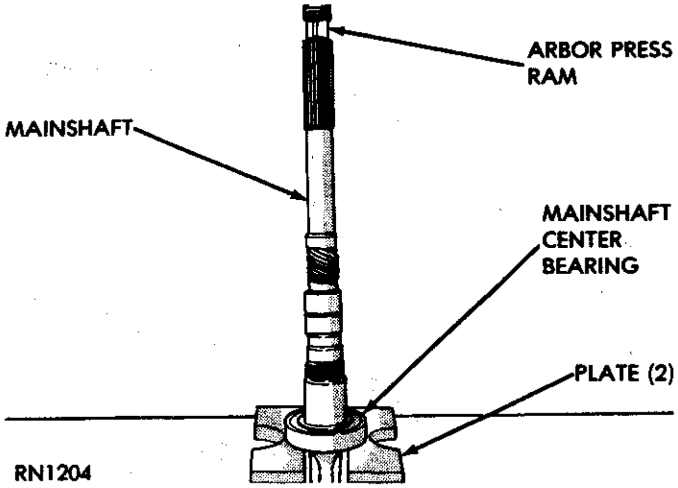

Fig. 58 Removing Center Bearing

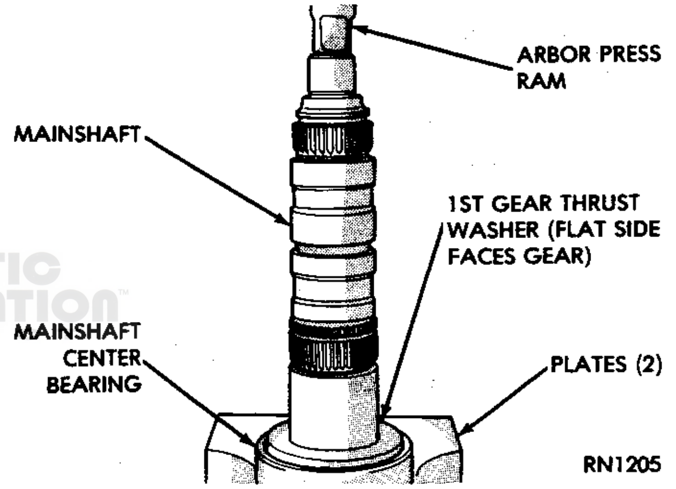

Fig. 59 Installing Center Bearing

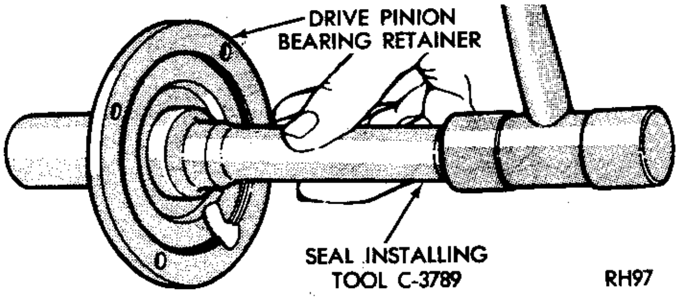

Fig. 60 Installing Bearing Retainer Seal

COUNTERSHAFT GEAR BEARING REPLACEMENT

(1) Remove bearing if not removed previously (Fig. 53).

(2) Install new bearing with tool C-4974 (Fig. 61).

(3) Note countershaft gear bearing and spacer position (Fig. 62).

(4) Remove countershaft front bearing cone with tools C-4983 and C-4983-4 (Fig. 63).

(5) Install front bearing cone with tool C-4967 (Fig. 64).

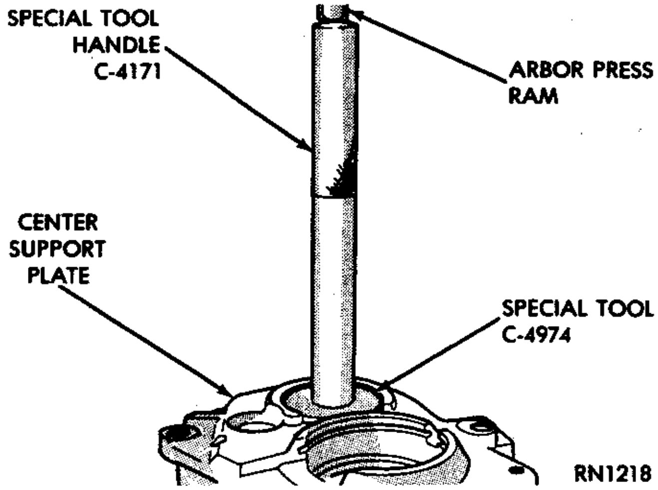

Fig. 61 Installing Countershaft Gear Center Bearing

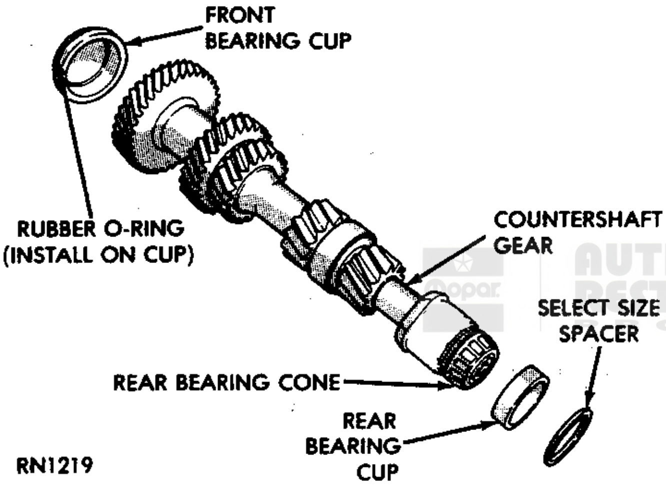

Fig. 62 Countershaft Gear Components

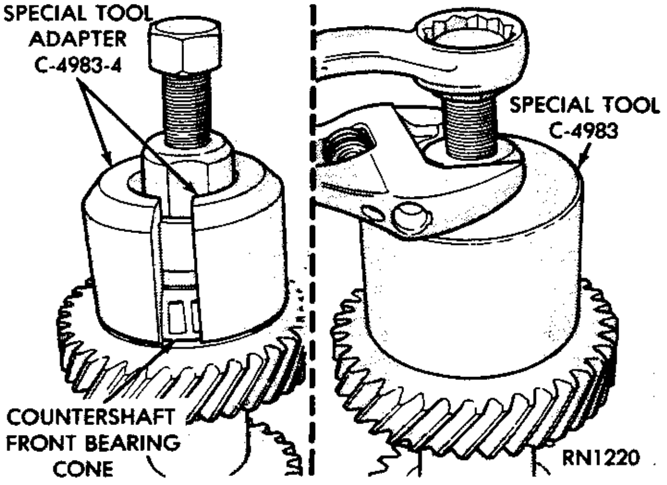

Fig. 63 Removing Countershaft Gear Front Bearing Cone

(6) Remove front bearing cup with shop press and suitable tool (Fig. 65).

(7) Install front bearing cup with tools C-4171 and C-4968 (Fig. 66).

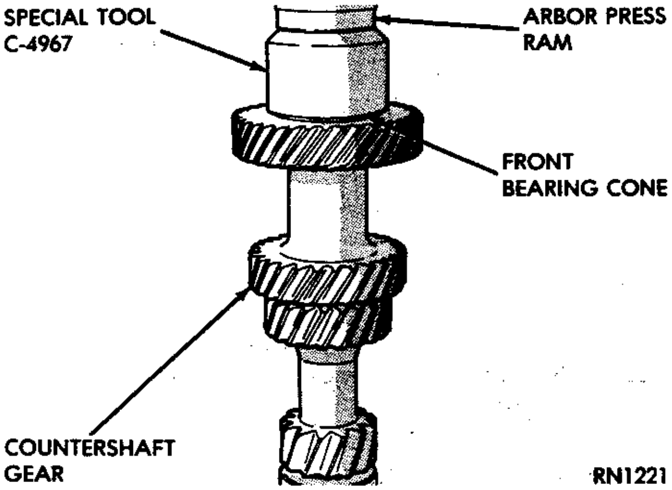

Fig. 64 Installing Countershaft Gear Front Bearing Cone

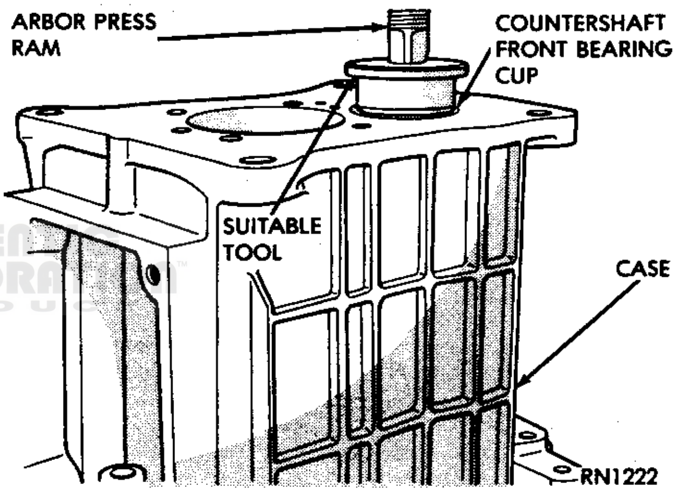

Fig. 65 Removing Countershaft Gear Front Bearing Cup

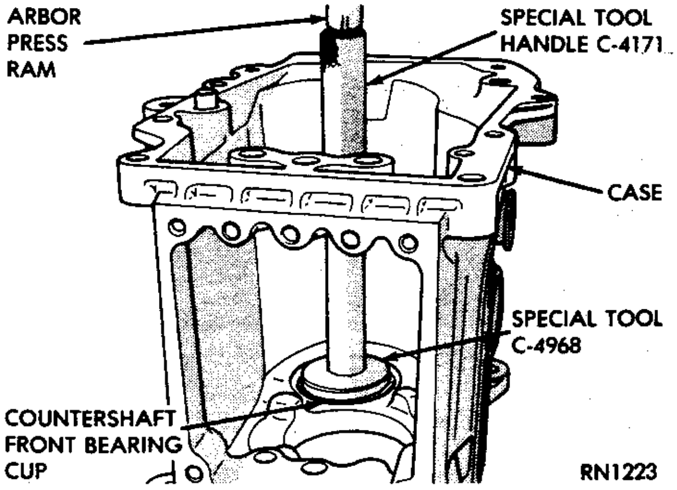

Fig. 66 Installing Countershaft Gear Front Bearing Cup

(8) Remove rear bearing cone with tools C-4983-5 and C-4983 (Fig. 67).

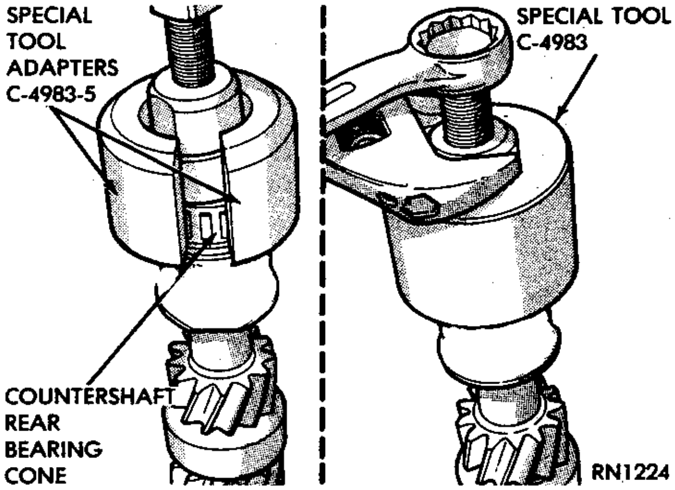

Fig. 67 Removing Countershaft Gear Rear Bearing Cone

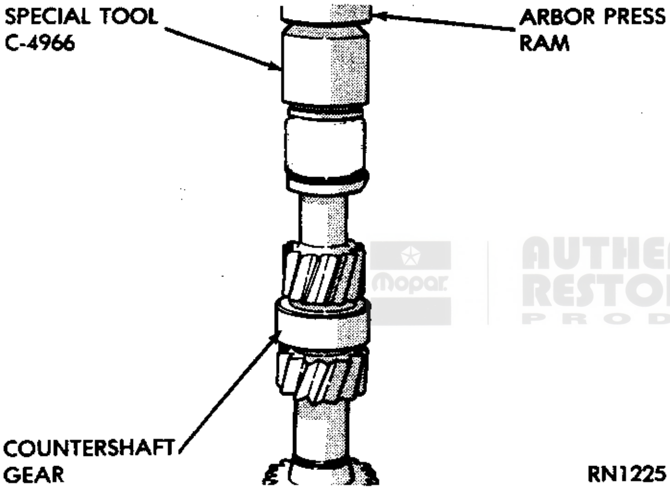

Fig. 68 Installing Countershaft Gear Rear Bearing Cone

(9) Install rear bearing cone with tool C-4966 (Fig. 68).

(10) Remove rear bearing cup with tools L-4454 and L-4518 (Fig. 69).

(11) Install rear bearing cup with tools C-4171 and C-4973 (Fig. 70).

MAINSHAFT REAR BEARING REPLACEMENT

(1) Remove bearing snap ring (Fig. 71).

(2) Tap bearing out of extension housing (Fig. 71).

(3) Install new bearing and snap ring in extension (Fig. 71).

EXTENSION HOUSING BUSHING REPLACEMENT

(1) Remove seal with tool C-3985.

(2) Remove bushing with tool C-3996 (Fig. 72).

(3) Install new bushing with tool C-3996 (Fig. 72).

(4) Install new housing seal with tool C-3995.

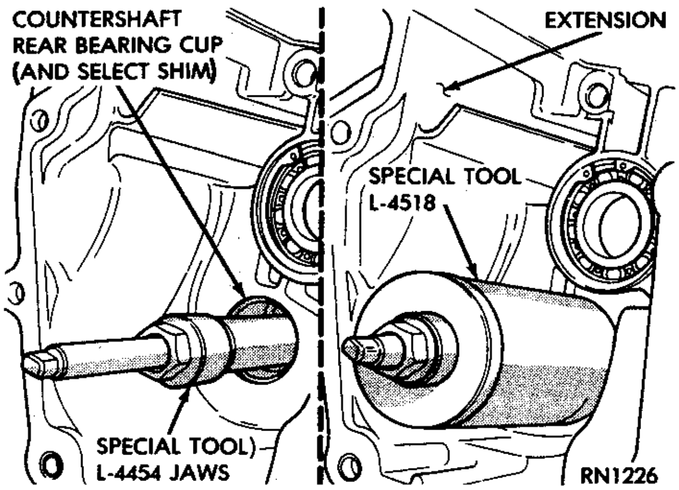

Fig. 69 Removing Countershaft Gear Rear Bearing Cup

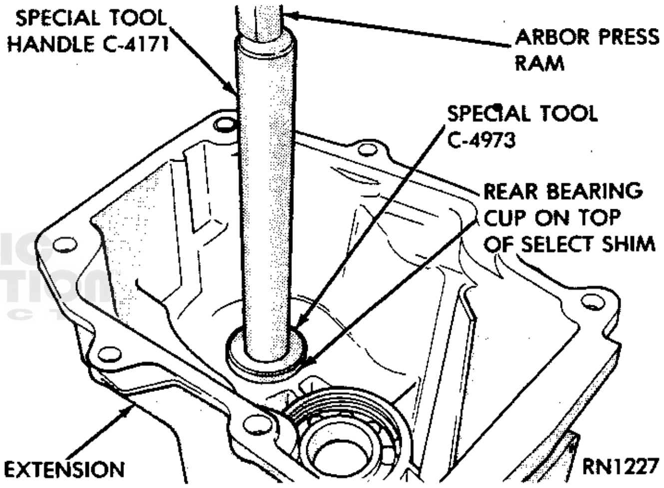

Fig. 70 Installing Countershaft Gear Rear Bearing Cup

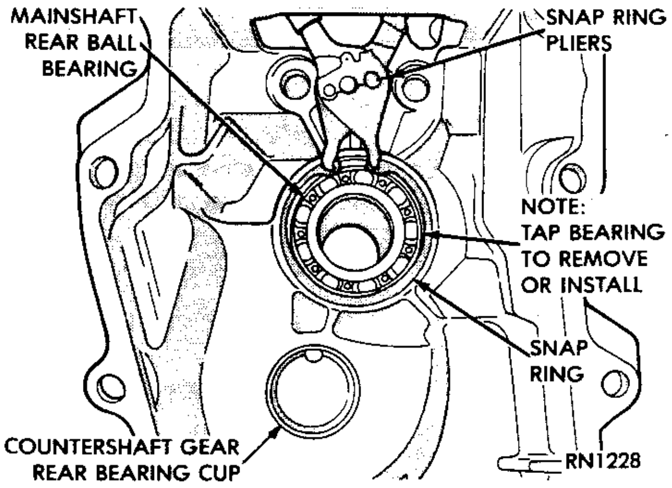

Fig. 71 Mainshaft Rear Bearing Replacement

TRANSMISSION ASSEMBLY

Lubricate transmission components with fresh 10W-30 engine oil during assembly. Lubricate the

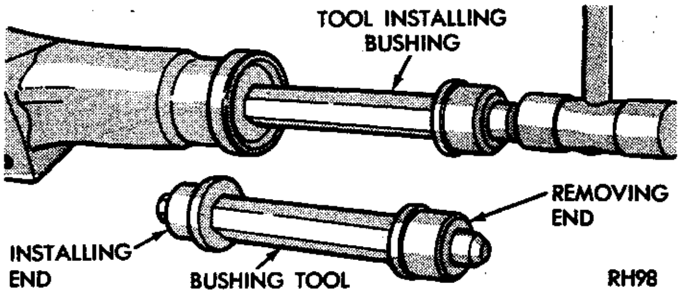

Fig. 72 Replacing Extension Housing Bushing

synchronizer components and all bearings and bearing contact surfaces **before** assembly and installation.

Assemble the transmission on a clean work surface. Do not allow dirt or foreign material to enter the case or gear components during assembly operations.

Verify that bearings cups and cones are correctly positioned before starting assembly operations.

ASSEMBLING GEAR SET

(1) Assemble 1-2 and 3-4 synchronizers (Fig. 44).

(2) Install center bearing snap ring, caged needle bearings and first gear on mainshaft (Fig. 43). **Be sure the chamfered side of the snap ring faces the first gear.**

(3) Install 1-2 synchronizer assembly (Fig. 42) and install assembly retaining snap ring (Fig. 41).

(4) Install second gear (Fig. 40).

(5) Install two-piece thrust washer, retaining ring and anti-spin pins (Fig. 38). Note washer and ring position before installation (Fig. 39).

(6) Install third speed gear (Fig. 37) and 3-4 synchronizer assembly (Fig. 36).

(7) Install snap ring gear set snap ring (Fig. 35).

CENTER SUPPORT PLATE/REVERSE IDLER ASSEMBLY

(1) Install countershaft gear center bearing snap ring (Fig. 52).

(2) Install new O-rings on reverse idler shaft. Then lubricate, assemble and install idler gear, shaft, bearings and spacer in support (Fig. 51).

(3) Install idler shaft snap ring (Fig. 50).

ADJUSTING COUNTERSHAFT GEAR END PLAY

(1) Install countershaft gear in support plate (Fig. 73).

(2) Install support plate and gear in case.

(3) Install and tighten support-to-gear case bolts snug but not to final torque.

(4) Install original countershaft gear end play shim and attach extension to support and case.

(5) Attach dial indicator to front of case and position indicator plunger against countershaft gear (Fig. 73).

(6) Move gear forward and zero indicator.

(7) Move gear rearward and note dial indicator reading. End play should be .03 to .13 mm (.001 to .005 inch).

(8) If necessary, select new shim (Fig. 74).

(9) Remove dial indicator and countershaft gear and continue with assembly.

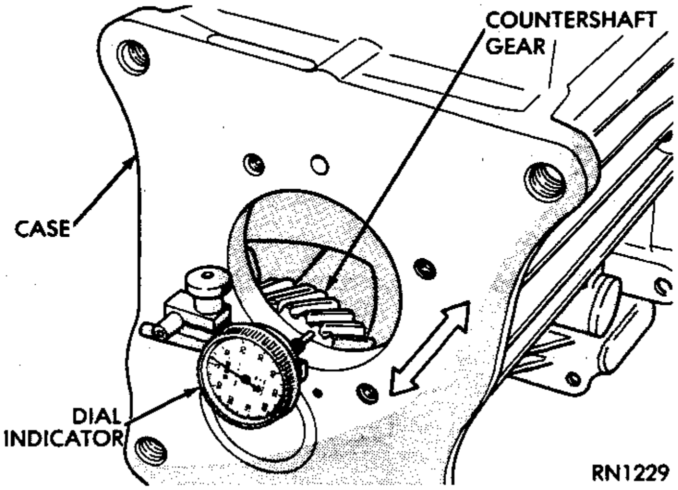

Fig. 73 Measuring Countershaft Gear End Play

Part No.	Thickness	
	Millimeters	Inches
4338275	1.37-1.39	.0539
4338276	1.46-1.48	.0579
4338277	1.55-1.57	.0614
4338278	1.64-1.66	.0650
4338279	1.73-1.75	.0685
4338280	1.82-1.84	.0720
4338281	1.91-1.93	.0756
4338282	2.00-2.02	.0791
4338283	2.09-2.11	.0827
4338284	2.18-2.20	.0862
4338285	2.27-2.29	.0898

J9021-100

Fig. 74 Countershaft Gear End Play Shim Chart

INPUT SHAFT INSTALLATION

(1) Coat mainshaft pilot roller bearings with petroleum jelly and install rollers in shaft (Fig. 49). Extra petroleum jelly can be used to hold rollers in place.

(2) Insert input shaft into front bearing bore from inside case (Fig. 48).

(3) Seat shaft in bore and install locating snap ring on front bearing (Fig. 47).

(4) Install new retainer gasket on case and install front bearing retainer (Fig. 46). Tighten retainer bolts to 28 N•m (21 ft-lbs) torque.

GEAR SET AND SUPPORT PLATE ASSEMBLY

(1) Install countershaft gear in support plate (Fig. 34).

(2) Install mainshaft and gear set assembly in support plate (Fig. 33).

(3) Seat mainshaft center bearing snap ring (Fig. 33).

CAUTION: The center bearing snap ring is chamfered. Be sure the chamfered side of the snap ring is facing the first speed gear.

(4) Verify gear set installation position (Fig. 32).

INSTALLING GEAR SET IN GEAR CASE

(1) Install alignment studs in case (Fig. 31).

(2) Install gear set and extension in gear case (Figs. 29, 30).

(3) Install center support plate bolts (Fig. 28). Tighten bolts to 54 N•m (40 ft-lbs) torque.

(4) Install square anti-spin pin and reverse gear thrust washer (Fig. 27).

SHIFT RAIL AND FORK INSTALLATION

(1) Install reverse gear and needle bearings (Fig. 26).

(2) Install shift forks (Fig. 24).

(3) Install 3-4 shift rail and interlock plate (Fig. 23).

(4) Position synchronizer in reverse/OD shift fork. Then install assembled components (Fig. 22).

(5) Install reverse/OD synchronizer snap ring (Fig. 21).

OVERDRIVE GEAR INSTALLATION

(1) Install mainshaft overdrive gear (Fig. 20).

(2) Install overdrive gear thrust washer and anti-spin pin (Fig. 19).

(3) Install overdrive gear snap ring (Fig. 18).

(4) Install overdrive countershaft gear with tools C-4982, C-4982-2, C-4982-6 and a wood block (Fig. 75). Refer to Figure 17 for installer tool components.

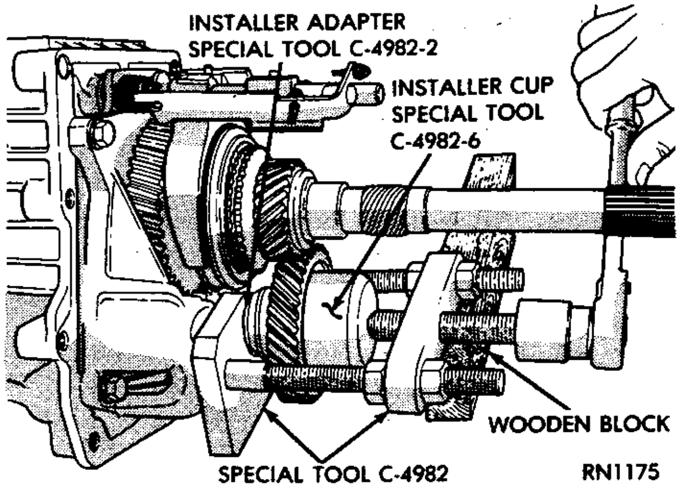

Fig. 75 Installing Countershaft Overdrive Gear

(5) Install countershaft overdrive gear snap ring (Fig. 14).

FINAL ASSEMBLY

(1) Install 1-2 shift rail and interlock plates (Fig. 13).

(2) Install shift fork pins (Fig. 12).

(3) Seat overdrive shift rail and blocker spring (Fig. 11).

(4) Apply bead of sealer to extension housing and install housing over gears and on center support plate (Fig. 10). Tighten attaching bolts to 54 N•m (40 ft-lbs) torque.

(5) Install detent springs and bullets (Fig. 7).

(6) Apply bead of sealer to access cover and install cover on case (Fig. 4). Tighten cover bolts to 28 N•m (21 ft-lbs) torque.

(7) Install shifter assembly. Tighten shifter bolts to 28 N•m (21 ft-lbs) torque.

(8) Install backup lamp switch.

(9) Install drain plug.

(10) Install countershaft gear O-ring and expansion plug.

TRANSMISSION INSTALLATION

(1) Lightly lubricate input shaft and front bearing retainer with Mopar high temperature grease.

(2) Align input shaft with clutch disc and slide transmission into place on housing.

(3) Install and tighten transmission-to-clutch housing bolts.

(4) Install crossmember and insulator.

(5) Install transfer case, if equipped.

(6) Remove supports.

(7) Install speedometer adapter and distance sensor.

(8) Connect backup lamp switch wires.

(9) Align and connect propeller shaft(s).

(10) Refill transmission with 10W-30, API SG/CD engine oil.

(11) Lower vehicle and install upper part of shift lever.

NP435 MANUAL TRANSMISSION

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GENERAL INFORMATION

The NP435, four-speed manual transmission used for heavy service applications (Fig. 1). Second, third, and fourth gears are helical, constant mesh gears with synchronizers. First and reverse gears are spur type and not synchronized. The reverse idler gear is serviced as an assembly complete with integral bearings. The countershaft gear is a one-piece design.

A ball bearing supports the main drive pinion. A pilot roller bearing recessed in the main drive pinion supports the front end of themainshaft with the rear end supported by a ball bearing.

The front synchronizer unit consists of a sliding clutch gear, energizer springs, floating solid pins and synchronizer cones. The unit is serviced only as an assembly. The stop rings can be serviced separately but should be used in sets with the new floating solid pin type synchronizer.

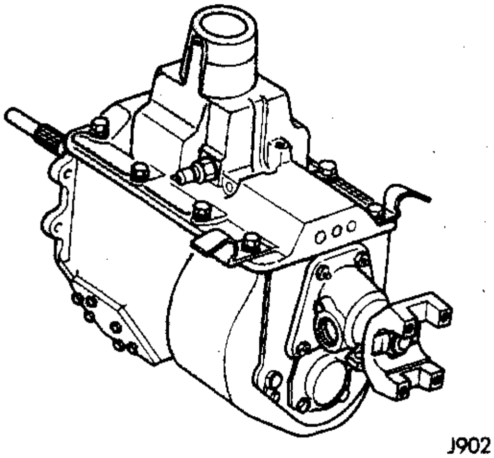

Fig. 1 NP435 Manual Transmission

SERVICE DIAGNOSIS

The majority of transmission malfunctions are caused by insufficient lubricant, incorrect lubricant, misadjusted or damaged internal components, loose attaching parts, or improper operation.

HARD SHIFTING

A low lubricant level, loose or worn shift lever, or loose, damaged shift housing components are common causes of hard shifting. If hard shifting is also accompanied by gear clash, synchronizer stop rings or mainshaft clutch gear teeth may be worn or damaged.

Hard shifting may also be caused by a loose, or misaligned shift housing. Either fault can result in component bind and high shift efforts.

NOISY OPERATION

Transmission noise is most often a result of worn or damaged components. Chipped, broken gear or synchronizer teeth and brinnelled, spalled bearings all cause noise. Abnormal wear and damage to internal components is frequently the end result of insufficient lubricant, non-recommended lubricants, or improper operation.

SLIPS OUT OF GEAR

Transmission disengagement may be caused by misaligned or damaged shift components, or worn synchronizer clutch teeth on the mainshaft gears. Incorrect assembly will also contribute to gear disengagement.

LOW LUBRICANT LEVEL

Insufficient transmission lubricant is usually the result of leaks, or inaccurate fluid level check or refill method. Leaks will be evident by the presence of gear oil around the leak point. If leakage is not evident, the condition is probably the result of an underfill condition.

If air powered lubrication equipment is used to fill a transmission, be sure the equipment is properly calibrated. Equipment out of calibration can lead to an underfill condition.

CLUTCH PROBLEMS

Worn, damaged, or misaligned clutch components can cause difficult shifting, gear clash and noise.

A worn pilot bushing will cause noise and input shaft misalignment. The result is hard shifting and noise.

A worn or damaged clutch disc, pressure plate, or release bearing can cause hard shifting and gear clash.

Damaged or worn clutch hydraulic components, or leaks in the fluid lines or cylinders will cause hard shifting and gear clash. Failure of one of the clutch hydraulic cylinders can result in incomplete clutch release or engagement.

Be sure that the clutch components are all in good condition before removing the transmission for repair.

TRANSMISSION REMOVAL

(1) Remove the shift lever retainer by pressing down, rotating the retainer counterclockwise slightly and releasing it (Fig. 2).

(2) Remove transfer case (if so equipped) as follows:

(3) Remove 4 bolts attaching skid plate rear crossmember to underside of frame, if so equipped.

(4) Remove bolts attaching front end of skid plate to transmission crossmember. Remove skid plate.

(5) Disconnect speedometer cable.

(6) Disconnect front and rear output shafts (support each shaft, do not allow shafts to hang).

(7) Disconnect shift rods at transfer case.

(8) With suitable jack, support transfer case. Be sure transfer case is safely secured in removing device.

(9) Remove extension to transfer case mounting bolts.

(10) Move transfer case rearward to disengage front input spline.

(11) Lower transfer case assembly and remove from under vehicle.

(12) Disconnect back-up lamp switch lead.

(13) Install engine support fixture C-3487A, with adapter tool DD-1279 firmly over frame rails. Be sure support ends are up against underside of oil pan flange.

(14) Support transmission with a suitable jack.

(15) Remove transmission crossmember.

(16) Remove transmission to clutch housing bolts. Slide transmission toward rear until drive pinion shaft clears clutch disc, before lowering transmission.

(17) Lower transmission and remove from under vehicle. Thoroughly clean exterior of unit.

TRANSMISSION DISASSEMBLY

SHIFT COVER AND PARKING BRAKE

(1) Mount transmission in holding fixture.

(2) Shift gears into neutral by replacing gear shift lever temporarily, or using bar or screwdriver.

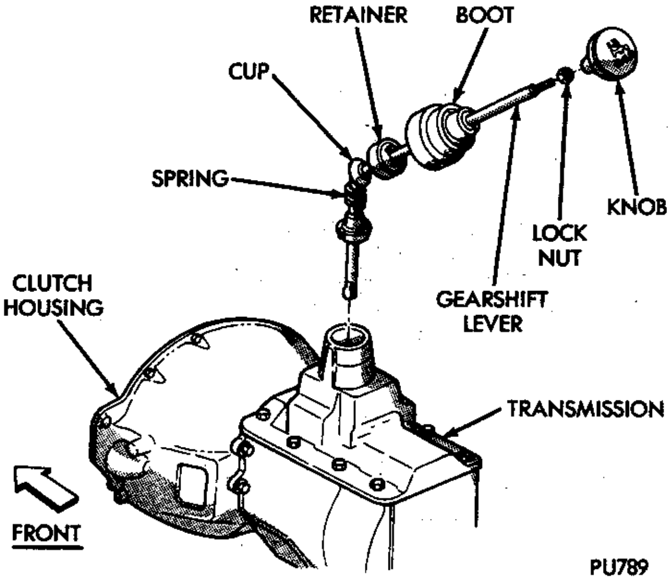

Fig. 2 NP435 Gear Shift Lever Components

(3) Remove cover screws. Second screw from front on each side is shouldered with split washer for installation alignment.

(4) While lifting cover, rotate slightly counterclockwise to provide clearance to shift forks and remove cover (Fig. 3).

(5) Remove extension housing.

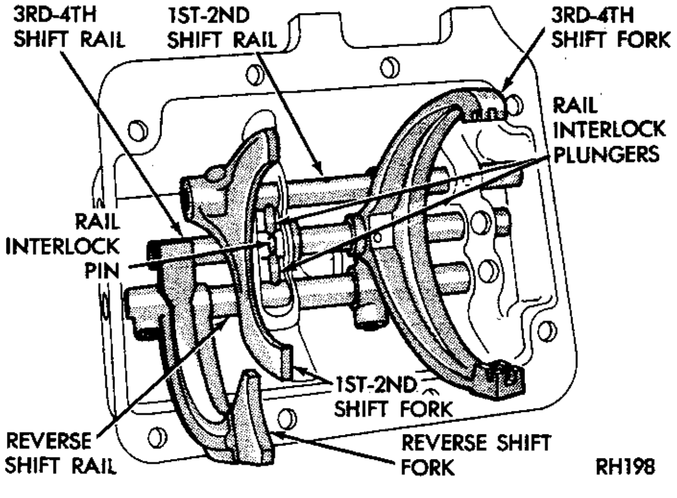

Fig. 3 Transmission Cover Assembly

SYNCHRONIZER END PLAY CHECK

Measure end play between synchronizer outer stop ring and third speed gear (Fig. 4). Do this before removing drive pinion and mainshaft. Use two feeler gauges as shown.

Correct end play is 1.27 to 1.78 mm (.050 to .070 inch). Record end play so that correction shims can be installed during reassembly. Thick or thin shims are available as required.

DRIVE PINION

(1) Remove drive pinion bearing retainer.

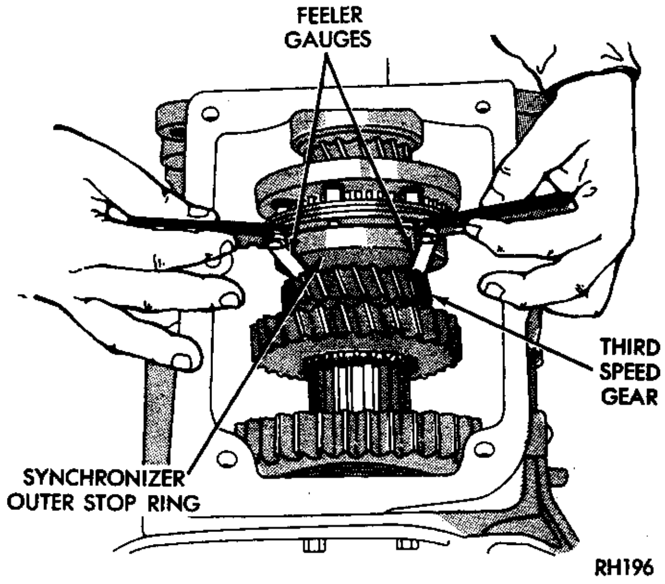

Fig. 4 Measuring Synchronizer End Play

(2) Rotate the drive pinion gear to align space in pinion gear clutch teeth with countershaft drive gear teeth. Remove drive pinion gear and ball bearing from transmission. Pull on pinion shaft and tap face of case with brass hammer to remove.

(3) Remove snap ring, washer, and pilot roller bearings from recess in drive pinion gear.

MAINSHAFT

(1) Place a brass drift in front center of mainshaft and drive mainshaft to rear.

(2) When mainshaft rear bearing has cleared case remove rear bearing with a suitable puller.

(3) Move mainshaft assembly to rear and tilt front of mainshaft up.

(4) Remove roller type thrust bearing.

(5) Remove synchronizer and stop rings separately.

(6) Remove mainshaft assembly.

REVERSE IDLER GEAR

(1) Remove reverse idler lock screw and lock plate.

(2) With brass drift held at angle, drive idler shaft to rear and pull shaft.

(3) Lift reverse idler gear from case.

COUNTERSHAFT GEAR

(1) If excessive side play and end play are not found and teeth are not badly worn or chipped, countershaft gear should not require replacement. However, if gear is damaged, remove as follows.

(2) Remove bearing retainer at rear end of countershaft. The roller bearing assembly at rear end of shaft remains with retainer.

(3) Tilt countershaft gear assembly and work out of case.

(4) Using a suitable driver, remove front bearings from case.

COMPONENT DISASSEMBLY (Fig. 5)

MAINSHAFT

(1) Remove clutch gear snap ring.

(2) Remove clutch gear, synchronizer outer stop ring to third speed gear shim(s), and third speed gear.

(3) Remove special split lock ring with two screwdrivers. Remove second speed gear and synchronizer.

(4) Remove first and reverse sliding gear.

REVERSE IDLER GEAR

(1) Do not disassemble. If no longer serviceable replace as an assembly complete with integral bearings.

COVER AND SHIFT FORKS (FIG. 6)

(1) Cover and shift forks should be disassembled only if rails, poppets, interlock plungers, springs, shift forks, or cover itself need replacing.

(2) Remove roll pin from first and second speed shift fork. Remove roll pin from gate in the same manner. A square type or closely wound spiral easy-out mounted in a tap handle is preferable for this operation.

(3) Push shift rail out through the front to force expansion plug out of cover. Cover detent ball access hole in cover with cloth to prevent ball and spring from flying as rail clears hole. Remove rail, fork, and gate.

(4) Remove third and fourth speed rails in the same manner, then remove reverse rail.

(5) Compress reverse gear plunger and remove retaining clip. Remove plunger and spring from gate.

DRIVE PINION AND BEARING RETAINER

(1) Remove ball bearing from pinion shaft with suitable tool.

(2) Remove snap ring, washer and pilot rollers from gear bore (if not previously removed).

(3) Remove pinion shaft seal, with suitable seal remover.

COMPONENT ASSEMBLY (Fig. 5)

Use new expansion plugs, gaskets and seals during overhaul. Lubricate all parts with transmission lubricant before assembly. Use petroleum jelly to hold parts in place during assembly installation.

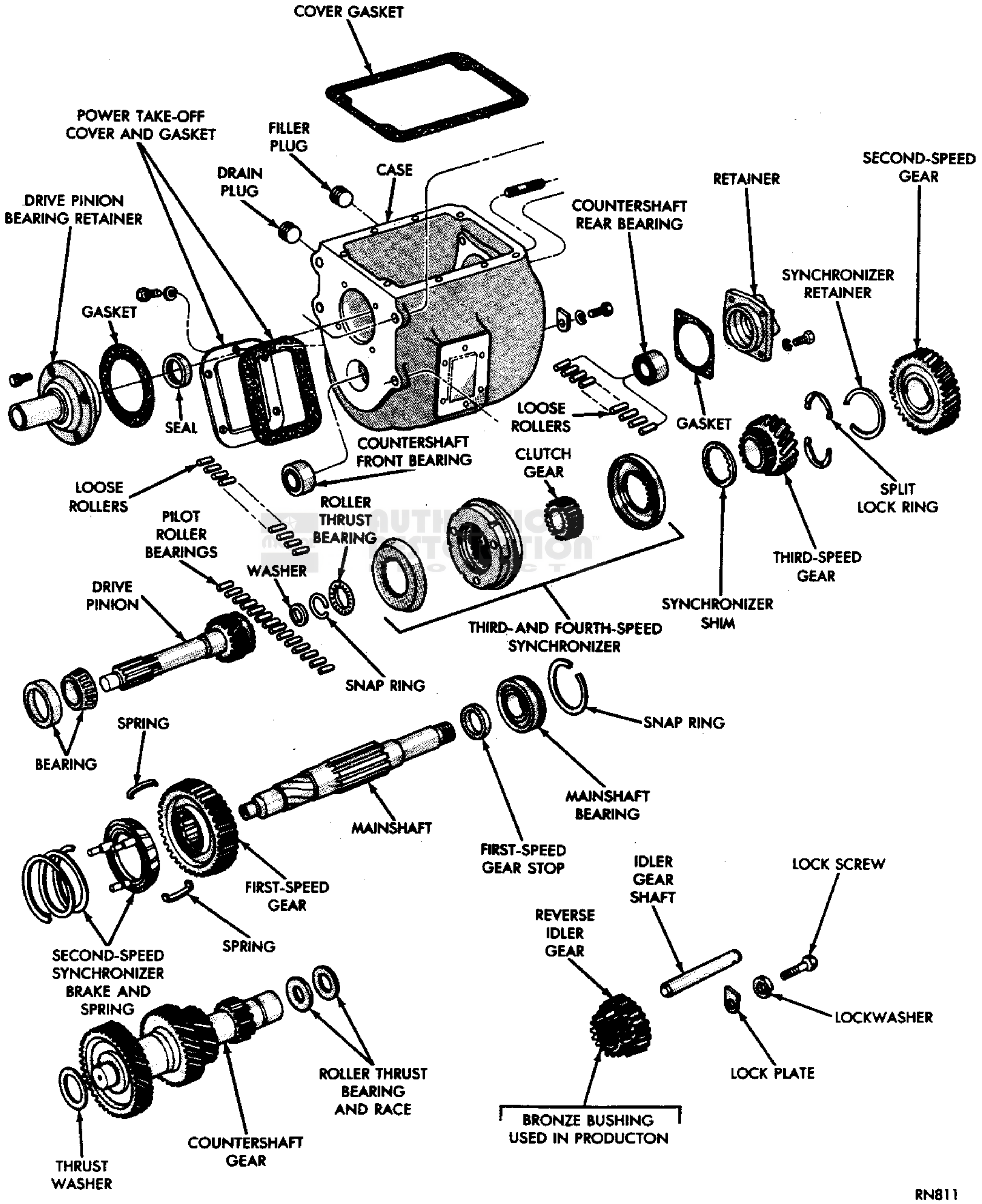

Fig. 5 NP435 Transmission Components

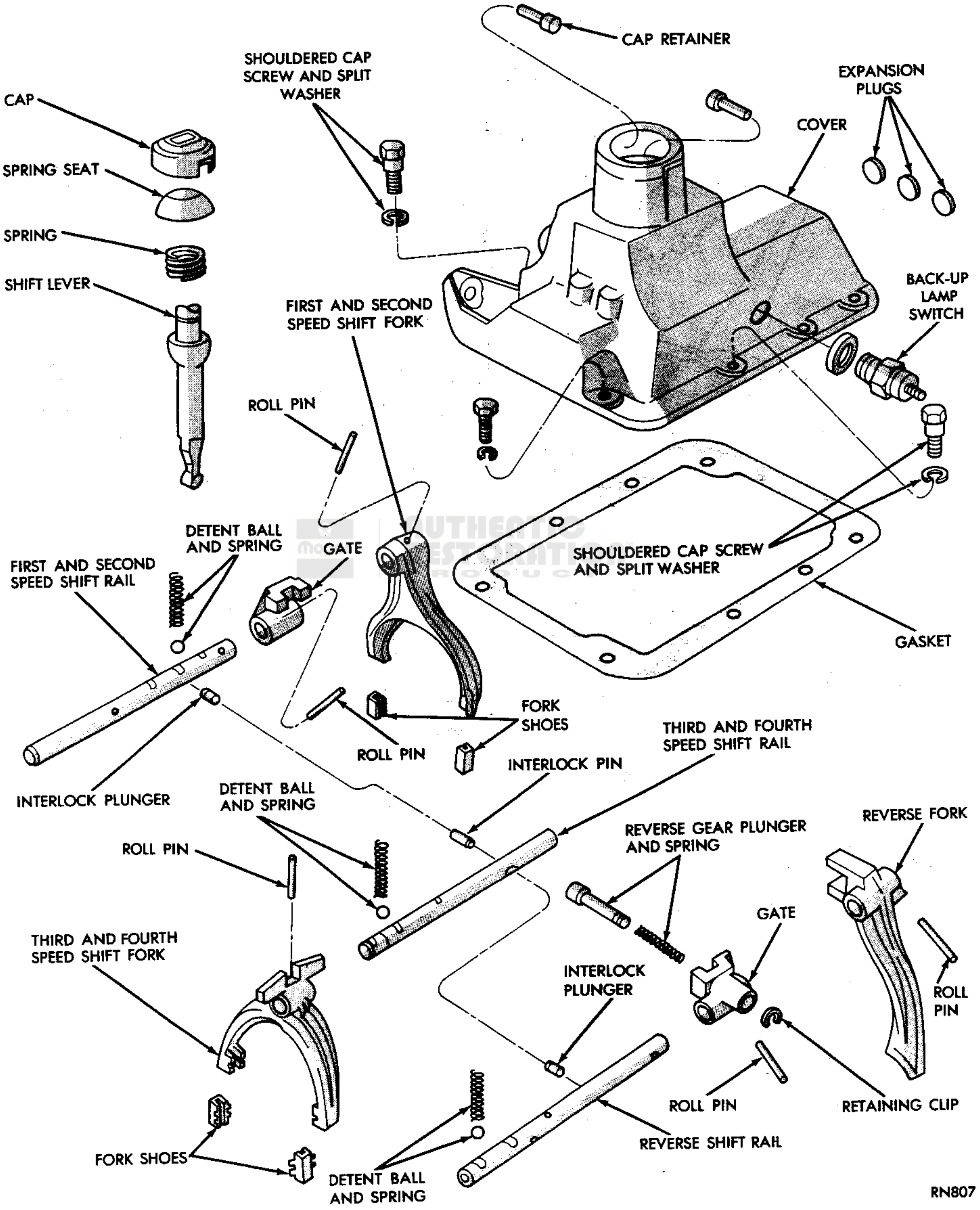

Fig. 6 Shift Cover Components

MAINSHAFT

(1) Place mainshaft in soft-jawed vise with rear end up.

(2) Install first and reverse speed gear. Be sure the two spline springs (if used) are in place inside gear as it is placed on shaft.

(3) Mount mainshaft in vise with forward end of shaft facing up. Use protective jaws to avoid damaging shaft surfaces.

(4) Install second gear synchronizer spring and synchronizer on gear. Secure with snap ring making sure that snap ring tangs are away from gear.

(5) Slide second speed gear onto front of output shaft making sure that synchronizer is toward rear. Secure gear to shaft with two-piece lock ring. Install third speed gear.

(6) Install shim(s) between third speed gear and third and fourth speed synchronizer stop ring. Refer to end play measurement at disassembly to determine shim thickness needed for correct end play of 1.27 - 1.78 mm (.050 to .070 inch). Exact determination of end play must be made after complete assembly of mainshaft and main drive pinion is installed in the transmission case.

REVERSE IDLER GEAR

No gear assembly required. If no longer serviceable, replace as an assembly complete with integral bearings.

DRIVE PINION AND BEARING RETAINER

(1) Coat roller bearings with petroleum jelly (to hold rollers in place) and insert in pocket of drive pinion gear.

(2) Install washer and snap ring.

(3) Press a new oil seal into place in bearing retainer. Make sure lip of seal is toward mounting surface (rearward).

COVER AND SHIFT FORKS (FIG. 6)

(1) Assemble spring on reverse gear plunger and hold it in reverse shift gate. Compress it in gate and install retaining clip.

(2) Enter reverse shift rail in cover and place detent spring and ball in position. Depress ball and slide rail over it.

(3) Install gate and fork on rail. Install a new roll pin in gate and in fork.

(4) Place reverse fork in neutral position.

(5) Install the two interlock plungers in their bores.

(6) Insert the interlock pin in the third and fourth speed shift rail. Install rail in the same manner as reverse shift rail.

(7) Install first and second speed shift rail in the same manner making sure the interlock plunger is in place.

(8) Check interlocks by shifting reverse shift rail into reverse position. It should not be possible to shift the other shift rails when this rail is shifted.

(9) If shift lever is to be installed at this point lubricate spherical ball seat and place cap in place.

(10) Install back-up lamp switch.

(11) Install new expansion plugs in bores of rail holes.

(12) Install rail interlock hole plug.

TRANSMISSION ASSEMBLY

COUNTERSHAFT

(1) Press front roller bearing into case until cage is flush with front of case. Lubricate roller bearings with petroleum jelly.

(2) Place transmission with front of case facing down. If uncaged bearings are reused, hold loose rollers in place in cap with light film of grease (not required with caged type).

(3) Lower countershaft assembly into case placing thrust washer tangs in slots in case, and inserting front end of shaft into bearing.

(4) Place roller thrust bearing and race on rear end of countershaft, holding in place with light coating of grease.

(5) While holding gear assembly in alignment install rear bearing retainer gasket, retainer and bearing assembly. Install and tighten cap screws.

REVERSE IDLER ASSEMBLY

(1) Position reverse gear and bearing assembly in case.

(2) Align idler shaft so lock plate groove in shaft is in proper alignment to install lock plate.

(3) Tap shaft into case far enough to start reverse gear.

(4) While holding gear in position, tap shaft through case and gear.

(5) Install lock plate, washer, and cap screw.

(6) Make sure gear turns freely on shaft.

MAINSHAFT AND DRIVE PINION

(1) Lower rear end of pre-assembled mainshaft into case holding first speed gear on shaft and maneuver shaft through rear bearing opening.

(2) With shaft assembly moved to rear of case, be sure third and fourth speed synchronizer and preselected shims remain in position.

(3) Install roller type thrust bearing.

(4) Place a wooden block between front of case and front of mainshaft.

(5) Install rear bearing on mainshaft by carefully driving bearing onto shaft and into case (snap ring flush against case) using a suitable sleeve against inner race of bearing.

(6) Install drive pinion and ball bearing assembly making sure pilot rollers remain in place.

(7) Install rear bearing retainer and gasket.

(8) Install drive pinion bearing retainer with gasket.

(9) Check synchronizer end play after all mainshaft components are installed and tightened. Two sets of equal feeler gauges are needed to check end play (Fig. 3). End play should be 1.27 - 1.78 mm (.050 to .070 inch). Keep gauges as close to both sides of the mainshaft as possible for best results. If necessary, disassemble mainshaft and change shim thickness.

(10) Shift gears and/or synchronizer into all speed positions and check for free rotation.

(11) Lubricate transmission parts with gear oil before installing cover.

(12) Move transmission gears into neutral position.

(13) Lower cover with new gasket on case, over transmission.

(14) Carefully engage forks into proper gears and lower cover into place.

(15) Install one shouldered alignment screw and split washer in each second-from-front hole on each side of cover and test gears for free rotation by shifting gears through cover tower with long screwdriver.

(16) Install remaining cover screws.

TRANSMISSION INSTALLATION

(1) Lubricate the pilot bushing with Mopar high temperature wheel bearing grease.

(2) Mount transmission on suitable jack and slide assembly under vehicle.

(3) Raise transmission until drive pinion is centered in clutch housing bore.

(4) Roll transmission slowly forward until pinion shaft enters clutch disc. Turn pinion shaft until splines are aligned, then work transmission forward until seated against clutch housing. Do not allow transmission to hang after pinion shaft has entered the clutch disc.

(5) Install transmission to clutch housing bolts and tighten to 142 N•m (105 ft-lbs).

(6) Install transmission rear mount assembly on crossmember.

(7) Install crossmember.

(8) Remove engine support fixture and disengage hooks from the frame side rails.

(9) Install shift lever.

(10) Install transfer case if equipped.

(11) Fill transmission with required lubricant.

(12) Road test vehicle to make sure transmission shifts smoothly and operates quietly.

A-998/999/727 AUTOMATIC TRANSMISSION

GENERAL INFORMATION

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TRANSMISSION APPLICATION

Chrysler A998/999 and A-727, three-speed automatic transmissions are used in AD models. All are fully automatic, hydraulically operated units with a compound planetary gear system (Figs. 1 and 2). The A-998/999 transmission is used for 3.9L and 5.2L applications. The A-727 is used for 5.9L applications.

TORQUE CONVERTER

A three element torque converter is used. A lockup torque converter is used with A-998/999 transmissions. A-727 transmissions are equipped with a non-lockup converter.

The converter impeller is connected to the engine crankshaft through the front cover which is welded to the impeller. The turbine is splined to the transmission input shaft and the stator is splined to the transmission reaction shaft.

The torque converter is a welded assembly and is not a repairable component. The converter is serviced as an assembly only.

WIDE RATIO PLANETARY GEARS

A wide ratio planetary gear set is used in A-998/999 transmissions (Fig. 3). The wide ratio gears provide a 2.74:1 first gear and a 1.54:1 second gear. Third gear is direct with ratio of 1.00:1.

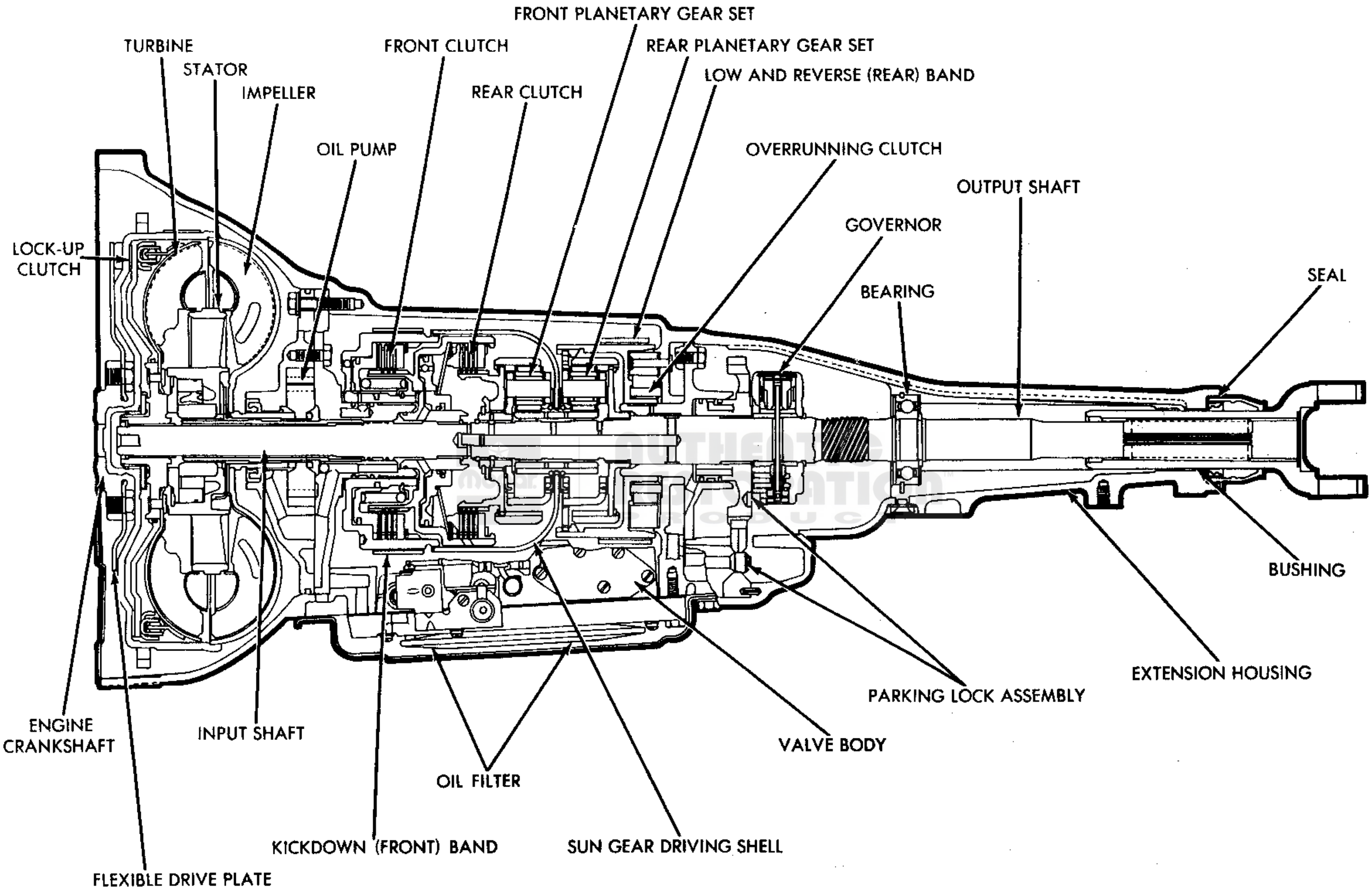

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Fig. 1 Automatic Transmission—A-998/999)

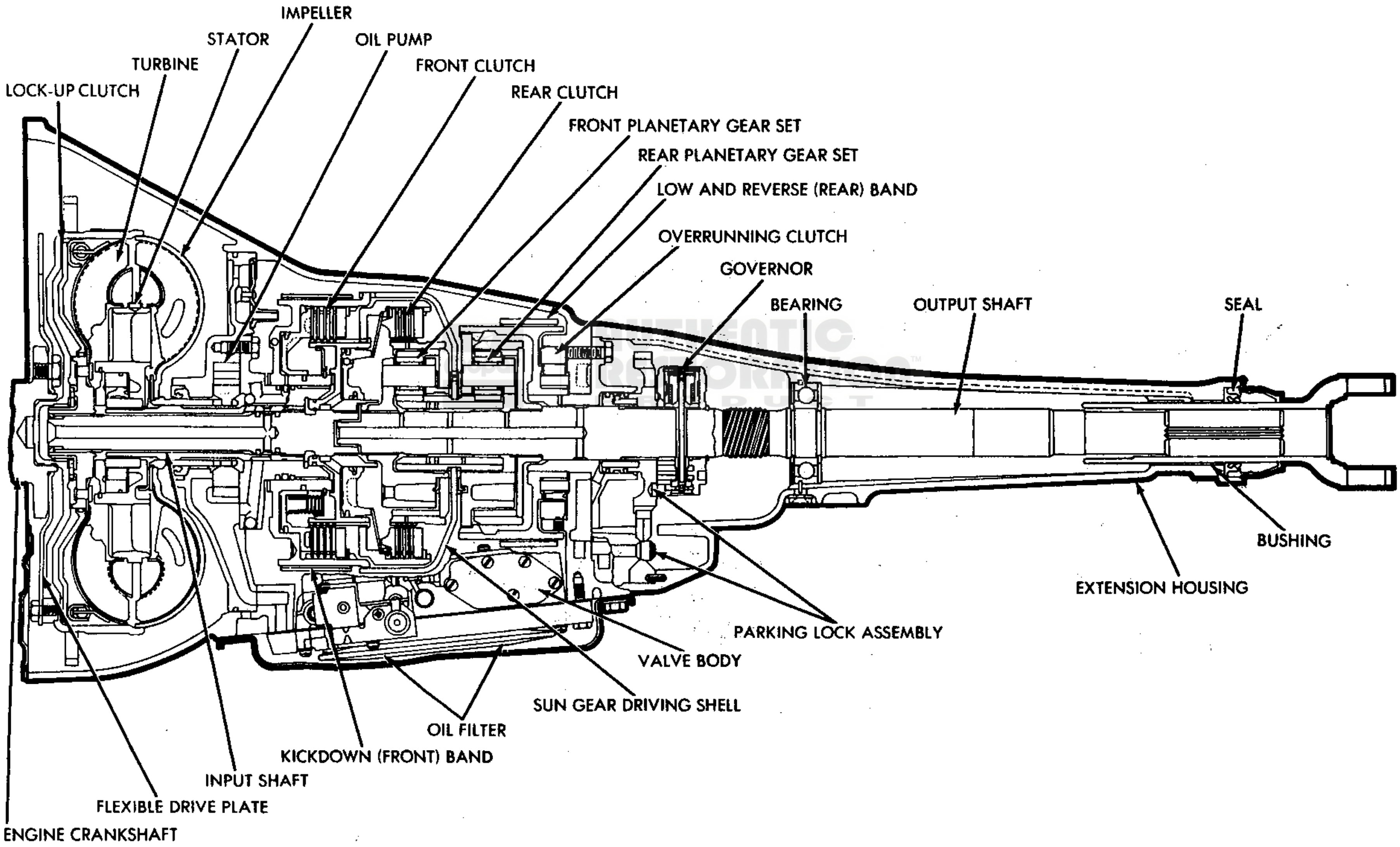

Fig. 2 Automatic Transmission—A-727

PR226

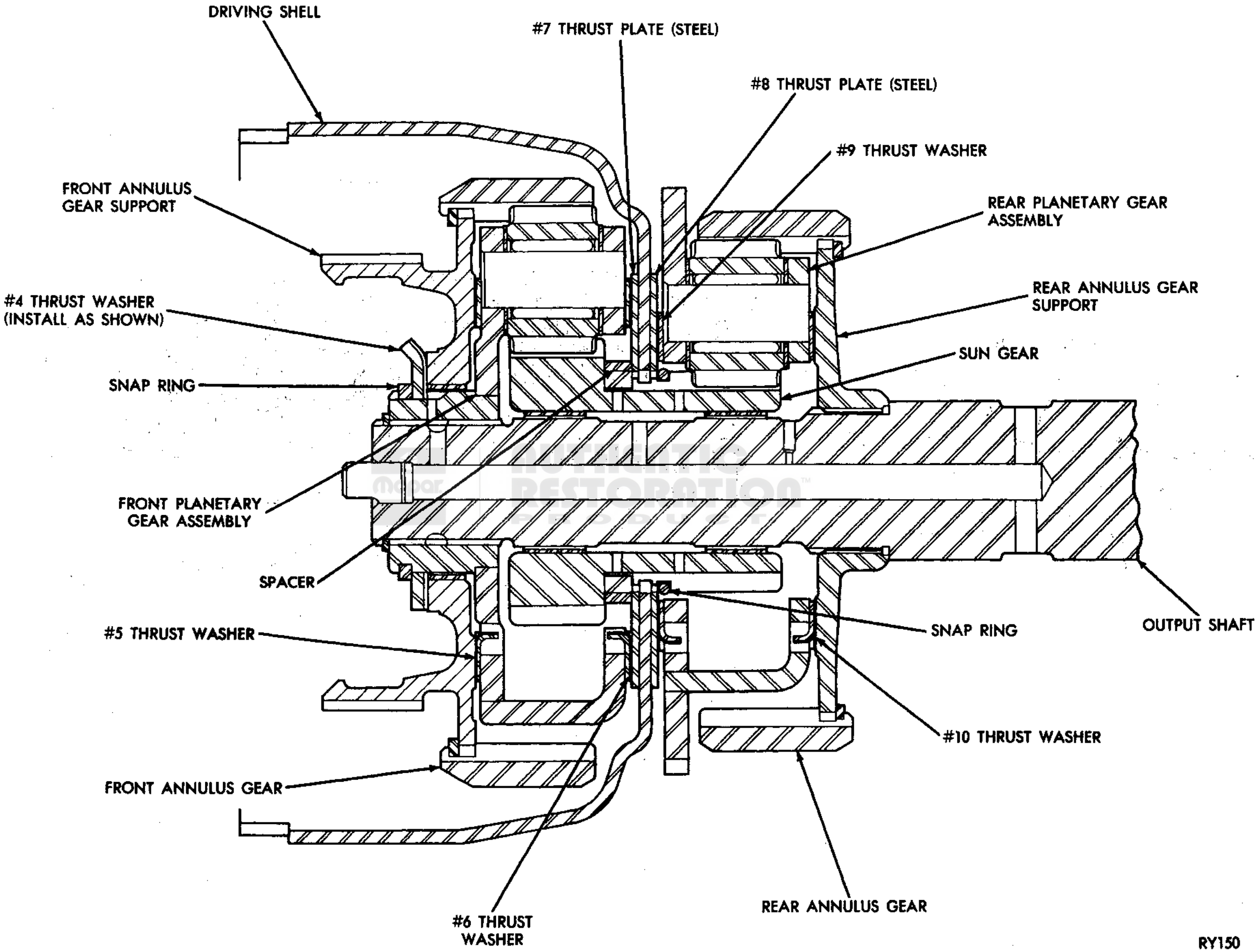

Fig. 3 Wide Ratio Gear Set—A-998/999

RECOMMENDED FLUID

Recommended fluid for all Chrysler automatic transmissions is Mopar ATF Plus, Type 7176, or Mopar Dexron II™.

Mercon™ transmission fluid should only be used for topping off the transmission fluid level during a normal maintenance check. It is not recommended for refilling after scheduled maintenance or after overhaul.

TRANSMISSION IDENTIFICATION

The transmission part/identification numbers are stamped on the left side of the case just above the oil pan gasket surface. Refer to this information when ordering replacement parts for any Loadflite transmission.

TRANSMISSION CONTROLS AND COMPONENTS

The transmission hydraulic control system provides fully automatic operation. The system performs five basic functions, which are: pressure supply, pressure regulation, flow control, clutch/band application, and lubrication.

Pressure Supply

The oil pump develops fluid pressure for clutch/band application and for lubrication. The pump is driven by the torque converter which is attached to the engine crankshaft by the driveplate.

Pressure Regulation

The pressure regulator valve maintains transmission line pressure. The amount of pressure developed is controlled by throttle pressure which is dependent on the degree of throttle opening. The regulator valve is located in the valve body. The governor valve is operated by the transmission output shaft.

The throttle valve determines line pressure and shift speed. Governor pressure increases in proportion to vehicle speed.

The throttle valve also controls upshift and downshift speeds by regulating pressure in conjunction with throttle position.

Flow Control And Lubrication

The manual valve is operated by the gearshift linkage and provides the operating range selected by the driver.

The 1-2 shift valve provides automatic 1-2 or 2-1 shifts and the 2-3 shift valve provides automatic 2-3 or 3-2 shifts. The kickdown valve provides forced 3-2 or 3-1 downshifts depending on vehicle speed. Downshifts occur when the throttle is opened beyond downshift detent position which is just before wide open throttle.

The 2-3 valve throttle pressure plug provides 3-2 downshifts with varying throttle openings and depending on vehicle speed. The 1-2 shift control valve transmits 1-2 shift pressure to the accumulator piston to control kickdown band capacity on 1-2 upshifts and 3-2 downshifts.

The limit valve determines maximum speed at which a 3-2 part throttle kickdown can be made. Some transmissions do **not** have the limit valve and maximum speed for a 3-2 kickdown is at the detent position.

The shuttle valve has two functions. First is fast front band release and smooth engagement during lift-foot 2-3 upshifts. The second is to regulate front clutch and band application during 3-2 downshifts.

The lockup valve automatically applies the converter lockup clutch when supplied with line pressure through the lockup solenoid. The solenoid is controlled by the engine electronics through an electrical connector at the rear of the transmission case.

Electronic control of torque converter lockup includes converter unlocking at closed throttle during warmup and during part throttle acceleration. The non-lockup A-998 used in California has a threaded plug in the rear of the transmission case in place of the lockup wiring connector.

The fail safe valve restricts feed to the converter lockup clutch if front clutch pressure drops. It permits lockup only in direct (third) gear and provides fast lockup release during a kickdown.

The switch valve directs apply fluid pressure to the lockup clutch in one position and releases it in the opposite position. It also directs oil to the cooling and lube circuits. The switch valve regulates oil pressure to the torque converter by limiting maximum oil pressure to 130 psi.

Clutch/Band Application

The front/rear clutch pistons and servo pistons are actuated by line pressure. When line pressure is removed, the pistons are released by spring tension.

On 2-3 upshifts, the front servo piston is released by spring tension and hydraulic pressure. The accumulator controls hydraulic pressure on the apply side of the front servo during 1-2 upshifts at all throttle openings.

Gearshift And Parking Lock Controls

The gearshift lever provides six operating positions: Park (P), Reverse (R), Neutral (N), and the D, 2 and 1 forward drive ranges.

1 position provides overrun braking when the throttle is released. However, upshifts are not provided in 1 position. 1-2 up shifts will occur in 2 position but no 2-3 upshift will take place. D position provides 1-2, 2-3 upshifts and 3-2 and 3-1 downshifts.

A neutral switch controls engine starting. The switch is designed to allow engine starts only in Park or Neutral positions.

The transmission parking lock mechanism is engaged when the shift lever is moved into the Park detent. The mechanism consists of a pawl that engages a gear on the output shaft.

OPERATING INSTRUCTIONS

The transmission will automatically upshift and downshift. The quality of shifts is important. All shifts should be smooth and positive without engine flare or runaway.

Gearshift And Parking Lock Controls

The column mounted gearshift lever has six lever positions which are: P (Park); R (Reverse); N (Neutral); D (Drive); 2 (Second Gear); and 1 (First Gear).

The parking lock is engaged by moving the shift lever past a gate into the P (Park) position. **Do not apply the parking lock until the vehicle has stopped. Otherwise a severe ratcheting noise will occur.**

Starting The Engine

The engine will start with the shift lever in Park or Neutral positions. As a safety precaution, apply the service or parking brakes when starting in Neutral. **If the engine will not start, do not attempt to start it by pushing or towing the vehicle. The transmission will not permit engine starting in this manner.**

Mountain Driving

Trailer towing or pulling heavy loads in mountainous terrain imposes severe loads on the transmission, torque converter and fluid. Shift the transmission into 2 or 1 range on steep upgrades which require heavy throttle application for 1/2 mile or more. This will reduce the possibility of overheating the transmission and torque converter.

Vehicle Towing

If the transmission is inoperative, either tow the vehicle with the rear end raised, or remove the propeller shaft and flat-tow the vehicle.

If the transmission is operating properly, shift the transmission into Neutral. The vehicle can then be towed with the front or rear end raised, or it can be flat-towed.

Towing speed should not exceed 30 mph (48 km/h).

If the vehicle must be towed for an extended distance, either tow the vehicle with the rear end raised, or remove the propeller shaft and flat-tow the vehicle. Since transmission lubrication only occurs when the engine is running, it is good practice to always tow a vehicle with the rear end raised or with the propeller shaft removed.

DIAGNOSIS AND TEST PROCEDURES

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GENERAL INFORMATION

Automatic transmission problems can be a result of poor engine performance, incorrect fluid level, incorrect linkage adjustment, band or hydraulic control pressure adjustments, hydraulic system malfunctions or mechanical component malfunctions.

Begin diagnosis by checking the easily accessible items such as fluid level and condition and linkage adjustments. A road test will determine if further diagnosis is necessary.

Procedures outlined in this section should be performed in the following sequence to realize the most accurate results:

- Preliminary diagnosis
- Fluid Level and condition
- Linkage Adjustment
- Road test
- Stall test
- Hydraulic pressure test
- Air pressure tests
- Leak Tests
- Analyze test results and consult diagnosis charts

PRELIMINARY DIAGNOSIS

Two basic procedures are required. One procedure for vehicles that are driveable and an alternate procedure for disabled vehicles (will not back up or move forward).

Vehicle Is Driveable

(1) Check fluid level and condition.

(2) Adjust throttle and gearshift linkage if complaint was based on delayed, erratic, or harsh shifts.

(3) Road test and note transmission operating characteristics.

(4) 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.

(5) Perform hydraulic pressure tests.

(6) Perform air pressure test to check clutch-band operation.

Vehicle Is Disabled

(1) Check fluid level and condition.

(2) Check for broken, disconnected throttle linkage.

(3) Check for cracked, leaking cooler lines, or loose, missing pressure port plugs.

(4) Raise vehicle, start engine, shift transmission into gear and note following:

(a) If propeller shafts turn but wheels do not, problem is with differential or axle shafts.

(b) If propeller shafts do 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 shafts do not turn and transmission is not noisy, perform hydraulic pressure test to determine if problem is a hydraulic or mechanical.

CHECKING FLUID LEVEL AND CONDITION

(1) Place the vehicle on a level surface. This is important for an accurate reading.

(2) To avoid false readings, which could produce under or over fill condition, do not check level until fluid is at normal operating temperature of 180°F.

(3) Shift transmission into Neutral.

(4) Apply parking brakes.

(5) Shift the transmission momentarily into all gear ranges. Then shift the transmission back to Neutral.

(6) Clean the top of the filler tube and dipstick to keep dirt from entering the tube.

(7) Check the fluid level. Correct level is as follows:

(a) If fluid is at normal operating temperature, the correct level is between the "Maximum Level Hot" and "Add" marks (crosshatched area) on the dipstick.

(b) If the fluid is only warm (85 to 125°F), the correct level is between the two dimples on the dipstick.

(8) If the fluid level is low, add only enough fluid to correct the level.

CAUTION: Do not overfill the tranmission. Overfilling may cause leakage out the pump vent which can be mistaken for a pump seal leak. In addition, overfilling will also cause fluid aeration and foaming as the excess fluid is picked up and churned by the gear train. This will reduce the life of the fluid significantly.

(9) Check fluid condition. Fluid should be dark to light red in color and free of dirt or debris.

(10) If fluid is discolored or smells burned but transmission operation was OK, flush cooler and lines and change fluid and filter. Then road test again to confirm proper operation.

(11) If fluid is black or dark brown, burned/turned to sludge, contains extensive amount of metal or friction material particles, transmission will probably need overhaul; Especially if problems were evident during road test and preliminary diagnosis.

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, aerating the fluid and causing the same conditions that occur with a low level.

In either case, air bubbles cause fluid overheating, oxidation and varnish buildup which interferes with valve, clutch and servo operation. Foaming also causes fluid expansion which can result in fluid overflow from the transmission vent or fill tube. Fluid overflow can easily be mistaken for a leak if inspection is not careful.

THROTTLE VALVE LINKAGE

Throttle valve linkage adjustment is important to proper operation. This adjustment positions the throttle valve which controls shift speed, quality and part throttle downshift sensitivity. If linkage setting is too short, early shifts and slippage between shifts may occur. If the setting is too long, shifts may be delayed and part throttle downshifts may be very sensitive. Refer to the In-Vehicle Service section for adjustment procedure.

GEARSHIFT LINKAGE

Gearshift linkage adjustment is important because it positions the valve body manual valve. Incorrect adjustment will cause creeping in Neutral, premature clutch wear, delayed engagement in any gear, or a no-start in Park or Neutral.

Proper operation of the neutral switch will provide a quick check of linkage adjustment. Refer to the In-Vehicle Service section for adjustment procedure.

ROAD TEST

Before road testing, be sure the fluid level and all linkage adjustments have been checked and adjusted if necessary.

Observe engine performance during the road test. A poorly tuned engine will not allow an accurate analysis of transmission operation.

Operate the transmission in all gear ranges. Check for slippage and shift variations. Note whether the shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Watch closely for slippage or engine flare which usually indicates clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul may be necessary to restore normal operation.

A slipping clutch or band can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch and Band Application chart (Fig. 1) provides a basis for analyzing road test results.

	Gearshift Lever Position								
DRIVE ELEMENTS	P	R	N	D			2		1
				1	2	3	1	2	
FRONT CLUTCH		●				●			
FRONT BAND (KICKDOWN)					●			●	
REAR CLUTCH				●	●	●	●	●	●
REAR BAND (LOW-REV.)		●							●
OVER-RUNNING CLUTCH				●			●		●

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Fig. 1 Clutch And Band Application Chart

ANALYZING THE ROAD TEST

Refer to the Clutch and Band Application chart (Fig. 1) and note which elements are in use in the various gear ranges.

The rear clutch is applied in all forward ranges (D, 2, 1). The overrunning clutch is applied in first gear (D and 2 range only).

The rear band is applied in 1 and R range only.

For example: If slippage occurs in first gear in D and 2 range but not in 1 range, the overrunning clutch is slipping. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

Applying the same method of analysis, note that both clutches are applied in D range third gear only.

If the transmission slips in third gear, either the front clutch or the rear clutch is slipping. By selecting another gear which does not use one of these units, the slipping clutch 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.

This process of elimination can be used to determine the 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 the condition is obvious, such as no drive in D range, first gear only, the transmission should not be disassembled until hydraulic and air pressure tests have been performed.

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. Use 100 psi test gauge C-3292 to check pressure at the accumulator, front servo, governor and fluid cooler line. Use 300 psi gauge C-3293 to check pressure at the rear servo.

PRESSURE TEST PORT LOCATIONS

There are pressure test ports at the accumulator, front servo, rear servo and governor.

Line pressure is checked at the accumulator port on the right side of the case (Fig. 2). The front servo release pressure port is at the right side of the case just behind the filler tube opening (Fig. 2).

The rear servo pressure port is at the right rear of the transmission case (Fig. 3). The governor pressure port is at the left side of case at the transmission rear (Fig. 3).

PRESSURE TEST PROCEDURE

Connect a tachometer to the engine. Position the tachometer so it can be observed from under the vehicle. Raise the vehicle on a hoist that will allow the wheels to rotate freely.

Test One-Transmission In 1 Range

This test checks pump output, pressure regulation, and condition of the rear clutch and rear servo circuits.

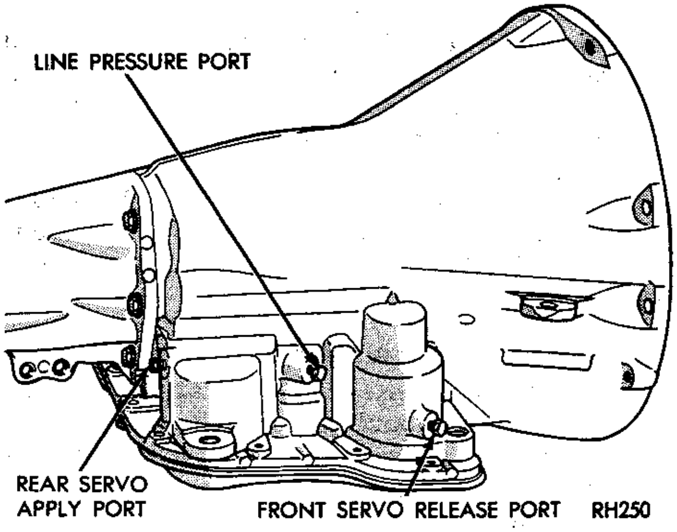

Fig. 2 Pressure Test Ports At Side Of Transmission

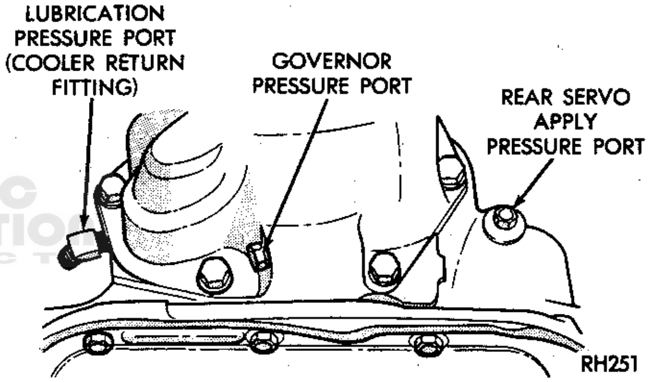

Fig. 3 Pressure Test Ports At Rear Of Transmission

(1) Connect test gauges to the line pressure and rear servo ports (Figs. 2, 3). **Be sure the 300 psi gauge is connected to the rear servo port.**

(2) Disconnect the throttle and gearshift rods at the transmission.

(3) Start and run the engine at 1000 rpm.

(4) Move the valve body selector lever all the way forward into 1 range.

(5) Read pressures on both gauges as the transmission throttle lever is is moved from full forward to full rearward position.

(6) 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.

(7) Rear servo pressure should be the same as line pressure within 3 psi.

Test Two-Transmission In 2 Range

This test checks pump output and pressure regulation.

(1) Connect a test gauge to the line pressure port (Fig. 2).

(2) Start and run the engine at 1000 rpm.

(3) Move the valve body selector lever one detent rearward from full forward position. This is 2 range.

(4) Move the transmission throttle lever from full forward to full rearward position and read pressure at both gauges.

(5) Line pressure should be 54-60 psi 372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as the lever is moved rearward.

Test Three-Transmission In D Range

This test checks pressure regulation and condition of the front and rear clutch circuits.

(1) Connect test gauges to the line pressure and front servo ports (Fig. 2).

(2) Start and run the engine at 1600 rpm for this test.

(3) Move the selector lever two detents rearward from full forward position. This is D range.

(4) Read pressures on both gauges as transmission throttle lever is moved from full forward to full rearward position.

(5) Line pressure should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase as lever is moved rearward.

(6) Front servo is pressurized only in D range and should be the same as line pressure within 3 psi (21 kPa) up to downshift point.

Test Four-Transmission In Reverse

This test checks pump output, pressure regulation and the front clutch and rear servo circuits.

(1) Connect the 300 psi gauge to the rear servo port (Fig. 3).

(2) Start and run the engine at 1600 rpm for test.

(3) Move the valve body selector lever four detents rearward from the full forward position. This is Reverse range.

(4) Move the throttle lever all the way forward then all the way rearward and note the gauge readings.

(5) Pressure should be 145 - 175 psi (1000-1207 kPa) with lever forward and increase to 230 - 280 psi (1586-1931 kPa) as lever is moved rearward.

Test Five-Governor Pressure

(1) This test checks governor operation by measuring governor pressure response to changes in engine speed. It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not downshift.

(2) Connect a test gauge to the governor pressure port (Fig. 3).

(3) Move the selector lever to D range.

(4) Apply brakes to stop wheels. Start and run the engine at curb idle speed and note pressure. At idle, pressure should be zero to 1-1/2 psi maximum. If pressure exceeds this figure, the governor valve or weights are sticking open.

(5) Slowly increase engine speed and observe speedometer and pressure test gauge. Governor pressure should increase in proportion to vehicle speed. Or approximately 1 psi for every 1 mph.

(6) Pressure rise should be smooth and drop back to 0 to 1-1/2 psi when wheels are stopped.

(7) Compare results of the pressure tests with the analysis chart (Fig. 4).

TEST CONDITION	INDICATION
Line pressure OK during any one test	Pump and regulator valve OK
Line Pressure OK in R but low in D, 2, 1	Leakage in rear clutch area (servo, clutch seals, governor support seal rings)
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area (servo, clutch seals, retainer bore, pump seal rings)
Pressure OK in 2 but low in R and 1	Leakage in rear servo
Front servo pressure in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck pressure regulator valve, worn or defective pump
Governor pressure too high at idle speed:	Governor valve sticking open
Governor pressure low at all mph figures	Governor valve sticking closed
Lubrication pressure low at all throttle positions	Clogged oil cooler or lines, seal rings leaking, output shaft plugged with debris, worn bushings in pump or clutch retainer

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Fig. 4 Pressure Test Analysis Chart

CONVERTER STALL TEST

Stall testing involves determining maximum engine rpm obtainable at full throttle with the rear wheels locked and the transmission in D range. This test checks the holding ability of the the converter overrunning clutch and both of the transmission clutches. When stall testing is completed, refer to the Stall Speed Specifications chart and Stall Speed Diagnosis guides.

WARNING: NEVER ALLOW ANYONE TO STAND IN FRONT OF THE VEHICLE DURING A STALL TEST. ALWAYS BLOCK THE FRONT WHEELS AND APPLY THE SERVICE AND PARKING BRAKES DURING THE TEST.

STALL TEST PROCEDURE

(1) Connect a tachometer to the engine.

(2) Check and adjust transmission fluid level.

(3) Start and run the engine until transmission fluid reaches normal operating temperature.

(4) Block the front wheels.

(5) Fully apply the service and parking brakes.

(6) Open the throttle completely for no more than five seconds and record maximum engine rpm registered on the tachometer.

CAUTION: Stall testing causes a rapid increase in transmission fluid temperature. Do not hold the throttle open any longer than five seconds. If more than one stall test is required, run the engine at 1000 rpm with the transmission in Neutral for at least 20 seconds to cool the fluid.

(7) If engine speed exceeds maximum shown in the stall speed chart, release the accelerator immediately. This indicates that transmission clutch slippage is occurring.

(8) Shift the transmission into Neutral. Operate the engine for 20 seconds. Stop the engine, shift the transmission into Park and release the brakes.

(9) Stall speeds should be: 1800-2100 rpm with 3.9L engine and 1700-2000 rpm with 5.2L/5.9L engines.

(10) Refer to Stall Test Diagnosis.

STALL TEST DIAGNOSIS

Stall Speed Too High

If the stall speed exceeds specifications by more than 200 rpm, transmission clutch slippage is indicated.

Stall Speed Too Low

Low stall speeds with a properly tuned engine indicate a torque converter overrunning clutch problem. The condition should be confirmed by road testing prior to converter replacement.

The converter overrunning clutch is slipping when: Stall speeds are 250 to 350 rpm below specified minimum and the vehicle operates properly at highway speeds but has poor low speed acceleration.

Stall Speed Normal

If stall speeds are normal but abnormal throttle opening is required to maintain highway speeds, the converter overrunning clutch is seized and the torque converter must be replaced.

Converter Noise During Test

A whining noise caused by fluid flow is normal during a stall test. However, loud metallic noises indicate a damaged converter. To confirm that noise is originating from the converter, operate the vehicle at light throttle in Drive and Neutral on a hoist and listen for noise coming from the converter housing.

AIR PRESSURE TEST

Air pressure testing can be used to check clutch and band operation 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 in Figure 5.

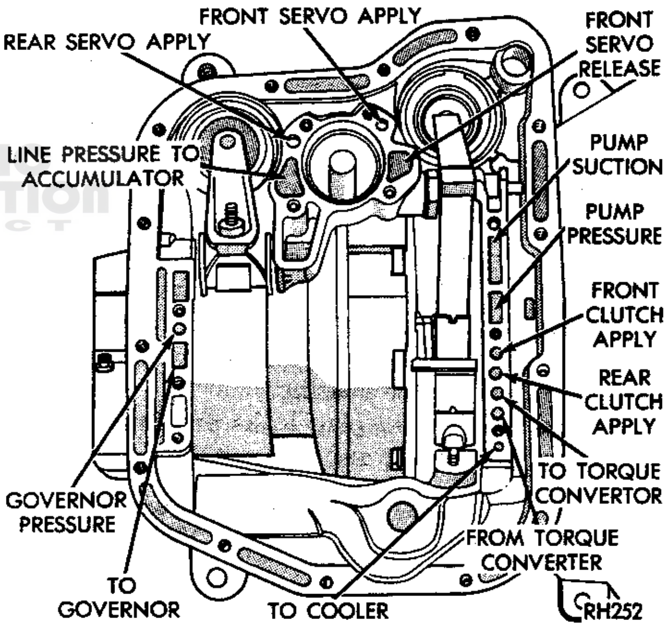


Fig. 5 Air Pressure Test Passages

Front Clutch Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage (Fig. 5). Piston movement can be felt and a soft thud heard as the clutch applies.

Rear Clutch Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage (Fig. 5). Piston movement can be felt and a soft thud heard as the clutch applies.

Front Servo 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 tension should release the servo when air pressure is removed.

Rear Servo 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 tension should release the servo when air pressure is removed.

CONVERTER HOUSING FLUID LEAK DIAGNOSIS

When diagnosing converter housing fluid leaks, two items must be established before repair. First, it must be verified that a leak condition actually exists. And second, the true source of the leak must be determined.

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 refill after repair.

Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair.

Pump seal leaks tend to move along the drive hub and onto the rear of the converter. Pump O-ring or pump body leaks follow the same path as a seal leak (Fig. 6).

Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 6).

Pump seal or gasket leaks usually travel down the inside of the converter housing.

Front band lever pin plug leaks are generally deposited on the housing and not on the converter.

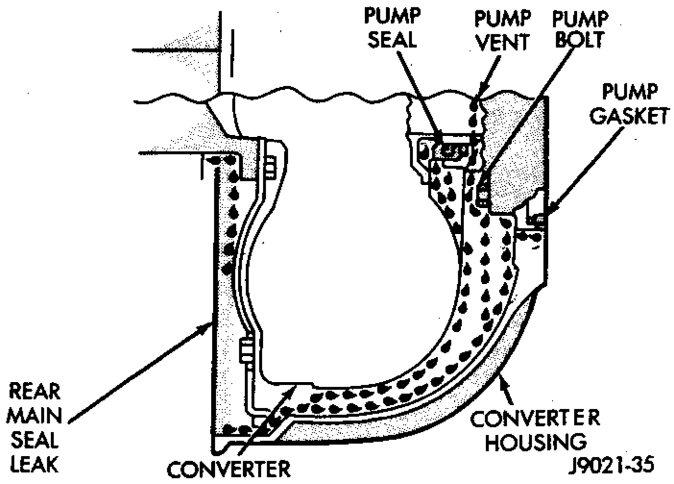


Fig. 6 Converter Housing Leak Paths

LEAK DIAGNOSIS PROCEDURE

(1) Raise the rear of the vehicle and allow accumulated fluid to drain out of the converter housing.

(2) Check and adjust the transmission fluid level.

(3) Raise the vehicle. Remove the converter housing dust cover and wipe as much fluid as possible from the converter housing.

(4) Fabricate a test probe (Fig. 7). Then attach the probe to the converter housing with one of the dust shield bolts (Fig. 7).

(5) Have a helper run the engine at 2500 rpm (with the transmission in Neutral) for two minutes; then stop the engine.

(6) Inspect the test probe and converter housing. If a leak is evident, note the color of the fluid. Transmission fluid is red. Engine oil ranges in color from brown to green, or to black when the oil is dirty.

(7) If the probe upper surface is dry, the converter and seal are not at fault. A path of fluid across the probe upper surface indicates a converter or seal leak. Fluid leaking **under** the probe is coming from the pump housing area (Fig. 8).

(8) Fluid leaking under the probe could be from the: pump seal and/or bushing, pump vent, kickdown lever shaft access plug, pump bolts, or porous spots in the pump body or transmission case (Fig. 8).

(9) If porous spots in the transmission case or pump body are the suspected leak source, pressurize the transmission as described in Leak Testing With Air Pressure.

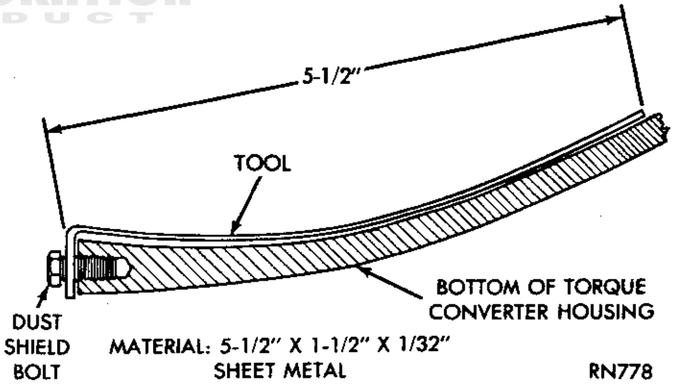


Fig. 7 Leak Test Probe

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are:

(a) Leaks at the weld joint around the outside diameter weld (Fig. 9).

(b) Leaks at the converter hub weld (Fig. 9).

LEAK TESTING WITH AIR PRESSURE

This test involves closing off the transmission openings and pressurizing the transmission to 8 psi with air pump tool C-4080.

A soapy water solution is applied to suspected leak points before and during the pressure test. Leaks will be indicated by the presence of air bubbles coming through the solution.

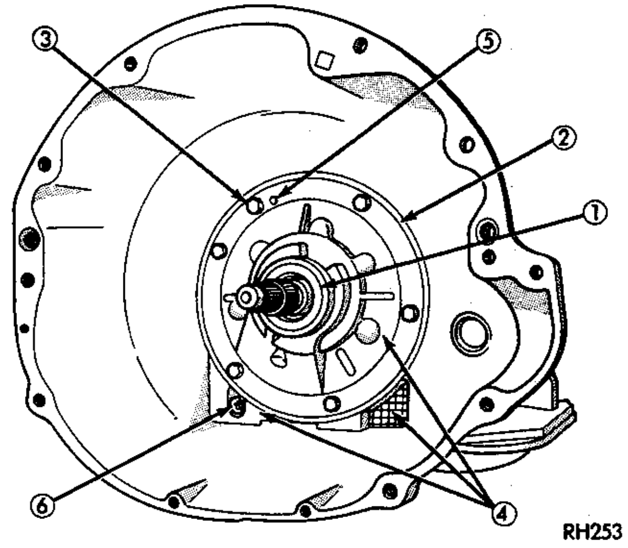


Fig. 8 Pump Area Inspection Points

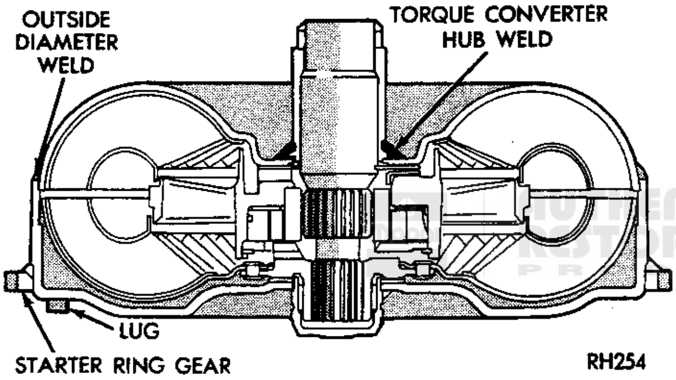


Fig. 9 Converter Leak Points (Nonlockup Shown)

Some transmission openings such as the fill tube and front cooler line fitting can be closed off with a rubber plug or similar device. Plugs can secured with wire or duct tape.

The transmission rear output shaft opening is closed off simply by leaving the transfer case bolted in place. However, if the transfer case has been removed, a shipping plug can used to close off this opening.

The torque converter hub opening in the pump and the pump vent require special tools to close them off. The converter hub seal cap is made from thin wall tube and a 1/8 inch thick disc (Figs. 10, 11). A retaining strap is needed to secure the seal cup for testing. The strap can be made from 1-1/4 inch wide stock (Fig. 12). The strap attaching hole positions are approximate only. Measure hole position on the converter housing before drilling.

The pump vent tool is made from 1/4 inch rod and 3/16 plate (Figs. 13, 14).

The fabricated tools can all be made from mild steel or aluminum stock.

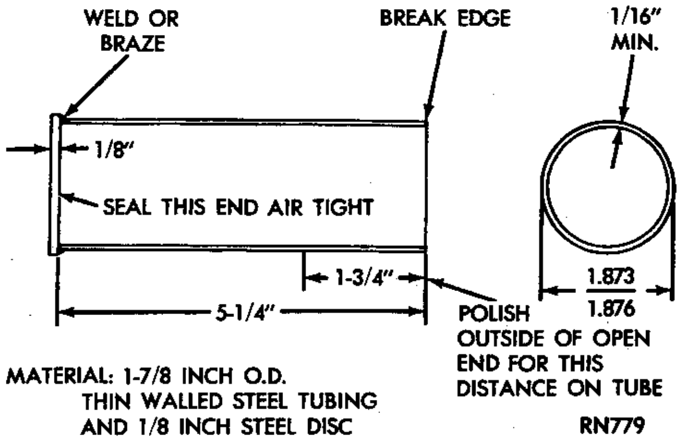


Fig. 10 Converter Hub Seal Cup—A-727

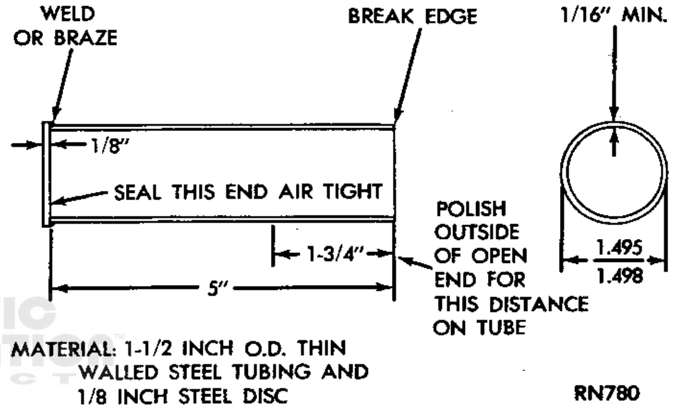


Fig. 11 Converter Hub Seal Cup—A-998/999

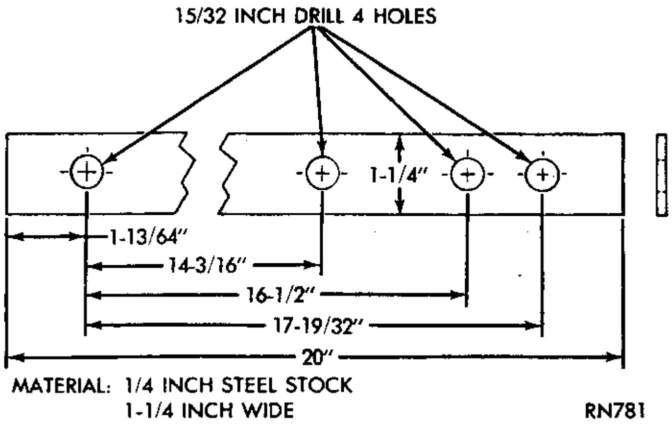


Fig. 12 Seal Cup Retaining Strap

AIR PRESSURE LEAK TEST PROCEDURE

(1) Install the vent plug, converter hub seal cup and cup retaining strap (Fig. 15).

(2) Close off the remaining transmission openings with rubber plugs, or stoppers. **Do not close off the rear cooler line fitting. The air pump will be attached to this fitting.**

(3) Attach air pump C-4080 to the rear cooler line fitting. Connect a length of copper tube to the fitting. Then attach the air pump hose to the tube with a hose clamp (Fig. 16).

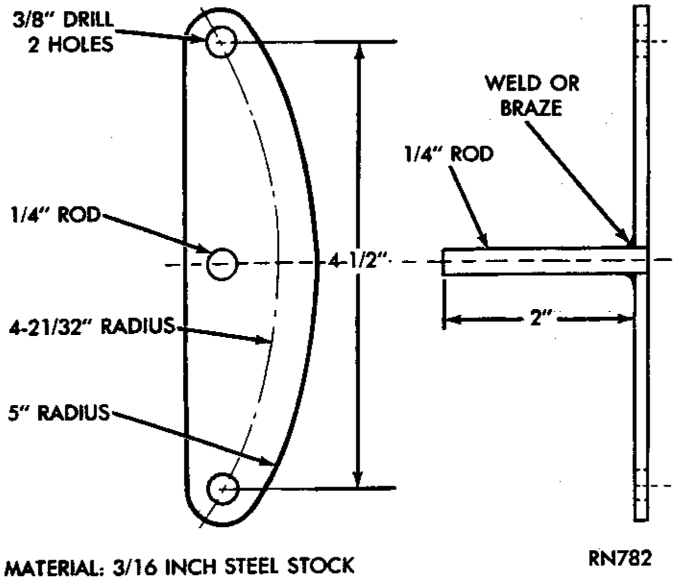


Fig. 13 Pump Vent Plug—A-727

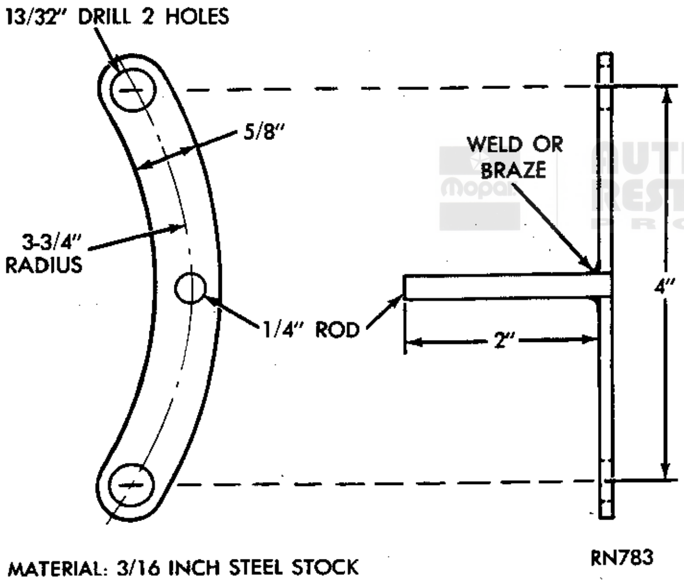


Fig. 14 Pump Vent Plug—A-998/999

(4) Apply a thick soapy water solution to the suspected leak areas.

CAUTION: The recommended test pressure is 8 psi. The maximum allowable test pressure is 10 psi. Do not exceed specified pressure.

(5) Pressurize the transmission to 8 psi with the air pump.

(6) Observe the suspected leak areas. Air bubbles appearing in the soapy water solution indicate leak points.

(7) Remove the test tools and plugs after test completion and make necessary repairs as described in the Leak Correction procedure.

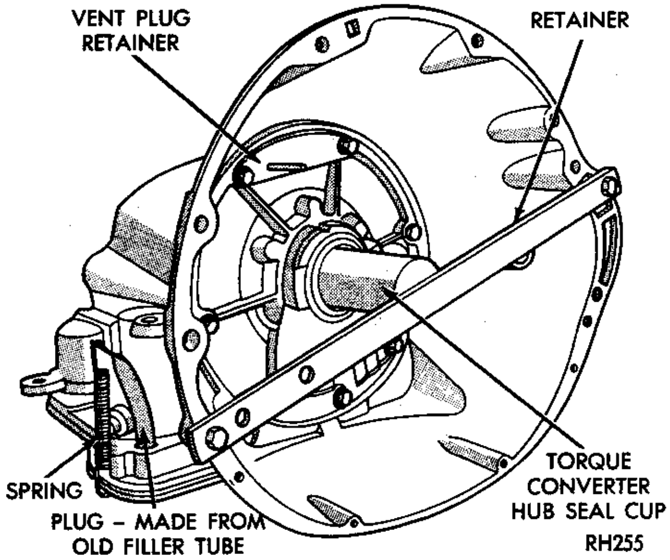


Fig. 15 Vent Plug And Hub Seal Cup Installation

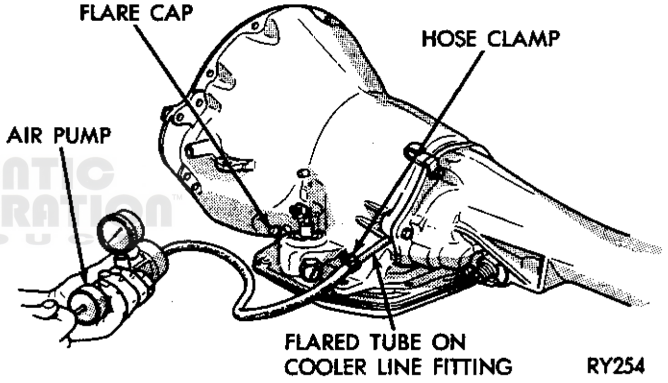


Fig. 16 Pressurizing Transmission

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove the converter.

(2) Tighten the front band adjusting screw until the band is tight around the front clutch retainer. This prevents the front clutch from coming out when the oil pump is removed.

(3) Remove the oil pump and seal. Inspect the pump housing drainback and vent holes for obstructions. Clear the holes with solvent and wire.

(4) Inspect the pump bushing and converter hub. If the bushing is scored, replace it. If the converter hub is scored, either polish it with crocus cloth or replace the converter if scoring is severe.

(5) Install a new pump seal, O-ring, gasket, bushing. Replace the oil pump if cracked, porous or damaged in any way.

(6) Loosen the kickdown lever pin plug two turns. Apply Permatex No. 2 or equivalent to the plug threads and tighten the plug to 17 N•m (150 in-lbs) torque.

(7) Adjust the front (kickdown) band.

(8) Lubricate the pump seal and converter hub with transmission fluid or petroleum jelly and install the converter.

(9) Install the transmission and converter housing dust shield

(10) Lower the vehicle.

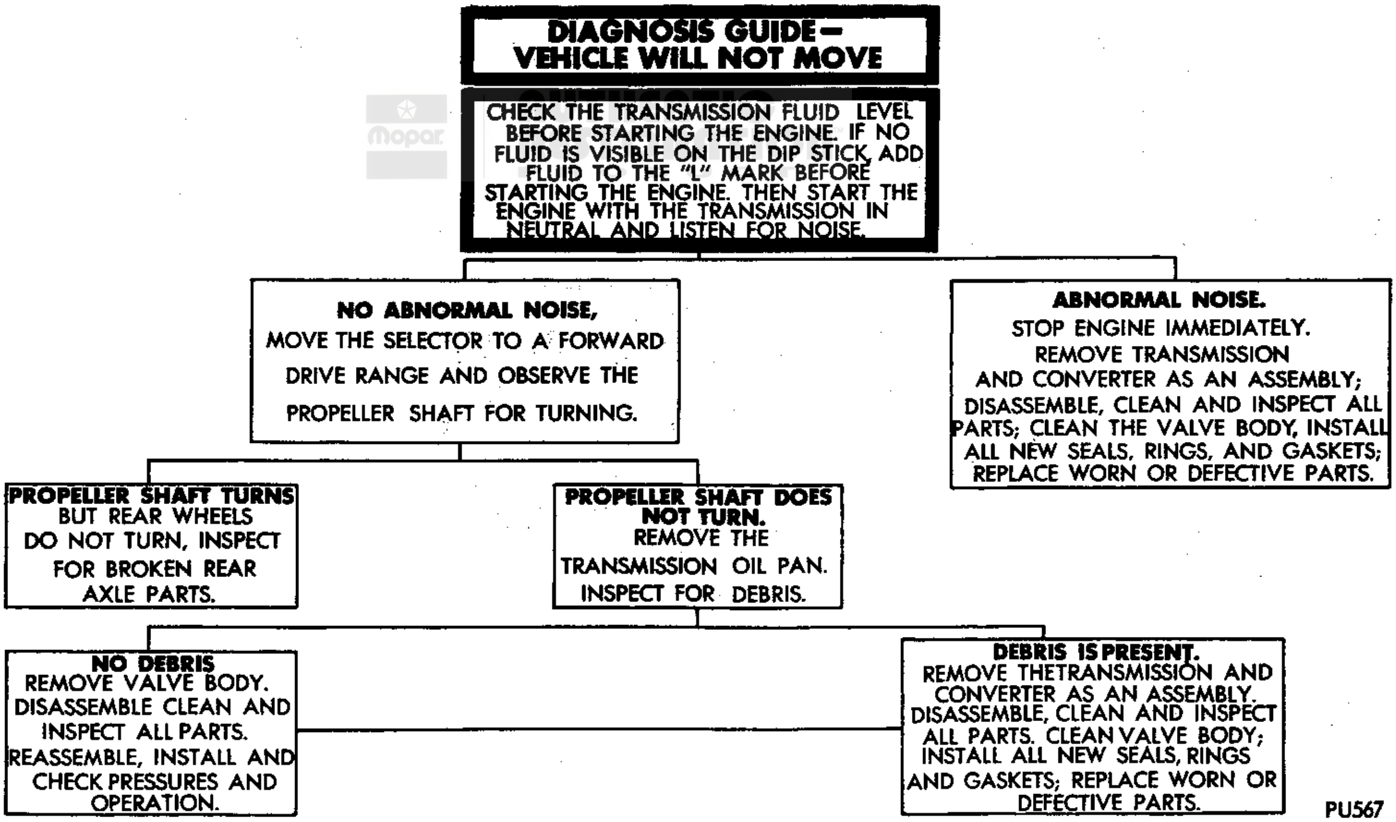
DIAGNOSIS GUIDES AND CHARTS

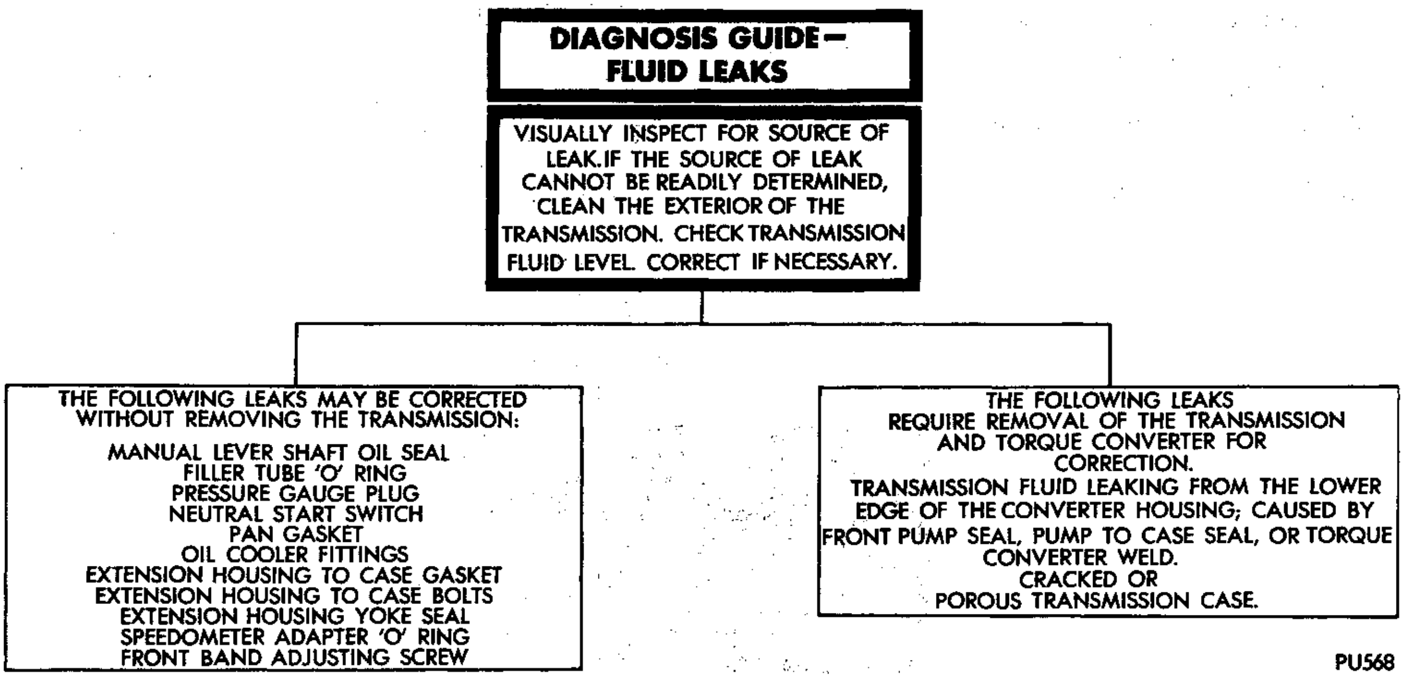
The diagnosis guides and charts provide additional reference a for transmission diagnosis.

The guides provide basic procedures for conditions involving, abnormal noise, fluid leaks, or if the vehicle will not move forward or in reverse.

The diagnosis chart provides general information on a variety of transmission fault conditions.

The hydraulic flow charts outline fluid flow and hydraulic circuitry. Circuit operation is provided for all gear ranges. Normal working pressures are also supplied for each of the various gear ranges.





DIAGNOSIS GUIDE— FLUID LEAKS

VISUALLY INSPECT FOR SOURCE OF LEAK. IF THE SOURCE OF LEAK CANNOT BE READILY DETERMINED, CLEAN THE EXTERIOR OF THE TRANSMISSION. CHECK TRANSMISSION FLUID LEVEL. CORRECT IF NECESSARY.

THE FOLLOWING LEAKS MAY BE CORRECTED WITHOUT REMOVING THE TRANSMISSION:

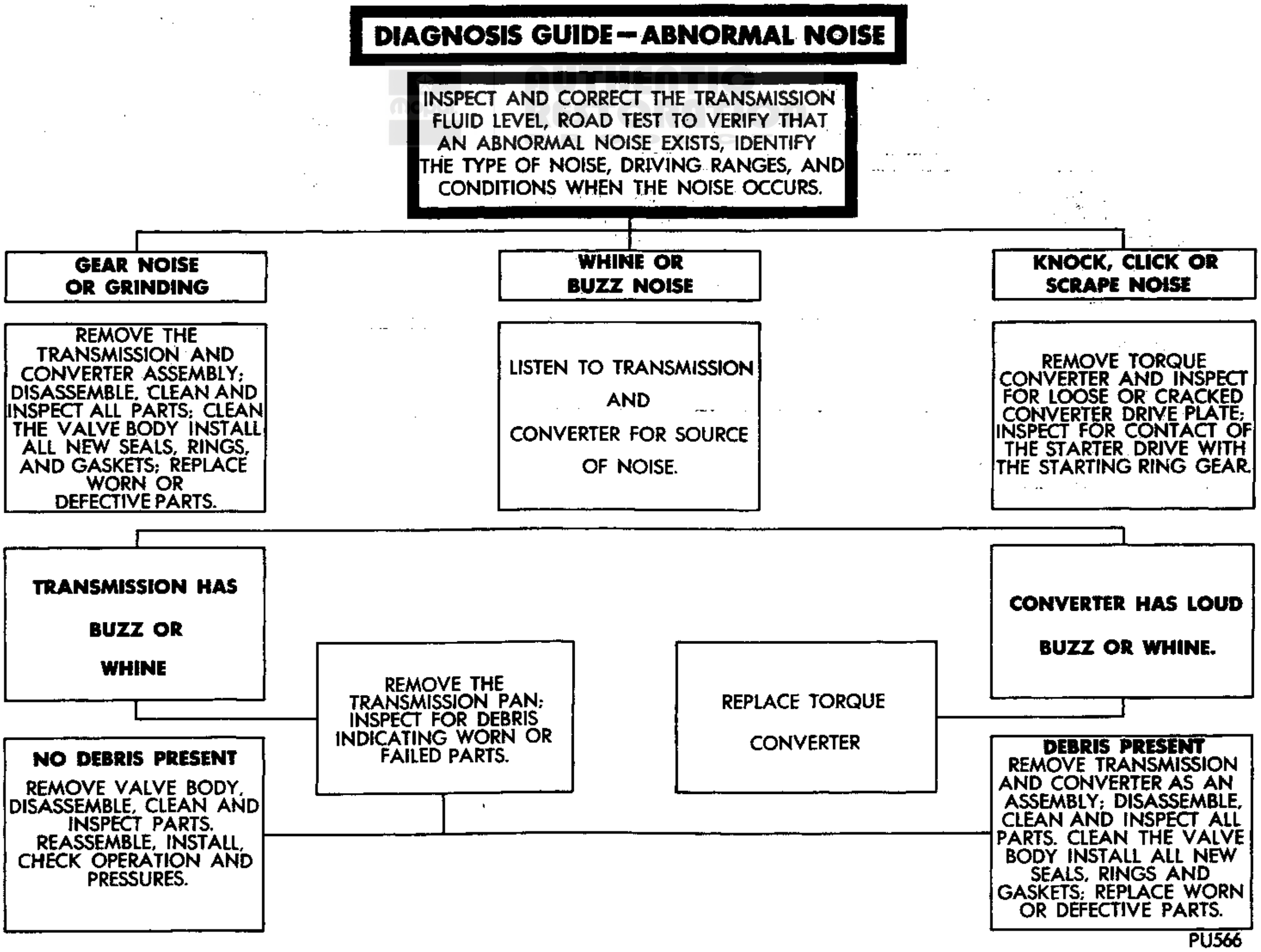
MANUAL LEVER SHAFT OIL SEAL
FILLER TUBE 'O' RING
PRESSURE GAUGE PLUG
NEUTRAL START SWITCH
PAN GASKET
OIL COOLER FITTINGS
EXTENSION HOUSING TO CASE GASKET
EXTENSION HOUSING TO CASE BOLTS
EXTENSION HOUSING YOKE SEAL
SPEEDOMETER ADAPTER 'O' RING
FRONT BAND ADJUSTING SCREW

THE FOLLOWING LEAKS REQUIRE REMOVAL OF THE TRANSMISSION AND TORQUE CONVERTER FOR CORRECTION.

TRANSMISSION FLUID LEAKING FROM THE LOWER EDGE OF THE CONVERTER HOUSING; CAUSED BY FRONT PUMP SEAL, PUMP TO CASE SEAL, OR TORQUE CONVERTER WELD.

CRACKED OR POROUS TRANSMISSION CASE.

PU568



DIAGNOSIS GUIDE—ABNORMAL NOISE

INSPECT AND CORRECT THE TRANSMISSION FLUID LEVEL, ROAD TEST TO VERIFY THAT AN ABNORMAL NOISE EXISTS, IDENTIFY THE TYPE OF NOISE, DRIVING RANGES, AND CONDITIONS WHEN THE NOISE OCCURS.

GEAR NOISE OR GRINDING

REMOVE THE TRANSMISSION AND CONVERTER ASSEMBLY; DISASSEMBLE, CLEAN AND INSPECT ALL PARTS; CLEAN THE VALVE BODY INSTALL ALL NEW SEALS, RINGS, AND GASKETS; REPLACE WORN OR DEFECTIVE PARTS.

WHINE OR BUZZ NOISE

LISTEN TO TRANSMISSION AND CONVERTER FOR SOURCE OF NOISE.

KNOCK, CLICK OR SCRAPE NOISE

REMOVE TORQUE CONVERTER AND INSPECT FOR LOOSE OR CRACKED CONVERTER DRIVE PLATE; INSPECT FOR CONTACT OF THE STARTER DRIVE WITH THE STARTING RING GEAR.

TRANSMISSION HAS BUZZ OR WHINE

REMOVE THE TRANSMISSION PAN; INSPECT FOR DEBRIS INDICATING WORN OR FAILED PARTS.

NO DEBRIS PRESENT

REMOVE VALVE BODY, DISASSEMBLE, CLEAN AND INSPECT PARTS. REASSEMBLE, INSTALL, CHECK OPERATION AND PRESSURES.

DEBRIS PRESENT

REMOVE TRANSMISSION AND CONVERTER AS AN ASSEMBLY; DISASSEMBLE, CLEAN AND INSPECT ALL PARTS. CLEAN THE VALVE BODY INSTALL ALL NEW SEALS, RINGS AND GASKETS; REPLACE WORN OR DEFECTIVE PARTS.

CONVERTER HAS LOUD BUZZ OR WHINE.

REPLACE TORQUE CONVERTER

PU566

TRANSMISSION DIAGNOSIS CHART

POSSIBLE CAUSE		CONDITION																					
		HARSH ENGAGEMENT FROM NEUTRAL TO D OR R	DELAYED ENGAGEMENT FROM NEUTRAL TO D OR R	RUNAWAY UPSHIFT	NO UPSHIFT	3-2 KICKDOWN RUNAWAY	NO KICKDOWN OR NORMAL DOWNSHIFT	SHIFTS ERRATIC	SLIPS IN FORWARD DRIVE POSITIONS	SLIPS IN REVERSE ONLY	SLIPS IN ALL POSITIONS	NO DRIVE IN ANY POSITION	NO DRIVE IN FORWARD DRIVE POSITIONS	NO DRIVE IN REVERSE	DRIVES IN NEUTRAL	DRAGS OR LOCKS	GRATING, SCRAPING GROWLING NOISE	BUZZING NOISE	HARD TO FILL, OIL BLOWS OUT FILLER TUBE	TRANSMISSION OVERHEATS	HARSH UPSHIFT	DELAYED UPSHIFT	SLIPS IN REVERSE OR MANUAL LOW
Faulty lockup clutch	35	x																			x		
Overrunning clutch inner race damaged.	34																	x					
Overrunning clutch worn, broken or seized.	33								x				x			x	x						
Planetary gear sets broken or seized.	32											x	x	x		x	x						
Rear clutch dragging.	31														x								
Worn or faulty rear clutch.	30	x	x						x				x	x	x								
Insufficient cutch plate clearance.	29														x					x			
Faulty cooling system.	28																			x			
Kickdown band adjustment too tight.	27															x				x			
Hydraulic pressure too high.	26	x																			x		
Breather clogged.	25																		x				
High fluid level.	24																		x				
Worn or faulty front clutch.	23		x	x	x	x		x		x				x								x	
Kickdown servo band or linkage malfunction.	22			x	x	x	x	x														x	
Governor malfunction.	21				x		x	x														x	
Worn or broken reaction shaft support seal rings.	20		x	x	x	x		x		x				x								x	
Governor support seal rings broken or worn.	19				x			x														x	
Output shaft bearing and/or bushing damaged.	18																x						
Overrunning clutch not holding.	17								x				x										
Kickdown band out of adjustment.	16					x											x				x	x	
Incorrect throttle linkage adjustment.	15			x	x	x	x	x	x												x	x	
Engine idle speed too low.	14		x																				
Aerated fluid.	13		x	x		x		x	x	x	x							x	x				
Worn or broken input shaft seal rings.	12		x						x		x		x										
Faulty oil pump.	11		x					x	x	x	x	x				x		x		x			x
Oil filter clogged.	10		x	x				x	x		x	x							x				
Incorrect gearshift control linkage adjustment.	9		x		x			x	x	x				x	x					x			
Low fluid level.	8		x	x	x	x		x	x	x	x	x	x					x		x			
Low-reverse servo, band or linkage malfunction.	7		x							x				x									
Valve body malfunction or leakage.	6	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x					x
Low-reverse band out of adjustment.	5									x				x		x	x						
Hydraulic pressure too low.	4		x	x	x	x		x	x	x	x	x	x	x						x	x		
Engine idle speed too high.	3	x																		x			
Stuck lockup valve.	2															x							
Stuck switch valve.	1																			x			

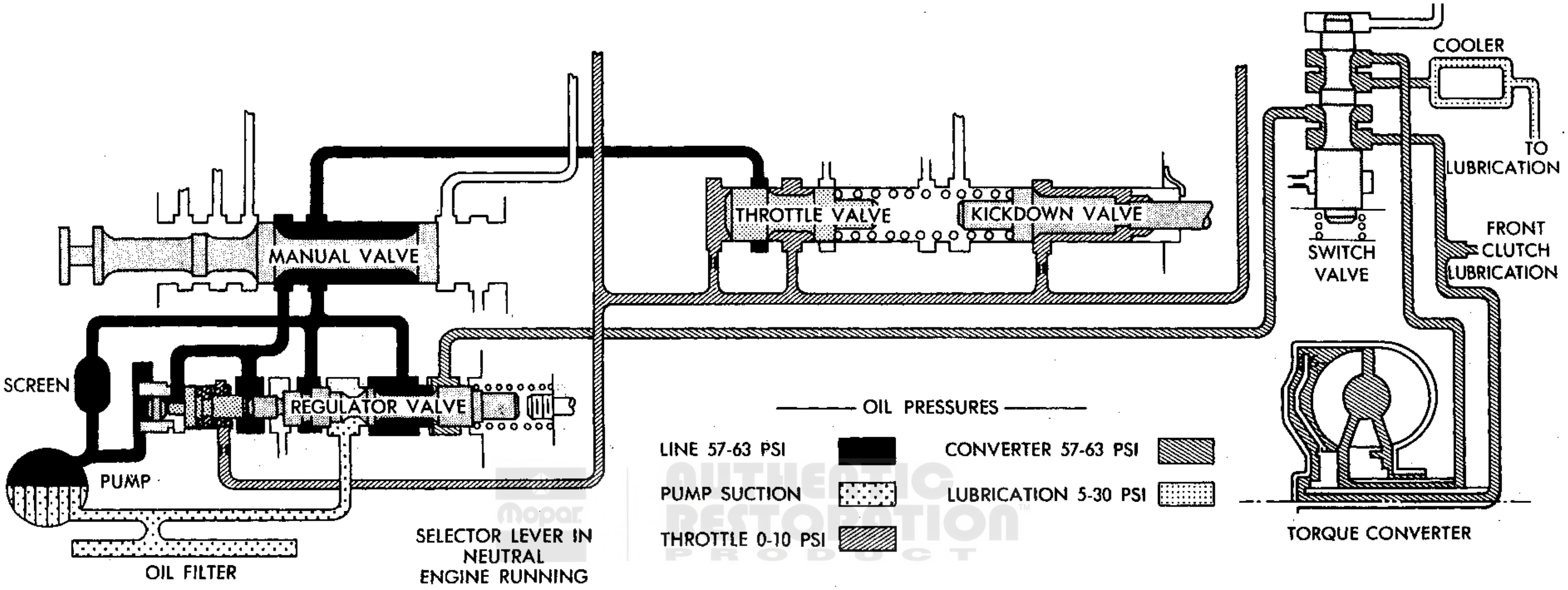
J9021-61

LOCKUP TORQUE CONVERTER DIAGNOSIS CHART

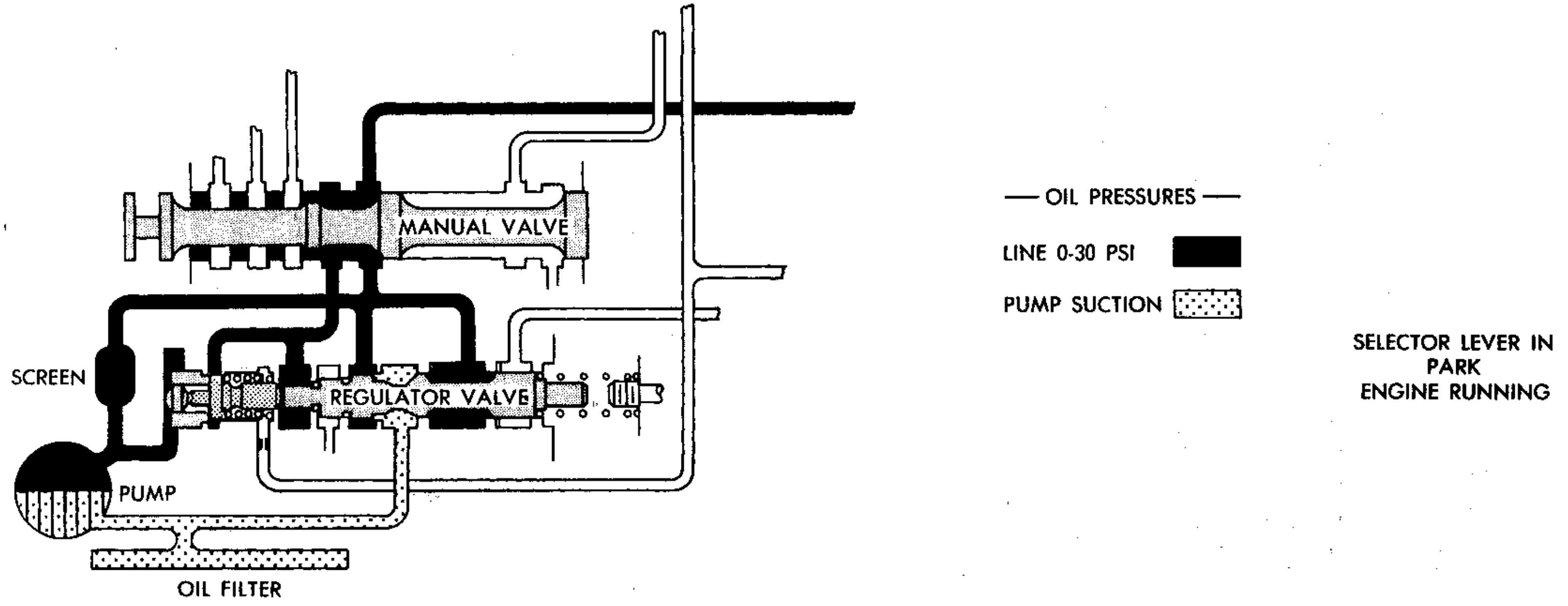
POSSIBLE CAUSE

CONDITION	NO LOCKUP	WILL NOT UNLOCK	STAYS LOCKED UP TO TOO LOW A SPEED IN DIRECT	LOCKS UP OR DRAGS IN LOW OR SECOND	STALLS OR IS SLUGGISH IN REVERSE	LOUD CHATTER DURING LOCKUP ENGAGEMENT—(COLD)	VIBRATION OR SHUDDER DURING LOCKUP ENGAGEMENT	VIBRATIONS AFTER LOCKUP ENGAGEMENT	VIBRATION WHEN "REVED" IN NEUTRAL	OVERHEATING: OIL BLOWING OUT DIPSTICK OR PUMP SEAL	SHUDDER AFTER LOCKUP ENGAGEMENT
FAULTY OIL PUMP	X			X	X		X				X
STICKING GOVERNOR VALVE	X	X	X								
PLUGGED COOLER, LINES OR FITTINGS					X					X	X
VALVE BODY MALFUNCTION	X	X	X	X	X		X				X
STUCK SWITCH VALVE	X	X	X	X	X					X	
STUCK LOCKUP VALVE	X	X	X								
STUCK FAIL-SAFE VALVE	X	X	X	X							
STUCK LOCKUP SOLENOID	X		X								
SOLENOID WIRING DISCONNECTED	X										
FAILED LOCKUP SOLENOID	X										
FAILED LOCKUP RELAY	X		X								
FAULTY TORQUE CONVERTER:	X					X	X	X			X
OUT OF BALANCE									X		
FAILED LOCKING CLUTCH	X					X					X
LEAKING TURBINE HUB SEAL	X					X					
ALIGN EXHAUST SYSTEM								X			X
TUNE ENGINE							X	X			X
FAULTY INPUT SHAFT OR SEAL RING	X				X						
THROTTLE LINKAGE MISADJUSTED								X			X

J9021-62

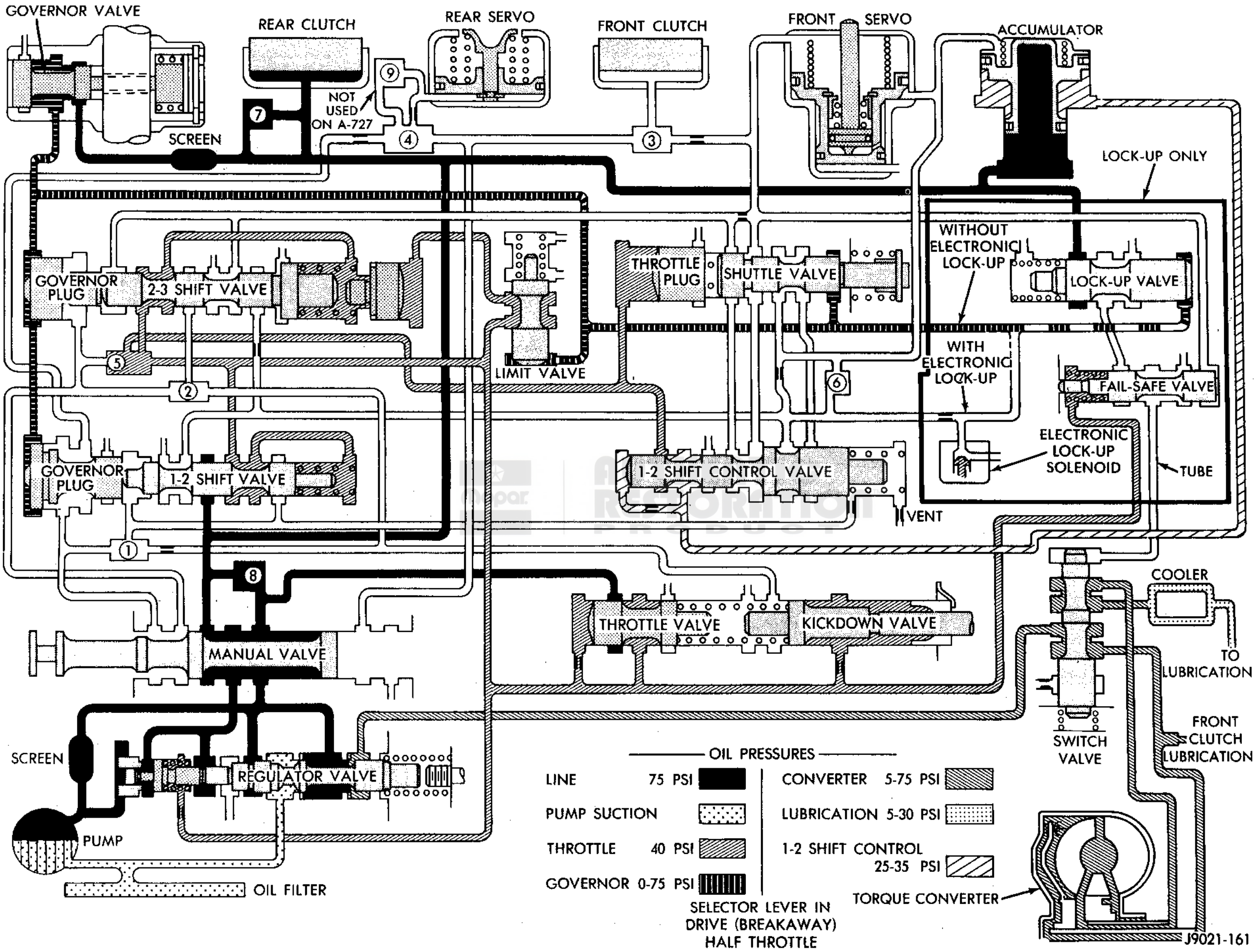


SELECTOR LEVER IN
NEUTRAL
ENGINE RUNNING

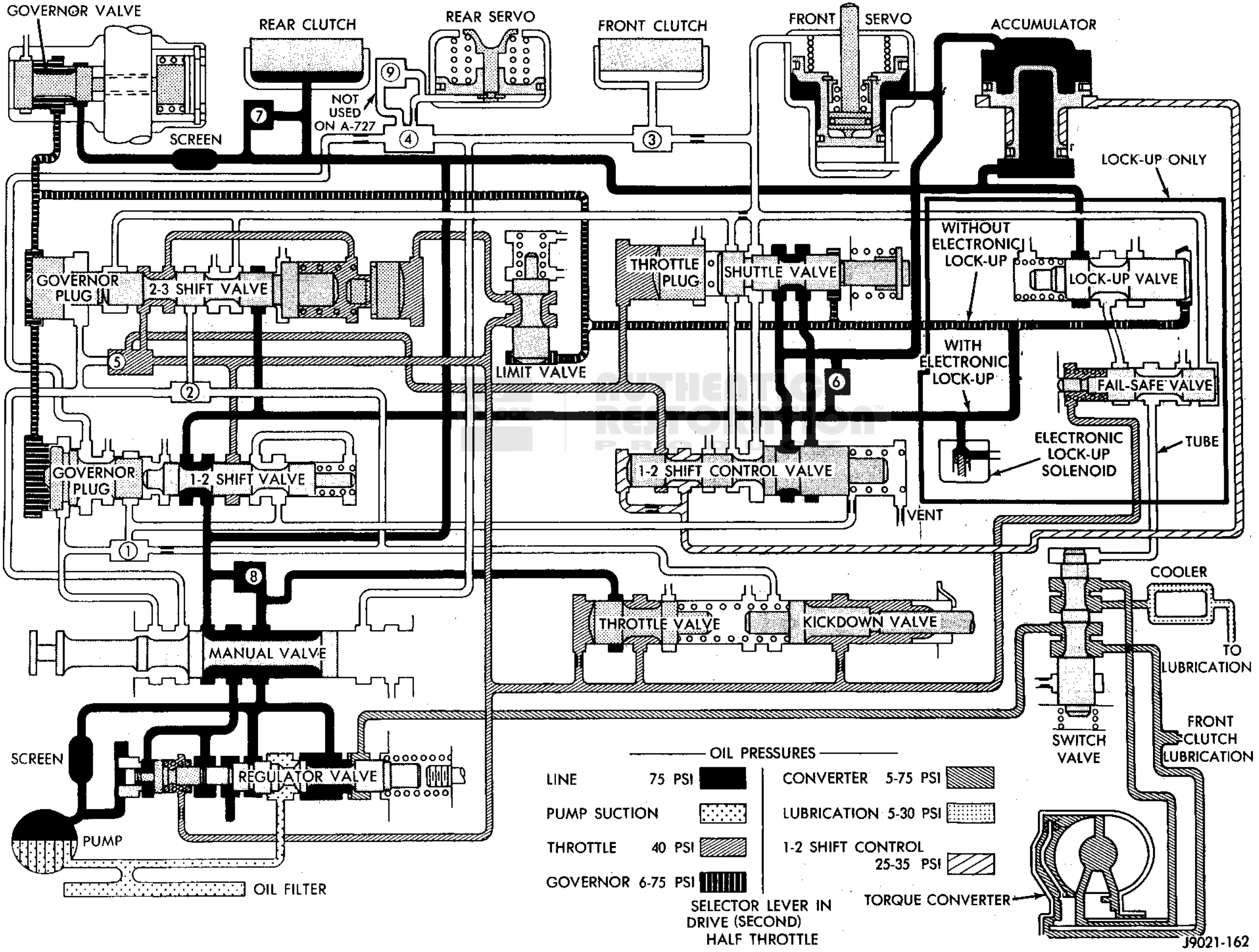


SELECTOR LEVER IN
PARK
ENGINE RUNNING

J9021-160

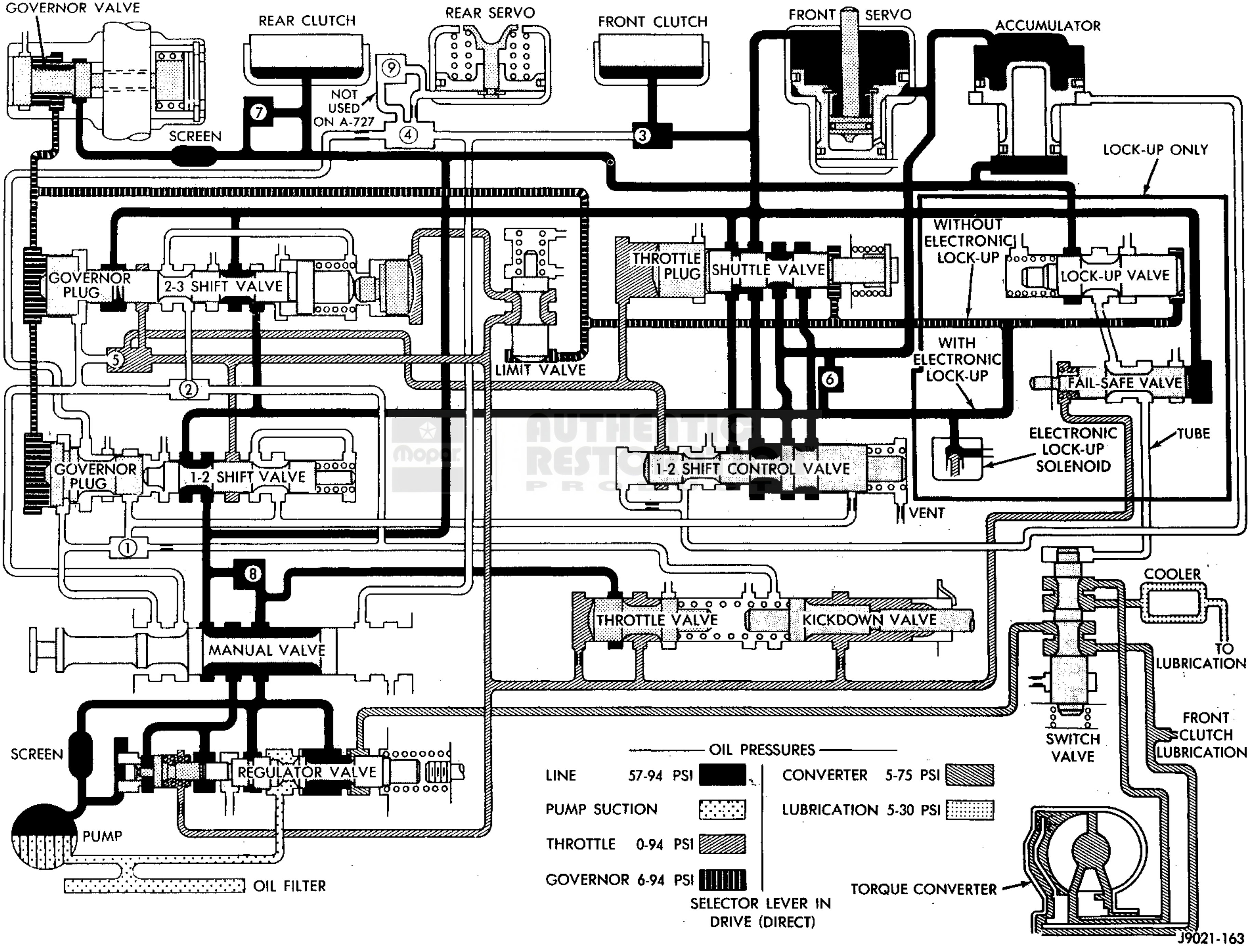


SELECTOR LEVER IN DRIVE (BREAKAWAY) HALF THROTTLE



SELECTOR LEVER IN DRIVE (SECOND) HALF THROTTLE

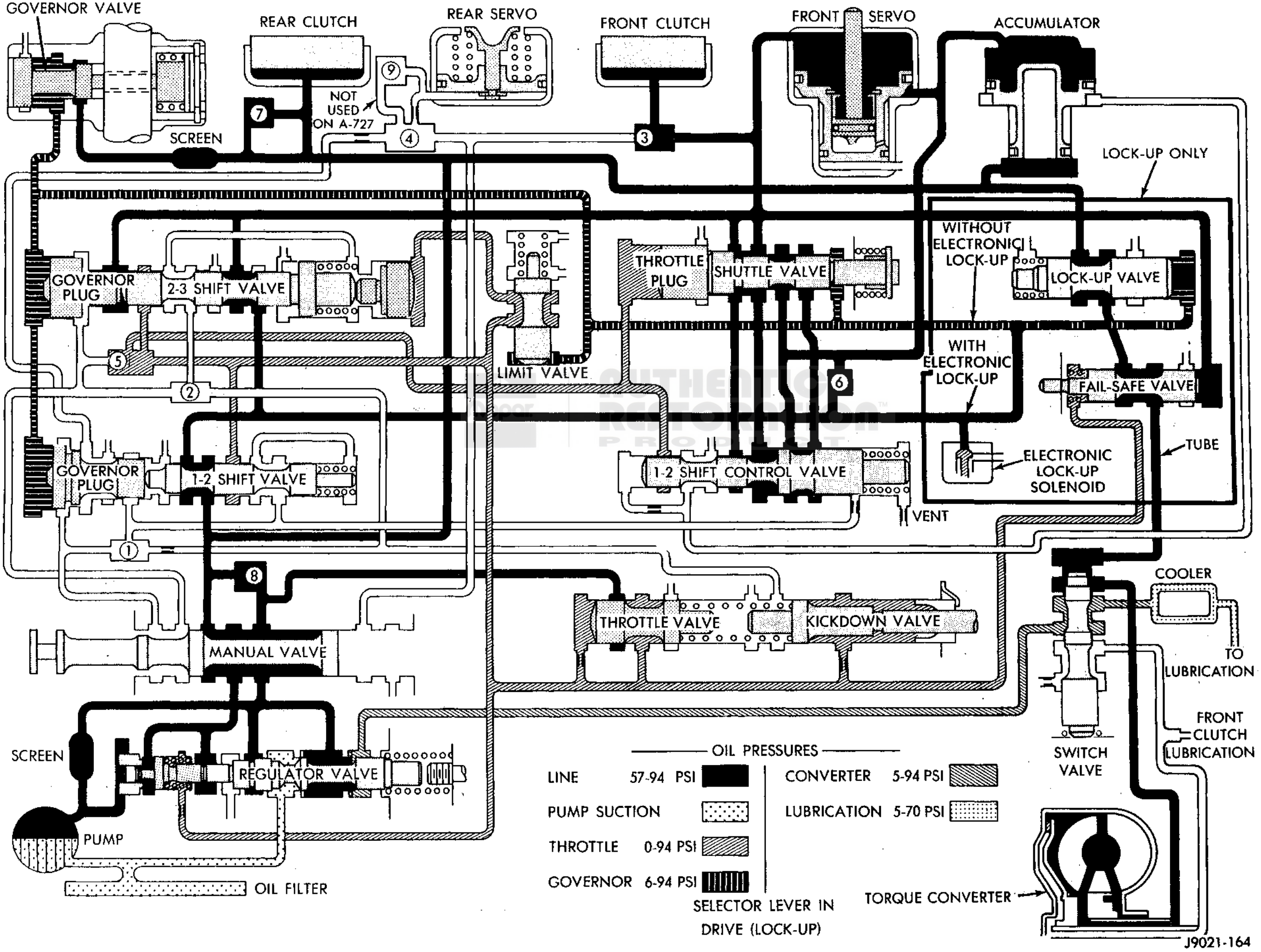
J9021-162



SELECTOR LEVER IN DRIVE (DIRECT)

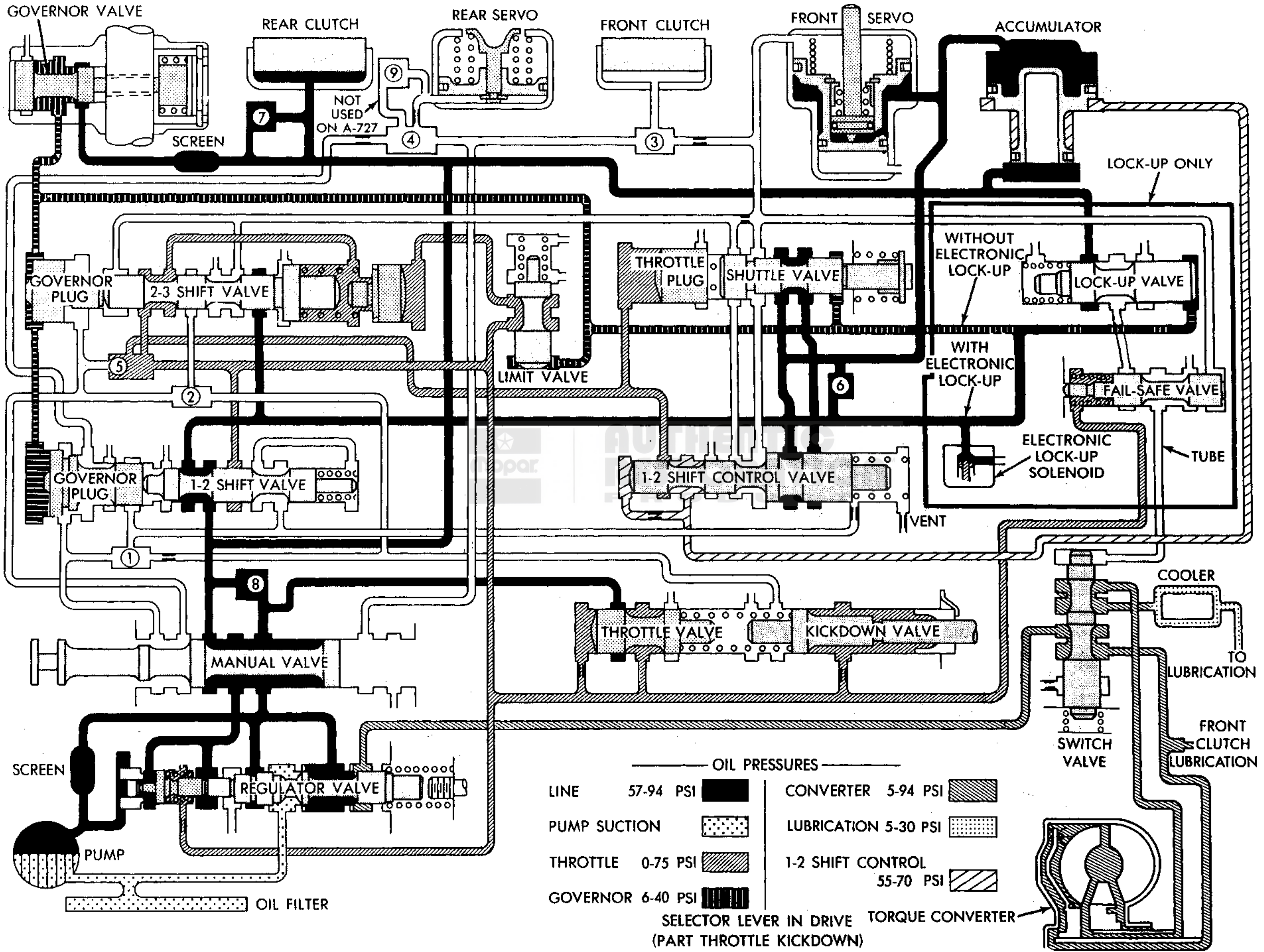
J9021-163

◆



SELECTOR LEVER IN DRIVE (LOCK-UP)

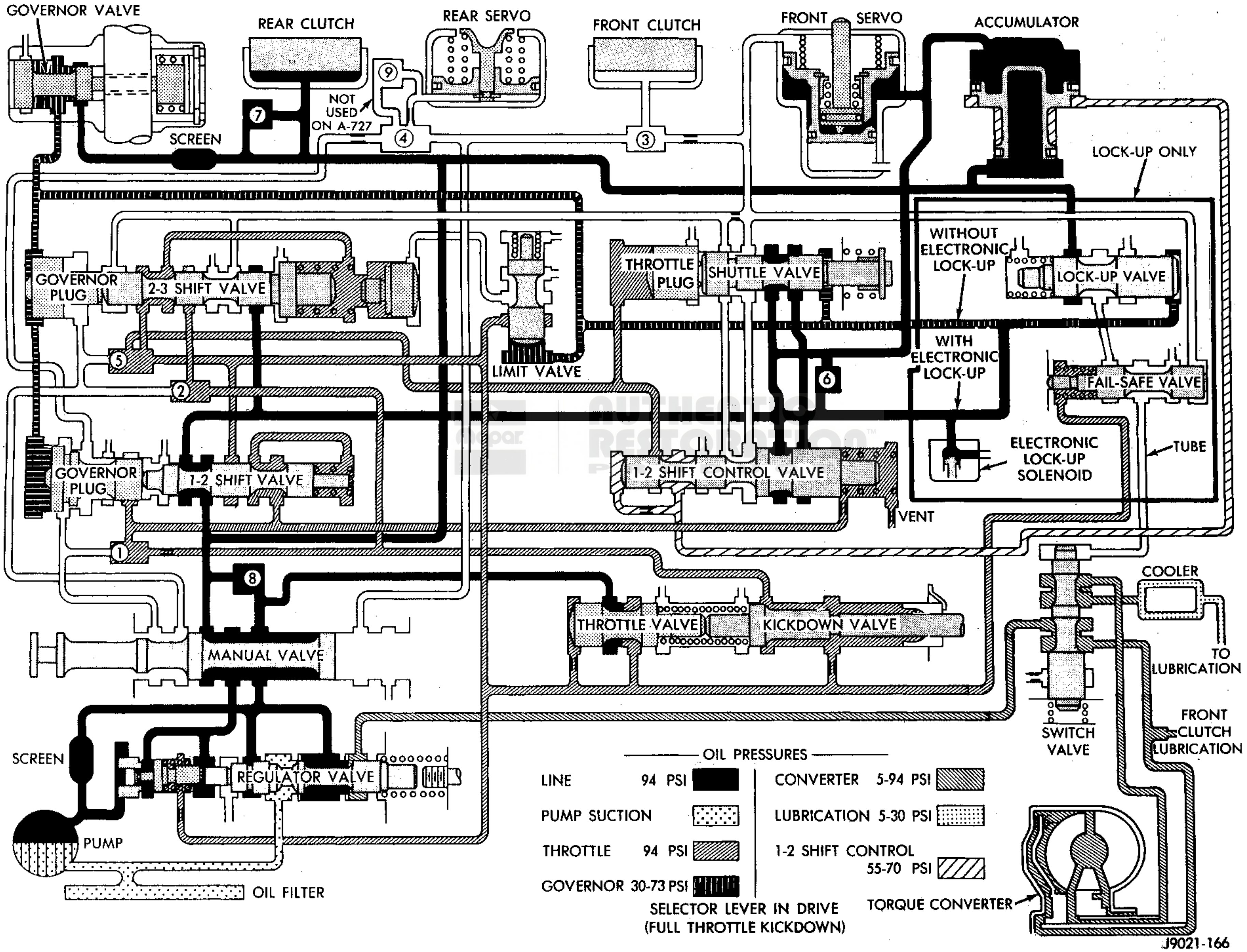
J9021-164



SELECTOR LEVER IN DRIVE
(PART THROTTLE KICKDOWN)
BELOW 40 M.P.H.

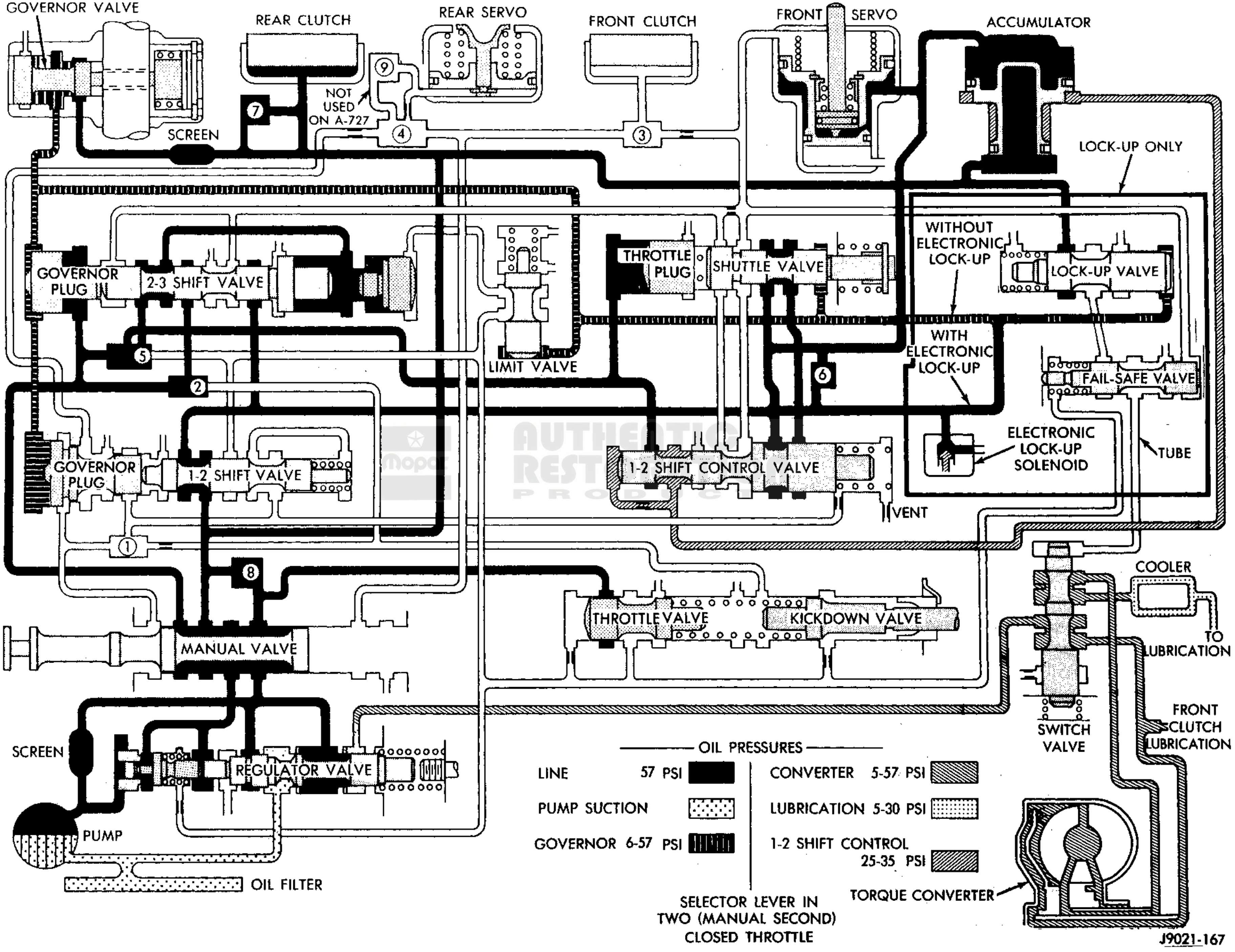
J9021-165

◆



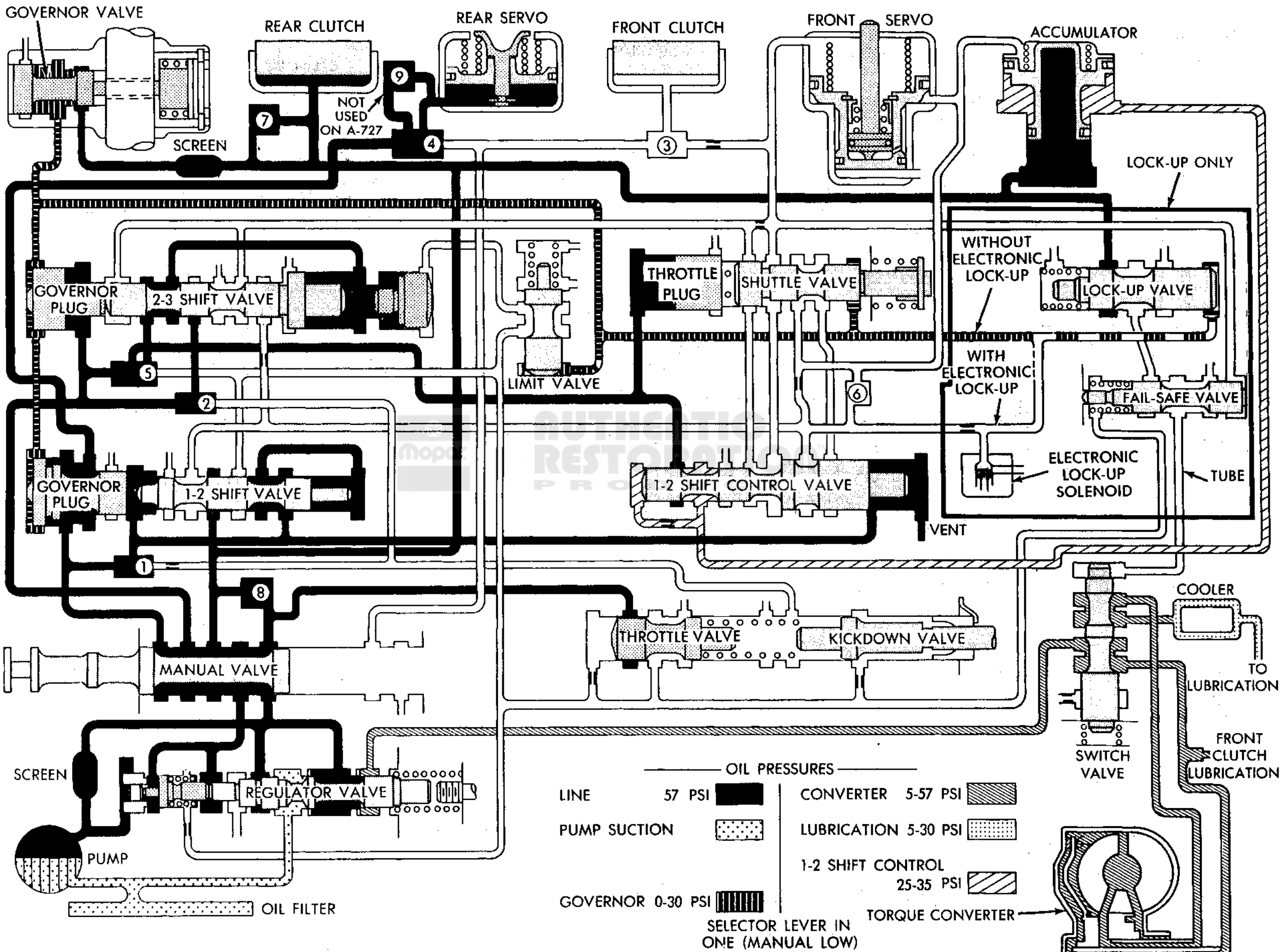
SELECTOR LEVER IN DRIVE
(FULL THROTTLE KICKDOWN)

J9021-166



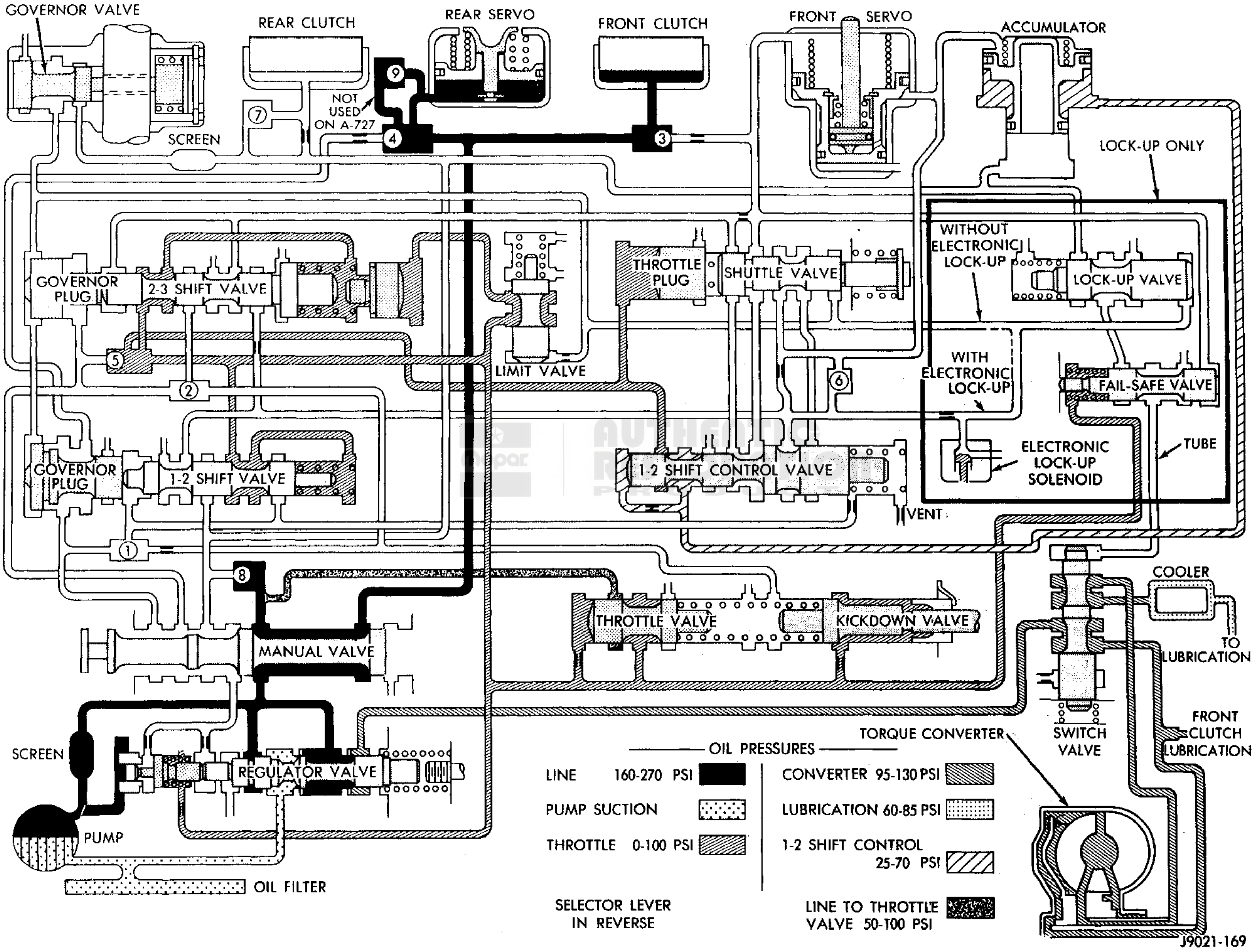
SELECTOR LEVER IN
TWO (MANUAL SECOND)
CLOSED THROTTLE

J9021-167



SELECTOR LEVER IN ONE (MANUAL LOW) CLOSED THROTTLE

J9021-168



SELECTOR LEVER IN REVERSE

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MAINTENANCE AND ADJUSTMENTS

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Throttle Linkage Adjustment 72
Valve Body Control Pressure Adjustments 73

FLUID LEVEL CHECK

Transmission fluid level should be checked at least twice a year under normal operation. If the vehicle is used for trailer towing or heavy load hauling, check fluid level **and condition** four or more times each year.

FLUID CHECK PROCEDURE

(1) Position the vehicle on a level surface. This is necessary for an accurate check.

(2) Start and run the engine at curb idle speed.

(3) Shift the transmission into Neutral and apply the parking brakes.

(4) Clean the top of the filler tube and dipstick to keep dirt from entering the tube.

(5) Fluid level should be:

(a) Between the "ADD" and "MAXIMUM LEVEL HOT" marks when the fluid is at normal operating temperature of approximately 180° F (82° C).

(b) Between the two dimples on the dipstick if fluid is only warm (85°-125°F).

FLUID AND FILTER CHANGE

NORMAL CHANGE INTERVAL

The fluid and filter should be changed (and the bands adjusted) at recommended maintenance intervals, or whenever the transmission has been disassembled for any reason.

Refer to the Driveline section in Lubrication and Maintenance Group O at the front of this manual for recommended change intervals. Refer to the fluid/filter replacement and band adjustment procedures in this section.

SEVERE USAGE CHANGE INTERVAL

Under severe usage, the fluid and filter should be changed and the bands adjusted at 12,000 mile (19 000 Km) intervals.

Severe usage is defined as:

(a) More than half of vehicle operation occurs in heavy city traffic during hot weather (above 90° F).

(b) Vehicle is used for Taxi, Police, Limousine, or similiar commercial operations.

(c) Vehicle is used for trailer towing or heavy load hauling.

When the factory fluid is drained, refill the transmission with Mopar ATF Plus, type 7176, or Dexron II™ automatic transmission fluid.

FLUID AND FILTER REPLACEMENT

(1) Raise the vehicle.

(2) Remove the oil pan and drain the fluid.

(3) Remove the three filter screws and remove the filter.

(4) Position the new filter on the valve body and install the filter screws finger tight.

(5) Tighten the filter screws to 35 in-lbs (4 N•m) with a torque wrench.

(6) Position a new gasket on the oil pan and install the pan on the transmission. Tighten pan bolts to 150 in-lbs (17 N•m) torque.

(7) Lower the vehicle and refill the transmission with Mopar ATF Plus type 7176, or Dexron II™ fluid.

GEARSHIFT LINKAGE ADJUSTMENT

Check linkage adjustment by starting the engine in Park and Neutral. Adjustment is OK if the engine starts only in park and Neutral. 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 neutral switch may be faulty.

LINKAGE ADJUSTMENT PROCEDURE

Do not attempt linkage adjustment if any components are worn or damaged. In addition, if either linkage rod must be disconnected, the plastic grommet securing the rod in the lever must be replaced. Disconnect the rod with a pry tool. Pry only where the grommet and rod attach and not on the rod itself. Then cut away the old grommet. Use pliers to snap the new grommet into the lever and to snap the rod into the grommet.

(1) Shift the transmission into Park.

(2) Raise the vehicle.

(3) Check condition of the shift rods, control lever, bushings, washers and torque shaft (Fig. 1). Tighten, repair, or replace worn or damaged parts.

(4) Loosen the shift rod adjusting swivel lock screw. Be sure the swivel turns freely on the rod.

(5) Verify that the valve body shift control lever is in Park detent. Move the lever all the way rearward to check.

(6) Adjust swivel position (on the shift rod) to a obtain free pin fit in the torque shaft lever (Fig. 1). Then tighten the swivel lock screw to 90 in-lbs torque.

(7) Check adjustment by starting the engine in Park and Neutral. Engine should start in these positions only. **If engine starts in any position other than Park or Neutral, adjustment is incorrect or neutral switch is faulty.**

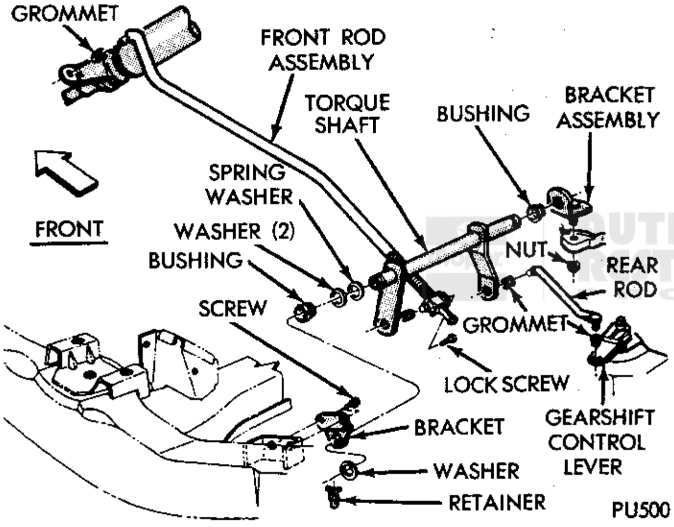

Fig. 1 Column Gearshift Linkage

THROTTLE LINKAGE ADJUSTMENT

(1) Retract ISC actuator with DRB II, or with jumper wires as follows:

(a) If DRB II is used, connect tester to diagnostic connector in engine compartment (connector is located near SBEC connector). Start engine and place DRB II in in "Throttle Body Minimum Air Flow Test". Disconnect electrical connector on ISC actuator. Then shut engine off and disconnect DRB II tester. Actuator is now fully retracted.

(b) If jumper wires are used, shut engine off and disconnect electrical connector at ISC actuator. Connect pair of jumper wires to battery. Connect negative jumper to top pin of ISC actuator and positive jumper to second pin of actuator. Leave jumpers connected for no more than five seconds then disconnect them. Actuator is now fully retracted.

(2) Raise vehicle to make adjustment at transmission throttle lever.

(3) Loosen adjustable swivel lock screw (Fig. 2). Be sure swivel slides freely on throttle rod so that return spring action is not restricted.

(4) Disassemble and clean linkage parts if binding was encountered in step (3). Clean linkage parts as necessary.

(5) Hold transmission throttle lever firmly forward against its internal stop and tighten swivel lock screw to 90 in-lbs (10 N•m) torque.

(6) Lower vehicle

(7) Check linkage freedom of operation. Verify that linkage backlash is removed by return spring. Press throttle rod rearward and release it slowly. Rod should return to full forward position when released.

(8) Reconnect ISC actuator.

(9) Reposition ISC actuator for normal operation as follows. Turn ignition key to ON position for a minimum of five seconds. **Do not start the engine.** Then turn key to OFF position. Actuator is now positioned for normal operation.

FRONT (KICKDOWN) BAND ADJUSTMENT

The front (kickdown) band adjusting screw is located on the left side of the transmission case above the manual valve and throttle valve levers.

(1) Raise the vehicle.

(2) Loosen the band adjusting screw locknut. Then back the locknut off 4-5 turns. Be sure the adjusting screw turns freely in the case.

(3) Tighten the band adjusting screw to 72 inch-pounds (8 N•m) torque. However, if adapter extension C-3705 is used on the torque wrench, tighten the screw to only 47-50 inch pounds (5 N•m) torque (Fig. 3).

(4) Back off the band adjusting screw 2-1/2 turns.

(5) Hold the adjuster screw in position and tighten the locknut to 30 ft-lbs (41 N•m) torque.

(6) Lower the vehicle.

REAR (LOW-REVERSE) BAND ADJUSTMENT

The transmission oil pan must be removed for access to the rear band adjusting screw.

(1) Raise the vehicle.

(2) Remove the transmission oil pan and drain the fluid.

(3) Loosen the band adjusting screw locknut 5-6 turns. Be sure the adjusting screw turns freely in the lever.

(4) Tighten the adjusting screw to 8 N•m (72 in-lbs) torque (Fig. 4).

(5) On A-998/999 transmissions, back off the adjusting screw **four turns**. On A-727 transmissions, back off the adjusting screw **two** turns.

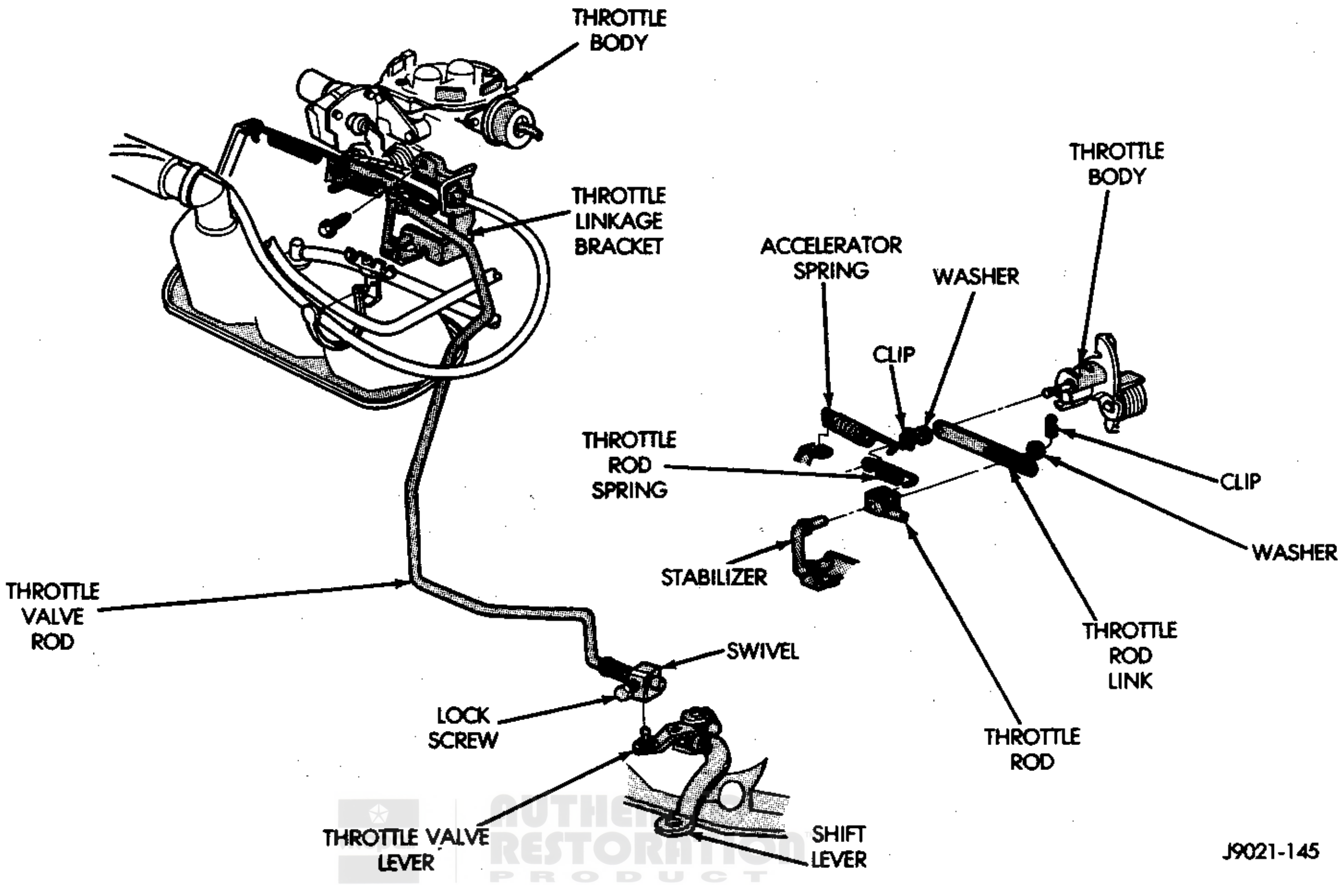

Fig. 2 Throttle Rod And Linkage

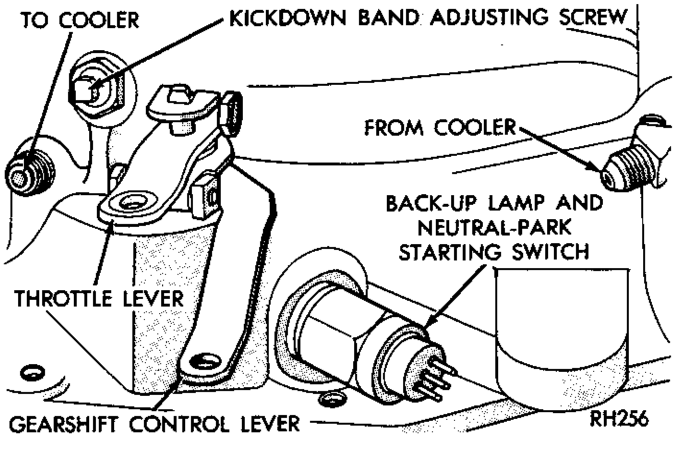

Fig. 3 Front Band Adjustment Screw Location

(6) Hold the adjusting screw in place and tighten the locknut to 34 N•m (25 ft-lbs) torque.

(7) Position a new gasket on the oil pan and install the pan on the transmission. Tighten the pan bolts to 17 N•m (150 in-lbs) torque.

(8) Lower the vehicle and refill the transmission with Mopar ATF Plus, type 7176, or Dexron II™ fluid.

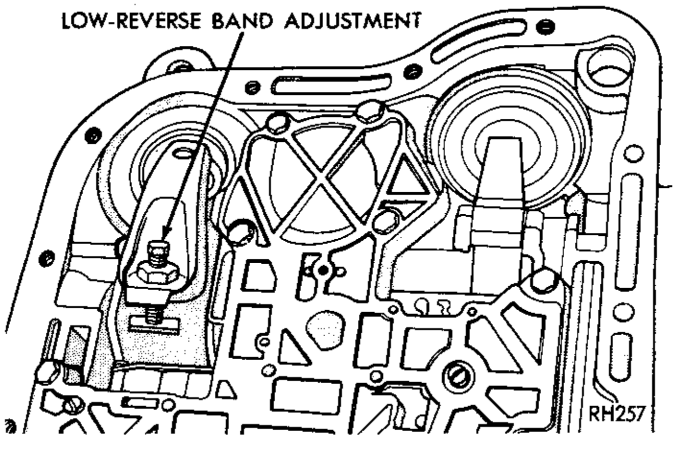

Fig. 4 Rear Band Adjustment Screw Location

VALVE BODY CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body which are: Line pressure and throttle pressure.

Because line and throttle pressures are interdependent (each affects the shift quality and timing), both adjustments must be performed properly and in the correct sequence, the line pressure adjustment first, the throttle pressure adjustment last.

LINE PRESSURE ADJUSTMENT

Measure distance from the valve body to the inner edge of the adjusting screw with an accurate steel scale (Fig. 5).

Distance should be 33.4 mm (1-5/16 inch).

If adjustment is required, turn the adjusting screw in, or out, to obtain required distance setting.

The 33.4 mm (1-5/16 inch) setting is an approximate setting. Because of manufacturing tolerances, it may be necessary to vary from this dimension to obtain desired pressure. One complete turn of the adjusting screw changes line pressure approximately 9 kPa (1-2/3 psi). Turning the adjusting screw counterclockwise increases pressure while turning the screw clockwise decreases pressure.

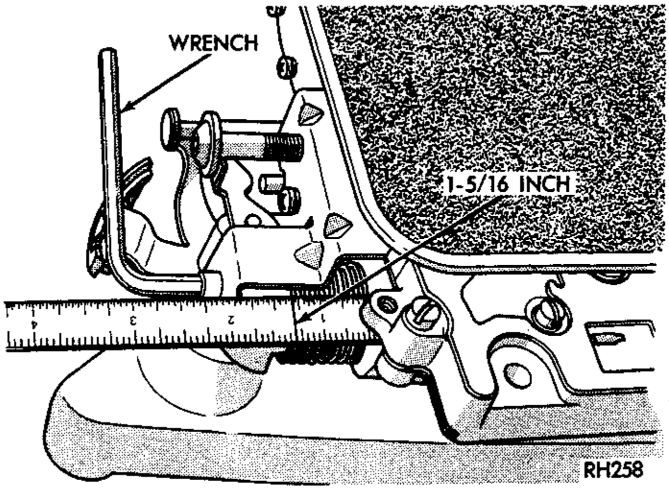

Fig. 5 Line Pressure Adjustment

THROTTLE PRESSURE ADJUSTMENT

Insert gauge tool C-3763 between the throttle lever cam and kickdown valve (Fig. 6).

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.

The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

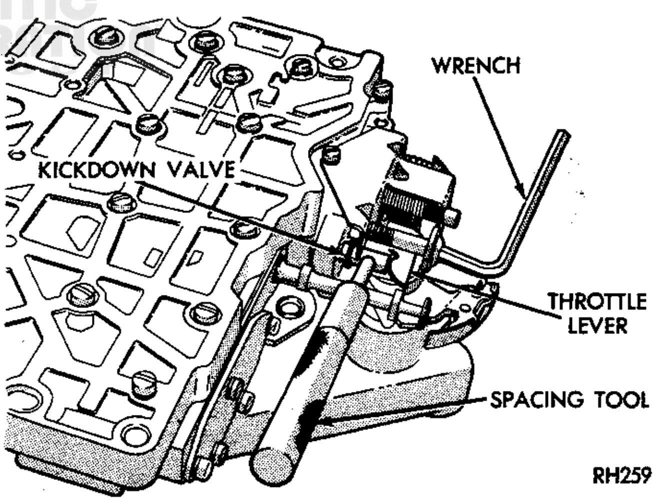

Fig. 6 Throttle Pressure Adjustment

IN-VEHICLE SERVICE

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SPEEDOMETER PINION AND ADAPTER SERVICE

Rear axle gear ratio and tire size determine pinion gear requirements. If the gear must be replaced, refer to the parts catalogue information for the correct gear.

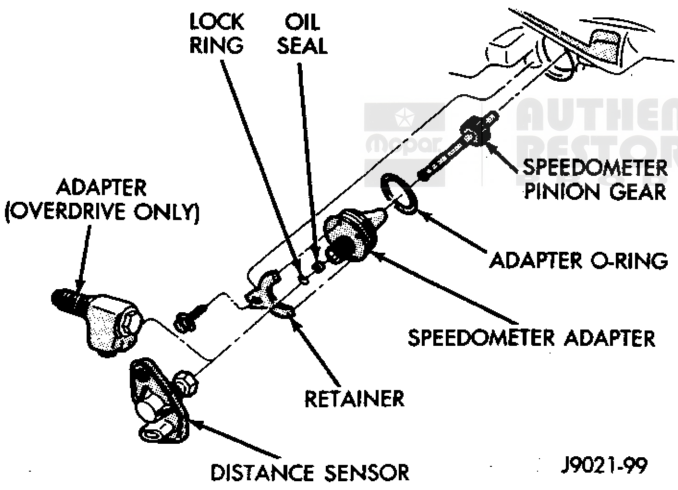

Fig. 1 Speedometer Components

ADAPTER AND PINION REMOVAL/INSTALLATION

(1) Raise the vehicle.

(2) Remove the distance sensor from the speedometer adapter (Fig. 1). On A-500/518, remove the sensor adapter as well.

(3) Check the distance sensor mounting area in the pinion adapter. If transmission fluid is found in this area, the adapter oil seal is leaking and will have to be replaced.

(4) Remove the bolt and retainer securing the pinion gear adapter to the extension housing.

(5) Carefully work the adapter and gear out of the housing.

(6) Remove and discard the adapter O-ring if damaged (Fig. 1).

(7) Remove the adapter oil seal if necessary. Start a new seal in the adapter by hand. Then press the seal into the adapter with tool C-4004 until the tool bottoms (Fig. 2).

CAUTION: Before installing the pinion and adapter assembly, make sure adapter flange and mating area on the extension housing are clean. Dirt or sand will cause misalignment resulting in speedometer pinion gear damage.

(8) Thoroughly clean the adapter flange and adapter mounting surface in the extension housing. These surfaces must be clean for proper adapter alignment and speedometer operation.

(9) Lubricate the adapter oil seal and O-ring with transmission fluid.

(10) Count the number of teeth on the pinion gear before installing the gear in the adapter.

(11) Note the range numbers on the adapter face (Fig. 3). These numbers correspond to the number of teeth on the pinion.

(12) Install the adapter in the extension housing.

(13) Rotate the adapter until the required range numbers are at a six o-clock position (Fig. 3). Be sure the adapter range numbers correspond to the number of teeth on the pinion.

(14) Lightly push or tap the adapter all the way into the extension housing.

(15) Install the adapter retainer. Tighten the retainer bolt to 11 N•m (100 in-lbs) torque.

(16) Install the distance sensor. Tighten the sensor coupling nut to 17 N•m (150 in-lbs) torque and install the sensor wires.

(17) Lower the vehicle and top off the transmission fluid level.

NEUTRAL START AND BACK-UP LAMP SWITCH

The center terminal of the neutral start and backup lamp switch is the starter circuit terminal. It provides the ground for the starter solenoid circuit

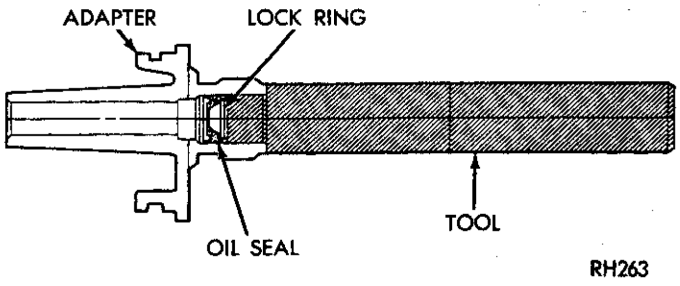

Fig. 2 Replacing Speedometer Adapter Seal

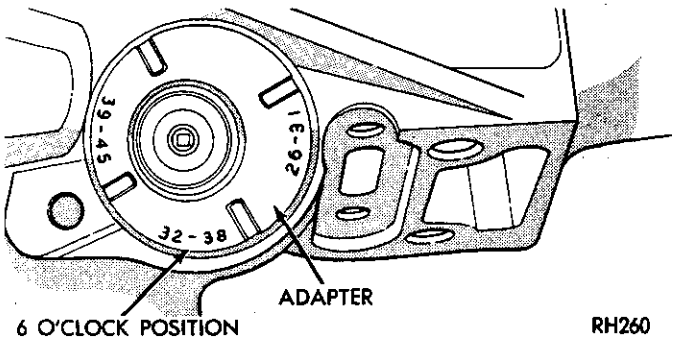

Fig. 3 Indexing Speedometer Adapter

through the selector lever in Park and Neutral positions only. The outer terminals on the switch are for the backup lamp circuit.

SWITCH TEST

To test the switch, remove the wiring connector. Then test continuity between the center terminal and the transmission case. Continuity should exist only when the transmission is in Park or Neutral.

Shift the transmission into reverse and test continuity at the switch outer terminals. Continuity should exist only when the transmission is in Reverse. Continuity should not exist between the outer terminals and the case.

Check gearshift linkage adjustment before replacing a switch that tests bad.

SWITCH REPLACEMENT

(1) Raise the vehicle and position a drain pan under the switch.

(2) Disconnect the switch wires.

(3) Remove the switch from the case.

(4) Move the shift lever to Park and Neutral positions. Verify that the switch operating lever fingers are centered in the switch opening in the case (Fig. 4).

(5) Install a new seal on the switch and install the switch in the case. Tighten the switch to 34 N•m (25 ft-lbs) torque.

(6) Test continuity of the new switch with the test lamp.

(7) Connect the switch wires and lower the vehicle.

(8) Top off the transmission fluid level.

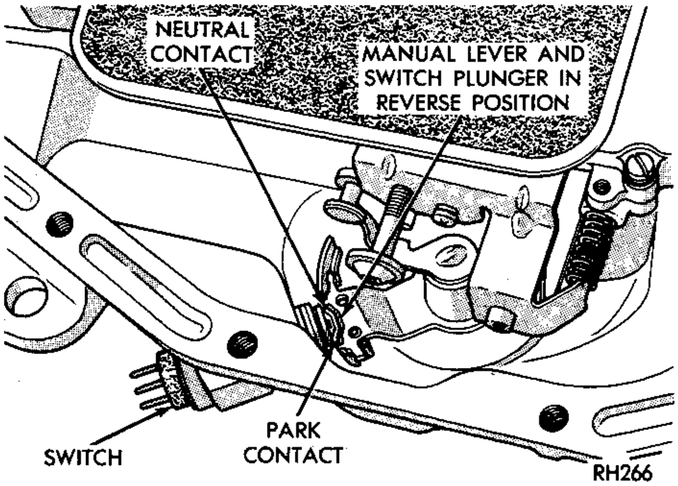

Fig. 4 Neutral Start Switch Contacts

EXTENSION HOUSING YOKE SEAL

YOKE SEAL REPLACEMENT

(1) Raise the vehicle.

(2) Mark propeller and axle yokes for alignment reference. Then disconnect the shaft at the yoke and remove the shaft.

(3) Remove the old seal with tool C-3985 (Fig. 5).

(4) Install the new seal. Position the seal in the extension opening. Then tap the seal into place with tool C-3995 or C-3972 (Fig. 6).

(5) Carefully guide front universal joint yoke into extension housing and on the mainshaft splines. Align marks made at removal and connect propeller shaft to rear axle pinion shaft yoke.

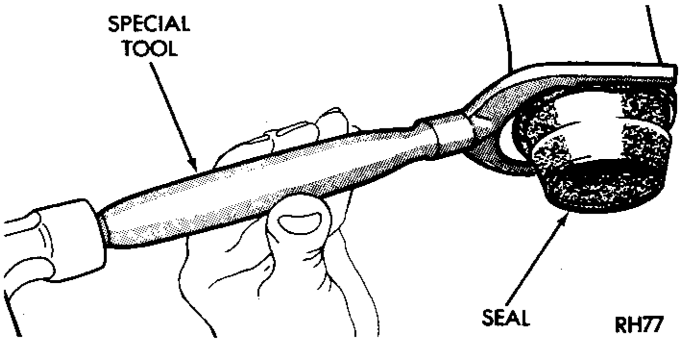

Fig. 5 Removing Extension Housing Yoke Seal

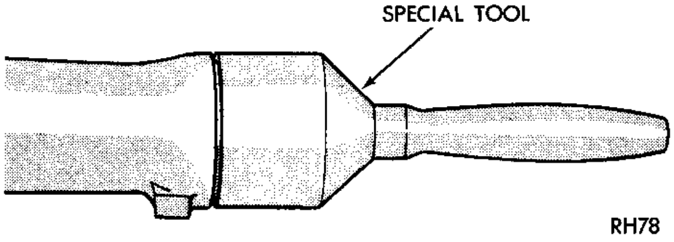

Fig. 6 Installing Extension Housing Yoke Seal

EXTENSION HOUSING BUSHING AND OUTPUT SHAFT BEARING

EXTENSION HOUSING REMOVAL

(1) Shift the transmission into 1 (first gear) position.

(2) Raise the vehicle.

(3) Mark the propeller shaft and axle yokes for alignment reference. Then disconnect the shaft from the yoke and remove the shaft.

(4) Remove the distance sensor, speedometer adapter and speedometer pinion gear (Fig. 1).

(5) Remove the bolts attaching the extension housing to the crossmember.

(6) Raise the transmission slightly with a service jack.

(7) Remove the center crossmember and support assembly.

(8) Remove the extension housing-to-transmission bolts.

(9) Verify that the transmission is in 1 position. The park lock rod can only be disengaged/engaged with the sprag in this position.

(10) Remove the access plate and gasket from the underside of the extension housing mounting pad.

(11) Spread the large snap ring on the output shaft bearing outer race (Fig. 7).

(12) Hold the snap ring in a spread position and carefully tap the extension housing off the shaft bearing.

(13) Carefully pull the extension housing rearward to move the ball on the park lock control rod past the sprag.

(14) Remove the housing.

OUTPUT SHAFT REAR BEARING REPLACEMENT

(1) Using heavy duty snap ring pliers, remove the rear snap ring that retains the bearing on the shaft.

(2) Remove the bearing from the output shaft. Note that A-727 transmissions have a second snap ring at the front of the shaft bearing. A-998/999 transmissions do not have this second snap ring.

(3) Install the new bearing on the shaft. Be sure the large snap ring groove in the outer circumference of the bearing is facing forward (Fig. 8).

(4) Install the rear snap ring to secure the bearing on the shaft (Fig. 8). However, **do not** install the large snap ring on the bearing. The large snap ring will be installed in the extension housing at assembly.

EXTENSION HOUSING BUSHING REPLACEMENT

(1) Remove the housing oil seal with Tool C-3985 (Fig. 5).

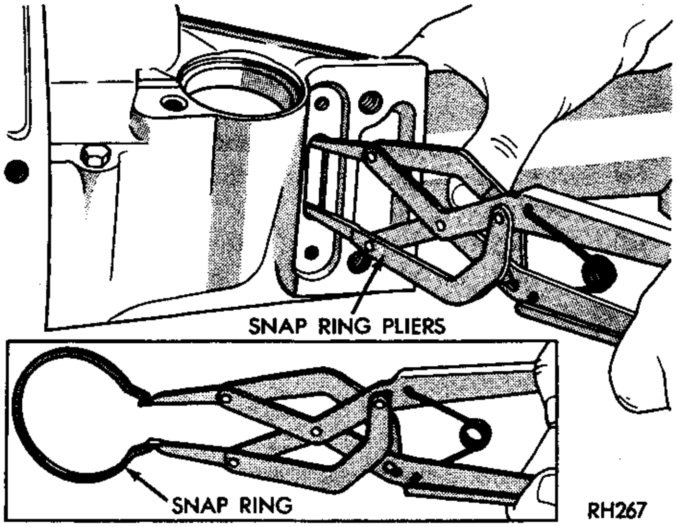

Fig. 7 Removing/Installing Output Shaft Bearing Snap Ring

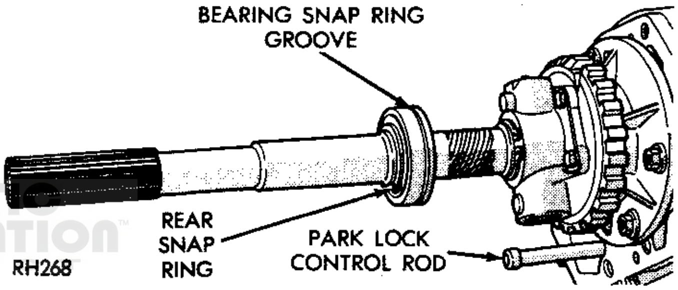

Fig. 8 Output Shaft Bearing Position

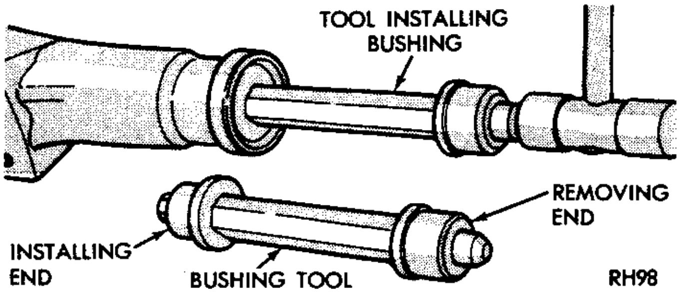

Fig. 9 Extension Housing Bushing Replacement

(2) On A-998/999, remove the housing bushing with tool C-3996. On A-727, remove the bushing with tool C-3974 (Fig. 9).

(3) On A-998/A-999, slide the new bushing on the installing end of tool C-3996. On A-727, slide the bushing on installing end of tool C-3974 (Fig. 9).

(4) Align the bushing oil hole with the oil slot in the extension housing. Then press or drive the bushing into place (Fig. 9).

(5) Install a new oil seal in the housing. On A-998/A-999 use seal installer C-3995. On A-727, use tool C-3972 (Fig. 6).

EXTENSION HOUSING INSTALLATION

(1) Position a new gasket on the extension housing.

(2) Install the large snap ring (for shaft bearing) in the extension housing.

(3) Slide the extension housing onto the output shaft. Work the ball on the park rod past the sprag while manuevering the housing onto the shaft.

(4) Spread the large snap ring (in the housing) as far as possible (Fig. 7).

(5) Carefully tap the housing into place and release the snap ring. Be very sure the snap ring is fully seated in the bearing outer race.

(6) Install and tighten the housing-to-transmission bolts to 43 N•m (32 ft-lbs) torque.

(7) Install the gasket and access plate on the underside of the housing.

(8) Install the center crossmember and rear mount assembly.

(9) Remove the supporting jack and lower the transmission.

(10) Install and tighten the housing-to-crossmember bolts to 68 N•m (50 ft-lbs) torque.

(11) Install the speedometer pinion and adapter.

(12) Align and install the propeller shaft.

(13) Lower the vehicle.

(14) Top off the transmission fluid level.

GOVERNOR AND PARK GEAR

GOVERNOR AND PARK GEAR REMOVAL

(1) Remove the extension housing and output shaft bearing as described in this section.

(2) Carefully pry the snap ring from the weight end of the governor valve shaft (Fig. 10).

(3) Slide the valve and shaft assembly out of the governor body.

(4) Remove the large snap ring from the weight end of the governor body and lift the governor valve and weight assembly out of the body.

(5) Remove the snap ring from inside the governor weight and remove the inner weight and spring from the outer weight (Fig. 11).

(6) Remove the snap ring retaining the governor and gear on the output shaft (Fig. 10).

(7) Slide the governor and park gear assembly off the output shaft.

(8) Remove the bolts attaching the governor body to the gear and separate the two components.

(9) Remove the filter screen from the governor body.

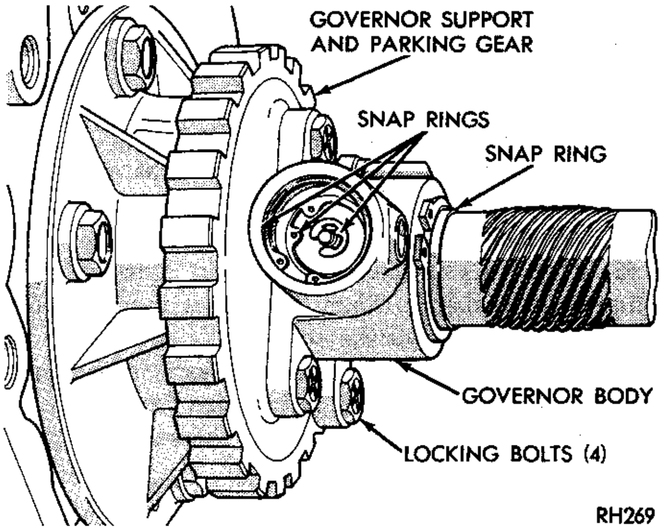

Fig. 10 Governor Snap Rings

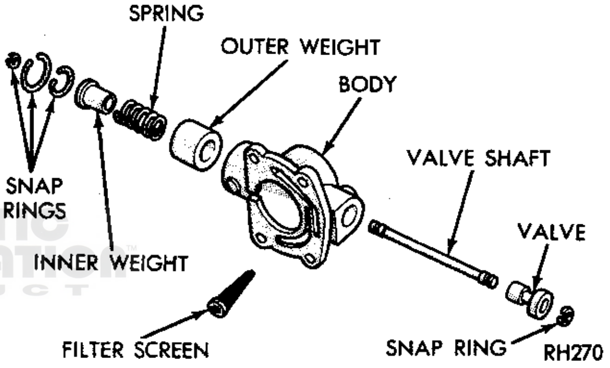

Fig. 11 Governor Components

CLEANING AND INSPECTION

Thoroughly clean all the governor parts in a suitable cleaning solution but do not use any type of caustic cleaning agents. The weights and valves should slide freely in the bores when clean and dry. Minor surface scratches and burrs can be removed with crocus cloth. Inspect the governor weight spring for distortion. Replace the spring, if damaged. Clean the filter in solvent and dry it with compressed air. Replace the filter, if damaged. Inspect the park gear for chipped or worn gear teeth or damaged ring grooves. Replace the gear, if damaged.

GOVERNOR AND PARK GEAR ASSEMBLY AND INSTALLATION

(1) Assemble the governor body, screen and park gear. Tighten the gear to governor bolts finger tight. Make sure the oil passage in the governor body aligns with matching passage in the gear.

(2) Install the assembled governor body and gear on the output shaft.

(3) Position the assembly so the valve shaft hole in the governor body aligns with the hole in the output shaft. Then slide the the assembly into place.

(4) Install the snap ring securing the governor and park gear to the output shaft (Fig. 10).

(5) Tighten the bolts attaching the governor body to the park gear to 11 N•m (95 in-lbs) torque. The attaching bolts have a self-locking nylon patch and can be reused.

(6) Assemble the governor weights and spring. Secure the inner weight and spring in the outer weight with the snap ring (Fig. 11).

(7) Install the weight assembly in the governor body and install the retaining snap ring (Fig. 11).

(8) Place the governor valve on the valve shaft and insert valve and shaft in the body and through the governor weights and output shaft.

(9) Secure the valve shaft with the small snap ring.

(10) Install the output shaft bearing and extension housing as described in this section.

PARKING LOCK COMPONENTS

PARKING LOCK COMPONENT REMOVAL

(1) Remove the extension housing as described in this section.

(2) Slide the sprag shaft out of the extension housing and remove the parking sprag and spring (Fig. 12).

(3) Remove the snap ring and slide the reaction plug and pin assembly out of the housing.

(4) To replace the parking lock control rod, refer to Valve Body Removal and Installation.

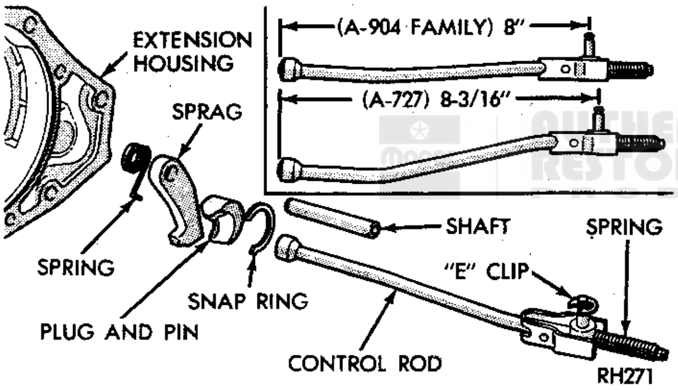

Fig. 12 Parking Lock Components

COMPONENT INSPECTION

Inspect the sprag shaft for scores and free movement in the housing and sprag. Inspect the sprag and control rod springs for distortion and loss of tension. Inspect the square lug on the sprag for broken edges. Check the lugs on the park gear for damage. Inspect the ball on the end of the control rod for nicks and burrs. Also be sure the ball rotates freely.

PARKING LOCK COMPONENT INSTALLATION

(1) Install the reaction plug and pin assembly in the housing and secure with a new snap ring (Fig. 12).

(2) Position the sprag and spring in the housing and insert the sprag shaft. Make sure the square lug on the sprag is toward the park gear. Also be sure the spring is positioned so it moves the sprag away from the gear.

(3) Replace the parking lock control rod if necessary.

(4) Install the extension housing as described in this section.

VALVE BODY REMOVAL

(1) Raise the vehicle.

(2) Remove the oil pan and drain the fluid.

(3) Loosen the clamp bolts and remove the throttle and manual valve levers from the manual valve shaft.

(4) Remove the neutral start and backup lamp switch (Fig. 4).

(5) Remove the filter from the valve body.

(6) Remove the valve body attaching screws.

(7) Lower and remove the valve body. Pull the valve body forward to disengage the park lock rod and remove valve body. If necessary, rotate the propeller shaft so the park lock rod will clear the sprag.

(8) Remove the accumulator piston and spring from the transmission case (Fig. 13).

FRONT/REAR SERVO

The front and rear servos are accessible and can be serviced after valve body removal. Refer to the servo overhaul procedures in the Transmission Overhaul section

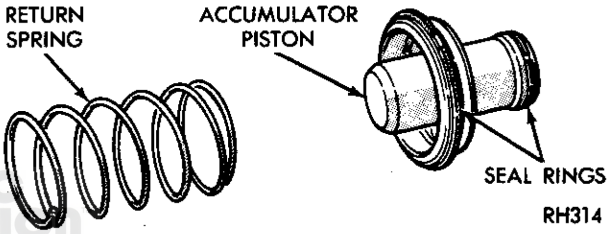

Fig. 13 Accumulator Piston And Spring

VALVE BODY DISASSEMBLY

CAUTION: Tag all valve body springs for reference as they are removed. Do not clamp any part of the valve body in a vise. This practice will distort the valve body and transfer plate and result in valve bind. When removing the valves and plugs, slide them out carefully. Do not use force at any time. The valves and valve body will both be damaged if force is used.

TRANSFER PLATE/CHECK BALL REMOVAL

(1) Mount valve body on repair stand (Fig. 14).

(2) Remove lock rod E-clip (Fig. 12) and remove park lock rod from valve body.

(3) Remove top and bottom screws from spring retainer and adjusting screw bracket (Fig. 15).Hold spring retainer firmly against spring force while removing last screw.

(4) Remove spring retainer and bracket and line pressure adjusting screw assembly. **Do not disturb adjusting screw settings.**

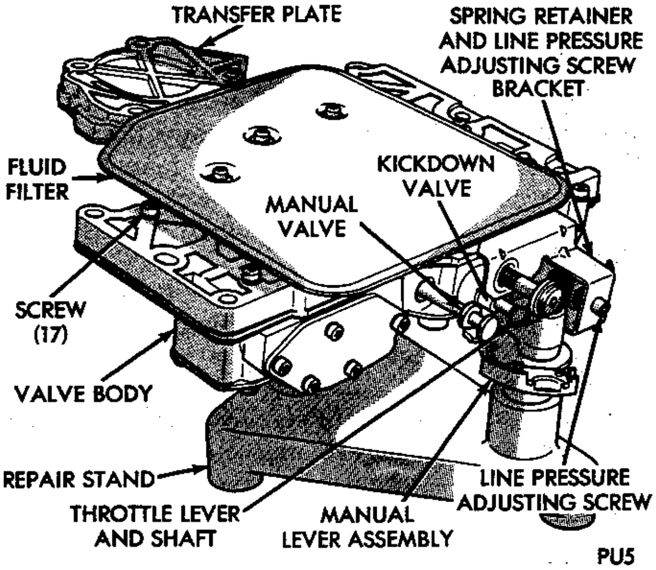

Fig. 14 Valve Body Mounted On Repair Stand

(5) Remove switch valve, pressure regulator valve and valve springs (Fig. 15).

LOCKUP MODULE REMOVAL

(1) Remove lockup module (or stiffener plate on nonlockup models) (Fig. 16).

(2) Remove lockup module end plate and remove lockup and failsafe valves and springs. **On nonlockup California A-998 models, an empty lockup module is used instead of a stiffener plate.**

(3) Remove lockup module connecting tube (Fig. 16).

TRANSFER PLATE/SEPARATOR PLATE/ CHECK BALL REMOVAL

(1) Remove transfer plate screws and remove transfer plate and separator plate (Fig. 17).

(2) Remove lockup module solenoid retaining screw and pull solenoid out of transfer plate.

(3) Remove screws attaching transfer and separator plates and remove the separator plate from the transfer plate (Fig. 17).

(4) On 999 models, remove and retain rear (low-reverse) servo check ball (Fig. 17).

(5) Remove rear clutch check ball (Fig. 17).

(6) Remove and inspect the filter screen in the separator plate (Fig. 17). Replace the screen if damaged.

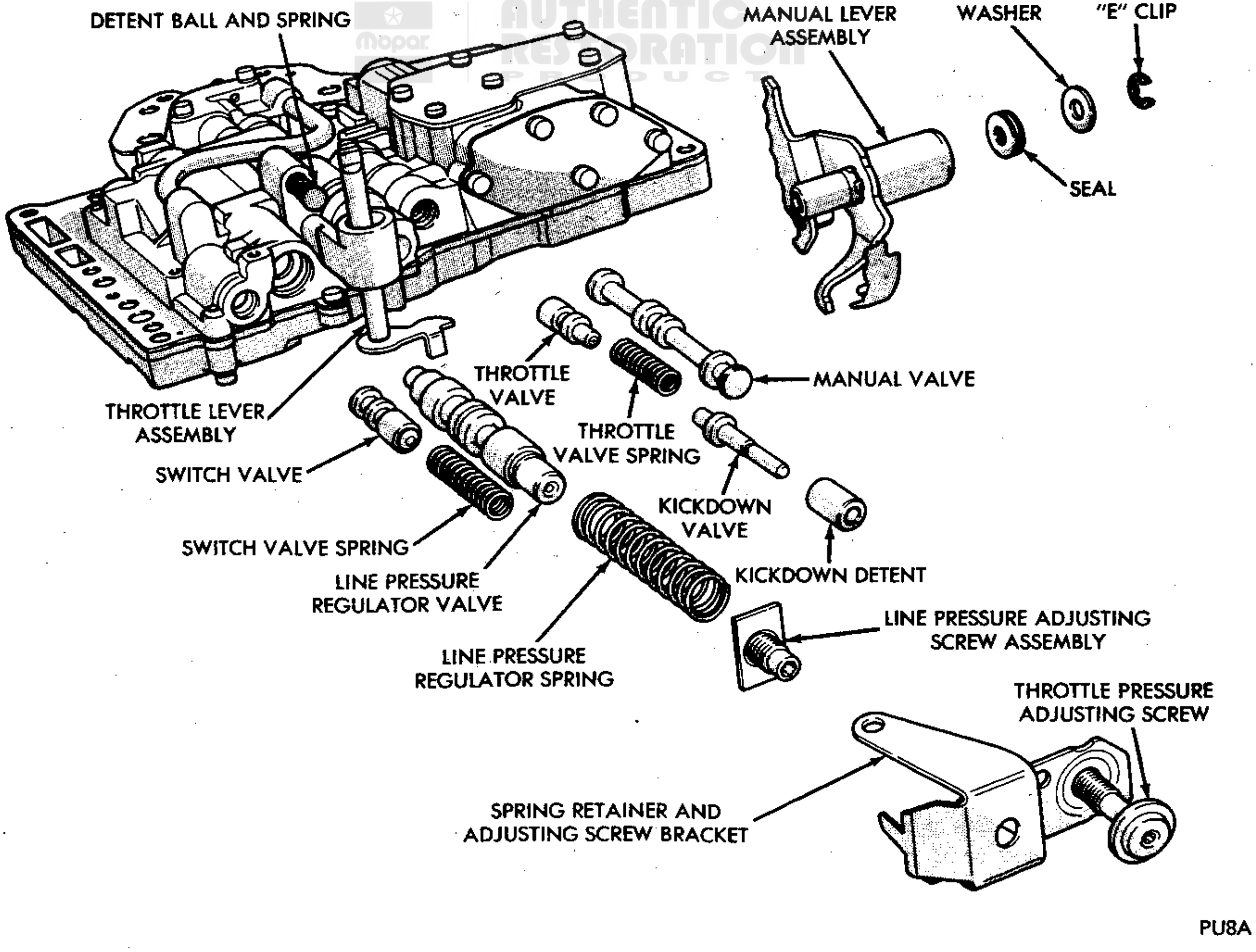

Fig. 15 Pressure Regulators And Manual Controls

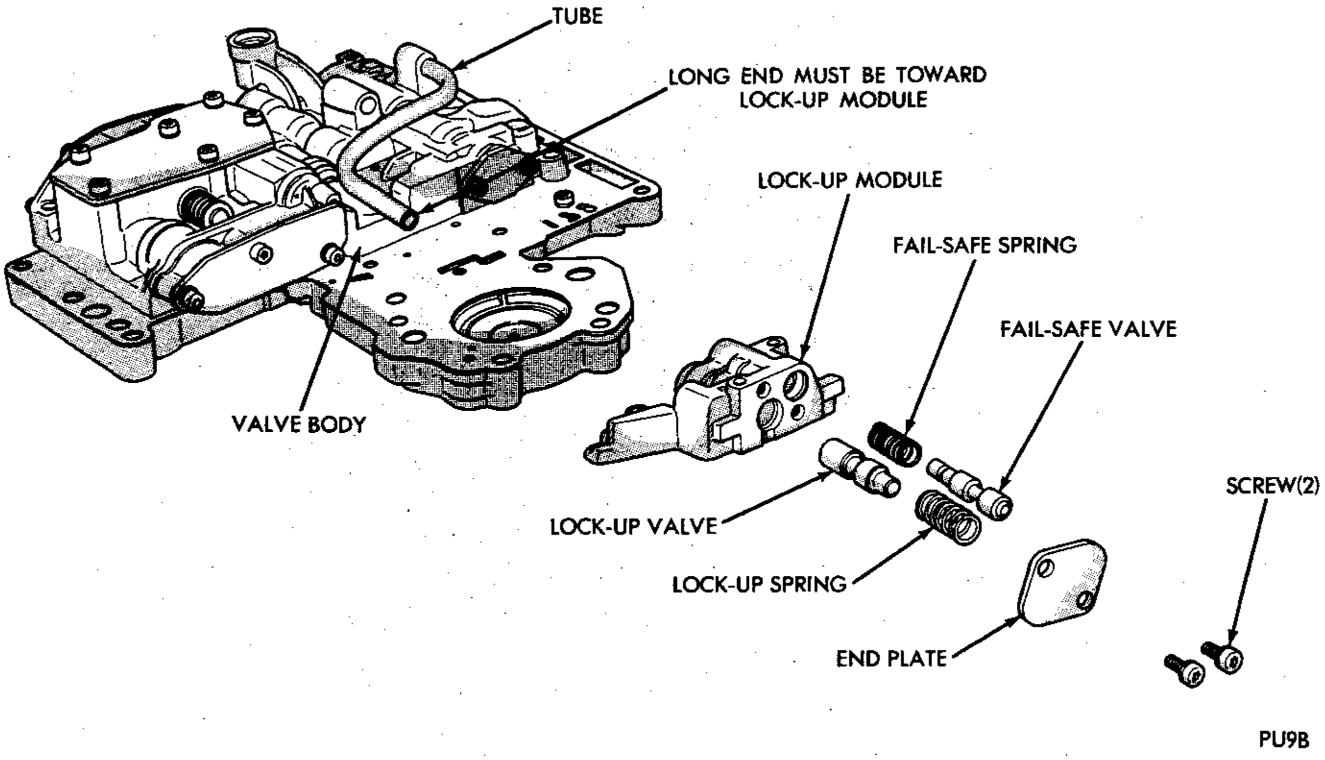

Fig. 16 Lockup Module Components

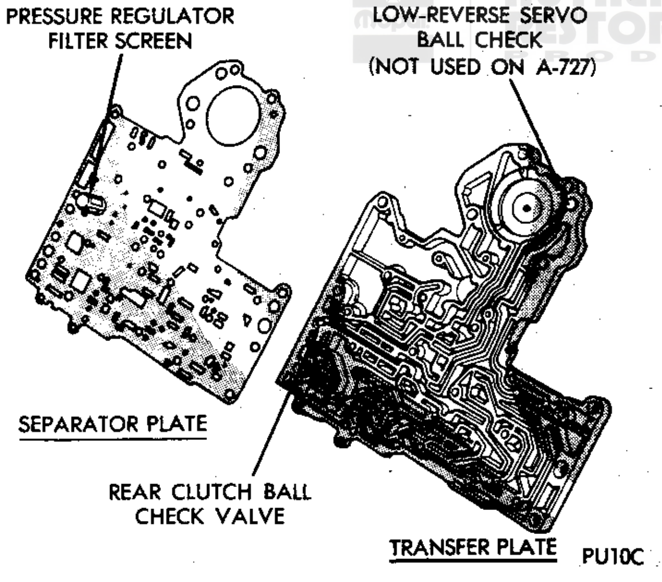

Fig. 17 Transfer And Separator Plates

(7) Remove the valve body check balls (Fig. 18). Note check ball sizes and location for assembly reference.

SHUTTLE VALVE/GOVERNOR PLUG REMOVAL (FIG. 19)

(1) Turn the valve body over.

(2) Remove the shuttle valve end plate (Fig. 19).

(3) Remove the governor plug end plate (Fig. 19).

(4) Remove the shuttle valve, plug, spring and governor plugs (Fig. 19).

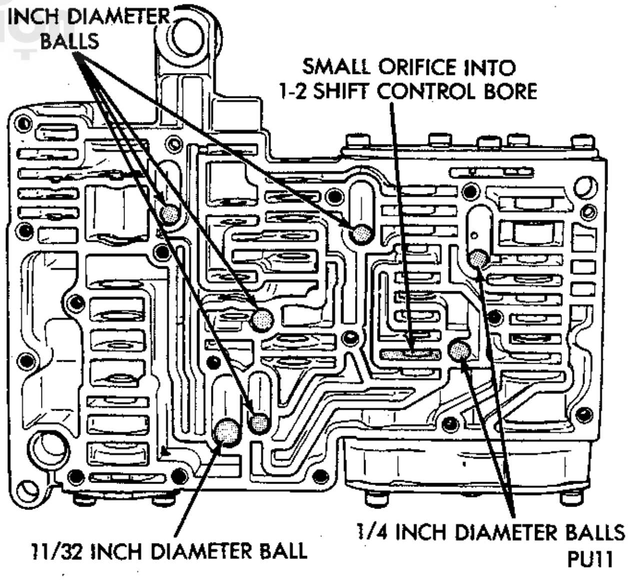

Fig. 18 Valve Body Check Balls

(5) Remove the E-clip and remove the shuttle valve secondary spring and guides (Fig. 19).

MANUAL VALVE/THROTTLE LEVER REMOVAL

(1) Remove manual lever E-clip, washer and seal (Fig. 15).

(2) Remove any burrs from throttle valve shaft by polishing with crocus cloth or very fine grit paper.

(3) Secure detent ball and spring (Fig. 14) with tool C-3765 and slide manual lever off throttle shaft (Fig. 14).

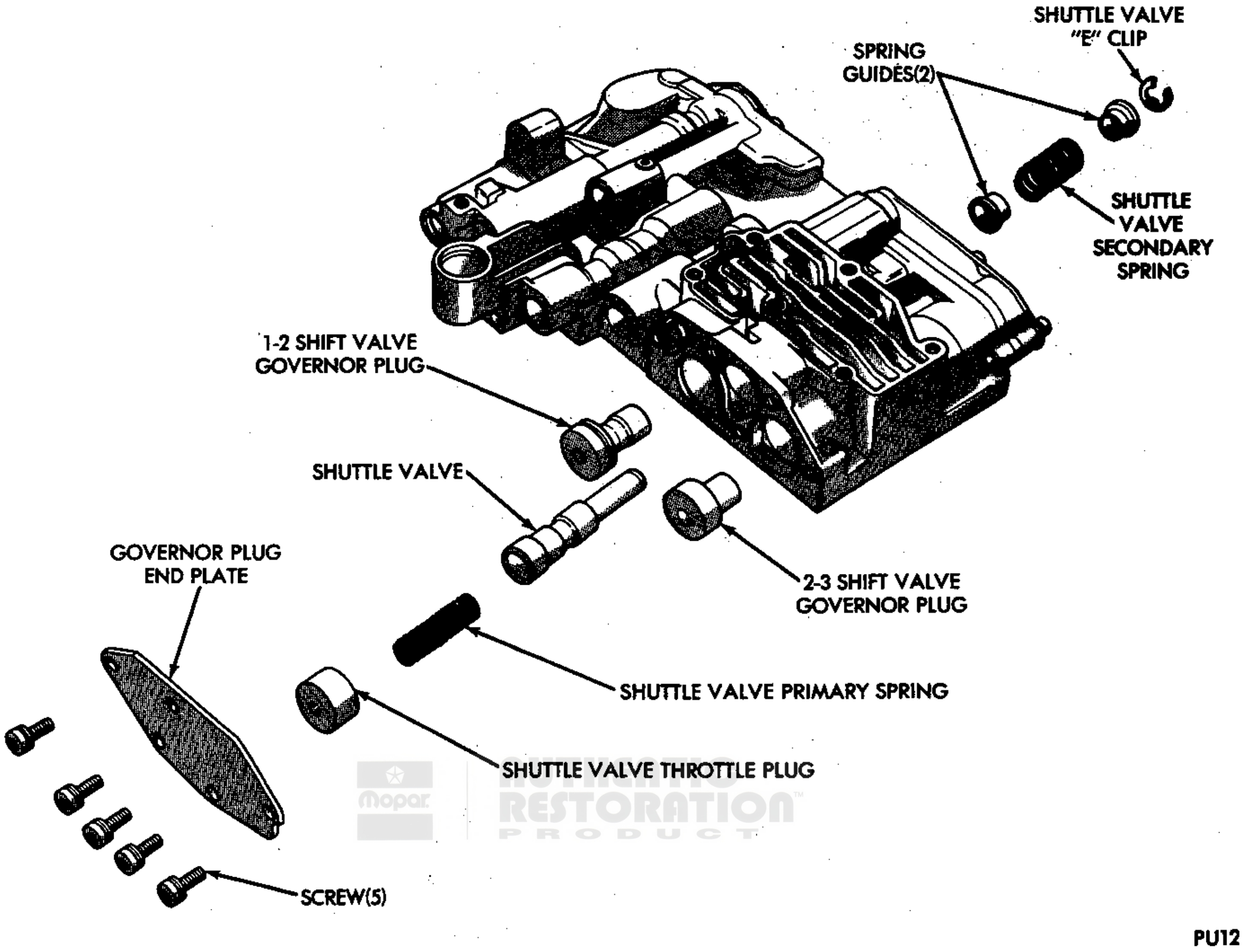

Fig. 19 Shuttle Valve And Governor Plugs

(4) Remove and retain detent ball and spring (Fig. 15).

(5) Remove throttle lever assembly (Fig. 15).

(6) Remove manual valve, kickdown valve and detent, and throttle valve components (Fig. 15).

SHIFT VALVES/PRESSURE REGULATOR PLUG REMOVAL

(1) Remove the line pressure end plate and remove the line pressure plug and sleeve and the throttle pressure plug and spring (Fig. 20).

(2) Remove the limit valve end plate and limit valve housing if equipped (Fig. 20).

(3) Remove the throttle plug from the housing (Fig. 20).

(4) Slide the retainer from the housing and remove the limit valve and spring (Fig. 20).

(5) Remove the 1-2 and 2-3 shift valves and springs from the valve body (Fig. 20).

VALVE BODY CLEANING AND INSPECTION

Clean the valve body components in clean solvent. Dry the parts with compressed air. Make sure all passages are clean and free from obstructions.

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 mating surface may be corrected by smoothing the surface with a sheet of crocus cloth placed on a surface plate (or equally flat surface). If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

Verify that the 1-2 shift orifice is clear. Check the orifice by inserting a .79 mm (1/32 inch) diameter drill bit through the orifice and into the 1-2 shift bore.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Minor surface scratches can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.** Maintaining the

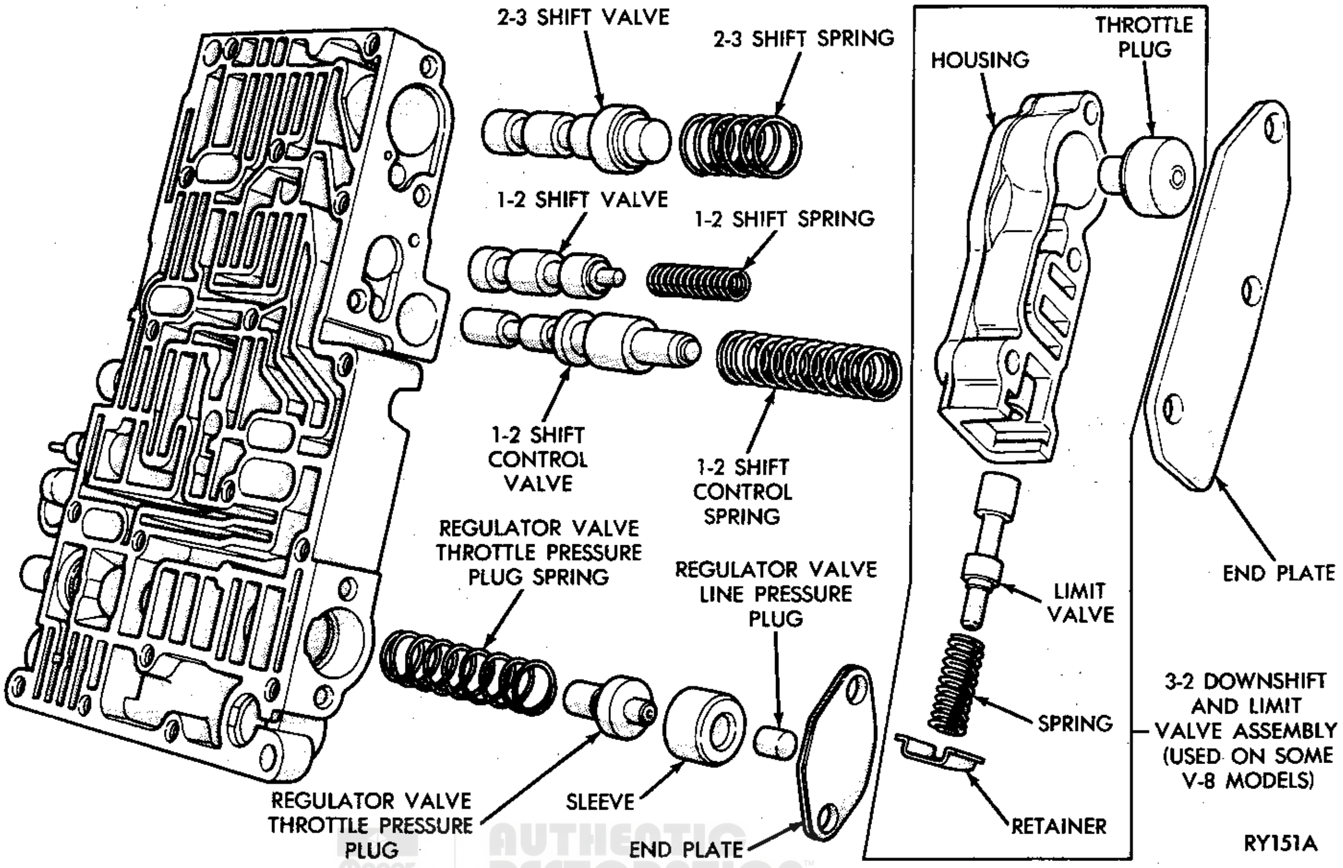

Fig. 20 Shift And Pressure Regulator Valves/Plugs

sharpness of these edges is vitally important. These 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.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should slide freely in 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 repair. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

VALVE BODY ASSEMBLY

CAUTION: Do not force any valves or plugs into place during reassembly. If the valves, plugs and bores are free of distortion or burrs, they should slide into place easily. In addition, do not overtighten the valve body screws during reassembly. Overtightening will distort the valve body resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten the screws alternately and evenly to 4 N•m (35 in-lbs) torque.

SHIFT VALVE/PRESSURE REGULATOR PLUG INSTALLATION (FIG. 20)

(1) Install 1-2 and 2-3 shift valves and throttle and pressure regulating plugs and springs.

(2) On models so equipped, install limit valve and spring and throttle plug in limit valve housing. Then secure limit valve and spring with retainer.

(3) Install pressure plugs, sleeve and spring.

(4) Install small end plate.

(5) Install limit valve housing and end plate.

SHUTTLE VALVE/GOVERNOR PLUG INSTALLATION (FIG. 19)

(1) Install 1-2 and 2-3 shift valve governor plugs in their respective bores.

(2) Install shuttle valve and hold it in place with index finger while installing secondary spring, guides and E-clip.

(3) Install primary shuttle valve spring and throttle plug.

(4) Install governor plug end plate and shuttle valve cover plate. Tighten plate retaining screws to 4 N•m 35 in-lbs (4 N•m) torque.

MANUAL VALVE/THROTTLE LEVER INSTALLATION

(1) Install throttle valve and spring, kickdown valve and valve detent in valve body (Fig. 15).

(2) Install the manual valve (Fig. 15).

(3) Install throttle lever in valve body (Fig. 15).

(4) Insert detent ball and spring in bore. Compress spring with tool C-3765 and and slide manual lever onto throttle lever shaft (Fig. 21).

(5) Install seal, retaining washer and E-clip on to secure manual lever on throttle lever shaft (Fig. 15).

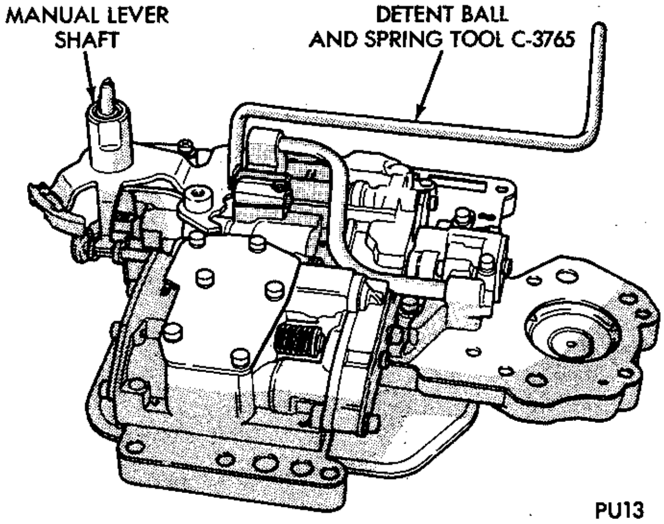

Fig. 21 Installing Detent Ball And Spring

INSTALLING FILTER/TRANSFER PLATE/ LOCKUP SOLENOID/PRESSURE REGULATORS/CHECK BALL

(1) Install check balls in valve body (Fig. 18).

(2) Install rear clutch check ball in transfer plate (Fig. 17).

(3) Install low-reverse servo ball check in transfer plate. **This ball check is only used in A-998/999 transmissions.**

(4) Install pressure regulator filter screen in separator plate (Fig. 17).

(5) Assemble transfer and separator plates and install three attaching screws in transfer plate.

(6) Position transfer plate on valve body. Align pressure regulator filter screen and install transfer plate screws finger tight. The short screws are for the transfer plate and valve body. The three long screws are for the fluid filter.

(7) Tighten transfer plate screws evenly to 4 N•m (35 in-lbs) torque. Tighten screws starting at center and working outward.

(8) Install switch valve, line pressure valve and valve springs in valve body bore (Fig. 15).

(9) Assemble and install line pressure adjusting screw and throttle pressure adjusting screw and bracket assembly (Fig. 15). Secure the components with one screw for the time being. Use the screw that goes into the side of the valve body.

(10) Install lockup valve and spring. Then install fail safe spring and valve in lockup module (Fig. 16).

(11) Install lockup module 9or stiffener plate) on transfer and separator plates. Be sure connecting tube is properly seated in valve body and lockup module. Then install and tighten module attaching screws to 4 N•m (35 in-lbs) torque.

(12) Install new O-ring on lockup solenoid nozzle. Then install nozzle in transfer plate bore and tighten retaining screw to 35 in-lbs) torque.

(13) Route lockup solenoid wire between solenoid and limit valve housing cover and under edge of fluid filter. **Solenoid wire routing is extremely important. The wire must be routed away from the low-reverse band lever.**

(14) Secure pressure adjusting screw bracket to valve body with remaining attaching screw.

(15) Check and adjust valve body pressure settings if necessary. Refer to procedure in Maintenance And Adjustments section.

(16) Secure park lock control rod to valve body with new E-clip (Fig. 12).

MANUAL LEVER SHAFT SEAL

If the lever shaft seal must be replaced, tap it out of the transmission case with a punch. Then install the new seal with a 15/16 socket (Fig. 22).

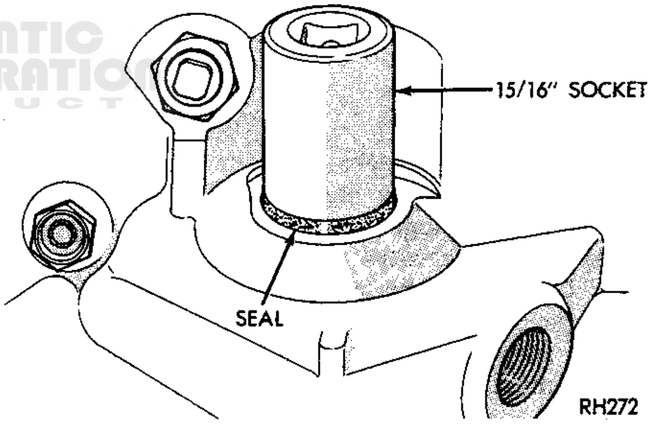

Fig. 22 Installing Manual Lever Shaft Seal

VALVE BODY INSTALLATION

(1) Verify that neutral start switch has NOT been installed in the case. Valve body cannot be installed with switch in place. Remove the switch if necessary.

(2) Install new seals on accumulator piston and install piston in case.

(3) Place valve body manual lever in low (1 position) so ball on park lock rod can be installed in sprag.

(4) Use screwdriver to push park sprag into engagement with park gear. This allows ball on park lock rod to move past sprag when valve body is installed. Rotate output to verify sprag engagement.

(5) Position accumulator spring between piston and valve body.

(6) Position valve body on transmission and work ball on park lock rod past the sprag.

(7) Hold the valve body in position and install the valve body attaching bolts finger tight only.

(8) Install neutral start and backup lamp switch in case.

(9) Move manual lever to Neutral position.

(10) Move valve body as needed to align neutral finger of manual lever with plunger of neutral start switch.

(11) Tighten valve body attaching screws alternately and evenly to 11 N•m (100 in-lbs) torque.

(12) Install new fluid filter on valve body. Install and tighten the three, long filter screws to 4 N•m (35 in-lbs) torque.

(13) Install manual and throttle levers on throttle lever shaft. Tighten lever clamp screws and check for free operation. Shaft and levers must operate freely without any bind.

(14) Install oil pan and new gasket. Tighten pan bolts to 17 N•m (150 in-lbs) torque.

(15) Connect neutral switch and lockup solenoid wires.

(16) Install the speedometer pinion gear, adapter and distance sensor.

(17) Lower the vehicle.

(18) Fill transmission with Mopar ATF Plus, type 7176, or Dexron II™ fluid.

(19) Adjust gearshift and throttle linkage.

TRANSMISSION COOLER SERVICE

FLUSHING COOLERS AND LINES

If a transmission malfunction contaminates the fluid, the cooler and lines must be reverse flushed thoroughly. This is necessary to prevent sludge and particles from flowing back into the transmission after repair. The flushing procedure applies to standard and auxiliary coolers.

Pressure equipment is preferred for cooler reverse flushing. However, reverse flushing can be performed with hand operated equipment as follows.

Flushing Procedure

(1) Identify and disconnect the cooler pressure and return lines at the transmission.

(2) Position a drain pan under the cooler pressure line to catch material flushed through the cooler and lines.

(3) Reverse flush the cooler using a hand operated suction gun filled with mineral spirits. Insert the gun nozzle (or hose) into the cooler return line. Then force mineral spirits into the line and through the cooler.

(4) Continue reverse flushing until the fluid exiting the cooler pressure line is clear and free from debris. **Replace the cooler if fluid cannot be pumped through it.**

(5) Clear the flushing materials from the cooler and lines with short pulses of compressed air. Insert the air gun nozzle into the cooler return line and continue the short air pulses until all fluid is cleared from the cooler and lines.

(6) Pump one quart of automatic transmission fluid through the cooler and lines before reconnecting the lines.

CHECKING COOLER FLUID FLOW

Cooler flow is checked, by measuring the amount of fluid pumped through the cooler in a specified time by the transmission oil pump.

(1) Disconnect the cooler return line from the transmission and place it in a one quart test container.

(2) Add extra quart of fluid to transmission.

(3) Use stopwatch to check test time.

(4) Shift into Neutral.

(5) Start and run engine at curb idle speed and note cooler flow. A minimum of one quart (0.9 liter) of fluid should flow into test container in 20 seconds.

(6) If fluid flow is intermittent, flows less than one quart in 20 seconds, or fails to flow at all, cooler is plugged or damaged and should be replaced.

If a transmission malfunction contaminates the fluid, the fluid coolers and lines must be flushed thoroughly. This is necessary to prevent sludge and particles from flowing back into the transmission after repair. The flushing procedure applies to standard and auxiliary coolers.

MAIN COOLER REPLACEMENT

The main transmission cooler is located in the radiator lower tank. The cooler is not a serviceable component. If the cooler is damaged in any way, the radiator will have to be replaced.

AUXILIARY COOLER REPLACEMENT

(1) Remove grille.

(2) Remove brackets securing cooler to radiator and raditor support (Fig. 23).

(3) Tag cooler hoses for installation reference (Fig. 23).

(4) Position drain pan under cooler lines.

(5) Loosen cooler connecting hose clamps and disconnect the hoses.

(6) Remove the cooler

(7) Connect cooler to hoses.

(8) Position cooler on radiator and install cooler support brackets and attaching fasteners.

(9) Tighten cooler hose clamps securely.

(10) Install grille.

(11) Check and adjust transmission fluid level.

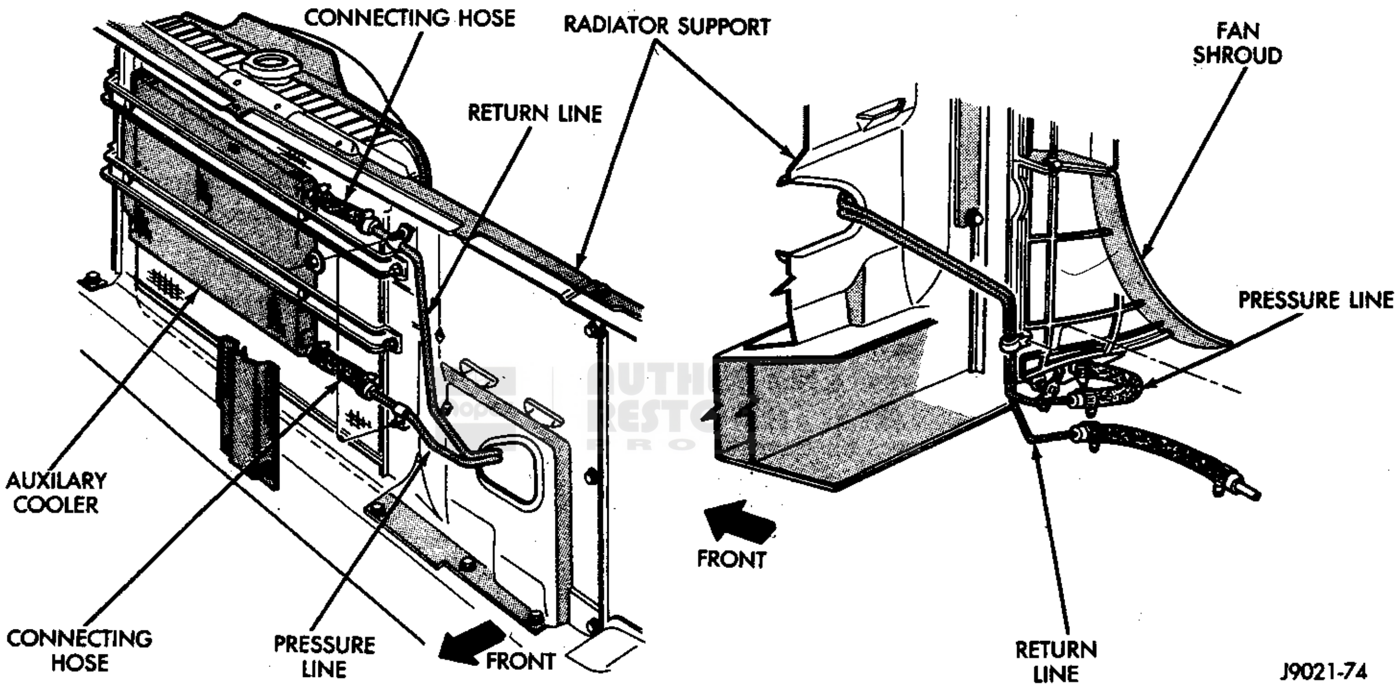

Fig. 23 Auxiliary Cooler

ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transmission case and in the valve body can be repaired with Heli-Coil or equivalent quality thread inserts. Essentially, repair consists of drilling out the worn or damaged threads, tapping the hole with a special tap and installing a thread insert into the tapped hole. This procedure returns the hole threads to original size. Heli-Coil, or equivalent, tools and inserts are readily available from most automotive parts suppliers.

TRANSMISSION AND TORQUE CONVERTER REMOVAL/INSTALLATION

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TRANSMISSION AND CONVERTER REMOVAL

The transmission and torque converter must be removed as an assembly; otherwise, the converter drive plate, pump bushing, or oil seal may be damaged. The drive plate will not support transmission weight. Do not allow the plate to support transmission weight at any time during removal.

(1) Disconnect the battery negative cable.

(2) Disconnect and lower or remove necessary exhaust components. Refer to Group 11 for procedures.

(3) Remove engine-to-transmission struts, if so equipped.

(4) Remove fluid cooler lines at transmission.

(5) Remove starter motor and cooler line bracket.

(6) Remove torque converter access cover.

(7) Loosen oil pan bolts and tap pan to break it loose allowing fluid to drain. Then reinstall pan.

(8) Mark torque converter and drive plate for assembly alignment. The crankshaft flange bolt circle, inner and outer circle of holes in the drive plate and the tapped holes in the front face of the torque converter all have one hole offset. This ensures that these parts are installed in the original position to maintain balance of the engine and torque converter.

(9) Rotate engine in clockwise direction (with socket wrench on vibration dampener bolt) until converter bolts are accessible. Then remove the bolts.

(10) Mark propeller shaft U-joint and axle yoke parts for assembly alignment. Then disconnect and remove popeller shaft.

(11) Disconnect wires from neutral start switch and lockup solenoid, if so equipped.

(12) Disconnect gearshift rod and torque shaft assembly from transmission. When necessary to disconnect linkage rods from levers that use plastic grommets as retainers, grommets should be replaced with new ones. Use pry tool to remove rod from grommet and cut away old grommet. Use pliers to snap new grommet into lever and to snap rod rod into grommet at assembly.

(13) Disconnect throttle rod from lever at the left side of transmission. Remove linkage bellcrank from transmission, if so equipped.

(14) Remove oil filler tube and speedometer cable.

(15) Install engine support fixture Tool C-3487-A with frame hooks (or a suitable substitute) to support rear of engine (Fig. 1).

(16) Raise transmission slightly with service jack to relieve load on the supports.

(17) Remove bolts securing transmission mount to crossmember and crossmember to frame and remove crossmember.

(18) Remove all converter housing bolts.

(19) Carefully work transmission and torque converter assembly rearward off engine block dowels and disengage torque converter hub from end of crankshaft. Attach a small C-clamp to edge of bell housing to hold torque converter in place during transmission removal.

(20) Lower transmission and remove assembly from under the vehicle.

(21) To remove torque converter, remove C-clamp from edge of bell housing and carefully slide torque converter out of the transmission.

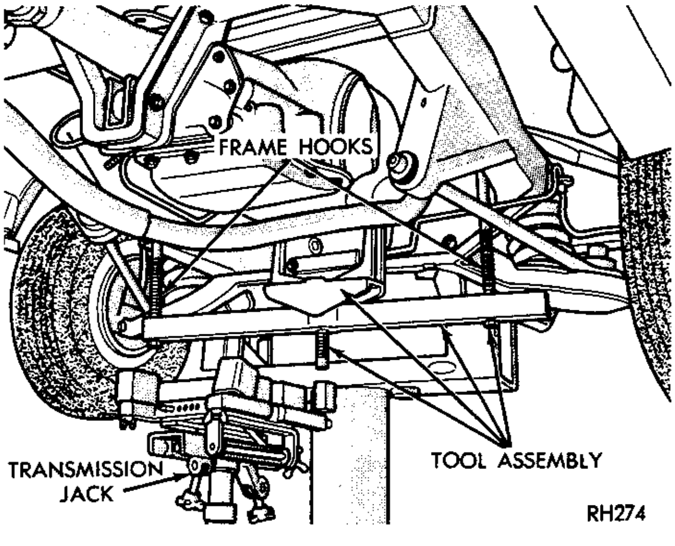

Fig. 1 Typical Engine Support Fixture

STARTER RING GEAR REPLACEMENT

The starter ring gear on nonlockup torque converters can be removed and a new gear welded in place. However, lockup torque converters with a damaged starter ring gear must be replaced as an assembly. The heat from welding would damage the converter lockup clutch friction material.

The starter ring gear is mounted directly on the outer diameter of the torque converter front cover. Gear replacement is as follows:

RING GEAR REMOVAL

(1) Cut through weld material at rear side of ring gear with a hack saw or grinding wheel. Be careful not to cut or grind into front cover stamping.

(2) Scribe heavy line on front cover next to front face of ring gear. Line is needed to properly locate new gear on converter.

(3) Support torque converter on front cover with blocks of wood (Fig. 2) Position blocks adjacent to converter lugs to avoid altering lug position. **The torque converter must not rest on the front cover hub during this operation.**

(4) Using blunt chisel or drift and a hammer, tap downward on ring gear near welded areas to break any remaining weld material (Fig. 2).

(5) Tap around ring gear until it comes off the torque converter.

(6) Smooth off weld areas on the cover with a file.

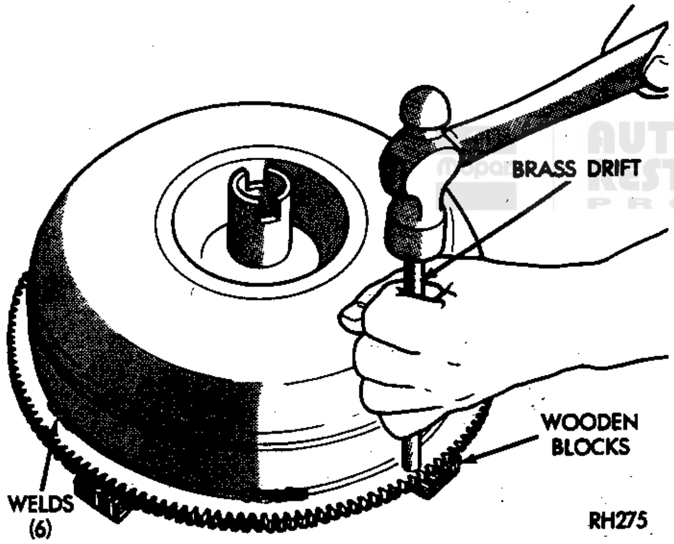

Fig. 2 Removing Starter Ring Gear

RING GEAR INSTALLATION

(1) Heat and expand the new starter ring gear for installation on the converter. Any of the following methods are acceptable:

(a) Oven: Place gear in oven and set temperature at 200° F (93° C) Allow ring gear to remain in oven for 15 to 20 minutes.

(b) Boiling Water: Place ring gear in shallow container. Add water and heat for approximately eight minutes after water has come to a boil.

(c) Steam: Place ring gear on a flat surface and direct a steam flow around gear for approximately 2 minutes.

(d) Flame: Place ring gear squarely on a flat surface. Using a medium size tip, direct a slow flame evenly around inner rim of the gear. Do not apply flame to the gear teeth. Place a few drops of water on face of gear at intervals during heating process. When gear is hot enough to just boil the water, gear is ready for installation.

(2) After ring gear is expanded by heating, immediately place gear in position on converter front cover.

(3) Quickly tap gear onto cover evenly with plastic or rawhide mallet. Continue tapping gear until face of gear is even with scribe line (made during removal) on the front cover.

(4) Before proceeding, make sure gear is even with scribed line around full circumference of the front cover.

(5) The following suggestions are offered as an aid in welding the new ring gear to the converter. **Do not gas weld with oxy-acetylene equipment.** Use a D.C. welder set at straight polarity, or use an A.C. welder if the proper electrode is available. Use a 3 mm (1/8 inch) diameter welding rod and a welding current of 80 to 125 amps. Direct the arc at the intersection of the gear and front cover from an angle of 45 degrees from the rear face of the gear.

(6) Weld new ring gear to torque converter front cover. Take care to place same amount of weld material (or as nearly as possible) in original weld locations. This is essential in maintaining converter balance. Position welds alternately on opposite sides of converter and ring gear to minimize distortion.

(7) Inspect gear teeth and remove all nicks where metal is raised, weld metal splatter, etc., in order to ensure quiet starter operation.

PUMP OIL SEAL

SEAL REPLACEMENT

The pump oil seal can be replaced without removing pump and reaction shaft support assembly from the transmission case.

To remove the seal use remover tool C-3981 on A-998/999 transmission, or tool C-3861 on A-727 transmission. Thread the seal remover tool into the seal. Then tighten the tool puller screw to withdraw the seal (Fig. 3).

To install the seal, use driver handle C-4171 and installer tool C-4193 (A-998/999) or installer tool C-3860-A (A-727). Place the new seal in the pump opening with the seal lip facing inward. Then tap the seal into place with the driver handle and installer tool (Fig. 4).

CONVERTER AND DRIVE PLATE SERVICE

After the transmission has been removed, the drive plate and torque converter can replaced or removed for service access.

The torque converter is not a serviceable part. If the converter is contaminated or damaged in any way, it must be replaced as an assembly. **Do not at-**

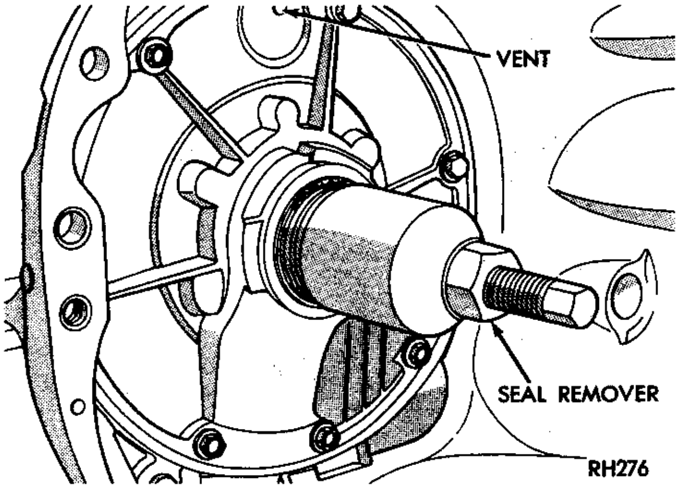

Fig. 3 Pump Seal Removal

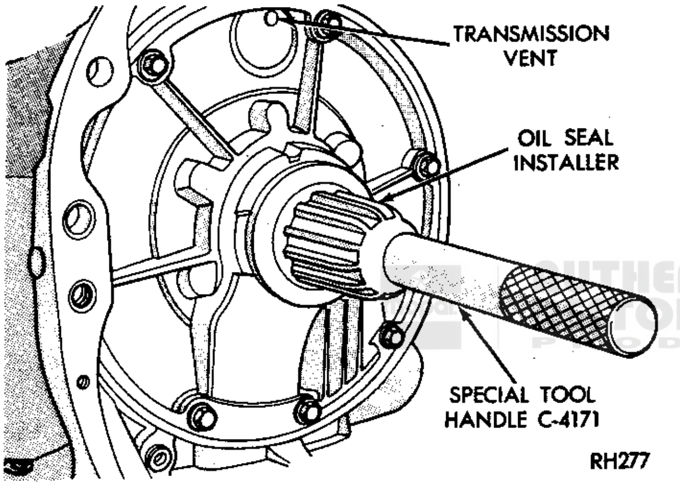

Fig. 4 Pump Seal Installation

tempt to flush a converter contaminated by metal or clutch facing particles. Flushing will not remove these contaminants.

TRANSMISSION AND CONVERTER INSTALLATION

(1) If the torque converter was removed, align the pump gears before installing the converter.

(2) Rotate converter until drive slots in converter hub are aligned with rotor lugs. Then remove aligning tool and carefully insert converter hub into pump. Be sure converter is fully seated in pump gears.

(3) Check converter seating with a scale and straightedge (Fig. 5). Surface of converter lugs should be 1/2 inch to rear of straightedge when converter is fully seated.

(4) Temporarily secure converter with C-clamp attached to housing or with metal strap attached across converter housing.

(5) Position transmission on jack and secure it with chains.

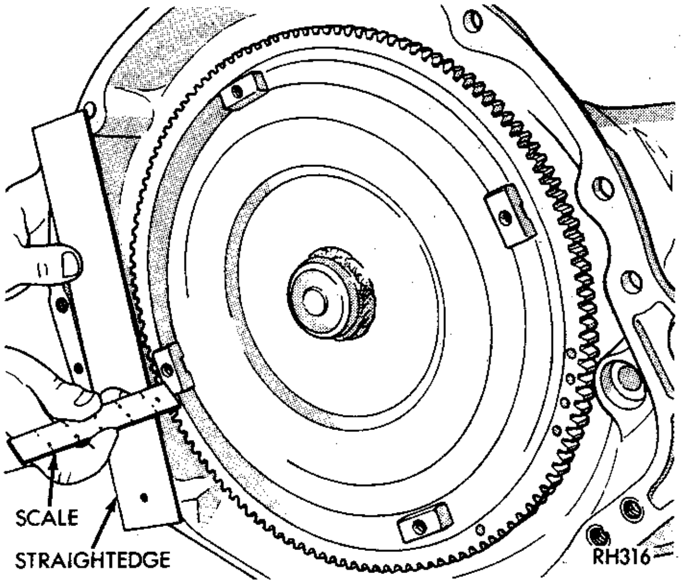

Fig. 5 Checking Torque Converter Seating

(6) Check condition of converter driveplate. Replace the plate if cracked, distorted or damaged. **If driveplate replacement was necessary, be sure transmission dowel pins are seated in engine block and protrude far enough to held transmission in alignment.**

(7) Coat pilot hub of torque converter with Mopar high temperature grease.

(8) Raise transmission and align converter with drive plate.

(9) Move transmission forward. Then raise, lower or tilt transmission to align converter housing with engine block dowels.

(10) Rotate converter so alignment marks scribed on converter are aligned with mark on driveplate. The offset holes in plate are next to 1/8 inch hole in inner circle of plate (Fig. 6).

(11) Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft.

(12) Install bolts attaching converter housing to engine. Tighten bolts to 41 N•m (30 ft-lbs) torque.

(13) Install crossmember. Then lower transmission onto crossmember and install bolts attaching transmission mount to crossmember.

(14) Remove engine support fixture.

(15) Install distance sensor and speedometer.

(16) Connect gearshift and throttle linkage to transmission. **If any linkage rods were disconnected, replace the plastic grommets that secured the linkage rod to the lever.**

(17) Connect the wires to the neutral start switch, lockup solenoid and oxygen sensor. Be sure the transmission harnesses are properly routed (Figs. 7-8).

(18) Install torque converter-to-driveplate bolts. Tighten bolts to 31 N•m (23 ft-lbs) torque.

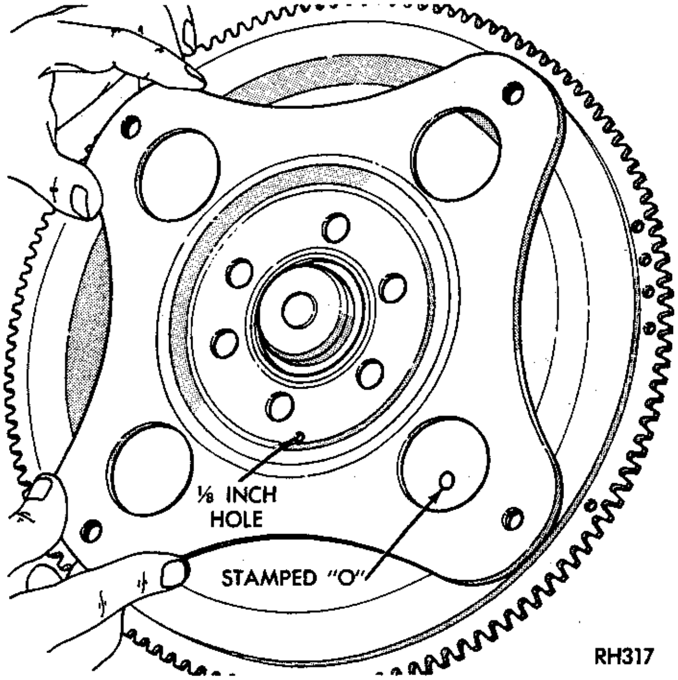

Fig. 6 Torque Converter And Driveplate Markings

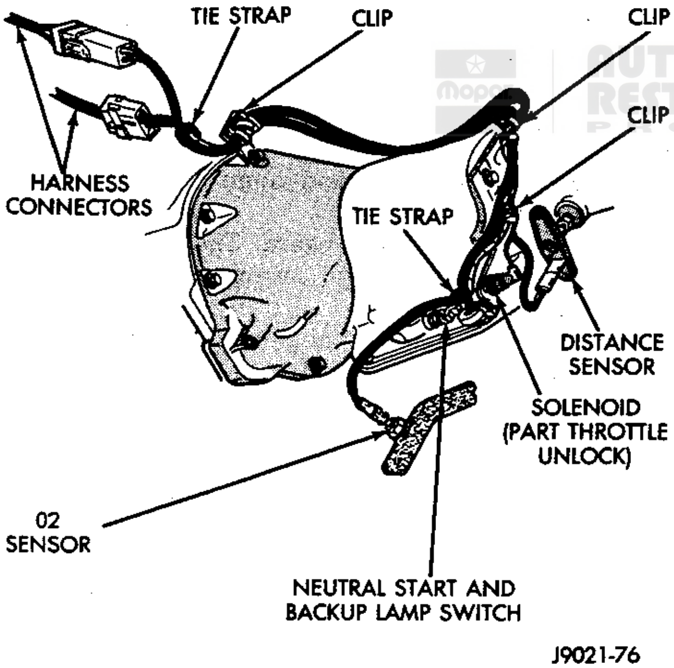

Fig. 7 Transmission Wire Routing—A-998/999/727

(19) Install converter housing access cover.

(20) Install starter motor and cooler line bracket.

(21) Connect cooler lines to transmission.

(22) Install transmission fill tube (Fig. 9). Install new seal on tube before installation.

(23) Install engine-to-transmission struts, if equipped (Fig. 9). Tighten strut-to-transmission bolts first and to 17 N•m (150 in-lbs) torque. Tighten strut-to-engine bolts last and to 41 N•m (30 ft-lbs) torque.

(24) Install exhaust components.

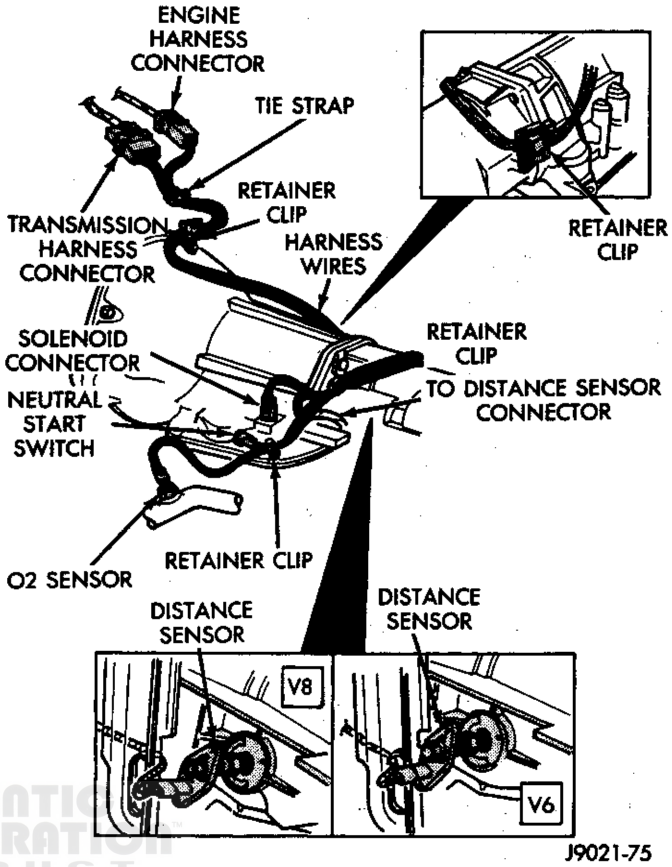

Fig. 8 Transmission Wire Routing—A-500/518

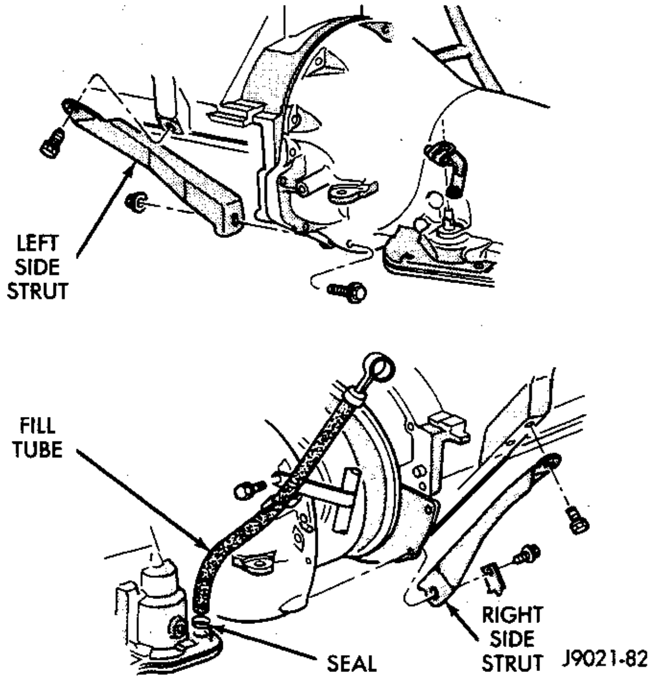

Fig. 9 Strut And Fill Tube Mounting

(25) Align and install propeller shaft.

(26) Adjust gearshift and throttle linkages.

(27) Fill transmission with Mopar ATF Plus, type 7176, or Dexron II™ fluid.

TRANSMISSION OVERHAUL

TRANSMISSION DISASSEMBLY

(1) Clean transmission exterior with a steam cleaner or with solvent. Cleanliness during overhaul is extremely important. Clean all parts with solvent and dry with compressed air only. **Do not use shop towels to dry transmission parts. Shop towels will leave lint particles on transmission parts which can plug fluid passages or interfere with valve operation.**

(2) Place transmission in a repair stand (Fig. 1).

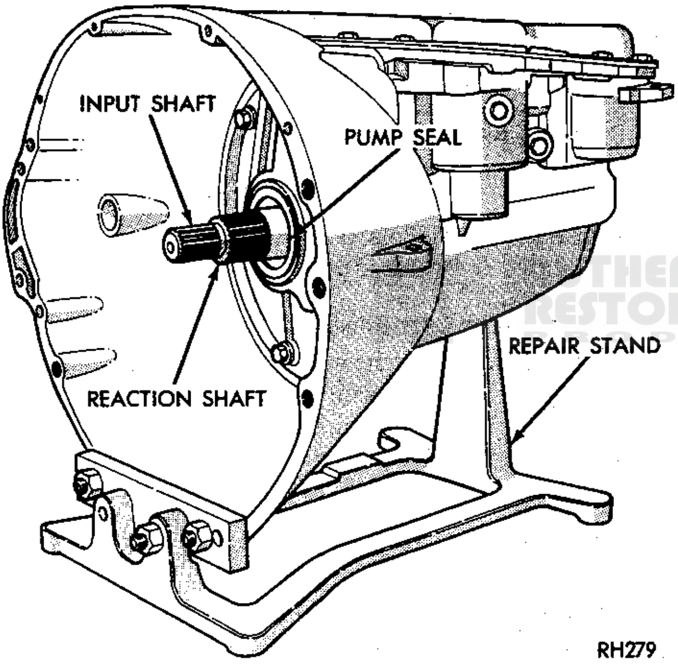

Fig. 2 Transmission Mounted On Repair Stand

(3) Measure input shaft end play before disassembly to determine if a thrust washer change is needed (Fig. 2).

(4) Attach dial indicator to converter housing (Fig. 1). Position indicator plunger against input shaft and zero indicator. Move input shaft in and out and record reading. End play should be.56 - 2.31 mm (.022 - .091 inch on 998/999 models and .86 - 2.13 mm (.034 - .084 inch) on 727 models.

Oil Pan And Valve Body

(1) Remove oil pan bolts and remove pan and gasket.

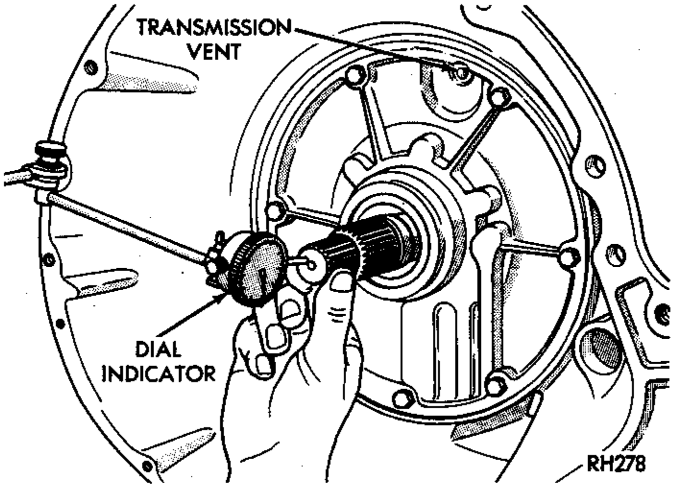

Fig. 2 Measuring Input Shaft End Play

(2) Loosen clamp bolts and remove throttle and manual valve levers from manual shaft.

(3) Remove neutral switch.

(4) Remove valve body bolts and park lock rod E-clip. Lift valve up and off transmission and remove lock rod from valve body.

(5) Remove accumulator spring and piston.

Extension Housing

(1) Pull parking lock rod out of case.

(2) Remove distance sensor and speedometer and gear if not previously removed.

(3) Remove plate and gasket from underside of housing.

(4) Spread output shaft bearing snap ring as far as possible and work housing off transmission and output shaft.

(5) Remove snap ring securing output shaft bearing to shaft. Use heavy duty snap ring pliers for this task.

(6) Remove the bearing from the shaft.

(7) On 727, remove the second snap ring used to position the bearing on the output shaft (998/999 do not have this second snap ring).

Governor And Park Gear

(1) Remove snap ring that retains governor and park gear on output shaft.

(2) Remove governor valve shaft snap rings and remove governor valve and shaft from governor body.

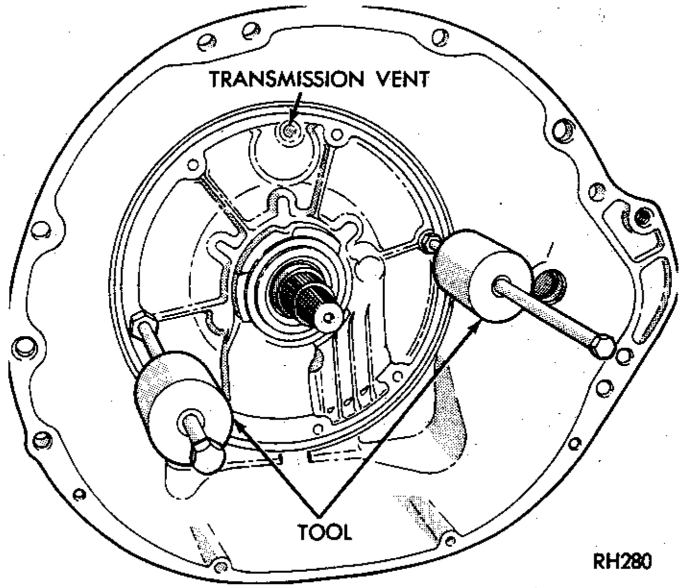

Fig. 3 Removing Oil Pump

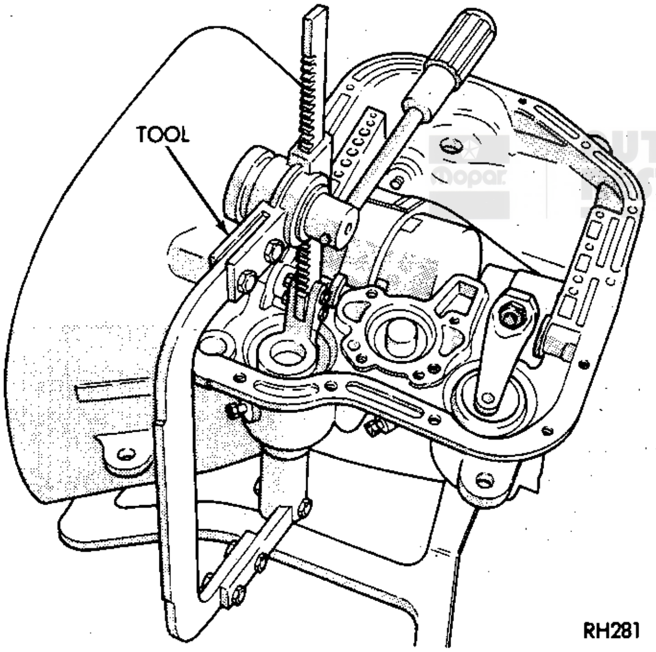

Fig. 4 Removing Front Servo Components

(3) Slide governor body and park gear off output shaft.

Oil Pump And Reaction Shaft Support

(1) Tighten front band adjusting screw until band is tight on front clutch retainer. This prevents retainer from coming out with pump and causing unecessary damage to clutch components.

(2) Remove oil pump bolts.

(3) Remove oil pump and reaction shaft support assembly with two slide hammer tools C-3752 (Fig. 3). Thread slide hammers into threaded holes in pump body flange.

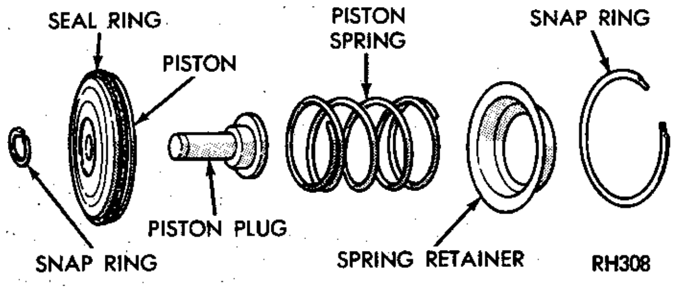

Fig. 5 Rear Servo Components

Front Clutch

(1) Loosen the band adjusting screw.

(2) Remove band strut and and remove strut anchor on 727 models.

(3) Slide front clutch out of case.

Input Shaft And Rear Clutch

(1) Pull input shaft and rear clutch assembly out of case.

(2) On 998/999 models, remove and retain thrust washer located between input and output shafts.

Planetary Gears-Sun Gear-Driving Shell

(1) Lift and support output shaft and driving shell.

(2) Carefully slide assembly forward and out of case. Be careful with the finely machined surfaces of the output shaft. Do not allow these surfaces to become nicked or damaged during removal.

Rear Band-Low Reverse Drum

(1) Remove low-reverse drum.

(2) Loosen rear band adjusting screw.

(3) Remove snap ring retaining drum.

(4) On 727, remove band strut and link then remove rear band.

(5) On 998/999, loosen band adjuster screw.

(6) Remove band and drum as assembly.

Overrunning Clutch

Remove only the overrunning clutch rollers and springs as an assembly. The clutch cam will be removed during subassembly overhaul if replacement is necessary.

Kickdown (Front) Servo

(1) Remove plug from front servo test port.

(2) Compress servo piston and spring with tool C-3422A (Fig. 4).

(3) Remove servo piston snap ring and remove the compressor tool.

(4) Remove servo piston.

Rear Servo

(1) Compress servo piston and remove snap ring (Fig. 5).

(2) Remove servo retainer, springs, piston plug and spring and piston.

SUBASSEMBLY OVERHAUL

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OIL PUMP AND REACTION SHAFT SUPPORT—A-998/999

PUMP AND SUPPORT DISASSEMBLY

(1) Remove the support bolts and separate the support and pump body (Fig. 6).

(2) Remove the O-ring seal from pump body.

(3) Remove the pump seal with punch.

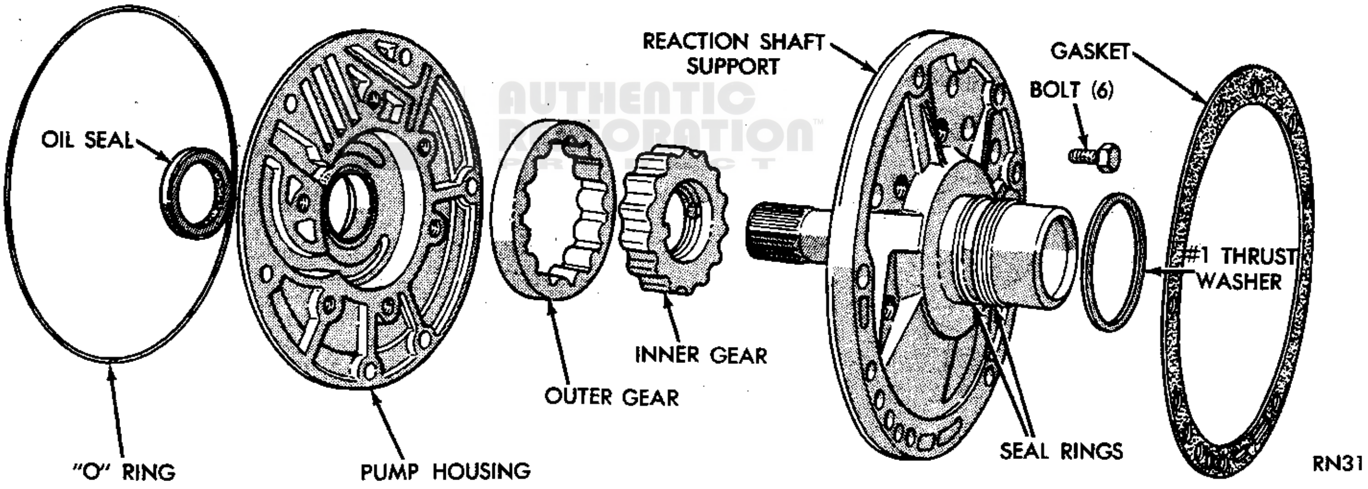

Fig. 6 Oil Pump And Reaction Shaft Support Components—A-998/999

(4) Mark the pump gears for assembly reference and remove the gears.

(5) Remove the seal rings from the reaction shaft support (Fig. 6).

(6) Clean the pump and support components with solvent and dry them with compressed air.

PUMP AND SUPPORT INSPECTION

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 No. 1 thrust washer for damage. Then check the support-to-front clutch retainer thrust washer. Replace the washer if worn.

Replace the pump bushing and the reaction shaft support bushing if scored, worn or damaged.

Install the gears in the pump body and measure end clearance with a feeler gauge and straightedge (Fig. 7). Clearance should be .010 - .063 mm (.0004 - .0025 in).

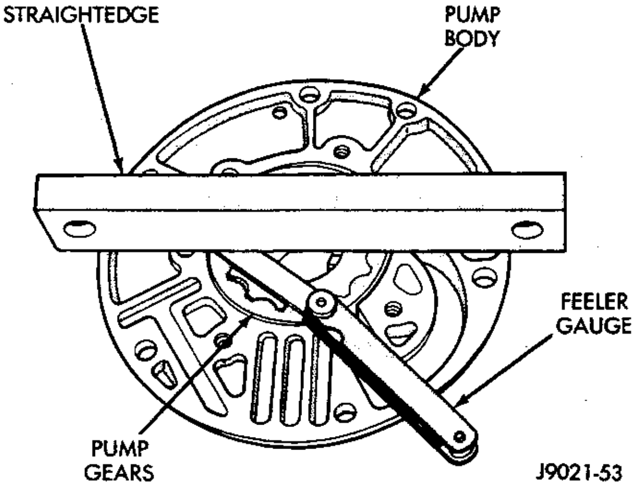

Fig. 7 Measuring Pump Gear End Clearance—All

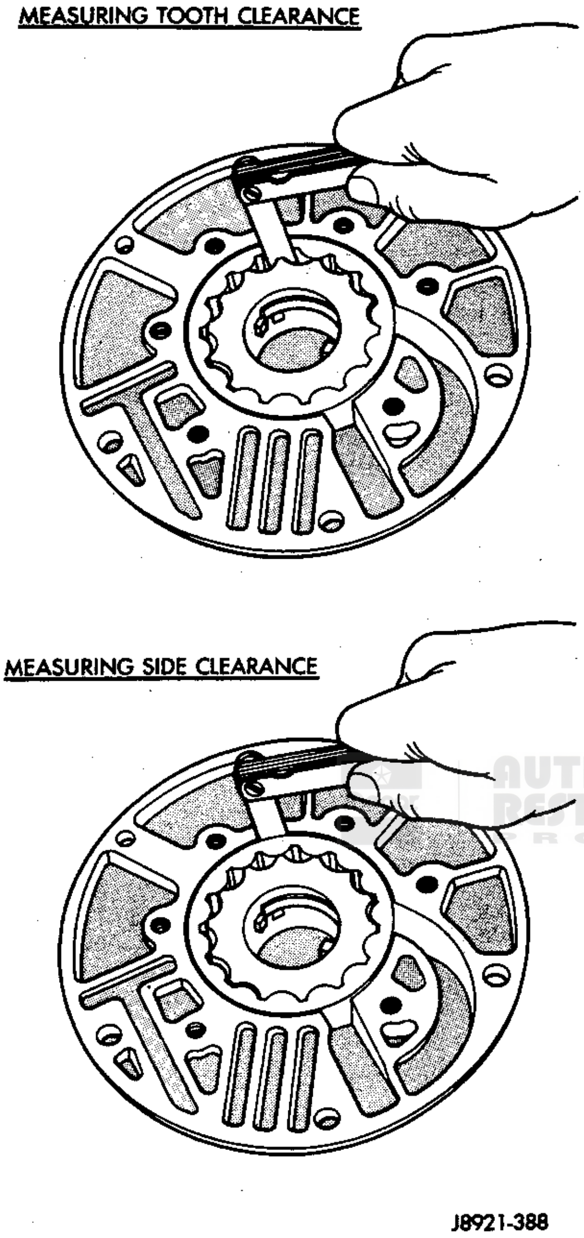

Fig. 8 Measuring Pump Gear Clearances—All

Measure gear tooth clearance with a feeler gauge. Align one tooth of the outer gear with one tooth of the inner gear and measure clearance (Fig. 8). Clearance should be .089 - 1.90 mm (.0035 - .0075 inch).

Measure clearance between the outer gear and the pump body (Fig. 8). Clearance should be .089 - 1.90 mm (.0035 - .0075 inch).

REPLACING OIL PUMP BUSHING—A-998/999

(1) Remove the pump bushing with driver handle C-4171 and remover tool SP 3551 (Fig. 9).

(2) Install the new pump bushing with driver handle C-4171 and installer tool SP 5117 (Fig. 9). Bushing should be flush with pump body bore.

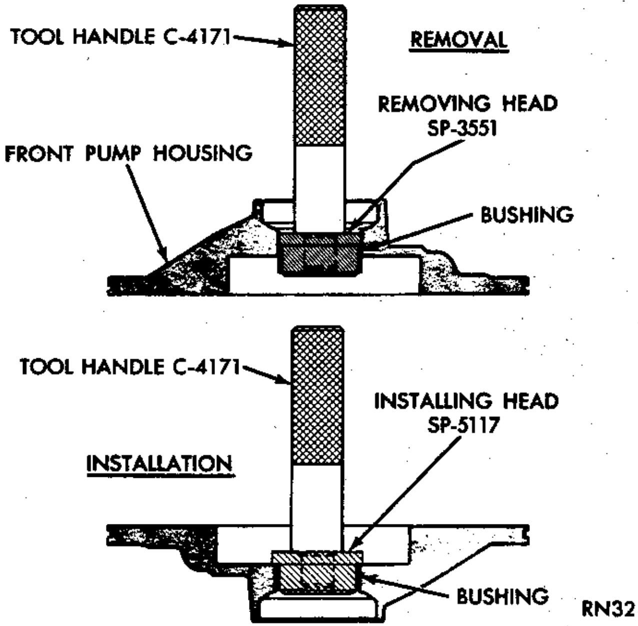

Fig. 9 Replacing Oil Pump Bushing—A-998/999

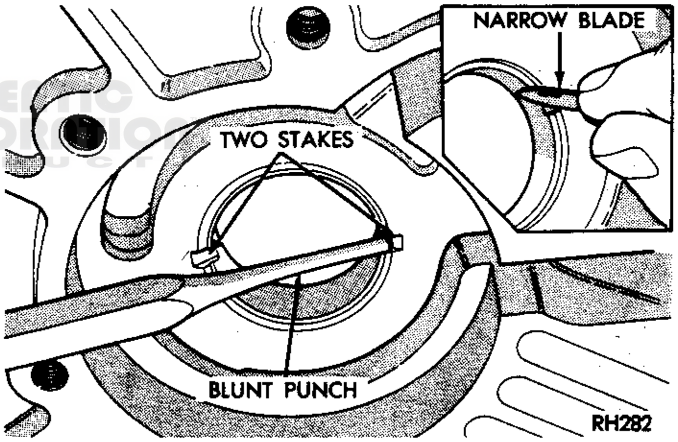

Fig. 10 Staking Oil Pump Bushing—A-998/999

(3) Stake the new pump bushing in two places with a blunt punch. Then remove burrs from the stake points with a knife blade (Fig. 10).

REPLACING REACTION SHAFT SUPPORT BUSHING—A-998/999

(1) Assemble the bushing remover tools SP 1191, 3633 and 5324 (Fig. 11). **Do not clamp any part of the reaction shaft or support in a 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 an additional 3-4 turns into bushing with wrench.

(3) Turn tool hex nut down against cup to pull bushing from reaction shaft. Clean all chips from shaft after bushing removal.

(4) Lightly grip old bushing in a vise or with pliers and back remover tool out of bushing.

(5) Assemble bushing installer tools C-4171 and SP-5325 (Fig. 11).

(6) Slide the new bushing onto installer tool SP-5325.

(7) Position the reaction shaft support upright on a clean smooth surface.

(8) Align the bushing in the bore. Then tap the bushing into place installer tool SP-5325 bottoms.

(9) Clean reaction the shaft support thoroughly after installing the bushing.

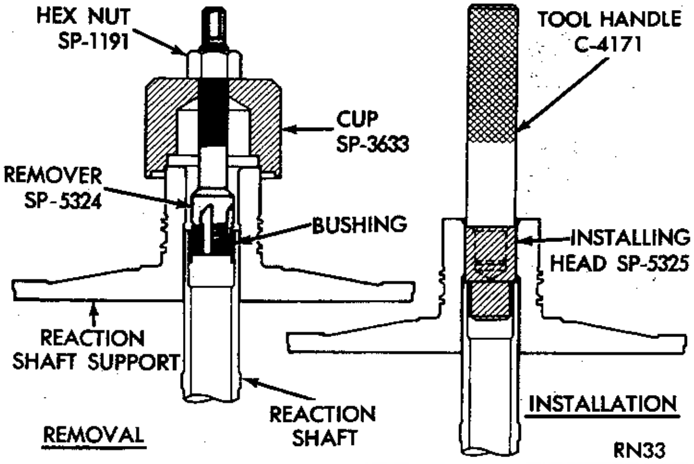

Fig. 11 Replacing Reaction Shaft Support Bushing—A-998/999

ASSEMBLING OIL PUMP AND REACTION SHAFT SUPPORT—A-998/999

(1) Lubricate the pump gears with transmission fluid and install them in the pump body.

(2) Install a new thrust washer and seal rings on the reaction shaft support. Lubricate the washer and seal rings with transmission fluid.

(3) Place the reaction shaft support in assembly tool C-3759. The shaft hub and assembly tool should be positioned on a clean smooth work surface.

(4) Thread two pilot stud tools C-3283-A into the threaded holes of the reaction shaft support flange (Fig. 12).

(5) Align and lower the pump body onto the pilot studs (Fig. 12).

(6) Insert aligning tool C-3756 through the pump body and engage the pump inner gear.

(7) Rotate the pump gears with the tool to center them in the pump body.

(8) Tighten the clamping tool securely when the gears are centered and the pump body is firmly seated against the reaction shaft support.

(9) Turn the assembly tool, pump and support over. Then install and tighten the support-to-pump bolts to 20 N•m (175 in-lbs) torque.

(10) Remove the assembly tool from the pump and support.

(11) Install a new pump seal with tool C-4193 and handle C-4171. Be sure the seal lip faces inward.

(12) Install a new O-ring on the pump body (Fig. 6).

(13) Lubricate the O-ring and the lip of the pump seal with transmission fluid or petroleum jelly.

(14) Set the assembled pump and support aside for assembly installation.

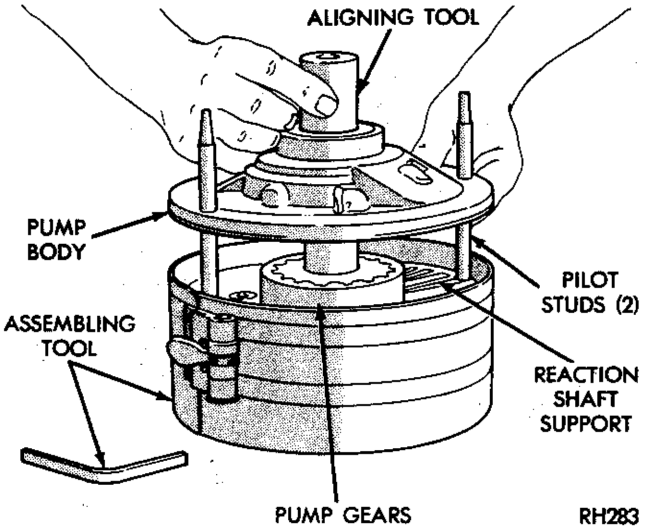

Fig. 12 Assembling Oil Pump And Reaction Shaft Support—A-998/999

OIL PUMP AND REACTION SHAFT SUPPORT—A-727

PUMP AND SUPPORT DISASSEMBLY

(1) Remove the support bolts and separate the support and pump body (Fig. 13).

(2) Remove the O-ring seal from the pump body.

(3) Remove the pump seal with a blunt punch.

(4) Mark the pump gears for assembly reference and remove the gears.

(5) Remove the seal rings and thrust washer from the reaction shaft support (Fig. 13).

(6) Clean the pump and support components with solvent and dry them with compressed air.

INSPECTING PUMP AND SUPPORT

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 No. 1 thrust washer. Replace the washer if worn or damaged.

Replace the pump bushing and the reaction shaft support bushing during overhaul. Do not reuse the original bushings even if they look OK.

Install the gears in the pump body and measure end clearance with a feeler gauge and straightedge (Fig. 7). Clearance should be .025 - .076 mm (.001 - .003 in).

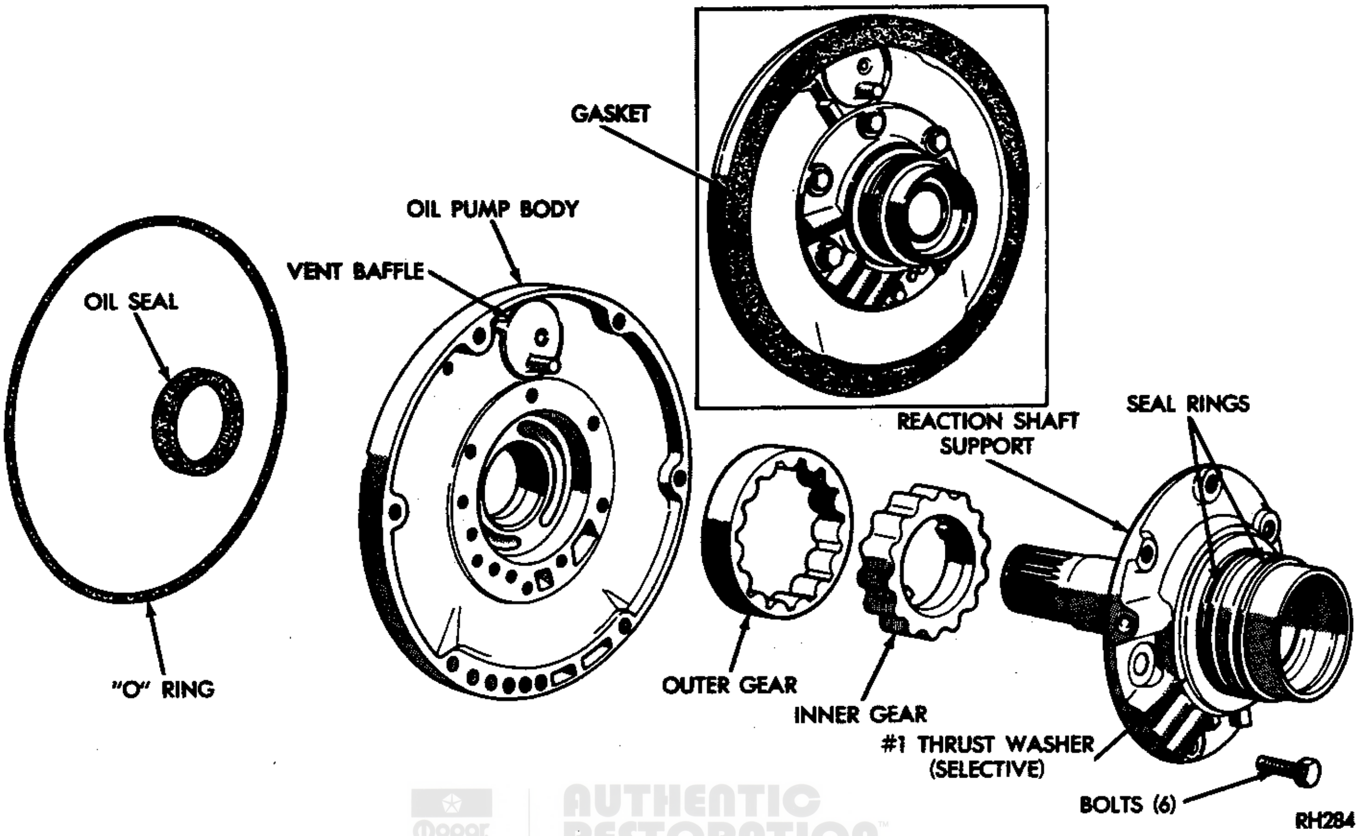

Fig. 13 Oil Pump And Reaction Shaft Support Components—A-727

Clearance between the pump outer gear and the pump body should be .089 - 1.90 mm (.0035 to .0075 inch).

OIL PUMP BUSHING REPLACEMENT—A-727

(1) Position the pump housing on a clean, smooth surface with the gear cavity facing down.

(2) Remove the bushing with handle C-4171 and remover tool SP-3550 (Fig. 14).

(3) Assemble handle C-4171 and bushing installer tool SP-5118 (Fig. 14).

(4) Place the new bushing on the installer tool and start the bushing into the shaft (Fig. 14).

(5) Tap the bushing into place until tool SP-5118 bottoms in the pump cavity (Fig. 14). Keep the tool and bushing square with the bore. Do not allow the bushing to become cocked during installation.

(6) Stake the pump bushing in two places with a blunt punch. Then remove burrs from the stake points with knife blade (Fig. 15).

REPLACING REACTION SHAFT SUPPORT BUSHING—A-727

(1) Assemble cup tool SP-3633, nut SP-1191 and remover SP-5301 (Fig. 16).

(2) Hold the cup tool firmly against the reaction shaft. Thread the remover tool into the bushing as far as possible by hand.

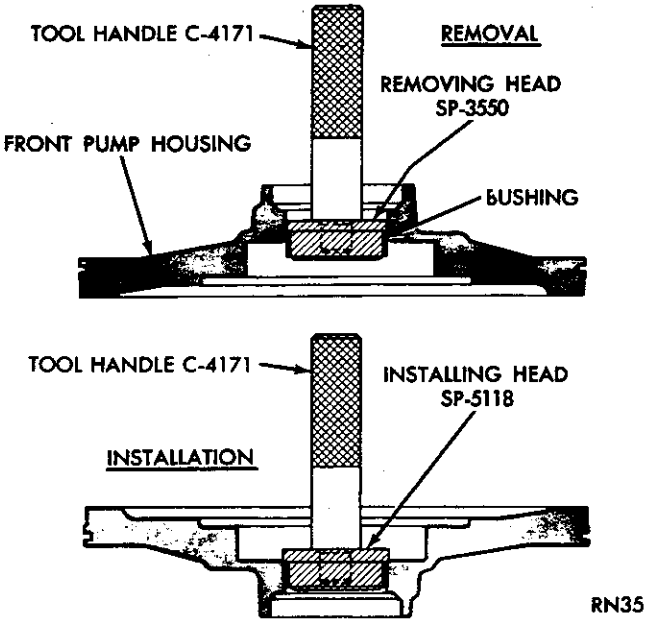

Fig. 14 Replacing Oil Pump Bushing—A-727

(3) Using a wrench, thread the remover tool an additional 3-4 turns into the bushing to firmly engage the tool in the bushing.

(4) Tighten the tool hex nut against the cup tool to pull the bushing from the shaft. Clean all chips from the shaft and support after bushing removal.

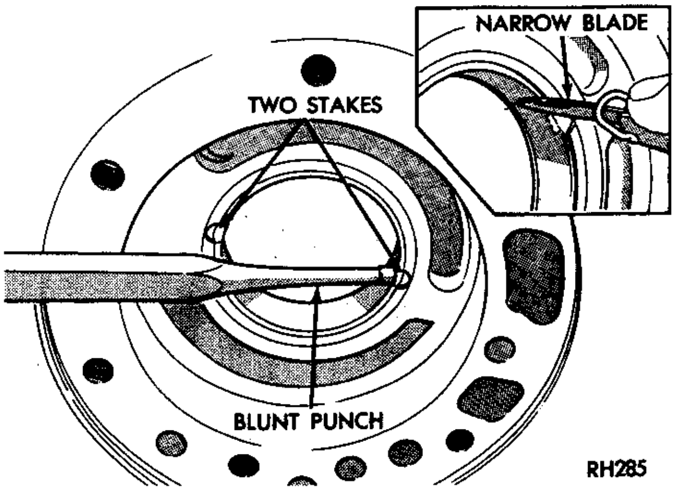

Fig. 15 Staking Pump Bushing—A-727

(5) Place the reaction shaft support upright on a clean, smooth surface.

(6) Assemble bushing installer tools C-4171 and SP-5302 (Fig. 16). Then slide the new bushing on the installer tool.

(7) Start the bushing into the shaft. Then tap the bushing into the shaft until the installer tool bottoms against the support flange (Fig. 16).

(8) Clean the reaction shaft support thoroughly after bushing replacement.

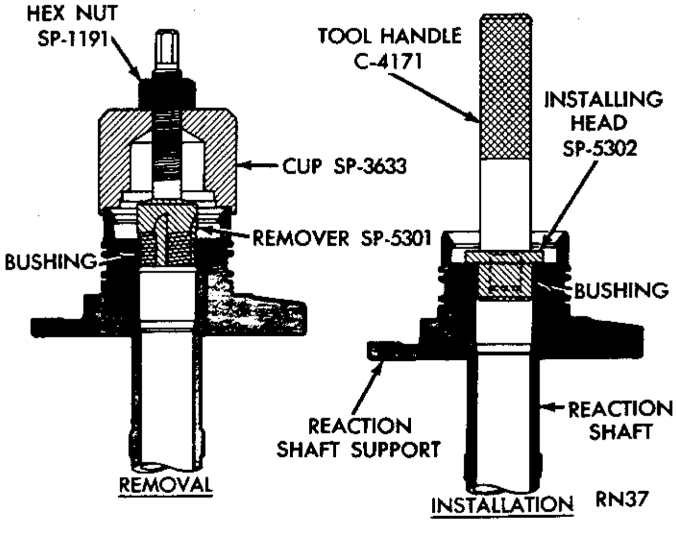

Fig. 16 Replacing Reaction Shaft Support Bushing—A-727

ASSEMBLING OIL PUMP AND REACTION SHAFT SUPPORT—A-727

(1) Lubricate the pump gears with transmission fluid and install them in pump body.

(2) Install a new thrust washer and seal rings on the reaction shaft support. Lubricate the seal rings with transmission fluid.

(3) Align and install the reaction shaft support on the pump body.

(4) Install the bolts attaching the reaction shaft support to the pump. Tighten the bolts to 175 in-lbs (20 N•m) torque.

(5) Install a new seal in the oil pump with installer C-3860-A and driver handle C-4171.

(6) Install a new O-ring on the pump body. Lubricate the oil seal and O-ring with transmission fluid or petroleum jelly.

(7) Set the assembled pump and support aside for assembly installation.

FRONT CLUTCH—A-998/999

FRONT CLUTCH DISASSEMBLY

(1) Remove the waved snap ring and remove the pressure plate, clutch plates and driving discs (Fig. 17).

(2) Compress the return spring and spring retainer with compressor tool C-3575-A (Fig. 18).

(3) Remove the piston snap ring and spring retainer. Then remove the compressor tool.

(4) Remove the clutch piston and piston retainer (Fig. 17).

(5) Remove and discard the piston inner and outer seals. Also discard the retainer snap ring.

CLUTCH INSPECTION

Clean and 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 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 return spring and spring retainer if either is 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.

REPLACING FRONT CLUTCH RETAINER BUSHING—A-998/999

(1) Assemble driver handle C-4171 and bushing remover SP-3627 (Fig. 19).

(2) Insert the remover tool in the bushing and drive the old bushing out of the retainer (Fig. 19).

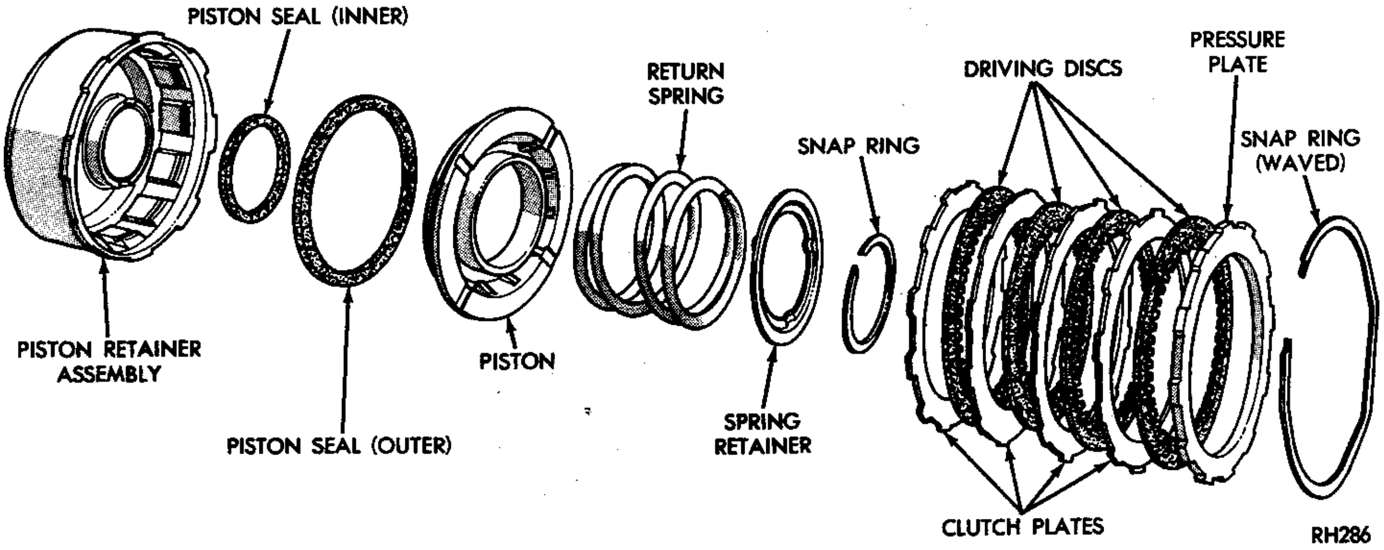

Fig. 17 Front Clutch Components—A-998/999

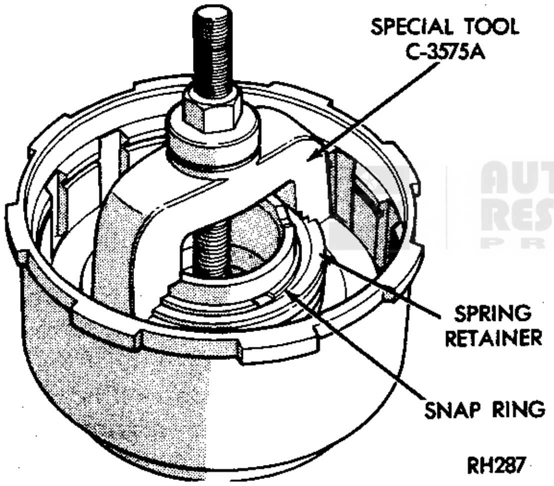

Fig. 18 Removing Front Clutch Spring Retainer Snap Ring—A-998/999

(3) Mount bushing installer tool SP-3626 on the driver handle. Then slide the new bushing onto the installer tool.

(4) Align and install the new bushing. Tap the bushing into the retainer until the installer tool bottoms against the retainer (Fig. 19).

(5) Remove the installer tools and clean the retainer thoroughly.

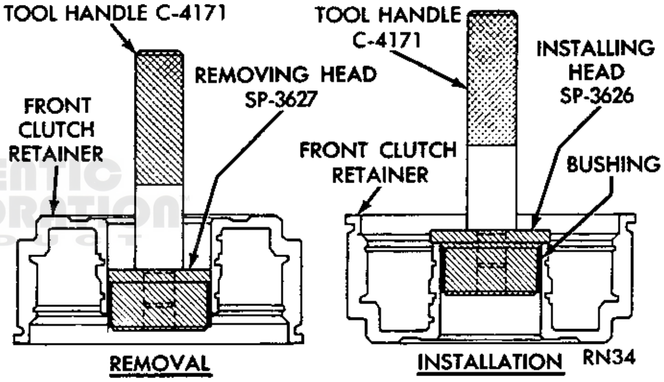

Fig. 19 Clutch Retainer Bushing Replacement—A-998/999

FRONT CLUTCH ASSEMBLY—A-998/999

(1) Lubricate the clutch plates and soak the clutch discs with transmission fluid.

(2) Lubricate the new inner and outer piston seals with Door Ease, or petroleum jelly.

(3) Install the new seals on the clutch piston. Be sure the seal lips face the inside of the retainer.

(4) Install the clutch piston in the retainer. Use a twisting motion to seat the piston at the retainer bottom. **Do not attempt to force the piston straight in. This will fold the seals over causing leakage and clutch slip.**

(5) Install the return spring and spring retainer.

(6) Compress the return spring and spring retainer with compressor tool C-3575-A. Then install a new snap ring to secure the spring retainer (Fig. 18).

(7) Install the clutch plates and discs (Fig. 17). Install a steel plate then disc until all plates and discs are installed.

(8) Install the pressure plate and waved snap ring (Fig. 17).

(9) Check clutch plate clearance (Fig. 20). Clearance should be 1.70 - 3.40 mm (.067 to .134 inch) with a 4-disc clutch and 1.90 - 3.86 mm (.075 to .152 inch) with a 5-disc clutch. If clearance is incorrect, clutch plates, discs and/or pressure plate will have to be changed.

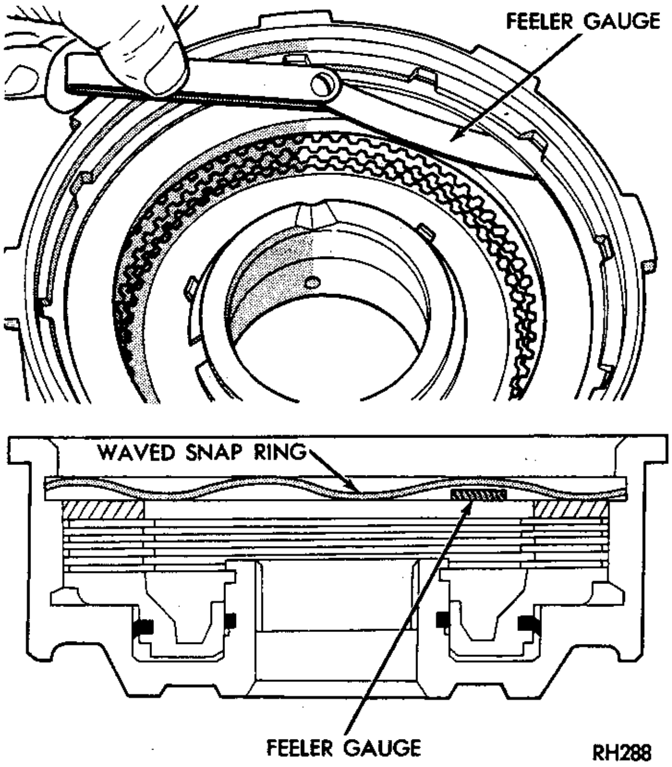

Fig. 20 Measuring Front Clutch Pack Clearance (Typical)

FRONT CLUTCH—A-727

Clutch Disassembly

(1) Remove the waved snap ring and remove the pressure plate, clutch plates and driving discs (Fig. 21).

(2) Compress the clutch piston retainer and springs with compressor tool C-3863-A (Fig. 22).

(3) Remove the piston snap ring and spring retainer (Fig. 21).

(4) Remove the piston springs. **Note the number and position of the piston springs for assembly reference.**

(5) Remove the compressor tool.

(6) Remove the clutch piston from the retainer.

(7) Remove and discard the clutch piston seals. Also discard the spring retainer snap ring.

Clutch Inspection

Clean and 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 if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston 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

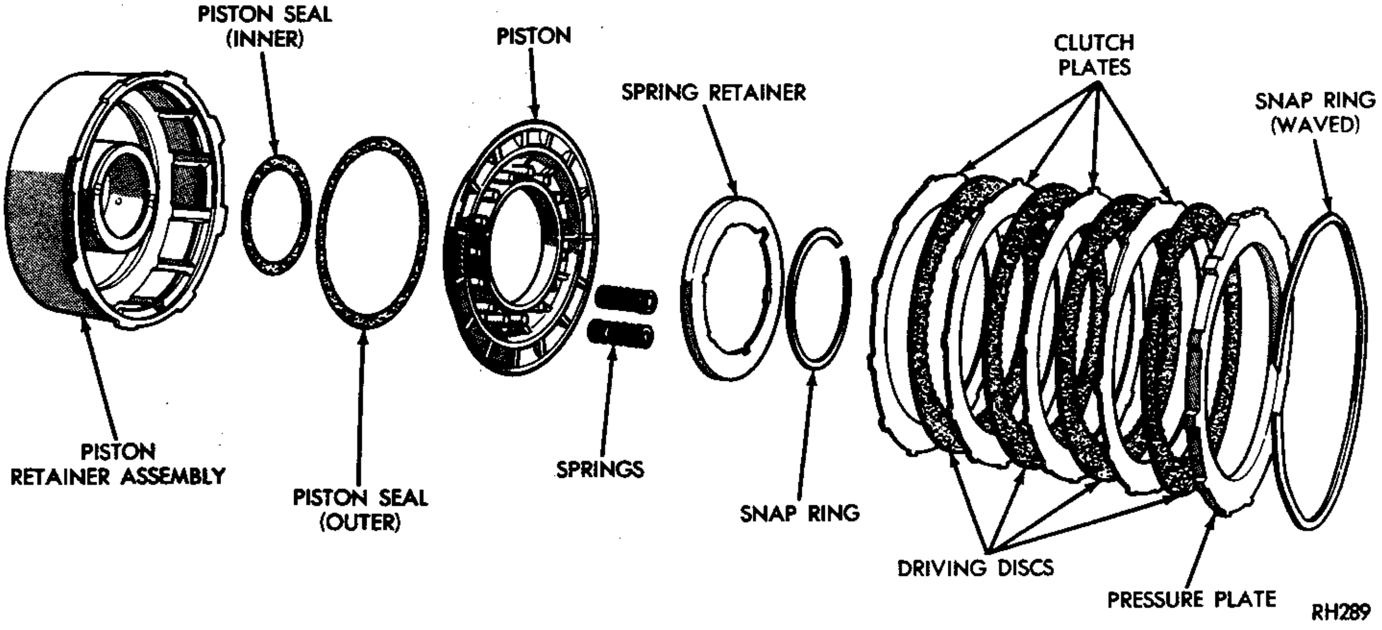

Fig. 21 Front Clutch Components—A-727

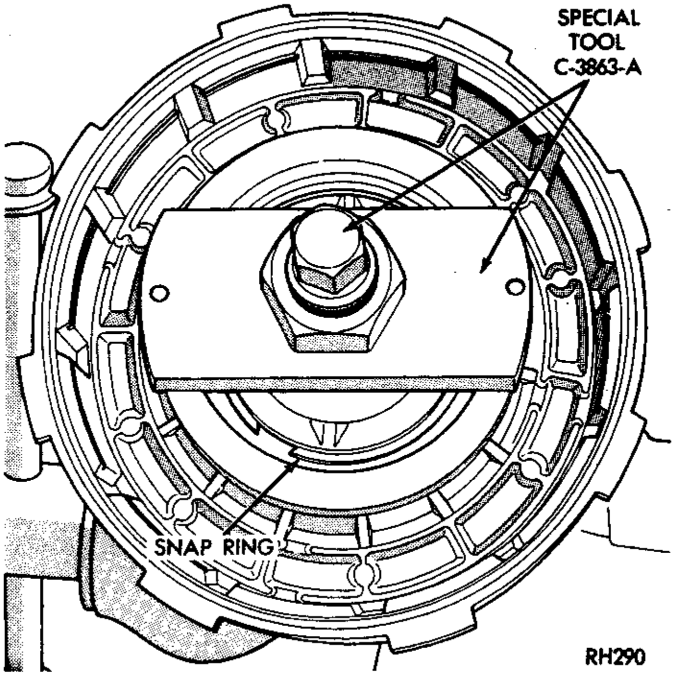

Fig. 22 Removing Front Clutch Spring Retainer Snap Ring—A-727

with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

REPLACING FRONT CLUTCH RETAINER BUSHING—A-727

(1) Assemble driver handle C-4171 and bushing remover head SP-3629 (Fig. 23).

(2) Insert the remover head in the bushing and drive the bushing straight out of the piston retainer.

(3) Mount bushing installer head SP-5511 on the driver handle (Fig. 23).

(4) Slide the new bushing onto the installer head and start the bushing in the retainer.

(5) Install the new bushing until the installer head bottoms against the retainer (Fig. 23).

(6) Remove the installer tools and clean the retainer thoroughly.

ASSEMBLING A-727 FRONT CLUTCH

(1) Lubricate the clutch plates and soak the clutch discs with transmission fluid.

(2) Lubricate the new inner and outer piston seals with Door Ease, or petroleum jelly.

(3) Install the new seals on the clutch piston. Be sure the seal lips face the inside of the retainer.

(4) Install the clutch piston in the retainer. Use a twisting motion to seat the piston at the retainer bottom. **Do not attempt to force the piston straight in. This will fold the seals over causing leakage and clutch slip.**

(5) Install the clutch piston springs.

(a) On a 9 spring clutch, position the springs as shown (Fig. 24).

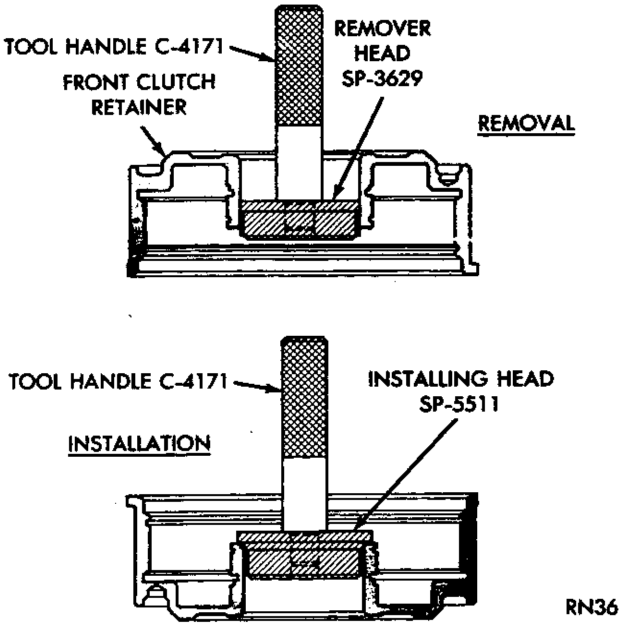

Fig. 23 Replacing Front Clutch Retainer Bushing—A-727

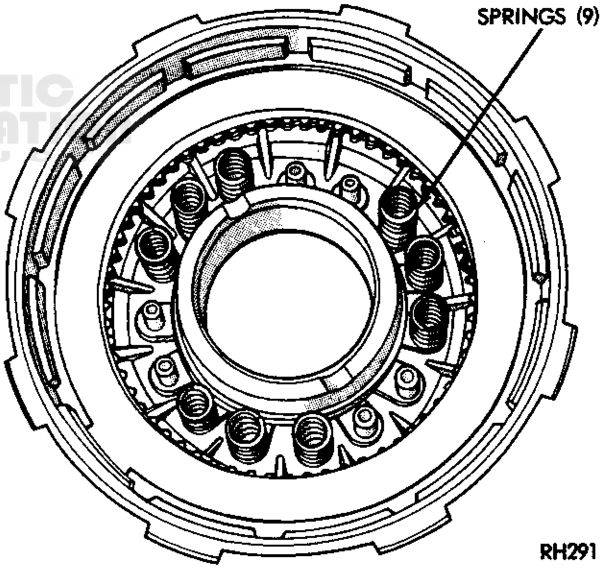

Fig. 24 Front Clutch Spring Location—9 Spring

(b) On an 11 or 13 spring clutch, position the springs as shown (Fig. 25).

(6) Install the piston spring retainer on the springs.

(7) Compress the spring retainer and piston springs with tool C-3863-A (Fig. 22).

(8) Install a new spring retainer snap ring (Fig. 22). Then remove the compressor tool.

(9) Install the clutch plates and discs (Fig. 21). Install a steel plate then a disc until four plates and discs are installed.

(10) Install the pressure plate and waved snap ring (Fig. 21).

(11) Check front clutch pack clearance (Fig. 20). Clearance between the waved spring and the pressure plate should be 2.08 - 3.83 mm (.082 to .151

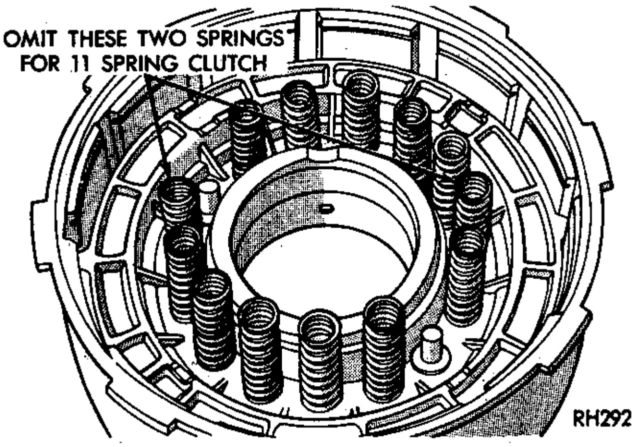

Fig. 25 Front Clutch Spring Location—11 or 13 Spring

inch). If clearance is incorrect, the clutch plates, discs and/or pressure plate will have to be changed.

(12) Set front clutch aside for assembly installation.

REAR CLUTCH—A-998/999

CLUTCH DISASSEMBLY

(1) Remove the selective snap ring (Fig. 26).

(2) Remove pressure plate and the clutch discs and steel plates (Fig. 26).

(3) Remove the wave spring and piston spring (Fig. 26).

(4) Remove the #2 thrust washer (Fig. 26).

(5) Turn the clutch retainer over and tap it on wood block to dislodge the clutch piston.

(6) Remove and discard the piston seals.

(7) Remove the input shaft snap ring and press the input shaft out of the retainer. Discard the shaft snap ring. Use a new ring at assembly.

(8) Remove the seal ring from the clutch retainer but leave the input shaft seal rings in place for inspection.

Clutch Inspection

Clean the clutch components with solvent.

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off. Replace the steel plates and the pressure plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston spring and wave spring if part is 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 condition of the #2 thrust washer. Replace the washer if worn or damaged. Washer thickness should be .061 to .063 inch.

Check condition of the teflon or cast iron seal rings on the input shaft. Replace these seal rings only if they are obviously damaged. If new rings are required, service replacement rings will be cast iron hooked-joint type.

Check the input shaft for wear, or damage. Replace the shaft if worn, scored or damaged in any way.

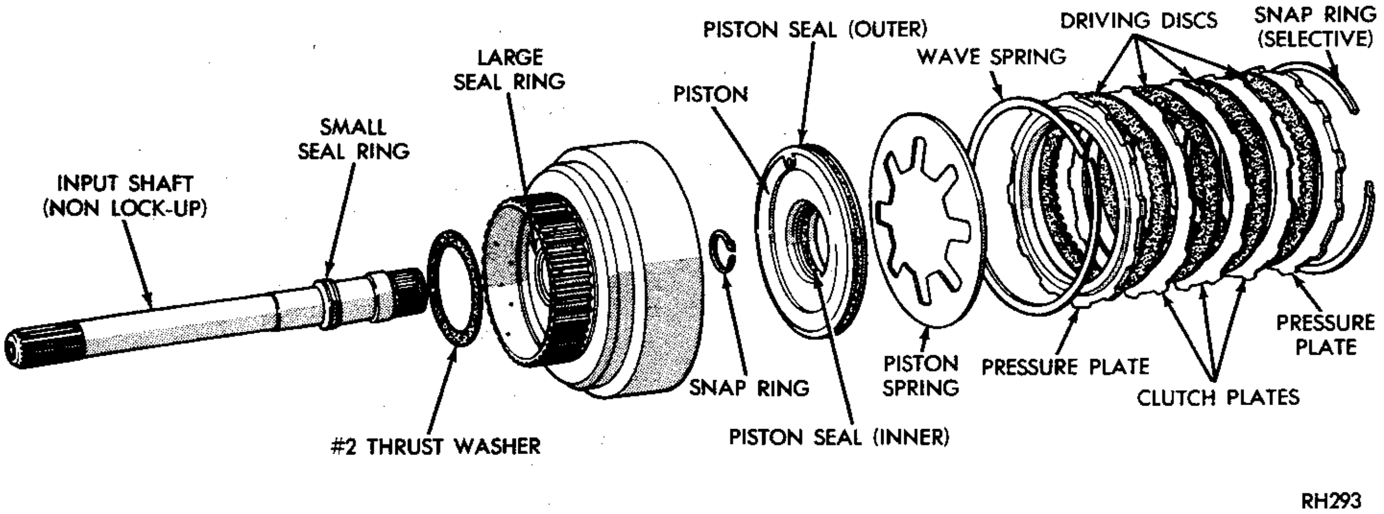

Fig. 26 Rear Clutch Components—A-998/999

ASSEMBLING REAR CLUTCH—A-998/999

(1) Lubricate the steel plates and soak the drive discs with transmission fluid.

(2) Install new seal rings in the clutch retainer and on the input shaft if necessary.

(3) Press the input shaft into the clutch retainer and secure the shaft with a new snap ring.

(4) Install new seals on the clutch piston. Then lubricate the seals with Door Ease or petroleum jelly to ease piston installation.

(5) Install the clutch piston in the retainer. Use a twisting motion to seat the piston at the retainer bottom. **Do not force the piston straight in. This could cut or fold the seals over causing leakage and slip.**

(6) Install the piston spring and wave spring (Fig. 27). **Do not install a spacer ring in the 999 rear clutch. The spacer ring is only used in the 727 rear clutch (Fig. 27).**

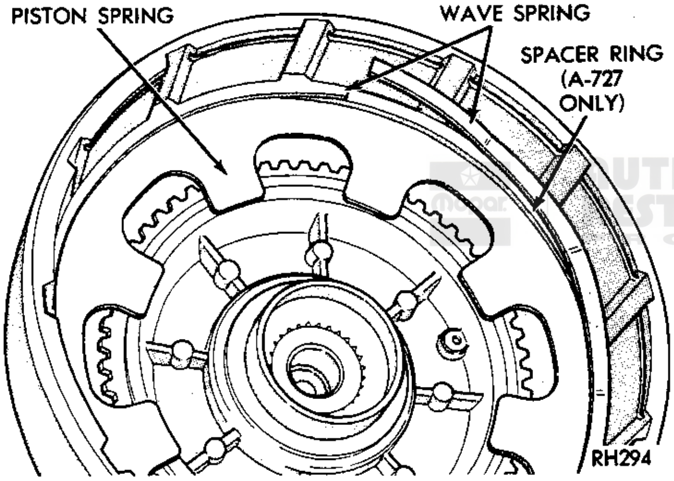

Fig. 27 Piston Spring And Wave Spring Position—All

(7) Install the first pressure plate in the retainer. Then install a clutch disc followed by a steel plate until all discs and plates are installed (Fig. 26).

(8) Install the remaining pressure plate and the selective snap ring (Fig. 26).

(9) Measure clutch pack clearance (Fig. 28). Clearance should be .81 - 1.39 mm (.032 - .055 inch). If clearance is incorrect, change the selective snap ring (see specifications section). However, if a thicker or thinner snap ring does not provide proper clearance, the steel plates, discs and pressure plates may have to be changed.

(10) Coat the #2 thrust washer with petroleum jelly and install it over the input shaft and into the piston retainer. Use enough petroleum jelly to hold the washer in place in the retainer.

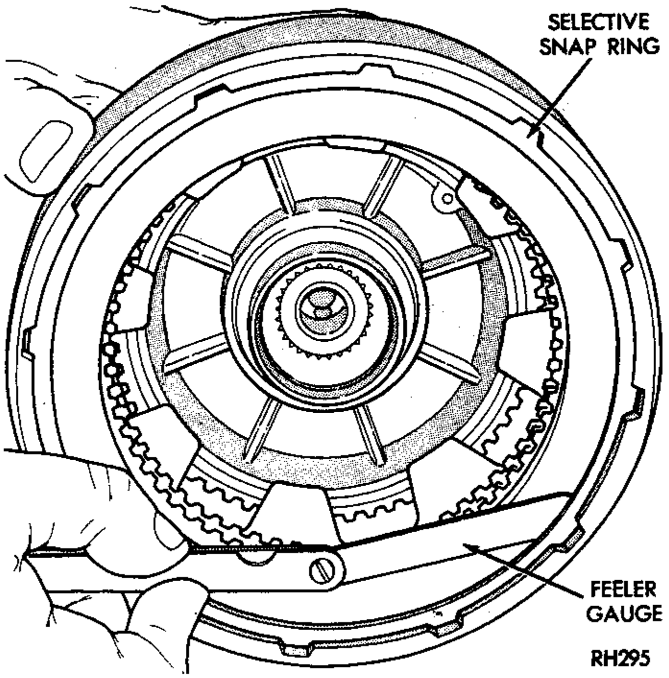

Fig. 28 Measuring Rear Clutch Pack Clearance—All

REAR CLUTCH—A-727

CLUTCH DISASSEMBLY

(1) Remove the selective snap ring (Fig. 29).

(2) Remove the outer pressure plate and the steel plates and discs (Fig. 29).

(3) Remove the inner pressure plate, wave spring, spacer ring and piston spring (Fig. 29).

(4) Remove the clutch piston and piston retainer from the clutch retainer. Bump the clutch retainer on a wood block to dislodge the piston and retainer.

(5) Remove the #2 thrust washer.

(6) Remove the input shaft snap ring and press the shaft out of the clutch retainer.

(7) Remove and discard the clutch piston seals (Fig. 29).

(8) Do not remove the input shaft seal rings unless they are obviously damaged (broken, cracked).

Clutch Inspection

Clean the clutch components with solvent.

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off. Replace the steel plates and the pressure plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston spring and wave spring if part is 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

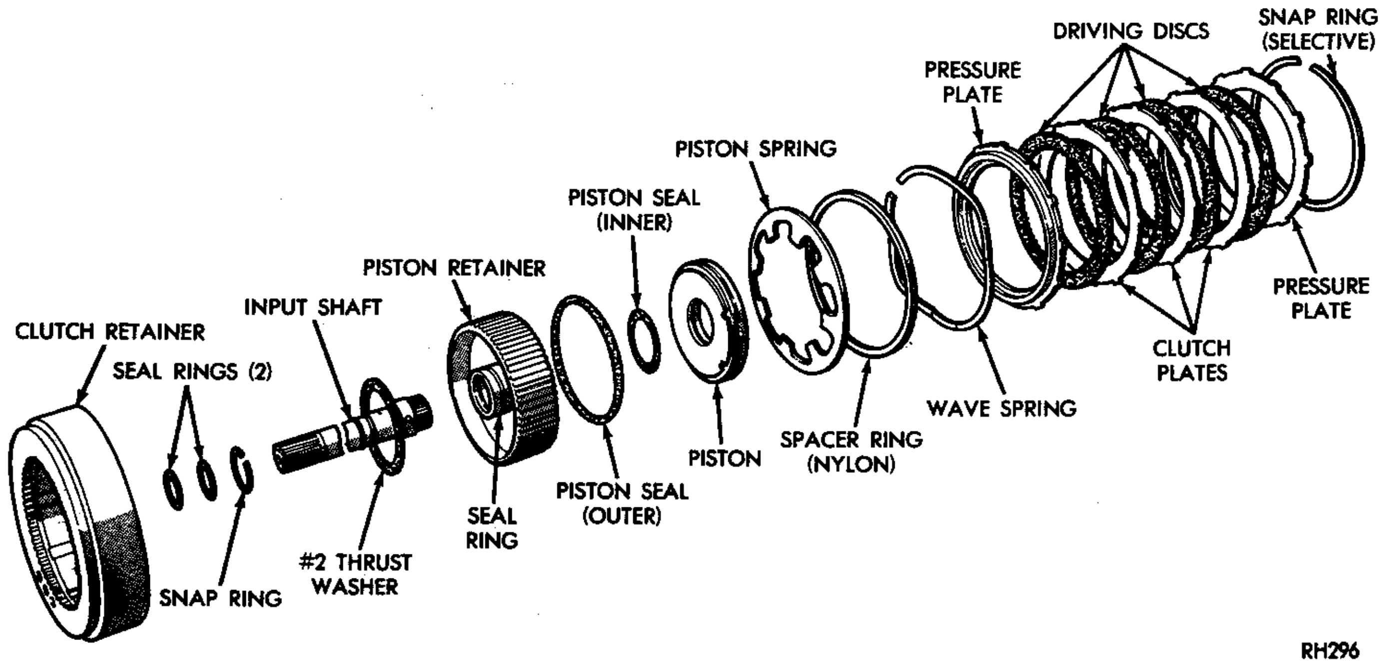

Fig. 29 Rear Clutch Components—A-727

piston retainer. The ball must move freely and not stick.

Replace the input shaft bushing (in the retainer) 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 condition of the #2 thrust washer. Replace the washer if worn or damaged. Refer to Specifications for washer thickness.

Check condition of the seal rings on the input shaft and piston retainer. Replace these seal rings if worn or damaged.

Check the input shaft for wear, or damage. Replace the shaft if worn, scored or damaged in any way.

INPUT SHAFT BUSHING REPLACEMENT—A-727

(1) Clamp the input shaft in a vise with protective jaws. Do not clamp the seal ring lands or bearing journals.

(2) Assemble remover tool SP-3630, cup tool SP-3633 and hex nut SP-1191 (Fig. 30).

(3) Hold the cup tool firmly against the clutch piston retainer. Then thread the remover tool into the bushing as far as possible by hand.

(4) Thread the bushing remover an additional 3-4 turns using a wrench to firmly engage the tool in the bushing.

(5) Tighten the hex nut with a wrench to pull the bushing out of the input shaft (Fig. 30).

(6) Clean the input shaft thoroughly to remove chips. Be sure the small lubrication hole next to the shaft ball is not plugged. Also be sure the ball itself is not restricted by any chips.

(7) Assemble tool handle C-4171 and bushing installer head SP-3636 (Fig. 30). Then slide the new bushing on the installer head.

(8) Align the bushing in the shaft. Tap the bushing into place until the installer head bottoms.

(9) Remove the bushing installer tools and clean the clutch retainer and shaft a second time.

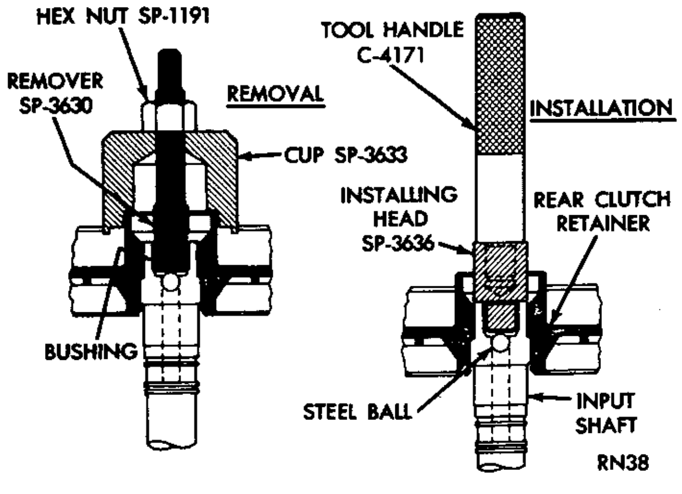

Fig. 30 Replacing Input Shaft Bushing—A-727

ASSEMBLING REAR CLUTCH—A-727

(1) Lubricate the clutch plates and soak the discs with transmission fluid.

(2) Install new seal rings on the input shaft and piston retainer (Fig. 29).

(3) Press the input shaft into the clutch retainer.

Secure the shaft with a new snap ring.

(4) Install new seals on the clutch piston. Lubricate the piston seals with Door Ease or petroleum jelly to ease installation. Be sure the seal lips face the input shaft.

(5) Install the clutch piston in the piston retainer. Use a twisting motion to seat the piston at the bottom of the retainer. **Do not attempt to push the piston straight in. This could fold the seals over causing leakage and clutch slip.**

(6) Install the #2 thrust washer on the piston retainer (Fig. 29). Use petroleum jelly to hold the thrust washer in place.

(7) Install the assembled piston retainer in the clutch retainer (Fig. 29).

(8) Install the piston spring, spacer spring and wave spring in the clutch retainer (Fig. 27). Be sure the wave spring is fully seated. Tap the spring into place if necessary.

(9) Install the inner pressure plate. Then install the first disc followed by a steel plate until all the discs and plates are installed.

(10) Install the outer pressure plate and the selective snap ring.

(11) Check clutch pack clearance with a feeler gauge (Fig. 28). Clearance should be .63 - 1.14 mm (.025 - .045 inch).

(12) If clutch pack clearance is incorrect, change the selective snap ring as needed. See the specifications section for available snap ring thicknesses.

PLANETARY GEAR TRAIN—A-998/999

GEARTRAIN END PLAY MEASUREMENT

(1) Measure planetary gear train end play before disassembly (Fig. 31).

(2) Stand the assembly upright with the forward end of the output shaft on a wood block. This is necessary for accurate measurement. it causes the planetary components to move forward against the snap ring at front of the shaft (Fig. 31).

(3) Measure end play with a feeler gauge. Insert the gauge between the shoulder on the output shaft and the rear annulus gear support hub (Fig. 31).

(4) End play should be .12 - 1.21 mm (.005 - .048 inch). If end play is incorrect, the snap ring or thrust washer may have to be replaced.

PLANETERY GEARTRAIN DISASSEMBLY—A-998/999

(1) Remove selective snap ring and #3 thrust washer from front end of output shaft (Fig. 32).

(2) Remove planetary gear components from output shaft (Fig. 32).

(3) Remove snap ring and #4 thrust washer (Fig. 32).

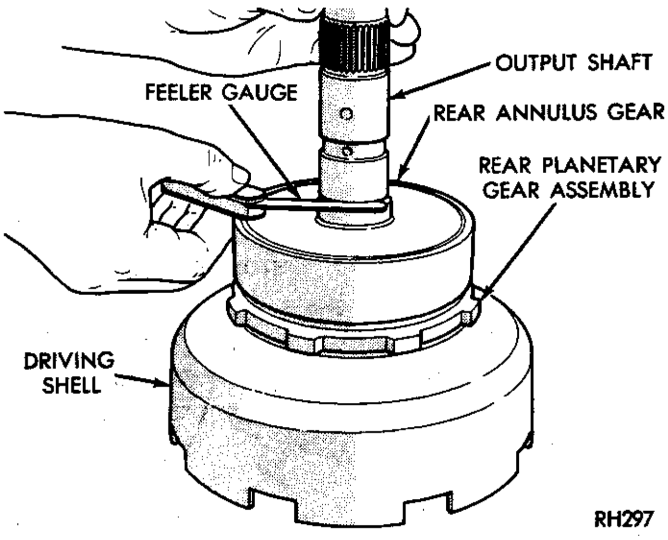

Fig. 32 Measuring Planetary End Play—All

(4) Remove annulus support, annulus gear, #5 thrust washer, front planetary, #6 thrust washer, sun gear, spacer and #7 thrust plate (Fig. 32).

(5) Remove driving shell, #8 thrust plate, snap ring rear planetary and #10 thrust washer (Fig. 32).

(6) Remove and dissassemble rear annulus gear, support, low-reverse drum and output shaft (Fig. 32).

Geartrain Inspection

Clean the planetary components in solvent and dry them with compressed air.

Check sun gear and driving shell condition. Replace the gear if damaged or if the bushings are scored or worn (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 gear and support if either component is worn or damaged. Inspect machined surfaces of output shaft.

Replace the output shaft if scored, pitted, or damaged in any way. Replace the thrust washers and plates if worn or damaged.

ASSEMBLING PLANETARY GEARTRAIN—A-998/999

(1) Lubricate planetary components with transmission fluid during assembly. Petroleum jelly can be used to lubricate and hold thrust washers and plates in position.

(2) Assemble low-reverse drum, annulus gear and support and output shaft.

(3) Install #10 thrust washer on rear planetary gear and install gear in rear annulus.

(4) Install #9 thrust washer and snap ring on output shaft and seat washer against rear planetary.

(5) Assemble #8 and #7 thrust plates, spacer, sun gear and driving shell (Fig. 32). Install assembled components on output shaft.

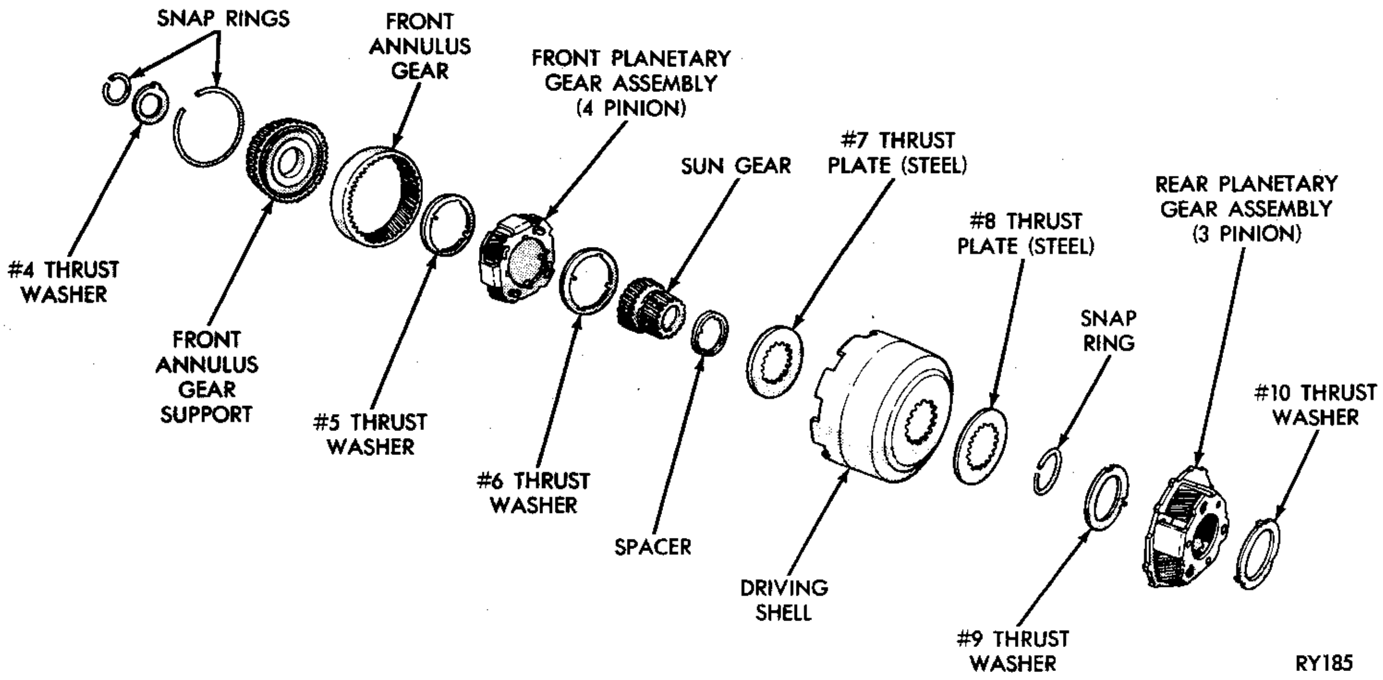

Fig. 32 Planetary Gear Train—A-998/999

(6) Assemble #6 thrust washer, front planetary gear and annulus gear and support (Fig. 32). Install assembled components on output shaft.

(7) Verify that all planetary components are properly seated and properly meshed.

(8) Install final snap ring and check end play again. If end play is not correct, it can be adjusted with a different thickness snap ring. Select fit snap rings are available in 1.07, 1.63, and 2.13 mm (.042, .064 and .084 inch) thicknesses.

PLANETARY GEAR TRAIN—A-727

GEARTRAIN END PLAY MEASUREMENT

(1) Measure gear train end play before disassembly (Fig. 31).

(2) Stand assembly upright with forward end of output shaft on wood block so all parts will move forward against snap ring at front of shaft (Fig. 31). This is necessary for an accurate measurement.

(3) Insert feeler gauge between shoulder on output shaft and rear annulus gear support hub (Fig. 31). End play should be .15 - 1.21 mm (.006 - .048 inch).

(4) If end play is incorrect, the selective snap ring or thrust washer may need replacement.

PLANETARY GEARTRAIN DISASSEMBLY—A-727

(1) Remove select fit snap ring (Fig. 33).

(2) Remove front planetary gear, #4 thrust washer, front annulus gear and #5 thrust washer (Fig. 33).

(3) Remove snap ring and remove sun gear, driving shell and #6 thrust plate (Fig. 33).

(4) Remove snap ring and remove #7 thrust washer, rear planetary gear, #8 thrust plate, rear annulus and low-reverse drum (Fig. 33).

Geartrain Inspection

Clean the geartrain components in solvent and dry them with compressed air.

Check sun gear and driving shell condition. Replace the sun gear as an assembly if the gear or bushings are scored or worn (the sun gear bushings are not serviceable). Replace the driving shell if damaged in any way.

Replace thrust washers and plates if cracked, scored or worn.

Inspect the planetary gear sets. Replace the gear sets if the gears, pinion pins, or carrier are damaged in any way.

Check condition of the annulus gear and support. Replace the annulus gear and support if either component is worn or damaged.

Inspect the machined surfaces of the output shaft. Replace the shaft if scored, pitted, or damaged in any way.

Inspect the low-reverse drum and annulus gears. Replace the annulus gears and the low reverse drum if worn, cracked or damaged in any fashion.

ASSEMBLING PLANETARY GEARTRAIN—A-727

(1) Lubricate planetary components with transmission fluid during assembly. Petroleum jelly can be used to lubricate and hold thrust washers and plates in position.

(2) Assemble low-reverse drum, rear annulus gear, #8 thrust plate and rear planetary gear (Fig. 33). Install the assembled components on the output shaft.

(3) Install #7 thrust washer on rear planetary gear

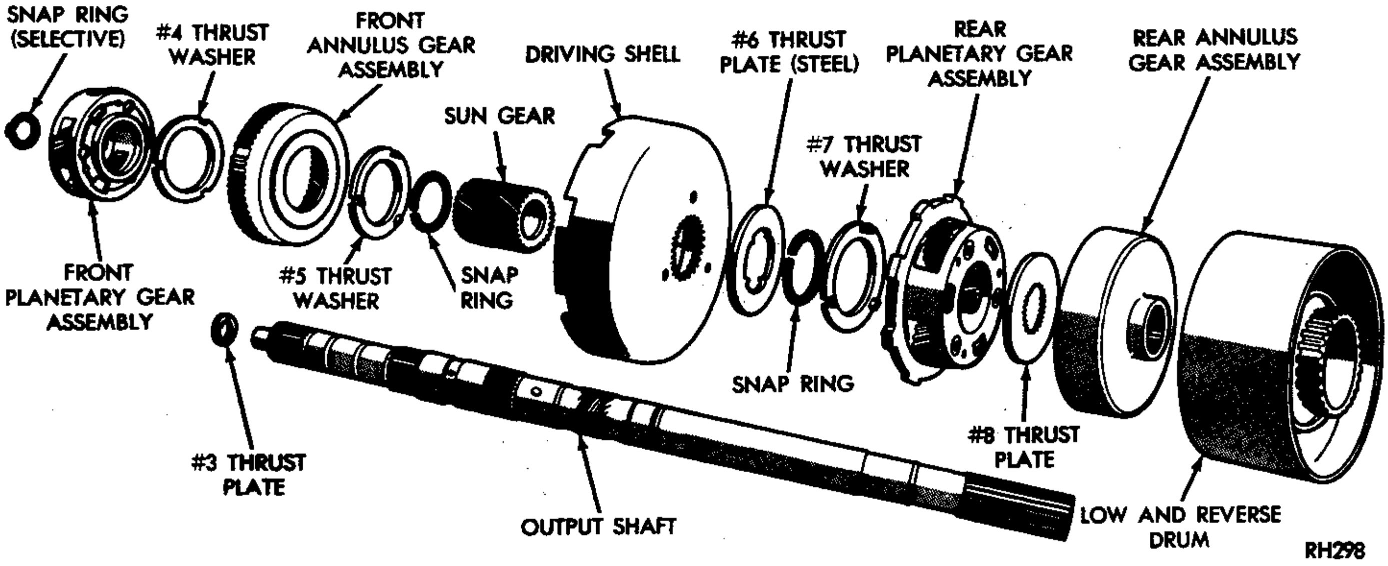

Fig. 33 Planetary Gear Train—A-727

and install snap ring on output shaft (Fig. 33).

(4) Assemble sun gear, #6 thrust plate, and driving shell. Install assembled components on output shaft and install retaining snap ring.

(5) Install #5 thrust washer front annulus gear, #4 thrust washer and front planetary gear (Fig. 33).

(6) Install select fit snap ring on output shaft and check end play again. If end play is not correct, it can be adjusted with a different thickness snap ring. Select fit snap rings are available in 1.22, 1.40 and 1.57 mm (.048, .055 and .062 inch) thicknesses.

(7) Set gear train aside for final assembly.

TRANSMISSION CASE

Clean the case thoroughly with solvent and dry with compressed air. Apply air through all case channels and passages to be sure they are clear and to remove cleaning residue.

Inspect the case for cracks, stripped threads, or other damage. Stripped threads in case bolts holes can be repaired with steel thread inserts. However, do not attempt to repair cracks or porous spots in the case.

Inspect the band levers, pins, links and adjusting levers. Replace any component exhibiting wear or damage.

OVERRUNNING CLUTCH

Inspect the overrunning clutch cam, rollers and spring retainer. Replace the cam as an assembly if the rollers are worn, chipped, flat spotted, or any of the roller or cam surfaces are brinneled or damaged.

The clutch rollers, springs and retainer are serviced as an assembly. Do not attempt to remove or disassemble the rollers and springs.

The clutch cam is attached to the case with bolts. The cam and shaft support must both be indexed to each other and to the case.

The support has an alignment arrow on it indicating correct installation position.

The clutch cam has one hole that is not threaded. This hole does not align with any of the bolt holes in the case. It aligns with a flat surface on the case instead.

Tighten the cam bolts alternately and evenly when installing the cam. This is necessary to seat the cam properly and avoid distortion or cocking.

FRONT (KICKDOWN) SERVO AND BAND—All

FRONT SERVO DISASSEMBLY

(1) Remove the small snap ring from the servo piston.

(2) Remove the piston, rod, springs and guide (Fig. 34).

(3) Remove and discard the servo piston rings and O-ring.

Front Band And Servo Inspection

Clean the servo components with solvent and dry them with compressed air.

Inspect the servo components. 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.

Replace the front band if distorted, the lining is burned or flaking off, or worn (grooves no longer visible at any point on band).

Check the servo piston bore for wear. Replace the piston and rod as an assembly if either part is worn or damaged.

Replace any servo component if doubt exists about its condition. Do not reuse suspect parts.

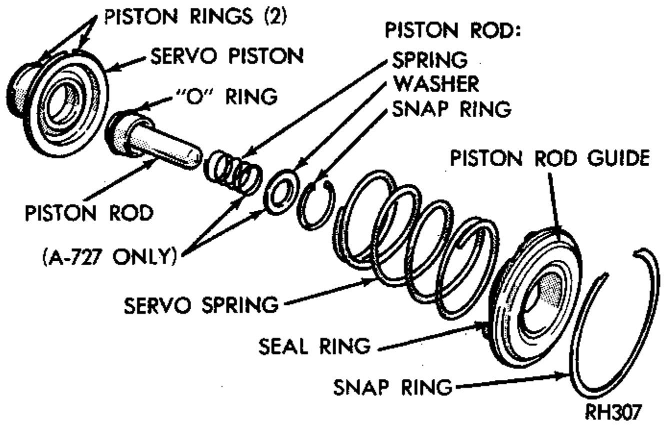

Fig. 34 Front (Kickdown) Servo Components—All

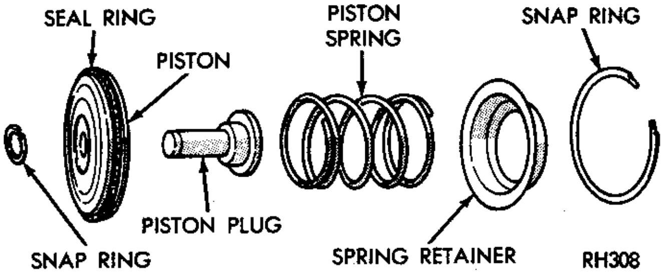

Fig. 35 Rear (Low-Reverse) Servo Components—All

FRONT SERVO ASSEMBLY

(1) Lubricate the seal rings and O-rings with petroleum jelly. Lubricate the other servo parts with transmission fluid.

(2) Install a new O-ring on the piston rod.

(3) Install a new seal on the piston rod guide and install new seal rings on the the piston.

(4) Assemble the rod, piston, servo springs, washer (727 only) and the snap ring (Fig. 34).

REAR (LOW-REVERSE) SERVO AND BAND—All

(1) Dissassemble the servo piston, plug, spring and retainer (Fig. 35).

(2) Remove and discard the servo piston seal ring.

Rear Servo And Band Inspection

Clean the servo components with solvent and dry them with compressed air.

Inspect the servo components. Replace the spring if collapsed, distorted or broken. Replace the plug and piston if cracked, bent, or worn. Discard the servo snap ring if distorted or warped.

Check rear band condition. Replace the band if distorted, the lining is burned or flaking off, or the lining is worn (grooves no longer visible at any point on band).

If doubt exists about the condition of any servo component, replace it. Do not reuse suspect parts.

ASSEMBLING LOW-REVERSE SERVO

(1) Lubricate the piston and guide seals with petroleum jelly. Lubricate the other servo parts with transmission fluid.

(2) Install a new seal ring on the piston (Fig. 35).

(3) Assemble the piston, plug and snap ring (Fig. 35).

TRANSMISSION ASSEMBLY

FRONT/REAR SERVO INSTALLATION

(1) Lubricate the front servo bore in the transmission case with transmission fluid. Then install the front servo assembly in the bore with a twisting motion. Compress the servo with tool C-3422-A. Secure the servo with a new snap ring and remove the compressor tool.

(2) Lubricate the rear servo bore in the transmission case with transmission fluid. Then install the rear servo assembly in the case bore with a twisting motion. Compress the servo with tool C-3422-A. Secure the servo with a new snap ring and remove the compressor tool.

OVERRUNNING CLUTCH INSTALLATION

(1) Place the transmission case in an upright position.

(2) Install the overrunning clutch hub, rollers and springs. Lubricate the hub, rollers and springs with transmission fluid.

REAR BAND AND LINKAGE INSTALLATION—A-727

(1) Assemble the lever, pin and link and anchor (Fig. 36).

(2) Install a new O-ring on the rear band pin (Fig. 36).

(3) Position the rear band in the case.

(4) Install the short strut. Then connect the link and anchor to the band. Be sure the link and anchor are installed as shown in Figure 36.

(5) Tighten the band adjuster screw just enough to hold the strut in place.

(6) Install the low-reverse drum. Then verify that the link does not touch the drum (if it does, link and anchor are improperly installed).

DOUBLE WRAP REAR BAND INSTALLATION—A-998/999

(1) Install a new O-ring on the band reaction pin and lubricate the pin with transmission fluid (Fig. 37).

(2) Push the reaction pin into the case until it is flush with the gasket surface.

(3) Position the double wrap band in the case so the band lugs are resting against the reaction pin (Fig. 38).

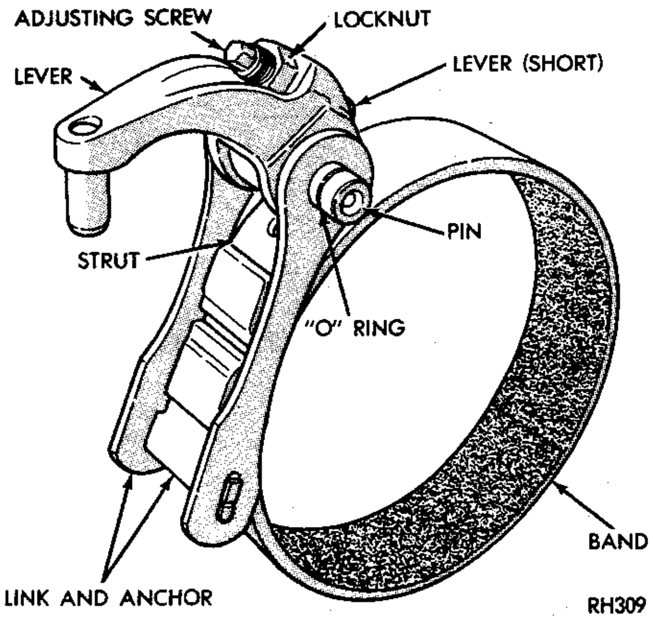

Fig. 36 Low-Reverse (Rear) Band And Linkage—A-727

(4) Install the low-reverse drum into the band and overrunning clutch.

(5) Lubricate the adjuster lever pivot pin with transmission fluid.

(6) Install the adjuster lever.

(7) Position the adjuster lever so the lever pivot pin is flush with the case and the adjusting screw is touching the center lug of the band.

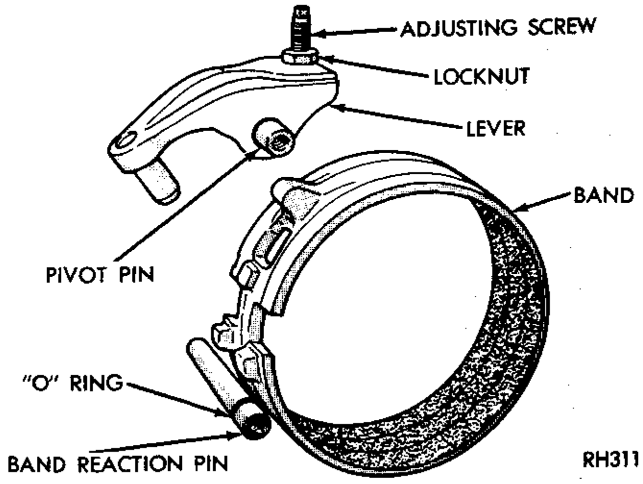

Fig. 37 Low-Reverse Band Components—A-998/999

INSTALLING PLANETARY GEARS, SUN GEAR AND DRIVING SHELL

(1) Lubricate the output shaft and geartrain with transmission fluid.

(2) Insert the output shaft through the rear support.

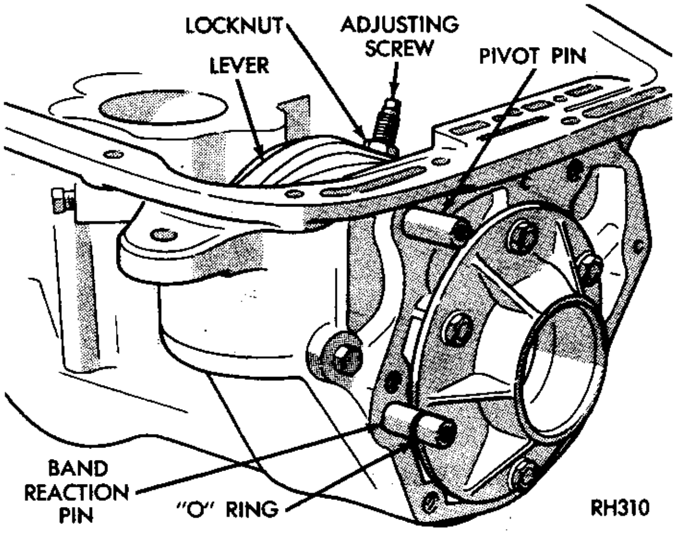

Fig. 38 Low-Reverse Band Installation—A998/999

(3) Carefully work the shaft and geartrain assembly rearward. Continue rearward movement until the rear planetary gears are fully engaged in the low-reverse drum slots.

POSITIONING TRANSMISSION CASE FOR FINAL ASSEMBLY

The remaining transmission components (clutches, front band, oil pump/reaction shaft support), are much easier to install if the transmission case is in an upright position.

Two methods can be used to hold the transmission case upright. The first method involves using a C-clamp style transmission holding tool. The second (and simpler) method only requires modifying a shop workbench.

Workbench modification involves drilling or cutting a 8.89 cm (3-1/2 inch) diameter mounting hole in the bench; then cutting notches at the hole sides large enough to clear the output shaft support flanges. **Be sure the mounting hole will be located at a convenient location on the bench before cutting/drilling.**

After preparing the workbench mounting hole, carefully lower the transmission output shaft through the hole until the shaft support and case are resting on the bench surface.

ASSEMBLING/INSTALLING FRONT AND REAR CLUTCHES

(1) Coat No. 3 thrust washer with petroleum jelly and insert washer in end of input shaft (Fig. 39). Use enough petroleum jelly to hold it in place.

(2) Coat output shaft thrust plate with petroleum jelly and install plate on forward end of output shaft (Fig. 39).

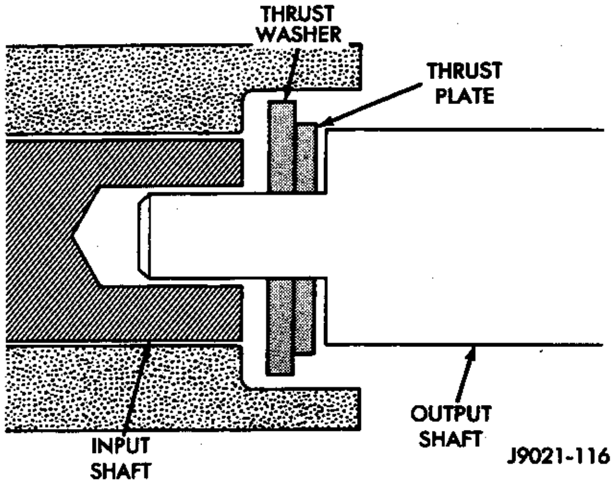

Fig. 39 No. 3 Thrust Washer And Output Shaft Thrust Plate Position

(3) Align front clutch plate inner splines. Then install front clutch on rear clutch. **Be sure front clutch plate splines are fully engaged in rear clutch hub.**

(4) Lower front/rear clutch assembly into case.

(5) Carefully work assembled clutches in a circular motion to engage rear clutch splines over splines of front annulus gear. Be sure the front clutch drive lugs are fully engaged in slots of driving shell.

FRONT (KICKDOWN) BAND INSTALLATION

(1) Slide the front band over the front clutch.

(2) Install the band lever and shaft (Fig. 40).

(3) Install the band strut (Fig. 40).

(4) Install the band adjusting screw. On A-727, also install the adjusting screw anchor.

(5) Coat the lever shaft plug with a non-hardening sealer such as Permatex No. 2 and install the plug in the case.

OIL PUMP AND REACTION SHAFT SUPPORT INSTALLATION

(1) If the oil pump was an extremely tight fit and difficult to remove at the start of overhaul, warm the pump mounting area of the case with a heat lamp. A few minutes of heat application should expand the case enough ease pump installation. Leave the heat lamp on until the pump is ready for installation.

(2) On A-998/999, install the #1 thrust washer on the reaction shaft support hub (Fig. 6). Use petroleum jelly to hold the washer in place.

(3) On A-727, if input shaft end play measured during disassembly was incorrect, install a new thrust washer that will provide correct end play. Select fit washers are available for this purpose. Refer to the specifications section for select fit washer thicknesses.

(4) Install two pilot stud tools C-3288-B in the pump mounting holes (Fig. 41).

(5) Install a new pump gasket over the studs and seat the gasket in the case.

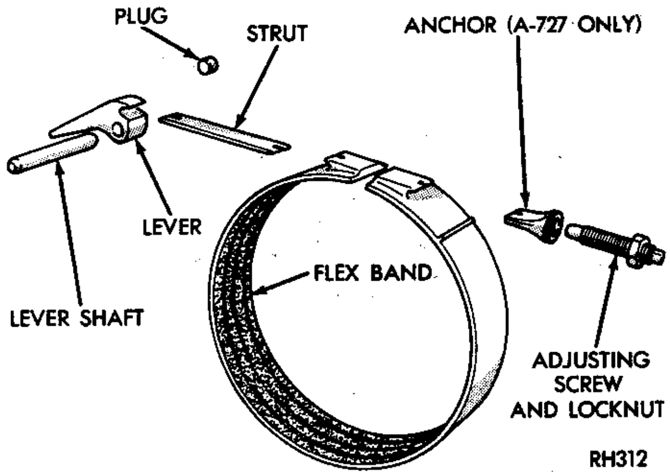

Fig. 40 Front (Kickdown) Band And Linkage

(6) Coat the pump O-ring with Door Ease or petroleum jelly to aid installation. Apply either of the same lubricants to the lip of the pump oil seal.

(7) Remove the heat lamp (if used).

(8) Position the pump and reaction shaft support assembly on the pilot studs. Then slide the pump and shaft assembly into the case (Fig. 40). Gently tap the pump body with a rubber mallet to fully seat it.

(9) Remove the pilot stud tools and install the pump bolts. Tighten the bolts snugly but not to final torque at this time.

(10) Check for correct component installation as follows:

(a) Rotate the input and output shafts and observe shaft operation.

(b) If both shafts rotate freely, proceed to the next assembly step.

(c) If either shaft binds, the clutches, planetary gears or thrust washers are misassembled. Remove and reassemble transmission components as necessary to eliminate the bind condition.

(11) Final-tighten pump bolts to 20 N•m (175 in-lbs) torque.

(12) Check input and output shaft rotation one more time.

GOVERNOR AND SUPPORT INSTALLATION

(1) Lubricate the governor valve, weights, body and shaft with transmission fluid.

(2) Install the filter screen in the governor body.

(3) Position the governor body on the park gear and install the body attaching bolts finger tight.

(4) Install the assembled park gear and governor body on the output shaft (Fig. 42).

(5) Align the governor valve shaft holes in the governor body and output shaft.

(6) Install the governor retaining snap ring on the output shaft.

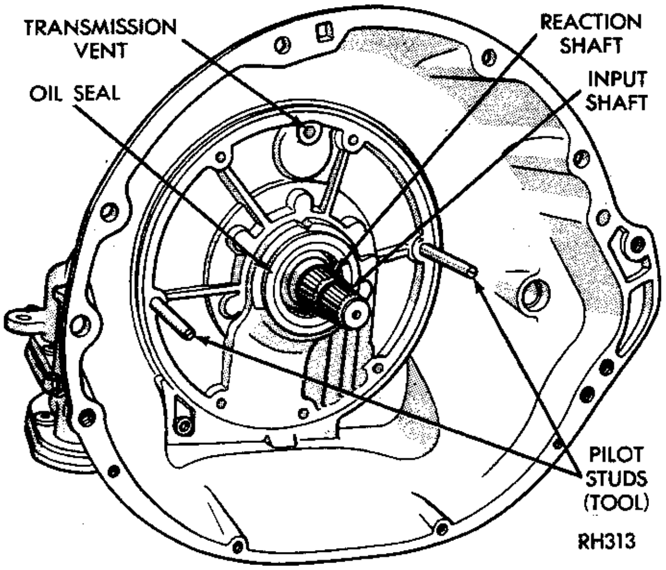

Fig. 41 Installing Oil Pump And Reaction Shaft Support

(7) Tighten the bolts attaching the governor body to the park gear to 11 N•m (95 in-lbs) torque.

(8) Assemble the governor weights and spring. Use a new snap ring to secure the inner weight and spring in the outer weight.

(9) Install the weights in the governor body and install the retaining snap ring (Fig. 42).

(10) Assemble the governor valve, valve shaft and snap ring. Then insert the shaft into the governor body and through the output shaft and governor weights. Secure the shaft to the weights with a new snap ring.

(11) Verify that the governor valve and weights move freely in the governor body.

REAR BEARING AND EXTENSION HOUSING INSTALLATION

(1) Position a new housing gasket on the transmission case.

(2) Install a new oil seal in the extension housing.

(3) Install the rear bearing on the output shaft. Secure the bearing with one new snap ring (A-998/999) or two new snap rings (A-727).

(4) Install the output shaft snap ring in the extension housing. Then spread the snap ring and work the housing onto the bearing and transmission case. Be sure the shaft bearing snap ring is seated.

(5) Install the snap ring access plate in the housing.

(6) Tighten the housing attaching bolts to 33 N•m (24 ft-lbs) torque.

VALVE BODY, ACCUMULATOR AND OIL PAN INSTALLATION

(1) Make sure the neutral switch has **not** been installed in the case (it will interfere with valve body installation if mounted in the case).

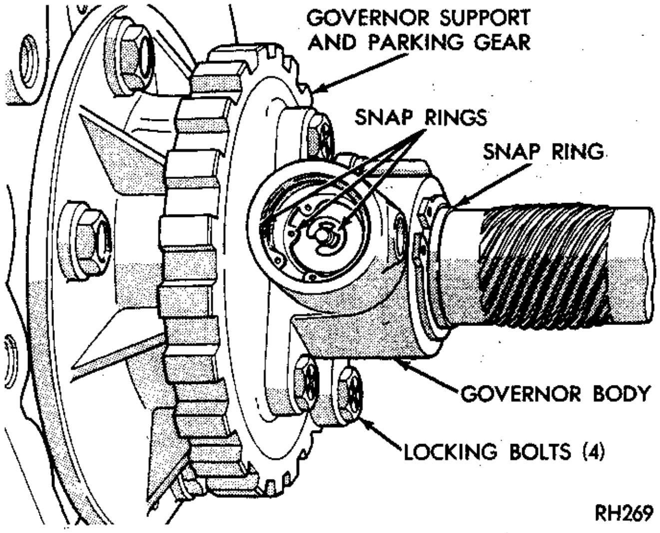

Fig. 42 Governor And Park Gear Installation

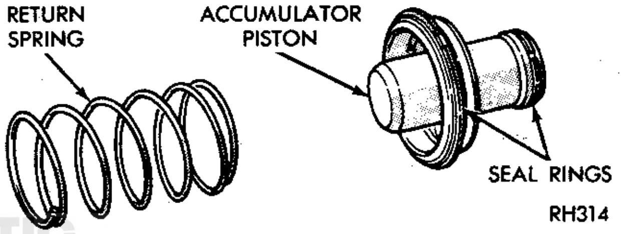

Fig. 43 Accumulator Piston And Spring

(2) Install new seal rings on the accumulator piston (Fig. 43).

(3) Lubricate the accumulator piston, seals and the accumulator bore (in the case) with transmission fluid.

(4) Install the accumulator piston and spring (Fig. 43) in the case.

(5) Place the valve body manual lever in low to move the park lock rod rearward.

(6) Position the valve body on the case. Work the park lock rod past the sprag and install the valve body bolts finger-tight.

(7) Install the neutral start switch in the case and move the park lock rod to Neutral position.

(8) Align the valve body on the transmission case and install the valve body bolts. Tighten the bolts alternately and evenly to 35 in-lbs (4 N•m) torque. Start at the center and work outward when tightening the bolts.

(9) Install a new filter on the valve body. Tighten the filter bolts evenly to 35 in-lbs (4 N•m) torque.

(10) Install a new manual lever shaft seal the in case. Then install the throttle valve and manual valve levers on the shaft.

(11) Position a new oil pan gasket on the case.

(12) Install the oil pan and tighten the pan bolts to 17 N•m (150 ft-lbs) torque.

A-500/A-518 AUTOMATIC TRANSMISSION

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GENERAL INFORMATION

DESCRIPTION/APPLICATION

The A-500/518, four speed automatic transmissions are a unique two-section design. They consist of a modified Chrysler three speed automatic transmission with an overdrive unit attached to the rear of the transmission (Fig. 1).

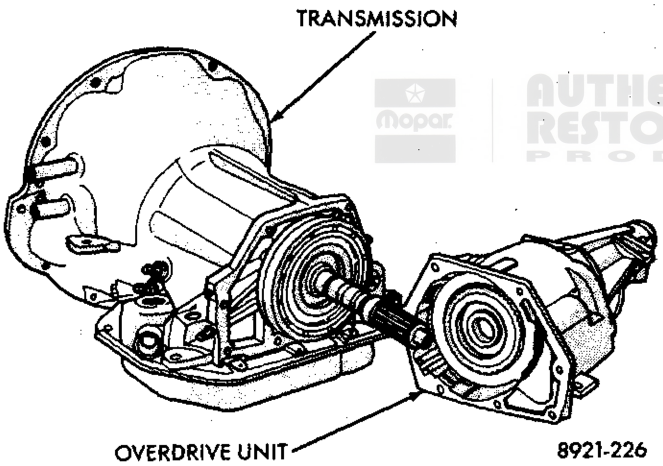

Fig. 1 A-500/518 Transmission And Overdrive Unit

The front section of the A-500 overdrive automatic transmission is a modified A-999, three speed transmission. The front section of the A-518 overdrive automatic transmission is a modified A-727 three speed transmission.

The overdrive unit is mounted at the rear of the transmission case in place of the normal extension housing. The overdrive unit is connected to the front section intermediate shaft. The overdrive unit provides a fourth gear ratio of 0.69 to 1 (Fig. 1). The first three gear ratios of the A-500/518 transmission are the same as those in the applicable three speed automatic transmission.

The A-500 is used for 3.9L and 5.2L applications. The A-518 transmission is used for 5.2 and 5.9 L gas engine applications.

OVERDRIVE COMPONENTS

The components in the front section of the A-500/518 transmission are basically the same as those in the applicable Chrysler transmission. However, different components are needed to attach the overdrive unit.

The three speed transmission has an intermediate shaft instead of the usual output shaft. It serves as the front section output shaft and connects the overdrive unit to the front section.

The governor and speedometer drive are relocated to the rear of the overdrive unit output shaft. Two bearings are used to support the overdrive output shaft. A longer park lock rod assembly is also required.

Rotating seal rings and pressurized oil for the overdrive and direct clutches in the overdrive unit are not required. The governor is the only component receiving pressurized oil (through slip fit tubes). Pressurized oil for the overdrive lubrication circuit is supplied through the intermediate shaft.

Governor pressure and overdrive pressure taps are provided in the rear of the transmission case for in-vehicle pressure testing.

The overdrive fourth gear range is provided by a third planetary gear set, a direct clutch, an overdrive clutch and an overrunning clutch. A high tension spring that exerts up to 800 pounds (5,516 kPa) force, holds the sun gear to the annulus for direct drive. For coasting or reverse gear, power flows only through the direct clutch.

The lockup timing valve releases the torque converter to normal operation prior to the 4-3 downshift.

The standard valve body is modified by adding several new components to a lower housing (Figs. 2 and 3). The new components include: an overdrive solenoid, a lockup solenoid (A-500 only), a 3-4 shift valve, a 3-4 timing valve, a 3-4 accumulator, and a 3-4 shuttle valve.

In fourth gear overdrive, the A-500 converter lockup solenoid, lockup valve, and lockup timing valve are actuated. At lockup, the converter turbine is locked to the converter housing by the converter lockup clutch.

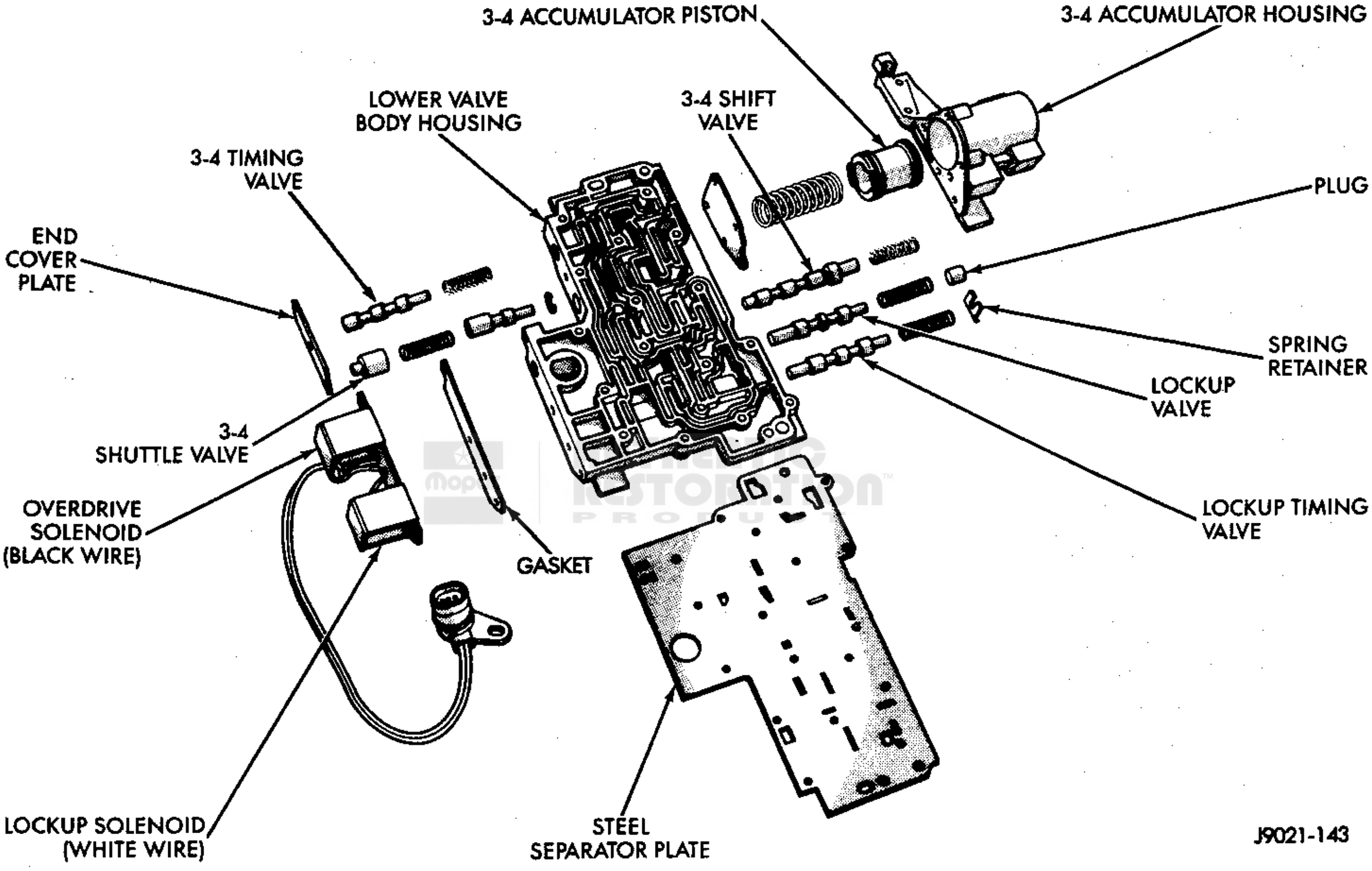

Fig. 2 A-500 Valve Body Lower Housing

OVERDRIVE CONTROL AND OPERATION

Fourth gear overdrive is electronically controlled and hydraulically activated. A variety of sensor inputs are supplied to the engine controller which operates the valve body solenoids. The solenoids energize and close a vent allowing a 3-4 upshift. The engine electronic module also controls operation of the lockup torque converter using many of the same sensor inputs.

Closed throttle 3-4 upshifts occur at 25-28 mph, regardless of axle ratio. Closed throttle 4-3 downshifts occur at approximately 25 mph, regardless of axle ratio.

A 3-4 upshift will not occur if throttle opening is greater than approximately 70 percent.

Converter lockup in overdrive fourth gear is controlled by sensor inputs to the engine controller. In third gear above 25 mph, sensor inputs to the controller that determine lockup and shift timing are: coolant temperature (verifies temperature minimum of 60° F), engine speed, vehicle speed, throttle position and manifold vacuum through the map sensor.

The column gear shift mechanism provides the same shift positions used with three speed automatic transmissions (P-R-N-D-2-1). The shift into overdrive fourth gear range occurs only after the transmission has completed the shift into D third gear range. The shift to overdrive fourth gear occurs automatically and is determined by sensor input to the engine controller.

The overdrive control switch is located in the instrument panel. In the On position, automatic shifts into fourth gear overdrive will occur. In the Off position, the switch overrides the electronic control module preventing a shift to fourth gear.

The control switch has an indicator light that illuminates when overdrive is turned off. The switch also resets when the ignition key is turned to the Off position so the overdrive feature is restored.

Fault codes are employed to help diagnose electronic components that operate the overdrive unit and lockup converter.

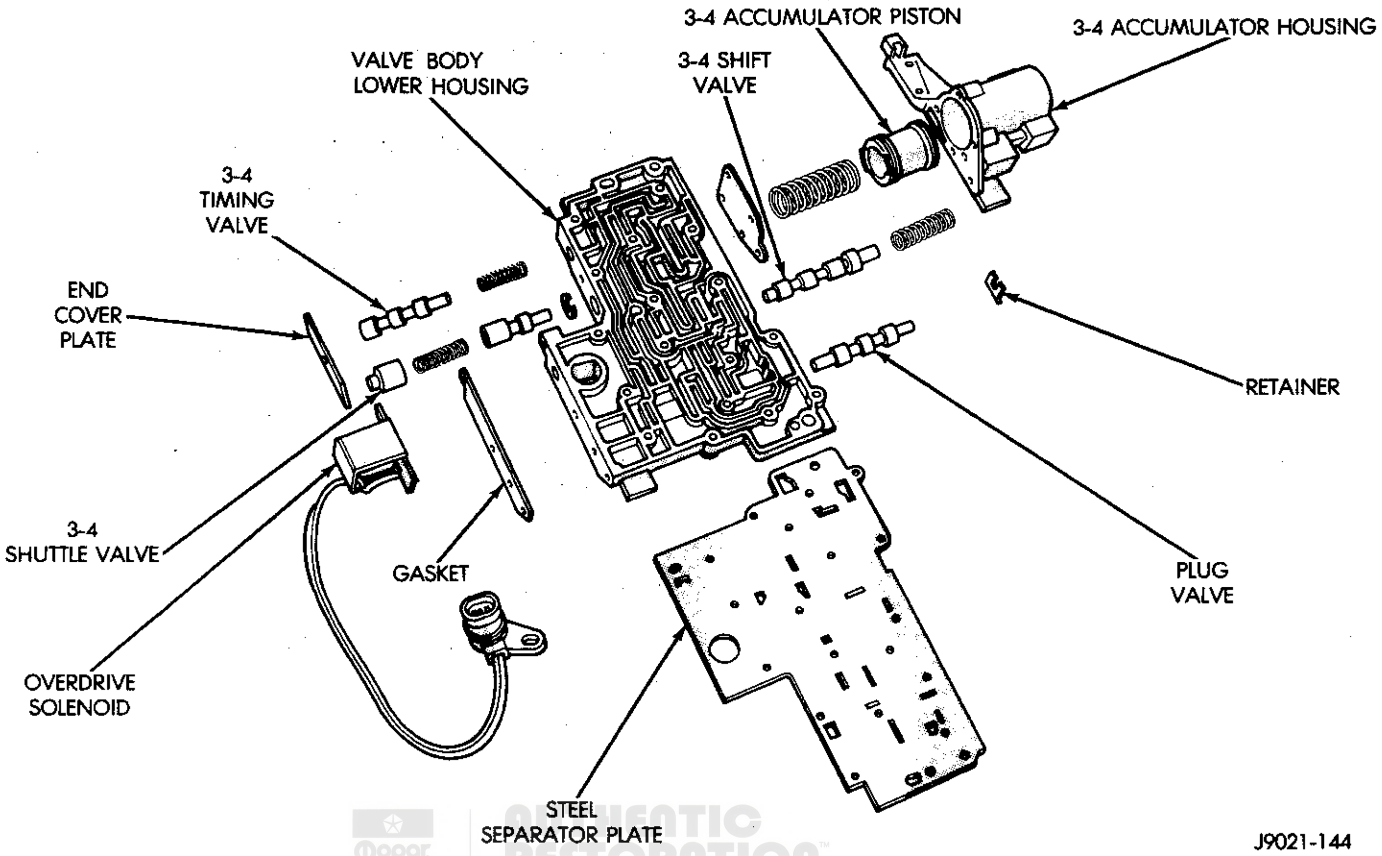

Fig. 3 A-518 Valve Body Lower Housing

TORQUE CONVERTER APPLICATION

Lockup and nonlockup torque converters are used. A lockup converter is used with the A-500. A-518 models are equipped with a nonlockup converter.

RECOMMENDED FLUID

Recommended fluid for use in A-500/518 overdrive transmissions is Mopar ATF Plus, Type 7176. Mopar Dexron II™ can be used if ATF Plus is not available.

Mercon™ fluid is not recommended for use in A-500/518 transmissions for refilling after filter/fluid changes, or after overhaul. It can only be used for topping off the fluid level during periodic checks.

SERVICE DIAGNOSIS

GENERAL DIAGNOSIS INFORMATION

A-500/518 automatic transmission problems can be a result of: poor engine performance; incorrect fluid level; incorrect linkage adjustment; electronic component shorts-grounds-opens; band or hydraulic control pressure adjustments; hydraulic system malfunctions; or mechanical component malfunctions.

Begin diagnosis by checking the easily accessible items such as fluid level and condition, linkage adjustments and overdrive fuse, solenoid and wire condition. A road test will determine if further diagnosis is necessary. The overdrive unit should not be removed unless diagnosis reveals an actual overdrive fault.

ROAD TESTING

Before road testing, be sure fluid level and linkage adjustments are correct and that the overdrive circuit fuse and electrical connections are OK.

Observe engine performance during the road test. A poorly tuned engine will not allow an accurate analysis of transmission operation.

Operate the transmission in all gear ranges. Check for slippage and shift variations. Note whether the shifts are harsh, spongy, delayed, early, or if downshifts are sensitive.

Watch closely for slippage or engine flare which usually indicates clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul may be necessary to restore normal operation.

A slipping clutch or band can often be determined by comparing which internal units are applied in the various gear ranges. The clutch and band application chart (Fig. 1) provides a basis for analyzing road test results.

For example: If slippage occurs during the 3-4 shift or in fourth gear, the overdrive clutch is slipping. Similarly, if the direct clutch were to fail, the transmission would lose reverse gear and overrun braking

LEVER POSITION	A500/ A518 OVER-DRIVE	START SAFETY	PARKING SPRAG	TRANSMISSION FRONT SECTION						OVERDRIVE UNIT		
				CLUTCHES				BANDS		CLUTCHES		
				K/D FRONT	REAR	O'RUN	LOCKUP	FRONT	REVERSE/REAR	O/D	O'RUNNING	DIRECT
P-Park		X	X									
R-Reverse	2.21			X					X			X
O-Drive												
First	2.74				X	X					X	X
Second	1.54				X			X			X	X
Third	1.00			X	X		X				X	X
O/D	.69			X	X		X			X		
2-Second												
First	2.74				X	X					X	X
Second	1.54				X			X			X	X
1-Low	2.74				X	X			X		X	X

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Fig. 1 Elements In Use In All Gear Ranges

in 2 (manual second gear) position. If the transmission slips in any other two forward gears, the transmission front section rear clutch may be slipping.

OVERDRIVE UNIT SERVICE DIAGNOSIS

Condition	Possible Cause
(1) No reverse or slips in reverse	(1) Failed direct clutch (a) Overdrive spring lost load. (b) Wrong overdrive piston bearing spacer selected.
(2) No overdrive shift.	(2) Blown fuse (a) Faulty overdrive solenoid. (b) Faulty wiring or connectors. (c) Faulty overdrive off switch. (d) Faulty engine controller. (e) Failed overdrive clutch. — Wrong overdrive piston bearing spacer selected. — Low overdrive pressure.
(3) Runaway overdrive shift.	(3) Failed overdrive overrunning clutch.
(4) Overdrive shift occurs immediately after 2-3 shift.	(4) Faulty overdrive solenoid — not venting. (a) Lower valve body malfunction. (b) Faulty wiring. (c) Faulty engine controller.
(5) Excessively delayed overdrive shift.	(5) Incorrect overdrive piston bearing spacer. (a) Faulty sensor.
(6) No 4-3 downshift.	(6) Faulty lockup solenoid — not venting. (a) Lower valve body malfunction. (b) Faulty wiring. (C) Faulty engine controller.
(7) No 4-3 downshift with overdrive off switch.	(7) Faulty overdrive off switch. (a) Faulty engine controller. (b) Faulty lockup solenoid — not venting. (c) Faulty wiring.
(8) Torque converter locks up in 2nd and 3rd gears.	(8) Faulty lockup solenoid — not venting.
(9) Harsh shifts 1-2, 2-3, & 3-2.	(9) Faulty lockup solenoid — not venting.
(10) Low governor pressure.	(10) Leaking governor tubes: (a) Bent. (b) Loose fit. (c) Governor seal rings broken or worn.
(11) Noisy.	(11) Failed overdrive piston bearing. (a) Failed gear train needle thrust bearings. (b) Failed overdrive planetary. (c) Failed overdrive overrunning clutch.

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OVERDRIVE UNIT REMOVAL

The overdrive removal and installation procedures in this section apply to the overdrive unit only. If the complete transmission assembly must be removed for service, refer to the procedures in the three speed transmission section.

(1) Shift the transmission into Park.

(2) Raise the vehicle.

(3) Remove the transmission oil pan and gasket and drain the fluid. Then reinstall the oil pan plus a new gasket.

(4) If the malfunction involved an overdrive clutch or governor problem, remove only the overdrive unit. However, if the failure generated metal particles, or if the fluid is contaminated with friction material, remove the entire transmission.

(5) Mark propeller shaft universal joint and axle pinion yoke for alignment reference (Fig. 1).

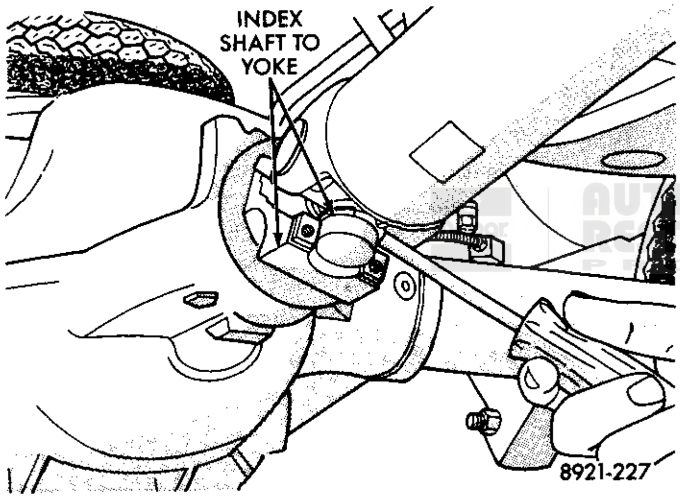

Fig. 1 Mark Propeller Shaft And Yoke For Alignment Reference

(6) Disconnect and remove the propeller shaft, or shafts on four wheel drive models.

(7) On four wheel drive models, remove the transfer case from the overdrive unit.

(8) Support the transmission with a transmission jack.

(9) Remove the crossmember. Mark position of crossmember for reassembly.

(10) Remove the distance sensor and speedometer adapter.

(11) Remove the bolts attaching the overdrive unit to the transmission (Fig. 2).

CAUTION: Support the overdrive unit during removal. Do not allow the front section intermediate shaft to support the entire weight of the overdrive unit.

(12) Carefully slide the overdrive unit off the intermediate shaft. Retain the bearing and select fit spacer that may remain on the overdrive piston, rear of the transmission case, sliding hub, or intermediate shaft.

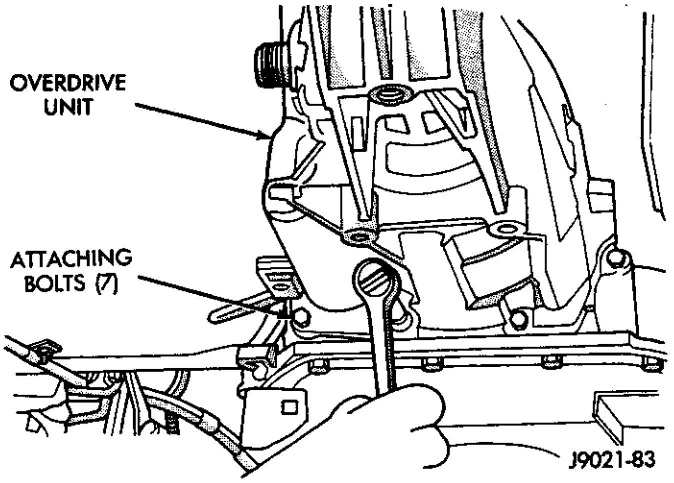

Fig. 2 Removing/Installing Overdrive Unit Attaching Bolts

(13) Place several clean shop towels on the workbench.

(14) Tilt the overdrive unit to drain any fluid remaining in the case. Examine the fluid for clutch material or metal fragments. If the fluid contains these items, an overhaul will be necessary.

OVERDRIVE VALVE BODY SERVICE

GENERAL SERVICE INFORMATION

The upper part of the overdrive valve body is similar to the three speed automatic transmission valve body (Fig. 3). It contains the throttle valves, governor plugs, pressure regulators, 1-2 shift valves, pressure adjustment components and the manual valve and lever. Refer to the Loadflite transmission section for service procedures.

The lower section of the overdrive valve body (Fig. 3) contains the fourth gear shift components. These include the 3-4 shift valve, 3-4 accumulator, 3-4 timing valve, lockup and timing valves, 3-4 shuttle and timing valves and the dual overdrive/lockup solenoid assembly (Fig. 3).

VALVE BODY REMOVAL/INSTALLATION

Removal and installation procedures for the overdrive valve body are the same as for the three speed valve body. Refer to the procedures in the three speed transmission section.

VALVE BODY OVERHAUL AND ADJUSTMENT

The overdrive valve body overhaul procedures vary from the three speed procedures only in regard to lower housing components (Fig. 4). Cleaning and inspection methods are the same except for the dual solenoid assembly and solenoid connector. These

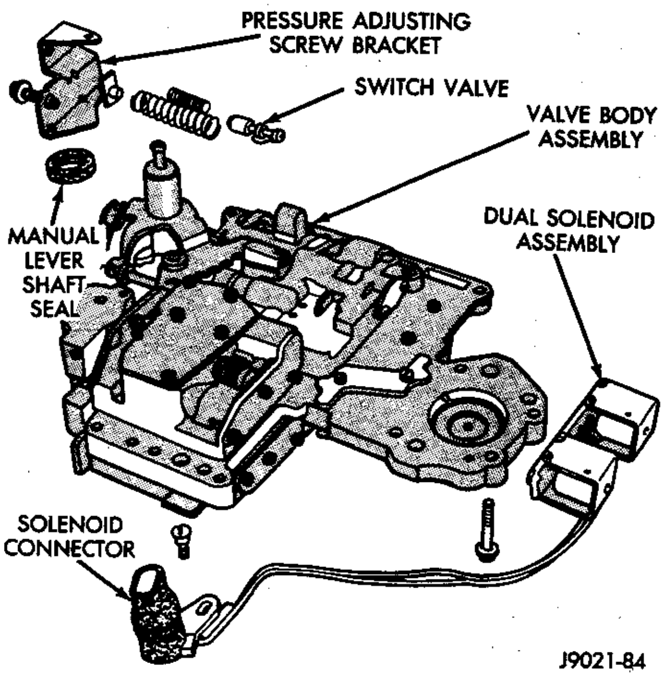

Fig. 3 A-500/518 Valve Body

components must not be immersed in solvent. Wipe them dry with lint free shop towels for inspection and test purposes.

Overdrive valve body screw tightening torques are unchanged and remain at 4 N•m (35 in-lbs) torque. Screw tightening sequence also remains the same (start at center and work outward).

The hydraulic pressure adjustments for the overdrive valve body are the same as for Chrysler automatic transmission valve bodies. Refer to Maintenance and Adjustments in the three speed transmission section for procedures.

OVERDRIVE UNIT DISASSEMBLY

(1) Remove overdrive clutch wire retaining ring (Fig. 5).

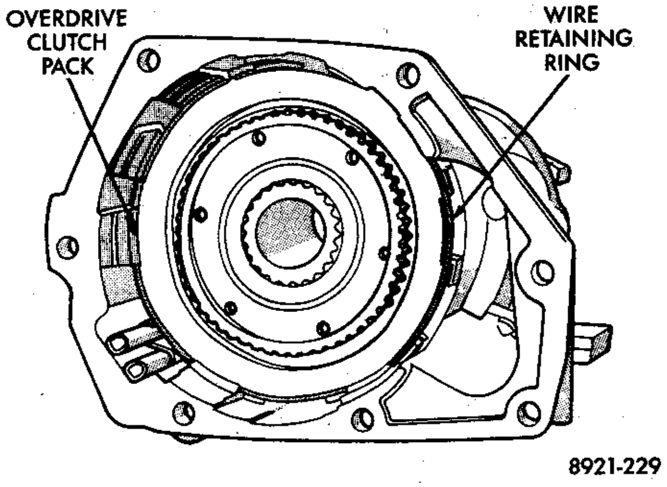

Fig. 5 Remove Clutch Pack Retaining Ring

(2) Remove overdrive clutch pack plates and discs (Fig. 6. Thickest plate is the clutch pressure plate. This plate is positioned at front of clutch pack.

(3) Remove overdrive clutch wave ring (Fig. 7). This special ring acts as a cushion to absorb shock when the overdrive clutch engages.

(4) Remove large flat snap ring from same groove as wave ring was installed in (Fig. 8).

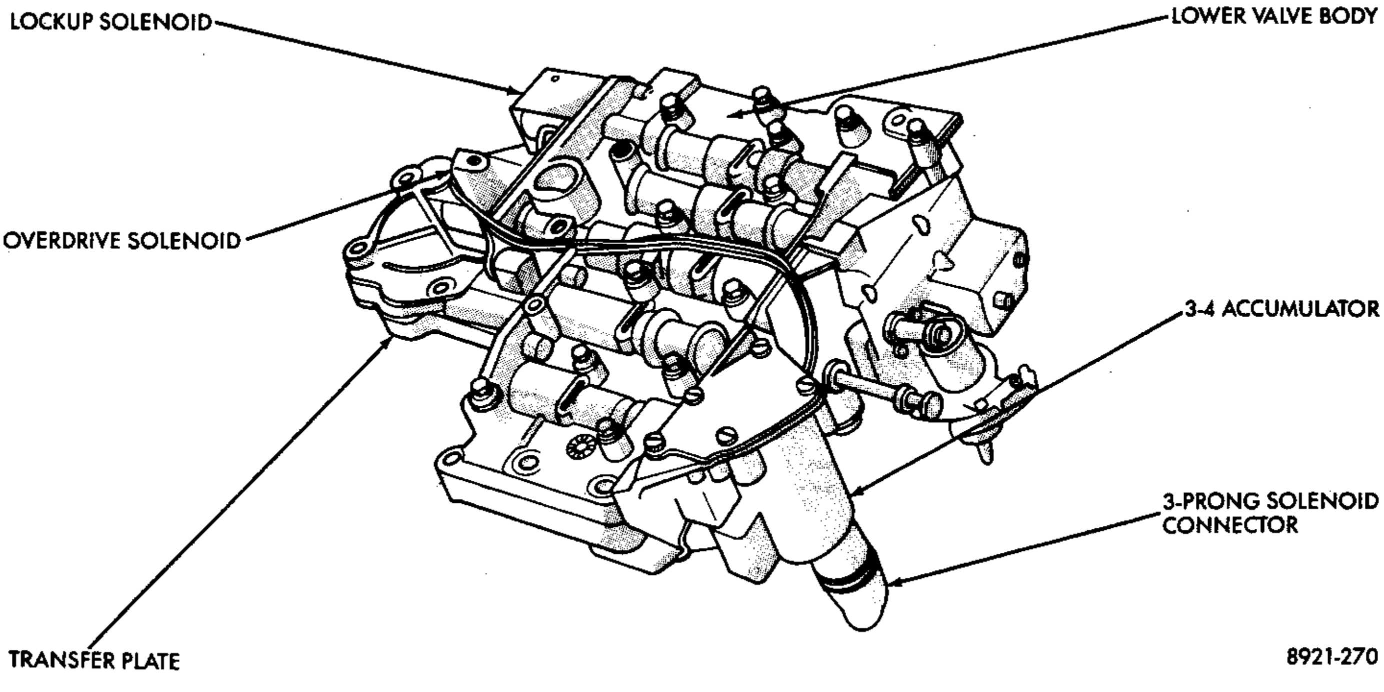

Fig. 4 Valve Body

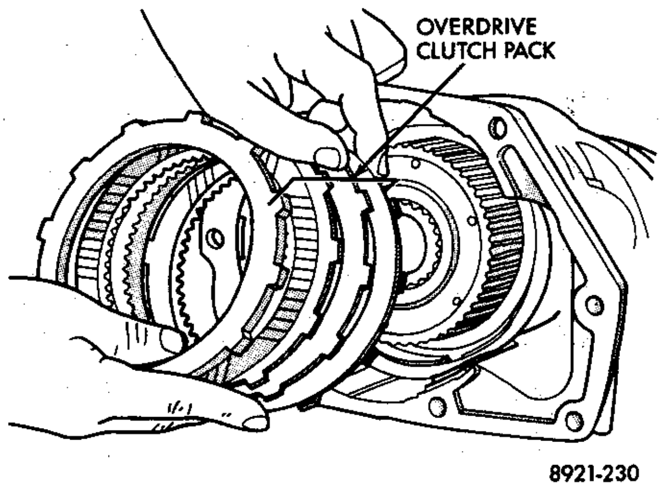

Fig. 6 Removing/Installing Overdrive Clutch Pack

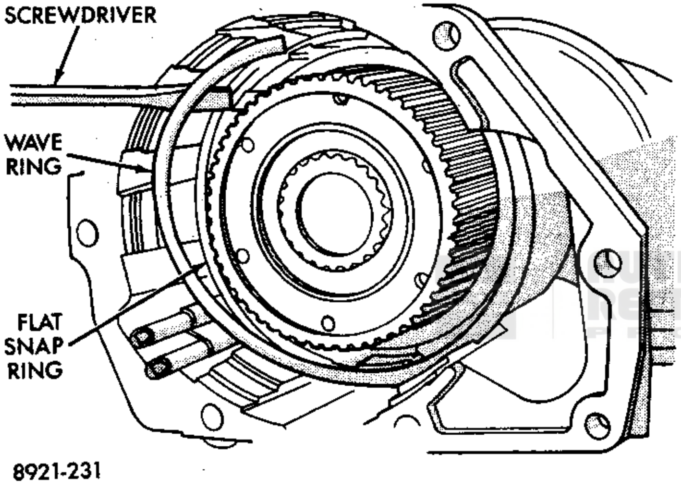

Fig. 7 Removing/Installing Overdrive Clutch Wave Ring

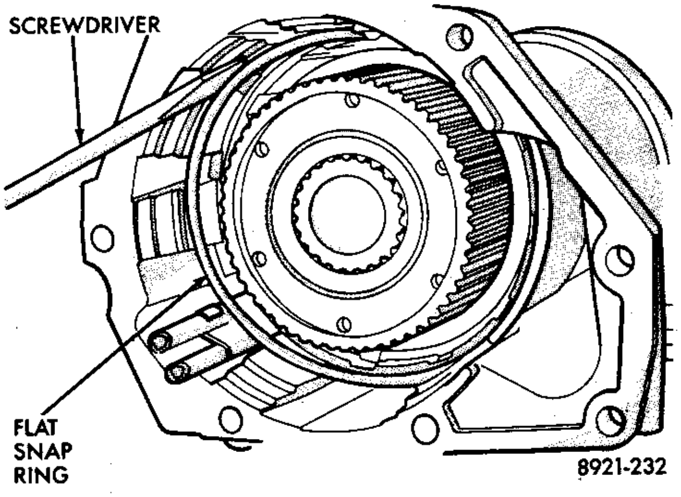

Fig. 8 Removing/Installing Overdrive Clutch Flat Snap Ring

(5) Remove access cover (Fig. 9). Cover provides access to snap ring that holds output shaft front bearing in place.

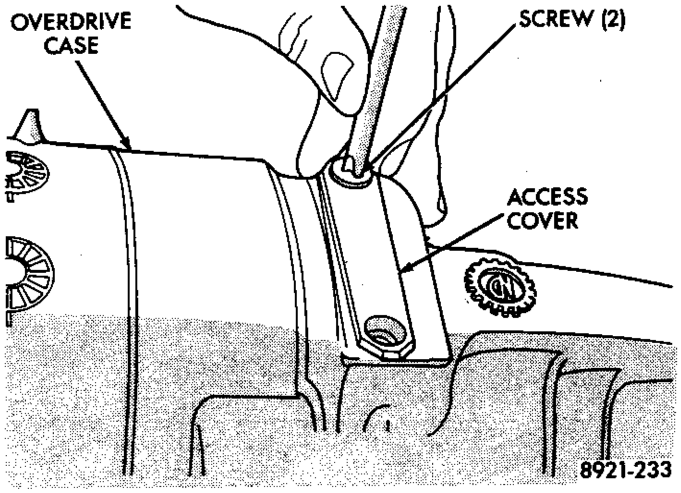

Fig. 9 Removing/Installing Access Cover

(6) Insert alignment Tool C-6277-2 into sun gear (Fig. 10). Be sure tool is firmly seated as it will be used to remove entire gear train as an assembly.

(7) After seating the alignment tool C-6227-2, turn overdrive unit over and position it on the alignment tool (Fig. 11).

(8) Expand the output shaft bearing snap ring with expandable snap ring pliers (Fig. 11). Then lift the overdrive case off the geartrain.

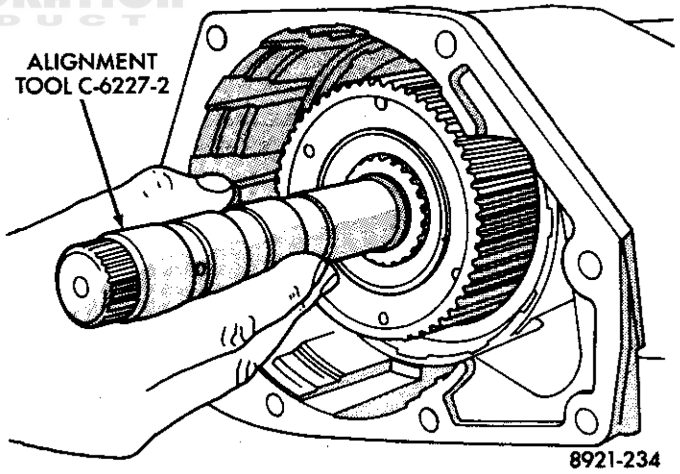

Fig. 10 Installing Alignment Tool C-6227-2

(9) Remove the governor retaining snap ring and remove the governor and shaft key (Fig. 12). This prevents damaging the governor when the direct clutch spring is compressed in an arbor press.

(10) Set gear train aside for overhaul operations and continue disassembly of case components.

(11) Remove the output shaft front bearing snap ring (Fig. 13). Then remove the governor support snap ring.

(12) Remove the governor support and the slip fit pressure tubes from the case (Fig. 14).

(13) Remove output shaft rear bearing snap ring with locking-type snap ring pliers (Fig. 15).

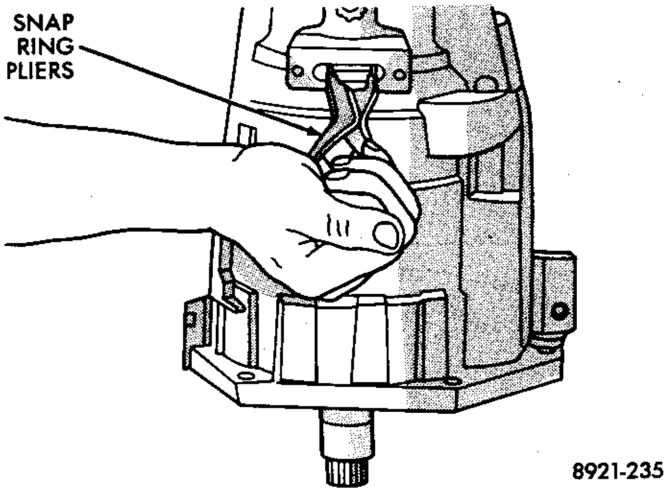

Fig. 11 Expanding Output Shaft Bearing Snap Ring (To Remove Case From Geartrain)

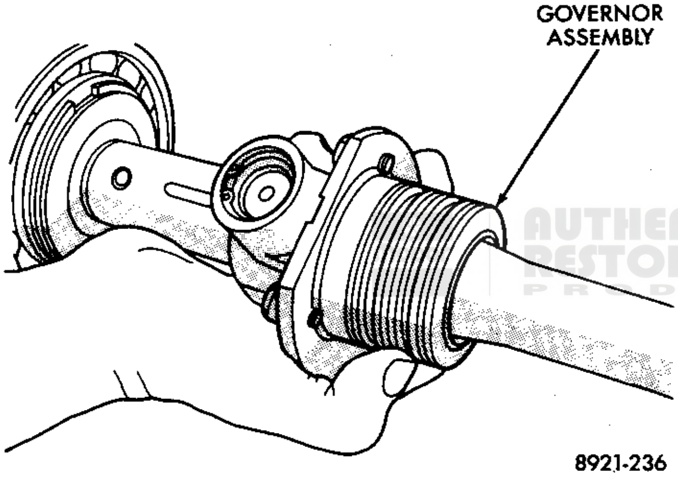

Fig. 12 Removing Governor Assembly

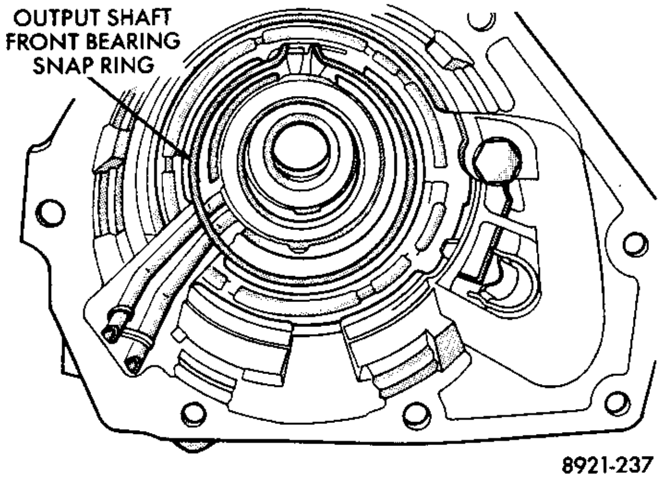

Fig. 13 Removing Output Shaft Front Bearing Snap Ring

(14) Tap overdrive case downward on wood block to remove the rear bearing.

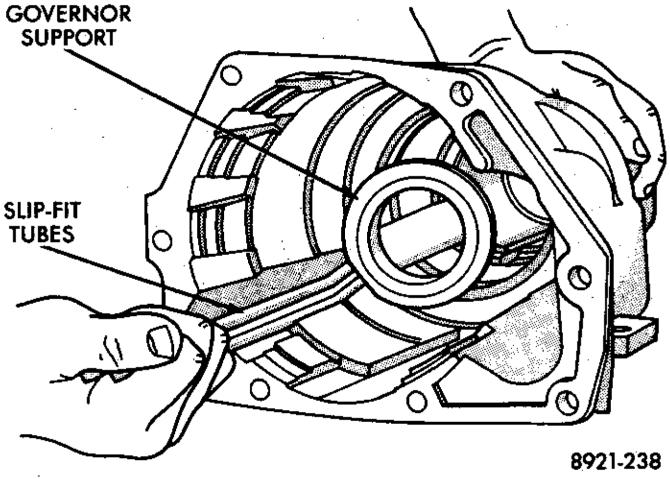

Fig. 14 Removing Governor Support And Pressure Tubes

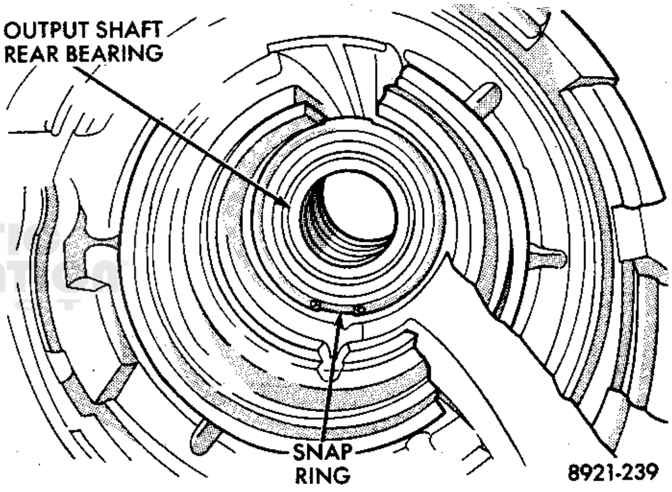

Fig. 15 Removing Output Shaft Rear Bearing And Snap Ring

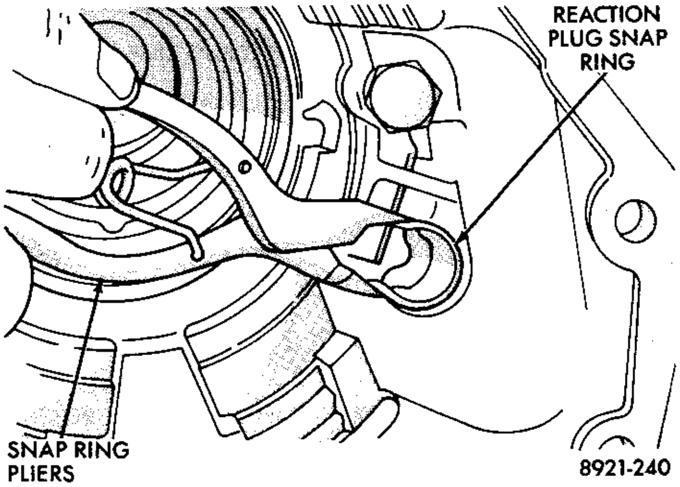

Fig. 16 Removing Reaction Plug And Snap Ring

(15) Remove the reaction plug snap ring and the reaction plug. Compress snap ring just enough to allow removal (Fig. 16).

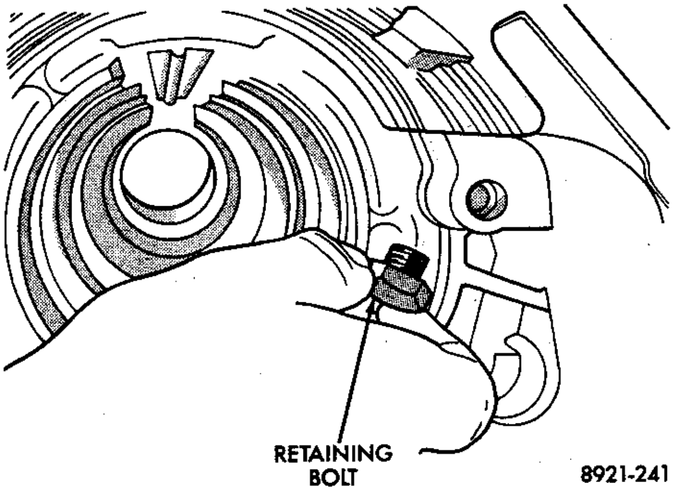

Fig. 17 Removing Parking Pawl Shaft Retainer Bolt

(16) Remove the bolt securing the park pawl shaft in the case (Fig. 17).

(17) Tap the case lightly on a wood block to dislodge the pawl shaft, pawl and spring (Fig. 18).

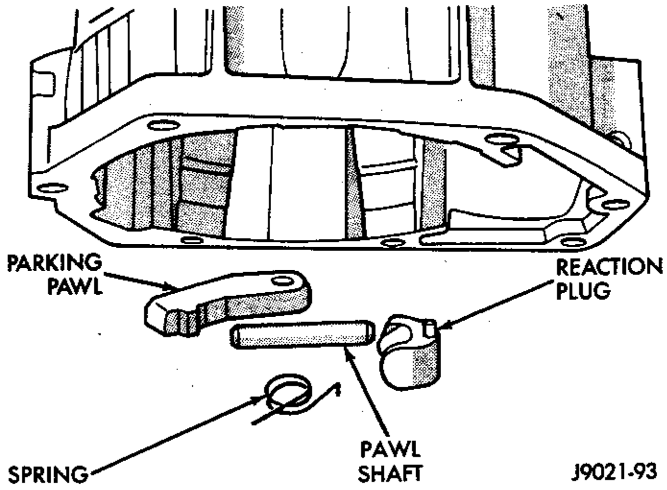

Fig. 18 Parking Pawl Components

(18) Remove the seal and damper weight from the overdrive case (Fig. 19).

(19) Remove the park lock rod from the valve body if the rod or ball end are worn or damaged (Fig. 19).

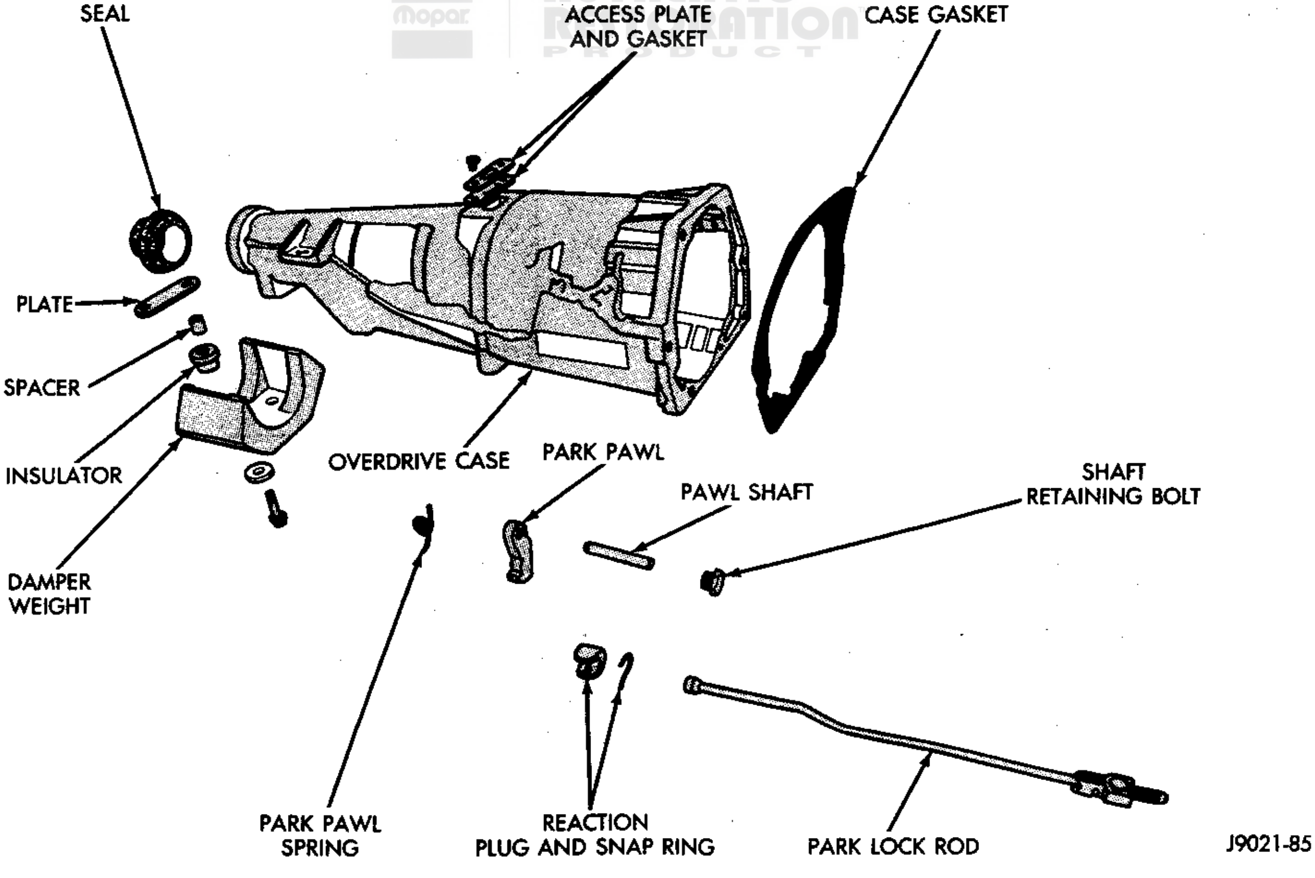

Fig. 19 Overdrive Case Components

OVERDRIVE GEARTRAIN DISASSEMBLY

WARNING: THE FIRST STEP IN GEARTRAIN DISASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH SPRING. BECAUSE THE SPRING EXERTS OVER 800 POUNDS FORCE ON THE SLIDING HUB, IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED FOR THIS PURPOSE. SPRING COMPRESSOR TOOL C-6227-1 AND A SHOP PRESS WITH A MINIMUM PRESS RAM TRAVEL OF THREE INCHES ARE REQUIRED TO COMPRESS THE SPRING SAFELY. SPRING TENSION MUST ALSO BE RELEASED SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY. DO NOT ATTEMPT TO COMPRESS THE SPRING WITH ANYTHING OTHER THAN THE COMPRESSOR TOOL AND SHOP PRESS.

(1) Mount the geartrain assembly in a shop press with the output shaft facing downward. Position the output shaft in a fixture that will support the output shaft flange.

(2) With the geartrain assembly properly supported in the press, install spring compressor tool C-6227-1 in the sliding hub (Fig. 20).

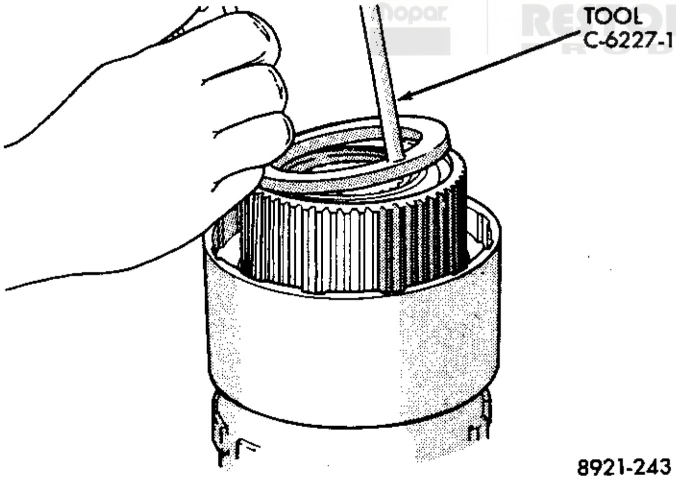

Fig. 20 Installing Clutch Spring Compressor Tool

(3) Align the press ram with the compressor tool and have a helper operate the press to compress the direct clutch spring.

(4) When the spring and hub are compressed, remove the large load retaining ring (Fig. 21) and the small load retaining safety ring (Fig. 22).

(5) Release the press load on the clutch spring **slowly**. Then remove the compressor tool and geartrain from the press.

(6) Remove the sliding hub and direct clutch pack as an assembly (Fig. 23).

(7) Remove direct clutch spring, sun gear and clutch spring thrust plate, needle thrust bearing, and planetary gear assembly (Fig. 24).

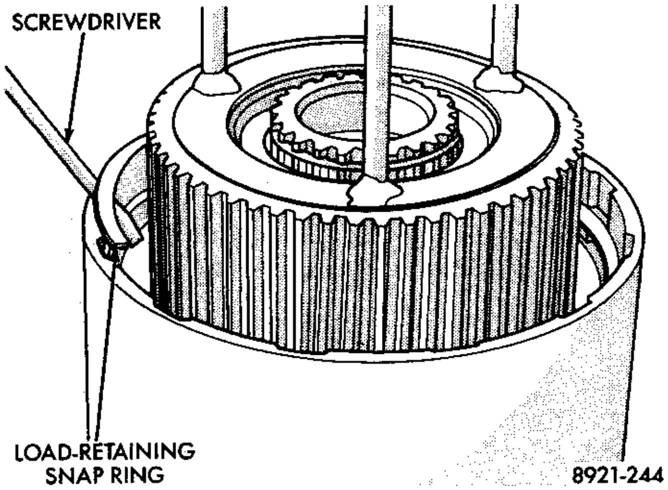

Fig. 21 Removing Load Retaining Snap Ring

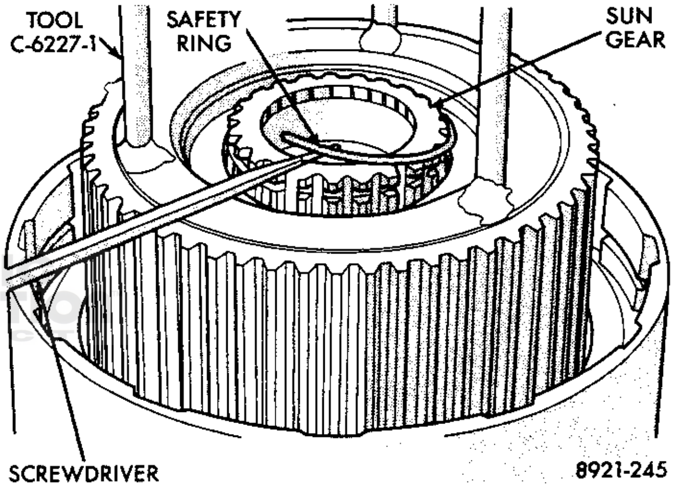

Fig. 22 Removing Safety Ring From Sun Gear

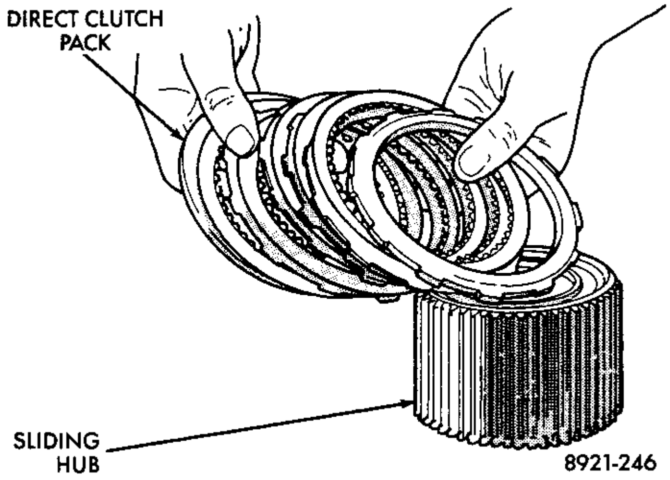

Fig. 23 Removing Sliding Hub And Direct Clutch Pack

(8) Turn the output shaft over.

(9) Remove the overrunning clutch as an assembly with expanding snap ring pliers (Fig. 25). Reach into the inner splines of the clutch and engage the pliers.

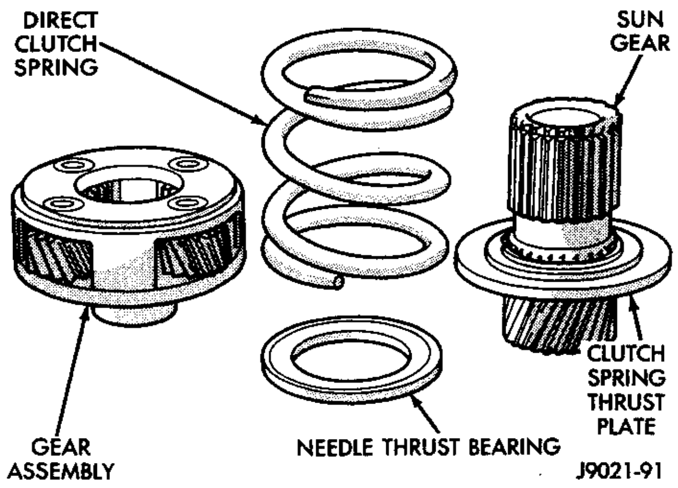

Fig. 24 Planet Carrier, Sun Gear And Clutch Spring

Then remove the overrunning clutch assembly with a quick counterclockwise twisting motion.

(10) Remove the needle thrust bearing from the clutch hub (Fig. 25).

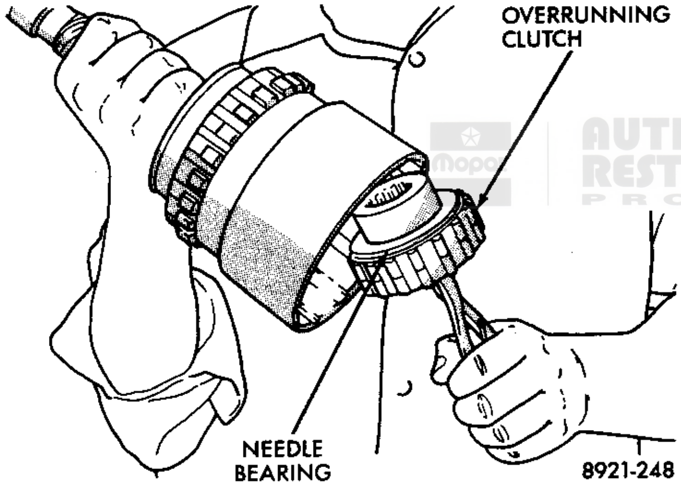

Fig. 25 Removing/Installing Overrunning Clutch

(11) Mark the direct clutch drum and annulus for reassembly (Fig. 26).

(12) Two wire retaining rings secure the direct clutch drum to the annulus. Remove the rear inner ring first (Fig. 27). Then remove the front outer retaining ring at the rear of the drum (Fig. 28).

(13) Slide the clutch drum off the annulus.

(14) Mark annulus gear and output shaft for alignment at assembly (Fig. 29).

(15) Remove the annulus gear snap ring. Then lightly tap the gear with a plastic mallet to remove if from the shaft (Fig. 30).

(16) Remove the output shaft front bearing.

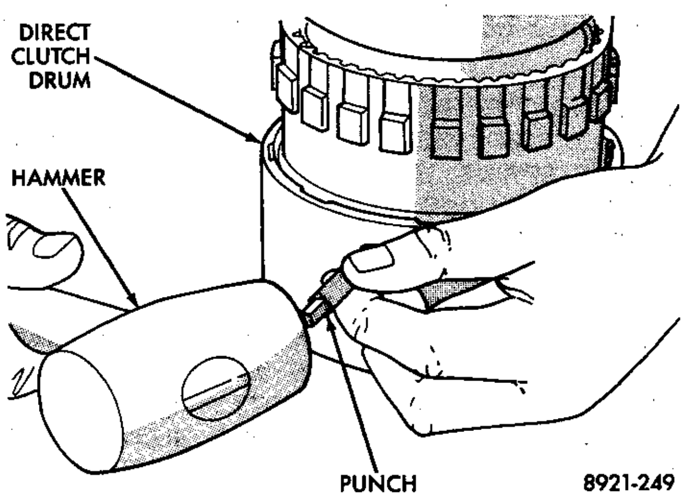

Fig. 26 Marking Direct Clutch Drum And Annulus For Assembly Alignment

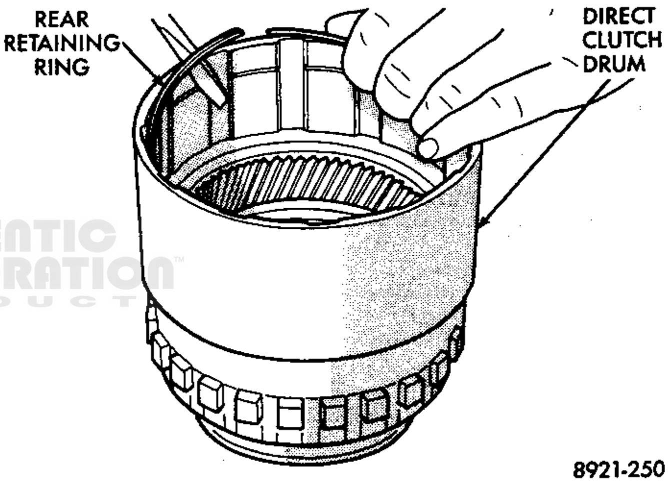

Fig. 27 Removing Clutch Drum Rear Retaining Ring

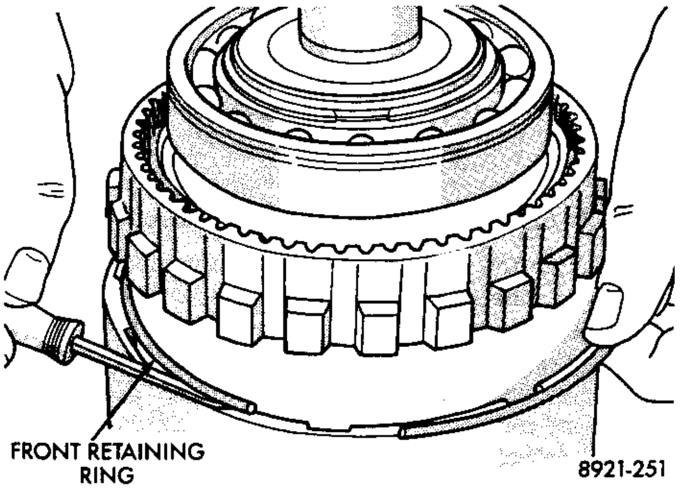

Fig. 28 Removing/Installing Clutch Drum Front Retaining Ring

CLEANING AND INSPECTION

Clean the geartrain and case components with solvent. Then 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 a lint-free type. Lint from shop towels can plug the transmission filters and oil passages.

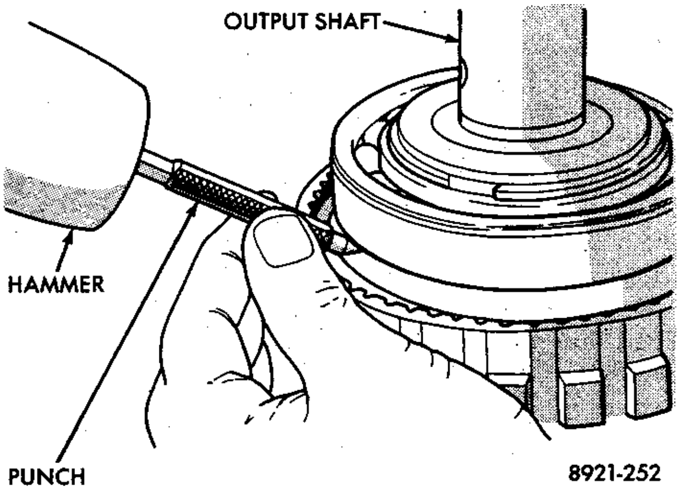

Fig. 29 Marking Annulus And Output Shaft For Assembly Reference

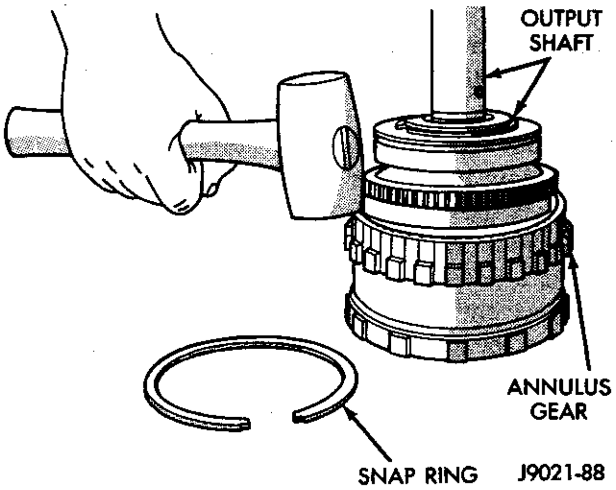

Fig. 30 Removing Annulus Gear

Discard old gaskets and seals. Do not attempt to salvage these parts. Replace any of the overdrive unit snap rings if distorted or damaged. If in doubt about the condition of a particular snap ring, replace it. Refer to Figure 31 for snap ring identification.

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.

Examine the overdrive and direct clutch discs and plates (Fig. 31). 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.

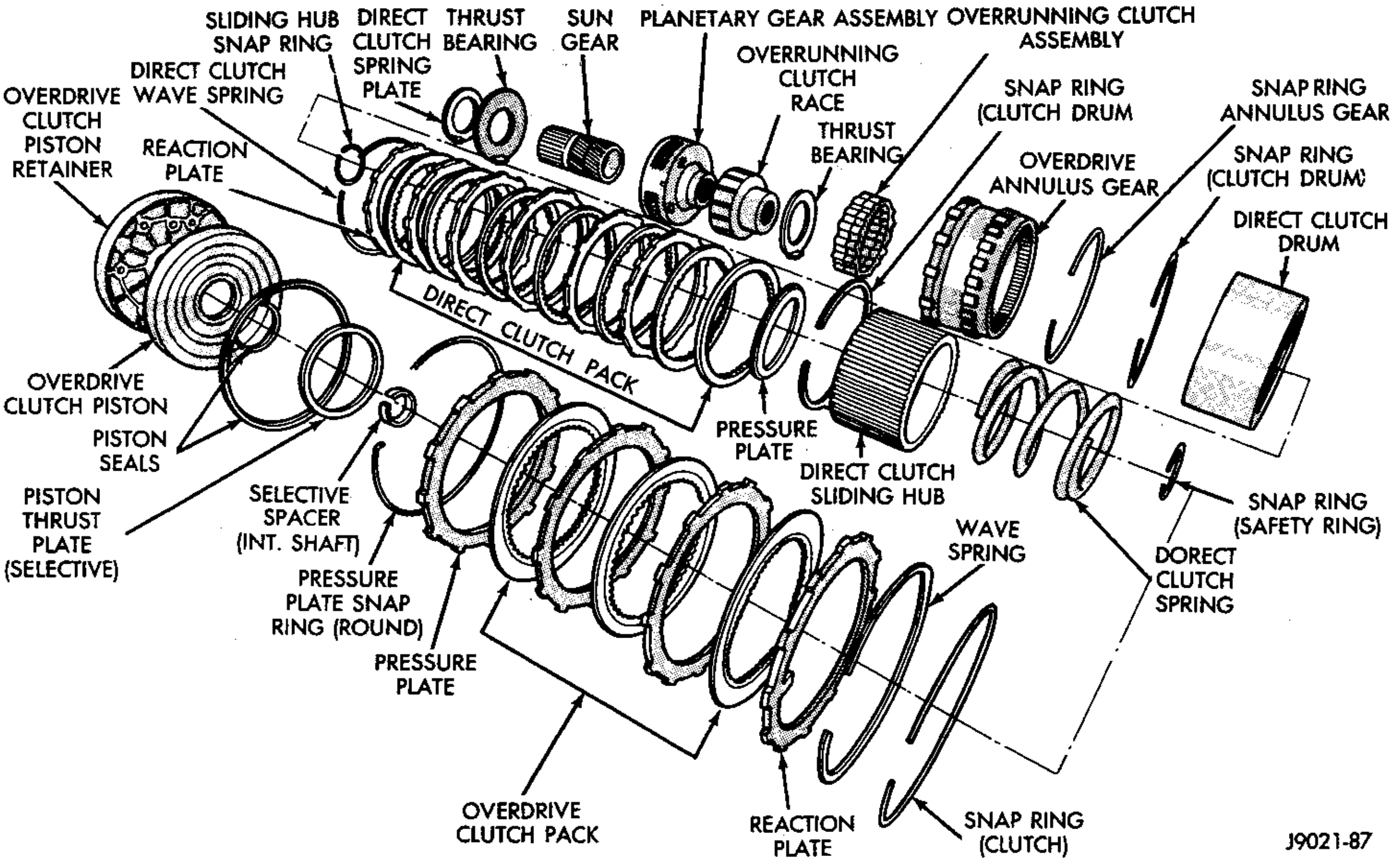

Fig. 31 Overdrive Geartrain Components

Check condition of the annulus gear, sliding hub, clutch drum and clutch spring (Fig. 31). 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 and on these components.

Inspect the thrust bearings and plate (Fig. 31). Replace the plate if worn or scored. replace the bearings if rough, noisy, brinneled, or worn.

Inspect the planetery gear assembly and the sun gear and bushings (Fig. 31). 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.

Inspect the overrunning clutch and race (Fig. 31). 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.

Inspect the output shaft and governor components (Fig. 32). 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 be 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.

Check condition of the governor components. Replace the governor drive seal rings if damaged. Also be sure the seal ring grooves are in good condition. Check operation of the governor valve, weights and shaft. The valves and weights should slide freely in the governor body (Fig. 32).

Inspect the governor oil pressure tubes (Fig. 32). The tubes must not be pinched, kinked, collapsed, or distorted. Blow them out with compressed air to be sure they are clear. The tubes are designed to be a slip fit. Do not modify the tube ends in an effort to make them fit tighter.

Check condition of the governor valve and weight snap rings. Replace any snap ring that appears bent or distorted. Replace any snap ring if its condition is doubtful.

OVERDRIVE GEARTRAIN ASSEMBLY AND ADJUSTMENT

(1) During assembly operations, lubricate the overdrive components with Mopar ATF Plus, Type 7176 transmission fluid. The clutch discs can be immersed

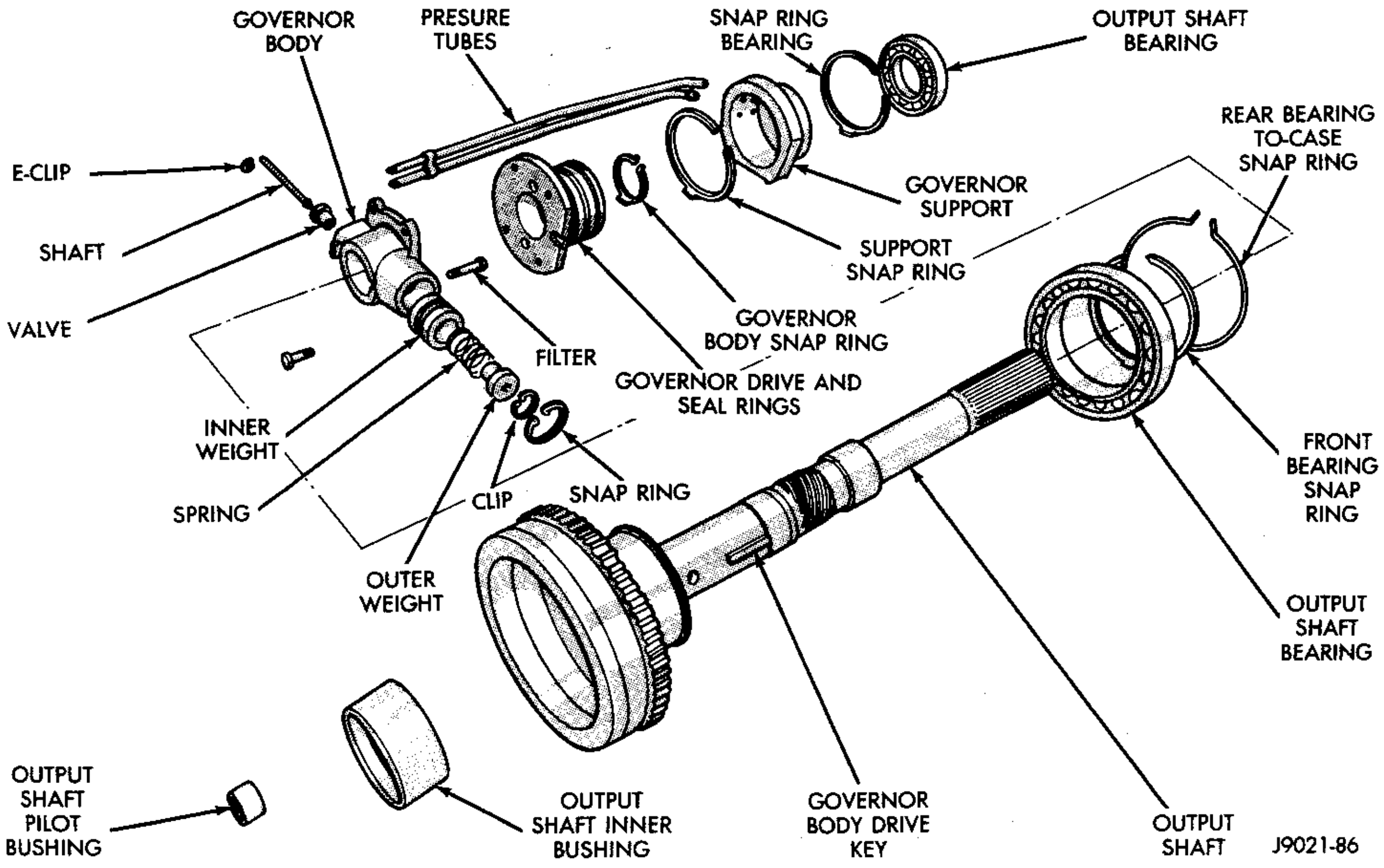

Fig. 32 Output Shaft And Governor Components

in fluid for a time before installation if desired. Use Door Ease or petroleum jelly to lubricate seals and ease seal installation.

(2) Install the front bearing and bearing snap ring on the output shaft.

(3) Align and install the output shaft in the annulus gear. Install the large snap ring to secure the gear to the shaft (Fig. 33).

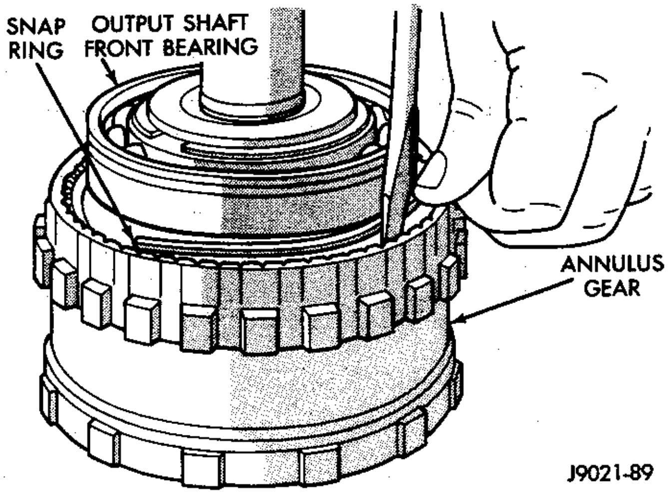

Fig. 33 Installing Annulus Gear And Snap Ring

(4) Align and install the clutch drum on the annulus gear (Fig. 34). Be sure the drum is engaged with the lugs on the annulus gear.

(5) Slide the clutch drum forward to expose the snap ring groove and install the front retaining ring (Fig. 28).

(6) Install the clutch drum rear retaining ring (Fig. 34).

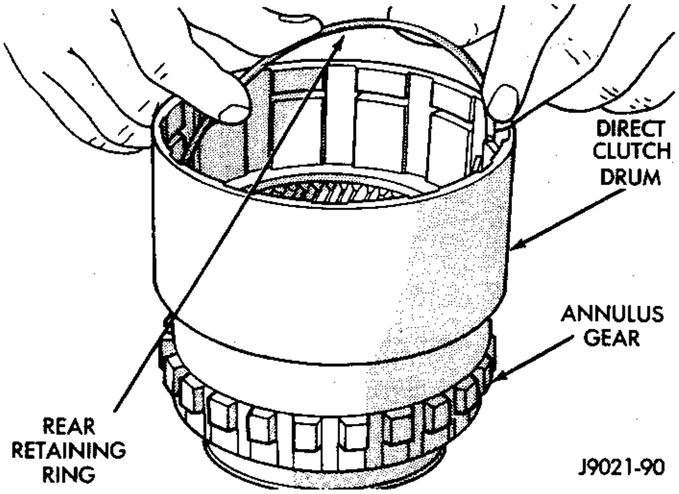

Fig. 34 Installing Clutch Drum And Rear Snap Ring

(7) Install the overrunning clutch on the race.

(8) Install the needle thrust bearing on the overrunning clutch race (Fig. 25).

(9) Install the overrunning clutch assembly. Hold the assembly with expanding type snap ring pliers. Then install the assembly into the annulus gear and clutch drum with a counterclockwise twisting motion (Fig. 25).

(10) Carefully install planetary gear assembly in annulus gear (Fig. 35).

(11) Align planetary gear in annulus with alignment tool C-6227-2 (Fig. 36).

(12) Install needle thrust bearing in planetary gear assembly.

(13) Remove the alignment tool.

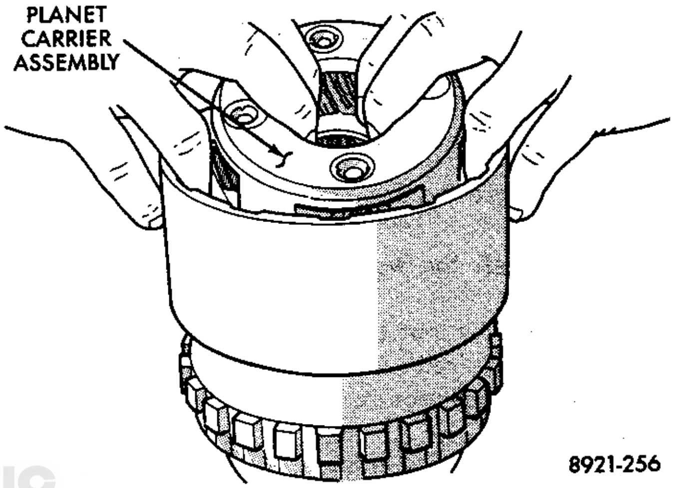

Fig. 35 Installing Planetary Gear Assembly

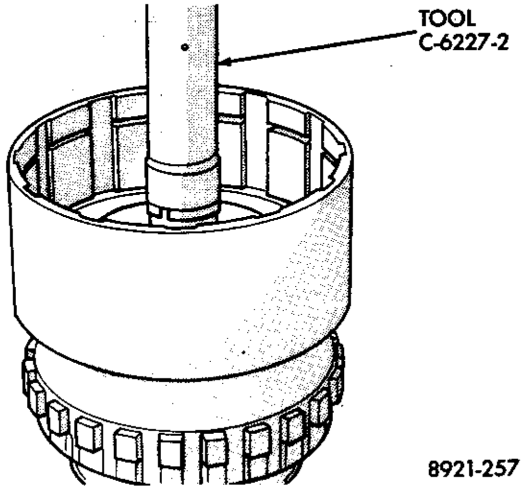

Fig. 36 Aligning Planetary Gear Assembly

(14) Install the assembled sun gear and clutch spring thrust plate (Fig. 37). Be sure the sun gear is fully seated.

(15) Install and position the direct clutch spring on the clutch spring thrust plate (Fig. 37).

(16) Install the sliding hub over and onto the direct clutch spring.

(17) Reinstall the alignment tool through the sun gear and into the planetary gears.

(18) Install the direct clutch pack on the sliding hub as follows (Fig. 38).

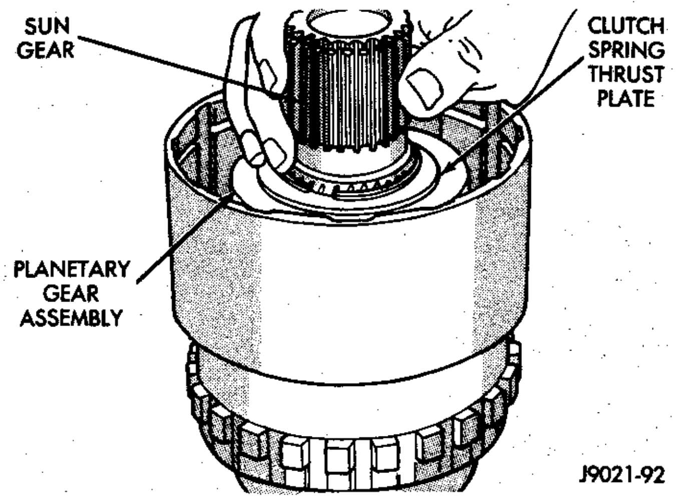

Fig. 37 Installing Sun Gear And Clutch Spring Thrust Plate

(a) Install the wave spring and reaction plate (Fig. 31).

(b) Install a clutch disc followed by a steel plate until the required number of discs and plates are installed. A-500 requires six discs. A-518 requires 8 discs.

(c) Install the pressure plate last (Fig. 31).

(19) Remove the alignment tool.

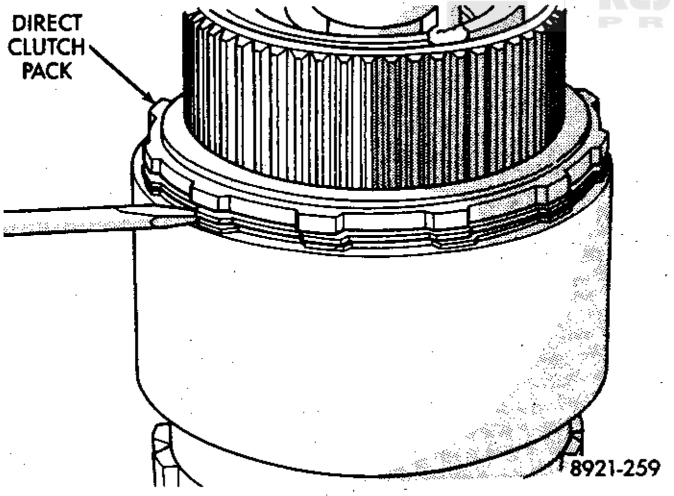

Fig. 38 Direct Clutch Pack Installation

WARNING: THE DIRECT CLUTCH SPRING EXERTS OVER 800 POUNDS FORCE ON THE SLIDING HUB. FOR SAFETY REASONS, IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING. USE SPRING COMPRESSOR TOOL C-6227-1 AND A SHOP PRESS WITH A MINIMUM PRESS RAM TRAVEL OF THREE INCHES FOR THIS PURPOSE. TO AVOID PERSONAL INJURY, DO NOT ATTEMPT TO COMPRESS THE SPRING WITH ANYTHING OTHER THAN THE COMPRESSOR TOOL AND SHOP PRESS.

(20) Mount the geartrain assembly in a shop press. Use a fixture that will support the assembly on the output shaft and annulus gear.

(21) Install compressor tool C-6227-1 and compress the clutch spring (Fig. 39).

(22) Install the load retaining snap ring (Fig. 39).

(23) Install the safety snap ring (Fig. 40).

(24) Release the press ram slowly and remove the compressor tool.

(25) Remove the geartrain from the shop press.

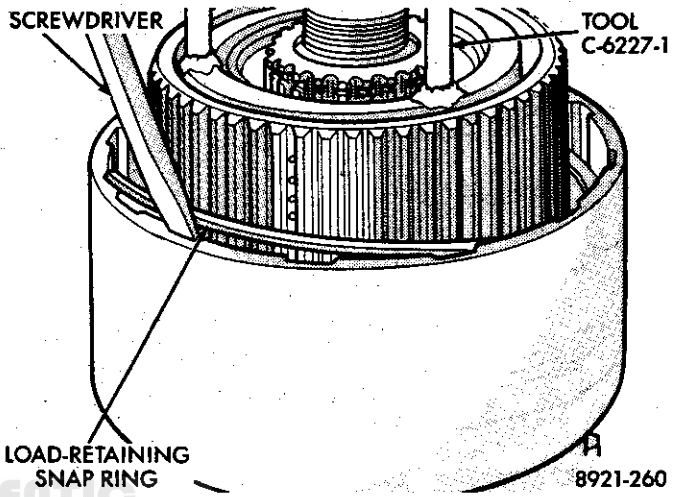

Fig. 39 Compressing Clutch Spring And Installing Load Retaining Snap Ring

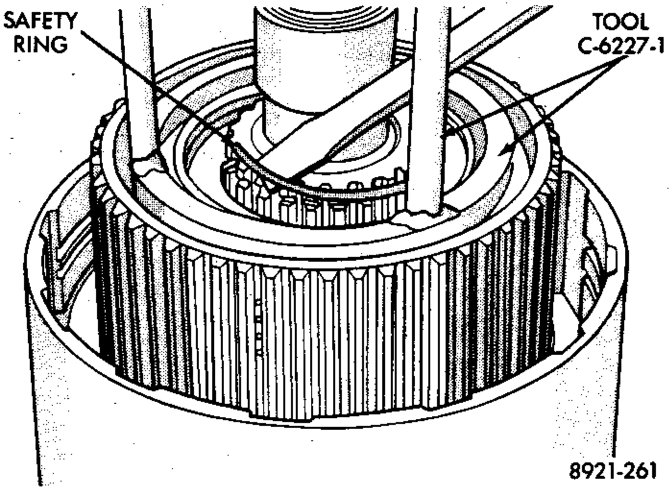

Fig. 40 Installing Safety Ring

(26) Install the large bearing on the output shaft (Fig. 32).

(27) Install the governor drive key in the output shaft (Fig. 32).

(28) Assemble the governor drive and body on the output shaft (Fig. 32). Be sure the filter is properly seated and positioned in the governor body before assembly.

(29) Install the assembled governor drive and body on the output shaft. Be sure the drive is engaged in the shaft key.

(30) Install the governor valves and weights in the governor body (Fig. 32)

(31) Reinstall alignment tool C-6227-2 and set the geartrain aside for final assembly.

OVERDRIVE UNIT ASSEMBLY AND ADJUSTMENT

(1) Install the parking pawl and spring in the case (Fig. 41).

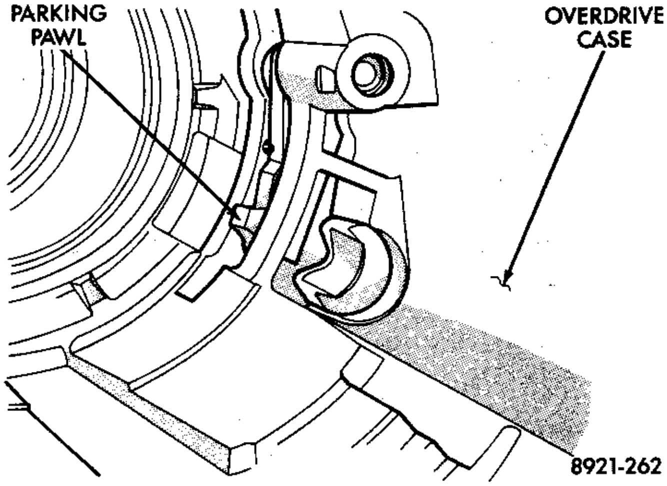

Fig. 41 Installing Parking Pawl And Spring

(2) Install the pawl shaft and shaft retaining bolt (Fig. 19). Tighten the bolt to 27 N•m (20 ft-lbs) torque.

(3) Install the reaction plug and snap ring (Fig. 42). Compress the snap ring only enough to install it.

(4) Install the output shaft rear bearing in the case. Make sure the snap ring groove in the bearing outer race is facing the front of the case (Fig. 43).

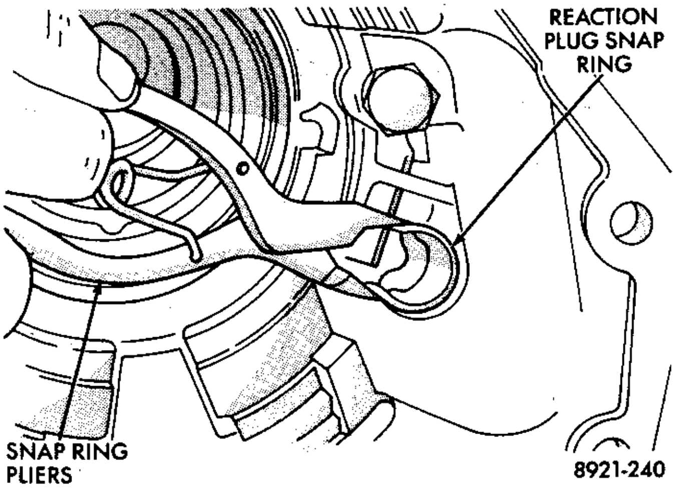

Fig. 42 Installing Reaction Plug And Snap Ring

(5) Install the governor support and the governor pressure tubes in the case (Fig. 44). The tubes are designed to be a slip fit.

(6) Install the governor support snap ring (Fig. 45).

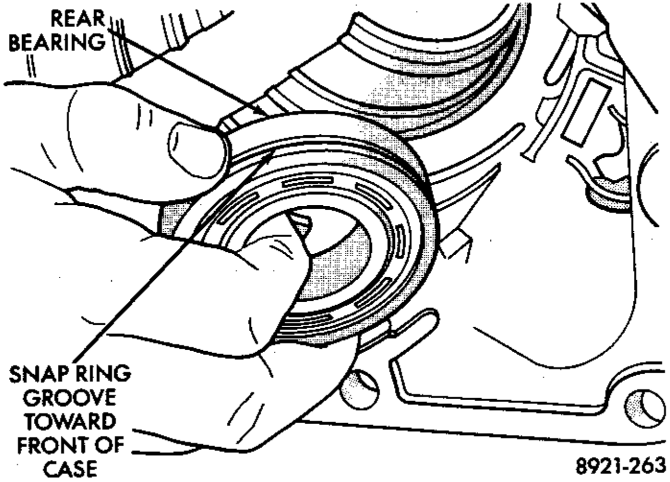

Fig. 43 Installing Output Shaft Rear Bearing

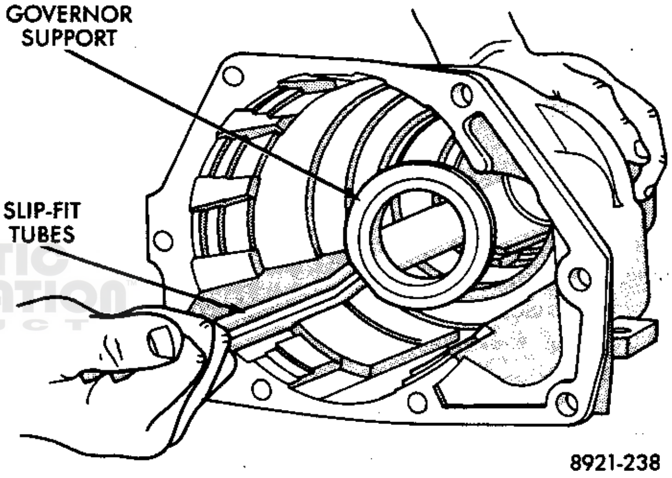

Fig. 44 Installing Governor Support And Oil Pressure Tubes

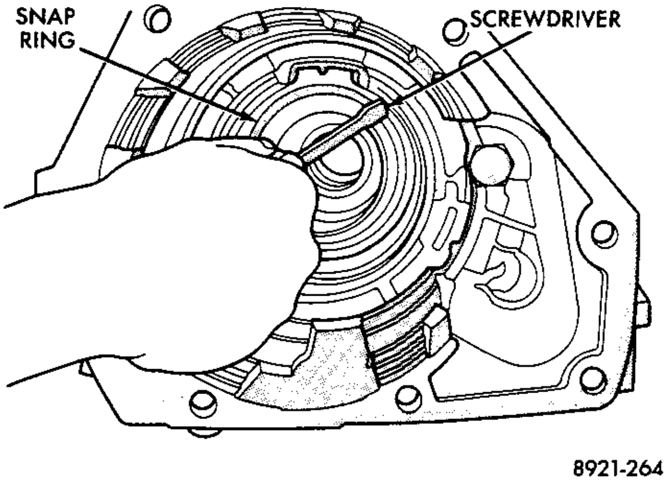

Fig. 45 Installing Governor Support Snap Ring

(7) Install the output shaft front bearing snap ring in the case.

(8) Make sure the alignment tool is installed in the gear train. Then invert the gear train and slip the case over output shaft.

(9) Expand the bearing snap ring and slide the case downward until the snap ring locks in the bearing groove. Release the snap ring.

(10) Install the gasket and access plate at the underside of the case.

(11) Install the overdrive clutch components as follows:

(a) Install the flat ring (Fig. 46) followed by the wave ring (Fig. 7). The rings fit in the same ring groove. Use a large screwdriver to seat each ring.

(b) Install the reaction plate (Fig. 31).

(c) Install a clutch disc followed by a clutch plate until the required number of discs and plates have been installed. A-500 requires three discs. A-518 requires 4 discs for standard engine applications and five discs for diesel engine applications.

(d) Install the pressure plate (Fig. 47). The pressure plate is the thickest plate in the clutch pack.

(12) Mount the overdrive unit in a vise in a vertical position.

(13) Determine the proper intermediate shaft spacer thickness as follows:

(a) Insert tool C-6312 through the sun gear. Be sure the tool bottoms against the carrier spline shoulder.

(b) Position tool C-6311 across the face of the overdrive case (Fig. 48).

(c) Position dial caliper C-4962 over tool C-6311 and measure distance to the top of tool C-6312 (Fig. 48).

(d) Select the proper thickness end play spacer from the chart (Fig. 49) based on distance measured.

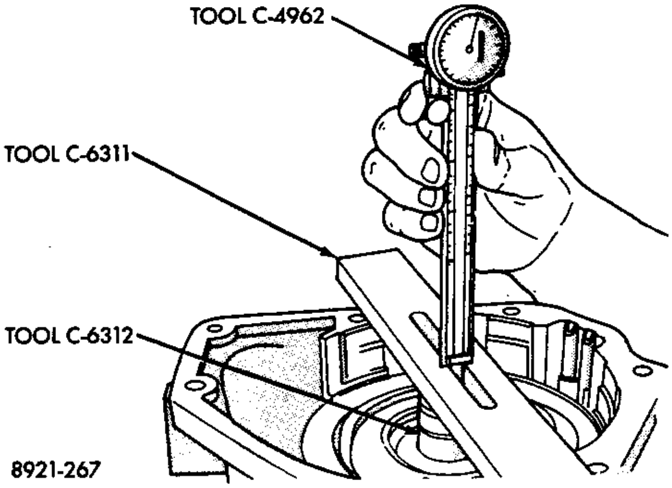

Fig. 48 Intermediate Shaft Spacer Measurement

(14) Determine the proper thickness thrust plate for the overdrive piston as follows:

Measurements (Inches)	Spacer Part Number	Spacer Thickness (Inches)
.7336-.7505	4431916	.159-.158
.7506-.7675	4431917	.176-.175
.7676-.7855	4431918	.194-.193
.7856-.8011	4431919	.212-.211

J9021-94

Fig. 49 Intermediate Shaft Selective Spacer Chart

(a) Position Tool C-6311 across the face of the overdrive case (Fig. 50).

(b) Position dial caliper C-4962 over tool C-6311 (Fig. 50).

(c) Measure distance to the sliding hub bearing seat at four points 90 degrees apart. Average the measurements by adding them and dividing by four.

(d) Select the required thrust plate from the chart (Fig. 51).

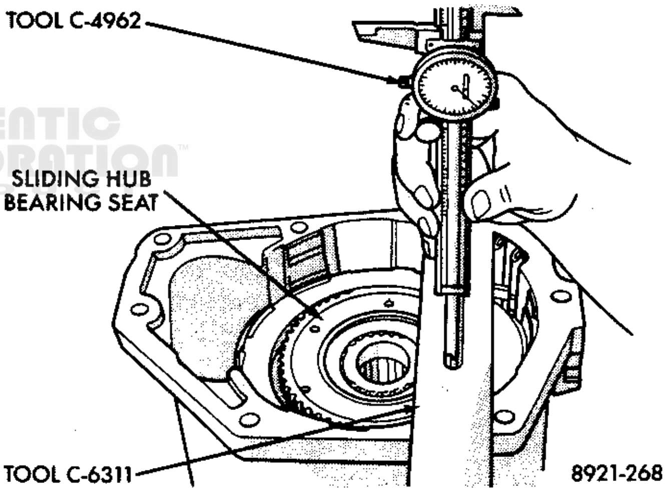

Fig. 50 Overdrive Piston Thrust Plate Measurement

OVERDRIVE UNIT INSTALLATION

(1) Before installing the overdrive unit, it will be necessary to trim the new case gasket to size. Using a sharp knife, cut out the old gasket around the piston (Fig. 52). Then remove and place the old gasket on the new gasket for a template and trim the new gasket to fit.

(2) Place the new gasket on the overdrive case.

(3) Install the selective spacer on the intermediate shaft. The spacer goes in the groove just rearward of the shaft rear splines (Fig. 53).

(4) Install the overdrive piston thrust plate on the piston hub. Use petroleum jelly to hold the plate in position.

(5) Install the thrust bearing in the sliding hub. Use petroleum jelly to hold the bearing in position.

Measurement (Inches)	Spacer Part Number	Spacer Thickness (Inches)
1.7500-1.7649	4431730	.108-.110
1.7650-1.7799	4431585	.123-.125
1.7800-1.7949	4431731	.138-.140
1.7950-1.8099	4431586	.153-.155
1.8100-1.8249	4431732	.168-.170
1.8250-1.8399	4431587	.183-.185
1.8400-1.8549	4431733	.198-.200
1.8550-1.8699	4431588	.213-.215
1.8700-1.8849	4431734	.228-.230
1.8850-1.8999	4431590	.243-.245

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Fig. 51 Overdrive Piston Selective Thrust Plate Chart

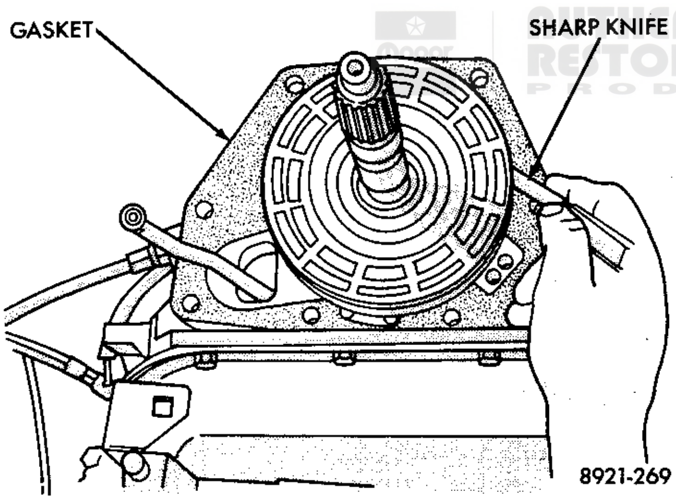

Fig. 52 Trimming Overdrive Case Gasket

CAUTION: Be sure the shoulder on the inside diameter of the bearing is facing forward.

(6) Carefully raise the overdrive unit and slide it straight onto the transmission intermediate shaft. Insert the ball on the parking rod into the reaction plug at the same time.

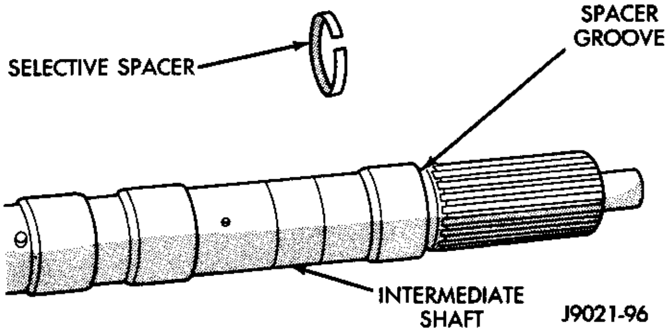

Fig. 53 Intermediate Shaft Selective Spacer Location

CAUTION: Do not tilt the unit during installation. Tilting the unit could cause the planetary gear and and overrunning clutch splines to rotate out of alignment. If this happens, it will be necessary to remove the overdrive unit and realign the components with tool C-6227-2.

(7) Align the slip-fit governor tubes and push the overdrive unit forward until it touches the transmission case.

(8) Install the overdrive unit attaching bolts. Tighten the bolts in a crisscross pattern to 34 N•m (25 ft-lbs).

(9) Install the crossmember.

(10) On four wheel drive models, install the transfer case.

(11) Install the distance sensor and speedometer adapter. Be sure to index the adapter .

(12) Connect the distance sensor and overdrive wires.

(13) Align and install the propeller shaft, or shafts on four wheel drive models.

(14) If the valve body was also removed, adjust the bands, install the valve body and install the transmission oil pan.

(15) Lower the vehicle and refill the transmission with Mopar ATF Plus, Type 7176 transmission fluid.

NP205 TRANSFER CASE

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GENERAL INFORMATION

The NP205 transfer case is a gear drive unit with a one-piece, cast iron gear case. The NP 205 provides four operating ranges which are: four-wheel drive high, neutral, two-wheel drive high and four-wheel drive low (Fig. 1). The NP205 is used in W-250/350 models.

The transfer case geartrain consists of constant mesh, helical gears. The gears rotate on shafts supported by ball and roller bearings. Sliding clutch sleeves and shift forks are used to engage or disengage the transfer case drive gears.

The NP205 geartrain provides high and low ranges in four-wheel mode. The high range has a 1:1 ratio for normal operation and a low range with a reduction ratio of 1.96:1 for off road or heavy operation. In two-wheel drive range, the transfer case front output shaft drive gear is disengaged. Torque is not transmitted to the front propeller shaft.

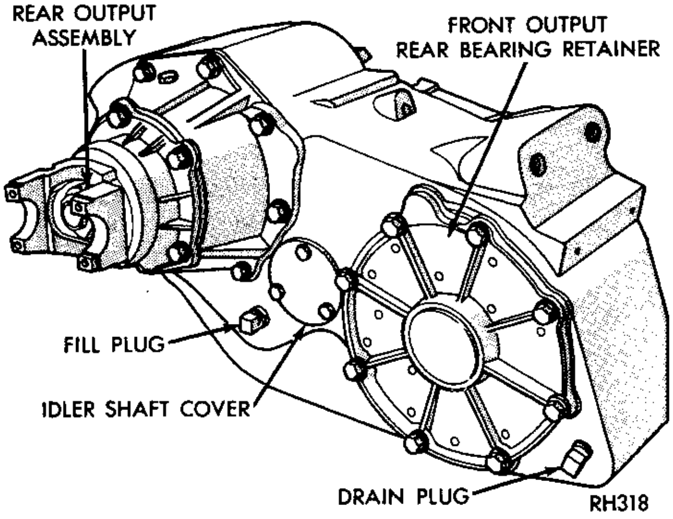


Fig. 1 NP205 Transfer case

TRANSFER CASE LUBRICANTS

Recommended lubricants for the NP205 transfer case include multi purpose gear oils and single weight engine oils.

Engine oil should be API classification SF/CC or SF/CD. Use SAE 30 at ambient temperatures below 0° C (+32° F) and SAE 50 at temperatures above this point.

SAE multipurpose gear oils of API, GL 5 quality can be used when heavy duty operation is anticipated. SAE 80, 90 and 140 are all acceptable. Use SAE 80 when ambient temperatures are below -23° C (-10° F) or SAE 90 when temperature is above the stated range. SAE 140 can be used when severe service is anticipated, or when ambient temperatures are expected to exceed +32° C (90° F)

The transfer case shift linkage pivot and contact surfaces should be lubricated with engine oil at recommended intervals. Lubrication frequency for the linkage is described in Group O, Lubrication And Maintenance.

TRANSFER CASE IDENTIFICATION

The NP205 identification tag is attached to the PTO cover on the driver side of the transfer case. The tag contains transfer case manufacturing and assembly part numbers. Refer to this information when ordering service replacement parts.

SERVICE DIAGNOSIS

The most frequent causes of transfer case malfunctions are improper operation, insufficient lubricant, non-recommended lubricant, misadjusted shift linkage, or improper assembly after repair.

The general problems and causes of transfer case malfunctions are outlined below.

LOW LUBRICANT LEVEL

A low lubricant level is usually the result of loose components, leakage, or improper checking and/or filling techniques.

Lubricant leaks can occur at the shaft seals, case vent, or gasket joints. Most leaks will be evident by the presence of lubricant around the leakage point. However, be sure the leakage is actually from a transfer case component. Leakage from other sources (engine, transmission, etc.) can be blown back onto the transfer case by air flow under the vehicle. A blocked transfer case vent can also cause leakage at the shaft seals due to internal pressure build up.

Overfilling the transfer case can force fluid out the vent and be mistaken for a leak. Correct fluid level checking methods should prevent overfill problems.

Checking Fluid Level

The correct method of checking transfer case fluid level requires that the vehicle be level. If fluid level is checked with the vehicle parked on the shop floor, be sure the floor area used is level. If a hoist is used, a drive-on, or swivel arm type is preferred.

Allow the transfer case fluid to settle for a minute or so before checking. Correct fluid level is to the bottom edge of the fill plug hole.

HARD SHIFTING

Hard shifting is generally caused by misadjusted linkage, loose linkage or driveline components, driveline torque loads caused by operation on hard paved surfaces in 4WD, improper shifting techniques, or a lack of lubricant which caused internal wear and damage.

Loose linkage or driveline components are a result of improperly tightened, stripped, or missing fasteners. Remember that loose crossmember and mounting parts can also generate a hard shift condition.

Torque loads in the transfer case can cause hard shifting or even prevent shifting. Such loads are generally a product of extensive operation on hard, paved surfaces in 4WD range, unequal size tires, or by mismatched front/rear axle gear ratios.

Linkage adjustment should be performed as described in the service section. Improper shift and operating techniques can be corrected by instructing the driver. Internal component damage will require overhaul to correct.

NOISE

Some transfer case operating noise is normal. The rotating gear train can produce sounds that may become audible at higher speeds and loads. However, unusual noise is an indicator that internal components may be worn or damaged.

Low lubricant levels are a frequent cause of noisy operation. Insufficient lubricant will lead to overheating, subsequent damage to bearing and gear surfaces and hard shifting.

Transfer case bearing noise is higher in pitch than gear noise. If the unit is noisy in 4WD range only, the front shaft bearings are probably at fault. If the unit is noisy in all ranges, an overhaul will be necessary to locate the faulty bearing.

Gear noise is lower in pitch and usually most noticeable when engaged and under load. Gear noise in 4WD drive range only is an indicator that the front shaft gears are damaged. Noise in all ranges could be the idler or drive gears. An overhaul will be necessary to determine which is at fault.

Frequently, suspected transfer case noise may actually originate from another driveline component. The proximity of other driveline components can sometimes make it difficult to pinpoint the noise source.

TRANSFER CASE OPERATIONAL CHECK

The transfer case should not be removed until diagnosis indicates the unit has actually malfunctioned. If a transfer case problem is suspected, check and verify operation before attempting repair. A transfer case operational check may reveal that a problem is actually related to another driveline component.

(1) Raise the vehicle on a hoist that will allow all four wheels to rotate.

(2) Check lubricant level. If lubricant level is low, check for leaks at the bearing and seal retainers, yokes, drain/fill plugs, PTO cover and vent.

(3) If the vehicle is equipped with locking hubs, engage the hubs.

(4) Start the engine, shift the transmission into gear and operate the transfer case in all ranges. Observe propeller shaft action, shift efforts and operational sound levels as follows:

(a) Only the rear propeller shaft should rotate in two-wheel drive. Both propeller shafts should both rotate in four-wheel drive high and low ranges.

(b) If the front propeller shaft did not rotate in either four-wheel drive range, the transfer case shift components may be worn or damaged. Or, if the front shaft did rotate but the front wheels did not, check the front axle shift mechanism and the locking hubs (if equipped).

(c) If both propeller shafts rotate in four-wheel drive but the wheels on one axle did not rotate, the problem is in the axle.

(d) If neither propeller shaft rotates in any range, the problem is in the transmission or transfer case. To determine which component is at fault, proceed to next step.

(5) Determine if fault is with transfer case or transmission as follows:

(a) Raise vehicle and disconnect both propeller shafts at the transfer case.

(b) Position supports under the transmission.

(c) Remove the bolts/nuts attaching the transfer case adapter to the crossmember and transmission.

(d) Support the transfer case with a transmission jack and slide the transfer case and adapter clear of the transmission output shaft.

(e) Have helper start engine and shift transmission into gear. If transmission output shaft rotates, problem is with transfer case. If transmission shaft does not rotate, problem is with transmission or related component.

SHIFT LINKAGE ADJUSTMENT

Two adjustment procedures are provided. The procedure described in Figure 2 is used when the linkage has been removed and reinstalled (or replaced) during service operations. The second procedure outlined below is used when the linkage is in place and has not been removed from the vehicle.

ADJUSTMENT WITH LINKAGE IN PLACE

(1) Shift transfer case into neutral.

(2) Move shift rod boot upward for access.

(3) Loosen shift bracket bolts.

(4) Move bracket forward as far as possible and tighten bolts.

(5) Shift the transfer case into all ranges to check operation.

SPEEDOMETER SERVICE

The speedometer driven gear, adapter and distance sensor can be serviced with the transfer case in the vehicle.

SPEEDOMETER COMPONENT REMOVAL/ INSTALLATION

(1) Shift the transfer case into Neutral.

(2) Raise the vehicle.

(3) Disconnect the wires at the distance sensor.

(4) Loosen and disconnect the coupling nuts attaching the sensor to the adapter and the adapter to the driven gear.

(5) Remove the sensor and adapter.

(6) Loosen and remove the driven gear.

(7) Lubricate the driven gear with engine or gear oil and install the gear in the transfer case. Tighten the gear to 11 N•m (100 in-lbs) torque.

(8) Install the adapter and distance sensor. Tighten the coupling nuts to 17 N•m (150 in-lbs) torque.

(9) Connect the wires to the distance sensor.

(10) Lower the vehicle.

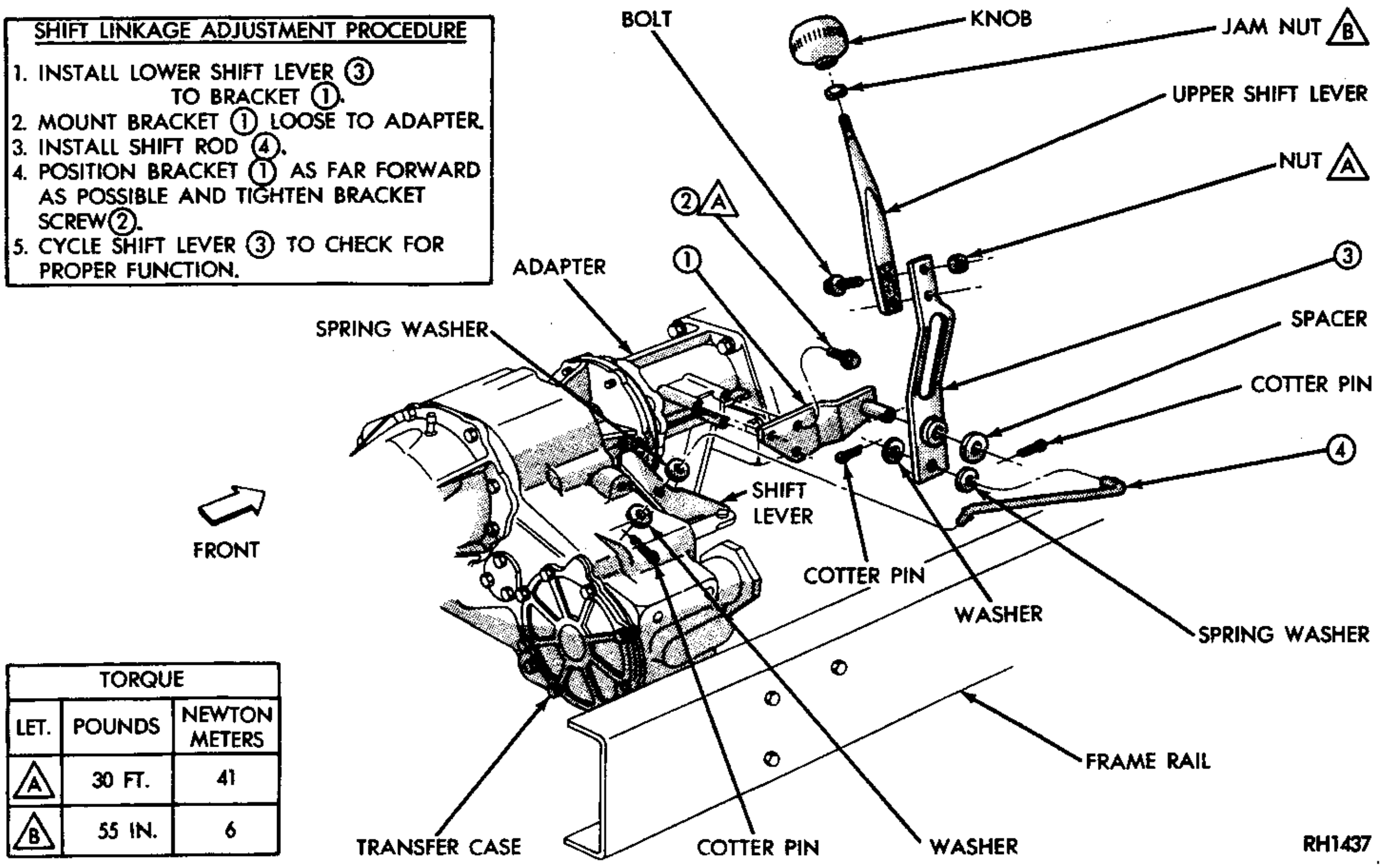
TRANSFER CASE REMOVAL

(1) Raise vehicle.

(2) Remove drain plug and drain transfer case lubricant.

(3) Disconnect distance sensor wires.

(4) Mark front/rear propeller shafts and yokes for installation reference.



SHIFT LINKAGE ADJUSTMENT PROCEDURE

1. INSTALL LOWER SHIFT LEVER ③ TO BRACKET ①.
2. MOUNT BRACKET ① LOOSE TO ADAPTER.
3. INSTALL SHIFT ROD ④.
4. POSITION BRACKET ① AS FAR FORWARD AS POSSIBLE AND TIGHTEN BRACKET SCREW②.
5. CYCLE SHIFT LEVER ③ TO CHECK FOR PROPER FUNCTION.

TORQUE		
LET.	POUNDS	NEWTON METERS
A	30 FT.	41
B	55 IN.	6

Fig. 2 NP205 Shift Linkage

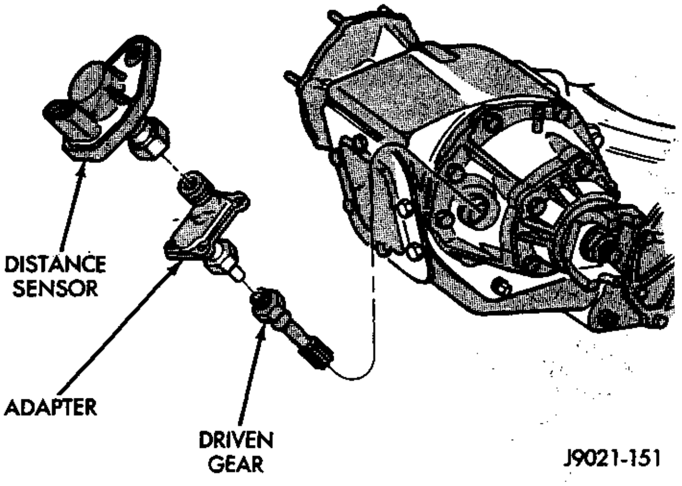


Fig. 3 NP205 Speedometer Components.

(5) Disconnect propeller shafts at transfer case. Move shafts aside for working clearance and secure them to frame rails with wire.

(6) Disconnect shift rod from shift lever on transfer case.

(7) Support transfer case with transmission jack.

(8) Remove bolts/nuts attaching transfer case to transmission adapter.

(9) Lower transfer case and move it from under vehicle.

① YOKE NUT
② WASHER
③ SEAL WASHER
④ REAR YOKE
⑤ OIL SEAL
⑥ REAR SEAL RETAINER
⑦ GASKET
⑧ SNAP RING
⑨ REAR OUTPUT SHAFT BEARING
⑩ SPEEDOMETER GEAR
⑪ BEARING RETAINER - REAR
⑫ VENT TUBE CONNECTOR
⑬ GASKET
⑭ REAR OUTPUT SHAFT SUPPORT BEARING
⑮ LOW GEAR RETAINING RING
⑯ THRUST WASHER (3/16" THICK)
⑰ THRUST WASHER (1/16" THICK)
⑱ LOW GEAR ROLLER BEARINGS (64)
⑲ BEARING SPACER
⑳ LOW GEAR - REAR SHAFT
㉑ THRUST WASHER (1/16" THICK)
㉒ REAR OUTPUT SHAFT
㉓ THRUST WASHER PIN
㉔ SLIDING CLUTCH
㉕ PILOT BEARING ROLLERS (15)
㉖ PILOT BEARING THRUST WASHER
㉗ LOCK RING
㉘ INPUT GEAR
㉙ IDLER SHAFT COVER
㉚ GASKET
㉛ IDLER SHAFT
㉜ IDLER GEAR BEARINGS
㉝ BEARING RACES
㉞ BEARING SPACER
㉟ IDLER GEAR
㊱ IDLER GEAR BEARING SHIMS
㊲ WASHER
㊳ IDLER SHAFT LOCK NUT
㊴ THRUST WASHER PIN
㊵ FRONT OUTPUT SHAFT
㊶ SLIDING CLUTCH
㊷ HIGH GEAR
㊸ THRUST WASHER
㊹ FRONT OUTPUT SHAFT FRONT BEARING
㊺ BEARING SNAP RING
㊻ FRONT OUTPUT SHAFT REAR BEARING
㊼ BEARING RETAINER - FRONT
㊽ GASKET
㊾ RETAINING RING
㊿ THRUST WASHER (3/16" THICK)
(51) LOW GEAR - FRONT SHAFT
(52) LOW GEAR ROLLER BEARINGS (64)
(53) BEARING SPACER
(54) FLANGE
(55) OIL SEAL
(56) FRONT SEAL RETAINER
(57) GASKET
(58) DRAIN PLUG
(59) CASE MAGNET AND CLIP
(60) FILL PLUG
(61) PTO COVER AND GASKET
(62) GEAR CASE
(63) SHIFT RAIL DETENT BALLS AND SPRINGS
(64) 4WD INDICATOR LIGHT SWITCH AND GASKET
(65) SHIFT FORK AND RAIL - REAR WHEEL
(66) INTERLOCK PINS (2)
(67) FORK-TO-RAIL LOCK PIN
(68) SHIFT RAIL OIL SEALS
(69) SHIFT RAIL LINK
(70) RETAINING CLIP (2)
(71) LINK-TO-RAIL RETAINING PIN (2)
(72) SHIFT FORK AND RAIL - FRONT WHEEL
(73) INTERLOCK HOLE PLUGS (4)
(74) FRONT OUTPUT SHAFT BEARING
(75) BEARING SNAP RING
(76) INPUT SHAFT SNAP RING
(77) ADAPTER OIL SEAL (2)
(78) GASKET
(79) TRANSFER CASE ADAPTER
(80) ADAPTER SLEEVE
(81) SLEEVE RETAINING RING
(82) GASKET
(83) TRANSMISSION ADAPTER

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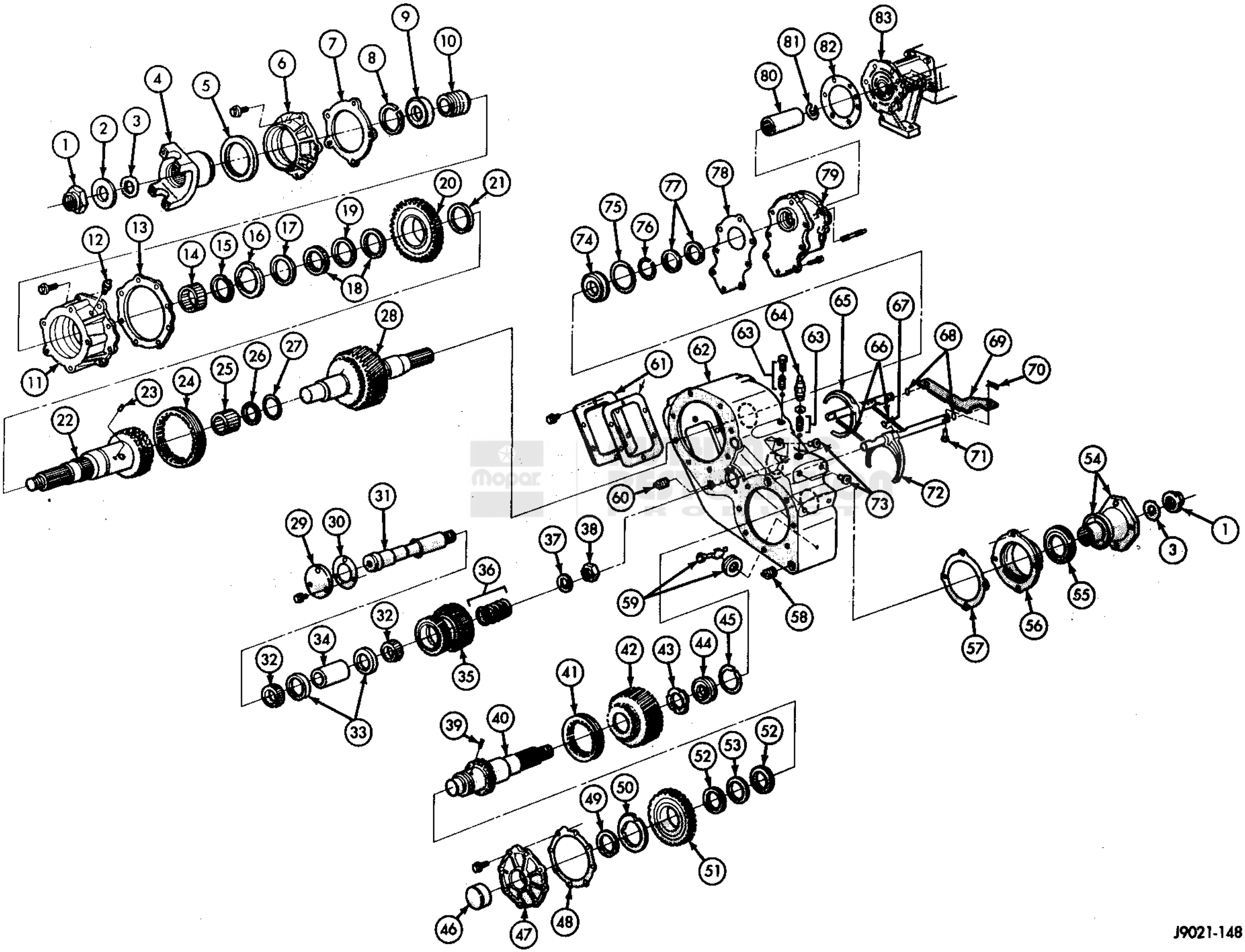

Fig. 4 NP205 Transfer Case Components

TRANSFER CASE DISASSEMBLY

REAR RETAINER AND OUTPUT SHAFT REMOVAL/DISASSEMBLY

(1) Loosen rear yoke nut until only 2-3 threads are holding nut on shaft.

(2) Remove bolts attaching rear bearing retainer to case.

(3) Pull yoke rearward to start rear outpt shaft out of clutch.

(4) Remove yoke nut, washer, seal washer and yoke.

(5) Remove rear retainer, rear output shaft and gears as assembly.

(6) Remove rear seal retainer from bearing retainer.

(7) Remove snap ring.

(8) Remove rear bearing retainer.

(9) Remove rear bearing, speedometer gear, shaft support bearings, thrust washer pin and low gear from rear output shaft (Fig. 4).

(10) Remove lock ring, thrust washer and pilot bearing rollers from rear output shaft (Fig. 4).

FRONT OUTPUT SHAFT RETAINER REMOVAL

(1) Remove front yoke nut, washer and flange (Fig. 4).

(2) Remove front seal retainer and gasket.

(3) Remove PTO cover and gasket.

(4) Remove detent plug and 4WD indicator light switch from case (Fig. 4).

(5) Remove shift rail detent springs and balls (Fig. 4). Use pencil magnet to remove these components.

(6) Remove bolts attaching front bearing retainer to case.

(7) Tap front output shaft with plastic mallet to loosen it. Then remove shaft, retainer and gears (Fig. 5).

(8) Remove shaft snap ring (Fig. 6).

(9) Remove thrust washer, gear, bearings and spacer.

SHIFT RAIL—IDLER GEAR—INPUT GEAR—FRONT SHAFT REMOVAL

(1) Remove adapter and gasket.

(2) Remove idler shaft nut and washer.

(3) Remove idler shaft cover plate and gasket.

(4) Remove cup plugs at top of case for access to shift fork lock pins. Use small punch to remove plugs.

(5) Place shift rails in Neutral position.

(6) Remove lock pins from shift forks with long handle easy-out tool (Fig. 7).

(7) Remove pins attaching shift rail link and remove link.

(8) Remove shift forks and sliding clutches.

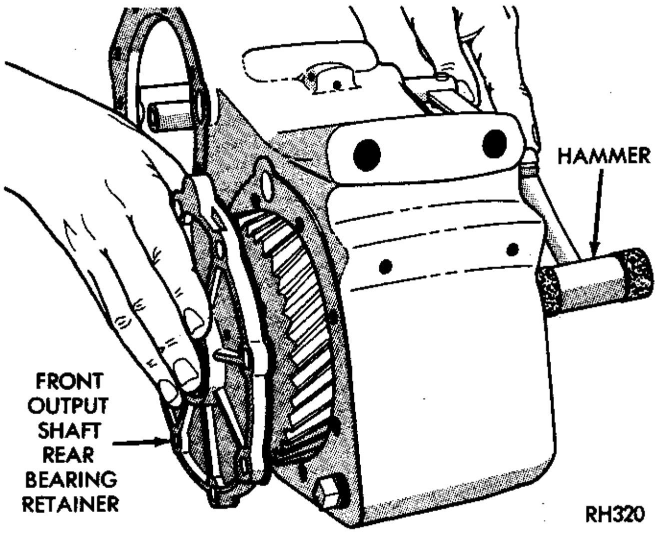

Fig. 5 Removing/Installing Front Output Shaft

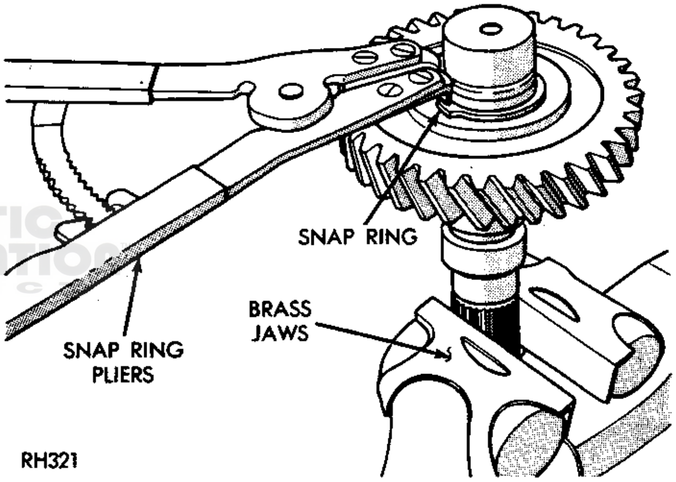

Fig. 6 Removing/Installing Front Shaft Snap Ring

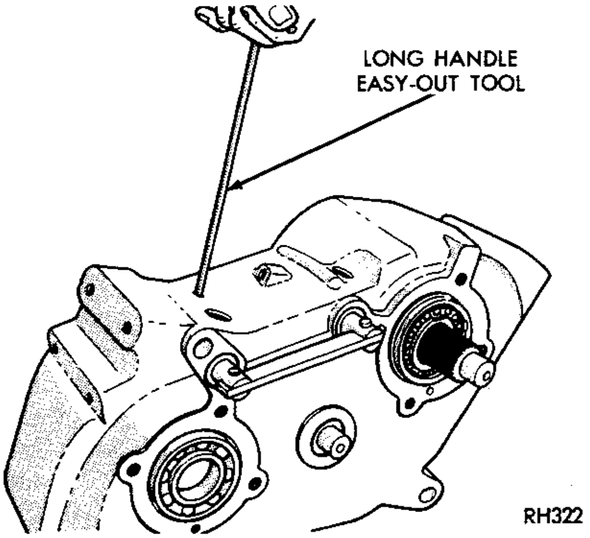

Fig. 7 Removing/Installing Shift Fork Lock Pins

(9) Remove snap ring, thrust washer and bearing from front shaft.

(10) Remove front shaft and high gear.

(11) Remove input gear, bearing, seals and washer.

(12) Loosen and remove idler shaft with plastic mallet (Fig. 8).

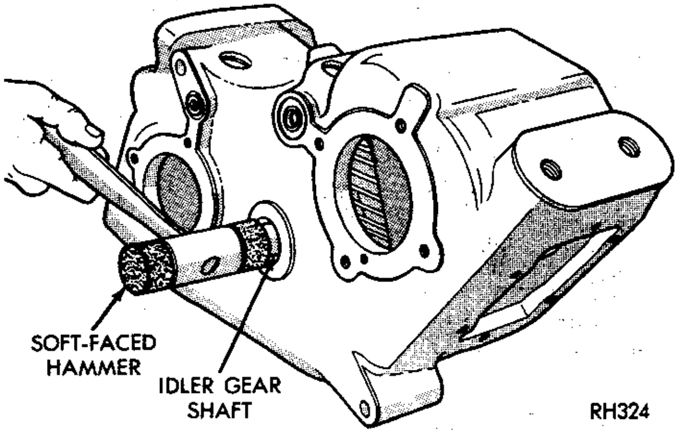

Fig. 8 Idler Shaft Removal

(13) Tilt case, roll idler gear toward front shaft opening in case and remove gear through this opening.

(14) Remove and retain idler shaft shims. Tie shims together to avoid losing them.

(15) Remove bearing cups and bearings from idler gear.

(16) Remove interlock pins from inside case. Remove pins through PTO cover opening.

(17) If front output shaft rear bearing must be replaced, replace the bearing and retainer as an assembly only.

TRANSFER CASE ASSEMBLY

Lubricate the transfer case gears and shafts with gear oil during assembly. Use petroleum jelly to prelubricate and hold bearings in place during installation. Use new gaskets and seals throughout. Do not reuse these components. Replace snap rings if distorted or damaged and use new yoke locknuts to secure the yoke and flange.

(1) Install bearing cups in idler gear with shop press (Fig. 9).

(2) Assemble idler gear, gear bearing cones, bearing spacer and shims on shaft tool DD1272 (Fig. 9). Then check end play (Fig. 9). End play should be .000 to .002 inch. Add or remove shims as needed to adjust end play.

(3) Press shift rail seals into case. Seals are wiper-type and should be installed with seal lip outward.

(4) Install idler gear assembly and shaft tool in case through front bore (large end first). Tilt case at 45 degree angle to ease bearing installation at boss (Fig. 10).

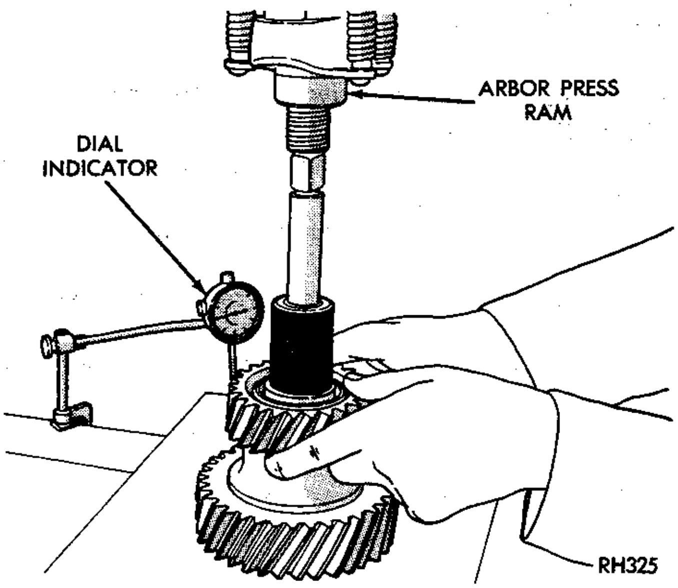

Fig. 9 Assembling/Adjusting Idler Gear And Bearings

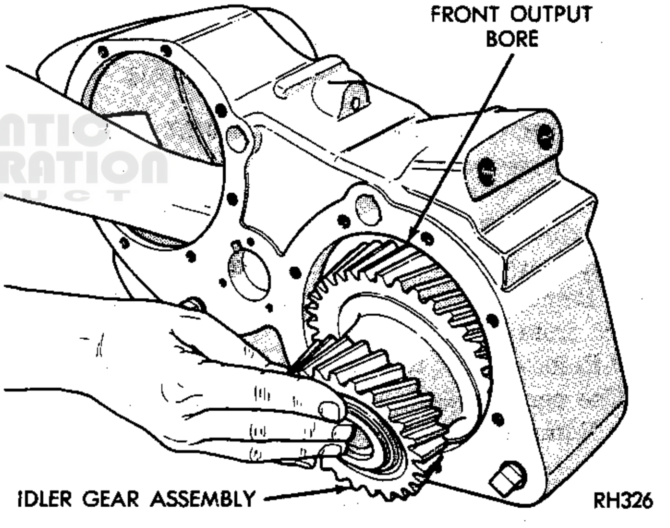

Fig. 10 Installing Idler Gear

(5) Install idler shaft. Insert shaft from large bore side and drive shaft into gear and bearings with heavy, soft face hammer. Remove shaft alignment tool as idler shaft pushes it out of gear and case.

(6) Install idler shaft washer and **new** locknut. Check end play and free rotation. Tighten locknut to 203 N•m (150 ft-lbs).

(7) Install front bearing and snap ring on input gear.

(8) Assemble front output shaft. Install gears, sliding clutch, bearings, thrust washer pin, thrust washers, snap ring and retainer on front output shaft.

(9) Install interlock pins through large case bore or PTO opening.

(10) Install input gear in case. Then install sliding clutch on input gear and position shift fork in clutch.

(11) Install rear wheel shift rail into case (from back), with slotted end first and detent notches facing up (Fig. 7). Then push rail through shift fork and into opposite end of case.

(12) Install front output shaft in case.

(13) Install front wheel shift fork in sliding clutch on front shaft. Then install front wheel shift rail into case and through shift fork.

(14) Secure shift forks to shift rails with new lock pins. Install pins through small bores at top of case.

(15) Install front output shaft bearing retainers. **Be sure oil drain slot in bearing retainer is aligned with drain hole in case before tightening bolts.** Use new gaskets and apply sealer to bolt threads before installation. Use extra gasket on retainers if necessary.

(16) Install flange on front shaft. Install seal washer on shaft and install flange locknut finger tight.

(17) Install washer, seals gasket and adapter on input shaft (Fig. 4).

(18) Install shift link and link retaining pins, clips.

(19) Assemble rear output shaft. Install gears, bearings and spacers (Fig. 4).

(20) Install new snap ring. Tap ring to seat it and check end play. End play should be .05 to .68 mm (.002 to .027 in).

(21) Install pilot bearing rollers in rear output shaft. Use as much petroleum jelly as needed to hold bearing rollers in place.

(22) Install pilot bearing thrust washer and new snap ring.

(23) Install retainer on rear output shaft install speedometer gear and spacer, install bearing (Fig. 11).

(24) Install retainer and shaft assembly. **Be sure oil drain slot in retainer is aligned with drain hole in case.** Use one or two retainer gaskets depending on clearance. Tighten retainer bolts to 54 N•m (40 ft-lbs).

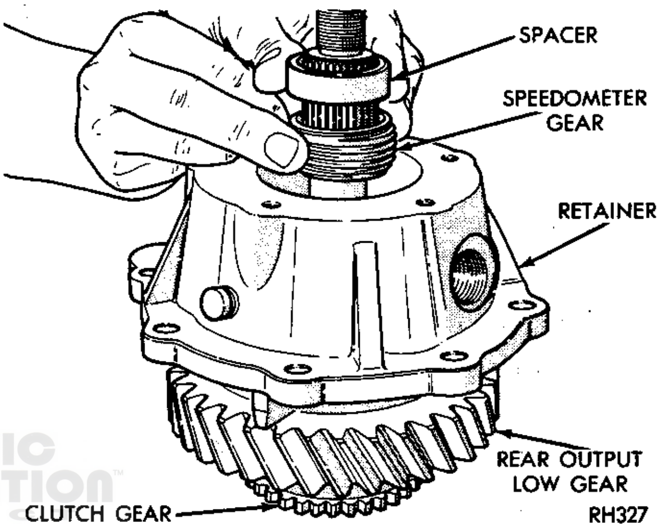

Fig. 11 Assembling Rear Retainer And Output Shaft

(25) Install seals in front and rear seal retainers. Position gaskets on case and install retainers over shafts and against case. Tighten bolts to 54 N•m (40 ft-lbs).

(26) Install yoke and flange. Tighten yoke and flange nuts to 176 N• (130 ft-lbs).

(27) Install detent balls, springs, plugs, cup plugs and 4WD indicator light switch.

(28) Install drain plug.

(29) Fill transfer case with proper lubricant to bottom of fill plug hole.

(30) Install fill plug.

NP241 TRANSFER CASE

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GENERAL INFORMATION

The NP241 is a part-time transfer case with a low-range gear system. It has three operating ranges plus a Neutral position. The low range system provides a gear reduction ratio for increased low speed torque capability.

The NP241 has three operating ranges which are: Two-wheel drive high, four-wheel drive high and four wheel-drive low. The four-wheel drive operating ranges are undifferentiated.

A front axle disconnect system is used to achieve two-wheel drive mode. The axle disconnect vacuum motor is actuated by a vacuum switch on the transfer case. The switch is operated by the transfer case range rod.

Two-wheel drive range is used for on road, highway operation. The four-wheel drive ranges are for off road operation or when the vehicle is driven on paved road surfaces covered by snow, ice or similar low traction elements.

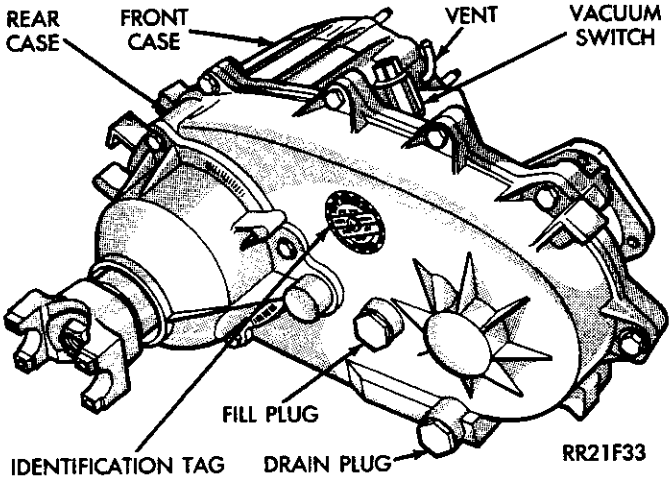

Fig. 1 NP 241 Transfer Case

TRANSFER CASE IDENTIFICATION

A circular identification tag (Fig. 1) is attached to the rear case of each Model 241 transfer case. The identification 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. For example, a serial number of 9-9-89 would represent September 9, 1989.

Transfer case operating ranges are selected with a floor-mounted shift lever. The shift lever is connected to the transfer case range lever by an adjustable linkage rod (Fig. 2). A straight line shift pattern is used. Range positions are marked on the gearshift lever knob.

A synchronizer assembly in the transfer case allows the unit to be shifted between the two and four-wheel high ranges while the vehicle is in motion.

RECOMMENDED LUBRICANT

Recommended lubricant for the NP241 is Mopar ATF Plus, type 7176, or Dexron II™ automatic transmission fluid. Use this fluid for topping off the fluid level, or refilling after fluid change or service.

Do not use antifriction additives or similar materials in the NP241 transfer case. Use the recommended fluid only.

NP241 transfer case lubricant should be changed at the intervals specified in the Maintenance Schedule or after service repairs.

SERVICE DIAGNOSIS

Before attempting to repair a suspected transfer case malfunction, check all other driveline components beforehand. The actual cause of a problem may be related to such items as: front hubs, axles, propeller shafts, wheels and tires, transmission, or clutch instead. If all other driveline components are in good condition and operating properly, refer to the Service Diagnosis chart for further information.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
TRANSFER CASE DIFFICULT TO SHIFT OR WILL NOT SHIFT INTO DESIRED RANGE	(a) Vehicle speed too great to permit shifting. (b) If vehicle was operated for extended period in 4H mode on dry paved surface, driveline torque load may cause difficulty. (c) Transfer case external shift linkage binding. (d) Insufficient or incorrect lubricant. (e) Internal components binding, worn or damaged.	(a) Stop vehicle and shift into desired range. Or reduce speed to 3-4 km/h (2-3 mph) before attempting to shift. (b) Stop vehicle, shift transmission to neutral, shift transfer case to 2H mode and operate vehicle on 2H on dry paved surface. (c) Lubricate, repair or replace linkage, or tighten loosen components as necessary. (d) Drain and refill to edge of fill hole with MOPAR ATF PLUS (Type 7176) or DEXRON II Automatic Transmission Fluid. (e) Disassemble unit and replace worn or damaged components as necessary.
TRANSFER CASE NOISY IN ALL DRIVE MODES	(a) Insufficient or incorrect lubricant.	(a) Drain and refill to edge of fill hole with MOPAR ATF PLUS (Type 7176) or DEXRON II Automatic Transmission Fluid. Check for leaks and repair if necessary. **If unit is still noisy after drain and refill, disassembly and inspection may be required to locate source of noise.**
NOISY IN—OR JUMPS OUT OF FOUR-WHEEL-DRIVE LOW RANGE	(a) Transfer case not completely engaged in 4L position. (b) Shift linkage loose or binding. (c) Range fork cracked, inserts worn, or fork is binding on shift rail. (d) Annulus gear or lockplate work or damaged.	(a) Stop vehicle, shift transfer case to Neutral, then shift back into 4L position. (b) Tighten, lubricate, or repair linkage as necessary. (c) Disassemble unit and repair as necessary (d) Disassemble unit and repair as necessary
LUBRICANT LEAKING FROM OUTPUT SHAFT SEALS OR FROM VENT	(a) Transfer case overfilled. (b) Vent closed or restricted. (c) Output shaft seals damaged or installed correctly.	(a) Drain to correct level. (b) Clear or replace vent if necessary. (c) Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores and nicks with fine sandpaper or replace yoke(s) if necessary.
ABNORMAL TIRE WEAR	(a) Extended operation on dry hard surface (paved) roads in 4H range.	(a) Operate in 2H on hard surface (paved) roads.

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IN-VEHICLE SERVICE

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FLUID LEVEL

Correct fluid level for the NP241 transfer case is to the bottom edge of the fill plug hole.

A correct method of checking fluid level is important. An accurate check requires that the vehicle be perfectly level. If fluid level is checked with the vehicle parked on the shop floor, be sure the floor area used is level. If fluid level is checked with the vehicle raised, use either a swivel arm or drive-on type hoist to be sure the vehicle is level.

FLUID DRAIN/REFILL

(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 54 N•m (40 ft-lbs).

(5) Remove drain pan.

(6) Fill transfer case to bottom edge of fill plug opening with Mopar ATF Plus, type 7176, or Dexron II™ automatic transmission fluid.

(7) Install fill plug. Tighten plug to 54 N•m (40 ft-lbs).

(8) Lower vehicle.

The front and rear yokes, output shaft seals, retainers and bearings, and speedometer drive gear can all be serviced with the transfer case in the vehicle. The following combined procedure outlines removal and installation of these components:

SPEEDOMETER GEAR/SHAFT SEAL/BEARING/RETAINER SERVICE

COMPONENT REMOVAL

(1) Raise vehicle.

(2) Remove fill and drain plugs and drain oil from transfer case.

(3) Mark propeller shaft and transfer case yoke for alignment reference.

(4) Disconnect propeller shaft. Secure shaft to underside of vehicle.

(5) Remove transfer case yoke retaining nut and seal washer. Use tool C-3281 to hold yoke while removing nut.

(6) Remove transfer case yoke.

(7) Remove retainer seal (if seal or bushing is to be replaced) using suitable tool.

(8) Install a new seal, if old seal was removed.

(9) Remove speedometer gear from rear retainer.

(10) Mark rear retainer for assembly alignment reference.

(11) Remove retainer attaching bolts and remove retainer. Pry retainer with screwdrivers to remove it (Fig. 2).

(12) Remove rear retainer (Fig. 3). Remove speedometer drive gear, if necessary.

(13) Completely clean off old sealant.

(14) If the retainer or bearing are to be replaced, remove bearing retainer snap ring from rear retainer and remove bearing.

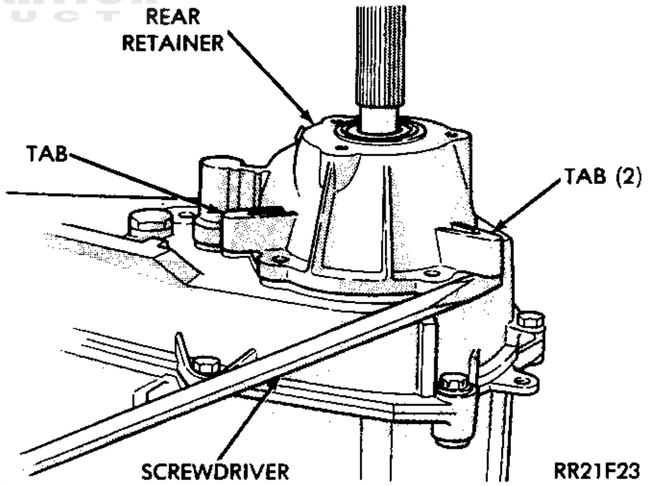


Fig. 2 Loosening Rear Retainer

COMPONENT INSTALLATION

(1) Install rear output bearing in rear retainer and install snap ring.

(2) Apply a 3.17 mm (1/8 in) wide bead of Mopar Gasket Maker or Loctite 515 sealant to mating surface of rear retainer.

(3) Align retainer case reference marks and install rear retainer on case.

(4) Install and tighten rear retainer attaching bolts to 24 N•m (18 ft-lbs).

(5) Install output shaft seal (if required).

(6) Install yoke, a new yoke seal washer and yoke nut. Tighten nut to 149 N•m (110 ft-lbs).

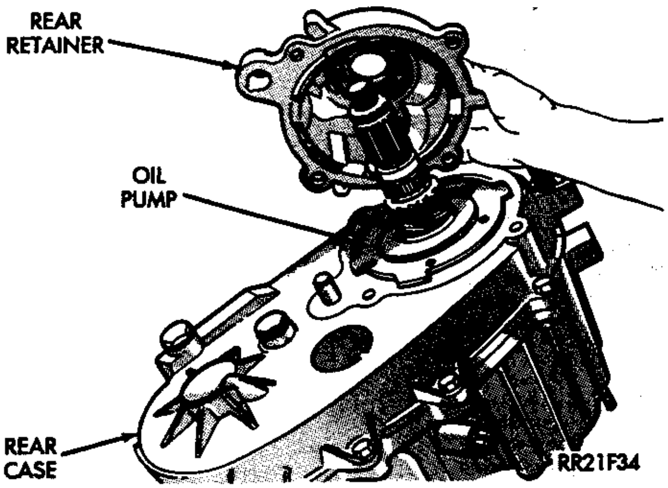


Fig. 3 Removing/Installing Rear Retainer

(7) Install speedometer driven gear.

(8) Install drain plug. Tighten plug to 54 N•m (40 ft-lbs).

(9) Fill transfer case to edge of fill plug opening with Mopar ATF Plus, type 7176 or Dexron II™ automatic transmission fluid.

(10) Install fill plug. Tighten plug to 54 N•m (40 ft-lbs).

(11) Connect propeller shaft. Tighten attaching bolts to 19 N•m (170 in-lbs).

(12) Lower vehicle.

SHIFT LINKAGE ADJUSTMENT

(1) Move transfer case shift lever boot aside for visual access to shift lever and gate.

(2) Move shift lever into 4H position. Be sure lever is against 4H gate (Fig. 4).

(3) Raise the vehicle.

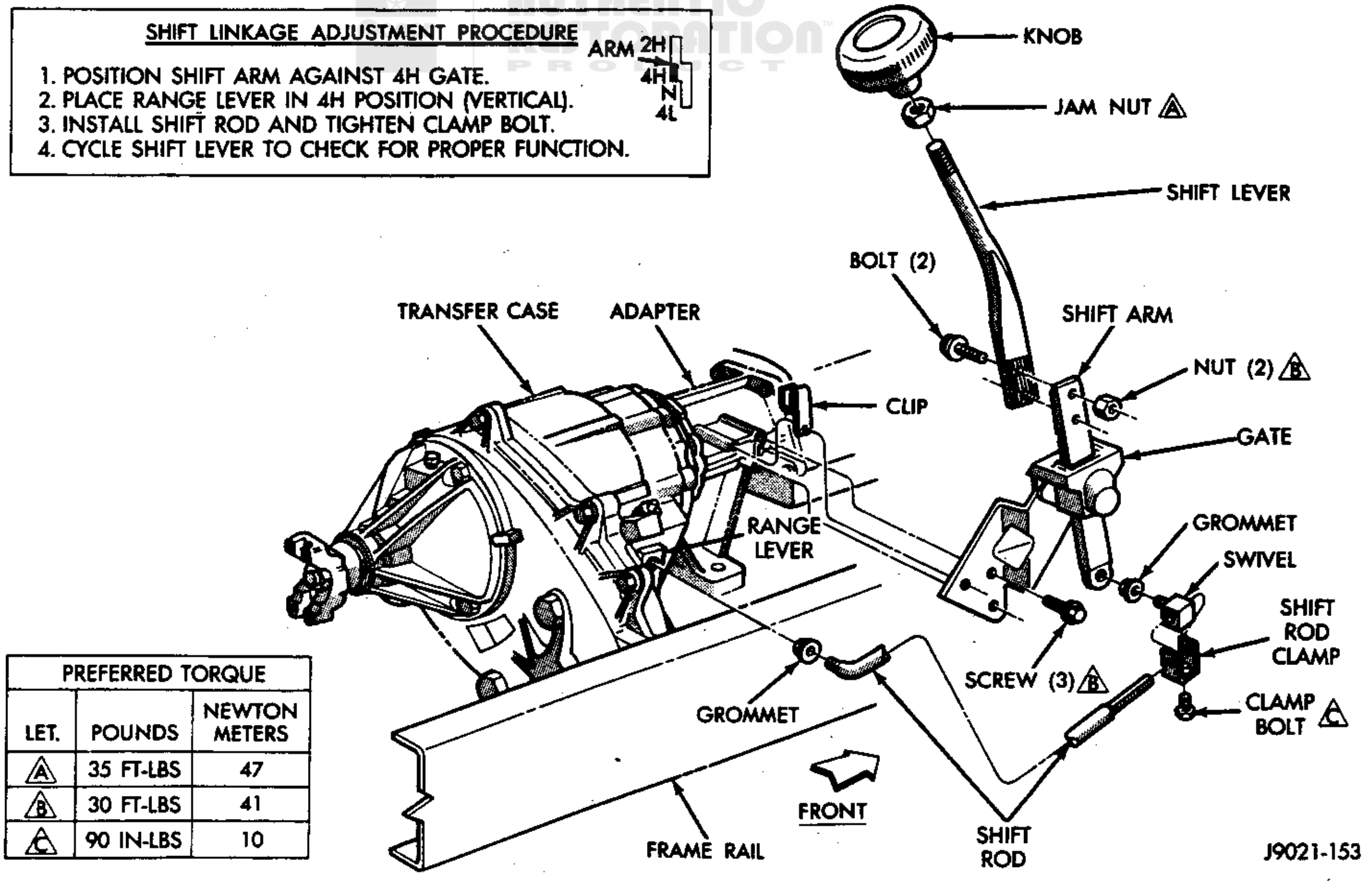
(4) Loosen shift rod clamp screw until shift rod is free to slide in swivel (Fig. 4).

(5) Verify that range lever is in 4H position (vertical). Move lever if necessary.

(6) Tighten shaft rod clamp screw to (90 in-lbs) torque.

(7) Lower vehicle.

(8) Check linkage operation.



SHIFT LINKAGE ADJUSTMENT PROCEDURE

1. POSITION SHIFT ARM AGAINST 4H GATE.
2. PLACE RANGE LEVER IN 4H POSITION (VERTICAL).
3. INSTALL SHIFT ROD AND TIGHTEN CLAMP BOLT.
4. CYCLE SHIFT LEVER TO CHECK FOR PROPER FUNCTION.

PREFERRED TORQUE		
LET.	POUNDS	NEWTON METERS
A	35 FT-LBS	47
B	30 FT-LBS	41
C	90 IN-LBS	10

Fig. 4 NP241 Shift Linkage

OUT-OF VEHICLE SERVICE

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TRANSFER CASE REMOVAL

(1) Raise vehicle.

(2) Drain lubricant from transfer case.

(3) Mark transfer case front and rear output shaft yokes and propeller shafts for assembly alignment reference.

(4) Disconnect speedometer cable and vacuum switch hoses.

(5) Disconnect shift lever link from operating lever.

(6) Place support stand under transmission and remove rear crossmember.

(7) Mark transfer case front and rear output shaft yokes and propeller shafts for assembly alignment reference.

(8) Disconnect front and rear propeller shafts at transfer case yokes. Secure shafts to frame rails with wire.

(9) Remove transfer case-to-transmission nuts.

(10) Move transfer case assembly rearward until free of transmission output shaft and remove assembly.

(11) Remove all gasket material from rear of transmission adapter housing.

TRANSFER CASE INSTALLATION

(1) Apply Permatex No. 3 sealer, or equivalent to both sides of transfer case-to-transmission gasket. Then position gasket on transmission.

(2) Align and install transfer case assembly on transmission. Be sure transfer case input gear splines are aligned with transmission output shaft. Align splines by rotating transfer case rear output shaft yoke if necessary. **Do not install any transfer case attaching nuts until the transfer case is completely seated against the transmission.**

(3) Align and install transfer case attaching nuts. Tighten nuts to 47 N•m (35 ft-lbs).

(4) Install rear crossmember and remove transmission support stand.

(5) Align and connect propeller shafts.

(6) Connect speedometer cable and vacuum switch hoses.

(7) Connect shift lever to operating lever. Tighten locknut to 10 N•m (90 in-lbs).

(8) Fill transfer case with Mopar ATF Plus, type 7176, or Dexron II™ fluid.

(9) Install fill plug.

(10) Lower vehicle.

TRANSFER CASE DISASSEMBLY

RETAINER AND REAR CASE REMOVAL

(1) Remove indicator switch from front case.

(2) Remove rear retainer (Figs. 2-3). Remove and discard retainer seal.

(3) Remove speedometer gear upper snap ring and remove speedometer gear (Fig. 5).

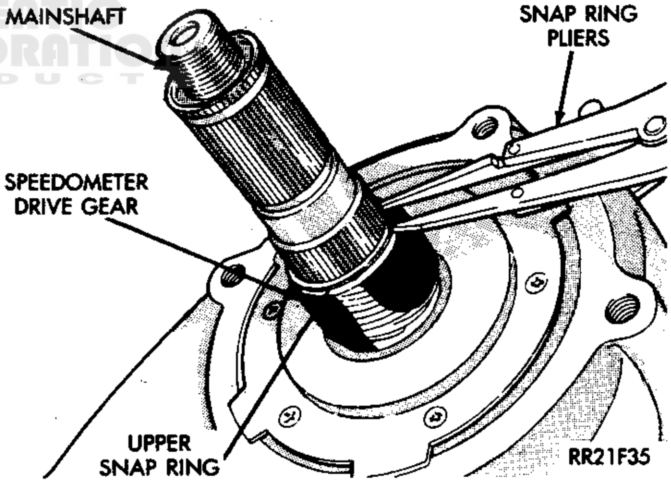

Fig. 5 Upper Snap Ring And Speedometer Gear Removal/Installation

(4) Remove lower snap ring (Fig. 6)

(5) Remove oil pump. Remove and discard oil pump seal.

(6) Loosen rear case by prying corners loose to break sealant bead (Fig. 7).

(7) Remove rear case from front case (Fig. 8)

(8) Remove oil pickup screen, tube and magnet from rear case.

DRIVE CHAIN, SPROCKET, SHIFT FORK AND MAINSHAFT SHAFT REMOVAL

(1) Remove mode spring from shift rail (Fig. 9).

(2) Remove driven sprocket snap ring (Fig. 10).

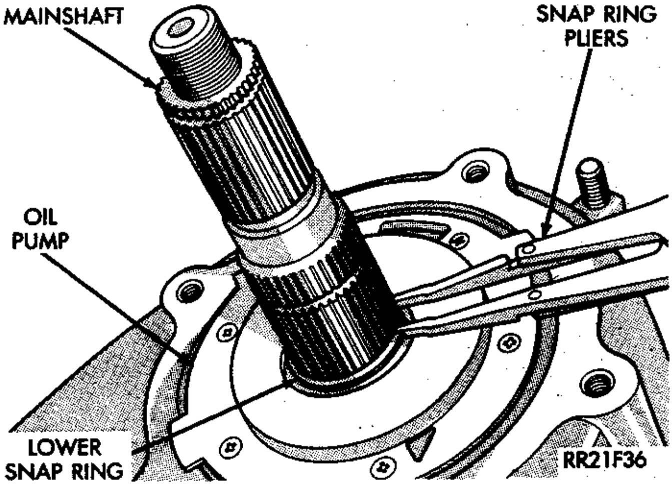

Fig. 6 Removing/Installing Shaft Lower Snap Ring

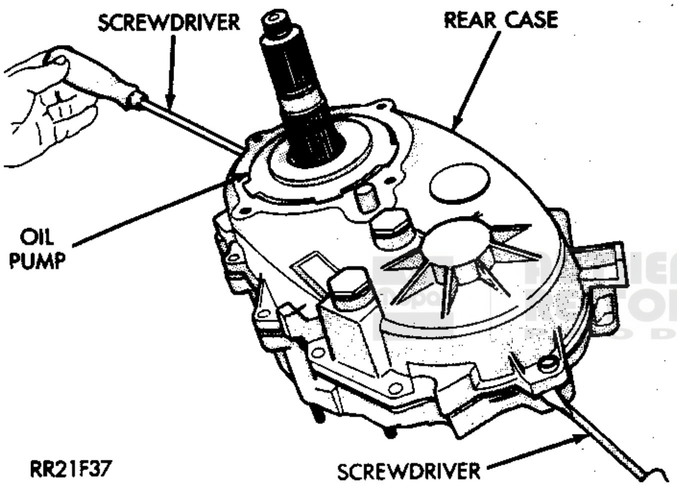

Fig. 7 Loosening Rear Case

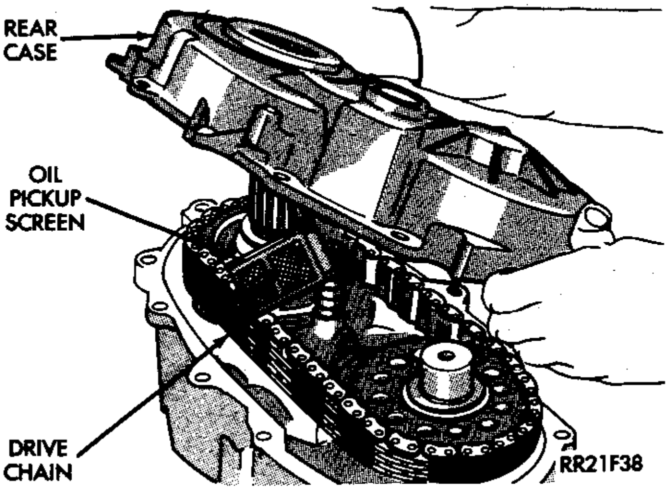

Fig. 8 Removing/Installing Rear Case

(3) Remove sprocket and drive chain (Fig. 11). Tilt mainshaft for clearance if necessary.

(4) Remove mainshaft, mode fork and shift rail as assembly.

(5) Remove front output shaft (Fig. 11).

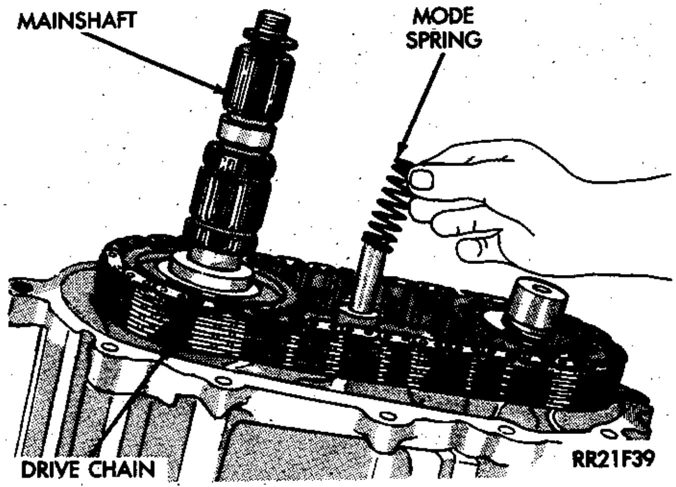

Fig. 9 Removing/Installing Mode Spring

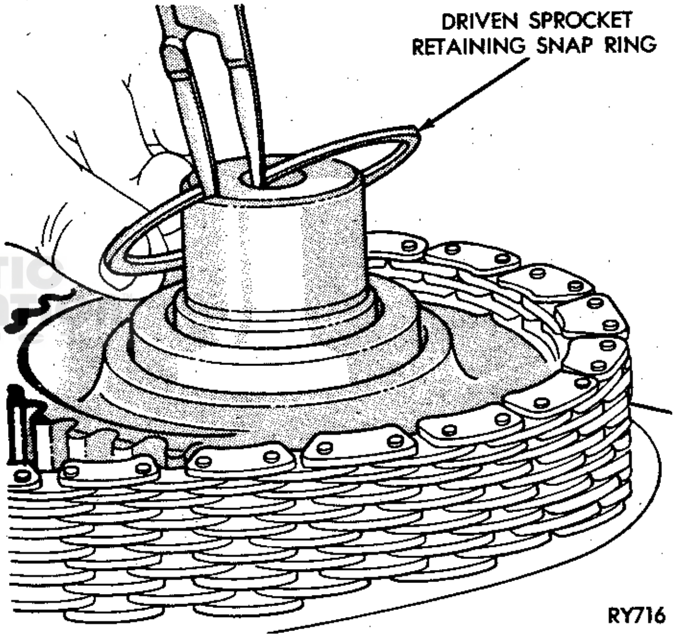

Fig. 10 Removing/Installing Sprocket Snap Ring

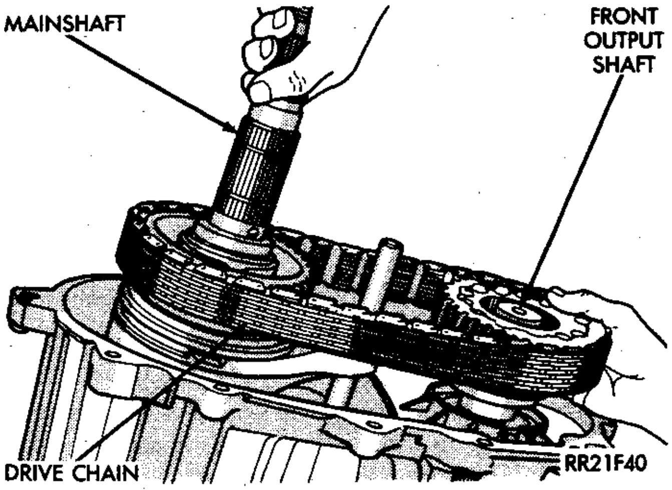

Fig. 11 Removing/Installing Drive Chain And Sprocket

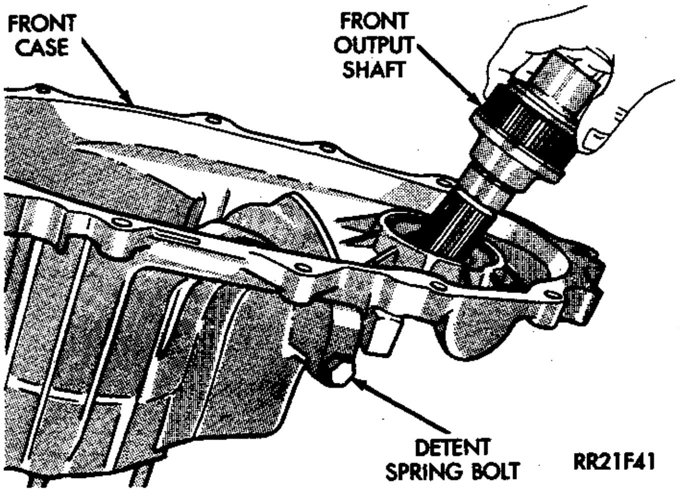

Fig. 12 Removing/Installing Front Output Shaft

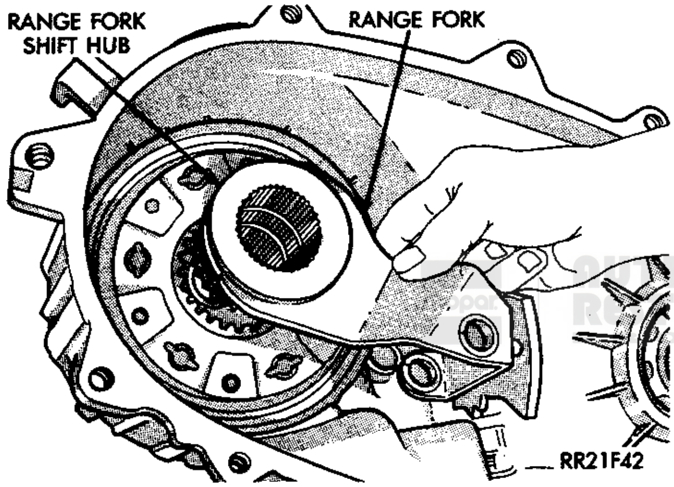

Fig. 13 Removing/Installing Range Fork And Hub

(6) Remove range fork and hub (Fig. 12).

INPUT GEAR LOW, RANGE GEAR, RETAINER AND SECTOR REMOVAL

(1) Remove input gear bearing retainer (Fig. 14).

(2) Remove input gear snap ring (Fig. 15).

(3) Remove low range gear and input gear as assembly (Fig. 16).

(4) Remove low range gear snap ring (Fig. 17).

(5) Remove input gear and thrust washer from low range gear.

(6) Remove shift detent plug, spring and plunger. Replace O-ring on plug if worn or cut.

(7) Remove shift sector and sector seals (Fig. 18).

MAINSHAFT DISASSEMBLY

(1) Remove Synchronizer snap ring (Fig. 19).

(2) Remove synchronizer sleeve and hub as assembly (Fig. 20). It is not necessary to disassemble the synchronizer components unless wear or damage is evident.

(3) Remove stop ring (Fig. 20).

(4) Remove drive sprocket from mainshaft (Fig. 21)

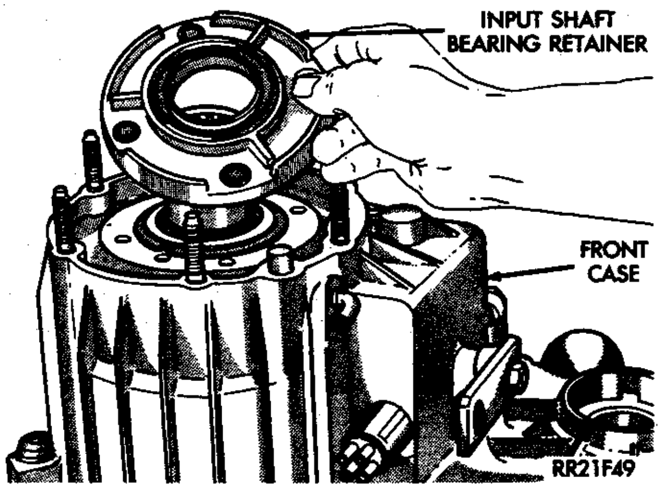

Fig. 14 Removing/Installing Input Gear Bearing Retainer

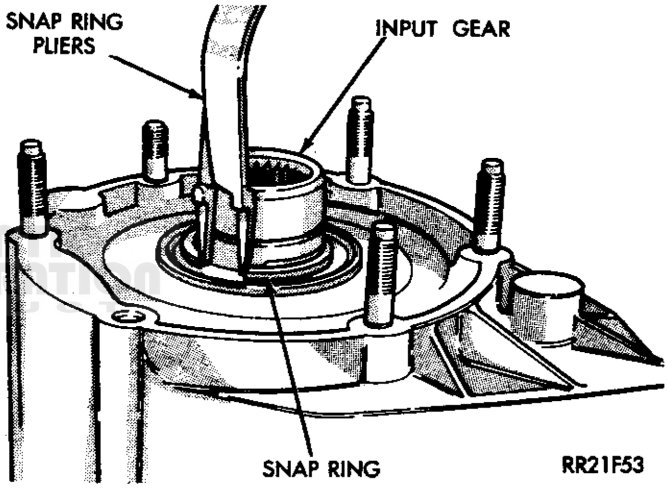

Fig. 15 Removing/Installing Input Gear Snap Ring

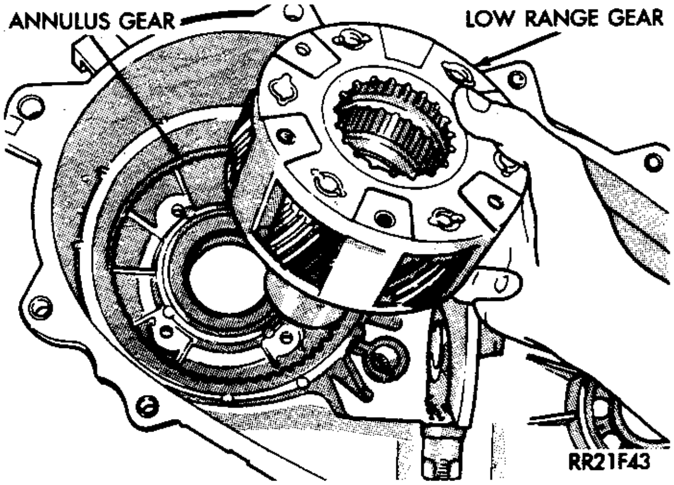

Fig. 16 Removing/Installing Low Range Gear And Input Shaft

CLEANING AND INSPECTION

Wash all parts thoroughly in clean solvent. Be sure all old lubricant, sealant, metal particles, dirt and

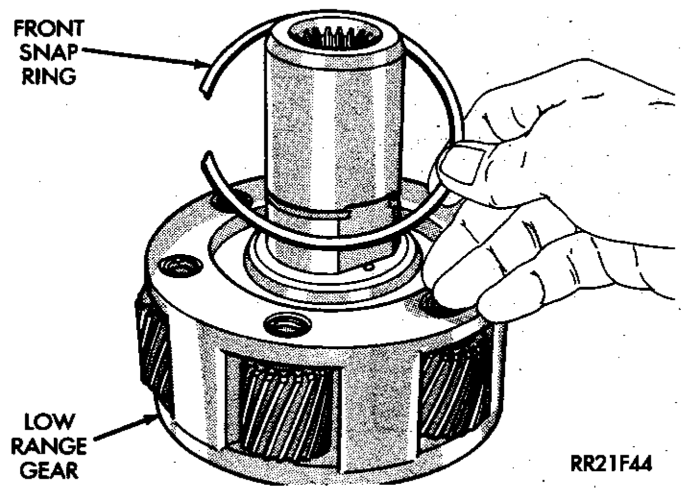

Fig. 17 Removing/Installing Low Range Gear Snap Ring

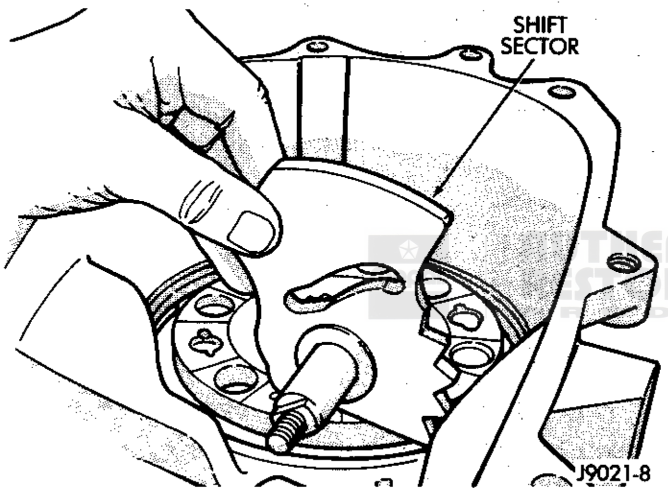

Fig. 18 Removing/Installing Shift Sector

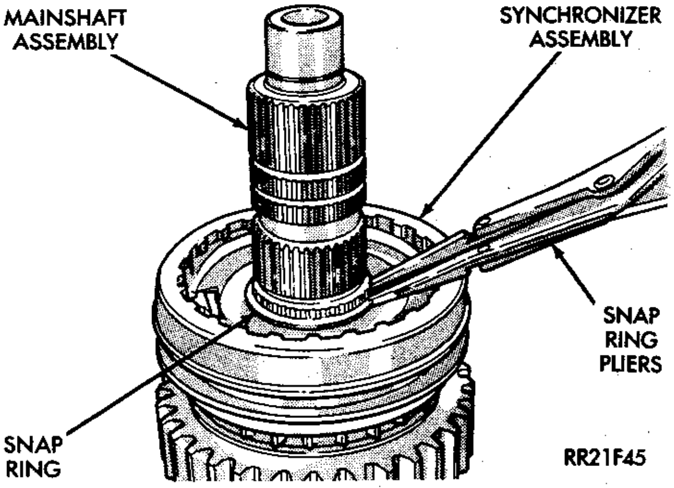

Fig. 19 Removing/Installing Synchronizer Snap Ring

foreign material are removed from the surfaces of every part.

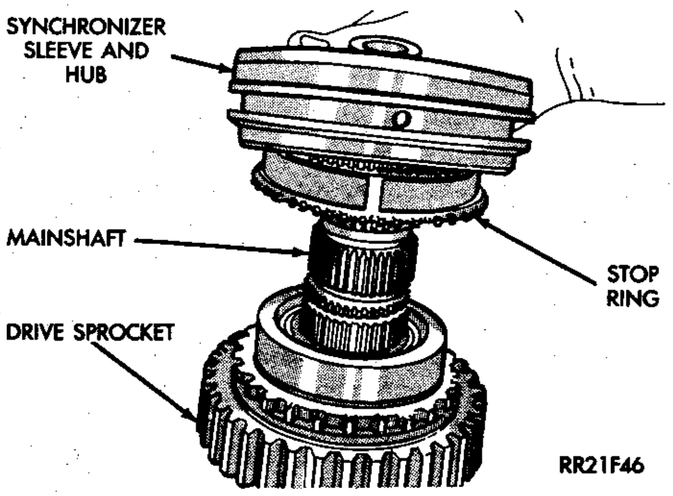

Fig. 20 Removing/Installing Synchronizer Sleeve, Hub And Stop Ring

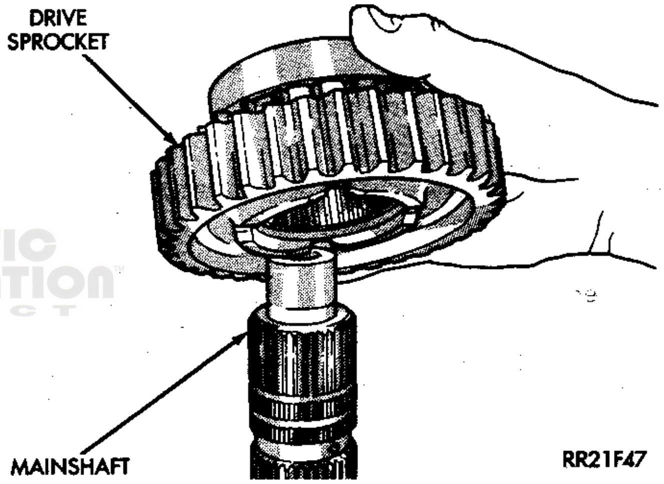

Fig. 21 Removing/Installing Mainshaft Drive Sprocket

Apply compressed air to each oil feed port and channel in both case halves to remove any foreign material or cleaning solvent residue.

Inspect the spline teeth on synchronizer sleeve, hub, and stop ring. If there is evidence of chipping or excessive wear, install new parts at reassembly. Be sure the clutch sleeve slides easily on the clutch hub.

Synchronizer springs should be in place with the tang inside the cavity of one strut. The rings should not exhibit any evidence of interference with the polished gear cone or inside diameters of the clutch hub. Inspect the stop ring for cracks and wear. Replace the ring if cracked or excessively worn on the threaded bore. Check new rings for proper fit on the cone with a minimum of wobble. Also check the synchronizer struts for wear or damage.

Inspect all gear teeth for excessive wear or damage and check all gear splines for burrs, nicks, wear, or damage. Remove minor nicks or scratches with an oil stone. Replace any part exhibiting excessive wear or damage.

Inspect all snap rings and thrust washers for excessive wear, distortion or damage. Replace worn or damaged parts.

Inspect the two case halves for cracks, porosity, damaged mating surfaces, stripped bolt threads, or distortion. Replace either case half if necessary.

Inspect condition of all needle, roller, ball, and thrust bearings in the front and rear case halves and the input gear. Also check condition of the bearing bores in both cases and in the input gear, rear output shaft, side gear, and rear retainer. Replace any component exhibiting excessive wear or damage. If the case or input gear bearings require replacement, refer to the Transfer Case Bearing Replacement procedures.

BEARING REPLACEMENT

CAUTION: The bearing bores in most of the transfer case components contain oil feed holes. Be sure replacement bearings do not block these feed holes.

REPLACING DRIVE SPROCKET BEARINGS

(1) Remove the two drive sprocket bearings simultaneously in a shop press with tool handle C-4171 and remover/installer tool C-4697-1 (Fig. 22).

(2) Clean the sprocket bearing bore after removing the old bearings.

(3) Before proceeding, note that the sprocket bearings are positioned differently (Fig. 23). The front bearing is installed flush with the end of the bore. However, the rear bearing is recessed slightly. Be sure to install the bearings as shown in Figure 23.

(4) Install the new sprocket bearings one at a time starting with the front bearing. Press the front bearing flush with the end of the bore as shown (Fig. 23). Then press the rear bearing into the sprocket until it is 4.6 mm (11/64 in) below the edge of the bore.

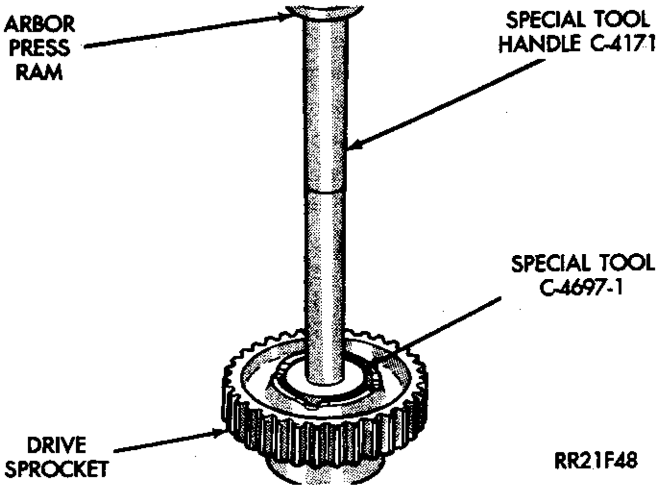

Fig. 22 Removing Drive Sprocket Bearings

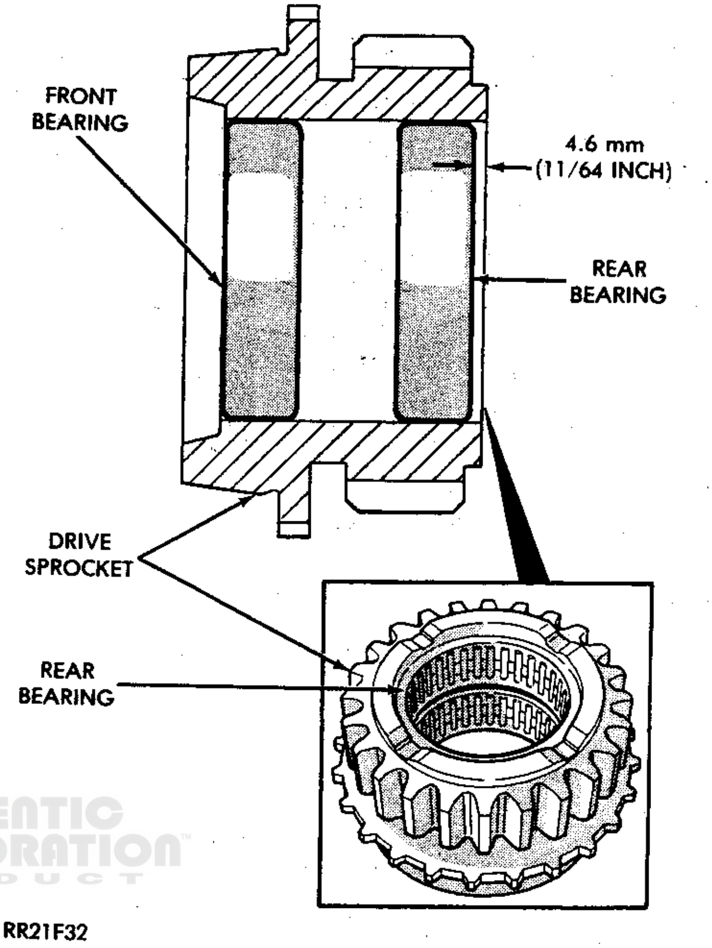

Fig. 23 Drive Sprocket Bearing Installation

REPLACING MAINSHAFT PILOT BEARING

The mainshaft pilot bearing is located in the input shaft. The bearing is removed from shaft bore with tool MD-998346 and two appropriate size backup wrenches (Fig. 24).

The new bearing is installed with tool handle C-4171 and installer tool 5065 (Fig. 25). A shop press is recommended to press the bearing into place. The bearing is seated when the installer tool contacts the input shaft.

REPLACING MAINSHAFT REAR (OUTPUT) BEARING

The mainshaft rear (output) bearing is located in the rear retainer. The seal must be removed before the bearing can be replaced.

(1) Remove the seal with tool C-4613 (Fig. 26).

(2) Remove the bearing with tool handle C-4171 and remover tool C-4610 (Fig. 27).

(3) Clean the bearing bore thoroughly.

(4) Install the new bearing with handle C-4171 and installer tool C-4609 (Fig. 28).

(5) Install a new seal in the rear retainer.

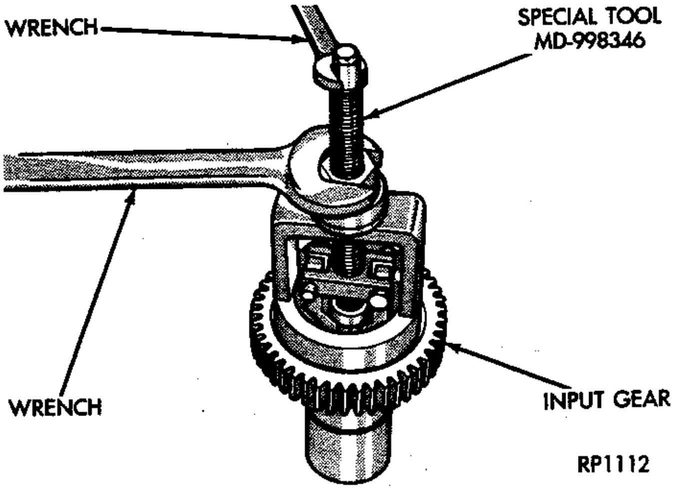

Fig. 24 Removing Mainshaft Pilot Bearing

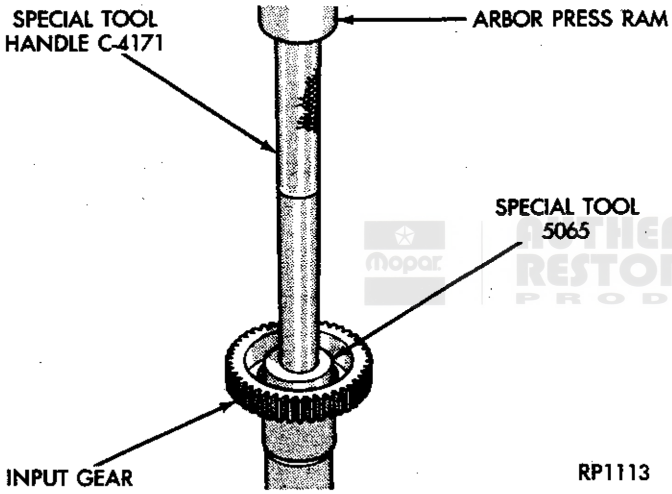

Fig. 25 Installing Mainshaft Pilot Bearing

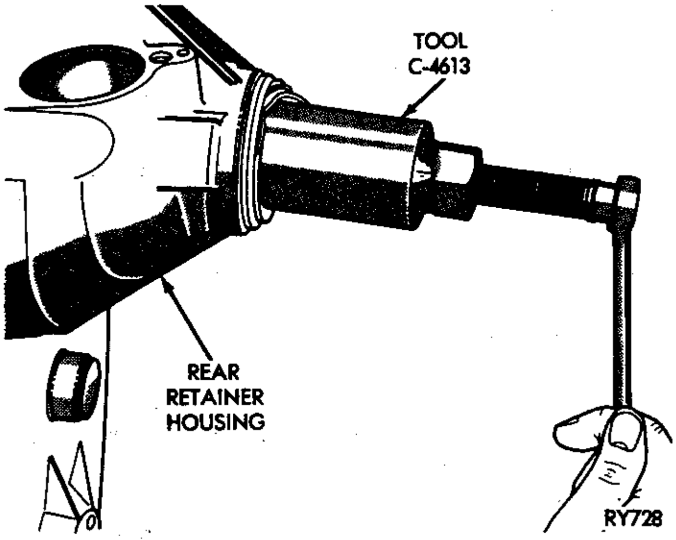

Fig. 26 Removing Rear Retainer Seal

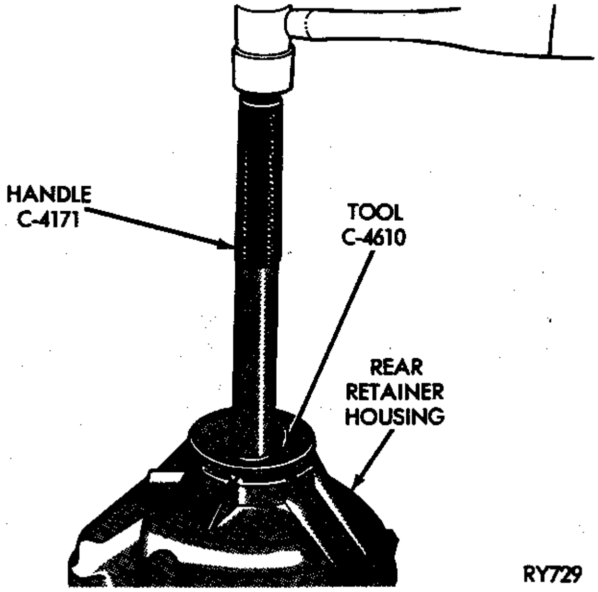

Fig. 27 Removing Mainshaft Rear (Output) Bearing

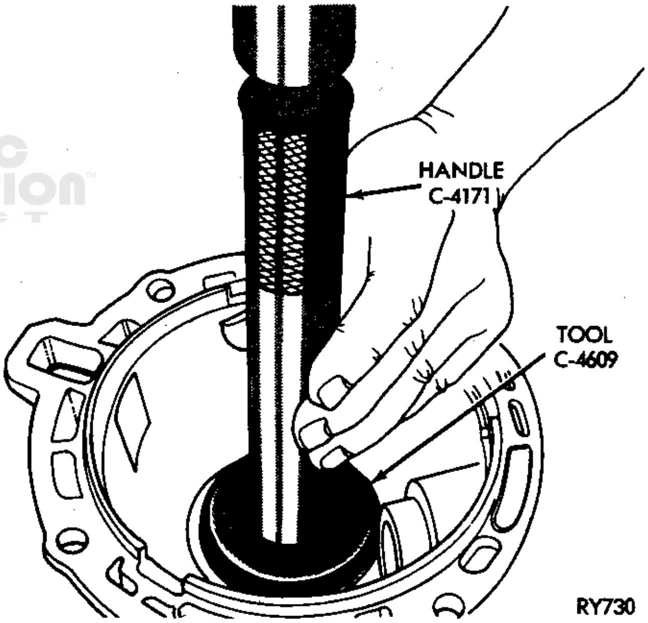

Fig. 28 Installing Mainshaft Rear (Output) Bearing

REPLACING FRONT OUTPUT SHAFT FRONT BEARING

(1) Remove the bearing from the front case bore with tool handle C-4171, remover tool C-4610 and a shop press (Fig. 29).

(2) Clean the bearing bore thoroughly.

(3) Install the new bearing with installer tool C-4210, tool handle C-4171 and a shop press (Fig. 30).

REPLACING FRONT OUTPUT SHAFT REAR BEARING

(1) Remove the bearing from the rear case bore with tools L-4518-1 and L-4454-1 (Fig. 31).

(2) Clean the bearing bore thoroughly.

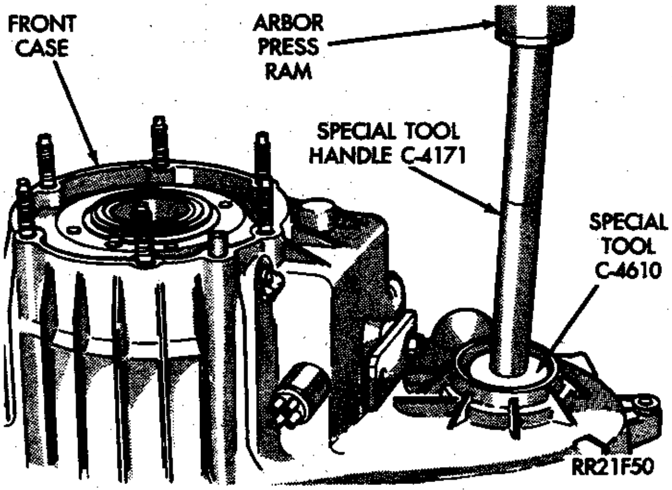

Fig. 29 Removing Front Output Shaft Front Bearing

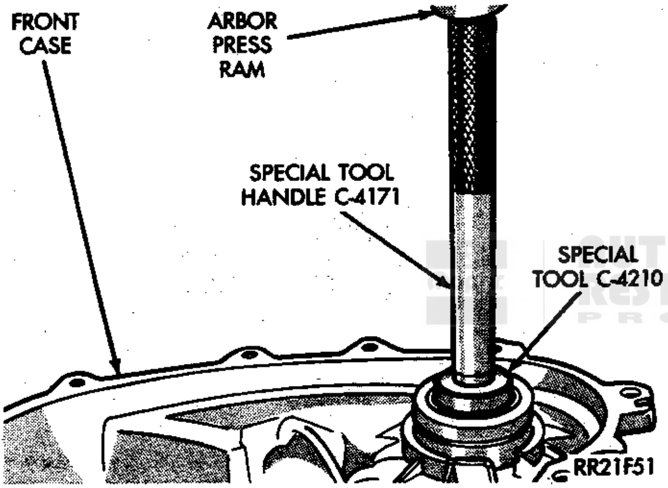

Fig. 30 Installing Front Output Shaft Front Bearing

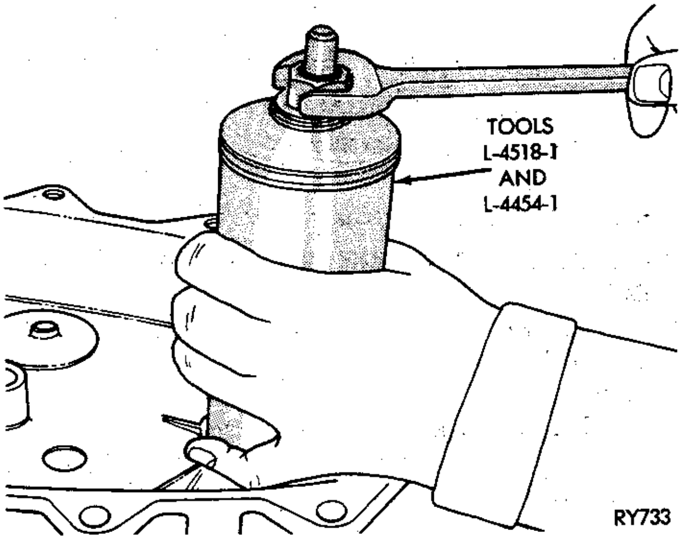

Fig. 31 Removing Front Output Shaft Rear Bearing

(3) Install the new bearing with tool handle C-4171 and installer tool C-4608 (Fig. 32).

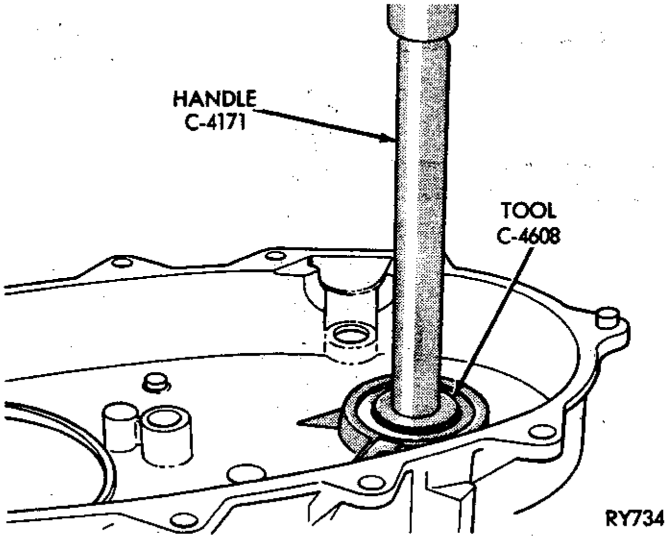

Fig. 32 Installing Front Output Shaft Rear Bearing

TRANSFER CASE ASSEMBLY

(1) Lubricate transfer case components with Mopar ATF Plus, type 7176 during assembly.

(2) **If transfer case bearings were replaced, verify that new bearings do not block any oil feed holes.**

(3) Assemble input gear, thrust washer and low range gear. Be sure low range snap ring is fully seated.

(4) Install input and low range gear assembly in front case. Secure input gear with snap ring (Fig. 15).

(5) Install shift sector and new sector shaft seals. Install range lever on sector shaft and tighten attaching locknut to 10 N•m (90) in-lbs).

(6) Install range fork and hub (Fig. 13).

(7) Install front output shaft in case (Fig. 12).

(8) Assemble mainshaft, stop ring, synchronizer and mainshaft drive sprocket (Figs. 18, 19, 20).

(9) Insert mode fork in synchronizer sleeve. Then install mainshaft and fork as assembly. Be sure shift rail is aligned in range fork and is seated in case bore.

(10) Install drive chain and front shaft sprocket (Fig. 11).

(11) Install snap ring that secures driven sprocket to front output shaft (Fig. 10).

(12) Install detent plunger, spring and plug. Replace O-ring on plug if necessary. Do not reuse old O-ring if damaged.

(13) Install mode spring on shift rail (Fig. 9).

(14) Install oil pump, pickup tube and screen in rear case.

(15) Apply 3 mm (1/8 in) wide bead of Mopar gasket maker, or Loctite 515 to front case sealing surface.

(16) Align and install rear case on front case. Install and tighten rear case-to-front case bolts to 31 N•m (23 ft-lbs).

(17) Install lower snap ring on mainshaft (Fig. 6).

(18) Install speedometer gear and upper snap ring (Fig. 5).

(19) Install new seals in retainers if necessary.

(20) Apply 3 mm (1/8 in) wide bead of Mopar gasket maker or Loctite 515 to sealing surface of rear retainer. Then install retainer and tighten retainer bolts to 31 N•m (23 ft-lbs).

(21) Install yokes, seal washers and retaining nuts. Tighten yoke nuts to 163 N•m (120 ft-lbs).

(22) Install indicator switch. Tighten switch to 24 N•m (18 ft-lbs).

(23) Fill transfer case with Mopar ATF Plus, type 7176 transmission fluid.

MANUAL OVERDRIVE 4 GENERAL SPECIFICATIONS

Gear Ratio:	
First	3.09
Second	1.67
Third	1.00
Overdrive	0.71
Reverse	3.00
Tolerances:	
Clutch Housing Face Squareness	.006 inch Max.
Clutch Housing Bore Runout	.008 inch Max.
Countershaft Gear End Play	.015 to .029 inch
Countershaft to Case Bore Fit	.005 to .0065 inch Loose
Lubricant — Capacity	7 pints (3.3 liters)
Type	ATF PLUS, Type 7176 OR "DEXRON II" Automatic Transmission Fluid
Downshift Speed Limits:	
Overdrive to 3rd	50 to 25 mph (80 to 40 km/h)
3rd to 2nd	25 to 15 mph (40 to 24 km/h)
2nd to 1st	15 to 0 mph (24 to 0 km/h)

TIGHTENING REFERENCE

	Ft. Lbs.	N·m
Back-Up Lamp Switch	15	20
Drive Pinion Bearing Retainer Bolts	30	41
Extension Housing to Case Bolts	50	68
Gearshift to Mounting Plate	24	33
Gearshift Mounting Plate to Extension	12	16
Shift Lever Nuts	18	24
Transmission to Clutch Housing Bolts	50	68
Transmission Drain Plug	25	34

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NP 2500 GENERAL SPECIFICATIONS

Gear Ratio:	
First	3.79
Second	2.29
Third	1.48
Fourth	1.00
Overdrive	0.79
Reverse	3.90
Tolerances:	
Clutch Housing Face Squareness	.006 inch Max.
Clutch Housing Bore Runout	.008 inch Max.
Countershaft Gear End Play	.001 to .005 inch
Lubricant — Capacity	4 pints (1.9 liters)
Type	SAE 10W-30 Engine Oil, API GRADE SG/CD

TIGHTENING REFERENCE

	Ft. Lbs.	N·m		Ft. Lbs.	N·m
Access Cover Bolts	21	28	Shift Assembly to Extension Bolts	21	28
Back-Up Lamp Switch	15	20	Speedometer Adapter Screw	8	11
Center Support to Case	40	54	Transmission to Clutch Housing Bolts	50	68
Extension Housing to Case Bolts	40	54	Transmission Drain Plug	30	41
Gearshift Lever	30	41	Transmission Fill Plug	30	41
Input Shaft Bearing Retaining Bolts	21	28			

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NP241 SPECIFICATIONS

Transfer Case Type	Part-time, dual range with low range reduction. Four-wheel-drive range is undifferentiated.
Torque Transfer Mode	Output shaft and sprocket driven by interconnecting drive chain.
Operating Ranges	2H, 4H, 4L, and Neutral. Low range reduction ratio is 2.72:1.
Case Configuration	Two-piece aluminum with removable extension and rear retainer housings.
Required Lubricant	MOPAR automatic transmission fluid. ATF Plus, Type 7176 or DEXRON® II
Transfer Case Fill Level	To bottom edge of fill plug hole.

TORQUE SPECIFICATIONS

Component	Service Set-To Torque	Service Recheck Torque
Oil Pump Screws	1.6 N•m (14 in-lbs)	1.4-1.8 N•m (12-15 in-lbs)
Yoke Nut	149 N•m (110 ft-lbs)	122-176 N•m (90-130 ft-lbs)
Vacuum Switch	27 N•m (20 ft-lbs)	20-34 N•m (15-25 ft-lbs)
Range Lever Nut	30 N•m (22 ft-lbs)	27-34 N•m (20-25 ft-lbs)
Front Case-to-Rear Case Bolts	41 N•m (30 ft-lbs)	35-46 N•m (26-34 ft-lbs)
Rear Retainer Bolts	24 N•m (18 ft-lbs)	20-27 N•m (15-20 ft-lbs)
Extension Housing Bolts	41 N•m (30 ft-lbs)	35-46 N•m (26-34 ft-lbs)
Drain/Fill Plugs	47 N•m (35 ft-lbs)	41-54 N•m (30-40 ft-lbs)
Detent Plug	20 N•m (15 ft-lbs)	16-24 N•m (12-18 ft-lbs)
Front Bearing Retainer Bolts	21 N•m (16 ft-lbs)	16-27 N•m (12-20 ft-lbs)

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GENERAL SPECIFICATIONS

Transmission Models	**A-998/A-999/A-500**	**A-727/A-518**
TYPE	Automatic with Torque Converter	
TORQUE CONVERTER DIAMETER	10-3/4 inches	10-3/4 inches

	A-998/A-999/A-500 U.S. Measure	A-998/A-999/A-500 Metric Measure	A-727/A-518 U.S. Measure	A-727/A-518 Metric Measure
OIL CAPACITY — TRANSMISSION AND TORQUE CONVERTER Lockup	17.1 Pts.	8.1 Liter	16.7 Pts.	7.9 Liter
NonLockup	—	—	17.1 Pts.	8.1 Liter
A-500/A-518	20.4 Pts.	9.6 Liter		

Use MOPAR ATF PLUS Automatic Transmission Fluid, Type 7176

COOLING METHOD	Water-Heat Exchanger
LUBRICATION	Pump (Gear Type)

GEAR RATIOS:	First	Second	Third	Reverse	overdrive
A-727/A-518	2.45	1.45	1 to 1	2.21	
A-998/A-999/A-500	2.74	1.54	1 to 1	2.21	0.69

	A-998/A-999/A-500	A-727/A-518
PUMP CLEARANCES:		
Outer Gear to Case Bore	.0035 to .0075 inch	
End Clearance — Gears	.0004 to .0025 inch	.001 to .003 inch
GEAR TRAIN END PLAY	.005 to .048 inch	.006 to .048 inch
INPUT SHAFT END PLAY	.022 to .091 inch	.034 to .084 inch
SNAP RINGS		
Rear Clutch Snap Ring (Selective)	.060 to .062 inch	.060 to .062 inch
	.068 to .070 inch	.074 to .076 inch
	.076 to .078 inch	.088 to .090 inch
	.098 to .100 inch	.106 to .108 inch
Output Shaft (Forward End)	.040 to .044 inch	.048 to .052 inch
	.062 to .066 inch	.055 to .059 inch
	.082 to .086 inch	.062 to .066 inch
CLUTCH PLATE CLEARANCE		
Front Clutch	4 Disc. .067 to .134 inch	4 Disc. .082 to .151 inch
	5 Disc. .075 to .152 inch	
Rear Clutch	4 Disc. .032 to .055 inch	4 Disc. .025 to .045 inch

CLUTCHES	**A-998**	**A-500**	**A-999**	**A-727**	**A-518**
Engine Cu. Liter	3.9L	3.9L/5.2L	5.2L	5.2L/5.9L	5.2L/5.9L
Number of Front Clutch Discs	4	5	5	4	—
Number of Rear Clutch Discs	4	4	4	4	—
Number of Direct Clutch Discs	—	6	—	—	8
Number of Overdrive Clutch Discs	—	3	—	—	4 (Gas)/ 5 (diesel)
BAND ADJUSTMENTS					
Kickdown (Front) Turns*	2-1/2	2-1/2	2-1/2	2-1/2	2-1/2
Low-Reverse (Internal) Turns*	4	4	4	2	2

*Backed off from 72 inch-pounds (5 N·m)

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THRUST WASHERS

	A-904/A-998/A-999/A-500	A-727/A-518
Reaction Shaft Support Thrust Washer	# 1 .061 to .063 inch	# 1 Selective .016 to .063 inch (Natural) .084 to .086 inch (Red) .102 to .104 inch (Yellow)
Rear Clutch Retainer Thrust Washer	# 2 .061 to .063 inch	# 2 .061 to .063 inch (Natural)
Output Shaft Thrust Washer	# 3 Selective .068 to .070 inch	# 3 Selective .052 to .054 inch (Tin) .068 to .070 inch (Red) .083 to .085 inch (Green)
Output/Input Shaft Thrust Plate	.060 to .063 inch (All)	
Front Annulus Thrust Washer	# 4 .121 to .125 inch	
Front Carrier (To Annulus) Thrust	# 5 .048 to .050 inch	# 4 .059 to .062 inch
Drive Shell (To Front Annulus) Thrust Washer	—	# 5 .059 to .062 inch
Front Carrier (To Drive Shell) Thrust Washer	# 6 .048 to .050 inch	
Sun Gear Drive Shell Thrust Plate	# 7 .050 to .052 inch	
	# 8 .050 to .052 inch	# 6 .034 to .036 inch
Rear Carrier (To Drive Shell) Thrust Washer	# 9 .048 to .050 inch	# 7 .059 to .062 inch
Rear Carrier (To Annulus) Thrust Plate	—	# 8 .034 to .036 inch
Rear Carrier (To Annulus) Thrust Washer	#10 .048 to .050 inch	

TIGHTENING REFERENCE

	Ft. Lbs.	N·m
Cooler Line Fitting	155*	18
Cooler Line Nut	85*	10
Converter Drive Plate To Cranksaft Bolt	55	75
Converter Drive Plate to Torque Converter Bolt	270*	31
Extension Housing to Transmission Case Bolt	32	43
Extension Housing to Insulator Mounting Bolt	50	68
Governor Body to Support Bolt	95*	11
Kickdown Band Adjusting Screw Lock Nut	30	41
Kickdown Lever Shaft Plug	150*	17
Lockup Solenoid Wiring Connector	150*	17

*Inch Pounds

	Ft. Lbs.	N·m
Neutral Starter Switch	25	34
Oil Pan Bolt	150*	17
Oil Pump Housing to Transmission Case Bolt	175*	20
Output Shaft Support Bolt	150*	17
Overrunning Clutch Cam Set Screw	40*	5
Pressure Test Take-Off Plug	120*	14
Reaction Shaft Support to Oil Pump Bolt	175*	20
Reverse Band Adjusting Screw Lock Nut	25	34
Speedometer Drive Clamp Screw	100*	11
Transmission to Engine Bolt	30	41
Valve Body Screw	35*	4
Valve Body to Transmission Case Bolt	105*	12

*Inch Pounds

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TIGHTENING REFERENCE

NP2500 5-Speed	Ft. Lbs.	N•m
Access Cover Bolts	21	28
Back-Up Lamp Switch	15	20
Center Support to Case	40	54
Extension Housing to Case Bolts	40	54
Gearshift Lever	30	41
Input Shaft Bearing Retaining Bolts	21	28
Shift Assembly to Extension Bolts	21	28
Speedometer Drive Clamp Screw	8	11
Transmission to Clutch Housing Bolts	50	68
Transmission Drain Plug	30	41
Transmission Fill Plug	30	41

A833 4-Speed	Ft. Lbs.	N•m
Back-Up Light Switch	15	20
Drive Pinion Bearing Retaining Bolts	30	41
Extension Housing to Case Bolts	50	68
Gearshift to Mounting Plate	24	33
Gearshift Mounting Plate to Extension	12	16
Shift Lever Nuts	18	24
Transmission to Clutch Housing Bolts	50	68
Transmission Drain Plug	25	34

NP435 4-Speed	Ft. Lbs.	N•m
Cover Screw	30	41
Drive Gear Retainer Screw	20	27
Front Countershaft Retainer Screw	20	27
Front Countershaft Bearing Washer Screw	17	23
Flange Nut	125	169
Mainshaft Rear Retainer Screw	20	27
Rear Countershaft Retainer Screw	20	27
PTO Cover Screw	10	14
Filler and Drain Plug	35	47
Reverse Idle Shaft Lock Screw	30	41
Brake Link Shoulder Screw	40	41
Transmission-To-Clutch Housing Bolts	50	68

Automatic Transmission: A-998/A-999/A-500/A727/A518	Ft. Lbs.	N•m
Cooler Line Fitting	155*	18
Cooler Line Nut	85*	10
Converter Drive Plate to Crankshaft Bolt	55	75
Converter Drive Plate to Torque Converter Bolt	270*	31
Extension Housing to Transmission Case Bolt	32	43
Extension Housing to Insulator Mounting Bolt	50	68
Governor Body to Support Bolt	95	11
Kickdown Band Adjusting Screw Locknut	30	41
Kickdown Lever Shaft Plug	150*	17
Lockup Solenoid Wiring Connector	150*	17
Neutral Starter Switch	25	34
Oil Pan Bolt	150*	17
Oil Pump Housing to Transmission Case Bolt	175*	20
Output Shaft Support Bolt	150*	17
Overrunning Clutch Cam Set Screw	40*	5
Pressure Test Take-Off Plug	120*	14
Reaction Shaft Support to Oil Pump Bolt	175*	20
Reverse Band Adjusting Screw Locknut	25	34
Speedometer Drive Clamp Screw	100*	11
Transmission to Engine Bolt	30	41
Valve Body Screw	35*	4
Valve Body to Transmission Case Bolt	105*	12

*Inch Pounds

*Inch Pounds

NP205 Transfer Case	Ft. Lbs.	N•m
Bearing Preload	5-30*	7-41
Drain and Fill Plugs	40	54
Front Adaptor Screws	30	41
Front Output Flange Nut	110	149
Front Output Rear Brg. Retainer	30	41
Front Output Seal Retainer	30	41
Idler Shaft Cover	20	27
Idler Shaft Nut	138	187
Detent Screw	20	27
PTO to Case	35	47
PTO Cover Screws	35	47
Rear Output Yoke Nut	138	187
Rear Retainer Assy	30	41
Rear Seal Retainer	30	41
Transfer Case to Extension	35	47

NP241 Transfer Case	Ft. Lbs.	N•m
Detent Bolt	23	31
Drain and Fill Plugs	40	54
Front and Rear Yoke Nuts	120	163
Indicator Switch	18	24
Operating Lever Locknut	90*	10
Rear Case-to-Front Case Bolts (All)	23	31
Rear Retainer Bolt	23	31
Transfer Case to Extension	40	54

*Inch Pounds

TIRES AND WHEELS

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GENERAL INFORMATION

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TIRES

CONSTRUCTION

BIAS-PLY TIRES

Bias-ply tires (Fig. 1) have plies of cords that extend at an angle from bead-to-bead across the center line of the tread. The even number plies (i.e., second, fourth, sixth, etc.) cross the odd number plies (i.e., first, third, fifth, etc.) at 90 degree angles.

RADIAL-PLY TIRES

Radial-ply tires (Fig. 1) have belts under the tread that encircle the tire and extend from the tread shoulder-to-tread shoulder. Radial-ply tires are also constructed with the carcass cord plies at a right angle (perpendicular) to the tread centerline (Fig. 1). The cord plies cross the centerline at an angle of approximately 90 degrees. Because the carcass cord plies radiate from the centerline of the tread, this type of tire carcass design was designated radial-ply.

Performance-type radial tires also have a nylon-belt overlay on the cord plies to provide increased dimensional stability during high-speed operation.

IDENTIFICATION

Bias-ply tires are identified by the numerical designations of the tread width (in inches) and the bead/rim diameter (in inches), and the code letter(s) designation for the tire type (e.g., 7.50-16LT).

The example (above) identifies a "light" truck (LT) tire with a seven and one-half inch (7.50) tread width and sixteen inch (16) bead/rim diameter.

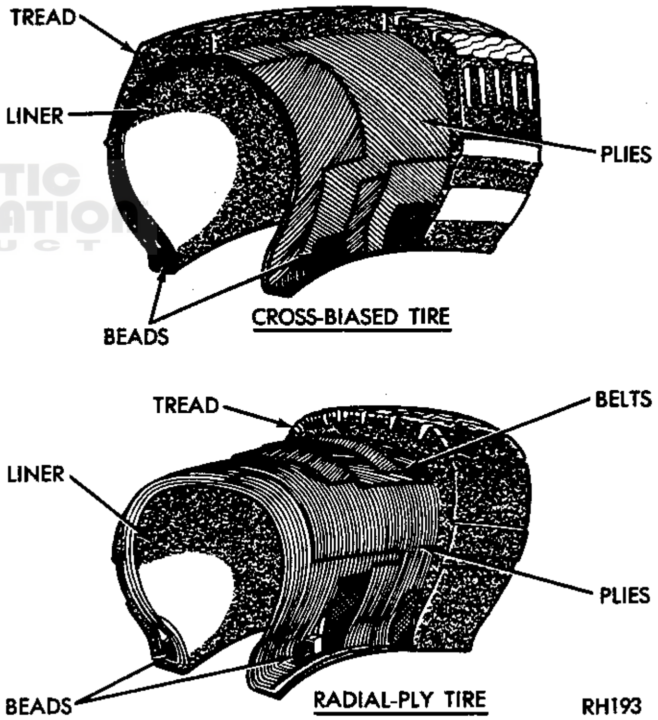

Fig. 1 Tire construction

Radial-ply tires are identified by the code letter **R** (e.g., P225/75**R**15) that appears in the tire identification imprinted on the tire sidewall.

As a result of their unique carcass design, radial-ply tires have a highly flexible sidewall. This flexibility allows the characteristic sidewall "bulge" that causes the tire to appear to be under-inflated. This is a normal condition for radial-ply tires. Do not attempt to reduce the "bulge" by over-inflating a tire. To ensure that a tire is properly inflated, use an accurate and reliable tire pressure gauge. Test and adjust tire

inflation pressure in accordance with the information listed on the tire inflation pressure decal affixed to the interior surface of the driver-side door pillar.

Size, Aspect Ratio And Speed Rating

The tire type, size, aspect ratio and speed rating are encoded in the combination of letters and numbers imprinted on the tire sidewall (e.g., P225/75SR15).

The first letter-number combination indicates the tire type and size:

- the letter **P** indicates the tire is designed for passenger vehicles, **LT** for "light-truck" vehicles and **T** for temporary spare; and
- **225** is the section width (including the 24-hour growth) of the tire when new (Fig. 2).

The section width (Fig. 2) that is imprinted on a tire sidewall (e.g., 225) is only valid when the tire is mounted on a wheel that has a rim width that conforms to the tire's design specifications.

After the slash, the aspect ratio (Fig. 2):

- **75** is the aspect ratio (i.e., the section height of the tire equals 75 percent of the section width).

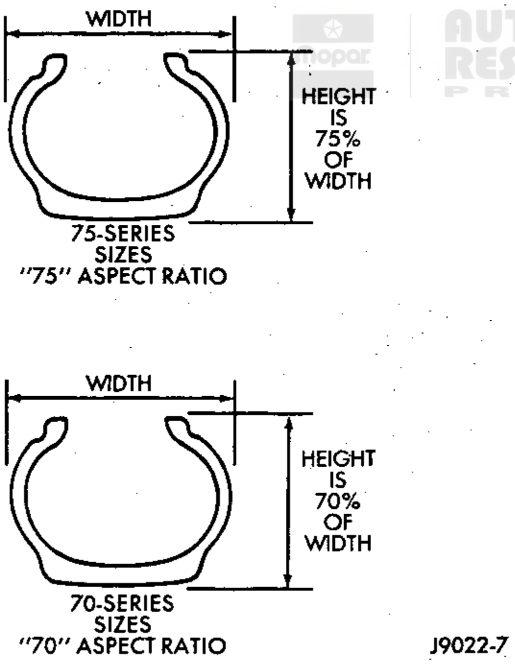

Fig. 2 Tire Aspect Ratio

The speed rating:

- the letter **S** indicates that the tire is "speed-rated" up to 112 mph,
- **Q** up to 100 mph,
- **T** up to 118 mph,
- **U** up to 124 mph,
- **H** up to 130 mph,
- **V** up to 149 mph, and
- **Z** for speeds exceeding 149 mph (238 km/h)—consult the tire manufacturer for the specific speed range.

The speed rating is not always imprinted on the tire.

The rim size:

- **15** is the tire bead/wheel rim diameter in inches.

Tread Life, Traction And Heat Resistance Ratings

The tread wear/traction/heat (temperature) resistance ratings are also imprinted on the tire sidewall (e.g., 250 AB).

The tread wear rating is expressed as a 3-digit number and is a comparative value based on the wear rate of a tire when tested under controlled conditions on a U.S. Government designated test course. For example, in theory, a tire with a tread wear rating of 300 would have a 50 percent better tread life than a tire with a rating of 200. In reality, the relative tread wear performance of the various tires also greatly depends upon the driving habits of the owner and upon the actual driving conditions, including tire service attention, the climate and the road/street surfaces that the tires usually encounter.

Tire tread wear (and vehicle stability) are affected greatly by tire size, inflation pressures, wheel rim size, distribution of the load within a vehicle, wheel alignment, road surface conditions, and individual driving habits.

Abrasive road surfaces accelerate tire tread wear.

Tires that are operated at low speeds, in cool climates, and with light loads, will have a longer tread life than tires operated at high-speeds, in hot climates, and with heavy loads.

Individual driving habits have more effect on tire tread life than any other factor. Careful/steady drivers will obtain, in most instances, far greater tire tread life than will intense or careless drivers. Rapid acceleration and deceleration, hard application of the brakes, high-speed driving, excessive turning speeds, contacting street curbs and other obstacles are just a few of the driving habits that will shorten the tread life of any tire.

The tire traction and the heat (temperature) resistance ratings follow the tread wear rating. They are encoded either **A, B or C.** An **A** code represents the best rating in either category.

The traction ratings are based upon a tires's ability to stop a vehicle on wet pavement when tested under controlled conditions on U.S. Government designated asphalt and concrete test surfaces.

The traction rating assigned to a specific tire is based on straight-ahead braking traction tests and does not include cornering/turning traction.

The heat (temperature) resistance rating represents a tire's resistance to temperature increases from rolling friction and its ability to dissipate heat under controlled conditions on a specified indoor laboratory test wheel. Sustained high tire temperature can cause the construction material of a tire to degenerate and this will greatly reduce the life of the tire. A C rating represents the minimum acceptable heat (temperature) resistance performance for a tire in accordance with FMVSS Number 109.

The heat (temperature) resistance rating assigned to a specific tire is based on the tire being properly inflated and not overloaded. Excessive speed, under-inflation and an excessive load, either separately or combined, can cause the temperature of a tire to increase well above normal and potentially cause tire failure.

ALL SEASON TIRES

An "All Season" tire will have either **M + S, M & S or M - S** (i.e., mud and snow) imprinted on the tire sidewall.

LOAD RANGE/PLY RATING

To obtain maximum vehicle stability and tire tread life, a vehicle must be equipped with the recommended suspension "package", including the correct tire size and load range rating. The recommended full-load capacity (load range) rating should never be exceeded. The load range/ply rating indicates the load capacity (i.e., the supporting ability) of a tire.

Radial-ply tires should always be installed in sets of four and should never be installed on the front only. Mixing radial-ply and bias-ply tires is not recommended. Mixed tire types can cause unpredictable vehicle handling.

LOAD RANGE-TO-PLY RATING

Load Range	Replaces Ply Rating
A	2
B	4
XL	4
C	6
D	8
E	10
F	12

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The gross (i.e., combined) weight of a vehicle can best be determined by weighing it after it has been loaded and is ready for travel. The vehicle should first be weighed via a commercial scale to ensure that the **gross vehicle weight rating (GVWR)** has not been exceeded. The weight being supported by the front and the rear tires should then be separately determined to ensure that the load is properly distributed. The air inflation pressures should then be adjusted, if necessary, to compensate for additional weight. Refer to **Inflation Pressures**.

INFLATION PRESSURES

The original equipment tires installed on Ram Truck and Ramcharger vehicles are selected and tested for conformance with the operating conditions normally encountered by these vehicles and for the tire load capacity. The recommended **cold** inflation pressures for different load conditions (i.e., light and full) are listed on the Tire Inflation Pressures chart and on a decal affixed to the interior surface of the door pillar.

Load conditions:

- light load—maximum of two passengers plus 200 lbs. (90 kg) cargo; and
- full load—heavier than a light load and up to the gross vehicle weight (GVW) specified for the vehicle.

The lower cold inflation pressures in the chart that are designated for tires involved with **light load** vehicle operation are intended to improve the quality of the "vehicle ride" and to decrease tire wear for vehicles that are normally operated either at or with less load weight than that specified for a light load.

The tire inflation pressures must be increased to those designated for full load operation for all vehicle load conditions that exceed the weight of a light load (as specified above).

Tire inflation pressure adjustments are not necessary for sustained, Interstate Highway operation up to 65 mph (104 km/h), however (where legal) passenger car type (i.e., P type) tires can be inflated to the recommended cold inflation pressure plus an additional 4 psi (27 kPa) if sustained vehicle operation exceeding 75 mph (120 km/h) is anticipated. **The inflation pressure must never exceed the maximum recommended air inflation pressure imprinted on the tire sidewall.**

Light-truck type (i.e., LT type) tires must be inflated to the recommended cold inflation pressure plus an additional 10 psi (69 kPa) if sustained vehicle operation exceeding 65 mph (104 km/h) is anticipated. **The inflation pressure must never exceed the maximum recommended air inflation pressure imprinted on the tire sidewall.**

For special vehicle operation with light-truck type tires (e.g., equipped with a camper or a similar "high center of gravity" vehicle application), the inflation pressure of the tires may be increased up to 10 psi (69 kPa) greater than the recommended cold inflation pressure.

The tire air inflation pressure should be measured and, if necessary, adjusted to the recommended air inflation pressure (cold) on a weekly basis. This is especially important if an extreme change (20°F/7°C or more) in the average seasonal temperature occurs.

MAXIMUM LOAD CAPACITY

PASSENGER CAR TYPE TIRES

TIRE SIZE	PER PAIR MAX. CAP. (LBS.)	PER PAIR MAX. CAP. (kg)	MAX. LOAD CAPACITY AT VARIOUS COLD INFLATION PRESSURES PSI & KILOPASCALS (PER PAIR)											
			PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa
			26	(180)	29	(200)	32	(230)	35	(240)	38	(260)	41	(283)
P195/75R15	2685	(1218)	2325	(1055)	2445	(1109)	2565	(1163)	2685	(1218)	–	–	–	–
P205/75R15	2905	(1318)	2525	(1145)	2665	(1208)	2785	(1263)	2905	(1318)	–	–	–	–
P225/75R15	3405	(1544)	2965	(1345)	3125	(1417)	3265	(1481)	3405	(1544)	–	–	–	–
P235/75R15-XL	3965	(1799)	3185	(1445)	3365	(1526)	3525	(1599)	3685	(1672)	3825	(1735)	3965	(1799)
P215/75R15	3167	(1436)	2745	(1245)	2885	(1309)	3025	(1373)	3167	(1436)	–	–	–	–

TRUCK TIRES USED WITH SINGLE REAR WHEELS

TIRE SIZE	LOAD RANGE	PER TIRE MAX. CAP. (LBS.)	PER TIRE MAX. CAP. (kg)	MAX. SINGLE TIRE LOAD CAPACITY AT VARIOUS INFLATION PRESSURES PSI & KILOPASCALS																					
				PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa
				30	(207)	35	(240)	40	(276)	45	(310)	50	(345)	55	(379)	60	(415)	65	(448)	70	(483)	75	(517)	80	(551)
7.50-16LT	D	2440	(1107)	1620	(735)	1770	(803)	1930	(875)	2060	(934)	2190	(993)	2310	(1048)	2440	(1107)	–	–	–	–	–	–	–	–
LT225/75R16	D	2335	(1060)	–	–	1500	(680)	1650	(748)	1790	(811)	1940	(880)	2060	(934)	2190	(993)	2335	(1059)	–	–	–	–	–	–
LT225/75R16	E	2680	(1215	–	–	1500	(680)	1650	(748)	1790	(811)	1940	(880)	2060	(934)	2190	(993)	2335	(1059)	2440	(1106)	2560	(1161)	2680	(1215)
LT245/75R16	E	3042	(1380)	–	–	1700	(771)	1865	(845)	2030	(920)	2205	(1000)	2335	(1058)	2480	(1125)	2623	(1189)	2765	(1254)	2900	(1315)	3042	(1380)
31 x 10.5R15LT	B	1775	(805)	1595	(723)	1775	(805)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
31-10.50R15LT	C	2250	(1020)	1595	(723)	1775	(805)	1945	(882)	2100	(953)	2250	(1020)	–	–	–	–	–	–	–	–	–	–	–	–
LT215/85R16	C	1940	(880)	–	–	1495	(678)	1640	(744)	1785	(810)	1940	(880)	–	–	–	–	–	–	–	–	–	–	–	–
LT215/85R16	D	2335	(1060)	–	–	1495	(678)	1640	(744)	1785	(810)	1940	(880)	2050	(930)	2180	(989)	7335	(1060)	–	–	–	–	–	–
LT235/85R16	E	3042	(1380)	–	–	1700	(771)	1870	(848)	2030	(920)	2205	(1000)	2335	(1058)	2485	(1127)	2623	(1189)	2765	(1254)	2905	(1317)	3042	(1380)
LT215/75R15	D			–	–	1345	(609)	1475	(668)	1600	(725)	1765	(800)	1845	(836)	1960	(888)	2095	(950)	–	–	–	–	–	–

TRUCK TIRES USED WITH DUAL REAR WHEELS

TIRE SIZE	LOAD RANGE	PER TIRE MAX. CAP. (LBS.)	PER TIRE MAX. CAP. (kg)	MAX. SINGLE TIRE LOAD CAPACITY AT VARIOUS INFLATION PRESSURES PSI & KILOPASCALS																					
				PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa
				30	(207)	35	(240)	40	(276)	45	(310)	50	(345)	55	(379)	60	(415)	65	(448)	70	(483)	75	(517)	80	(551)
7.50-16LT	D	2140	(971)	1430	(649)	1565	(710)	1690	(767)	1815	(823)	1930	(875)	2040	(925)	2140	(971)	–	–	–	–	–	–	–	–
LT225/75R16	D	2150	(975)	–	–	1365	(619)	1500	(680)	1630	(739)	1765	(800)	1875	(850)	1995	(904)	2150	(975)	–	–	–	–	–	–
LT215/85R16	C	1765	(800)	–	–	1360	(617)	1490	(676)	1625	(737)	1765	(800)	–	–	–	–	–	–	–	–	–	–	–	–
LT215/85R16	D	2150	(975)	–	–	1360	(617)	1490	(676)	1625	(737)	1765	(800)	1865	(844)	1985	(900)	2150	(975)	–	–	–	–	–	–

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INFLATION PRESSURE ADJUSTMENT

Correct tire inflation pressure is essential for safe and satisfactory operation of a vehicle. The following considerations are affected by incorrect tire pressure:

- under-inflation or over-inflation affect vehicle stability and can produce either a sluggish response or an over-response to driver operation;
- unequal inflation pressures (except as specified for certain driving conditions) can produce erratic and unpredictable vehicle response to driver steering operation;
- under-inflation results in rapid wear from the tread shoulders;
- under-inflation causes increased tire "flexing" and can result in complete tire failure;
- over-inflation produces an uncomfortable and "jarring" ride;
- over-inflation causes rapid wear from the center of the tread and the possibility of cuts, punctures and bruises;
- over-inflation causes decreased tire "flexing" (i.e., lost of ability to cushion road "shock") and hard objects on the road surface and/or "chuck holes" could can tire damage that could result in complete tire failure; and
- incorrect inflation pressure can cause uneven tread wear patterns to develop across the tire tread surface and these abnormal wear patterns will reduce the tread life, which will result in a necessity for earlier tire replacement.

Measure and adjust the inflation pressure only when either the tires are cold, have been driven less than 2 miles (3.2 km) at a speed less than 40 mph (64 km/h), or after the vehicle has been parked for 3 hours (or more).

Do not reduce the inflation pressure if the tires are hot, or have been driven more than 2 miles (3.2 km) at a speed exceeding 40 mph (64 km/h). Heat and high speed can cause the tire air pressure to increase as much as 6 psi (41 kPa) more than the cold inflation pressure because of the air expansion caused by the increased heat in the tire.

When measuring and adjusting a tire inflation pressure, always use a reliable and accurate gauge to ensure the proper inflation pressure.

TIRE INFLATION PRESSURES

RAMCHARGER AND RAM TWO-WHEEL DRIVE VEHICLES										
			LIGHT LOAD				FULL LOAD			
			FRONT TIRES		REAR TIRES		FRONT TIRES		REAR TIRES	
TIRE	LOAD RANGE	WHEEL SIZE (IN)	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa
P195/75R15	STD	15 x 6.5, 7	35	(240)	35	(240)	35	(240)	35	(240)
P205/75R15	STD	15 x 6.5, 7	35	(240)	35	(240)	35	(240)	35	(240)
P235/75R15	XL	15 x 6.5, HD, 7	35	(240)	35	(240)	35	(240)	41	(283)
LT215/85R16	C	16 x 6	35	(240)	35	(240)	45	(310)	50	(345)
LT215/85R16	D	16 x 6	35	(240)	35	(240)	50	(345)	65	(448)
LT 235/85R16	E	16 x 6	35	(240)	35	(240)	45	(310)	80	(551)
750-16 LT	D	16 x 6	35	(240)	35	(240)	45	(310)	60	(415)
WITH DIESEL ENGINE										
LT 235/85R16	E	16 x 6	40	(276)	40	(276)	45	(310)	80	(551)
P215/75R15	STD	15 x 6.5, 7	35	(240)	35	(240)	35	(240)	35	(240)

RAM VEHICLES WITH DUAL REAR WHEELS										
			LIGHT LOAD				FULL LOAD			
			FRONT TIRES		REAR TIRES		FRONT TIRES		REAR TIRES	
TIRE	LOAD RANGE	WHEEL SIZE (IN)	PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa
LT215/85R16	C	16 x 6	40	(276)	40	(276)	45	(310)	50	(345)
LT215/85R16	D	16 x 6	40	(276)	40	(276)	45[1]	(310)	65	(448)
750-16 LT	D	16 x 6	35	(240)	35	(240)	45	(310)	60	(415)
WITH DIESEL ENGINE										
LT215/85R16	C	16 x 6	45	(310)	45	(310)	50	(345)	50	(345)
LT215/85R16	D	16 x 6	45	(310)	45	(310)	50	(345)	65	(448)

[1] 50 PSI (345 kPa) for 159 inch wheelbase.

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Because of the wide variation in air pressure indications (inaccuracies) provided by many of the pressure gauges on service station air hoses, it is suggested that a pencil-type, air-pressure gauge be obtained and kept in the glove box for personal use whenever tire air pressures must be measured.

The tire valve caps (or valve extensions) should always be installed on the valve stem and tightened "finger tight" after air pressure measurement/adjustment. The caps assist in retaining air and also prevent foreign material from entering the valve.

SPARE TIRE

A conventional spare tire is standard equipment for all Ram Truck and Ramcharger vehicles.

ABNORMAL TIRE TREAD WEAR

Abnormal tire tread wear can be caused by incorrect inflation pressure, tire/wheel unbalance, worn suspension components, improper brake operation, bent wheels, incorrect front wheel alignment and excessive speed when turning the vehicle.

In most situations, inspection of the tire tread wear will reveal the cause of the abnormal wear. The illustration below (Fig. 3) depicts the various types of tire tread wear patterns and the recommended corrective action.

Rapid wear from the tire tread shoulders is usually caused by under-inflation or an excessive mileage interval between tire rotation, or a combination of both incidents. If this type of wear occurs and the tires are serviceable, rotate them and inflate them with the recommended air pressure when they are cool.

Rapid wear from the tire tread center is usually caused by over-inflation or an excessive mileage interval between tire rotation, or a combination of both incidents. If this type of wear occurs and the tires are serviceable, rotate them and inflate them with the recommended air pressure when they are cool.

Cracked tire treads are usually caused by alternate excessive under-inflation and over-inflation, exceeding the recommended full-load capacity, high temperature, excessive high-speed operation, or a combination of the incidents. Tires with cracked treads should be replaced and the replacement tires should be properly maintained to avoid a recurrence of the failure.

TIRE INFLATION PRESSURES (CONT'D)

RAMCHARGER AND POWER RAM FOUR-WHEEL DRIVE VEHICLES

TIRE	LOAD RANGE	WHEEL SIZE (IN)	LIGHT LOAD				FULL LOAD			
			FRONT TIRES		REAR TIRES		FRONT TIRES		REAR TIRES	
			PSI	kPa	PSI	kPa	PSI	kPa	PSI	kPa
P235/75R15	XL	15 x 6.5, 7	35	(240)	35	(240)	35	(240)	41	(283)
P235/75R15[1]	XL	15 x 6.5,HD	35	(240)	35	(240)	41	(283)	41	(283)
P235/75R15[2]	XL	15 x 6.5,HD	41	(283)	41	(283)	41	(283)	41	(283)
31 x 10.50R15 LT	C	15 x 7	35	(240)	35	(240)	35	(240)	50	(345)
LT 215/85R16	C	16 x 6	40	(276)	40	(276)	45	(310)	50	(345)
LT 215/85R16	D	16 x 6	40	(276)	40	(276)	45	(310)	65	(448)
LT 215/85R16[1]	D	16 x 6	45	(310)	45	(310)	55	(379)	65	(448)
LT 215/85R16[2]	E	16 x 6	55	(379)	55	(379)	55[3]	(379)	65	(448)
LT 235/85R16	E	16 x 6	35	(240)	35	(240)	45[3]	(310)	80	(551)
LT235/85R16[1]	E	16 x 6	40	(276)	40	(276)	45[3]	(310)	80	(551)
LT 235/85R16[2]	E	16 x 6	50[3]	(345)	50[3]	(345)	45[3]	(310)	80	(551)
750-16 LT	D	16 x 6	35	(241)	35	(241)	50	(345)	60	(415)
750-16 LT[2]	D	16 x 6	50	(345)	50	(345)	50	(345)	60	(415)
31 x 10.5R15 LT	B	15 x 7	35	(240)	35	(240)	35	(240)	35	(240)
WITH DIESEL ENGINE										
LT 235/85R16	E	16 x 6	45	(310)	45	(310)	55	(379)	80	(551)
POWER RAM WITH DUAL REAR WHEELS										
LT 215/85R16	C	16 x 6	45	(310)	45	(310)	50	(345)	50	(345)
LT 215/85R16	D	16 x 6	45	(310)	45	(310)	50	(345)	65	(448)
LT 215/85R16[1]	D	16 x 6	50	(350)	50	(345)	65	(448)	65	(448)
LT 215/85R16[2]	D	16 x 6	65	(448)	65	(448)	65	(448)	65	(448)
750-16 LT	D	16 x 6	35	(240)	35	(240)	50	(345)	60	(415)
750-16 LT[1]	D	16 x 6	40	(276)	40	(276)	55	(379)	60	(415)
750-16 LT[2]	D	16 x 6	55	(379)	55	(379)	55	(379)	60	(415)
WITH DIESEL ENGINE										
LT 215/85R16	C	16 x 6	50	(345)	50	(345)	50	(345)	50	(345)
LT 215/85R16	D	16 x 6	50	(345)	50	(345)	65	(448)	65	(448)
7.50-16 LT	D	16 x 6	45	(310)	45	(310)	55	(379)	60	(415)

[1] Equipped for snow plow service, but not carrying blade. **[3] 55 PSI (379 kPa) for heavy duty snow plow package.**
[2] Equipped for snow plow service and carrying blade.

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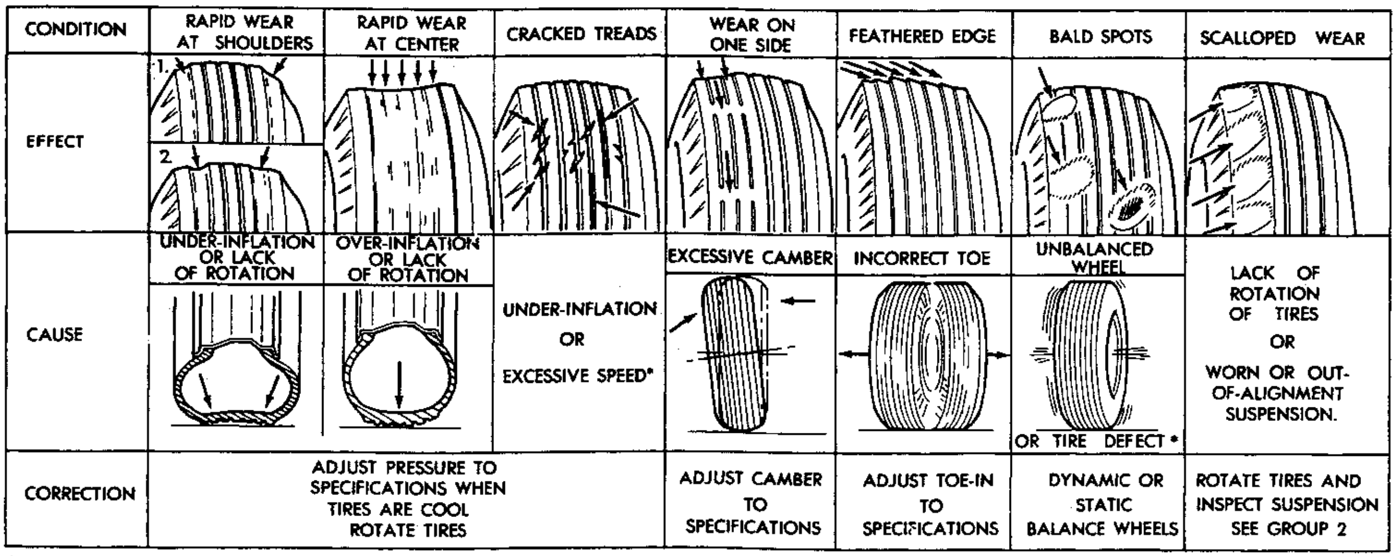

CONDITION	RAPID WEAR AT SHOULDERS	RAPID WEAR AT CENTER	CRACKED TREADS	WEAR ON ONE SIDE	FEATHERED EDGE	BALD SPOTS	SCALLOPED WEAR
EFFECT	1. 2.						
CAUSE	UNDER-INFLATION OR LACK OF ROTATION	OVER-INFLATION OR LACK OF ROTATION	UNDER-INFLATION OR EXCESSIVE SPEED*	EXCESSIVE CAMBER	INCORRECT TOE	UNBALANCED WHEEL OR TIRE DEFECT*	LACK OF ROTATION OF TIRES OR WORN OR OUT-OF-ALIGNMENT SUSPENSION.
CORRECTION	ADJUST PRESSURE TO SPECIFICATIONS WHEN TIRES ARE COOL ROTATE TIRES			ADJUST CAMBER TO SPECIFICATIONS	ADJUST TOE-IN TO SPECIFICATIONS	DYNAMIC OR STATIC BALANCE WHEELS	ROTATE TIRES AND INSPECT SUSPENSION SEE GROUP 2

*HAVE TIRE INSPECTED FOR FURTHER USE.

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Fig. 3 Abnormal Tire Tread Wear Patterns

Excessive wear from one tread shoulder can be caused by excessive speed on turns or by an incorrect camber angle. An incorrect negative camber angle will cause excessive wear from the inside tire shoulder while an incorrect positive camber angle will cause excessive wear outside tire shoulder. If this type of tread wear occurs, measure the camber angle. If the camber angle is within the specified limits, caution the owner about excessive speed when turning. If the tires are serviceable, rotate them and adjust them with the recommended air pressure.

An incorrect wheel "toe" position will cause the tire tread surface to develop a feathered edge. One side of the tread will be rounded while the opposite side will have a feathered edge. This type tread wearindicates that the tire is side slipping and scuffing as it moves over the street/road surface.

A feathered tread edge that faces toward the vehicle indicates excessive "toe-in". A feathered tread edge that faces away from the vehicle indicates excessive "toe-out". The direction that a feathered edge has developed can be determined by passing your hand over the tire tread surface. Bent steering knuckle arms can also cause this type of wear.

If a feathered edge develops, measure and correct the "toe" position as necessary and rotate the tires if they are serviceable.

WHEELS

STANDARD WHEELS

The standard equipment wheels installed on Ram Truck and Ramcharger vehicles are drop center, J-type, steel wheels with safety rims.

The steel wheels are the two-piece type that consist of a rim and center section (spider). The two sections are welded together to form a seamless, air-tight unit.

A wheel safety rim has a "ridge" (i.e., a raised edge) located inboard of each rim flange and at the top of the rim well (Fig. 4). When a tire is initially inflated, the air pressure forces the tire beads over the "ridges" and "seats" them in the "valleys" and against the rim flanges. During extreme "cornering" (i.e., turning a vehicle at high speed), tire and wheel rim separation is prevented because the tire air pressure retains each tire bead "seated" in the "valley" between the "ridge" and the rim flange. In addition, when tire failure occurs, the "ridges" also aid in retaining the tire beads in the "valleys" until the vehicle is safely stopped.

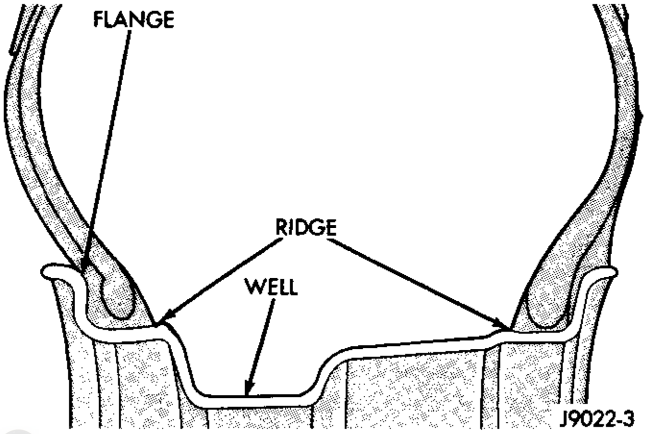

Fig. 4 Wheel Safety Rim

DUAL REAR WHEELS

Ram Truck Models D-350 and W-350 that are equipped with dual rear wheels have eight-stud hole rear wheels with four equally-spaced stud holes that are flanged outward and four that are flanged inward. The outer wheel must be installed so the flanged stud holes mate correctly with the flanged stud holes in the inner wheel (Fig. 5).

A locating pin in the hub provides assistance for correctly aligning the inner and outer wheels.

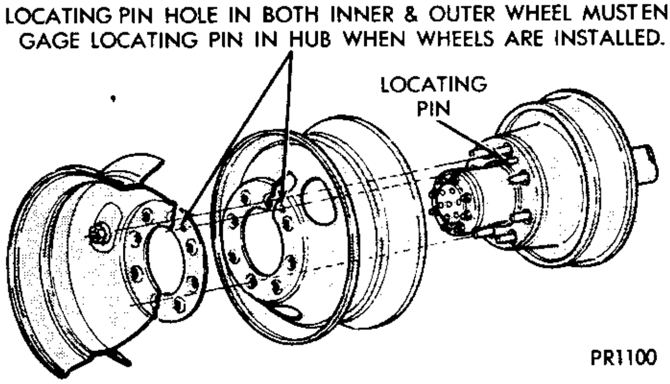

Fig. 5 Eight-Stud Hole Dual Rear Wheels

TIRE SERVICE

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INSPECTION

To maximize tire longevity, inspect tires frequently for the effects of incorrect inflation and other causes of uneven wear, which can also indicate a need for tire/wheel balancing, tire rotation or front-end alignment. Tires should also be inspected frequently for cuts, abrasions, stone bruises, blisters and for objects imbedded in the tire tread. Weekly inspection is recommended as the minimum interval of time. More frequent inspections are recommended when extreme temperature changes occur and when the street/road surfaces are rough (or littered with debris).

For an additional visual reminder of tire tread condition, tread wear indicators are molded into the bottom of the tire tread grooves. These indicators appear in the form of 1/2-inch (13-mm) wide bands across the tread when it has worn down to a thickness of 1/16 of an inch (1.58 mm) or less. The tire should be replaced when these bands become visible. The illustration below (Fig. 6) depicts tire tread that is still acceptable and tire tread that has worn down to a indicator (unacceptable).

As the tread depth decreases, the tires have less resistance to road hazards and are more likely to "hydroplane" on a road surface covered with water.

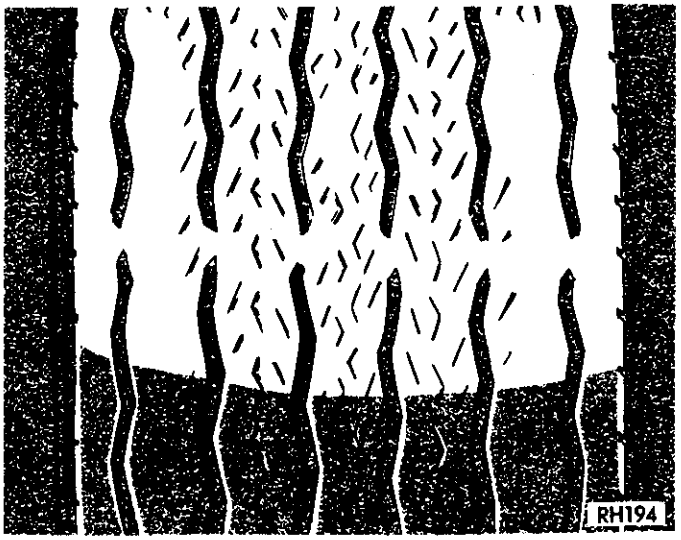

Fig. 6 Tire Tread Condition

CLEANING

Clean tires with a mild soap and water solution only and rinse them thoroughly with water. Do not use caustic solutions or abrasive materials. To clean white sidewalls and raised letters/numbers, use an approved whitewall cleaner only. Do not use steel wool, wire brushes or cleaning solutions that have a mineral oil base (e.g., gasoline, paint thinner and turpentine). These solutions are harmful to the tires and will also discolor white sidewalls and raised letters/numbers.

Most white sidewall tires have a colored protective coating that should be removed from the tires before delivery of the vehicle. **The protective coating is not as flexible as rubber and it will eventually crack, which could cause white sidewall "checking" (if not removed).** In any event, the tires should not be driven more than 50 miles (80 kilometers) before the protective coating is removed.

To remove the protective coating, wet the tire sidewall surface thoroughly with warm water and allow it to "soak" for one minute. Use a soft-bristle brush or sponge to wash the protective coating from the tire. The coating can also be removed by steam cleaning. Do not use gasoline or other harmful solvents. Do not use a wire brush.

REPAIR

GUIDELINES AND PRECAUTIONS

Punctured tires should be removed from the wheel and permanently repaired on the inside with a combination of a repair plug and a vulcanizing patch. When repairing punctures, always follow the manufacturer's instructions for a repair kit installation. Only punctures in the **tread area** are repairable (Fig. 7).

Never attempt to repair punctures in the tire shoulders or sidewalls.

In addition, never attempt to repair any tire that has any of the following damage conditions:

- bulges or blisters;

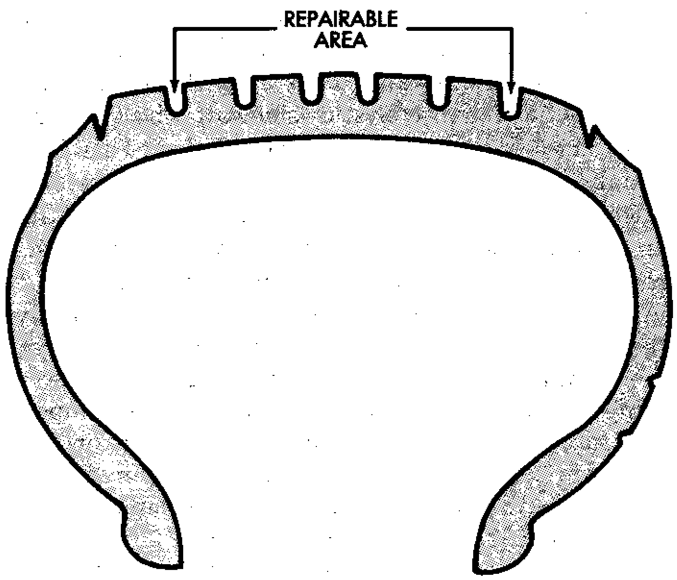

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Fig. 7 Repairable Puncture Area

- ply separations;
- broken, cut or cracked beads;
- fabric cracks cuts;
- tread worn to the fabric or to the wear indicators; or
- punctures larger than 1/4 of-an-inch in diameter.

Externally applied repair plugs, "blowout" patches and aerosol sealants should be considered as **emergency-type** repairs only. Tires repaired by any of these methods should not be driven at a speed exceeding 40 mph (64 km/h) or for more than 75 miles (121 km) before permanent tire repair or replacement of the tire.

TIRE REMOVAL/INSTALLATION

The tools used for "dismounting" and "mounting" tires must be smooth and free of sharp edges and burrs that could damage a tire bead and wheel rim.

A tire must be completely deflated before the tire beads are separated from the rim valley "seats". Before "mounting" a tire on a wheel, ensure that all "rust" scale is removed from the rim. Paint the rim, if necessary. Lubrication, either a mild soap solution or a commercial tire bead lubricant **MUST** be applied to both tire bead surfaces when either "mounting" or "dismounting" a tire.

A standard, commercial "tourniquet" type tire bead expander can be used to "seat" regular bias-ply tire beads, but bias-belted and radial-ply tires require a type of bead expander designed for less flexible tire sidewalls.

ROTATION

To equalize tread wear, tires should be rotated at the specified interval. The first tire rotation is the most important for establishing the prevention of uneven tread wear. After rotation, adjust the tire inflation to the air pressure recommended on the decal affixed to the interior surface of the driver-side door pillar.

Because "long-wearing" tires can be more susceptible to irregular tread wear, it is very important to rotate the tires at the specified interval to achieve the tread life potential of the tires. Also, correct wheel and tire balance and front end alignment must be maintained for extended tire tread life.

With continued severe operation (e.g., trailer towing), the tires should be rotated more frequently than the specified interval.

Uneven tire tread wear is frequently the cause of tire induced noises that are attributed to axle gears, bearings, etc. and often cause unnecessary repair to other chassis components in an effort to eliminate the noises.

The suggested methods of tire rotation for Ram Truck and Ramcharger vehicles are illustrated below (Figs. 8 and 9). The methods are completely compatible with the tire industry's currently recommended procedure for rotation of radial-ply and bias-ply tires. Other rotation patterns/methods can be used, but they will not necessarily provide all the tire longevity benefits that are derived from the suggested methods.

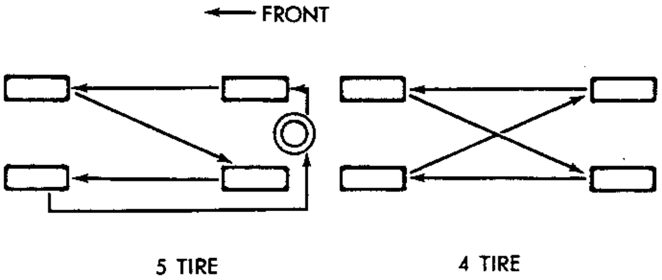

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Fig. 8 "Rearward Cross" Rotation Pattern

WIDE-TREAD TIRES

Radial-ply, wide-tread tires must be installed in complete sets and only when there is adequate clearance for the tire in the wheel well. **Tires with different widths must never be intermixed.**

CAUTION: The tires installed on van/wagon vehicles must all have the same circumference to maintain satisfactory operation. They must also be the same size, construction and have the same inflation pressure. Intermixing tires of different size or construction will cause unusual handling, noisy operation and accelerated wear of the driveline components.

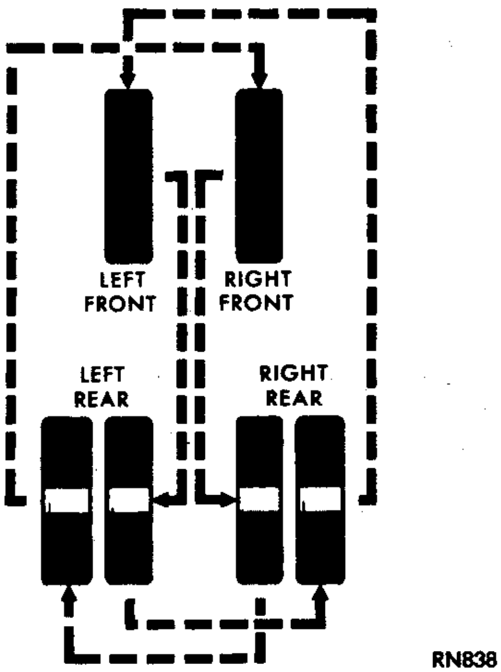

Fig. 9 Dual Wheel Tire Rotation Pattern

TIRE DIAGNOSIS

GENERAL INFORMATION

Roughness, vehicle vibration, tire “tramp”, wheel “shimmy” and tire “thump/wheel hop” are usually the result of either excessive tire/wheel “runout”, “cupped” tires or tire/wheel unbalance. These problem conditions can also be caused by driving over rough or irregular street/road surfaces. Test driving a vehicle on different street/road surfaces will usually help determine if the street/road surfaces or the tires are causing the undesirable ride condition.

Always road test a vehicle to determine the exact nature of a problem. Drive the vehicle for at least 10 miles (16 km) to warm the tires and remove temporary “flat” spots that could have formed while the vehicle was parked. Note the tire condition and wear, and measure and adjust the inflation pressure before road testing.

PERFORMANCE CHARACTERISTICS

As a result of their unique construction, radial-ply tires have **ride, handling and appearance** characteristics that are noticeably different from the tires previously used.

If the low-speed ride quality or “feel” of the tires appears harsh, this is a normal characteristic and is caused by the stiff belts used in radial-ply tire construction. Harshness often leads to the assumption that the tires are over-inflated. Do not under-inflate radial-ply tires in an attempt to correct this condition. Inflate radial-ply with the recommended air pressure only.

Because the radial tire plies are positioned at a 90 degree angle to the tread centerline, they have highly flexible sidewalls. It is this flexibility that produces the characteristic sidewall “bulge” and causes the tire to appear under-inflated. This is a normal condition. Do not attempt to reduce the “bulge” by over-inflating the tire. Measure the inflation pressures with an accurate gauge and inflate the tires with the recommended air pressure only.

At a speed of 15 mph (24 km/h) or less, radial-ply tires can cause a side-to-side or “waddle” motion. Wheel balancing will not correct this condition.

Proper installation of radial-ply tires is very important. Incomplete “seating” of the tire bead on the wheel rim can produce a high frequency vibration at a speed above 45 mph (72 km/h). Incomplete bead “seating” can be determined by visually inspecting the tire. Correction involves removing and “re-seating” the tire on the wheel rim.

Because of the construction, radial-ply tires are sometimes less responsive to certain methods of wheel balancing. Radial-ply tire balancing is best accomplished using dynamic, two-plane, off-vehicle balancing equipment.

TIRE THUMP

Tire “thump” (noise) is caused by the tire moving over irregularities in the streets/roads or by irregularities in the tire itself. The “thump” sound coincides with each wheel rotation.

To identify the tire that is causing the **thump**, inflate all the tires with 45 psi (310 kPa) of air pressure temporarily and drive over the same streets/roads. If the “thump” noise does not exist, reduce the air pressure in one tire at a time repeat the road test. Each road test is accomplished with three of the tires with high air pressure and one with the recommended air pressure. When the **thump** develops again, the tire that was the most recently reduced to normal inflation pressure is the defective tire.

TIRE TRAMP

Tire “tramp” is caused by either tire/wheel static unbalance or by excessive tire/wheel lateral runout.

Static unbalance occurs when a disproportional amount of weight (mass) is concentrated at a small area on the tire/wheel (Fig. 10). This causes a vibratory-type pounding action that is commonly referred to as tire **tramp** or wheel hop. Static balance is achieved by an equal distribution of weight (mass) around the circumference of the tire/wheel.

The most effective method of determining static unbalance is by the use of off-vehicle wheel balancing equipment.

WHEEL SHIMMY

Wheel “shimmy” is caused by tire/wheel dynamic unbalance.

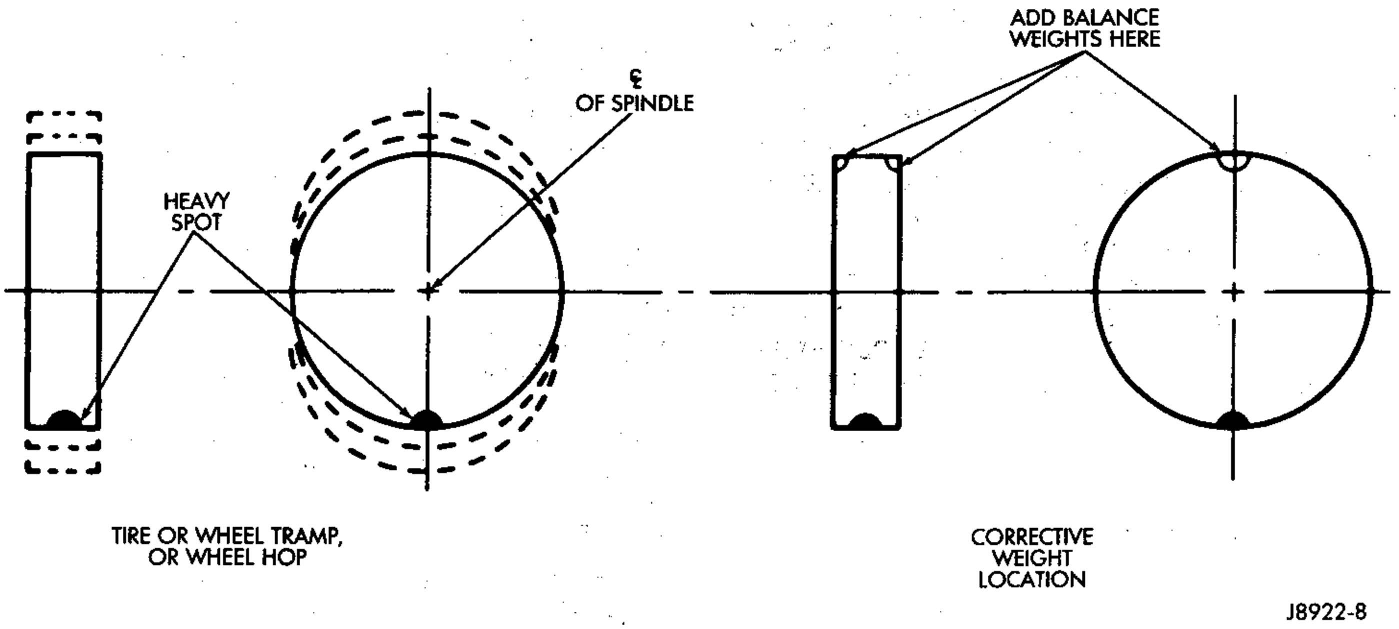

Fig. 10 Static Unbalance & Balance

Dynamic unbalance results from unequal forces being concentrated at opposing locations on the circumference of the tire/wheel during wheel rotation (Fig. 11). This condition causes wheel shimmy and vibration at medium and high wheel rotation speeds. Dynamic balance is achieved by an equal distribution of tire/wheel weight (mass) around the plane of rotation (Fig. 11). This equalizes the forces and allows the wheel to rotate smoothly around the axis that bisects the tire and wheel center line.

The most effective method for balancing tires/wheels is by the use of equipment that will detect both static and dynamic unbalance. Dynamic, two-plane balancing equipment is recommended.

CAUTION: DO NOT balance a tire/wheel that has been removed from a vehicle that has not been recently driven at least 10 miles (16 km) to eliminate any existing "flat spot". The "flat spot" results from the weight of the vehicle being supported by a small area of the tire for an extended period of time. The extent of the "flat spot" on a tire is usually more severe during cold weather.

Because balancing procedures vary with different types of equipment, follow the manufacturer's operating instructions explicitly to obtain satisfactory results.

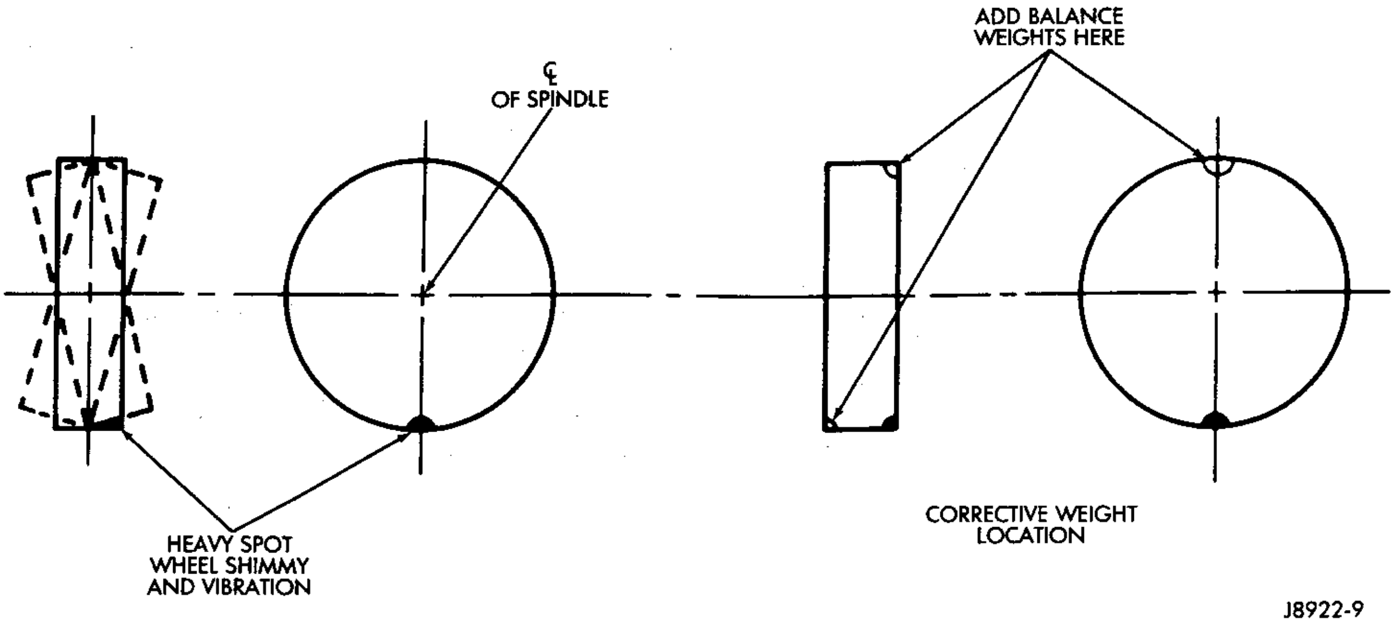

Fig. 11 Dynamic Unbalance & Balance

WARNING: ON-VEHICLE TYPE TIRE/WHEEL BALANCING EQUIPMENT CAN BE USED ON THE REAR WHEELS OF VEHICLES EQUIPPED WITH A "LIMITED-SLIP" (SURE-GRIP OR TRAC-LOK) DIFFERENTIAL, BUT ONLY AFTER RAISING THE REAR END AND REMOVING THE WHEEL OPPOSITE THE ONE TO BE BALANCED. IN ADDITION, DO NOT EXCEED 35 MPH (56 KM/H) WHEN ROTATING THE WHEELS. AS A RESULT OF THE DIFFERENTIAL ACTION, THE ACTUAL WHEEL ANGULAR VELOCITY IS TWICE THE SPEED INDICATED ON THE VEHICLE SPEEDOMETER. THE CENTRIFUGAL FORCE PRODUCED BY A TIRE ROTATING AT HIGH SPEED COULD CAUSE DAMAGE AND PERSONAL INJURY.

TIRE AND WHEEL RUNOUT

Excessive radial or lateral "runout" of a tire or wheel can cause roughness, vehicle vibration, tire "tramp", wheel "hop", excessive tire tread wear and wheel tremor.

Before measuring the tire/wheel **"runout"**, drive the vehicle for at least 10 miles (16 km) to remove any temporary flat spots that could have formed in the tires when parked. Flat spots must be removed to avoid false indications when measuring the runout.

Measure the "runout" with either a dial indicator or with wheel alignment equipment. All measurements should be accomplished with the tires inflated with the recommended air pressure and with the wheel bearings properly adjusted (if applicable).

Measure the radial "runout" (i.e., the tire perimeter eccentricity) at both the center and outside ribs of the tire tread face. Measure the lateral "runout" (i.e., the tire horizontal deviation) at the tire sidewall immediately above the buffing rib on the sidewall (Fig. 12). Identify and mark the tire radial and lateral **major** "runouts" for reference.

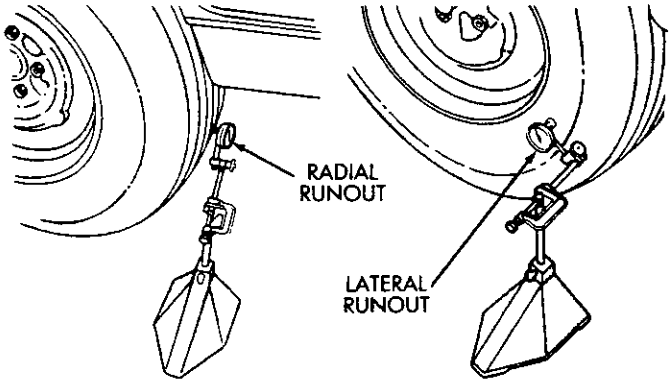

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Fig. 12 Tire Radial/Lateral "Runout" Measurement

The tire radial "runout" should not exceed 0.09 of-an-inch (2.29 mm) and the tire lateral "runout" should not exceed 0.10 of-an-inch (2.54 mm). If the tire radial and/or lateral "runout" exceeds the specified limit, it will be necessary to measure the wheel radial and/or lateral "runout" to determine whether the tire or the wheel is causing the excessive "runout".

Wheel radial "runout" (i.e., the wheel perimeter eccentricity) is measured on the wheel rim immediately inside the location where the wheel cover retaining "nibs" are normally "seated" (Fig. 13). Wheel lateral "runout" (i.e., the wheel horizontal deviation) is measured on the wheel rim flange immediately inboard of the curved lip/J-hook (Fig. 13). Identify and mark the wheel radial and lateral **major** "runouts" for reference.

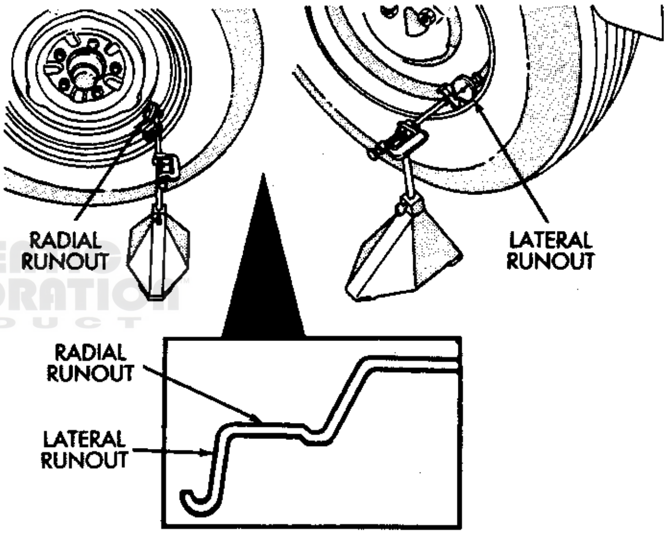

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Fig. 13 Wheel Radial/Lateral "Runout" Measurement

The wheel radial "runout" for 15-inch wheels should not exceed 0.030 of-an-inch (0.762 mm) and for 16-inch wheels should not exceed 0.045 of-an-inch (1.143 mm). The wheel lateral "runouts" should not exceed 0.045 of-an-inch (1.143 mm) for all wheels. Refer to the Wheel "Runout" Specifications chart.

WHEEL "RUNOUT" SPECIFICATIONS

WHEEL SIZE	RADIAL RUNOUT	LATERAL RUNOUT
15 X 6.5 inch	0.030 in (0.762 mm)	0.045 in (1.143 mm)
15 X 7.0 inch	0.030 in (0.762 mm)	0.045 in (1.143 mm)
16 X 6.0 inch	0.045 in (1.143 mm)	0.045 in (1.143 mm)

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If the tire "runout" (either radial or lateral) exceeds the specified limit but the corresponding wheel "runout" is within the specified limit, the tire "runout" can be reduced to an acceptable amount by changing the tire position on the wheel so that the previously marked **major** "runouts" on the tire and on the wheel are 180 degrees apart.

With disc brakes, excessive wheel lateral "runout" can also be caused by excessive rotor hub-to-bore "runout". Refer to the rotor inspection procedure in Group 5—Brakes.

VEHICLE VIBRATION

Vehicle vibration can be caused by tire/wheel unbalance or excessive "runout"; defective or tires with extreme tread wear; nylon overlay "flat spots" (performance tires only); incorrect wheel bearing adjustment (if applicable); loose or worn suspension/ steering components; certain tire tread patterns; incorrect drive shaft angles or excessive drive shaft/ yoke "runout"; defective or worn U-joints; excessive brake rotor or drum "runout"; loose engine or transmission supports/mounts; and by engine operated accessories.

VIBRATION TYPES

There are two types of vehicle vibration:

- mechanical and
- audible.

Mechanical vehicle vibration can be "felt" through the seats, floor pan and/or steering wheel. It will usually produce some visible motion in the rear view mirror, fenders, instrument panel and steering wheel.

Audible vehicle vibration is heard or "sensed" above normal background noise and, in some circumstances, it occurs as a "droning or drumming" noise, while in other situations it produces a buffeting sensation that is "felt or sensed" by the vehicle occupants rather than being heard.

Mechanical and audible vehicle vibrations are sensitive to changes in the engine torque, the vehicle speed and/or the engine speed (rpm). They usually occur within one (or sometimes within two) well-defined range of conditions in terms of vehicle speed, engine speed (rpm) and engine torque application.

ENGINE TORQUE SENSITIVE VIBRATION

This vibration condition can be improved or caused to be more severe by either accelerating, decelerating, coasting, or maintaining a constant vehicle speed and constant engine torque.

VEHICLE SPEED SENSITIVE VIBRATION

This vibration condition always occurs at the same vehicle speed regardless of the engine torque, engine speed (rpm) or the transmission gear selected.

ENGINE SPEED (RPM) SENSITIVE VIBRATION

This vibration condition occurs at varying vehicle speeds when a different transmission gear is selected. It can sometimes be isolated by increasing or decreasing the engine speed (rpm) with the transmission in **NEUTRAL** position.

VIBRATION DIAGNOSIS

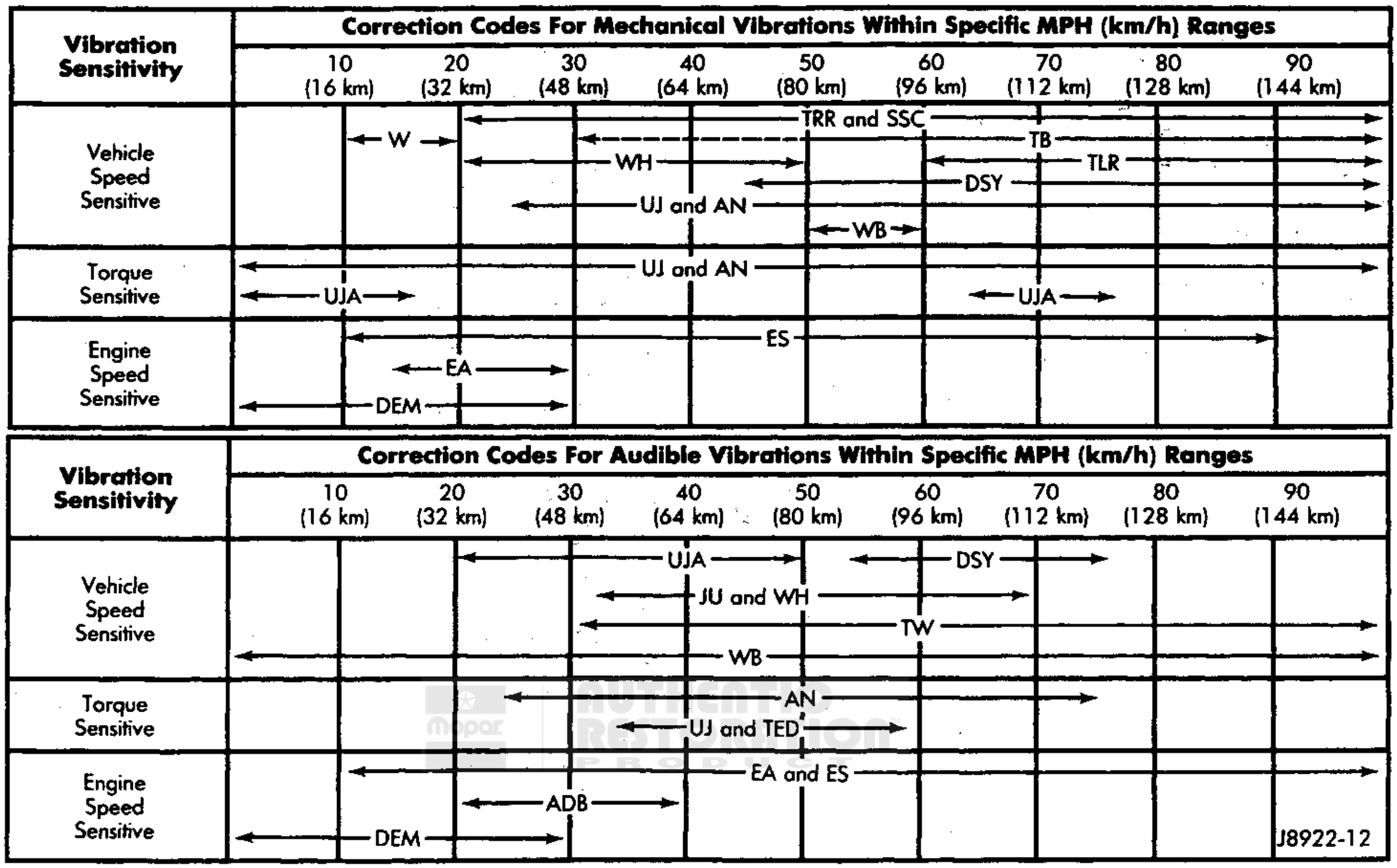
A vibration diagnosis should always begin with a preliminary 10 mile (16 km) trip (to "warm" the vehicle and tires) and then a road test to identify the characteristics of the vibration. Corrective action **should not** be attempted until the vibration type, magnitude and speed range have been identified via a road test.

During the road test, drive the vehicle on a street/ road that is smooth and free of irregular surface areas. If vibration exists, note and record the following information:

- identify the vehicle speed range when the vibration occurs;
- identify the type of vibration (i.e., mechanical or audible);
- identify the vibration sensitivity (i.e., engine torque sensitive, engine speed (rpm) sensitive or vehicle speed sensitive); and
- determine if the vibration is affected by changes in vehicle speed, engine speed (rpm) and engine torque.

When the vibration type, the sensitivity, the vehicle speed range and the source of any vibration changes have been identified, refer to the Vibration Diagnosis chart for probable causes. Consider correcting only those causes coded in the chart that are related to the vibration condition.

VIBRATION DIAGNOSIS



Refer to the following cause codes and descriptions for explanations when referring to the chart.

TRR—Tire and Wheel Radial Runout.

Vehicle speed sensitive, mechanical vibration. The "runout" will not cause vibration below 20 mph (32 km/h). The vehicle speed that is required to cause vibration will increase as the amount of "runout" decreases.

WH—Wheel Hop.

Vehicle speed sensitive, mechanical vibration. The wheel "hop" generates rapid up-down movement in the steering wheel and the instrument panel. The vibration is most noticeable in the 20 - 40 mph (32 - 64 km/h) vehicle speed range. The wheel "hop" will not cause vibration below 20 mph (32 km/h). Wheel "hop" is caused by a tire/wheel that has a radial "runout" of more than 0.045 of-an-inch (1.14 mm). If the wheel "runout" is acceptable and the combined "runout" cannot be reduced by repositioning the tire on the wheel, replace the defective tire.

TB—Tire/Wheel Balance.

Vehicle speed sensitive, mechanical vibration. Static tire/wheel unbalance will not cause vibration below 30 mph (46 km/h). Dynamic tire/wheel unbalance will not cause vibration below 40 mph (64 km/h).

TLR—Tire/Wheel Lateral runout.

Vehicle speed sensitive, mechanical vibration. The "runout" will not cause vibration below 50 - 55 mph (80 - 88 km/h) unless it extremely excessive. Extremely excessive lateral "runout" will also cause front-end "shimmy".

TW—Tire Wear.

Vehicle speed sensitive, audible vibration. Abnormal tire wear causes small vibration in the 30 - 55 mph (88 km/h) vehicle speed range and will produce a "whine" noise at high speed. The whine will change to a "growl" noise when the speed is reduced.

W—Tire Waddle.

Vehicle speed sensitive, mechanical vibration. Irregular tire uniformity can cause "waddle" (side-to-side) motion during speeds up to 15 mph (24 km/h). If the motion (waddle) is excessive: identify the defective tire(s) by removing each tire (one at a time); substituting it with a known good tire; and road testing. When identified, replace the defective tire(s).

UAJ—Universal Joint (Drive Shaft) Angles.

Torque/vehicle speed sensitive, mechanical/audible vibration. Incorrect drive shaft angles cause mechanical vibration below 20 mph (32 km/h) and in the 70 mph (112 km/h) range. The incorrect angles can also produce an audible vibration in the 20 - 50 mph (32 - 80 km/h) range.

UJ—Universal Joints.

Engine torque/vehicle speed sensitive, mechanical/audible vibration. If the needle bearings, bearing cups or bearing ends of the spiders are either worn, damaged, over-tightened or loose, they will cause vibration with almost any vehicle speed/engine torque condition.

DSY—Drive Shaft and Yokes.

Vehicle speed sensitive, mechanical/audible vibration. The condition will not cause vibration below 35 mph (56 km/h). Excessive "runout", unbalance, missing balance weights, undercoating on the shaft tube, dents and bends in the shaft tube will cause the vibration. Identify the actual cause and repair/replace as necessary.

WB—Wheel Bearings.

Vehicle speed sensitive, mechanical/audible vibration. Loose wheel bearings cause "shimmy-like" vibration at 35 mph (56 km/h) and above. Rough or damaged bearings will also produce a "growl" noise at low vehicle speed and/or a "whine" noise at high vehicle speed. The wheel bearings must be adjusted or replaced, as applicable.

AN—Axle Noise.

Engine torque/vehicle speed sensitive, mechanical/audible vibration. The axle will not cause mechanical vibration unless the axle shaft is bent. Worn or damaged axle drive pinion gear shaft or differential gears and bearings will cause noise at varying speed ranges in relation to the amount of engine torque applied. Replace the defective component(s) as necessary.

SSC—Suspension and Steering Components.

Vehicle speed sensitive, mechanical vibration. Worn, damaged or loose suspension/steering components (i.e., steering dampener, steering knuckles, pitman arm, springs, spring U-bolts or center bolts, shock absorbers, tie rod ball-stud ends, etc.) can cause mechanical vibration at speeds above 20 mph (32 km/h). Identify and repair or replace the defective component(s).

EA—Engine Driven Accessories.

Engine speed sensitive, mechanical/audible vibration. Vibration can be caused by loose or broken A/C compressor (or bracket), PS pump (or bracket), water pump, alternator (or bracket), etc. Usually more noticeable when the transmission is shifted into the NEUTRAL position and the engine speed (rpm) increased. Inspect the engine driven accessories in the engine compartment and repair/replace as necessary.

ADB—Accessory Drive Belts.

Engine speed sensitive, audible vibration. Loose/worn drive belts can cause a vibration that produces either a "droning, fluttering or rumbling" noise. Inspect the drive belts and tighten/replace them as necessary.

DEM—Damaged Engine or Transmission Support Mounts.

Engine speed sensitive, mechanical/audible vibration. If a support mount is either loose, worn or broken, noise or vehicle vibration will be the result if either the engine, transmission or an engine accessory contacts the vehicle body. Inspect the support mounts and repair/replace as necessary.

ES—Exhaust System.

Engine speed sensitive, mechanical/audible vibration. If loose or broken exhaust components contact the vehicle body they will cause noise and, in some instances, vehicle vibration. In addition, if mis-aligned exhaust components (e.g., muffler, converter, pipes, or hangers) contact the vehicle body or the driveline components, the result will be noise and/or vehicle vibration. Inspect the exhaust system for loose, broken and mis-aligned components and repair/replace as necessary.

WHEEL SERVICE

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INSPECTION

The wheels installed on Ram Truck and Ramcharger vehicles will provide maximum durability and performance when properly serviced and maintained.

A frequent inspection routine is recommended To ensure that the rims and wheels are in good condition. The wheel inspections should accomplished during tire inspections and when the tires are replaced.

Replace any wheel that is cracked, is bent, is severely dented, has excessive "runout" or has broken welds. The tire inflation valve should also be inspected frequently for wear, leakage, cuts and looseness. The valve should be replaced if defective or its condition is doubtful.

CLEANING

Clean the wheels with a mild soap and water solution only and rinse thoroughly with water. Never use abrasive or caustic materials, especially on aluminum or chrome-plated wheels because the surface will be etched or the plating severely damaged. After cleaning aluminum or chrome-plated wheels, apply a coating of protective wax to preserve the finish and the lustre.

LUG NUT TIGHTENING

SAFETY-RIM WHEELS

Always tighten safety-rim wheel lug nuts in a crisscross pattern (Fig. 14) with the specified torque. The lug nuts have right-hand threads.

DUAL REAR WHEELS

When Ram Truck Models D-350 and W-350 are equipped with dual rear wheels, a special, heavy duty lug nut tightening wrench is required for correct lug nut tightening (Fig. 15). Therefore, it is recommended to remove and install dual rear wheels only when a proper facility and wrench are available.

The dual rear wheels have eight-stud holes. Four stud holes are equally-spaced, outward flanged holes and four stud holes are equally spaced, inward flanged holes. The outer wheel must be installed so that its flanged stud holes mate correctly with the flanged stud holes in the inner wheel (Fig. 16).

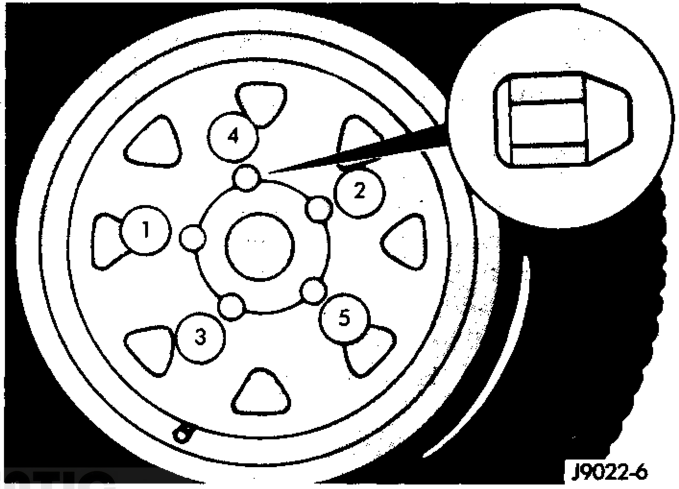

Fig. 14 Safety-Rim Wheel Lug Nut Tightening Pattern

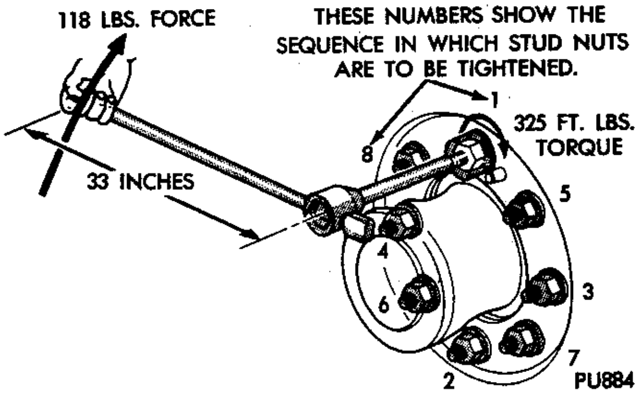

Fig. 15 Dual Rear Wheel Tightening Pattern

A locating pin in the hub provides assistance for correctly aligning the inner and outer wheels (Fig. 16).

INSTALLATION

The tires on both wheels must be completely raised off the ground when tightening the lug nuts to ensure correct wheel centering and maximum wheel clamping.

A 1 and 1/8-inch diameter flanged-type wheel lug nut with right-hand threads is used for retaining dual rear wheels on the hubs. A special, heavy duty

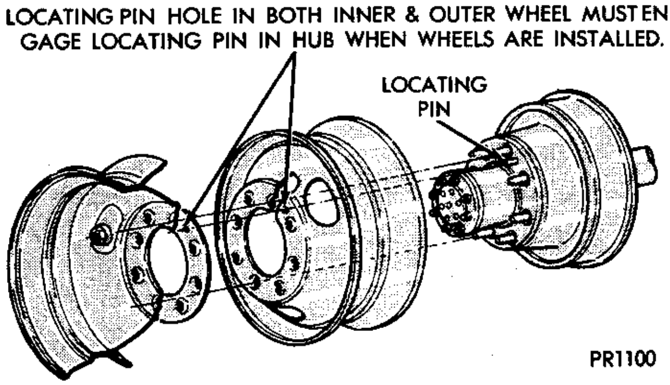

Fig. 16 Eight-Stud Hole Dual Rear Wheels

wheel lug nut wrench is necessary to correctly tighten the nuts with the required torque (Fig. 15).

The dual rear wheel lug nuts should be tightened according to the following procedure:

- tighten the wheel lug nuts in the numbered sequential pattern until they are "snug" tight (Fig. 15);
- tighten the wheel lug nuts in the numbered sequential pattern (Fig. 15) with 440 N•m (325 ft-lb) torque;
- tighten the lug nuts in the numbered sequential pattern (Fig. 15) a second time with the specified torque to ensure that the wheels are thoroughly mated; and
- re-tighten the lug nuts with the specified torque after 100 miles (160 kilometers) and after 500 miles (800 kilometers) of vehicle operation.

The wheel lug nuts should be tightened with the specified torque at every chassis lubrication interval thereafter.

WHEEL BALANCING

Wheel balancing can be accomplished with either on- or off-vehicle equipment. However, when using on-vehicle balancing equipment, observe the following precaution.

For vehicles with a "limited-slip" (Sure-Grip or Trac-Lok) rear axle differential, do not use on-vehicle equipment to balance a rear wheel/tire unless the opposite wheel/tire is removed from the hub.

When balancing aluminum or chrome-plated wheels, use care to avoid damaging the wheel surface when installing the balance weights. **Use only self-adhering type weights on aluminum wheels and install them on the back side of the wheel (whenever possible).**

WHEEL COVERS

To avoid damaging a wheel cover during removal or installation, care should be used to ensure that force is applied only at the correct areas on the wheel cover.

CAUTION: Do not pry outward or apply inward force to a wheel cover at the immediate area of the tire valve stem hole. A wheel cover is structurally stronger and will withstand the force required for removal and installation around the perimeter of the wheel cover away from the tire valve stem hole.

WARNING: HANDLE WHEEL COVERS WITH EXTREME CARE DURING REMOVAL AND INSTALLATION BECAUSE THE SHARP EDGES CAN CAUSE PERSONAL INJURY.

REMOVAL

(1) To remove a wheel cover, start by prying it loose (with a pry bar) from the wheel rim 180 degrees opposite the tire valve stem hole.

(2) Continue prying alternately around the perimeter of the wheel cover and toward the tire valve stem hole until the wheel cover is completely detached from the wheel rim.

INSTALLATION

(1) Use a rubber mallet to install a wheel cover.

(2) To install a wheel cover, insert the tire valve stem through the wheel cover valve stem hole and then "seat" this portion of the wheel cover on the wheel rim.

(3) Continue applying inward force with a rubber mallet alternately around the perimeter of the wheel cover and away from the tire valve stem hole until the wheel cover is completely "seated" on the wheel rim.

(4) Finally, apply inward force with a rubber mallet to the wheel cover 180 degrees opposite the tire valve stem hole to complete the installation.

16-INCH WHEEL TRIM RING AND WHEEL COVER

A special trim ring is available for 16-inch diameter wheels. The trim ring provides a reduced diameter perimeter surface area that is the same as that required for a standard 15-inch diameter wheel cover (Fig. 17). The procedures for removing and installing the special trim ring are similar to the procedures for a wheel hub cap.

The combined trim ring and wheel cover can be removed as a unit by prying outward on the trim ring (with a pry bar) 180 degrees opposite the tire valve stem hole.

To install, first position the trim ring on the wheel rim with the tire valve stem hole properly aligned around the valve stem and extension before installing the wheel cover (Fig. 17). Use the standard wheel cover installation procedure (above) to install the wheel cover on the trim ring.

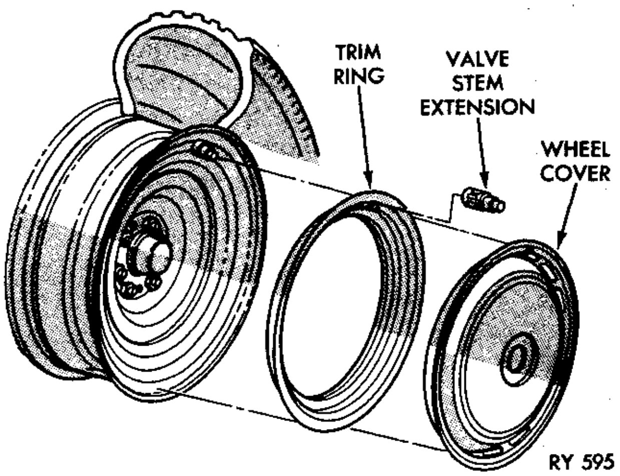

Fig. 17 16-Inch Wheel Trim Ring & Wheel Cover

WHEEL BEARING SERVICE

FRONT WHEELS

TWO-WHEEL DRIVE (2WD) VEHICLES

(1) Block the brake pedal in the up (non-depressed) position.

(2) Raise and support the vehicle. Remove the wheel/tire.

(3) Remove the retainer, anti-rattle spring and the disk brake caliper.

(4) Separate the brake caliper from the rotor and remove the inboard brake pad.

Support the caliper with wire at an out of the way location. Do not allow the caliper to hang by the brake fluid hose.

(5) Remove the dust cap, the cotter pin, the nut lock, the retaining nut, the thrust washer, and the outer wheel bearing from the rotor/hub (Fig. 18).

(6) Carefully slide the rotor/hub from the steering knuckle spindle. **Do not allow the seal or the inner wheel bearing to contact the steering knuckle spindle threads (the threads and the bearing could be damaged).**

(7) Remove the splash shield, the bearing seal and the inner wheel bearing from the rotor/hub. Discard the seal.

(8) Thoroughly clean both wheel bearings and the interior surface of the rotor/hub (i.e., remove all the hardened lubricant deposits).

To clean a wheel bearing, soak it in cleaning solvent. Strike the flat of the bearing against a hardwood block several times (immerse the bearing in solvent between the contacts with the block) to loosen and wash the particles of hardened lubricant from the bearing. Repeat this procedure until each bearing is clean.

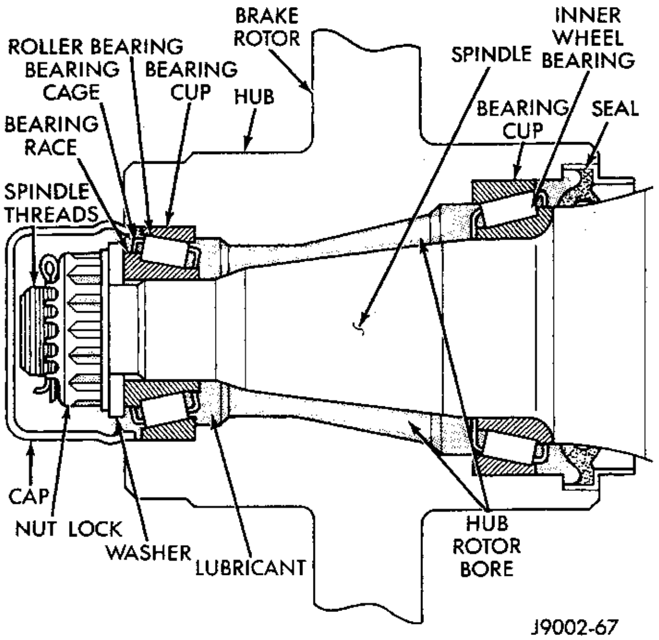

Fig. 18 Front Hub Area (Typical)

(9) Dry both bearings with compressed air but do not spin the rollers. After drying, lubricate both bearings with engine oil.

(10) Turn the bearing rollers slowly while applying force and examine them for "pitting" and roughness. If the bearing rollers are pitted or rough, replace the cup and the bearing.

Always replace excessively worn and defective bearings.

(11) If the wheel bearings are reusable, remove the engine oil, pack them with multi-purpose, NLGI Grade 2 EP (extreme pressure) lubricant (or an equivalent lubricant), and place them in a clean, covered container until installation time.

If a bearing packer tool is not available, hand pack lubricant into all the cavities between the cage and the rollers.

(12) If a bearing and cup are to be replaced, remove the cup with a brass drift or an appropriate removal tool. Install the replacement bearing cup with an appropriate installation tool.

(13) Apply a coat of lubricant to the complete interior surface (cavity and bore) of the rotor/hub (Fig. 18).

Lubricate the lip of the replacement bearing seal before installation.

(14) Install the inner wheel bearing in the rotor/hub bore, install a replacement bearing seal in the bore with an appropriate seal installation tool and install the splash shield. Tighten the splash shield attaching bolts with 25 N•m (220 in-lbs).

(15) Before installing the rotor/hub on the steering knuckle spindle, inspect the bearing and seal contact surfaces on the spindle for burrs and roughness. Remove all the burrs and rough surfaces.

(16) Apply a coat of multi-purpose, NLGI Grade 2 EP lubricant (or an equivalent lubricant) to the spindle.

(17) Position the rotor/hub bore at the spindle and carefully insert the spindle into the seal and the inner wheel bearing. **Do not allow the seal or the inner bearing to contact the spindle threads (the threads, the bearing and the bearing seal could be damaged).** "Seat" the rotor/hub against the steering knuckle.

(18) Install the outer wheel bearing, the washer and the retaining nut (Fig. 18).

(19) Tighten the retaining nut with 47 N•m (35 ft-lbs) torque while rotating the rotor/hub. Stop the rotor/hub rotation and "back-off" the retaining nut with a wrench and completely release the wheel bearing "preload" torque. Next, "finger tighten" the retaining nut, install the nut lock and install a replacement cotter pin (Fig. 18).

(20) The result of the adjustment should be a 0.0001- to 0.0030-inch wheel bearing "end play".

(21) Clean the dust cap and apply a coat of lubricant to the interior surface. **Do not fill the dust cap with lubricant.** Install the dust cap on the rotor/hub.

(22) Install the inboard brake pad on the caliper adapter.

(23) Position the caliper over the rotor and install the retainer and the anti-rattle spring. Tighten the clips with1/2-inch bolt 20 N•m (180 in-lbs) torque.

(24) Install the wheel/tire and tighten the lug nuts with the specified torque. Refer to the Torque Specifications chart for the correct torque value.

(25) Remove the supports, lower the vehicle, remove the block from the brake pedal and test drive the vehicle.

FOUR-WHEEL DRIVE (4WD) VEHICLES

Refer to **Group 2—Front Suspension** for front wheel bearing service.

REAR WHEELS

Refer to **Group 3—Rear Axles** for rear wheel bearing service.

SPECIFICATIONS

TORQUE SPECIFICATIONS

COMPONENT	SET-TO-TORQUE	RECHECK TORQUE
Lug Nut (Cone)		
1/2-20	142 N•m (105 ft-lbs)	
5/8-18	271 N•m (200 ft-lbs)	
Lug Nut (Flanged)		
5/8-18	440 N•m (325 ft-lbs)	
Front Hub Nut (2WD)	47 N•m (35 ft-lbs)	41-54 N•m (30-40 ft-lbs)
Brake Caliper Retainer Clip	20 N•m (100 in-lbs)	

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BODY

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INTERIOR TRIM

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MODEL IDENTIFICATION

AD4 = Ramcharger Two-Wheel-Drive
AD8 = Ramcharger Four-Wheel-Drive
AD1, 2 and 3 = Light Duty Truck Two-Wheel-Drive
AD5, 6 and 7 = Light Duty Truck Four-Wheel-Drive

REAR VIEW MIRROR (FIG. 1)

REMOVAL

(1) Loosen the set screw and slide the mirror up and off the button.

(2) Installation is accomplished by sliding the mirror over the button and tightening the set screw. Care should be exercised not to over tighten the screw.

REAR VIEW MIRROR BUTTON (FIG. 1)

REPLACEMENT

(1) Using a wax pencil, locate and mark the mounting position of the button on the outside of the wind-shield.

(2) If the vinyl pad had remained on the windshield glass, apply "low heat" to it with an electric heat gun until the vinyl softens; then peel the vinyl pad from the glass.

(3) Thoroughly clean the inner surface of the windshield glass in the mounting area of the mirror button using a mild abrasive cleaning powder such as Ajax, Comet, or equivalent, on a clean cloth saturated with alcohol. Then, apply alcohol to a paper towel and wipe off any traces of remaining cleaner.

(4) Thoroughly sand the windshield mounting surface (the side with least surface area) of the mirror button with a clean piece of fine grit sandpaper and wipe the surface clean with a clean paper towel saturated with alcohol.

(5) Using kit 4054099 or equivalent, crush the vial in the plastic housing of the accelerator. This saturates felt applicator. Remove paper sleeve. Apply a generous amount of Accelerator on the mounting surface of the mirror button.

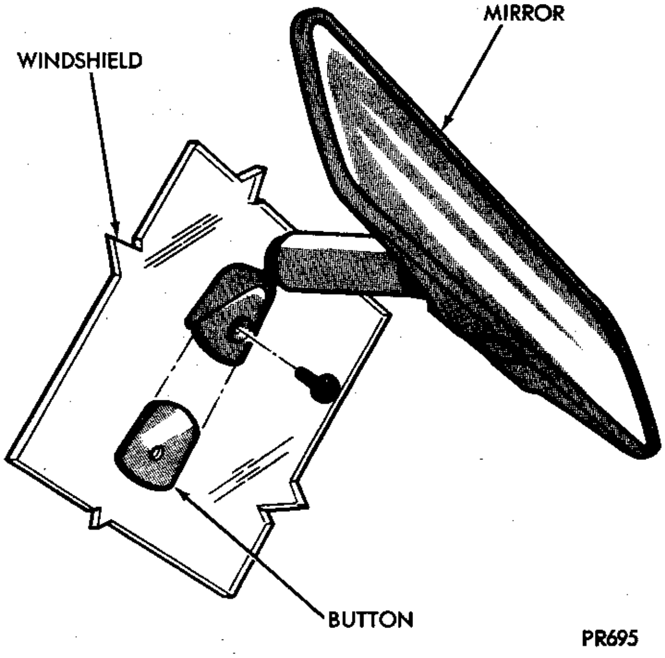

Fig. 1—Rearview Mirror

(6) Allow the accelerator to dry for five minutes. Do not touch the mounting surface of the button or glass.

(7) Apply a thin film of accelerator to the inner surface of the windshield in the button mounting area. Allow one minute to dry. Do not touch the surface.

(8) Apply one drop of adhesive to the center of the windshield mounting surface of the mirror button as shown on the attached sketch and, using the bottom of the Adhesive tube, quickly distribute the adhesive evenly over the entire bonding surface of the button.

(9) Position the bottom straight edge of the mirror button on the horizontal line and center it on the vertical line; then, press it firmly to the glass and apply pressure for about one minute. Proper location is essential as cement sets up very fast.

(10) Allow five minutes for the adhesive to set; then, remove any excess adhesive residue from the windshield in the attachment area using an alcohol-dampened cloth.

(11) Slide the mirror downward onto the button and tighten the screw.

COWL SIDE TRIM PANEL (FIGS. 2 AND 3)

The trim panel is secured to the cowl side panel with screws. Refer to the illustrations for screw locations.

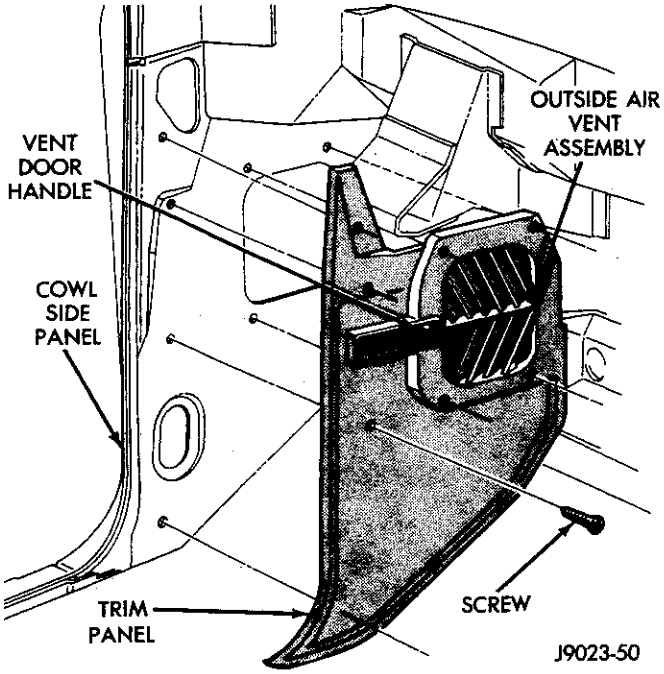

Fig. 2—Left Side Trim Panel and Air Vent

OUTSIDE AIR VENT (FIGS. 2 AND 4)

The air vent is mounted on the lower side cowl (Drivers side) with mounting screws. To operate the vent push or pull handle located on the vent assembly. To remove vent assembly, remove screws and remove assembly. To install vent assembly, place assembly into position and secure with mounting screws.

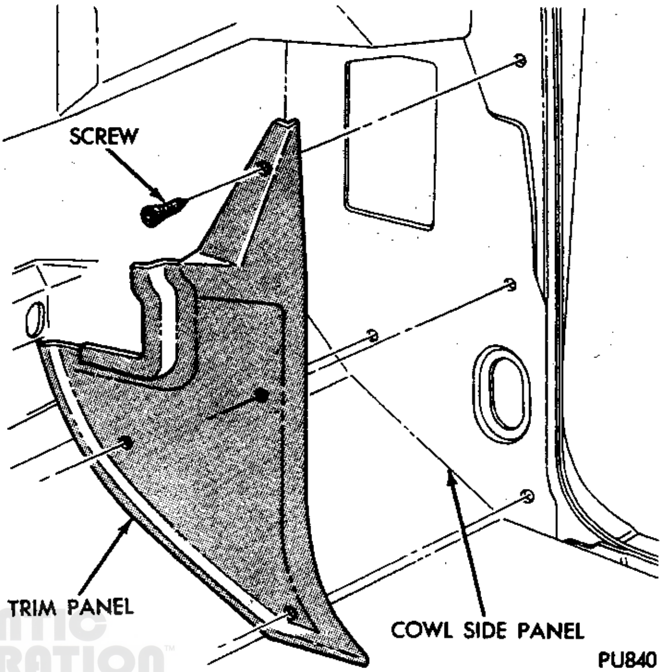

Fig. 3—Right Side Trim Panel

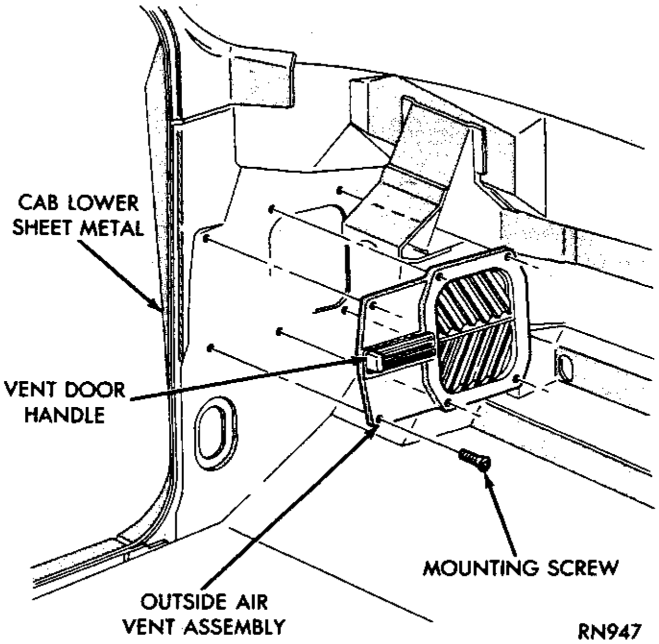

Fig. 4—Outside Air Vent

BUCKET SEAT-LEFT SIDE (FIG. 5)

REMOVAL

(1) To remove complete seat, adjuster, and riser, remove nuts mounting riser to underbody.

(2) To remove individual assemblies refer to the assembly in (Fig. 5).

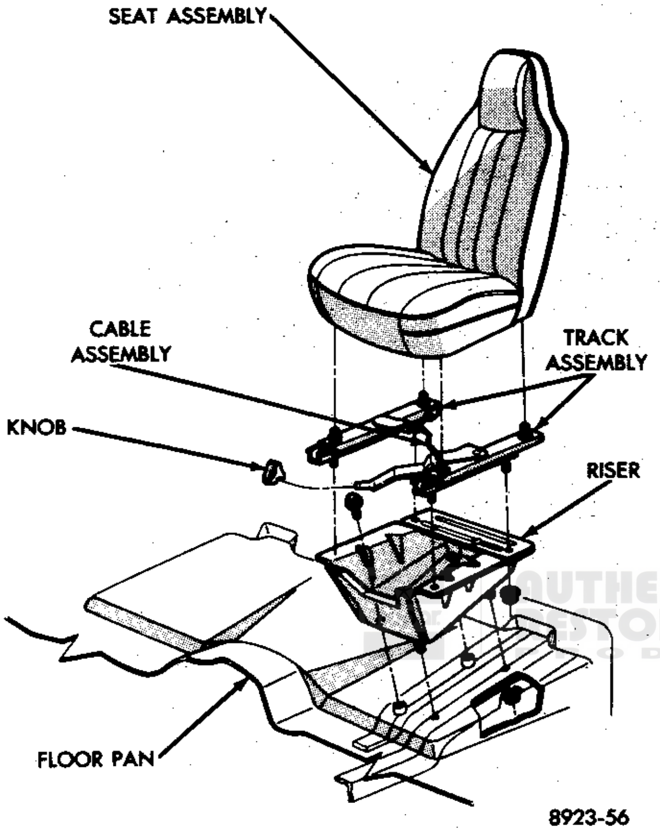

Fig. 5—Bucket Seat, Left Side

INSTALLATION

(1) To install complete seat adjuster and riser as one assembly, place assembly into position in vehicle and secure nuts to riser located on underbody.

(2) To install individual assemblies refer to (Fig. 5).

BUCKET SEAT-RIGHT SIDE (FIG. 6)

The passenger seat is equipped with a tilt seat riser for access to the rear seating area. This is a gas prop operated mechanism with a lock and release lever located on the side and on the rear of the seat.

REMOVAL

(1) To remove the seat assembly, remove the nuts mounting the hinge section of the riser to the underbody of vehicle.

(2) Disconnect gas prop on bottom of seat.

(3) Release the lock from the lock catch and remove the seat assembly from vehicle.

(4) The seat may be removed without the riser by removing bolts from seat to riser spacer.

INSTALLATION

(1) To install seat assembly, secure the hinge section of the riser to the underbody with nuts.

(2) The seat can be installed by mounting seat to riser spacers.

(3) Connect gas prop to seat.

(4) Lock should line up with lock catch mounted on the underbody.

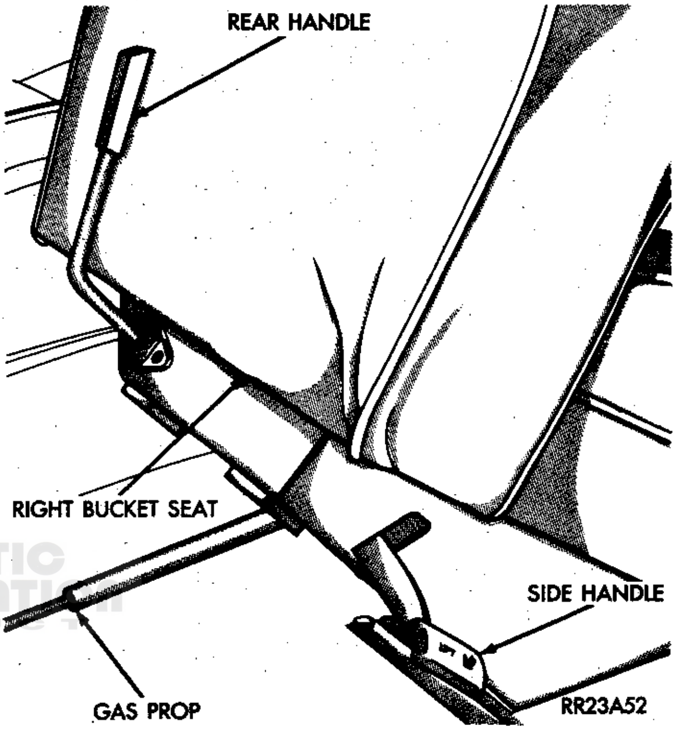

Fig. 6—Bucket Seat, Right Side

LOCK ASSEMBLY

REMOVAL

(1) To remove lock from riser, remove screws securing lock to riser.

(2) Remove clip from inside end of link.

(3) Remove lock from riser.

INSTALLATION

(1) Install lock to riser.

(2) Install linkage to lock lever clip.

(3) Adjust lock to eliminate vertical freeplay at rear of seat.

LOCK CATCH

The lock catch is mounted to the underbody with screws. To remove lock catch, remove screws and remove catch.

The lock catch can be adjusted with slotted holes in mounting area.

LATCH LEVER

The latch lever assembly has a knob, lever handle, escutcheon, spring pin and snap ring. For removal or installation of assembly, refer to (Fig. 6).

BENCH SEAT MOUNTING (FIG. 7)

Bench seats are mounted to the floor pan with fasteners accessible from underneath the vehicle. Refer to (Fig. 7) for mounting locations.

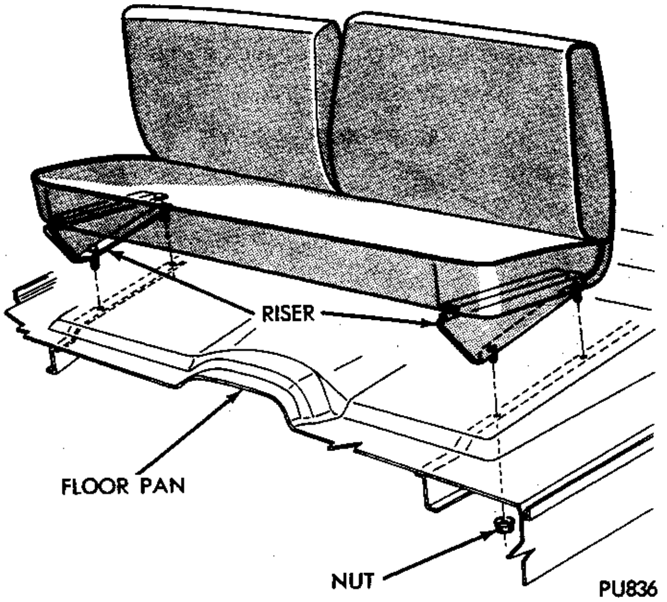

Fig. 7—Bench Seat Mounting

FOLDING REAR SEAT (FIGS. 8, 9, AND 10)

The rear seat is mounted to the underbody with studs mounted through brackets on the seat. For removal or assembly refer to (Fig. 10). Operation is accomplished by releasing seat latch and folding seat over and upward. The seat is retained in its folded position by relocating seat belt tip half out from between seat cushion and back. Pull tip half over top of seat and attach to buckle half as shown in Fig. 8.

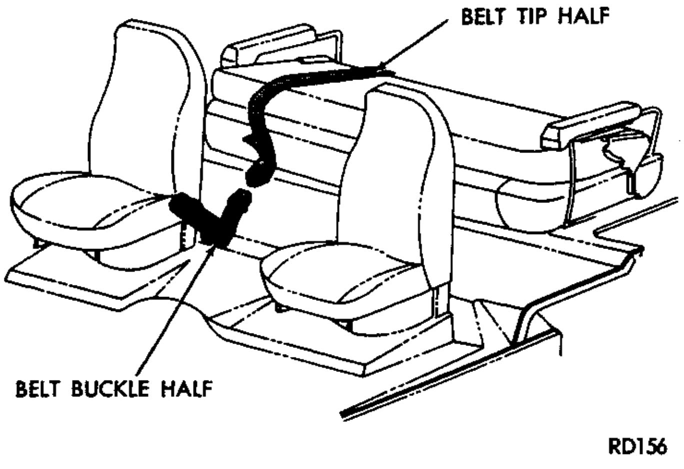

Fig. 8—Folding Rear Seat Retention

CONSOLE (FIG. 11)

(1) Open console door.

(2) Located in the bottom of the console, are screws mounting console to underbody, remove these screws.

(3) Remove console from vehicle.

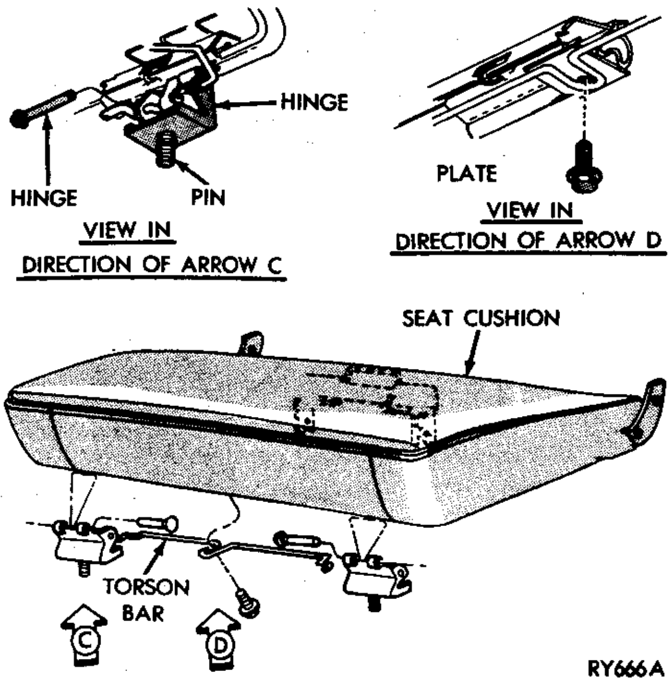

Fig. 9—Folding Seat Cushion

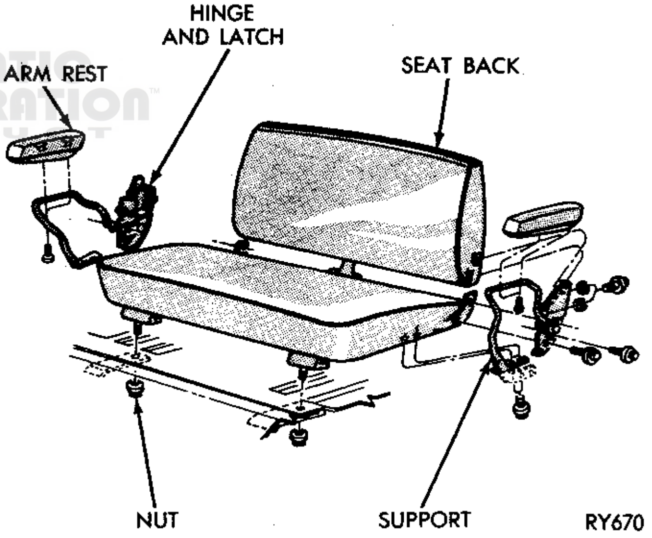

Fig. 10—Folding Seat Mounting

INSTALLATION

(1) Place console into position in vehicle.

(2) Secure console with mounting screws.

(3) Close console door.

CONSOLE LOCK

REMOVAL

(1) Open console door.

(2) Remove mounting screws on inner portion of door.

(3) Remove lock from door.

INSTALLATION

(1) Place lock into position in door.

(2) Secure with mounting screws.

(3) Close door and check for correct latching and key cylinder operation.

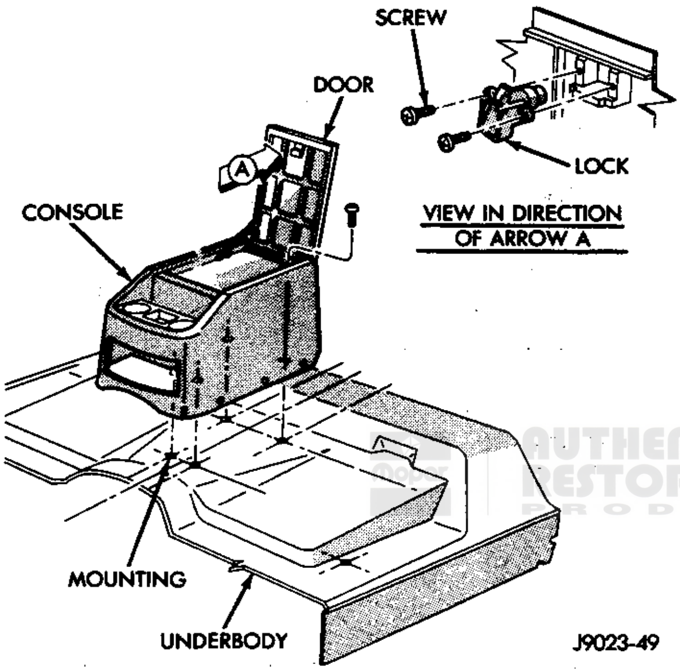

Fig. 11—Console

INTERIOR TRIM (FIGS. 12 AND 13)

The side trim right and left is mounted with screws to the side panel interior. The floor mat or carpet overlaps the bottom edge of the trim panel. Refer to (Fig. 12) for removal or installation of the side trim panel.

When removing a trim panel that is overlapped by an adjoining panel, loosen or remove the end attaching screw to prevent possible damage to both panels.

To assure correct alignment when installing the trim panels, install the screws finger tight, align the panels at each end and tighten the screws. Use care not to overtighten the screws or the trim panels will be damaged.

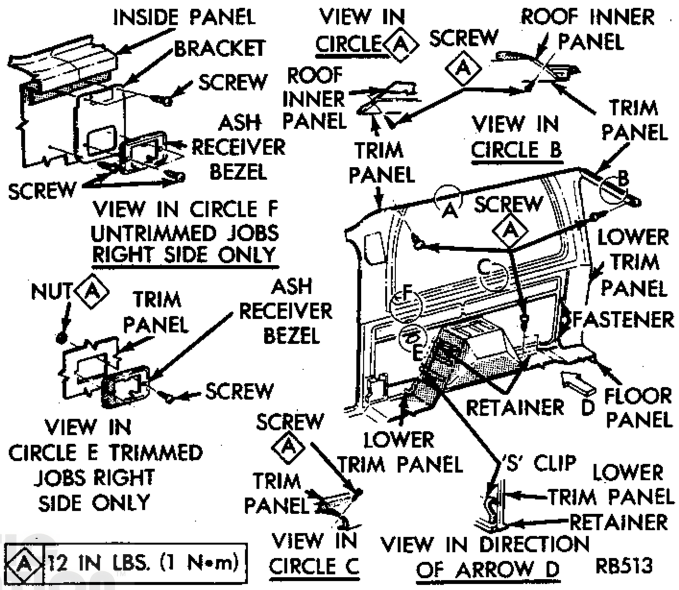

Fig. 12—Interior Trim AD4 and AD8

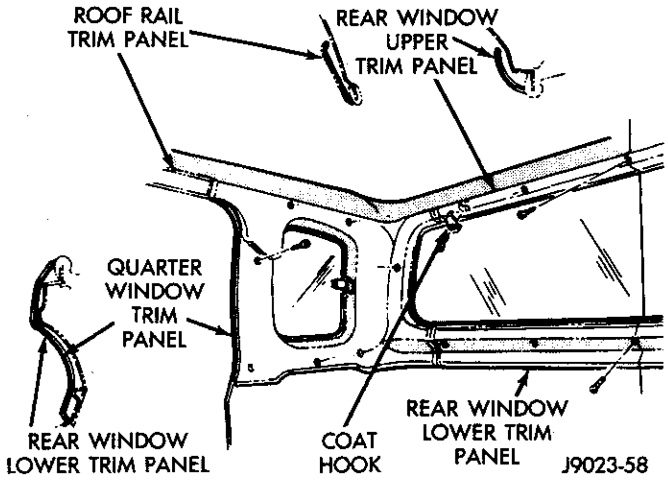

Fig. 13—Interior Trim — Club Cab

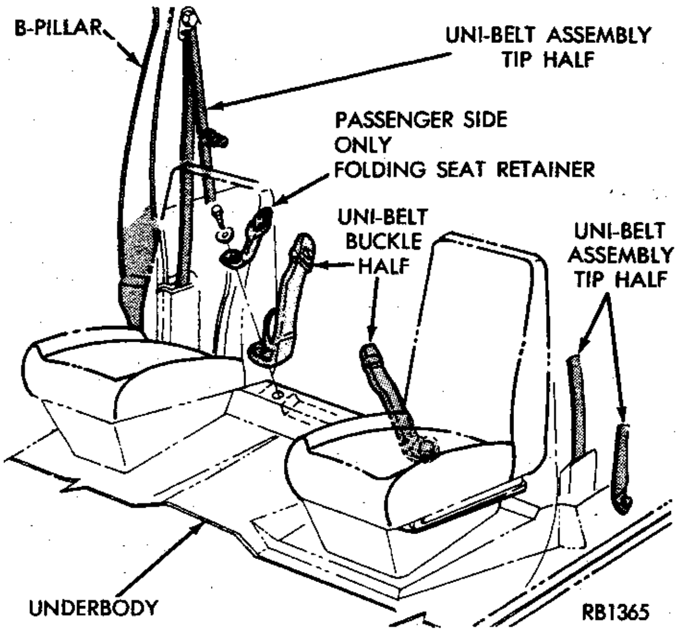

Fig. 1—Front Seat Uni-Belt

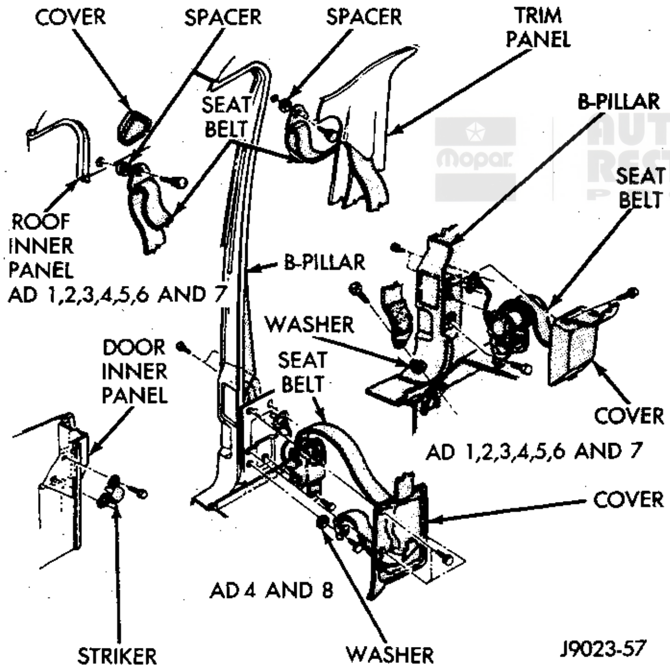

Fig. 2—Front Seat Uni-Belts

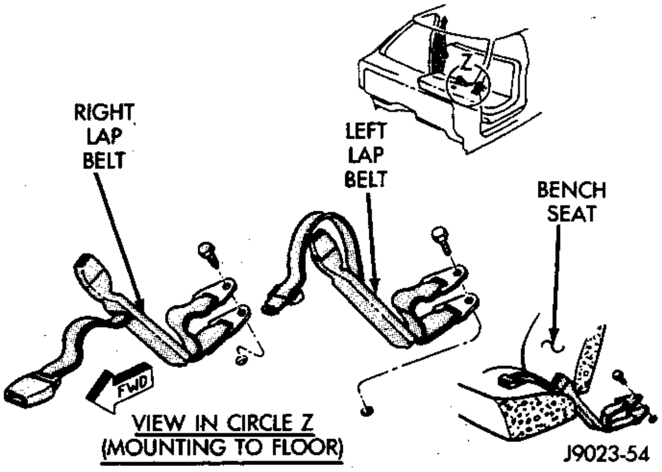

Fig. 3—Center Lap Belts

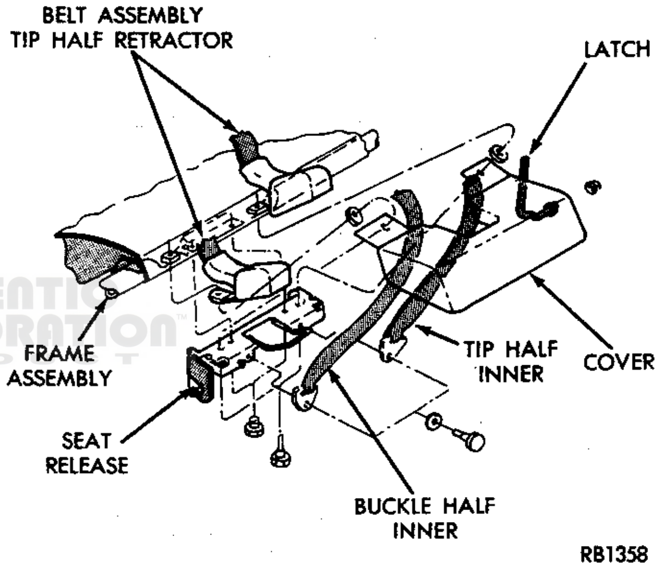

Fig. 4—Seat Belt Mounting Folding Rear Seat

UNI-BELTS—FRONT SEATS

The uni-belts are mounted to the 'B' pillar as shown in (Figs. 1, 2, and 3). The buckle half is located on the inboard side of the seat, mounted to the underbody. The 'B' pillar half of the belt is secured with bolts torqued to 350 inch pounds ± 150 inch pounds (40 N•m ± 17 N•m).

SAFETY BELTS—REAR SEAT

The rear folding seat (Figs. 4 and 5) is available with the outboard buckles mounted to the underbody and inboard retractors mounted on the seat frame rear cross member. The center buckle tip half is mounted to the latch mechanism. Torque the belt bolts to 350 inch pounds (40 N•m ± 17 N•m).

SEAT BELTS AND RETRACTORS

For assembly and views refer to (Figs. 1-5). The center belt mountings are typical. Be sure when belts or retractors are replaced that the bolts are tightened to 350 in. lbs. ± 150 in. lbs. (40 N•m ± 17 N•m) for safety requirements.

SEAT BELT AND HARNESS OPERATION

A hard pull on the shoulder belt will NOT lock the belt. The retractor has a pendulum weight which locks the shoulder belt during rapid deceleration of the vehicle.

Belts from different models are not interchangeable and no attempt should be made to mix belt lengths.

Safety belts should be worn whenever the vehicle is in motion. The operation and mounting of the belts should not be tampered with at any time. When removal, installation, or repair is necessary, refer to illustrations for proper system locations and mounting hardware. If the belts are removed for any reason, and the vehicle is to be driven, the seat belt retaining bolts should be reinstalled to prevent exhaust fumes from entering the vehicle.

HEADLINER—ALL MODELS (FIGS 6, 7 AND 8)

The headliner is mounted to the roof panel with screws. On AD4 and AD8 models the headliner is two piece and is joined by a push on moulding.

CARPET OR MAT ASSEMBLY—FRONT AND REAR (FIG. 9)

REMOVAL

(1) Remove seats, front and rear.
(2) Remove retainers and scuff plates.

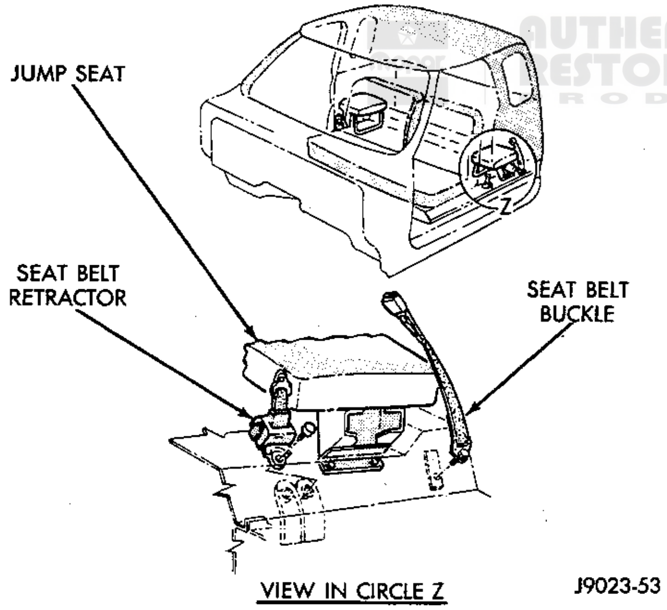

Fig. 5—Jump Seat Belts

(3) Remove front floor protective covers.
(4) Remove storage tray 4 (four screws).
(5) Remove mat or carpet, front and rear from vehicle.

INSTALLATION

(1) Place carpet or mat into position and secure front and rear.
(2) Install retainers and scuff plates.
(3) Install protective covers.

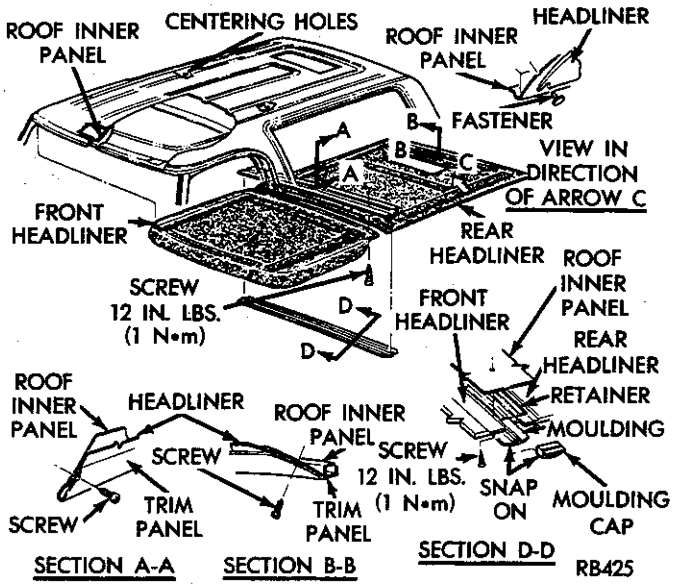

Fig. 6—Headliner AD4 and AD8

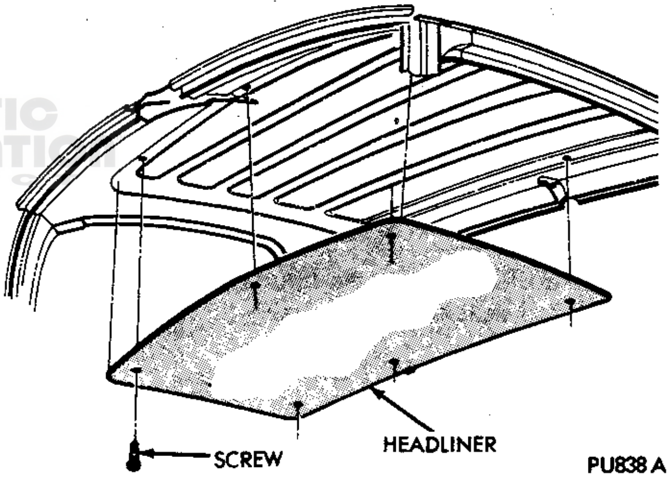

Fig. 7—Headliner AD1, 2, 3, 5, 6 and 7

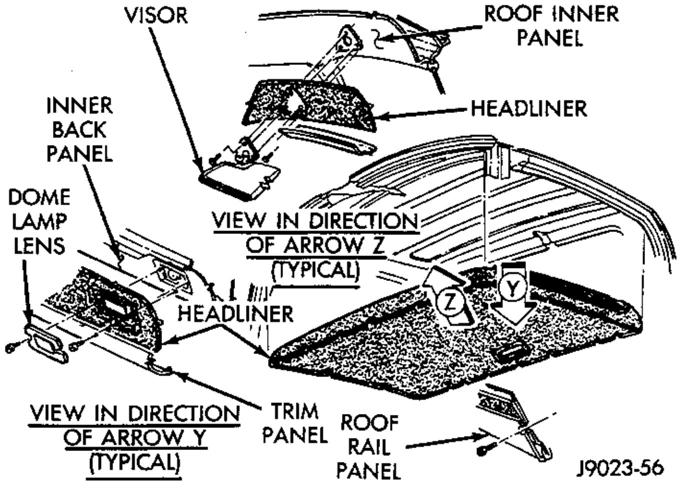

Fig. 8—Full Headliner

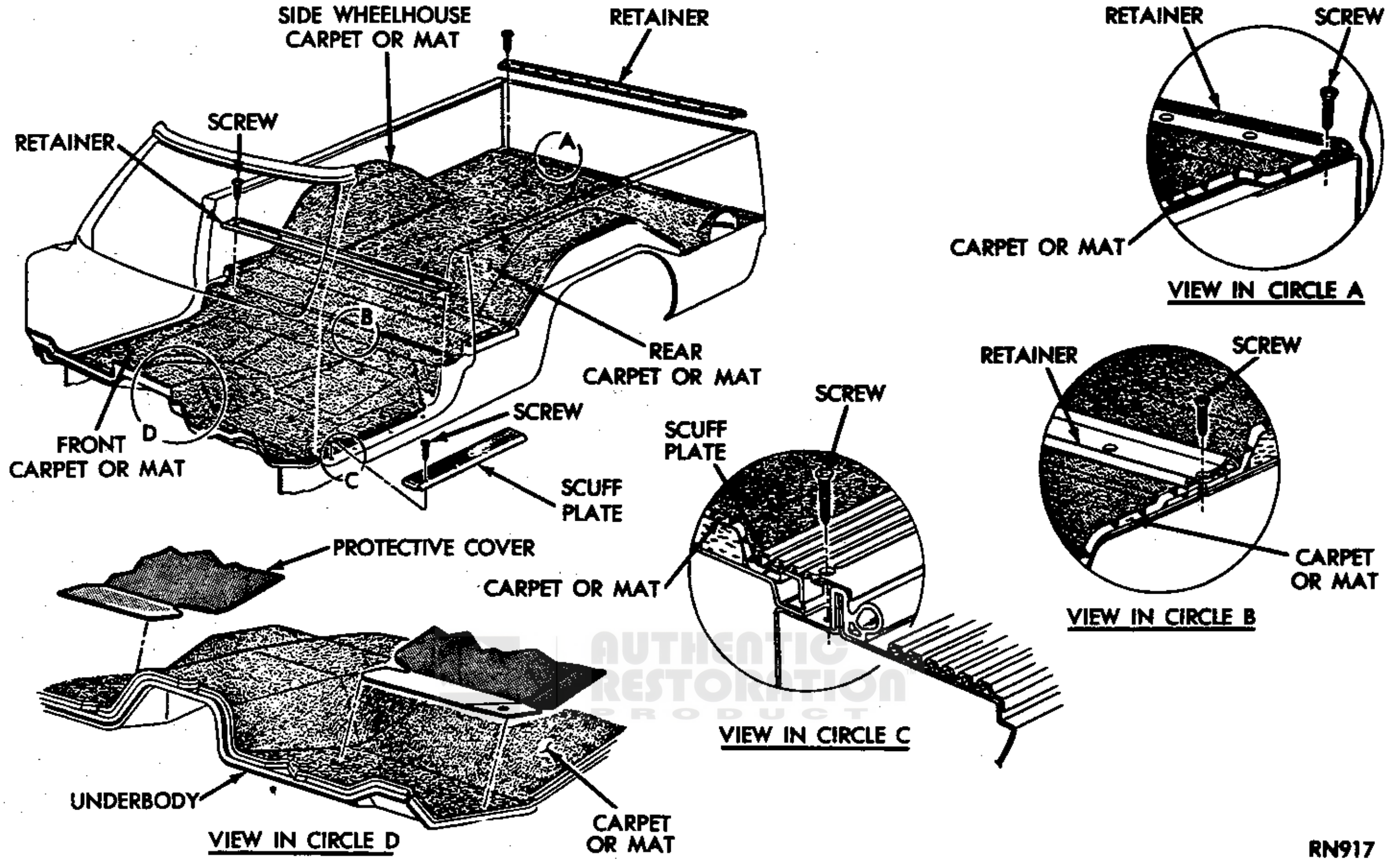

Fig. 9—Carpet or Mat Assembly—Typical

(4) Install storage tray 4 (four screws).
(5) Install seat front and rear.

STORAGE TRAY (FIG. 10)

The storage tray is located behind the front seat on all pickups. The tray is secured to the floor pan by four (4) screws.

INSTALLATION AND REMOVAL

(1) Position tray on floor pan.
(2) Insert four (4) screws.
(3) For removal, reverse the above procedure.

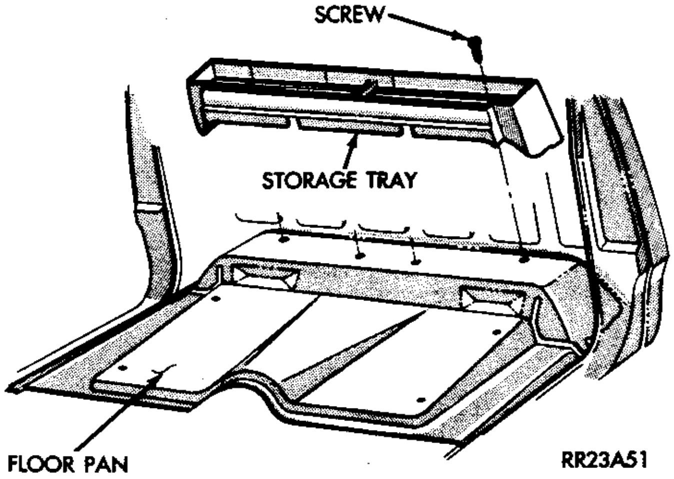

Fig. 10—Storage Tray

REAR JUMP SEAT—CLUB CAB (FIG. 11)

The back assembly is mounted to the side window opening area of the cab sheet metal with nut and washer without trim panel, with trim panel the back is mounted to the panel assembly. Refer to (Fig. 11) for assembly of back. The folding jump seat is mounted to the trimmed underbody of the cab. Place the seat assembly support studs through holes in floor pan and secure with nut and washers. The floor covering is embossed on the backside for location of holes for jump seat installation.

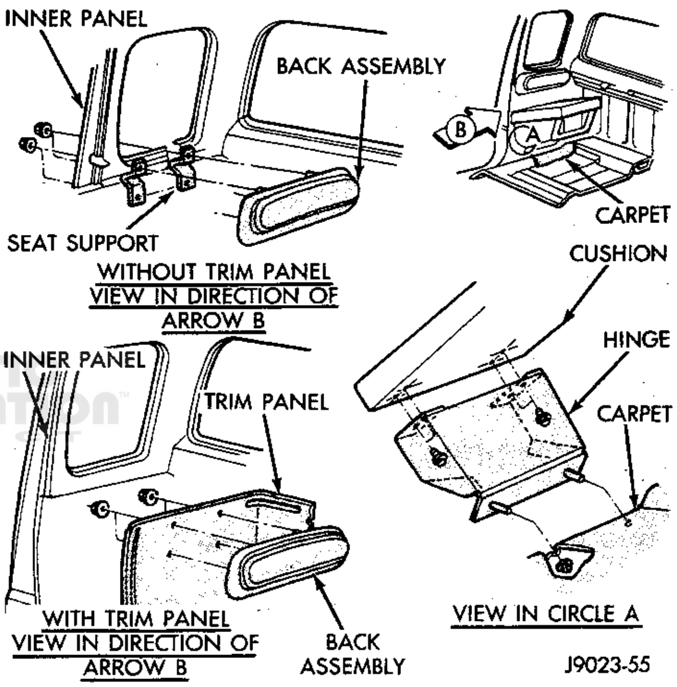

Fig. 11—Rear Jump Seat—Club Cab

SHEET METAL

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MODEL IDENTIFICATION

AD = Ramcharger Two-Wheel-Drive
AW = Ramcharger Four-Wheel-Drive
D = Light Duty Truck Two-Wheel-Drive
W = Light Duty Truck Four-Wheel-Drive

BUMPERS

FRONT (FIG. 1)

REMOVAL

(1) Remove bumper guard (if so equipped).

(2) Remove bumper to bracket fasteners and lift bumper off of mounting brackets.

(3) Reverse above procedure for installation.

FRONT BUMPERS

Place the brackets to the bumper, assemble with bolts, plain washer, lock washer and nuts. Line up the bumper brackets with the holes in the frame and secure with bolts, nuts, and washer. When the assembly is mounted to the vehicle, check the alignment to body sheet metal. For assembly procedures refer to (Fig. 1).

REAR

REMOVAL (FIG. 2)

(1) Remove bumper guards (if so equipped).

(2) Remove bumper to bracket fasteners and lift bumper off of mounting brackets.

(3) Reverse above procedure for installation.

REAR BUMPERS—STEP AND NON-STEP

The rear bumper is mounted to brackets in the same manner as the front bumpers. The assembly is then mounted to the chassis with bolts and nuts. Check to see that there is proper alignment with body sheet metal. See (Fig. 3) for installation.

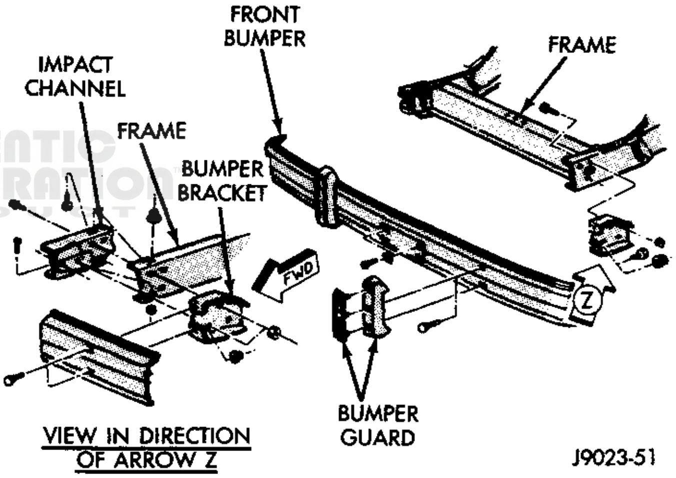


Fig. 1—Front Bumper, All

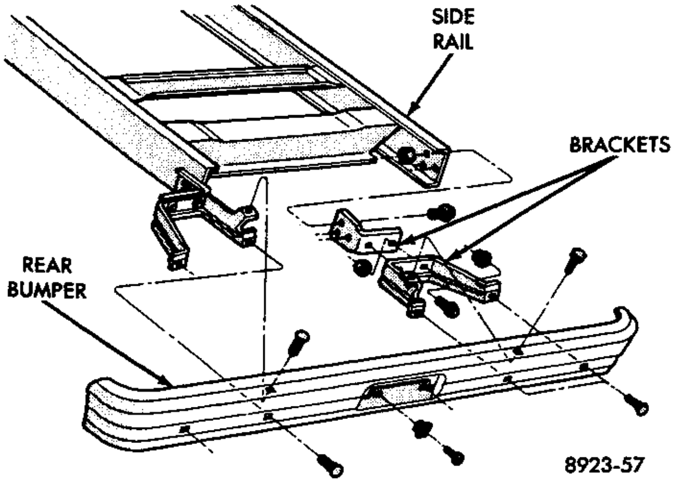


Fig. 2—Rear Bumper, Standard

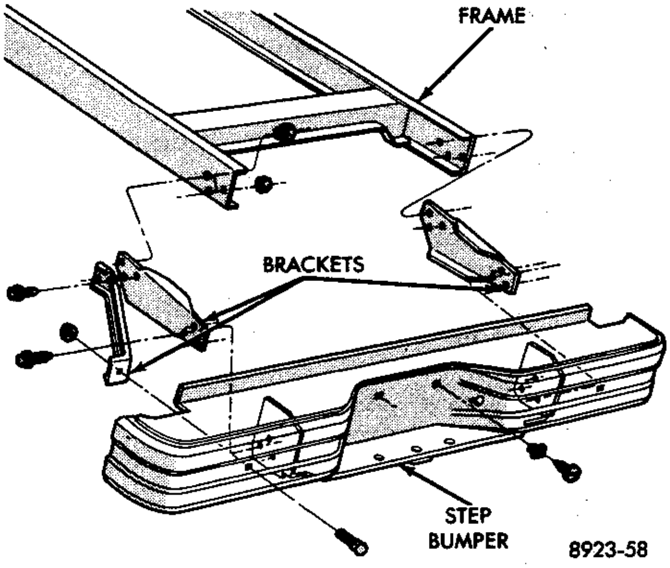


Fig. 3—Step Bumper, All

HOOD RELEASE (INSIDE) (Figs. 4 and 5)

REMOVAL

(1) Open hood.

(2) Disconnect hood latch release cable from latch assembly.

(3) Release cable assembly from routing clip along body sheet metal.

(4) Remove grommet from dash.

(5) From inside the vehicle remove mounting screws securing release handle to lower section of instrument panel.

(6) Route the hood release cable assembly out of the dash and remove from vehicle.

INSTALLATION

(1) From inside, route the hood release cable assembly through the dash.

(2) Mount the release handle to the lower section of the instrument panel.

(3) Install grommet to dash panel.

(4) Secure the cable to the rear routing clip along the body sheet metal.

(5) Route the cable over the support flange and connect the cable to the latch assembly.

(6) Adjust the cable to shroud clip to insure slack between the clip and the latch.

(7) Test hood latch release for proper function.

HOOD

ADJUSTMENTS (FIGS. 6 AND 7)

The hinge screw holes are oversized and elongated to permit up and down adjustment and "fore" and "aft" adjustment at the hood.

The hinge mounting at the fender panel provides up and down adjustment (Fig. 7).

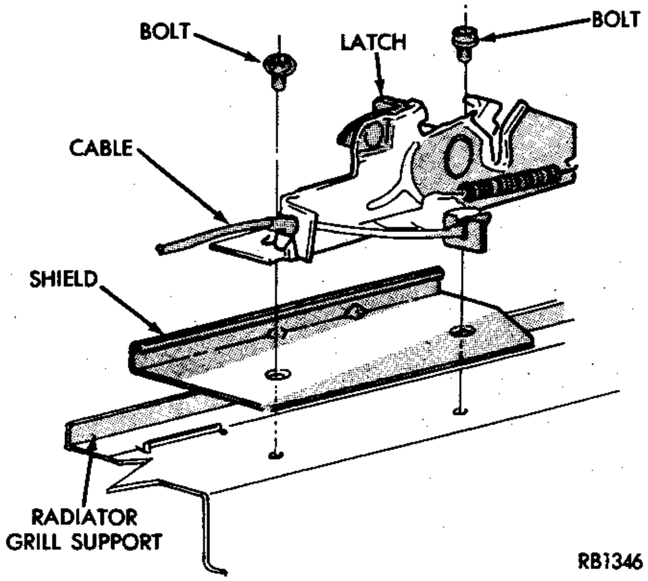


Fig. 4—Latch and Cable Mounting

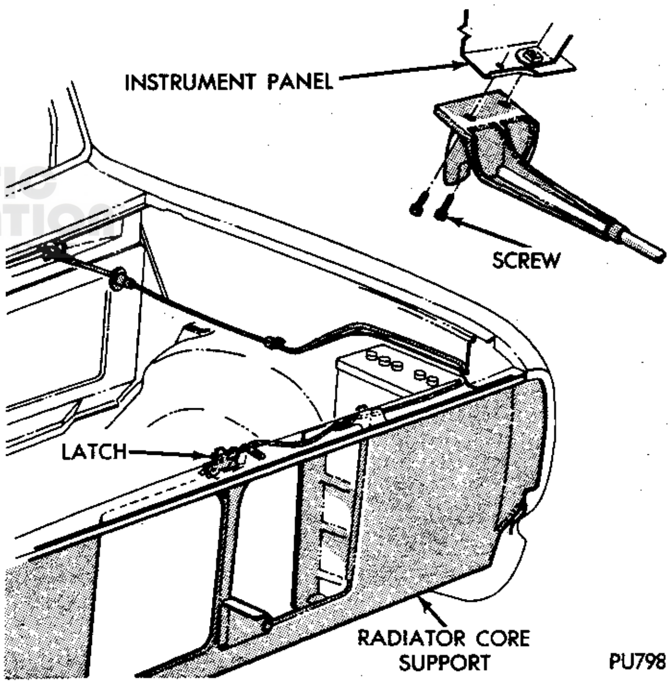


Fig. 5—Cable Routing

HOOD ALIGNMENT (FORE AND AFT)

The following sequence of hood alignment, lock and striker adjustment must be followed. An imporperly adjusted lock or striker could cause the hood to open to the safety catch.

(1) Loosen both hinge mounting bolts at hood mounting.

(2) Loosen hood latch from grille support.

(3) Close hood and adjust so approximately 3/16 inch clearance is obtained between back of hood and cowl.

(4) Raise hood to approximately 30 degrees and tighten hinge to hood mounting bolts.

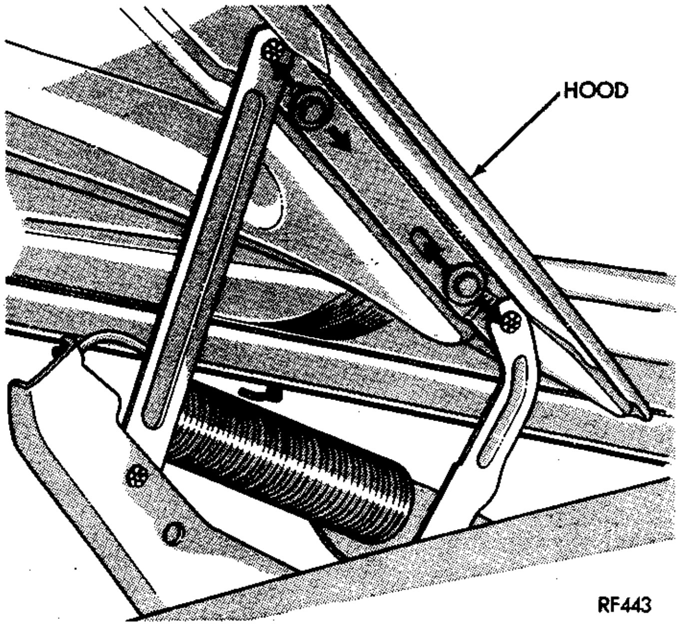


Fig. 6—Hood Adjusting Points

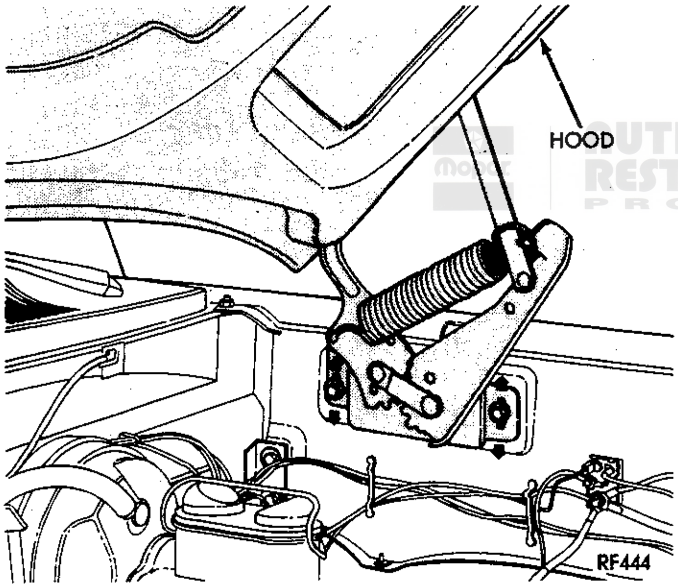


Fig.7—Hinge Adjusting Points

(5) Tighten latch, and lower the hood and check visually for proper front fender pad pressure.

(6) Open the hood. Using a substance such as clay or other suitable material capable of receiving an impression, coat top side of primary latch striker arm. Close hood to obtain a full latch position.

(7) Disengage hood latch and check latch imprint in subtance used. A properly adjusted latch will show a centered position on striker. If imprint is not proper, readjust hood latch.

REMOVAL

(1) Raise hood to full open position.

(2) With an assistant remove the bolts and remove the hood from vehicle.

(3) If new hood is to be installed, remove all serviceable components from old hood.

(4) Inspect hood hinges for proper operation and wipe clean with a suitable solvent.

(5) Lubricate hood hinges with a suitable lubricant.

INSTALLATION

(1) Install all serviceable components from old hood and any new parts as necessary.

(2) With an assistant position hood on vehicle and align holes to hinge, install bolts snugly but do not tighten.

(3) To align hood, latch, and striker, see steps (1) thru (7) under Hood Alignment.

HINGE REPLACEMENT

(1) Raise hood to full open position and loosen hood hinge bolts.

(2) Support the hood on the side the hinge is being removed. Remove the hinge.

(3) Position new hinge against fender shield and install bolts and tighten snugly.

(4) Align hood to hinge, install bolts snugly, do not tighten.

(5) To align hood, latch, and striker, see steps (1) thru (7) under Hood Alignment.

LATCH AND STRIKER

REMOVAL

(1) Raise hood and remove hood latch attaching bolts.

(2) Remove hood latch assembly.

(3) Loosen and remove attaching bolts of striker assembly and remove striker from grille support.

INSTALLATION

When installing a new latch, make sure assembly is well lubricated.

(1) Position latch assembly and install bolts. The mounting holes are elongated to allow lateral and vertical adjustment.

(2) Position striker assembly and install bolts, but do not tighten.

ADJUSTMENT

To adjust hood latch and striker see steps 1 through 7 under Hood Alignment.

GRILLE (Figs. 8 and 9)

REMOVAL

(1) Remove grille upper attaching screws.

(2) Remove lower grille attaching screws.

(3) Remove attaching screws located at each end of grille.

(4) Remove lower grille attaching screws (grille to extension).

(5) Remove attaching screws at each end of grille extension.

INSTALLATION

(1) Place grille extension in opening and install sheet metal screws loosely.

(2) Center grille extension and tighten screws.

(3) Place grille in opening and center, and install screws.

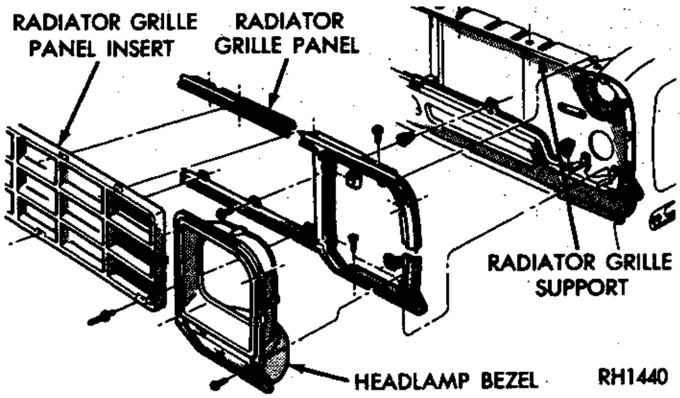


Fig. 8—Grille

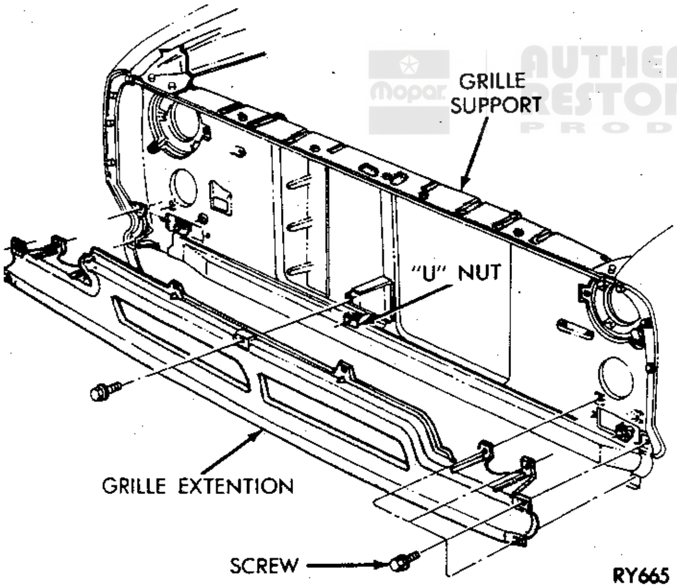


Fig. 9—Grille Extension

RADIATOR CORE SUPPORT, FENDER, AND SPLASH SHIELD

The radiator core support and fender assembly attach with "U" nuts, screws and nuts. The splash shield mounts on the inner side of sheet metal with screws.

RADIATOR CORE SUPPORT (FIG. 10)

REMOVAL

(1) Raise hood and remove battery.

(2) Drain and remove radiator (save coolant).

(3) Remove headlamp bezels.

(4) Remove upper and lower grille panels.

(5) Remove headlamps.

(6) Disconnect battery tray from radiator core support panel.

(7) Remove horns.

(8) Remove screws attaching splashshield to support.

(9) Remove front end sheet metal mount system, including studs.

(10) Remove screws from right fender to right splashshield so that right fender panel can swing out, pivoting at the cowl, allowing disengagement from radiator core support panel.

CAUTION: Care must be taken to avoid damage to fender or cowl panel.

(11) Remove radiator core support panel.

INSTALLATION

(1) Install "U" nuts on lower flange of radiator core support panel and install panel.

(2) Install screws attaching splashshield to support.

(3) Install front end sheet metal mount system.

(4) Engage right fender and secure to wheelhouse and radiator core support panel. Tighten screws.

(5) Install horns.

(6) Install and refill radiator.

(7) Attach battery tray to radiator core support panel.

(8) Install and aim headlamps.

(9) Install lower and upper grille panels.

(10) Install headlamp bezels.

(11) Install and connect battery.

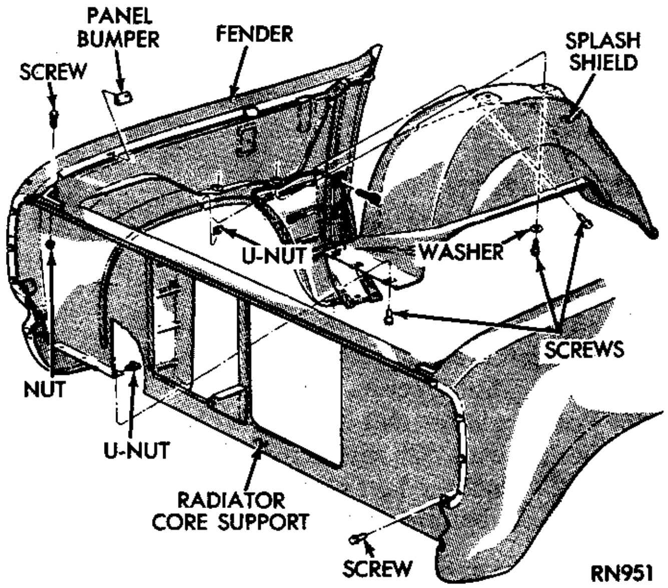


Fig. 10—Radiator Core Support, Fender and Splash Shield

COWL GRILLE (FIG. 11)

REMOVAL

(1) Remove wiper arms.
(2) Raise hood.
(3) Remove mounting screws.
(4) Disengage rear of grille from windshield weatherstrip and remove grille.
(5) Reverse above procedure for installation.

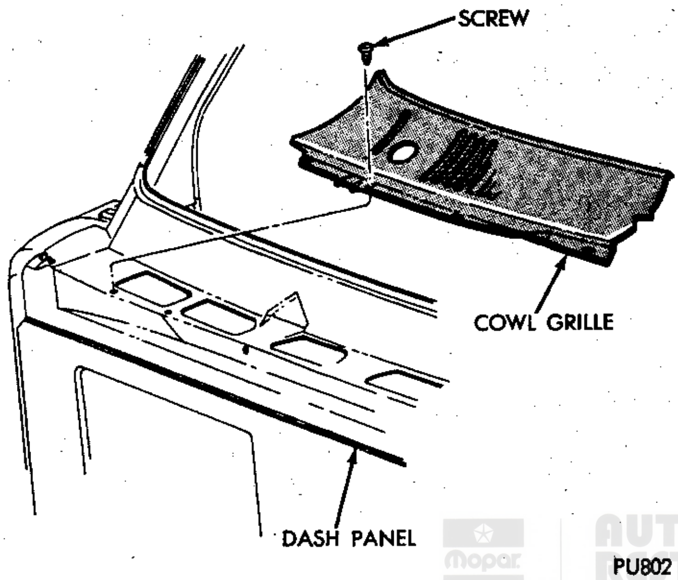


Fig. 11—Cowl Grille

BATTERY TRAY (Fig. 12)

REMOVAL

(1) Disconnect battery cables.
(2) Remove battery hold downs and remove battery from tray.
(3) Remove "C" nut and screw from lower brace to tray attachment.
(4) Remove brace from fender housing support.
(5) Remove tray from front end sheet metal.

INSTALLATION

(1) Place "U" nuts on tray assembly and align to holes.
(2) Place tray into front end sheet metal.
(3) Attach with screws, washers and nuts.
(4) Position brace to fender housing support and secure with "C" nut, screw and washer.
(5) Position lower end of brace to battery tray.
(6) Secure with "C" nut, screw, and washer.
(7) Install battery and battery hold downs.
(8) Connect battery cables to battery posts.

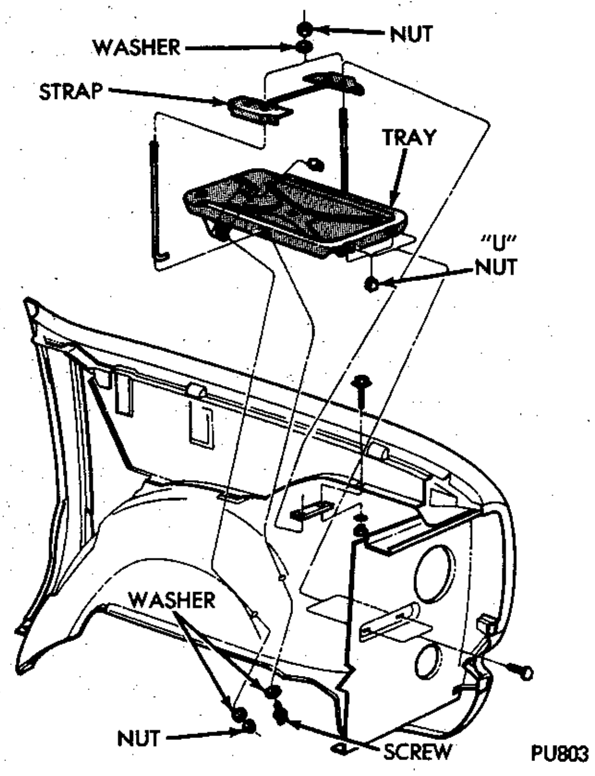


Fig. 12—Battery Tray

FRONT END MOUNTING (FIG. 13)

The front end sheet metal attaches to the body with spacers between the rear of fender and cowl, to achieve sheet metal alignment at the cowl plenum and grille. For mounting of sheet metal front end to cowl and cowl grille refer to (Fig. 13).

Be sure to note that the fender end is mounted in two different manners to the sheet metal. One way shown is with the use of two studs and the other is using a stud on the lower mounting and a 5/16-18 x

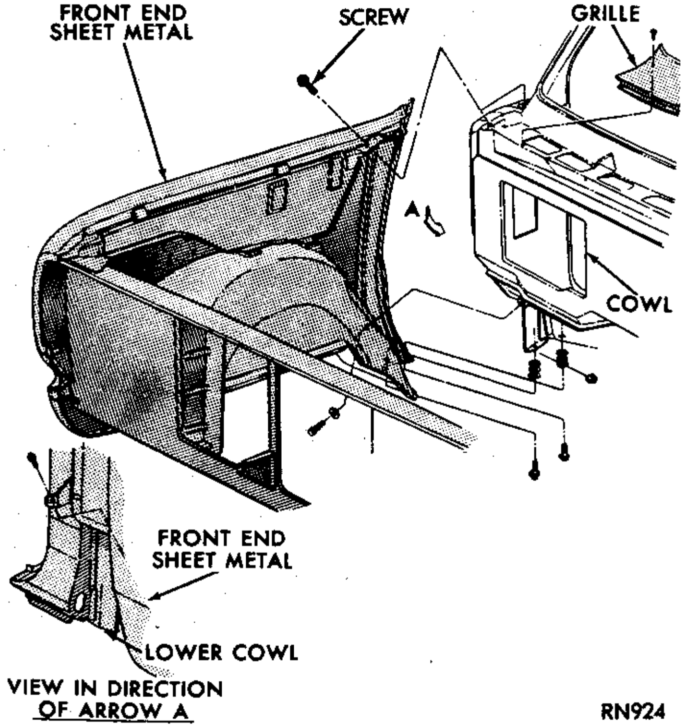


Fig. 13—Front Fender to Body and Cowl

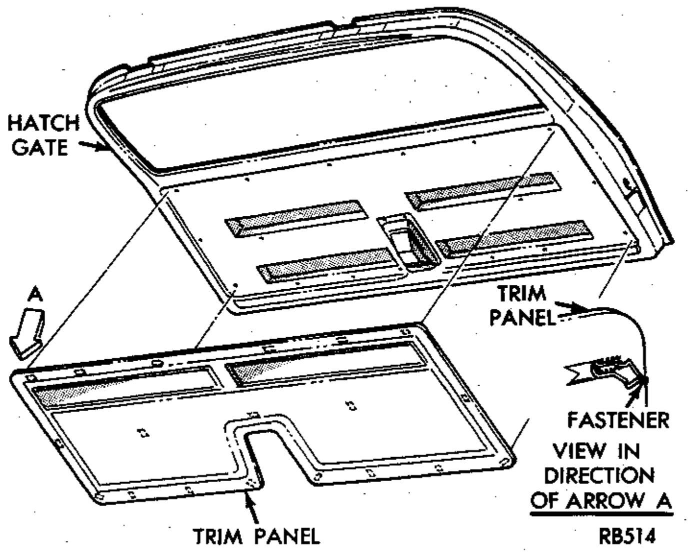


Fig. 14—Liftgate Trim Panel

1-1/4 screw and washer in the top mounting with spacers used under either method. Be sure during removal that the same amount of spacers removed are replaced during installation.

LIFTGATE HARDWARE (Figs. 14 thru 17)

LIFT ROD

REMOVAL

(1) Remove upper lift rod stud from roof panel.
(2) Remove lower lift rod stud from liftgate.
(3) Remove lift rod from liftgate.
(4) Support liftgate when removing lift rod.

INSTALLATION

(1) Install upper lift rod stud to roof panel.
(2) Install lower stud to liftgate.
(3) Check lift rod and liftgate for proper function.

LATCH LOCK ASSEMBLY (Fig. 16)

REMOVAL

(1) Open liftgate.
(2) Remove liftgate trim panel (Fig. 14).
(3) Remove latch lock cover (Fig. 16).
(4) Disengage right and left latch tubes (Fig. 16).
(5) Disconnect liftgate ajar wiring (Fig. 15).
(6) Remove latch lock assembly.

INSTALLATION

(1) Install latch lock assembly.
(2) Engage right and left latch tubes to latch lock.
(3) Check ajar switch wiring for installation.
(4) Install latch lock cover.
(5) Install liftgate trim panel.
(6) Check lock and latch for proper operation.

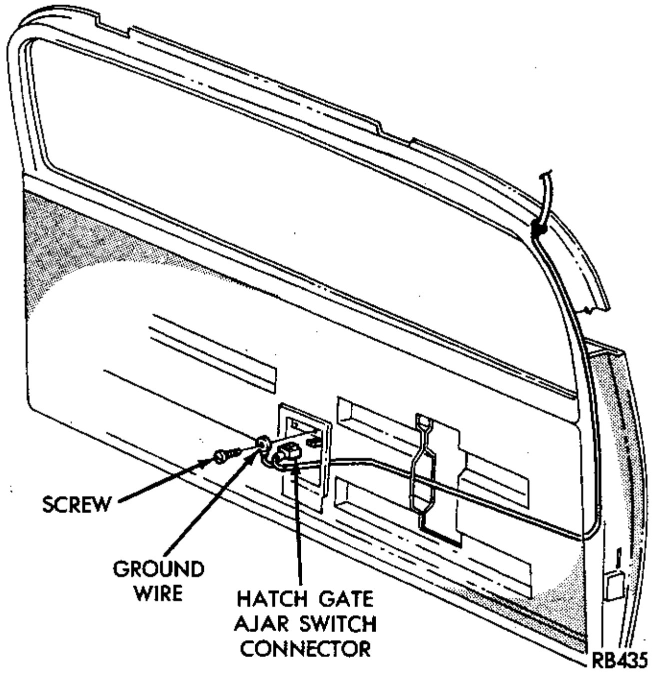


Fig. 15—Liftgate Ajar Connection

HINGE—LIFTGATE (Fig. 17)

REMOVAL

(1) Support liftgate when removing a hinge.
(2) Remove hinge to liftgate bolts.
(3) Remove hinge to roof bolts.
(4) Remove hinge assembly.

INSTALLATION

(1) Install hinge to roof.
(2) Install hinge to liftgate.
(3) Adjust hinge for proper alignment.

LIFTGATE (Fig. 17)

REMOVAL

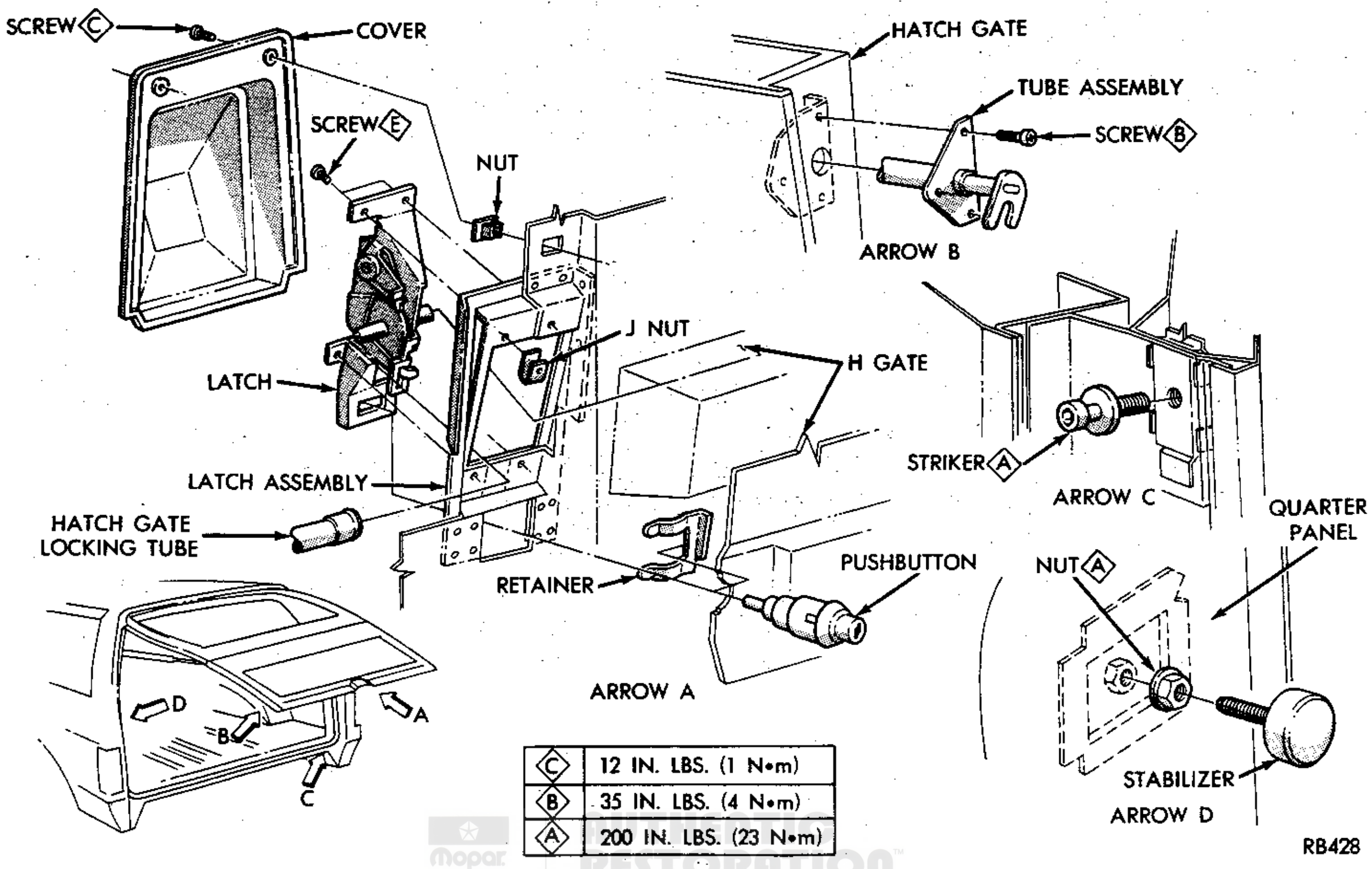
(1) Open liftgate.
(2) Remove mounting bolts from hinges to liftgate.
(3) Remove liftgate lift rod studs from roof section.
(4) Remove liftgate and lift rods from vehicle.

INSTALLATION

(1) Place liftgate and lift rods into position on vehicle.
(2) Install lift rod studs into roof section.
(3) Install liftgate to hinges.
(4) Check for alignment and proper operation.

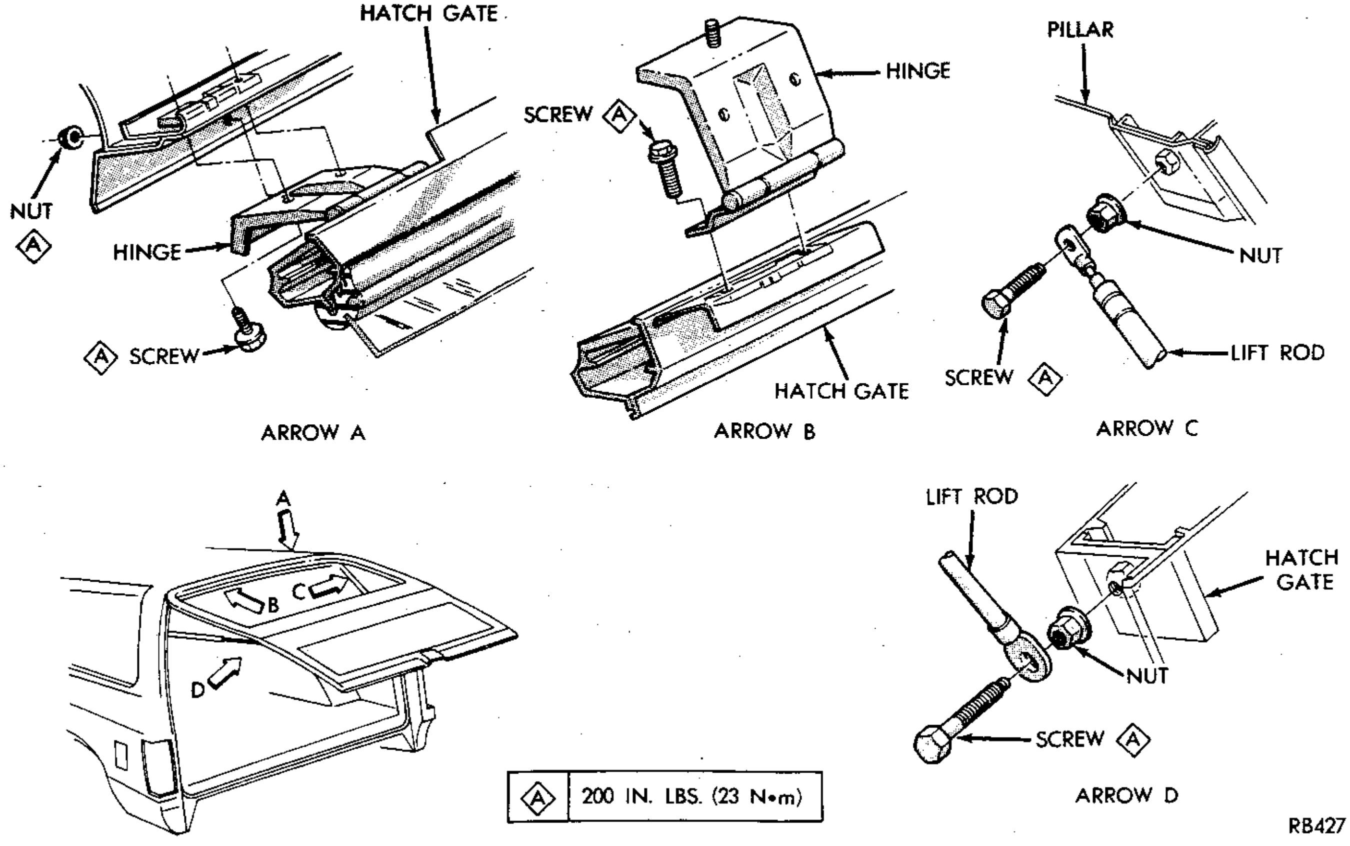
HOLD DOWN MOUNTINGS

For specific body mounting refer to (Fig. 18) to identify correct hardware. Be sure to torque hold down fasteners.



C	12 IN. LBS. (1 N•m)
B	35 IN. LBS. (4 N•m)
A	200 IN. LBS. (23 N•m)

Fig. 16—Liftgate Latch and Striker



A	200 IN. LBS. (23 N•m)

Fig. 17—Liftgate Installation

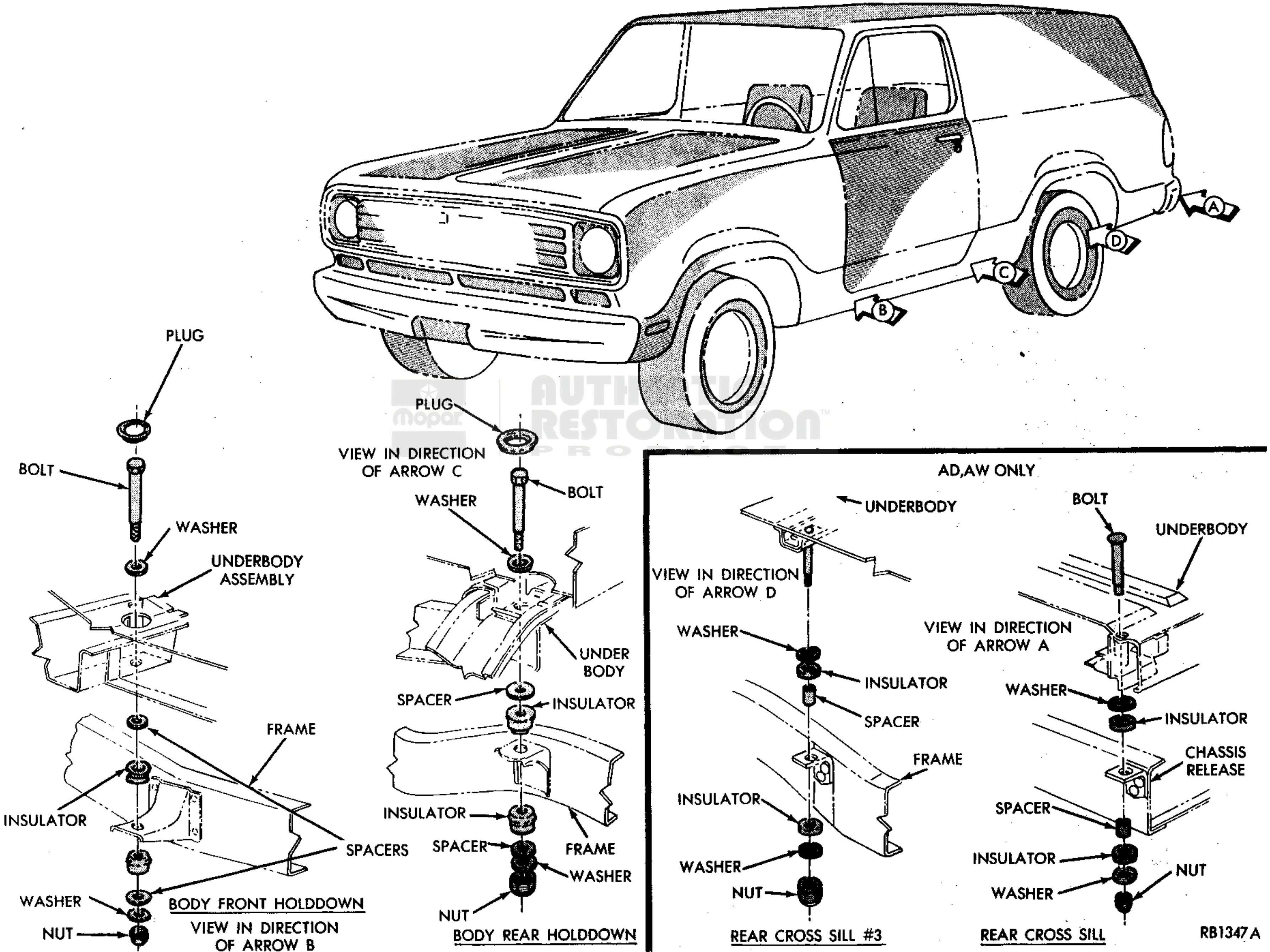


Fig. 18—Body Hold-Down Mounting

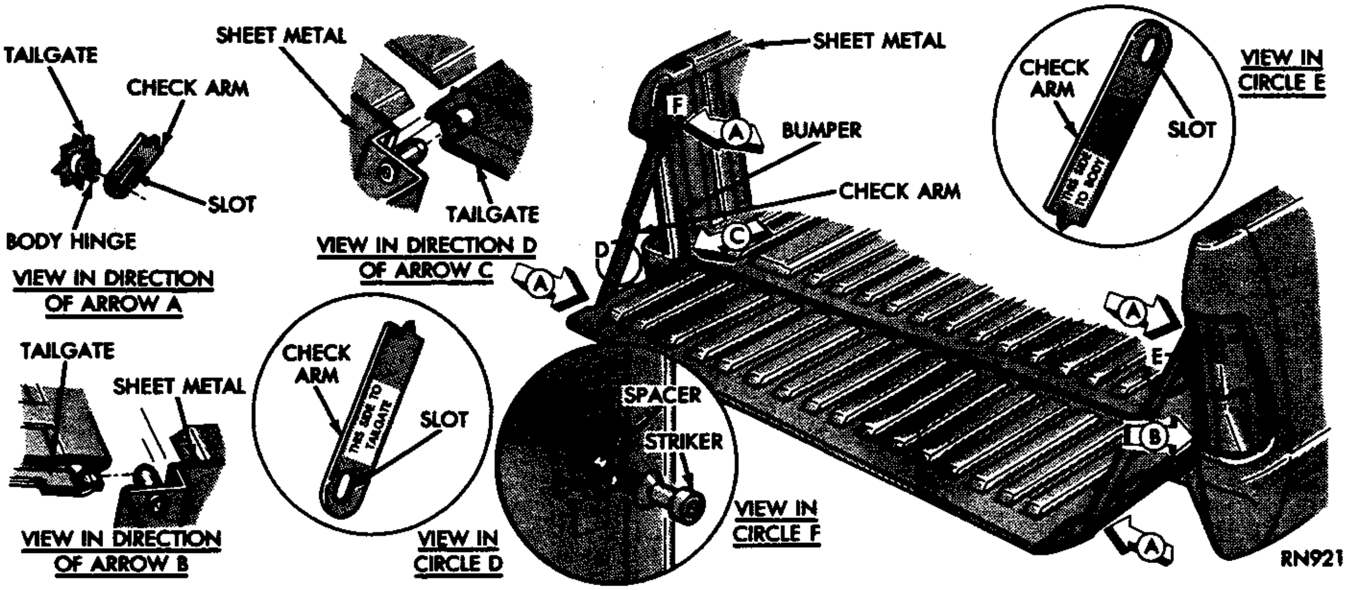


Fig. 19—Tailgate to Body

TAILGATE (Fig. 19)

REMOVAL

(1) Open tailgate.

(2) Angle gate so slot in check arm lines up with body hinge.

(3) Slip check arm away from hinge.

(4) Remove bottom of gate from slot in lower hinge on right side, facing gate.

(5) Remove left side of gate by sliding out of lower hinge.

INSTALLATION

(1) Slide gate into left lower hinge.

(2) Place right side into slotted hinge.

(3) Install check arms to gate, noting marking to correct position of arm and body.

(4) Bring gate up till top of check arm slotted section slips onto hinge.

TAILGATE, LOCK, AND LINKAGE (FIG. 20)

REMOVAL

(1) Remove screws mounting lock to inner tailgate sheet metal.

(2) Lower handle and lock assembly out of opening in front tailgate sheet metal.

(3) Disconnect clip from lock to linkage.

(4) Remove striker plates on left and right ends of tailgate.

(5) Remove linkage through ends of gate.

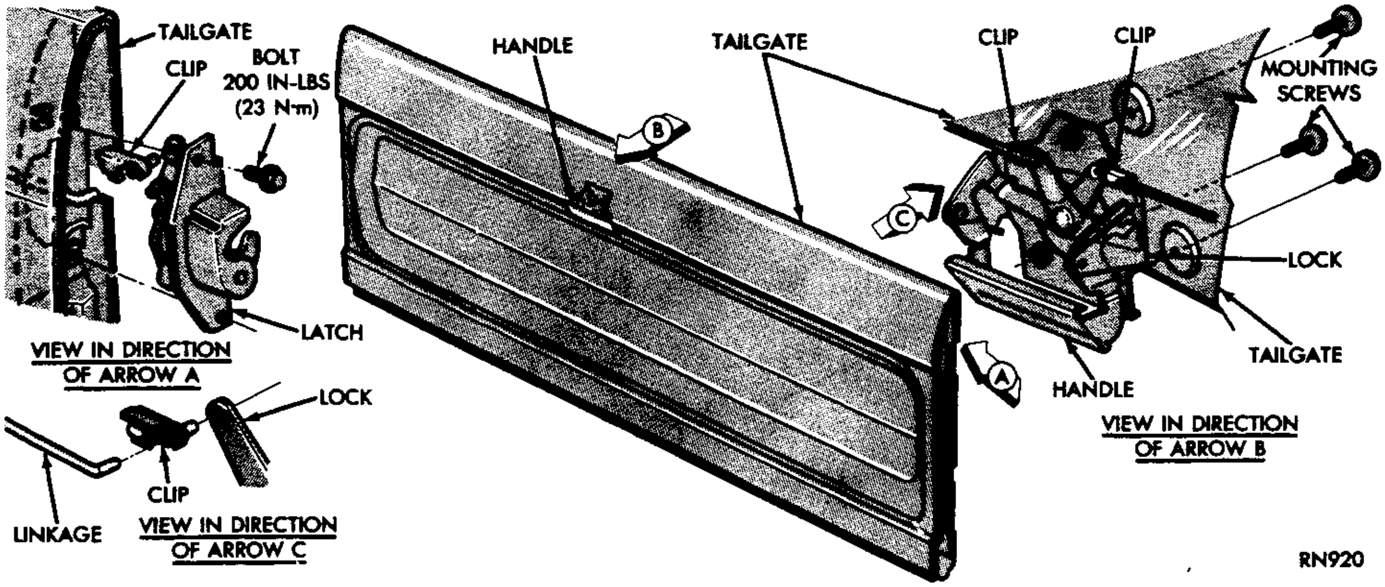


Fig. 20—Tailgate Linkage

INSTALLATION

Lubricate locks before installation.

(1) Insert lock into opening of tailgate.

(2) Guide linkage into ends of tailgate.

(3) Secure striker plates to end of gate.

(4) Insert linkage into lock assembly and install clips.

(5) Secure lock to tailgate with screws.

(6) Check locks for proper function, adjust fore and aft to eliminate gate rattles.

SPORT BAR ASSEMBLY (FIG. 21)

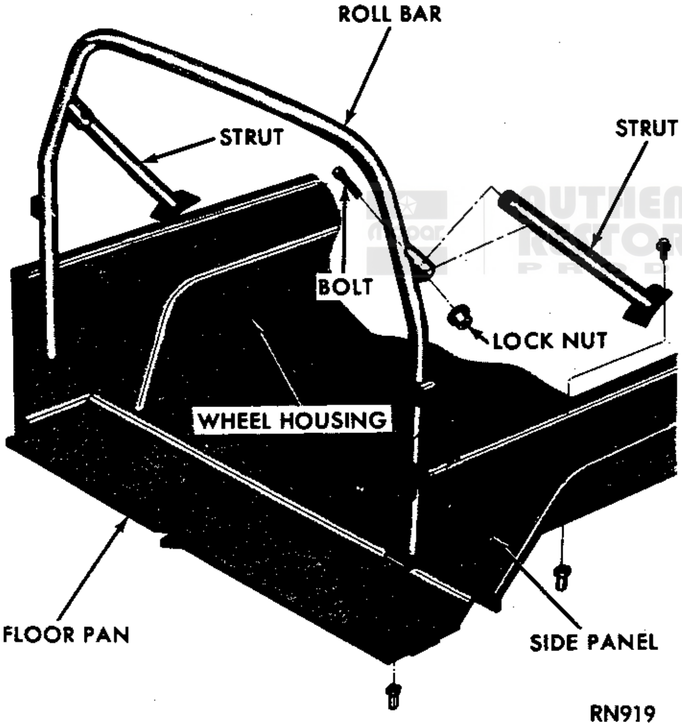


Fig. 21—Sport Bar Assembly

REMOVAL

(1) Remove bolts from bar struts, located on bar assembly.

(2) Remove screws and washer assemblies from bar to floor pan.

(3) Remove screws and washer assemblies from bar to side panels.

(4) Remove screws and washer assemblies from struts to wheel housing.

(5) Remove units from vehicle.

INSTALLATION

(1) Install bar assembly loosely to floor pan.

(2) Install bar assembly loosely to side panels.

(3) Install struts to bar with bolts.

(4) Install struts to wheel housing.

(5) Secure all loose bolts and screws.

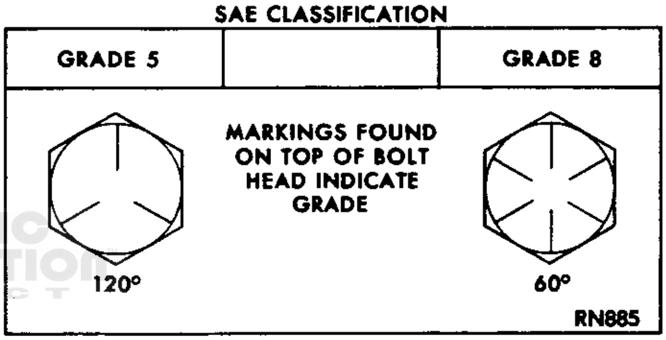


Fig. 22—Bolt Head Identification

BOLT TORQUE

	GRADE 5		GRADE 8	
Size	Ft. Lbs.	N•m	Ft. Lbs.	N•m
1/4-20	95 In. Lbs.	11	125 In. Lbs.	14
1/4-28	95 In. Lbs.	11	150 In. Lbs.	17
5/16-18	200 In. Lbs.	23	270 In. Lbs.	31
5/16-24	20	27	25	34
3/8-16	30	41	40	54
3/8-24	35	48	45	61
7/16-14	50	68	65	88
7/16-20	55	75	70	95
1/2-13	75	102	100	136
1/2-20	85	115	110	149
9/16-12	105	142	135	183
9/16-18	115	156	150	203
5/8-11	150	203	195	264
5/8-18	160	217	210	285
3/4-16	175	237	225	305

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GENERAL INFORMATION

Figure 1 is meant to serve as an index or component guide. They are meant to show component name and location. Service procedures on individual components can be found in this section also. Use (Fig. 1) as a tool to identify the part and its location on or in the door assembly.

Care should be exercised to keep all undercoating or rustproofing materials away from door components. A significant cause of door system malfunction is contamination by rust prevention materials.

BLIND RIVETS

The 1/4 inch blind rivets used to secure various door components should be removed as follows: drive out the center of the rivet with a drift punch then drill out the rivet with a 1/4 inch drill bit. Components should be reinstalled using a 1/4-20 x 1/2 screw (6030163) and nut (118613) or their equivalents torqued to 90 in. lbs.

HINGE REPLACEMENT

(1) Support door with a padded floor jack.
(2) Mark outline of hinge on door and body to aid in assembly.
(3) Remove hinge to body screws.
(4) Remove hinge to door screws and remove hinge.
(5) Reverse above procedure for installation.

DOOR ADJUSTMENT

Door adjustments should be made by loosening one hinge at a time and moving door into position. Support door with a padded floor jack.

FORE AND AFT adjustments are made by loosening bolts, attaching hinge to body pillars, and moving door to desired position.

UP AND DOWN adjustments are made by loosening bolts, attaching hinge to door pillar, and moving door to desired position. Up and down adjustments require loosening of both upper and lower hinges.

IN AND OUT adjustments are made by loosening the bolts, attaching hinge to door, and moving door to desired position.

FRONT DOOR TRIM PANEL (FIG. 2)

REMOVAL

(1) Remove remote control handle and spacer.
(2) Remove window regulator handle and spacer.
(3) Remove screws attaching lower trim panel to door.
(4) Remove screw at armrest.
(5) Using a trim stick or other suitable flat tool, gently pry trim panel away from door.
(6) Reverse above procedure for installation.

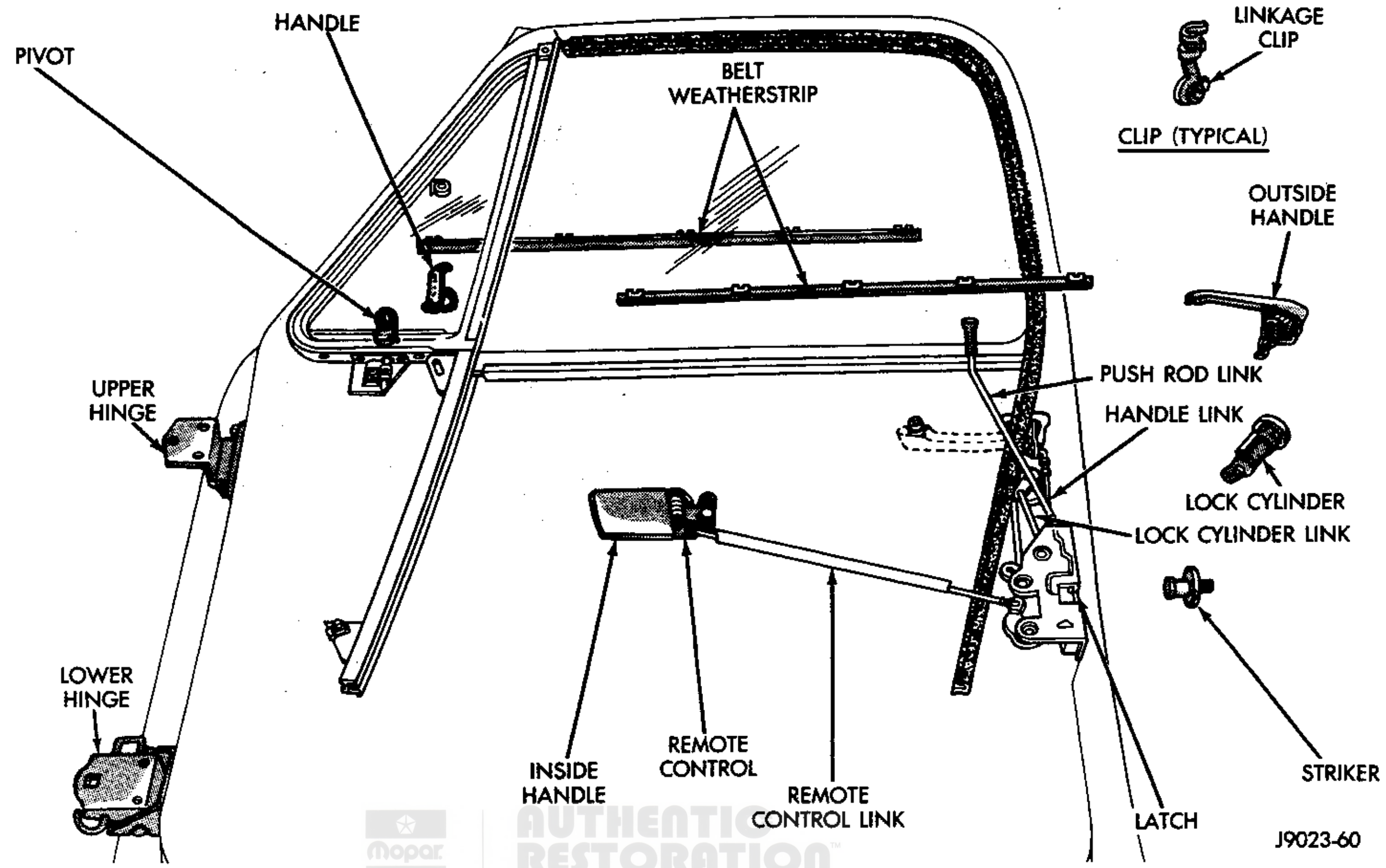

Fig. 1—Front Door Lock and Latch System

OUTSIDE HANDLE

REMOVAL

(1) Raise glass to full up position.

(2) Remove door trim panel or access panel.

(3) Disconnect handle link from latch assembly.

(4) Remove fasteners securing handle to door and remove handle and link.

(5) Reverse above procedure for installation.

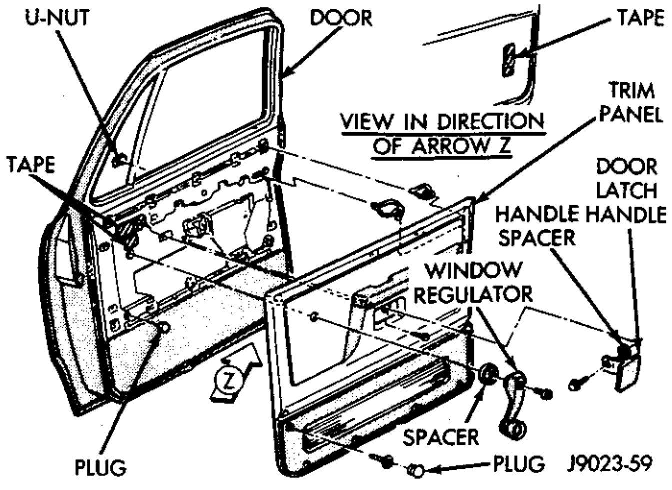

Fig. 2—Door Trim Panel

LATCH ASSEMBLY (FIG. 3)

REMOVAL

(1) Raise glass to full up position.

(2) Remove door trim panel or access panel.

(3) Disconnect all link attachments at latch.

(4) Remove latch attaching screws and lift latch out through access holes.

(5) Reverse above procedure for installation.

LINKAGE ADJUSTMENT

(1) Locate the .312 (8mm) diameter access hole in the door face at the latch area.

(2) Loosen door latch adjusting screw through the access hole.

(3) Push up on the latch lever through the access hole to remove all slack from the linkage.

(4) Tighten adjusting screw while holding latch lever in position.

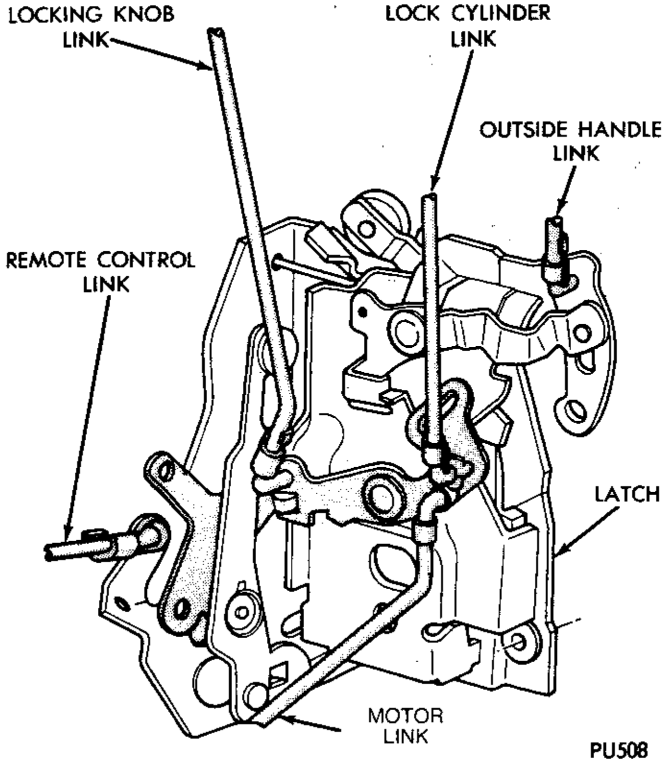

Fig. 3—Link Attachment to Latch

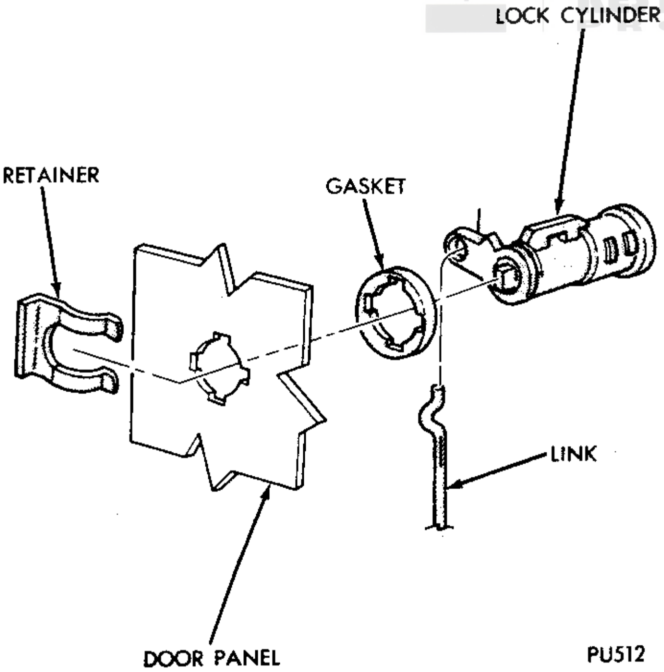

Fig. 4—Lock Cylinder

LOCK CYLINDER (Fig. 4)

REMOVAL

(1) Raise glass to full up position.

(2) Remove door trim panel.

(3) Remove lock cylinder link from latch.

(4) Remove lock cylinder retainer and remove lock cylinder and link from door.

(5) Reverse above procedure for installation.

LOCK CYLINDER PROCEDURES

The following procedures will allow the repair or replacement of lock cylinders while retaining the original key. It is no longer necessary to replace an entire set of lock cylinders when only one is defective.

Kits are available through MOPAR for repair of cylinders or an equivalent kit may be used. All necessary components are supplied in the kit for repairs, along with a key code book and instructions.

ESTABLISHING LOCK CYLINDER CODE (FIG. 5)

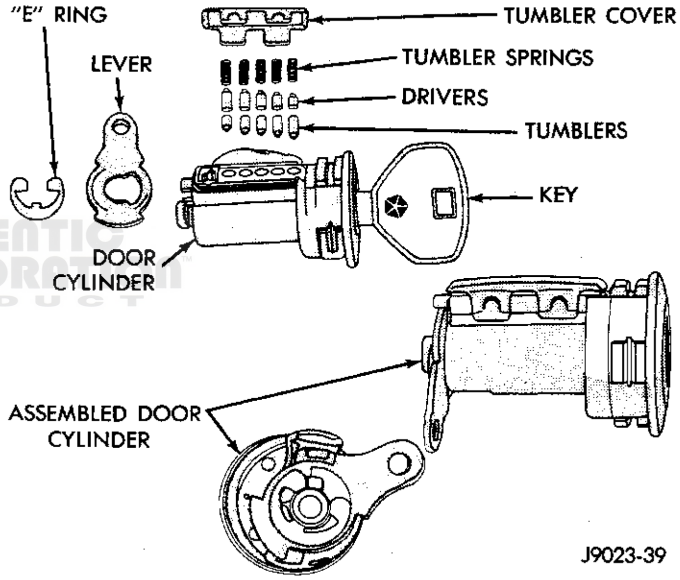

Fig. 5—Door Lock Cylinder Components

When the key or code number is not available the following procedure should be used to establish the code number.

(1) Remove door lock cylinder from vehicle.

(2) Remove cover from cylinder and discard.

(3) Remove each spring, driver and tumbler, one at a time.

(4) Measure and record the code using the code plate.

(5) Reassemble the same tumbler, driver and spring if not damaged.

(6) Continue the coding procedures through all sets of springs, drivers and tumblers.

(7) Assemble a new cover.

DOOR LOCK CYLINDER REPAIR (FIG. 5)

(1) Remove lock cylinder from door.

(2) The removed production lock cylinder, covers, drivers, springs, and tumblers should be scrapped. If the new springs get tangled, do not pull them apart ... unscrew them from each other so they are not stretched and distorted.

(3) Establish the key code.

(4) Assemble new drivers and tumblers, springs, and cover.

The lever and E-ring may be reused if not damaged.

(5) Test assembled door lock cylinder for function and reinstall into door.

ELECTRIC DOOR LOCK MOTOR

REMOVAL

(1) Raise glass to full up position.

(2) Remove door trim panel or access panel.

(3) Disconnect motor from wiring harness.

(4) Disconnect motor link from motor.

(5) Remove motor mounting screws and lift motor out through access hole.

(6) Reverse procedure for installation.

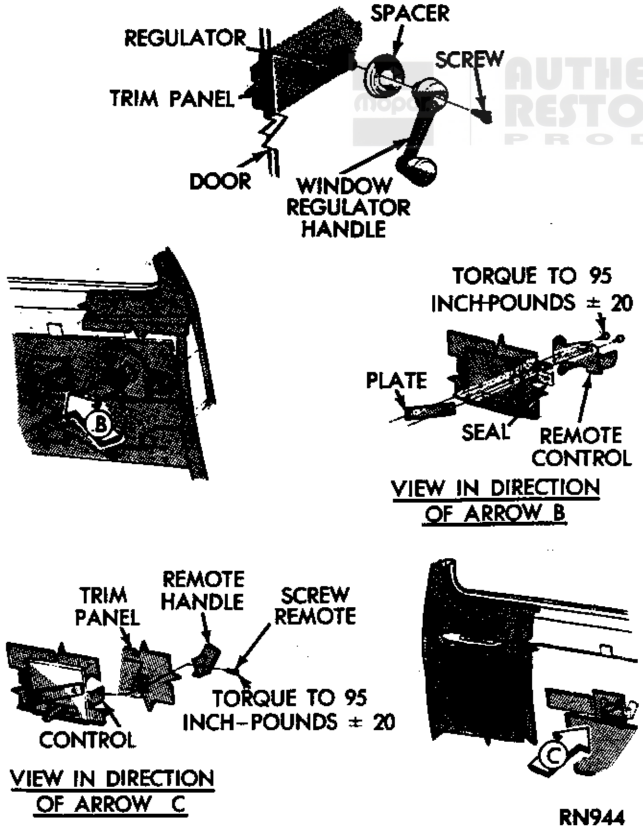

Fig. 6—Remote Control Assembly

REMOTE CONTROL (FIG. 6)

REMOVAL

(1) Remove regulator handle shown in (Fig. 6).

(2) Remove remote control handle.

(3) Remove trim panel, and watershield.

(4) Working through access hole remove linkage and mounting plate to remote control.

(5) Remove remote control.

INSTALLATION

(1) Slide remote control mounting plate through access hole and into door.

(2) Connect linkage and install screws to remote control assembly.

(3) Install remote control handle and adjust forward to eliminate excess handle travel.

(4) Install trim panel, remote and regulator handle.

DOOR WEATHERSTRIP (FIG. 7)

The weatherstrip is installed by pushing it over the fence, making sure that contact is made with the fence around corners and clinching it tightly around entire perimeter to avoid water leaks, puckering and stretching. Trim ends to overlap 6.3mm (.25).

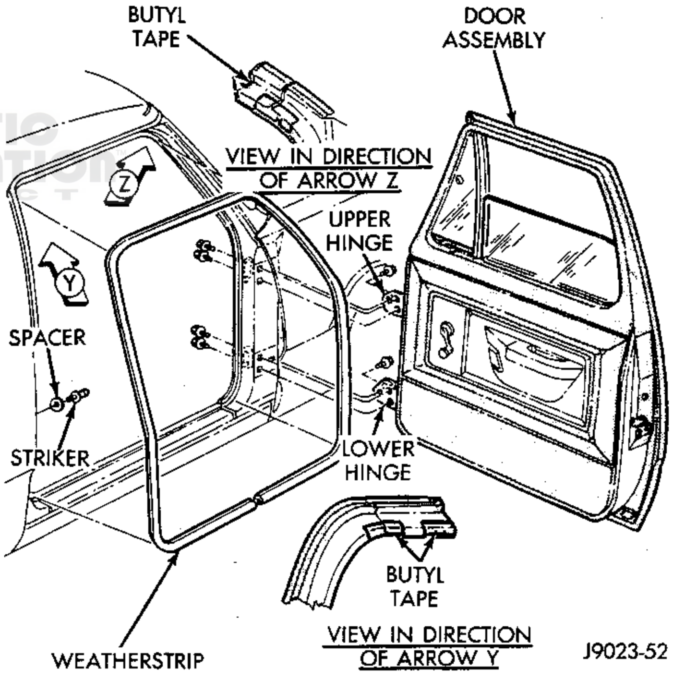

Fig. 7—Door Weatherstrip and Attachments

GLASS SYSTEMS

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Vent Wing Glass 25

GENERAL INFORMATION

Figure 1 is meant to serve as an index or component guide. It is meant to show component name and location. Service procedures on individual components can be found in this section also. Use (Fig. 1) as a tool to identify the part and its location on or in the door assembly.

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BLIND RIVETS

The 1/4 inch blind rivets used to secure various door components should be removed as follows: drive out the center of the rivet with a drift punch then drill out the rivet with a 1/4 inch drill bit. Components should be reinstalled using a 1/4-20 x 1/2 screw (6030163) and nut (118613) or their equivalent torqued to 90 in. lbs. (10 N•m).

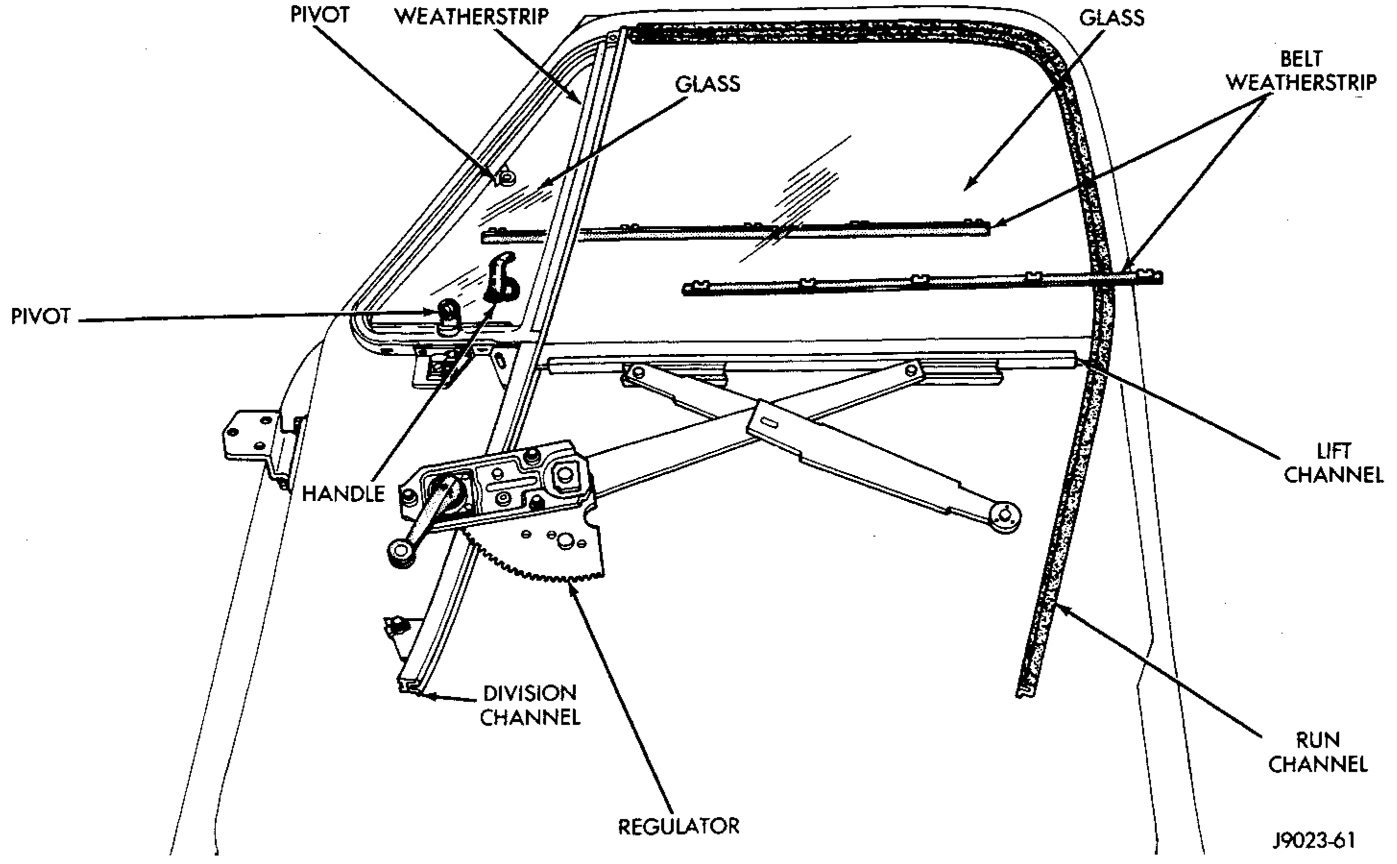

Fig. 1—Door Glass System

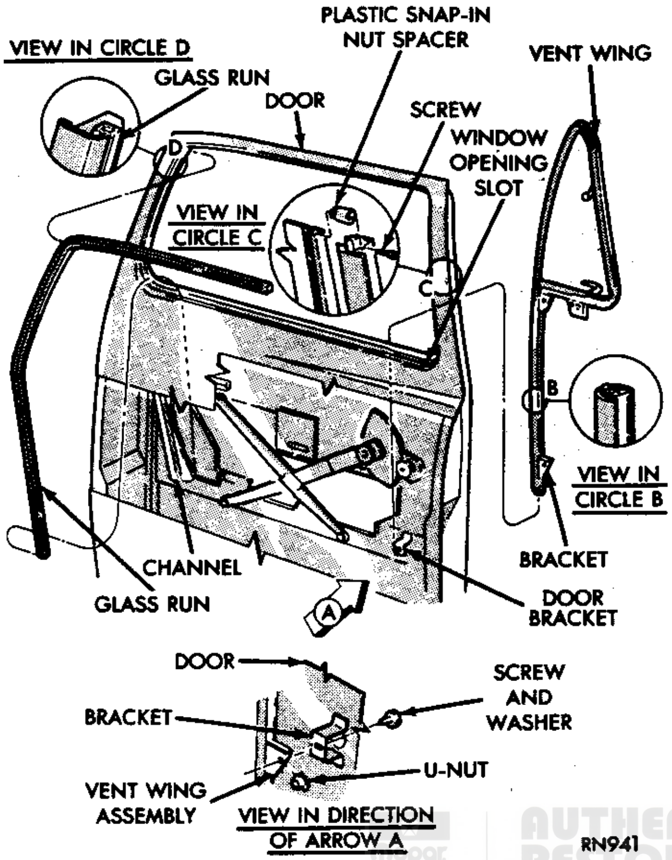

Fig. 2—Vent Wing and Glass Run

VENT WING AND GLASS RUN ASSEMBLY (FIG. 2)

REMOVAL

(1) Lower glass and remove inner weatherstrip.

(2) When removing inner belt weatherstrip use care not to scratch the beltline paint.

(3) Free the clip on the inner section of the weatherstrip with a wire hook or suitable tool.

(4) Pull back upper glass run 8 to 10 inches (20-25 Cm).

(5) Remove upper and lower vent wing attaching screws.

(6) Remove vent wing, taking care to avoid paint damage from glass lower pivot adjusting screws.

INSTALLATION

(1) Install plastic nut and "U" nut on vent wing assembly.

(2) Install vent wing assembly into door taking care not to damage paint with lower pivot adjusting screw.

(3) Install upper and lower vent wing attachment screws.

(4) Move glass run back to vent wing by placing run adjacent to door channel and press into channel using wide bladed screwdriver or similar tool. Press in both inside corners to insure hidden lip engages in channel.

(5) Install belt weatherstrip by aligning clips to holes in door and press in.

(6) Raise or lower vent to maintain a .06 (1.6mm) fore-aft glass freeplay then with glass up, tighten upper screws.

(7) Hold vent against glass (glass down) and tighten lower screws.

VENT WING GLASS

REMOVAL

(1) Remove trim panel.

(2) Remove screw from lower glass pivot.

(3) Remove upper glass pivot rivet and remove glass.

(4) Transfer latch handle to replacement glass.

INSTALLATION

(1) Lubricate lower glass pivot with Spray White Lube or equivalent.

(2) Install lower glass pivot into frame and install screw.

(3) Install upper glass pivot rivet.

(4) Install trim panel.

SIDE GLASS REPLACEMENT

REMOVAL

(1) Remove rear stationary glass.

(2) Remove inner and outer weatherstrips.

(3) Remove regulator arm from lower channel.

(4) Remove glass from door.

(5) Remove lower channel from glass.

INSTALLATION

Before installing glass, lubricate all moving parts of regulator with Spray White Lube or equivalent.

(1) Install lower channel on glass.

(2) Position glass into door opening.

(3) Install regulator arm roller into channel of glass lift bracket.

(4) Position glass into run channels and adjust glass.

(5) Install rear stationary glass.

(6) Install inner and outer weatherstrips.

GLASS AND WEATHERSTRIP (FIG. 3)

To assemble window glass to door (Fig. 3) insert glass to everseal. Place channel assembly onto everseal. Press seal onto channel securely and lubricate channel. Lower regulator to down position. Place glass and channel assembly into slot opening in door and lower it to the bottom of door. Reach through the access hole in door and install regulator to lower channel on glass, and to upper channel. Install vent wing. Test glass for proper movement. Adjust vent

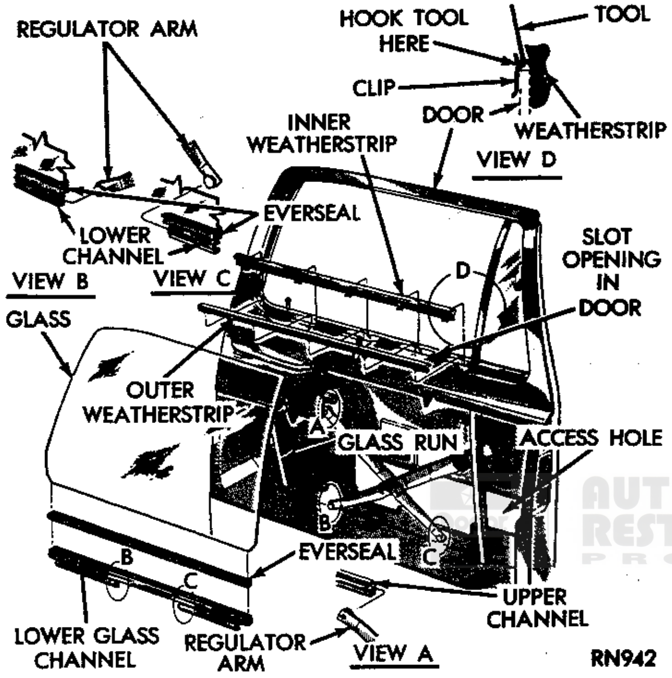

Fig. 3—Glass and Weatherstrip

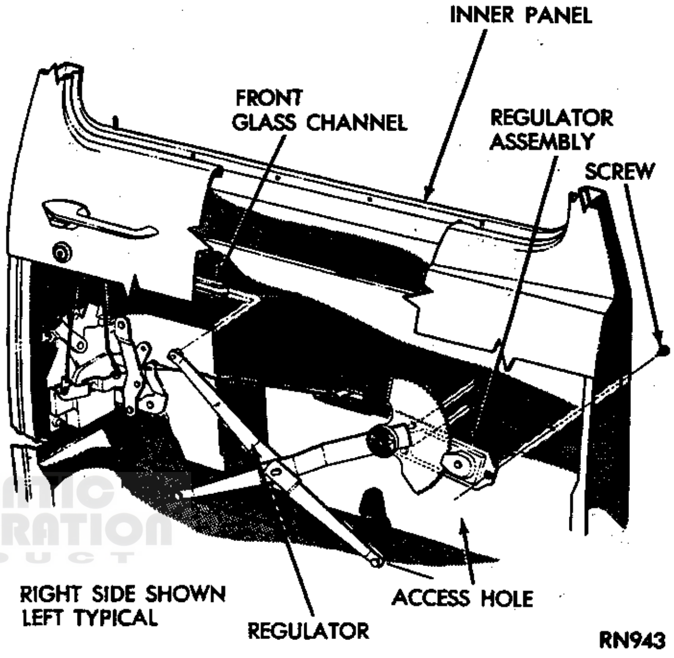

Fig. 4—Window Regulator

up to eliminate fore and aft freeplay. Then install the weatherstrip assembly front and rear to door.

MANUAL WINDOW REGULATOR (FIG. 4)

REMOVAL

(1) Lower window to full down position.

(2) Remove trim panel and watershield.

(3) On stereo equipped vehicles remove lower trim panel and remove speaker.

(4) Remove vent wing.

(5) Slide glass forward off of regulator arms and lower glass to door bottom.

(6) Drill out regulator mounting rivets and remove regulator through access hole.

INSTALLATION

(1) Insert upper regulator arm into door mounted channel.

(2) Mount regulator to door panel with 1/4-20 screws and nuts torqued to 90 in. lbs. (10 N•m).

(3) Slide glass onto regulator arms and into rear glass run.

(4) Install and adjust vent wing.

(5) Raise glass to full up position.

(6) Install stereo speaker (if so equipped).

(7) Install trim panel and watershield.

FIXED GLASS

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WINDSHIELD (FIG. 1)

REMOVAL (FIG. 2)

(1) Cover cowl panel to protect paint finish.

(2) Remove wiper arms and blades. Refer to Wiper Section in this service manual.

(3) Remove the retainer cap. Pry out one end of retainer and carefully pull retainer from around weatherstrip.

(4) With an assistant supporting the windshield on the outside, from inside cab, push one corner of glass out of weatherstrip. Progressively force entire glass out of weatherstrip.

(5) Remove glass from opening.

(6) The weatherstrip will remain in place on windshield opening if so desired.

INSTALLATION (FIG. 3)

Mineral spirits **only** should be used as a lubricant to aid installation.

(1) Install weatherstrip (if removed) on windshield opening fence carefully, making sure weatherstrip is properly seated.

(2) With an assistant's aid, slide one corner of glass into lower glass groove of weatherstrip.

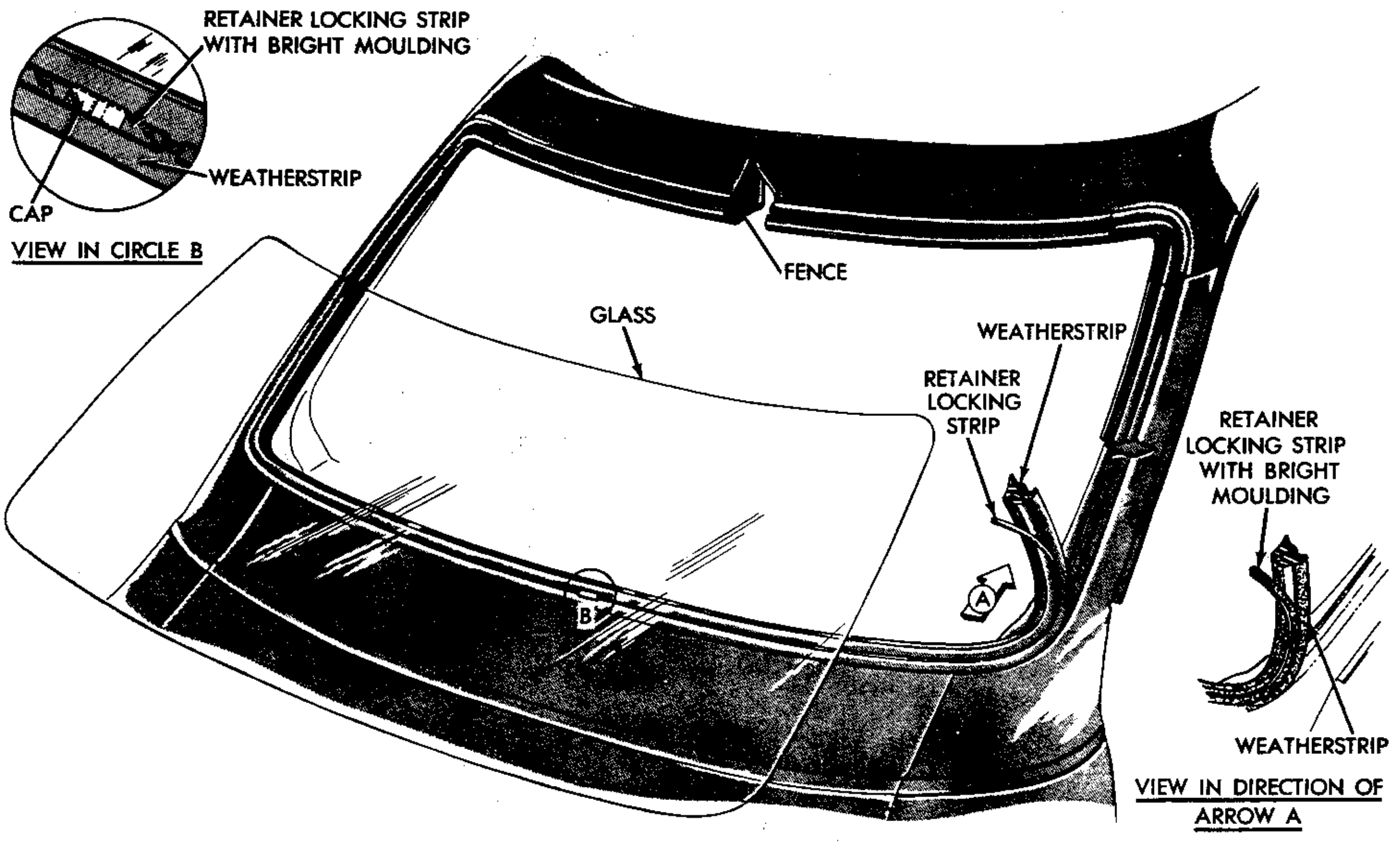

Fig. 1—Windshield Assembly

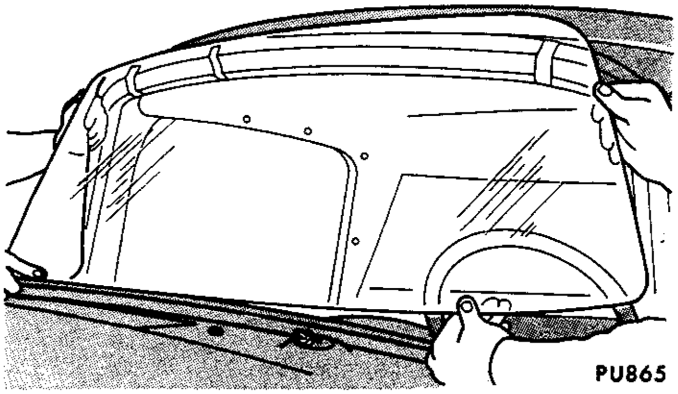

Fig. 2—Windshield Removal (Typical)

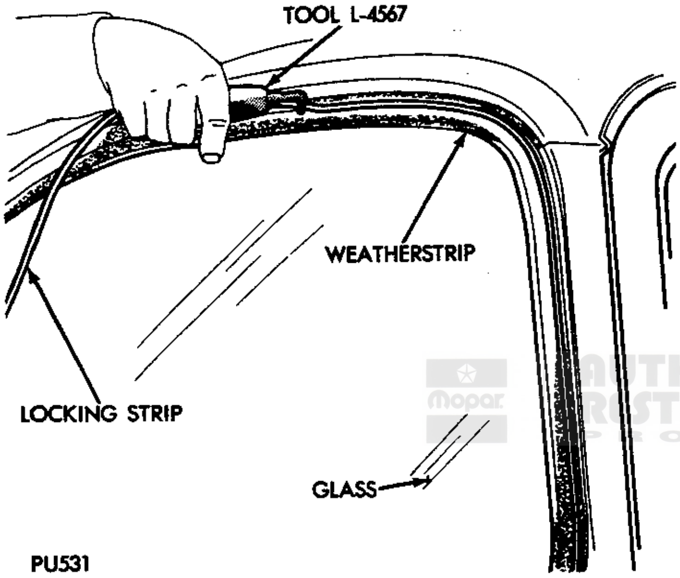

Fig. 3—Windshield Installation

(3) Move glass into groove as far as possible and using a fiber wedge force lip of weatherstrip over glass around its entire circumference.

(4) Start at one of lower corners of windshield and insert retainer in groove. Care should be taken not to overstretch locking strip when installing in weatherstrip. Install locking strip cap.

(5) Water test windshield area and inspect for leaks.

(6) Install windshield wiper arms and blades.

REAR WINDOW

REPLACEMENT (FIGS. 4, 5, 6)

REMOVAL

(1) Pry out one end of mylar retainer if applicable and carefully pull retainer from around weatherstrip.

(2) From inside the cab, push one corner of glass out of weatherstrip. Progressively force entire glass from weatherstrip.

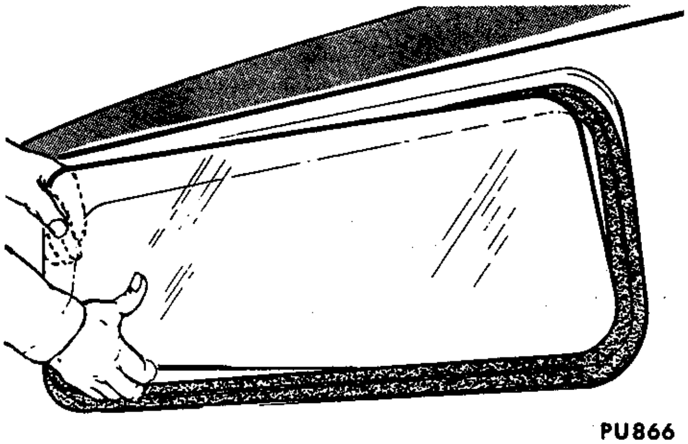

Fig. 4—Rear Window Removal

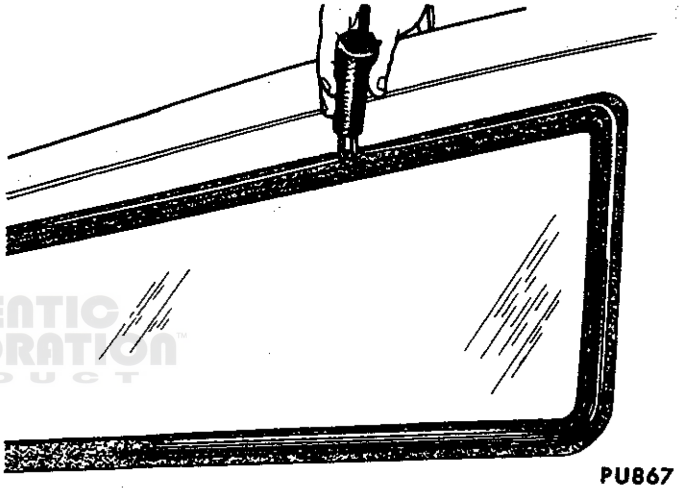

Fig. 5—Rear Window Installation

INSTALLATION

(1) Assemble weatherstrip to glass.

(2) Insert mylar locking strip to weatherstrip (if applicable).

(3) Install cord in weatherstrip retainer.

(4) Place the assembly to the glass opening.

(5) Install the assembly using the installation cord.

REAR WINDOW (SLIDING GLASS TYPE FIG. 6)

The procedure for service on the sliding glass window assembly is similar to the windshield.

To service the sliding glass sections follow that procedure.

SLIDING GLASS SECTION

REMOVAL

(1) Remove the complete rear window assembly.

(2) Place assembly in a clean padded area.

(3) Loosen screws located on the bottom of the frame.

(4) Carefully spread frame apart.

(5) Remove sliding glass section from assembly.

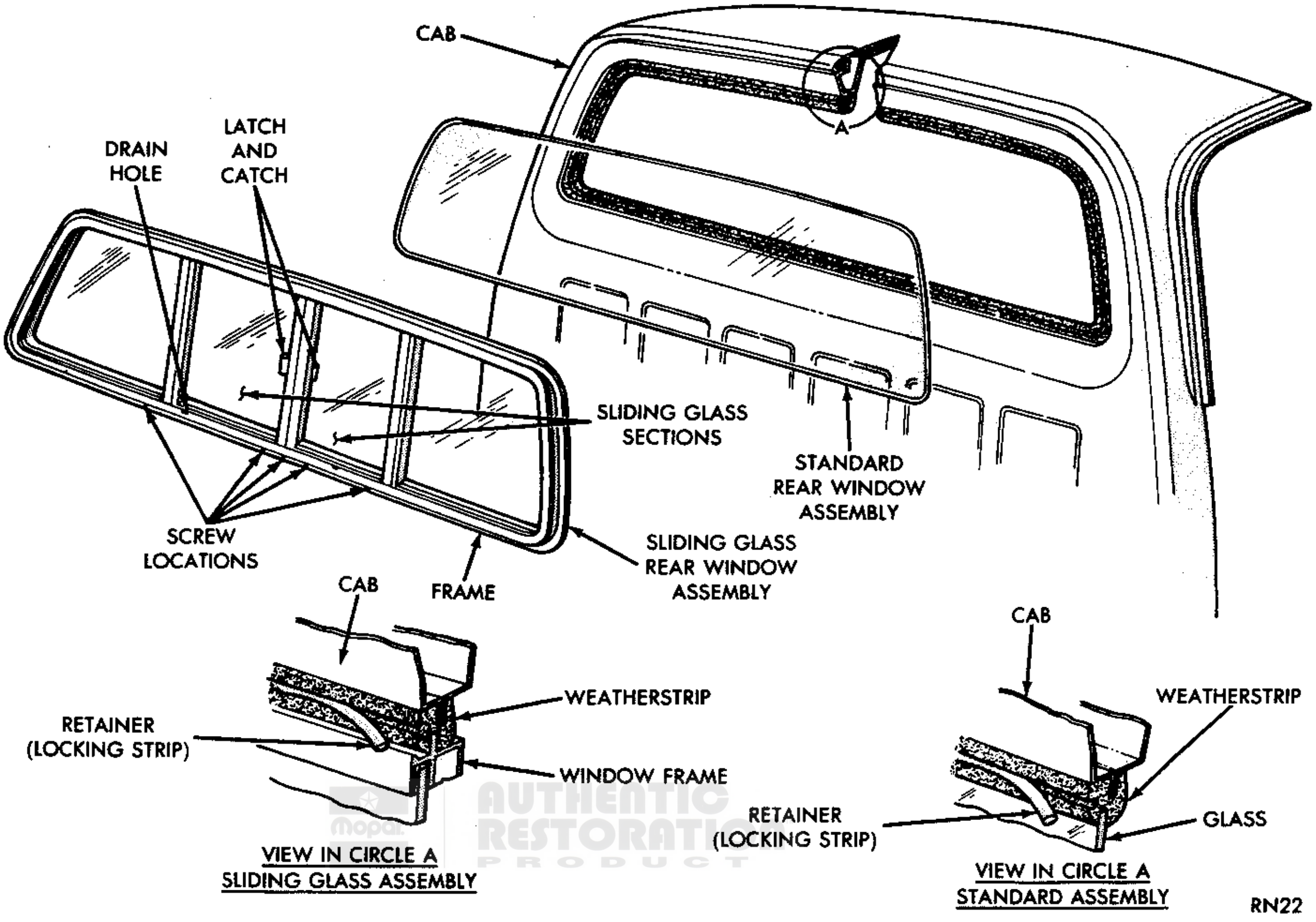

Fig. 6—Rear Window (Sliding Glass Type)

INSTALLATION

(1) Install sliding glass section into track in assembly.

(2) Tighten all screws on frame assembly.

(3) Check correct travel and latching of sliding sections.

(4) Install rear window assembly to vehicle.

(5) Check to see that drain holes are clear.

LATCH AND CATCH

The latch and catch are located on the sliding glass sections on the inside of cab with screws.

To service the latch or catch remove or replace screws.

LIFTGATE GLASS AND WEATHERSTRIP

REMOVAL

(1) Insert fiber stick between glass weatherstrip retainer and panel.

(2) With an assistant gently force glass and weatherstrip retainer away from frame.

(3) Remove glass and weatherstrip retainer assembly from liftgate.

INSTALLATION

(1) Install cord in weatherstrip retainer (Fig. 7).

(2) Install glass and weatherstrip assembly to liftgate opening.

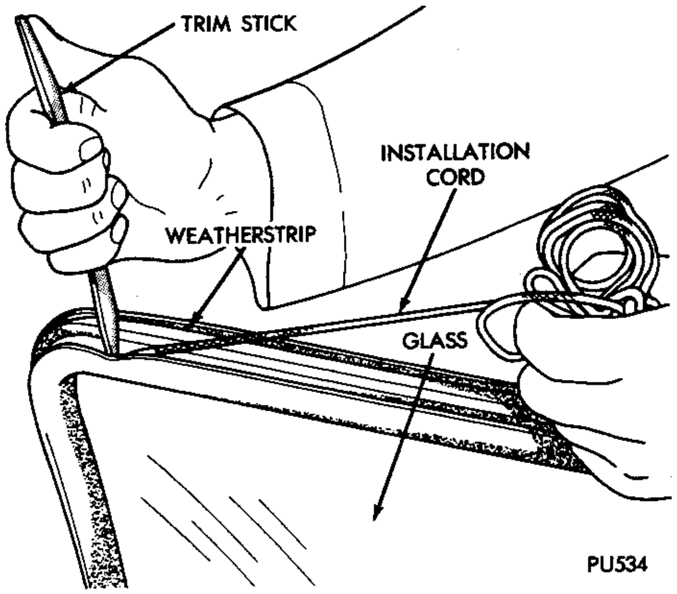

Fig. 7—Installation Cord

(3) Install the assembly to the door frame by using an installation cord.

(4) Clean glass.

QUARTER PANEL GLASS (FIXED)

REMOVAL

(1) Remove interior quarter glass trim (Fig. 8).

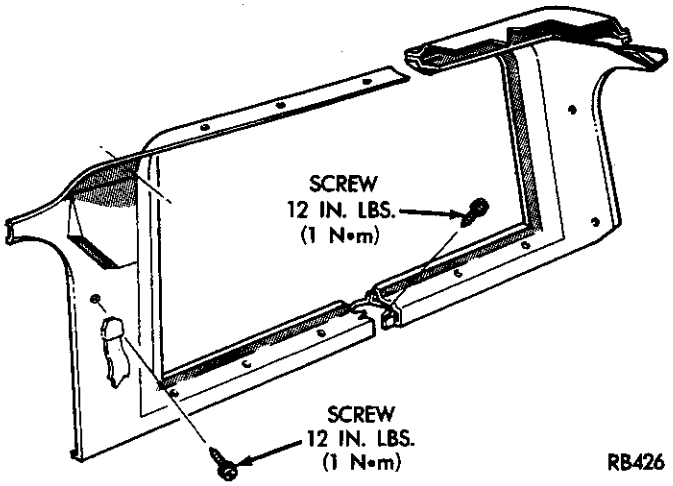

Fig. 8—Quarter Window Garnish Moulding

(2) Remove exterior mouldings (Fig. 9).

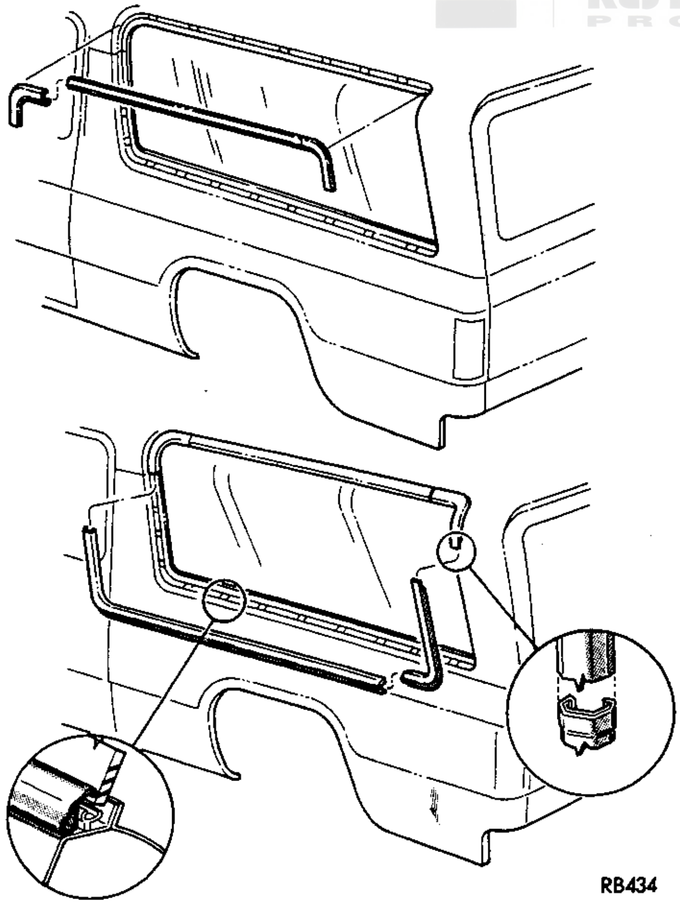

Fig. 9—Quarter Window Mouldings

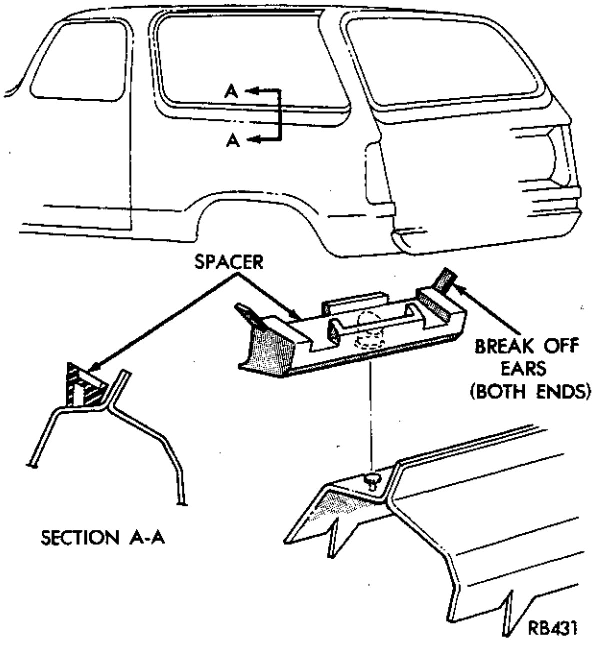

Fig. 10—Installing Quarter Window Spacers

(3) With an electric knife (Miller tool 4386 or equivalent) cut existing butyl tape as close as possible to fence flange.

(4) Remove the glass from opening by applying an even pressure to the glass.

INSTALLATION

(1) Remove remaining butyl tape on body opening surface as close as possible to the metal surface. If original glass is to be installed, remove all butyl tape from glass surface.

(2) Apply primer to glass and allow 10 minutes for primer to dry. Avoid contact with primed surface.

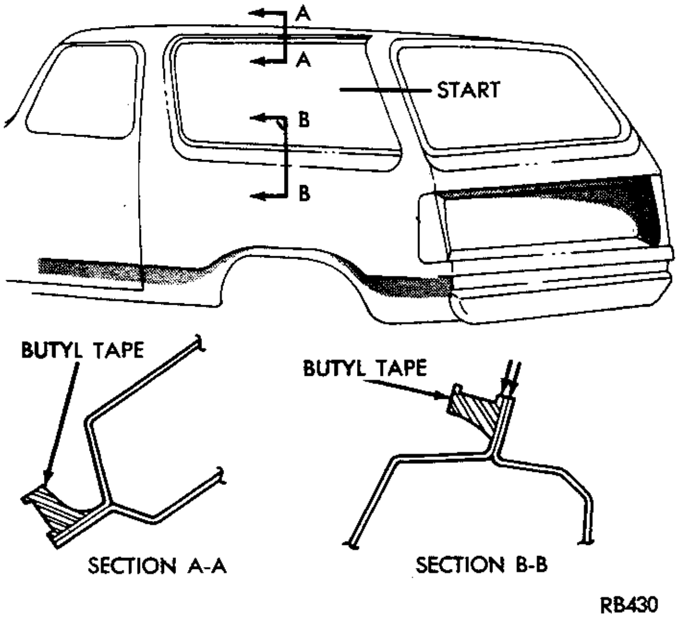

Fig. 11—Installing Butyl Tape

(3) Check quarter window spacers for proper installation (Fig. 10).

(4) Apply butyl tape to entire periphery of fence (Fig. 11).

(5) Cut excess tape away and butt the ends firmly together.

(6) Install quarter glass to butyl seal (Fig. 12)

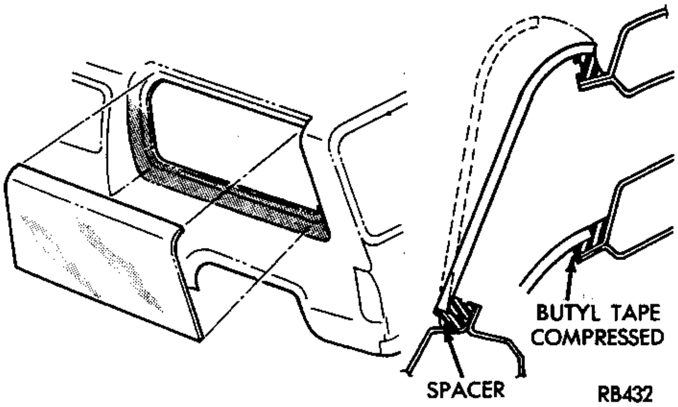

Fig. 12—Installing Quarter Window

(7) Compress glass to seal to achieve a good seal.

(8) Test quarter glass for water leaks.

(9) If leakage occurs, additional sealing may be required. Use a suitable windshield sealer (Fig. 13).

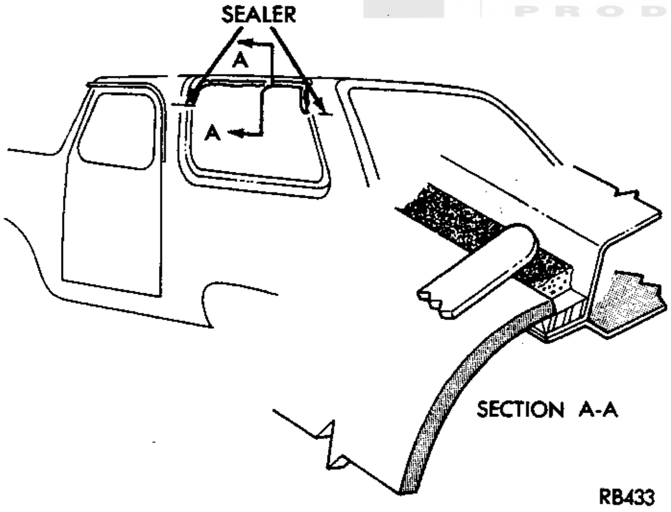

Fig. 13—Sealing Quarter Window

(10) Install mouldings.

(11) Clean glass.

ROOF VENT (Fig. 14)

VENT COVER

REMOVAL

(1) Open cover.

(2) Drill upper rivet head from cover/handle.

(3) Remove vent cover hinge.

(4) Remove cover.

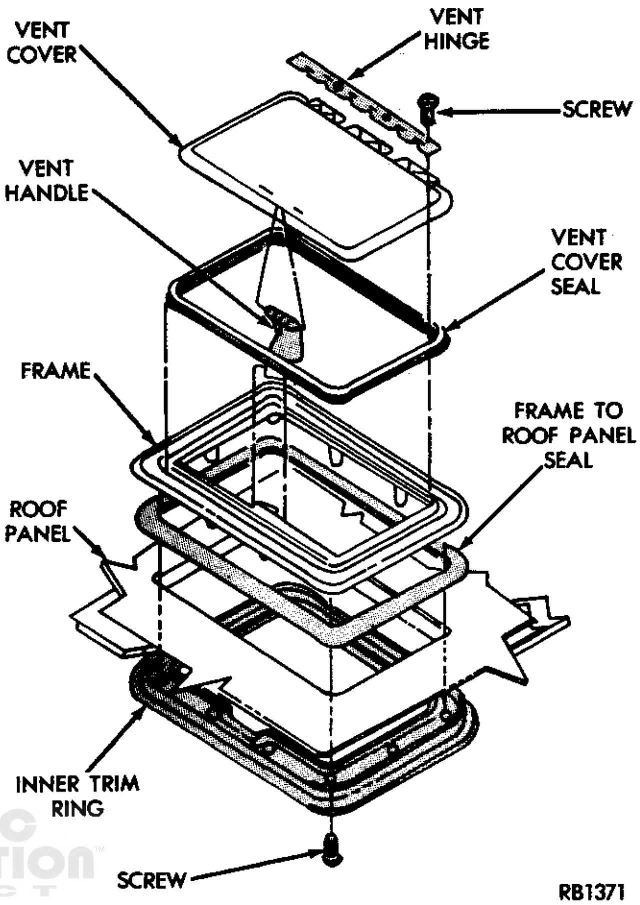

Fig. 14—Roof Vent

INSTALLATION

(1) Install cover.

(2) Attach hinge.

(3) Install handle to cover using rivet in Handle Package.

VENT COVER SEAL

REMOVAL

(1) Open cover.

(2) Remove cover hinge.

(3) Remove cover seal from frame.

INSTALLATION

(1) Clean seal area of frame.

(2) Using a weatherstrip cement install seal.

(3) Install cover hinge.

(4) Water test vent.

FRAME

REMOVAL

(1) Remove inner trim ring.

(2) Break the seal between frame and roof panel.

(3) Remove frame/cover assembly.

INSTALLATION

(1) Clean frame and roof sealing surfaces.

(2) Install seal to frame.
(3) Install frame to roof.
(4) Install inner trim ring and tighten.
(5) Water test frame area.

Note: R.T.V. Silicone Sealer may be used for additional sealing.

HANDLE

REMOVAL

(1) Open vent cover.
(2) Drill rivet head from handle to cover.
(3) Drill rivet head from handle to frame.
(4) Remove handle.

INSTALLATION

(1) Place handle in position.
(2) Install handle to cover using a rivet in Handle Package.
(3) Install handle to frame using a rivet in Handle Package.

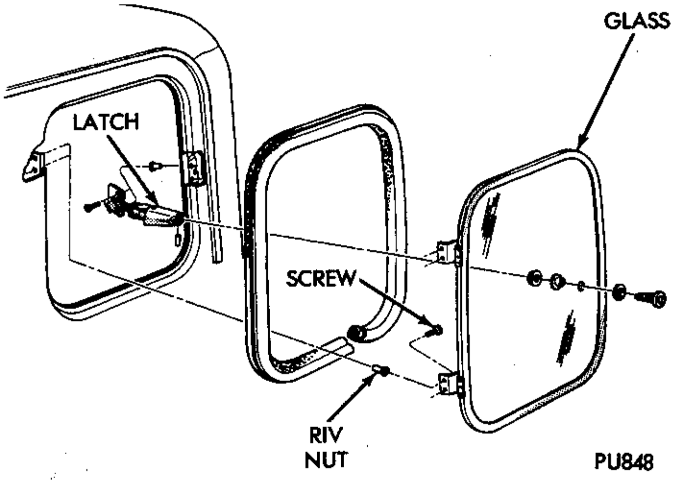

Fig. 15 — Vented Side Widow — Club Cab

VENTED SIDE WINDOW — CLUB CAB (Fig. 15)

REMOVAL

(1) Remove latch attaching screw from window frame.
(2) Remove hinge assembly screws and remove glass from vehicle.
(3) Reverse above procedure for installation and check window sealing.

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BASE COAT/CLEAR FINISH

Vehicles today are sprayed in a hospital clean environment to eliminate dirt and foreign substances. The paint used is a two part application. The base coat which is applied on top of a special eight stage primer, gives the vehicle its color. After the color (base coat) is applied, a special spray gun, called a turbo-bell, sprays the clear coat (topcoat) on the vehicle. This clear coat gives the paint finish its high gloss and durability.

To determine correct color and part number of enamel used on the car, refer to code on body number plate and then locate corresponding code on paint chart. Proper safety equipment should be used and work should be done in a well ventilated area.

DEFINITIONS OF TECHNICAL TERMS

SINGLE COAT

A single coat is a spray pattern applied from left to right. The returning right to left pattern is applied so that it covers approximately half of the preceding pattern. This process is repeated until coverage of the panel is complete.

DOUBLE COAT

A double coat is a spray pattern applied from left to right then back again over the same area. A panel is covered by overlapping each double coat by at least 50%.

DRYING

Drying or hardening of a film goes through several stages. **First** is known as "dust free" and is the time required for a film to reach the condition where, if any dust settles on it, dust will not become imbedded, but may be wiped off after film has hardened. **Second** stage is known as "tack free" and is the time required for a film to reach the condition where it may be touched with light pressure of finger. **Third** is "hard dry" and is the time required for film to become thoroughly hard so that it may be rubbed and polished.

DEGREASE—DEWAX

This is wiping with a clean cloth saturated with a commercial cleaner. Essential to good paint adhesion.

FEATHEREDGING

This is tapering of edges of a finish so that when a finger is passed over it no break will be felt. Featheredging is usually done with water and sandpaper on a sand block. This term applies to the sanding of a defect to the prime or color coat.

FERROUS AND NON-FERROUS METALS

Ferrous metals are those which are made from iron (steel). Non-ferrous metals are those which are not made from iron or do not present an iron (steel) surface, such as aluminum, aluminum alloys, brass, copper, and magnesium.

FLASH TIME

This is the time required for an applied coat of paint to lose most of its solvent.

MIST COAT

This is over thinning the color and spraying wet. Usually the final coat.

PRIMING

The function of a primer is to act as a surfacer for the finished color coat. It also forms a bond between the metal surface and the color coat.

A glazing putty is used for filling in small imperfections which are too deep to be taken care of by surfacer coats. It may be applied either before or after the last coat of primer surfacer.

REDUCERS

Reducers are mixtures of volatile liquids used to reduce alkyd and synthetic primers and enamels to the proper consistency for application.

SANDING BLOCK

As a rule a sanding block is a flexible rubber block, to which sandpaper may be fastened. It offers a good grip for the operator.

Wherever possible sanding should be done with a block as it distributes the pressures and gives a more uniform surface.

SURFACING

The function of a surfacer is to prepare a smooth surface for the color coats.

TACK RAG

This is a piece of cheesecloth that has been dipped in thin, non-drying varnish and then wrung out. It is kept in a container so that varnish will not harden but will remain tacky. Tack rag is used to wipe off a surface to remove dust and lint.

THINNERS

Thinners are mixtures of volatile liquids used to thin lacquer type finishing materials to proper consistency for application.

UNDERCOATS

All products used to prepare the surface to receive color coats are classified as undercoats, such as primers, surfacers, putties, primer surfacers and sealers.

PAINT REPAIRS ON GALVANIZED METALS

To perform paint repairs on galvanized rocker panels or any other galvanized steel surfaces, care must be exercised when preparing bare galvanized surface to properly accept primer surfacer and finish paint. Do not use shortcut methods nor intermixing of materials.

METAL PREPARATION

(1) Wire brush or steel wool entire metal surface and remove all grease or oil, with wax and grease remover.

(2) Thoroughly sand affected area to remove all corrosion products from exposed metal surface while carefully feathering all paint edges.

(3) Treat bare metal panel with a conditioner according to label directions.

(4) Rinse with clean water and blow off with compressed air.

REFINISHING

(1) Apply one light coat of primer for adhesion.

(2) Apply primer surfacer if required.

(3) Sand when dry and proceed with application of finish coats according to paint manufacturers recommendations.

RUST PROTECTION

Prior to applying any paint to the sheet metal clean the area to be repainted.

Eliminate all fingerprints, chemically treat all bare metal.

This conditions the exposed metal to resist rust.

BUFFING AND POLISHING

Minor imperfections in paint finish normally can be removed by sanding, buffing and polishing. The following procedure should be used when working on these minor conditions:

(1) Wet sand by hand affected area using #600 paper which has been soaked in mineral spirits. Caution should be used not to rub too hard over any of the affected areas or on ridges.

(2) Remove sand sludge.

(3) Tack off area with a clean, soft cloth.

(4) Buff entire area using a fine buffing compound.

COLOR SANDING, BUFFING, AND POLISHING

(1) Wrap a piece of 600 grit or finer wet or dry sandpaper around a two inch by three inch (2 x 3) rubber squeegee.

(2) Apply a few drops of mineral oil or water over and around the paint condition. (Baby oil can be substituted for mineral oil).

(3) Sand the paint condition in a light circular motion in order to just sand the top of the orange peel. Use rubber squeegee to check the sanding operation after three or four passes, making certain not to over sand.

(4) Use a buffing machine with a cutting pad and very fine compound to buff out the sanding marks.

(5) Either by hand or machine, remove wheel marks with a cleaner and polisher and detail work area until clean.

COLOR COATING PROCEDURE FOR PAINTING SECTIONS OF A PANEL—USING ACRYLIC ENAMEL

(1) Dewax and degrease complete panel by using correct solvents. Follow instructions and procedures printed on label of product being used.

(2) Sand the area to be repaired to within 1/16 or 1/8 of an inch of breakline or breaklines. 360 or 400 grit wet sanding paper can be used or 280 or 320 grit dry sanding paper can be used.

(3) Use blow gun with approximately 30 pounds air pressure and a good tack rag to remove dust and dirt from complete work area and adjacent panels.

(4) Apply 3/4 inch masking tape to the breakline or breaklines and allow approximately 3/16 of an inch of the tape to "overlap" the breakline or breaklines, then use the finger to fluff upward this 3/16 of an inch portion tape. Complete the masking operation with paper and tape to cover adjacent panels.

(5) Mix the color well on a paint shaker and cut the color with the correct solvents in a container which has marked measurements so as to follow the manufacturers instructions on how their materials should be used.

(6) Adjust air pressure at the air regulator only—not by air restrictor or kinking the 5/16 I.D. hose which should have large I.D. fittings.

(7) Apply the color with a good spraying technique, not twisting the wrist, until coverage and match is accomplished.

(8) Remove the masking when cured or dry and clean up or detail as necessary.

PREPARING THE SURFACE FOR PAINT

This operation is the backbone or foundation for finish color. It primes metal to insure adhesion and fills minor surface imperfections.

(1) Degrease and dewax the metal.

(2) Apply self-etching primer.

(3) To build substrate back to original thickness use a high blend primer.

(4) Sand undercoats (refer to paint manufacturer for recommended sandpaper grit).

(5) Respray with primer surface until the undercoat meets its original thickness.

(6) Resand undercoat with manufacturers recommended sandpaper.

(7) Reclean surface.

(8) Remove overspray from exterior and apply sealer recommended.

(9) Tack rag entire surface to remove lint and dust.

(10) Mix base coat.

(11) Apply base coat with light single coats. Allow for proper flash-off. Note: Apply sufficient amount of base coat to achieve coverage. If coverage is difficult to determine, tape on an opacity card on masking paper next to the surface to be painted.

(12) Allow proper dry time for base coat. Note: Do not use tack rag to remove dirt from base coat. This will only disturb the unprotected metallic flake and increases the dirt problem.

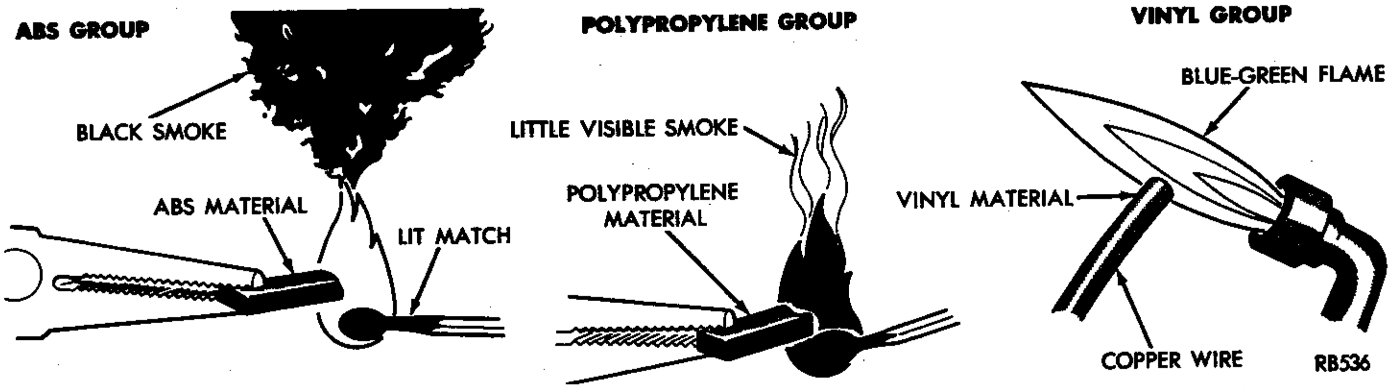

Fig. 1—Flame Test to Identify Plastic Materials

(13) Mix the clear coat according to manufacturers recommendations.

(14) Apply clear coat with light single coats. Allow for proper flash-off.

(15) Apply sufficient amount of clear coat to duplicate O.E.M. finish.

(16) Clean spraying equipment and detail car for customer pick-up.

COLOR APPLICATION

The most important step in color coat application is to follow the manufacturers instructions for the product being used. Similar products from different manufacturers will generally require different methods of application. Specific instructions on line pressure, coverage, thinning, etc. are usually available from paint supply manufacturers.

METALLIC COLOR AND PEARL COATS

Metallic color can appear to vary in richness. Variation can be described as:

A closed pattern that appears lighter with fine metallic dispersion.

An open pattern that appears richer with metallic flakes less noticeable.

An open pattern is achieved by lowering air pressure to 20-30 lbs. at gun, reducing acrylic lacquer color 100% with a blend of acrylic lacquer thinner and all purpose retarder.

FLEXIBLE PANEL REFINISHING

(1) Clean all surfaces with a wax and grease remover such as DX-330 ACRYLI-CLEAN or equivalent.

(2) Sand surface with #400 sandpaper and reclean surface as per step 1.

(3) Apply one full wet coat.

(4) Allow 10 to 15 minutes flash time.

(5) Apply a final full wet coat.

(6) Allow to dry 2 to 3 hours.

FLEXIBLE PANEL REPAIR

It may not be necessary to replace a damaged flexible panel. Flexible panels are repairable using a product such as 3M 8101 Structural Adhesive or equivalent. For best results follow manufacturers instructions.

PAINTING PLASTIC COMPONENTS

To paint plastic trim components it is necessary to:

(1) Identify the type of plastic to be painted.

(2) Follow procedures recommended for the different types of plastics.

To determine which plastic is being used, cut a small sliver of plastic from the backside of the part to be painted. Hold the sliver in needle nose pliers and burn the plastic (Fig. 1).

(1) The ABS (Acrylo-nitrile/butadiene/styrene) group will burn with a heavy black smoke.

(2) The polypropylene group burns with no readily visible smoke.

(3) Nylon can be identified by the distinct odor of burning wool during the burn, rather than by the color or intensity of the smoke.

(4) The vinyl group will burn with a blue green tint.

To test for vinyl, heat a piece of copper wire red hot. Immediately apply the wire end to a nonvisible portion of plastic until a glob of plastic adheres to the wire. Place the glob into a flame and observe the color.

The following chart shows the types of plastics commonly used on trim components, and the procedure to follow.

Plastic Type	Examples	Painting Procedures
Rigid Vinyl	Bumper Filler	Flex Agent Required
RIM Urethane (Reaction Injection Moulding)	Fascias	Flex Agent Required
TPU (Thermo-plastic Urethane)	End Caps Soft (Same as RIM)	Flex Agent Required
TPO (Thermo-plastic Olefin)	Bumper Fillers	Flex Agent Required
FRP (Fiberglass Reinforced Polyester)	Nose Cones (Hard)	Same as Steel
Phenolic	Ash Trays	Same as Steel
Nylon	Spoilers, Louvers	Same as Steel
ABS (Acrylo-nitrile/Butadiene /Styrene)	Louvers	No Flex Agent
Polypropylene	Hard Seat Back, Garnish Moulding Dash	No Flex Agent

RIGID ABS

Rigid ABS requires no printer. The appropriate paint will adhere satisfactorily to this plastic.

(1) Wash part thoroughly with a cleaning solvent such as DuPont Prep Sol, or equivalent.

(2) Color coat the part, using the appropriate color.

(3) Allow to dry. Install part.

SOFT EXTERIOR PLASTICS (FILLERS, FASCIAS, ETC.)

Paints to be used on soft exterior parts require additives to allow the paint to flex without cracking.

(1) Wash part thoroughly with a cleaning solvent such as DuPont Prep Sol, or equivalent.

(2) Sand the surface with 400 grit or finer paper. Reclean surface.

(3) Use the following Ditzler Flexative Agent (or equivalent).

(a) Mix DDL (Duracryl acrylic lacquer and Flexible additive (DX-1798) and Dyracryl lacquer thinner (DTL) as follows:

Duracryl Acrylic Lacquer DDL	Flexible Additive DX-1798	Duracryl DTL Thinner	Yield
1 pint or	1 pint or	1-1/2 pints	3-1/2 pints
8 ounces	8 ounces	or 12 ounces	1-3/4 pints

(b) Mix in the Duracryl (DDL) color and Flexible additive (DX-1798) thoroughly before adding the Duracryl thinner (DTL) best suited for the ambient temperature.

(c) Apply a minimum of eight to ten wet double coats,* allowing flash time between double coats. Use 30-35 pounds air pressure at the gun. As the film builds heavier, it will be necessary to allow longer flash off times between double coats to avoid trapping thinner. Trapped thinner can result in pinholing or bubbling.

Most colors will have adequate hiding after applying the minimum number of double coats. Some deep look colors may require additional double coats.

(d) Air dry for approximately four hours at 70°-85°F before installing or putting into service.

The new finish is naturally soft and pliable. When the proper Duracryl thinner (DTL) is used for the prevailing temperature, the finish should have adequate gloss. If compounding is desired, a minimum of two weeks should be allowed. Use only DXR-25 (a fine hand rubbing compound) or DRX-16 compound with a power buffer using only a very light pressure.

*See "Definitions of Technical Terms" on first page of "REFINISHING PROCEDURES".

WARNING: BECAUSE OF THE NATURE OF THE PRODUCTS SHOWN IN THESE FINISHING SYSTEMS, THEY MUST BE BLENDED WITH OTHER COMPONENTS. BEFORE OPENING THE PACKAGES, BE SURE YOU UNDERSTAND THE WARNING MESSAGES ON THE LABELS OF ALL COMPONENTS SINCE THE MIXTURE IS LIABLE TO HAVE HAZARDS IN ALL ITS PARTS. OBSERVE ALL APPLICABLE PRECAUTIONS.

SAFETY MEASURES

Use only with adequate ventilation. Do not take internally. Do not use if you have chronic (long term) lung or breathing problems, or if you have ever had a reaction to isocyanates. If engineering and administrative controls of air contaminants are not feasible, use a fresh air supplied respirator that respirator supplier recommends as effective for isocyanate vapors and mists. Follow directions for respirator use. Wear the respirator for the whole time of spraying and until all vapors and mists are gone. Avoid breathing of vapor or spray mist. Avoid contact with eyes and skin.

PAINT BAKE OVEN TREATMENT (WITH TEXTURED GRILLES)

To avoid warpage, all models with textured grilles and bezels should be covered with paper or other material to shield grille assembly from heat before vehicle enters paint bake ovens, or be completely removed from vehicle.

FIBERGLASS FINISHES

Fiberglass should be treated much the same as body steel; however, it is a non-corrosive material and does not require chemical conditioners.

Replacement or new panels may contain silicone oils on the surface due to the manufacturing process used. These oils must be removed from the surface, to prevent cratering of the freshly painted surface.

FIBERGLASS SURFACE PREPARATION

Under most repair situations when working with fiberglass, the working area should be well ventilated, and consideration should be given to protective clothing. Respiratory masks and safety glasses should also be worn.

The procedure does not represent a complete fiber glass repair, but does reflect the basic steps to be taken in the repair.

(1) In a well ventilated area, using alcohol, wash new molded parts liberally with a clean cloth.

(2) Thoroughly clean the surface with wax and grease remover.

(3) Re-clean surface and wipe dry with clean rags.

(4) If there are joints to be filled or the sanding operation exposes air pockets or glass strands, glaze a coat of body filler over the entire surface.

(5) Allow to cure, sand and re-clean.

(6) Apply primer or surfacer as directed.

(7) Allow to dry and sand smooth with fine sandpaper to minimize sand scratches.

(8) Blow surface off with air and tack rag the surface.

(9) If enamel top coats are to be used a synthetic primer-surfacer is also recommended.

(10) Apply color coats as recommended, by manufacturer.

FLEXIBLE PANEL REPAIR AND REFINISHING (TPO)

Flexible bumper fascias on P-Body vehicles are thermoplastic olefin (TPO). For repair and refinish use 3M system 2 or equivalent. Important: Do Not use repair and refinish methods for thermoplastic urethane (TPU) or RIM urethane.

FLEXIBLE PANEL REPAIR (TPO)

It may not be necessary to replace a damaged flexible fascia if the damage is minor in nature. Flexible panels are repairable using products such as 3M system 2, polytac adhesion promoter flexible parts repair, or equivalent. For best results, follow manufacturers instructions. Never use 3M flexible parts putty or body filler on thermoplastic olefin fascias.

FLEXIBLE PANEL REFINISH (TPO)

To eliminate outlie on repair area showing through top coat, apply coat of 3M flexible parts coating or equivalent.

CORPORATE IDENTITY CODE

Corporate White—8367	Corporate Blue—12785	Corporate Red—71831
The first two digits are accent or roof color. For special colors (coded 999) furnish Special Painted grilles are painted in exterior colors.	The second two digits are basic body color. Order (SO) Number.	

EXTERIOR PAINT

Paint Code	**Color Name**
HE4	Colorado Red Clear-Coat
HY3	Sand Metallic Clear-Coat
JT8	Dark Tundra Metallic Clear-Coat
GG7	Dark Forest Green Metallic Clear-Coat
HQ7	Aquamarine Blue Metallic Clear-Coat
JB6	Dark Spectrum Blue Metallic Clear-Coat
JB2	Light Spectrum Blue Metallic Clear-Coat
GB4	Daytona Blue Metallic Clear-Coat
DX8	Black Clear-Coat
HS3	Dover Gray Metallic Clear-Coat
HA2	Sterling Silver Metallic Clear-Coat
GW7	Bright White Clear-Coat

INTERIOR TRIM COLOR

Color Code	**Color Name**
R8	Bordeaux
T7	Tundra
S8	Charcoal

HEATING AND AIR-CONDITIONING

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GENERAL INFORMATION

Throughout this group, references may be made to a particular vehicle by number or letter designation. A chart showing the breakdown of these designations is included in the Introduction Section at the front of this service manual.

All models use a **Blend-Air** type heater. Outside air enters the heater through the cowl opening and passes through a plenum chamber to the heater core. Hood louver air intake or air intake at rear of hood at windshield wiper opening must be kept free of snow, ice, and other obstructions for heater or air conditioning to pick up sufficient outside air. A temperature control door in the heater housing directs incoming air through the heater core and/or the heater core by-pass. The amount of blend (heated and non-heated air) is determined by the setting of the temperature lever on the instrument panel. Direction of the blended air is controlled by the **Heat-Defrost** lever on the instrument panel.

The blower switch, in conjunction with a resistor block, controls the speed of the blower motor, and hence the velocity of the air flow from the heater outlets.

The resistor block consists of two helically wound wire resistors connected to terminals which are mechanically attached to a glass-filled phenolic board. This assembly is bolted to the plenum.

The blower switch controls the blower motor speed by selectively connecting in series, one, two or none of the resistors to the blower motor.

A self-adjusting clip, on each of two control cables has been incorporated to simplify cable adjustment. This clip snaps onto the control cable core wire and will slide along the wire under a specific load to provide an automatic cable adjustment.

HEATER OUTPUT CHECK

Proper function of the heater system can be checked by measuring the temperature of the air at the heater output duct under the instrument panel. Set the heater controls, as shown below, and measure the temperature using a thermometer and compare them with the values listed in the reference chart. Should the temperature not meet the minimum values shown, refer to "Heater Diagnosis" for possible causes and corrections.

TEST CONDITIONS

(1) Remove radiator pressure cap.

CAUTION: If vehicle has been run recently, wait 15 minutes before removing cap, then place a rag over the cap and turn it to the first stop. Allow pressure to escape through the overflow tube and when the system stabilizes remove the cap completely.

(2) Drain one pint of coolant from the radiator.

(3) Warm the engine to operating temperature by idling for 20 minutes, with the pressure cap off. Idle longer if working outdoors in cold temperatures.

(4) With the engine idling, place a thermometer into the coolant in the radiator filler neck.

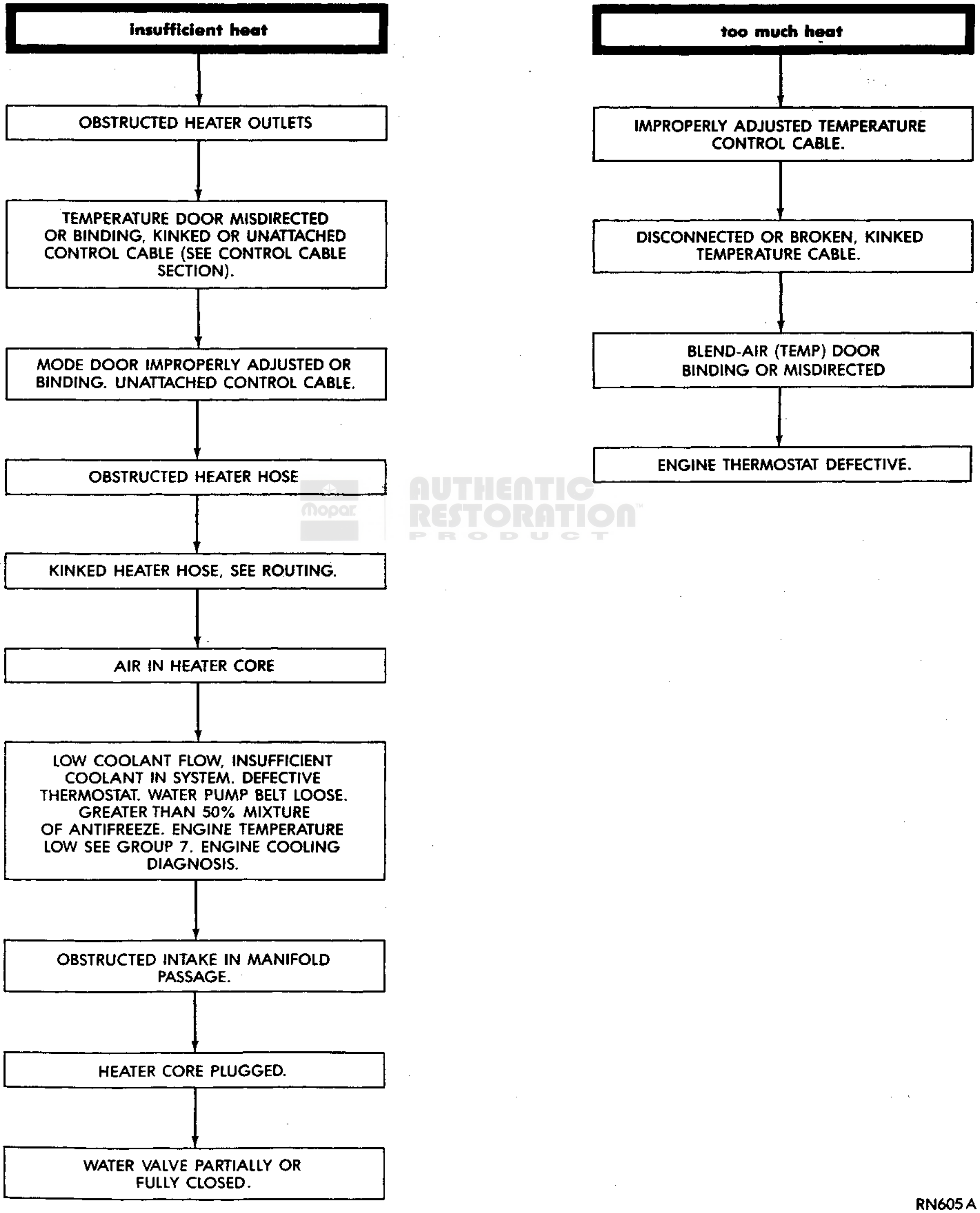
(5) Engine coolant temperature should stabilize at no lower than 187° (or 8° blow the thermostat opening temperature) during the vehicle operating cycle.

(6) Instrument panel control in **heat** mode.

(7) High blower speed.

(8) Temperature lever to maximum heat position.

HEATER DIAGNOSIS (MECHANICAL)



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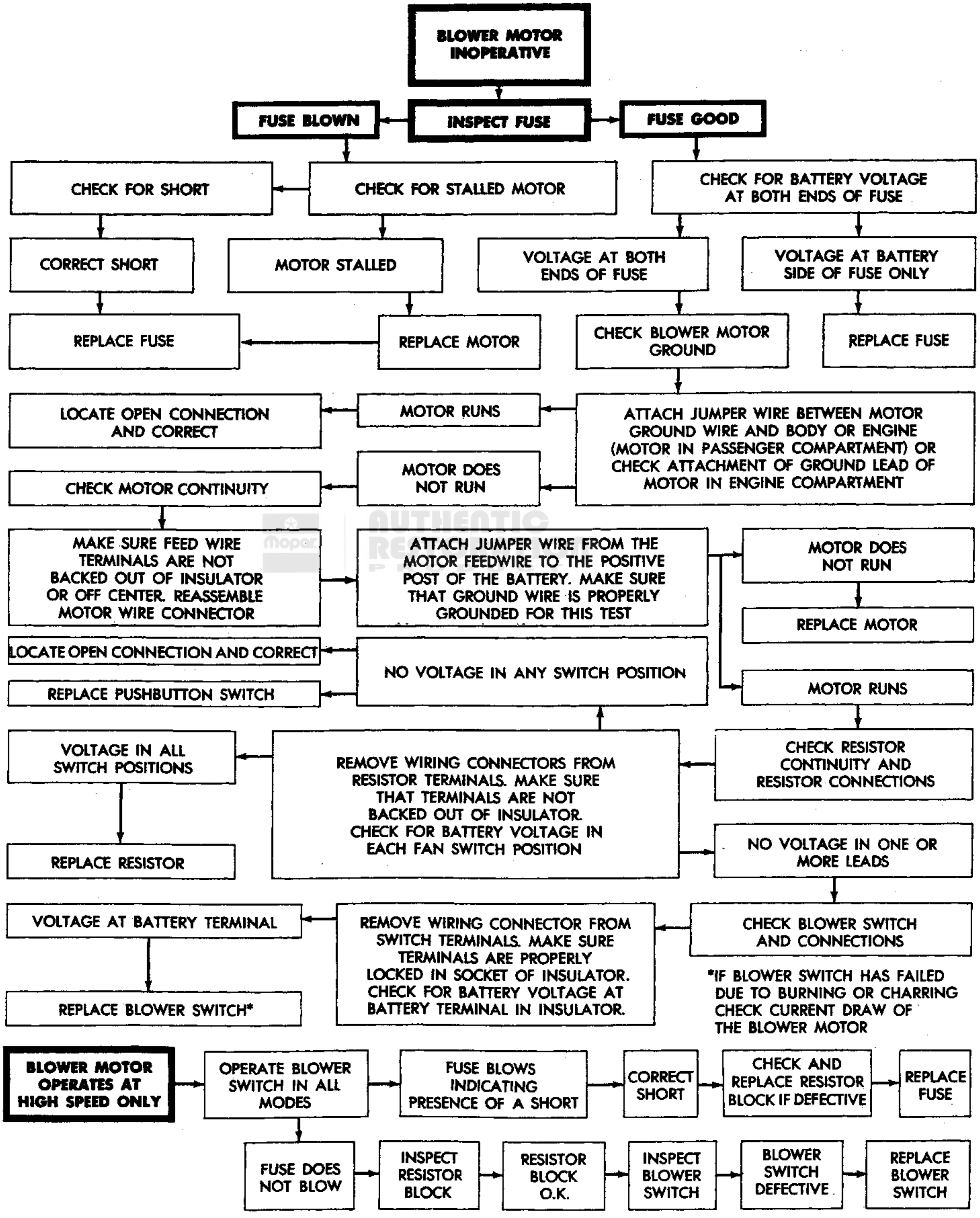
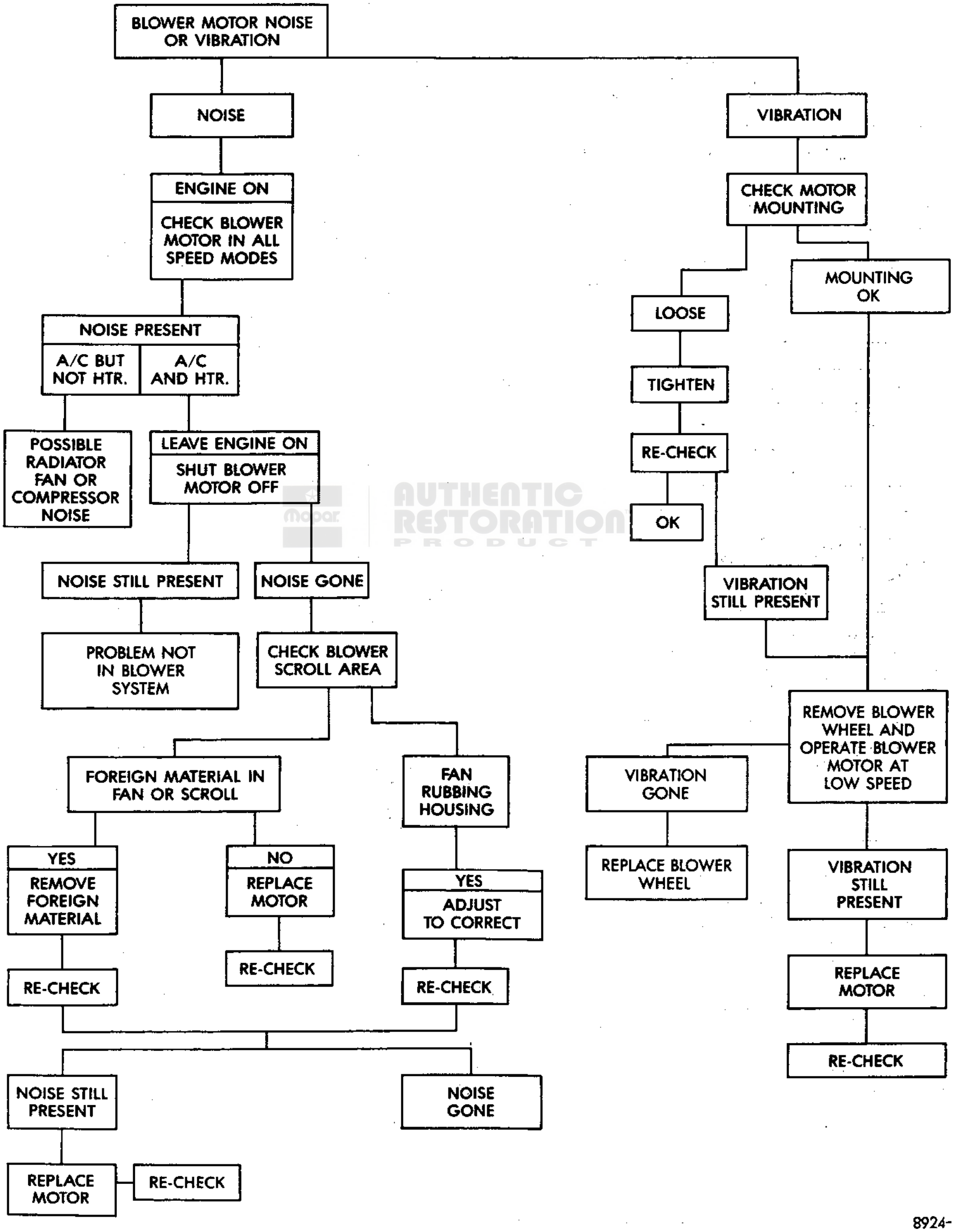
HEATER BLOWER MOTOR AND CONTROL SYSTEM DIAGNOSIS (ELECTRICAL)



BLOWER MOTOR NOISE/VIBRATION CHART



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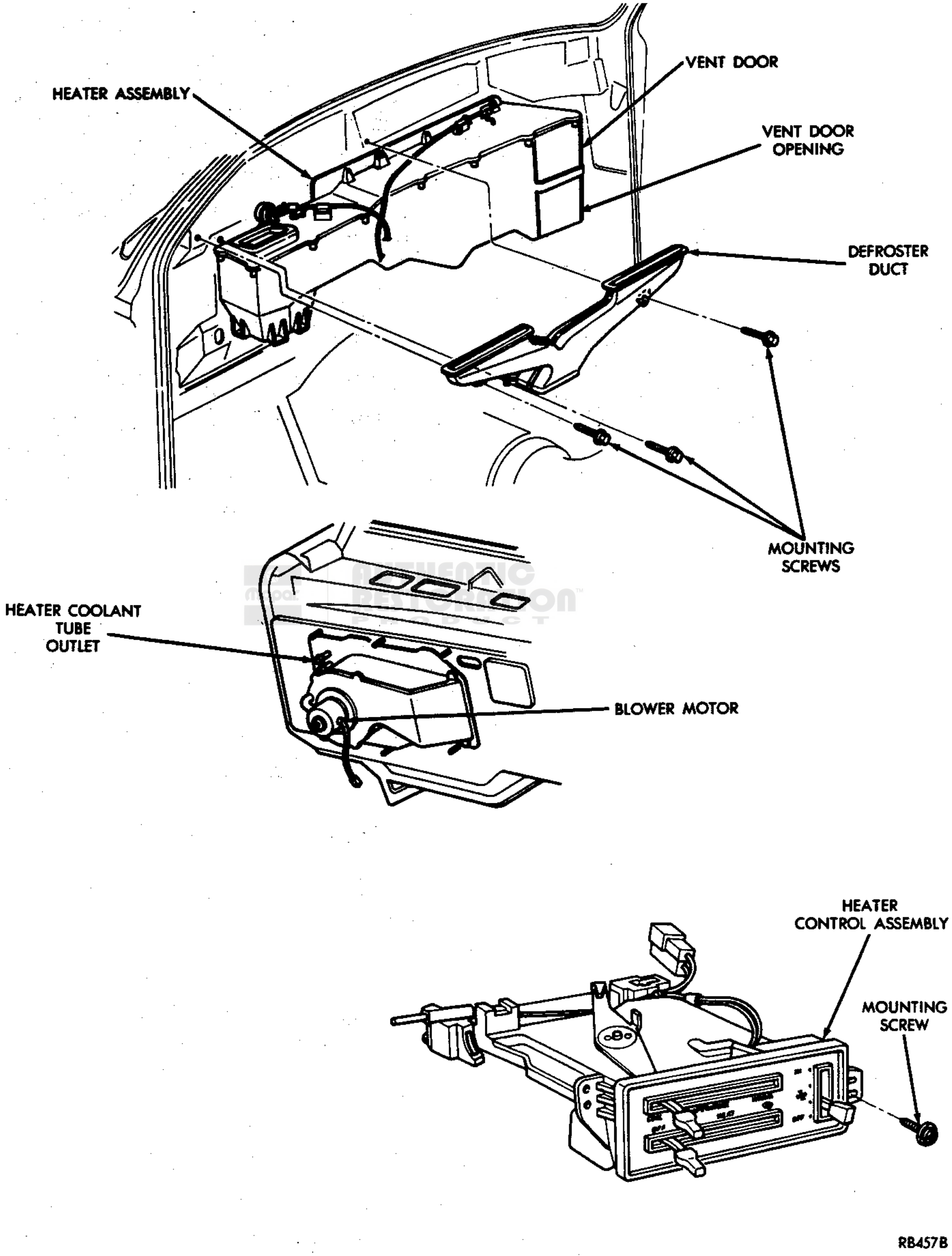

Fig. 1—Heater Assembly

SERVICE PROCEDURES

FACEPLATE

REMOVAL

(1) Remove map lamp.

(2) Remove screws which attach faceplate to base panel. Make sure the screw below the **Heater-A/C** control is removed (Fig. 2).

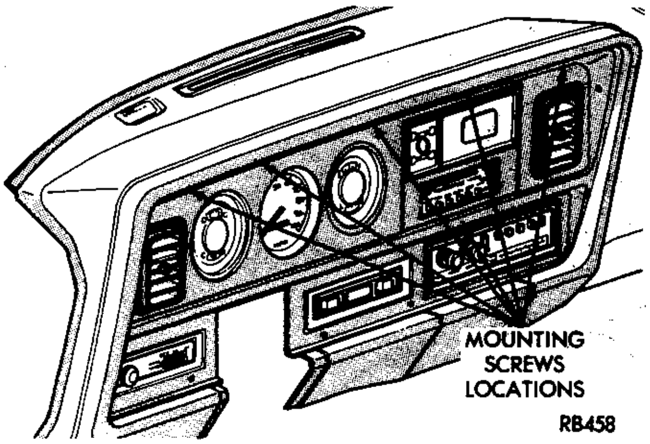

Fig. 2—Mounting Screw Locations

(3) Pull column shift lever in position "1".

(4) Remove faceplate by pulling the top edge rearward to clear the brow, disengage attaching clips around the bottom of the faceplate, and complete removal of faceplate.

(5) Disconnect wires to four wheel drive indicator, if equipped.

INSTALLATION

(1) Engage attaching clips around bottom of faceplate, connect four wheel drive indicator wiring, if equipped, roll faceplate into position, and install mounting screws (Fig. 2).

(2) Install map lamp.

HEATER CONTROL

REMOVAL

(1) Remove faceplate (see "Faceplate Removal").

(2) Remove attaching screws (Fig. 3).

(3) Pull control outward.

(4) Disconnect illumination light and switch wiring.

(5) Remove cables.

(6) Remove control unit.

INSTALLATION

(1) Install cables.

(2) Connect illumination light and switch wiring.

(3) Install unit in instrument panel and secure with mounting screws.

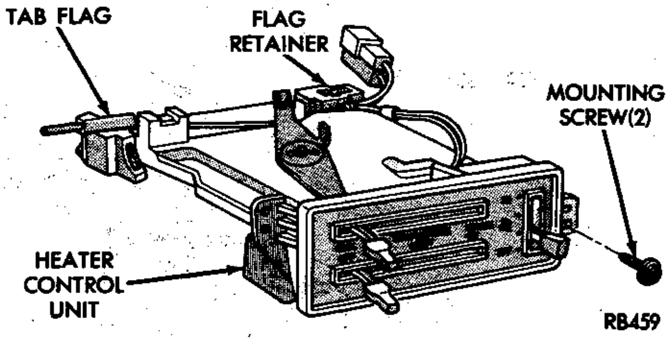

Fig. 3—Heater Control

(4) Move the levers to the extreme right to adjust the clips.

(5) Install faceplate.

TEMPERATURE AND MODE CONTROL CABLES

REMOVAL

(1) Remove faceplate (see "Faceplate Removal").

(2) Open glovebox past stops.

(3) Remove control unit from instrument panel (see "Heater Control Removal").

(4) Remove cables from control lever pins and remove flags from retainers (Figs. 4 and 5).

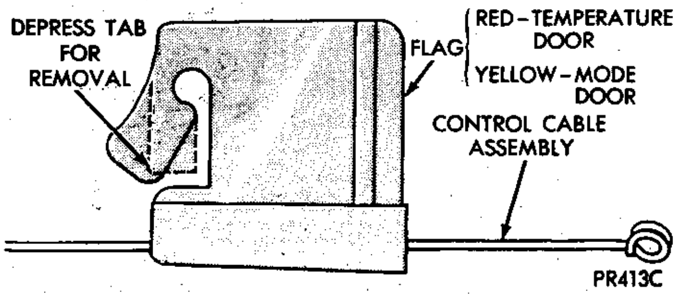

Fig. 4—Flag Tab Depressed for Removal

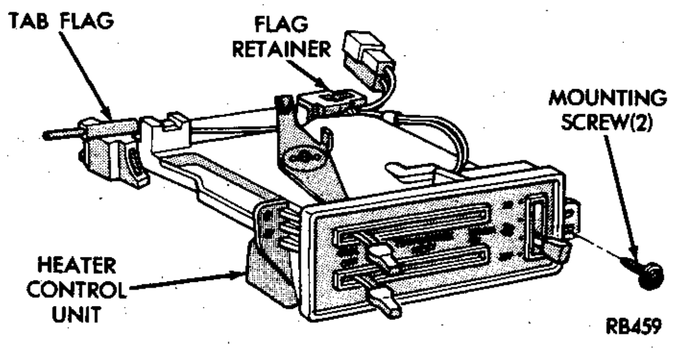

Fig. 5—Heater Control

(5) Detach cables from unit by removing self adjust clips from crank arms and removing flags from retainers (Fig. 6).

(6) Remove cable assemblies through glovebox opening.

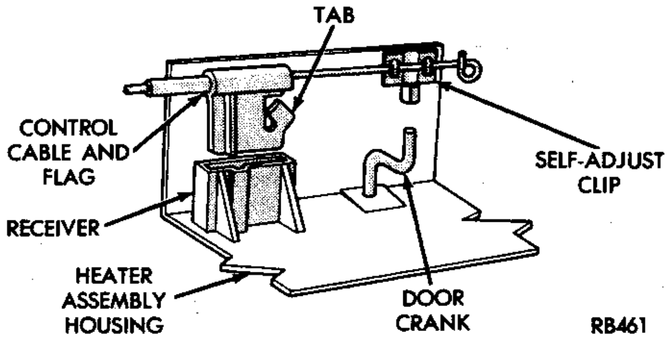

Fig. 6—Removing Cables from Unit

(7) Place a 7mm (1/4 inch) I.D. tube over clip and pry self-adjust clip off core wire if required (Fig. 7).

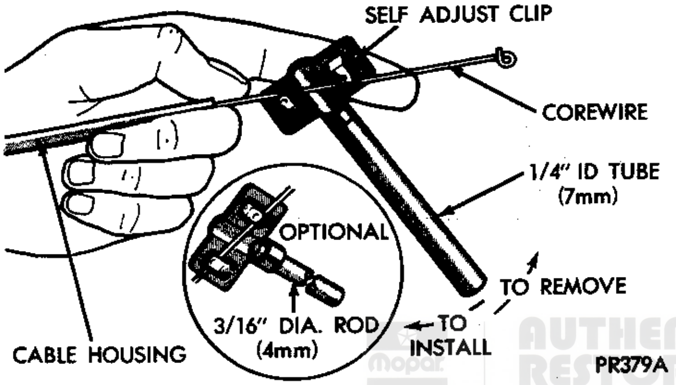

Fig. 7—Removing or Installing Self-Adjust Clip

INSTALLATION

(1) Position self-adjust clip on cable core wire 50mm (2 inches) from the small loop at heater assembly flag end. With a 7mm (1/4 inch) I.D. tube, snap self-adjust clip on core wire.

(2) Install cable assemblies through glovebox opening.

(3) Attach self-adjust clips to crank arms and replace flags in receivers on heater assembly.

(4) Install flages in retainers and attach cables to control levers on control unit.

(5) Install control unit into instrument panel (see "Heater Control Removal").

(6) Install faceplate (see "Faceplate Installation").

(7) Move levers to extreme right to adjust clips.

RESISTOR BLOCK

REMOVAL

(1) Remove connector.

(2) Remove mounting screws and resistor block from plenum.

INSTALLATION

(1) Install resistor block and secure with mounting screws.

(2) Install connector.

HEATER ASSEMBLY

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove water hoses on engine side and plug hoses and inlets on package (Fig. 8).

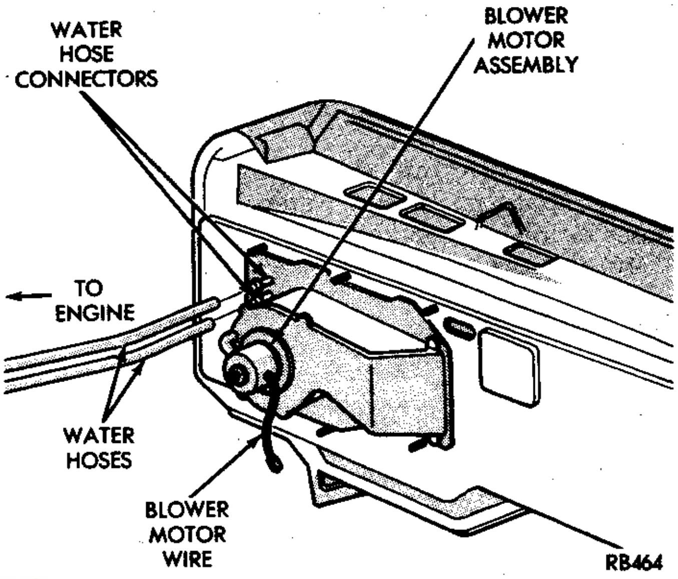

Fig. 8—Water Hose Connections

(3) Remove right cowl side trim panel, if equipped.

(4) Remove glovebox by removing mounting screws at base and swinging out from the bottom to avoid catch and stops.

(5) Remove structural brace through glovebox opening.

(6) Remove right half of instrument panel lower reinforcement (8 screws). Be sure to disconnect the ground strap.

(7) Disconnect control cables (see "Control Cable Removal").

(8) Disconnect blower motor wires on engine side.

(9) Remove screw that retains package to cowl side sheet metal.

(10) Remove unit retaining nuts on engine side (6 nuts).

(11) Remove unit.

INSPECTION

(1) Remove screws and mode door crank to separate cover from housing.

(2) Carefully slide heater core out.

(3) Peel dash panel seal below cover. Remove retaining screws and remove cover from blower motor assembly.

(4) Separate fan from motor, motor from housing and inspect all parts.

(5) Reassemble heater assembly using necessary new parts.

INSTALLATION

(1) Position heater assembly to dash and install retaining nuts on engine side.

(2) Install cowl side retaining screws.

(3) Connect blower mtoor.

(4) Connect control cables (see "Control Cable Installation").

(5) Install right, lower instrument panel reinforcement.

(6) Install structural brace through glovebox opening.

(7) Install glovebox.

(8) Install right cowl side trim panel, if equipped.

(9) Unplug inlets and water hoses and connect hoses to inlets on package (Fig. 8).

(10) Connect battery negative cable.

DEFROSTER DUCT

REMOVAL

(1) Disconnect battery negative cable.

(2) Open glovebox past stops.

(3) Remove right upper air duct by removing mounting screw and pulling duct out through glovebox openings, if equipped.

(4) Remove instrument panel center brace.

(5) Remove right kick pad.

(6) Remove right instrument panel pivot bolt.

(7) Remove instrument panel cluster (see "Instrument Panel", Group 8).

(8) Disconnect shift lever cable, if equipped.

(9) Lower steering column.

(10) Remove steering column studs.

(11) Remove radio, if equipped.

(12) Remove mounting screws and remove scoop connecting heater unit to center distribution duct, if equipped.

(13) Remove mounting screws and remove center distribution duct by pulling bottom of instrument panel out and dropping duct out, if equipped (Fig. 11).

(14) Remove heater control (see "Heater Control Removal").

(15) Remove mounting screws and then cover that retains instrument panel wiring and let wiring hang free.

(16) Remove mounting screw and slide left air duct out through instrument cluster opening, if equipped.

(17) Remove screws attaching defroster duct to dash panel.

(18) Reach in through instrument panel opening and disengage snaps to separate defroster duct into two pieces.

(19) Remove defroster duct halves through instrument cluster opening.

INSTALLATION

To install defroster duct, reverse removal procedure.

AIR-CONDITIONING

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GENERAL INFORMATION

RADIATOR CAP

Air-conditioned vehicles must be equipped with a radiator cap having a holding pressure of 14-18 psig (98 to 122 kPag). Replace the radiator cap that does not test within this specification.

CONDENSER

Inspect the condenser for obstruction or foreign-matter. Clean if present.

Any obstruction to the free flow of air across the condenser will decrease heat dissipation from the condenser, decrease the efficiency of the condenser and, in turn, decrease the evaporator's efficiency. These conditions result in increasing the discharge pressure and horsepower load on the engine. The use of a bug screen is not recommended, it also will decrease the free flow of air.

Inspect the condenser for bent or damaged fins.

The bent fins on the condenser deflect air flow and decrease the condenser area.

BUG SCREENS

Bug screens should **not** be installed on vehicles equipped with air conditioning. A bug screen installed in front of the condenser will reduce air flow and air-conditioner performance. Under severe heat conditions a bug screen may cause the engine to over-heat.

RESISTOR BLOCK

The blower motor switch, in conjunction with a re-

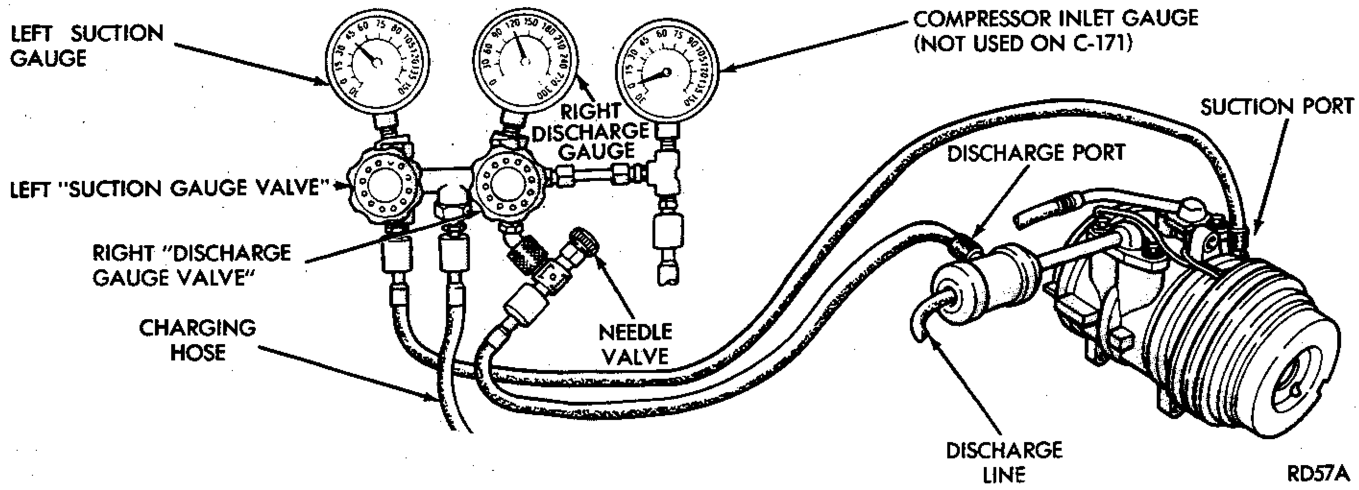

Fig. 1—Manifold Gauge Set Connections (Typical)

sistor block, controls the speed of the blower motor and the velocity of the air flow from the heater or air-conditioning outlets. The resistor block consists of 3 helically-wound wire resistors, connected to terminals which are mechanically attached to a phenolic board. This assembly is bolted to the plenum.

The blower switch controls the blower motor speed by selectively connecting in series one, two, three or none of the resistors to the blower motor.

SAFETY PRECAUTIONS

The refrigerant used in all air-conditioning installations is Refrigerant 12. It is transparent and colorless in both the liquid and vapor state. Since it has a boiling point of -21.7°F (-29.8°C), at atmospheric pressure, it will be a vapor at all normal temperatures and pressures. The vapor is heavier than air, nonflammable and nonexplosive.

REFRIGERANT RECYCLING

R-12 refrigerant contains chloroflorocarbons (CFCs) that can contribute to the depletion of the ozone layer in the upper atmosphere. Ozone filters out harmfull radiation from the sun. To assist in protecting the ozone layer, Chrysler Motors recommends that a R-12 refrigerant recycling device that meets SAE standard J1991 be used. Contact an automotive service equipment supplier for refrigerant recycling equipment that is available in your area. Refer to the operating instructions provided with the recycling equipment for proper operation.

CAUTION: It is non-poisonous except when it is in direct contact with open flame.

It is noncorrosive except when combined with water. The following precautions must be observed when handling Refrigerant 12.

CAUTION: Wear safety goggles when servicing the refrigeration system.

Refrigerant 12 evaporates so rapidly at normal atmospheric pressures and temperatures that it tends to freeze anything it contacts. For this reason, extreme care must be taken to prevent any liquid refrigerant from contacting the skin and especially the eyes.

Always wear safety goggles when servicing the refrigeration part of the air-conditioning system. Keep a bottle of sterile mineral oil handy when working on the refrigeration system. Should any liquid refrigerant get into the eyes, use a few drops of mineral oil to wash them out. Refrigerant 12 is rapidly absorbed by the oil. Next, splash the eyes with plenty of cold water. Call you doctor immediately even though irritation has ceased after first aid treatment.

WARNING: DO NOT HEAT REFRIGERANT 12 ABOVE 125 DEGREES F. (52°C). THE CAN MAY EXPLODE.

In most instances, moderate heat is required to bring the pressure of the refrigerant in its container above the pressure of the system when charging or adding refrigerant. A bucket or large pan of hot water not over 125°F (52°C) is all the heat required for this purpose. Do not heat the refrigerant container with a blow torch or any other means that would raise temperature and pressure above this temperature. Do not weld or steam clean on or near the system components or refrigerant lines.

CAUTION: Keep Refrigerant 12 containers upright when charging system.

When metering Refrigerant 12 into the refrigeration system, **keep the supply tank or cans in an upright position.** If the refrigerant container is on its side or upside down, liquid refrigerant will enter the system and damage the compressor.

CAUTION: Always work in a well-ventilated room.

Always maintain good ventilation in the working area. Always discharge the refrigerant into the service bay exhaust system or outside the building. Large quantities of refrigerant vapor in a small, poorly ventilated room can displace the air and cause suffocation.

Although Refrigerant 12 vapor is normally non-poisonous, it can be changed into a very poisonous gas if allowed to come in contact with an open flame. Do not discharge large quantities of refrigerant in an area having an open flame. A poisonous gas is produced when using the flame-type leak detector. Avoid inhaling the fumes from the leak detector.

CAUTION: Do not allow liquid refrigerant to touch bright metal.

Refrigerant will tarnish bright metal and chrome surfaces. Avoid splashing refrigerant on any surface. Refrigerant in combination with moisture is very corrosive and can cause great damage to all metal surfaces.

MANIFOLD GAUGE SET INSTALLATION (ALL MODELS)

The Manifold gauge set, Tool C-3740A, has two compound gauges and one discharge pressure gauge. With the C171 compressor only suction and discharge gauges are used. In this case the compressor inlet gauge can be left disconnected.

Evaporator Suction Gauge—the left side of the manifold set is calibrated to register 0 to 30 inches of vacuum (0 to -100 kPag) and 0 to 150 psig (0 to1000 kPag). This gauge is connected to the suction service port of the compressor. A special service port adapter, supplied with the gauge set, provides the means of connecting the gauge set manifold hose to the service port. When the adpater is installed at the port and tightened, the stem of the valve in the service port is depressed, opening the service port valve.

Discharge Pressure Gauge—the center of the manifold set is calibrated to register 0 to 300 psig (0 to 2100 kPag). For all tests this gauge is connected to the discharge service port of the system. The needle valve, located below the discharge pressure gauge, is used to damp out gauge needle oscillations so that accurate readings can be obtained.

Center Manifold Outlet—provides the necessary connection for a long service hose used when discharging the system, using a vacuum pump to "pull a vacuum" before charging the system, and for connecting the supply of refrigerant when charging the system.

Manifold Gauge Valves—should be closed when connecting the gauge set manifold to the service ports of the compressor. The suction gauge valve at the left is opened to provide a passage between the suction gauge and the center manifold outlet. The discharge gauge valve at the right is opened to provide a passage between the discharge pressure gauge and the center manifold outlet.

Detailed instructions for proper use of the manifold gauge set are contained in the test covering each service operation employing these gauges.

A/C REFRIGERANT SYSTEM COMPONENTS

Compressor—The prime purpose of the compressor is to compress the low pressure refrigerant vapor from the evaporator into a high pressure, high temperature vapor. The six cylinder C-171 compressor is used on all models.

Clutch Pulley and Coil—are mounted on the compressor providing a convenient way to drive it and disengage it in accordance to the cooling needs.

Condenser—is located in front of the engine cooling radiator. Its function is to cool the hot, high pressure refrigerant gas causing it to condense into high pressure liquid refrigerant.

Filter-Drier—is used to remove any traces of moisture from the refrigerant system. This component incorporates the sight glass and the high pressure relief valve.

Sight Glass—(at the top of the filter drier) is provided as a diagnostic tool to observe refrigerant flow and indicate refrigerant level.

High Pressure Relief Valve—is a safety device designed to open automatically if the system pressure reaches a predetermined level; it prevents system component damage.

Expansion Valve—the H-valve is used for all applications. Its function is to meter refrigerant into the evaporator in accordance with cooling requirements.

Evaporator Coil—is located in the A/C unit and its function is to cool and dehumidify the air before it enters the vehicle.

Freeze Control—The main function of a freeze control is to prevent condensate water on the face of the evaporator coil from freezing and restricting the

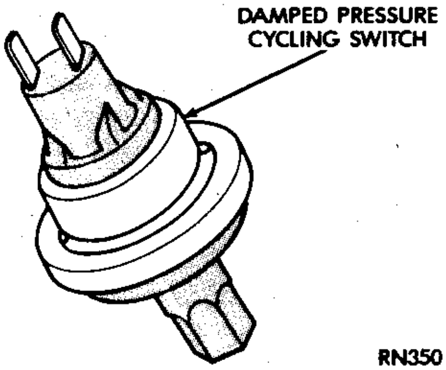

Fig. 2—Damped Pressure Cycling Switch

airflow. To perform this function, a damped pressure cycling switch (Fig. 2) is located on the refrigerant plumbing (suction line) near the H-valve, and is electrically in series with the A/C clutch coil. It is an on-off switch which turns the compressor on-off depending on the pressure in the suction line. The switch is a sealed, specially calibrated unit and if found defective, must be replaced.

Refrigerant Lines—are needed to carry the refrigerant between the various system components.

Service Valves—at the compressor and the discharge muffler are used to test and service the refrigerant system.

For safety reasons, the high pressure fitting has been changed to meet SAE safety practice J639. A special adapter is required for performance testing (C4803).

DIAGNOSING AIR-CONDITIONING

The reason for owner dissatisfaction must be thoroughly understood before any attempt is made to repair or replace any parts. It must be determined if the condition is the refrigerant system, air-conditioning air flow, or related to the compressor. After confirming the condition, a functional test involving one of the following diagnostic charts is suggested. After the condition has been properly diagnosed and corrected, check out the complete system to assure that it is péforming satisfactorily.

The following charts have been developed for quick reference. If the step by step method used is not completely understood, see the correct section of the Service Manual for detailed explanations.

TEST PROCEDURES

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SIGHT GLASS REFRIGERANT LEVEL TEST

The sight glass, which is an integral part of the filter-drier, is a refrigerant level indicator (Fig. 1). To check the refrigerant level, clean the sight glass and start the engine. Place the air-conditioning controls on A/C, the fan switch on high and the temperature lever on cool. The room temperature should be at least 70°F (21°C). After operating for a few minutes in this manner, check the sight glass.

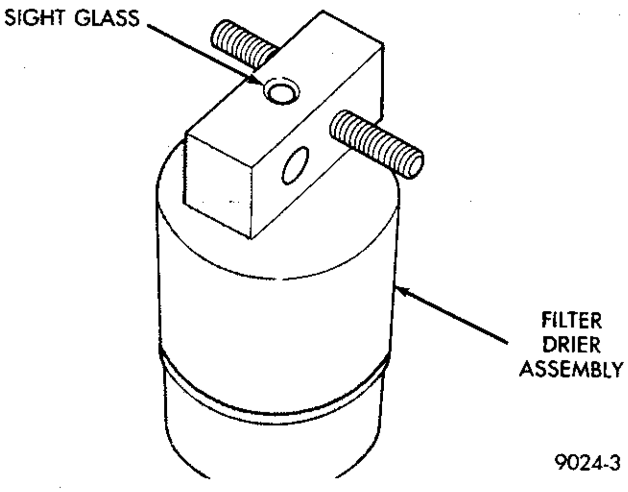


Fig. 1—Filter Drier

(1) If the sight glass is clear, the A/C clutch is engaged, the compressor discharge line is warm and the compressor inlet line is cool; the system has a full charge.

(2) If the sight glass is clear, the A/C clutch is engaged and there is not significant temperature difference between compressor inlet and discharge lines; the system is empty or nearly empty. Connect a gauge to the compressor discharge port. If the gauge reads less than 25 psi (172 kPag), the damped pressure cycling switch has failed.

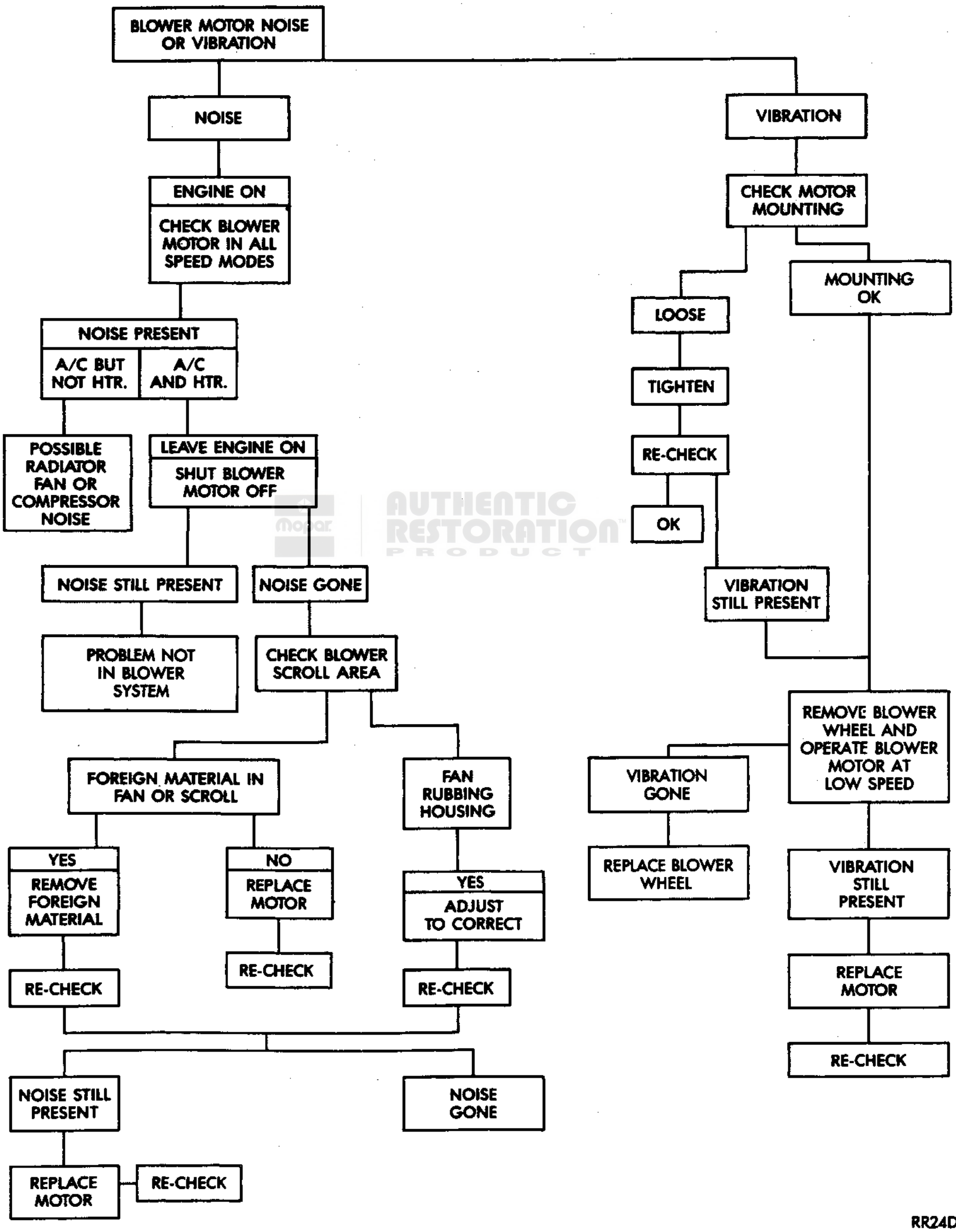
(3) If the sight glass is clear and the A/C clutch is disengaged; the clutch is defective or, the clutch circuit is open, or the system is out of refrigerant. Perform damped pressure cycling switch test to determine condition.

(4) If the sight glass shows foam or bubbles, the system could be low on charge. Occasional foam or bubbles is normal when the room temperature is above 110°F (43°C) or below 70°F (21°C).

Adjust the engine speed to 1300 rpm. Block the airflow thru the condenser to increase the compressor discharge pressure to 225 to 250 psig (1552 to 1724 kPag). If sight glass still shows bubbles or foam, system charge level is low.

The refrigerant system will not be low on charge unless there is a leak. Find and repair the leak. If the leak can be repaired without discharging the sys-

C/TYPE BLOWER MOTOR NOISE/VIBRATION FLOW CHART



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tem, the low refrigerant charge level can be corrected as follows. Maintaining the discharge pressure of 225 to 250 psig (1550 to 1720 kPag), add refrigerant gas through compressor suction line until foam is cleared from sight glass. Then add 13 oz. (368 g) or one can of refrigerant.

HIGH PRESSURE RELIEF VALVE

The **High Pressure Relief Valve** is located on the discharge muffler. Its function is to prevent damage to the air-conditioning system in the event that excessive pressure develops due to condenser air flow being restricted by, for example, leaves, newspaper, an overcharge of refrigerant or air in the system.

The high pressure relief valve vents only a small amount of refrigerant necessary to reduce system pressure and then reseats itself. The majority of the refrigerant is conserved in the system. The valve is calibrated to vent at a pressure of 450 to 550 psig. (3100 to 3790 kPag), therefore, the fact that the valve vented refrigerant, does not mean the valve is defective.

DAMPED PRESSURE CYCLING SWITCH

The damped pressure cycling switch is located on the refrigerant plumbing, suction line near the H-valve and is electrically in series with the clutch coil. It is an on-off switch which turns the compressor on and off depending on the pressure in the suction line. The switch is sealed, specially calibrated unit and if found defective, must be replaced.

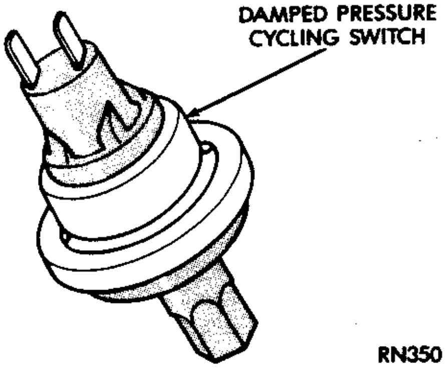


Fig. 2—Damped Pressure Cycling Switch

TESTING

(1) Remove the wires (boot connector) from the damped pressure cycling switch.

(2) Check continuity of the switch. Switch contacts are closed at temperatures above 7°C (45°F). If no continuity, replace switch.

(3) If contacts are closed, verify switch operation as follows:

(a) Reconnect wires to pressure cycling switch.

(b) Set temperature control lever to full cool position.

(c) Set A/C blower motor on low speed and push A/C button.

(d) Operate engine at 1300 rpm for approximately 5 minutes to stabilize the A/C system and verify that refrigerant system is full.

(e) If the compressor clutch cycles on and off 3 to 10 times per minute with temperature between 20° to 32°C (68° to 90°F), the pressure cycling switch is normal. If the compressor clutch fails to engage, check for continuity in the electrical circuit. Above 32°C (90°F) the compressor clutch may be continuously engaged (non-cycling) due to the high heat load. This condition is normal.

REMOVAL

(1) Remove the electrical wires to the switch.

(2) Rotate switch counterclockwise to remove from pressure switch port.

(3) Remove and discard old O-ring.

INSTALLATION

(1) Install new O-ring. Refrigerant oil must be applied to the new O-ring.

(2) Rotate switch clockwise to install on suction line pressure switch port. Tighten switch to 50 ± 5 in. lbs. torque.

CAUTION: Power tools should not be used for installation of the switch. The possibility of stripping the switch threads occurs above 52 in. lbs. torque.

(3) Connect wires.

(4) Verify operation.

EXPANSION VALVE (H TYPE) (Fig. 3)

REMOVAL

The system must be completely discharged before opening any refrigerant lines.

(1) Remove the 8mm x 30mm x 1.25 thread bolt in center of plumbing sealing plate.

(2) Carefully pull refrigerant line assembly towards front of vehicle (take care **not** to scratch valve sealing surfaces with tube pilots).

(3) Remove two 1/4-20 Torx Head screws. (Hold valve, once cap screws are removed valve is completely disconnected).

(4) Carefully remove valve.

INSTALLATION

(1) Remove and replace two aluminum N-gaskets (1 on evaporator plate and 1 on plumbing plate).

(2) Remove sealing cap from H-valve control head side sealing surface only and carefully hold it against evaporator sealing plate (do not scratch sealing surface) and install two 1/4-20 NC Torx Drive Screws and tighten 100 ± 30 inch pounds (11 ± 3 N•m).

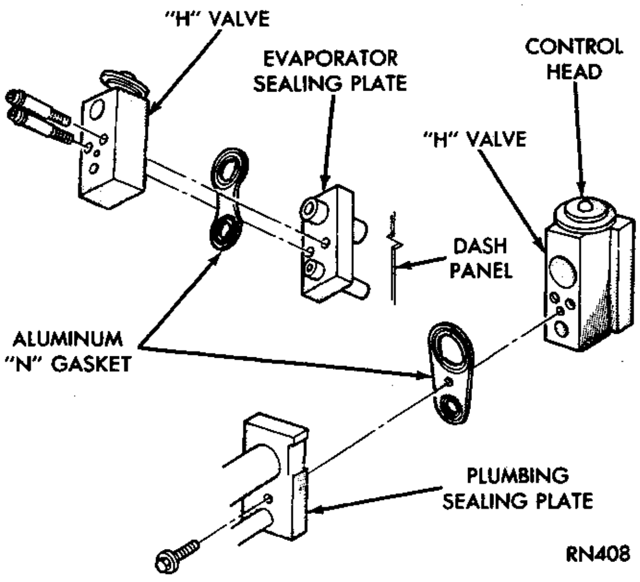


Fig. 3—H-Valve Assembly

(3) Remove sealing cap from plumbing side sealing surface and carefully hold plumbing up to valve and install the 8mm x 30mm x 1.25 thread bolt and tighten to 200 ± 30 inch pounds (23 ± 3 N•m).

(4) Connect wires to damped pressure cycling switch.

(5) After expansion valve is installed and system charged and leak checked, repeat performance check.

TESTING THE SYSTEM FOR LEAKS

If the air-conditioning system is not cooling the passenger compartment properly, determine whether the refrigerant system is fully charged with R12 by following the procedures in the "Sight Glass Refrigerant level Test" section of this group.

If the refrigerant system is empty or low in refrigerant charge, a leak at any of the line fittings or component seals is likely (Fig. 4). To detect a leak in the refrigerant system, perform one of the following procedures as indicated by the symptoms.

EMPTY REFRIGERANT SYSTEM LEAK TEST

(1) Evacuate the refrigerant system to the lowest degree of vacuum possible. See "Evacuating the System" for instructions.

(2) Prepare a 14 oz. refrigerant (R12) charge to be injected into the system. See "Charging the System" for instructions.

(3) Connect and dispense 14 ozs. of refrigerant (R12) into the evacuated refrigerant system. See "Charging the System".

(4) Proceed to step (2) of Low Refrigerant Level Leak Test.

LOW REFRIGERANT LEVEL LEAK TEST

(1) Review the "Safety Precautions" section of this group to determine if there is still R12 in the refrigerant system.

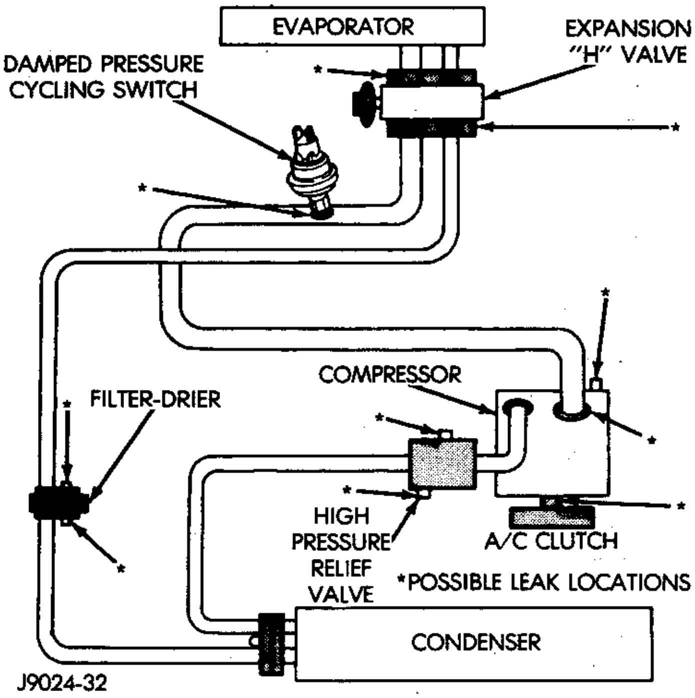


Fig. 4—Testing for Leaks

(2) Position the vehicle in a breeze free work area to make it less difficult to detect a small leak.

(3) With the engine not running, use an "Electronic Leak Detector" (or equivalent) and search for leaks (Fig. 12) in the most accessible areas first.

(a) Fittings, lines, or components that appear oily usually will implicate a refrigerant leak.

(b) To inspect the evaporator core for leaks, it is possible to insert the leak detector probe into the opening on the right side of the instrument panel.

(4) Refer to "Refrigerant Leak Repair Procedures" for more information.

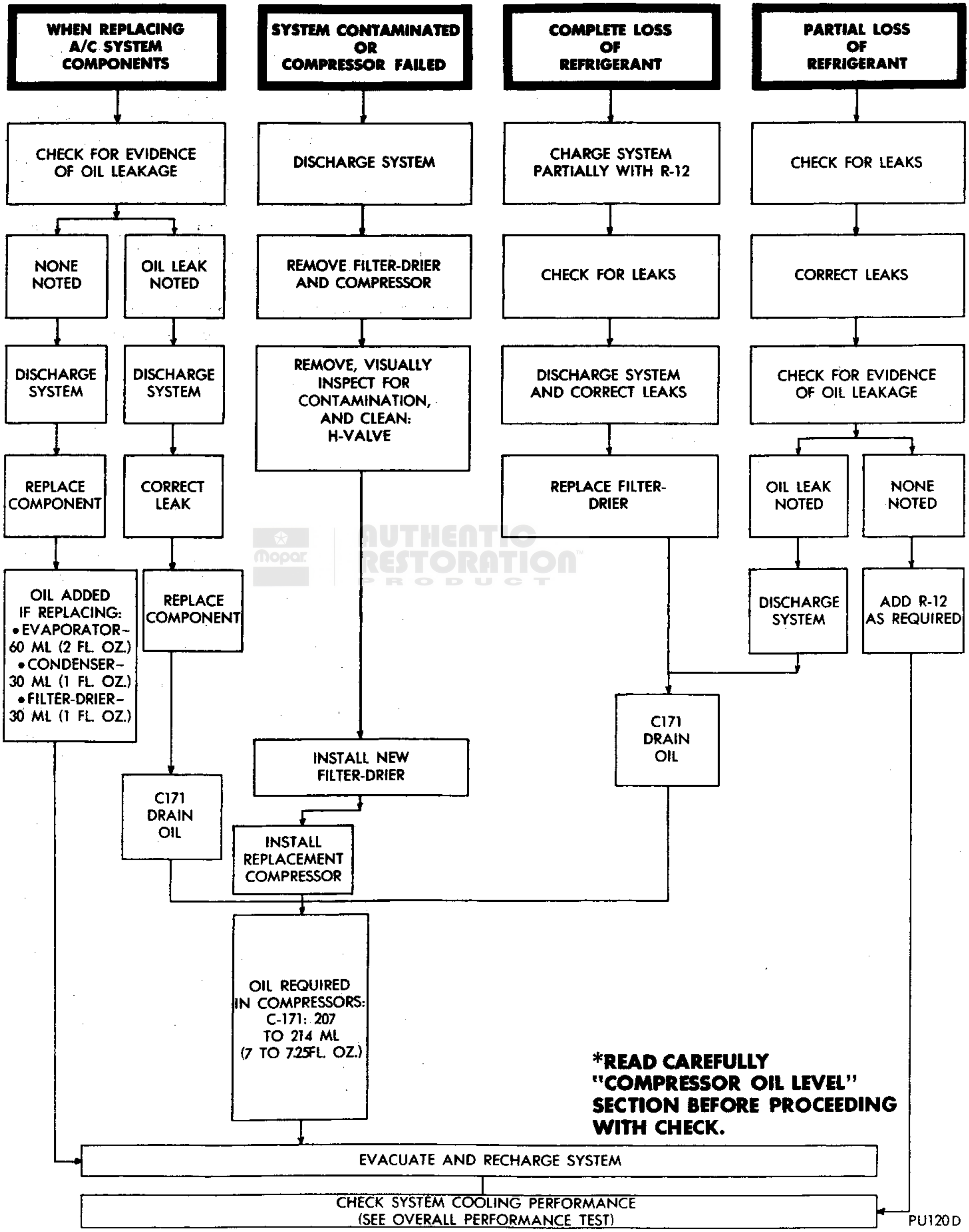
COMPRESSOR OIL LEVEL

It is important to have the correct amount of oil in the A/C system to ensure proper lubrication of the compressor. Too little oil will result in damage to the compressor, while too much oil will reduce the cooling capacity of the system and consequently result in higher discharge air temperatures.

To provide the desired balance for adequate lubrication and cooling capacity, each compressor is charged with 7 to 7.25 fl. oz. (207 to 214 ml) of oil at the factory.

The oil used in the compressors is a 500 SUS viscosity, wax-free refrigerant oil. Only refrigerant oil of the same type should be used to service the system. Do not use any other oil. The oil container should be kept tightly capped until it is ready for use, and then tightly capped after use to prevent entrance of dirt and moisture. Refrigerant oil will quickly absorb any moisture it comes in contact with.

COMPRESSOR OIL LEVEL ADJUSTMENT*



***READ CAREFULLY "COMPRESSOR OIL LEVEL" SECTION BEFORE PROCEEDING WITH CHECK.**

After the compressor has been installed and operated in the A/C system, the oil will be distributed throughout the system. Some of the oil will be trapped by components in the system. An equivalent amount of oil must be added to the system to compensate for the trapped oil when replacing the following:

Evaporator Coil: 2 fl. oz. (59.2 ml)
Condenser: 1 fl. oz. (30 ml)
Filter-Drier: 1 fl. oz. (30 ml)

It will not be necessary to check oil level in the compressor or to add oil unless there has been an oil loss due to a ruptured line, shaft seal leakage, leakage from the evaporator, condenser, filter-drier, or loss due to a collision. Oil loss at a leak point will be evident by the presence of a wet, shiny surface around the leak.

Replacement compressors are also charged with 7-7.25 fl. oz. (207-214 ml). When replacing compressor, remove, drain oil, measure amount and discard old oil. For the replacement compressor use the same amount of refrigerant oil as recovered from the failed compressor. This adjustment is not needed if the system has been flushed, removing retained oil.

The Oil Level Adjustment Chart should be followed to determine the need to perform an oil level adjustment.

CHECK OIL LEVEL (BASIC FILL)

(1) Slowly discharge complete system.

(2) With system discharged, disconnect suction and discharge lines, remove compressor, drain and discard oil through suction port and discharge port on top.

(3) Add 5 fluid ounces (148 ml) of clean refrigerant oil through the suction port.

(4) Install compressor, install and tighten suction and discharge lines to compressor. Use new gaskets to prevent leakage.

(5) Evacuate and charge system.

OVER-ALL PERFORMANCE TEST

Humidity has an important bearing on the temperature of the air delivered to the vehicle's interior. This is true of all air-conditioning systems. It is important to understand the effect humidity has on the performance of the system. When humidity is high, the evaporator has to perform a double duty. It must lower the air temperature and the temperature of the moisture carried in the air. Condensing the moisture in the air transfers a great deal of heat energy into the evaporator fins and tubing. This reduces the amount of heat the evaporator can absorb from the air.

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. However, an owner may expect too much from their air-conditioning system on humid days. A performance test is the best way to determine whether or not the system is performing up to standard. This test also provides valuable clues to the possible cause of trouble.

PERFORMANCE TEST PROCEDURE

Air temperature in test room must be 70°F (21°C) minimum for this test.

(1) Connect a tachometer and manifold gauge set (Fig. 5).

(2) Set A/C controls to Max A/C, temperature lever on full cool, and blower on high.

(3) Start engine and adjust rpm to 1000 with A/C clutch engaged.

(4) Engine should be warmed up with doors, windows, and hood closed.

(5) Insert a thermometer in the left center A/C outlet and operate the engine for 5 minutes. The A/C clutch may cycle depending on ambient conditions.

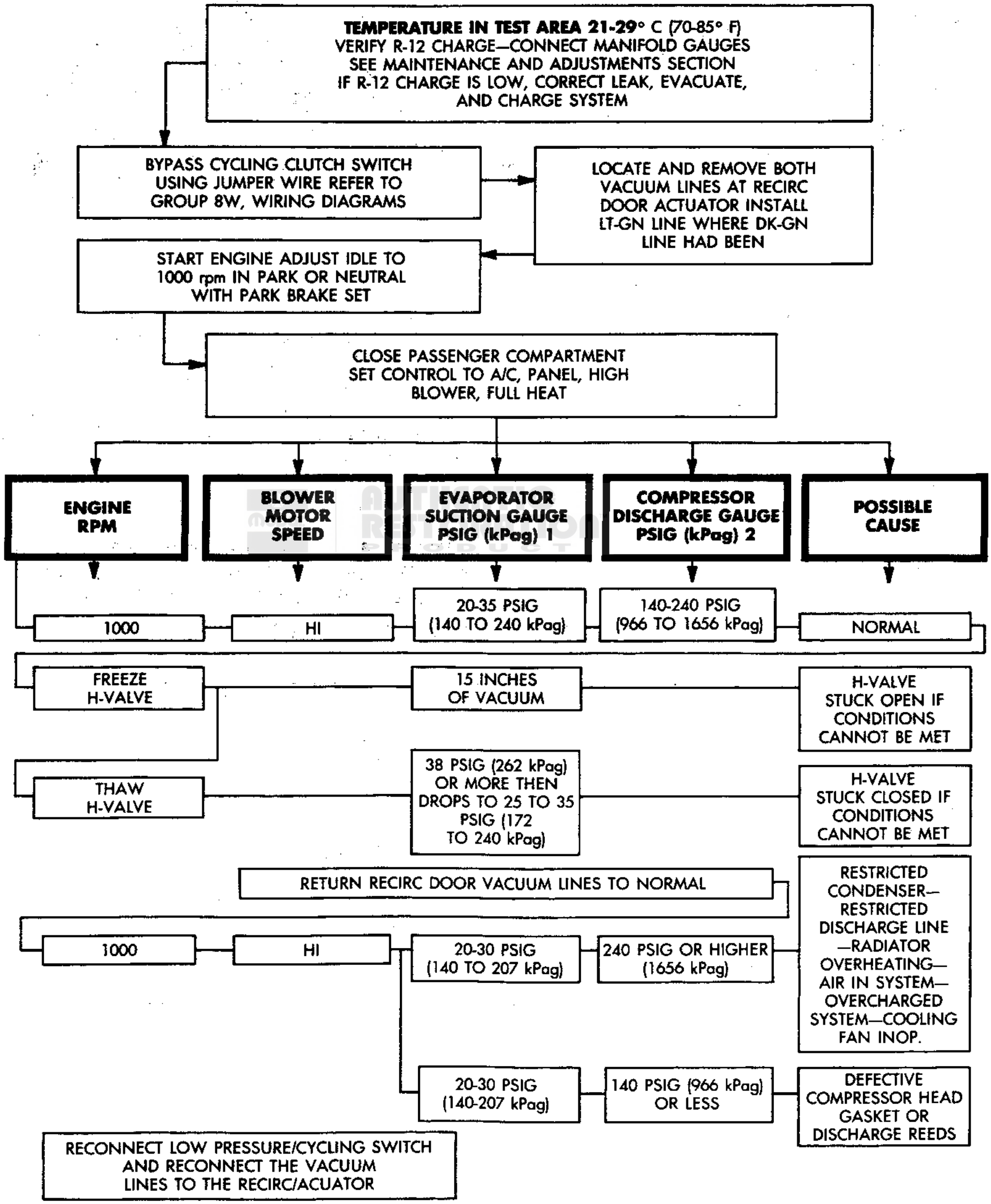
(6) After 5 minutes note the discharge air temperature. (If the clutch cycles take the reading before the clutch disengages).

(7) Open the hood and disconnect the gray vacuum line going to the heater water control valve. Observe the valve arm for movement as the line is disconnected. If it does not move refer to the heater valve controls sections of this group. Plug the vacuum line to prevent leakage.

(8) Operate the A/C for 2 more minutes and take the discharge air temperature reading again. If the temperature increased by more than 5°F (2°C), check the blend air door cable for correct operation. If the temperature does not increase more than 5°F (2°C), compare the discharge air temperature, suction, and discharge pressures with the values in the performance chart corresponding with the garage ambient temperature. Reconnect the gray vacuum line.

(9) If the discharge air temperature fails to meet the specifications in the performance temperature chart, refer to the diagnostic analysis charts for further test information.

AIR-CONDITIONING REFRIGERANT SYSTEM DIAGNOSIS



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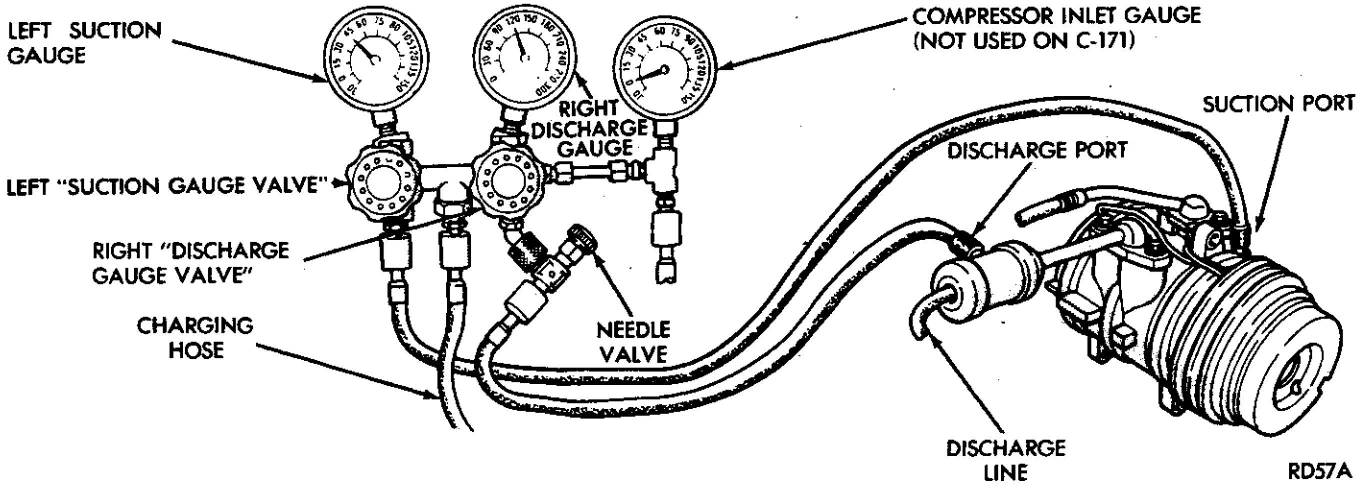


Fig. 5—Typical Manifold Gauge Set Installation

EXPANSION VALVE TEST

Test must be made at ambient temperature of 70° to 85°F (21°C to 29°C).

After performing all previously mentioned tests, conduct the H-valve test as follows:

(1) **A/C System**—Close the windows and operate the engine at 1000 rpm. Set air-conditioning controls for Max. A/C, high blower, temperature control lever in full reheat position and cycling clutch switch electrically bypassed. Disconnect and plug the water valve vacuum hose in the engine compartment.

(2) Operate the system for at least (5) minutes in order to obtain partial stabilization and sufficient reheat to load the system. Pressure at the discarge service port should reach 140-240 psig (966 to 1656 kPag) (Fig. 6). If head pressure of 140-240 psig (966 to 1656 kPag) cannot be obtained, check system charge level (see system charging section).

(3) Put crushed dry ice on control head (completely cover head) for a minimum of 30 seconds.

WARNING: EXTREME CARE MUST BE USED WHEN HANDLING DRY ICE AS SKIN INJURY CAN OCCUR IF PROTECTIVE GLOVES ARE NOT WORN.

PERFORMANCE TEMPERATURE CHART

Garage Ambient Temperature	70°F (21°C)	80°F (26.5°C)	90°F (32°C)	100°F (37.5°C)	110°F (43°C)
Discharge Air Temperature	38-50°F (3-10°C)	42-54°F (6-12°C)	46-58°F (8-14°C)	50-62°F (10-17°C)	54-66°F (12-19°C)
Compressor Discharge Pressure	120 psig 195 827 kPag 1344	160 psig 235 1103 kPag 1620	200 psig 270 1379 kPag 1861	240 psig 305 1655 kPag 2103	280 psig 340 1379 kPag 2344
Evaporator Suction Pressure	18 psig 30 124 kPag 207	20 psig 35 138 kPag 241	22 psig 39 152 kPag 269	25 psig 43 172 kPag 296	26 psig 47 179 kPag 324

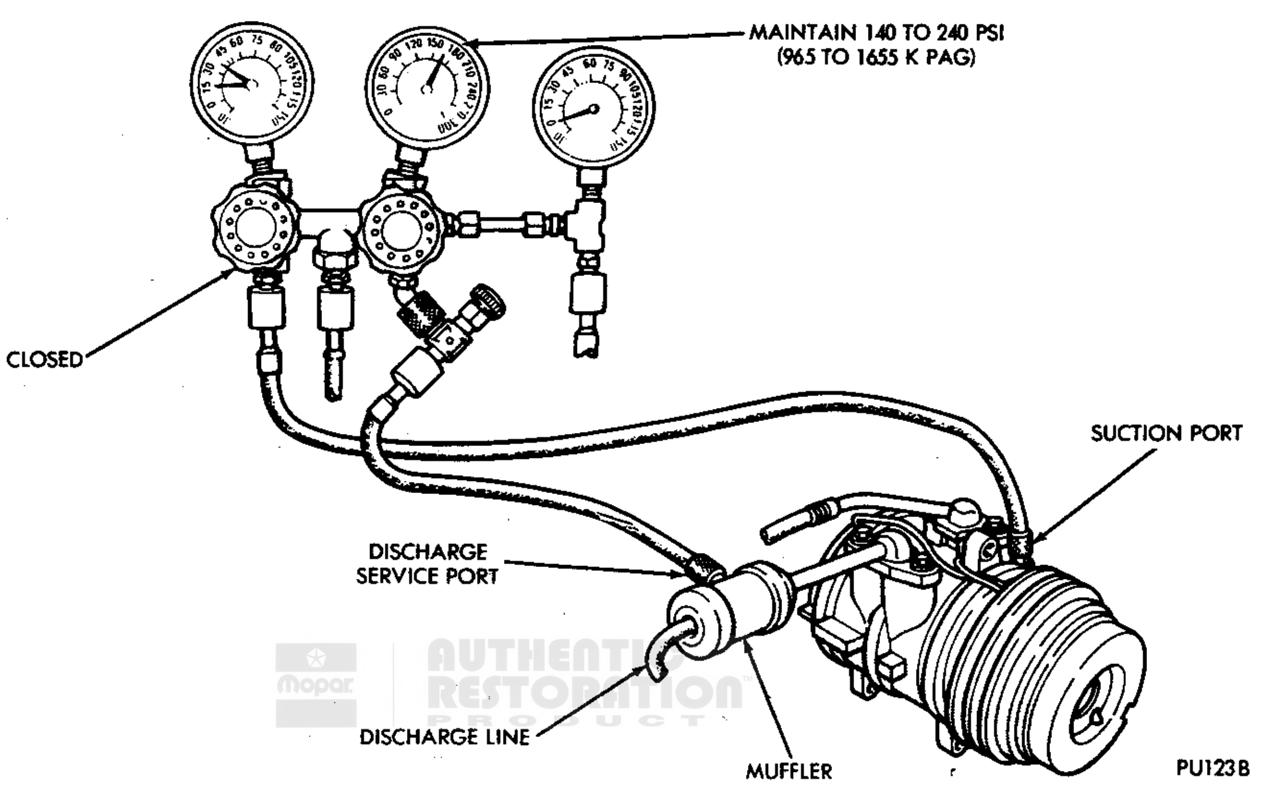


Fig. 6—Expansion Valve (H-Valve Test)

Evaporator suction pressure must drop to below 15″ of vacuum (-50 kPag). If the condition is not met the H-valve is stuck open and should be replaced. Remove dry ice and watch evaporator suction pressure; it should increase to a minimum of 38 psig (262 kPag) and then stabilize to a pressure of 25 to 35 psig (172 to 240 kPag). Any H-valve which does not produce this response is stuck open and should be replaced.

(4) Reconnect A/C water valve vacuum hose (gray) and set temperature control in cool position.

(5) Set engine speed at 1000 rpm and blower on HI. The evaporator suction pressure should be in the range of 20-30 psig (138 to 207 kPag). If compressor discharge is higher than 240 psig (1656 kPag), check for restricted discharge line, radiator overheating, air in system or faulty viscous fan drive. If discharge pressure is less than 140 psig (966 kPag), check compressor head gaskets and discharge reeds.

(6) Reconnect the electrical wires to the damped pressure cycling clutch switch.

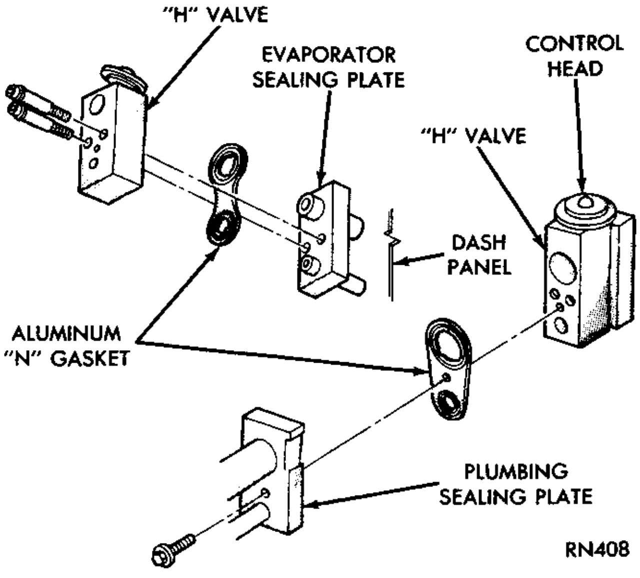
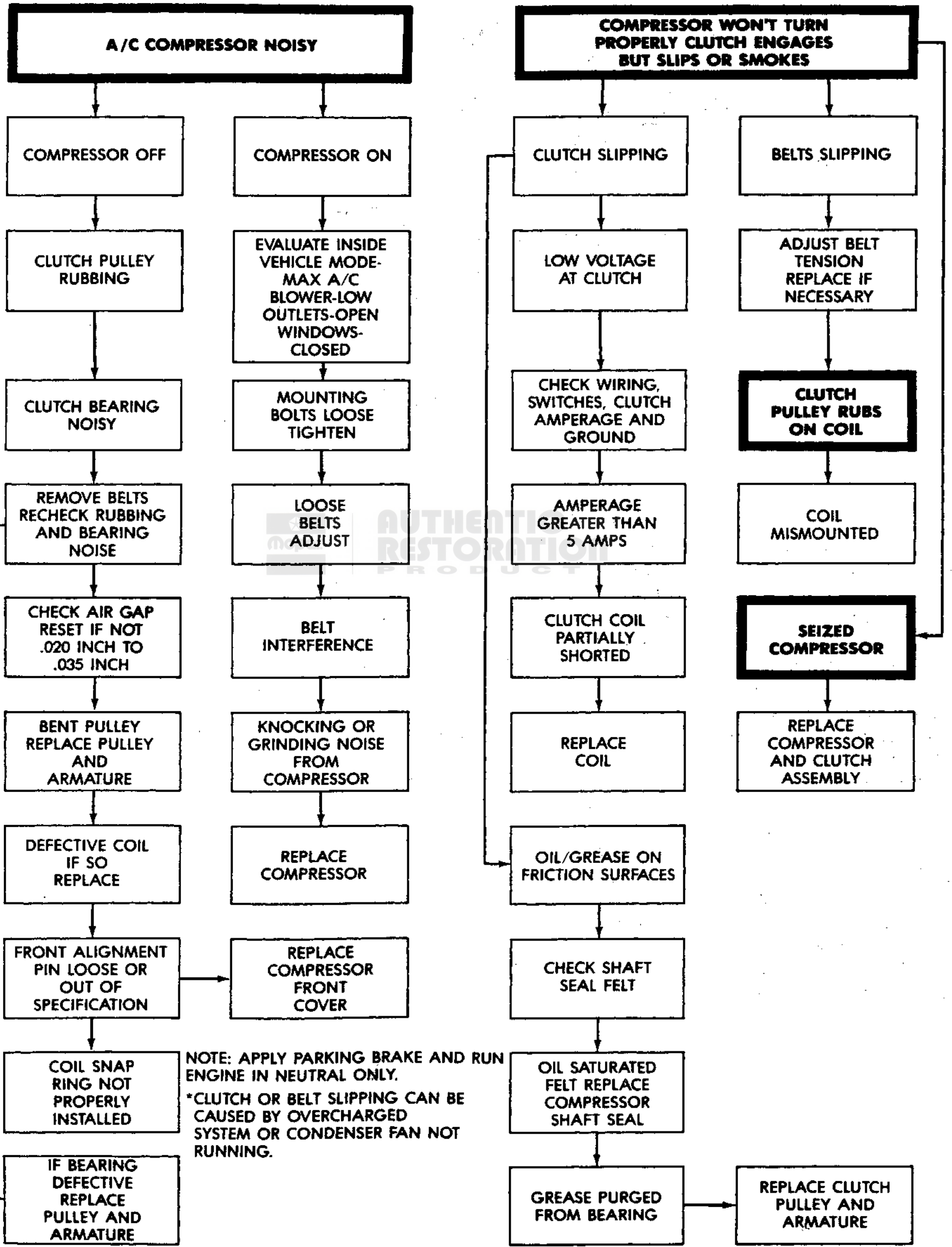


Fig. 7—H-Valve Assembly

A/C COMPRESSOR AND CLUTCH DIAGNOSIS



NOTE: APPLY PARKING BRAKE AND RUN ENGINE IN NEUTRAL ONLY.

*CLUTCH OR BELT SLIPPING CAN BE CAUSED BY OVERCHARGED SYSTEM OR CONDENSER FAN NOT RUNNING.

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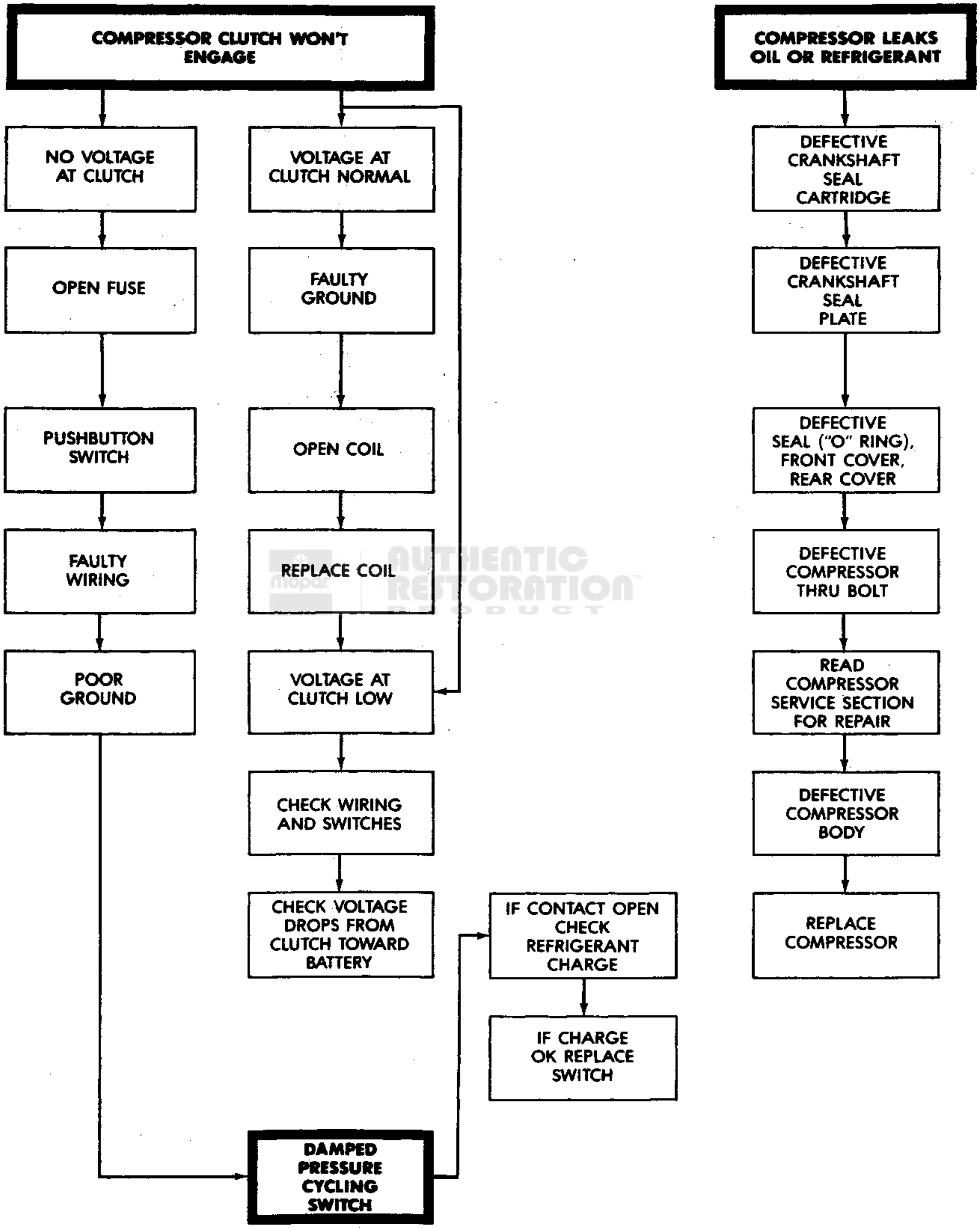
A/C COMPRESSOR AND CLUTCH DIAGNOSIS



NOTE: APPLY PARKING BRAKE AND RUN ENGINE IN NEUTRAL ONLY.

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REFRIGERANT SYSTEM SERVICE PROCEDURES

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REFRIGERANT LEAK REPAIR PROCEDURE

LOST CHARGE

If the system has lost all charge due to a leak:

(1) Evacuate the system.

(2) Charge the system with approximately one pound of refrigerant.

(3) Locate all leaks.

(4) Repair all leaks.

(5) Replace filter-drier bottle.

CAUTION: Replacement filter-drier units must be sealed while in storage. The drier used in these units absorbs and traps moisture quickly upon exposure to the atmosphere. When installing a drier, have all tools and supplies ready for quick reassembly to avoid keeping the system open any longer than necessary.

(6) Check system oil level (see test procedure).

(7) Evacuate and charge the system.

LOW CHARGE

If the system has not lost all of its refrigerant charge; locate and repair all leaks. If it is necessary to increase the system pressure to find the leak (because of an especially low charge), add 1/2 lb (230 g) of refrigerant. If there has been a significant oil loss, check the system oil level. If it has been possible to repair the leak without discharging the refrigerant system and if an oil level check was not necessary, use the procedure for correcting low refrigerant level.

CORRECTING LOW REFRIGERANT LEVEL

Since the refrigeration system is completely sealed, the refrigerant level will not be low unless there is a leak in the system.

Before adding refrigerant where the cause of a low level is not known, the system should be tested for leaks. Assuming that leaks have been corrected without discharging the system, proceed with partial charge.

Install and connect manifold gauge set (Fig. 1).

(1) Close both manifold gauge set valves. Open manifold gauge set needle valve.

(2) Connect the suction gauge test hose to the suction service port of the compressor. Connect the discharge gauge test hose to the discharge service port.

(3) Connect one end of long test hose to the center manifold outlet, and other end to refrigerant dispensing manifold.

(4) Close two dispensing manifold valves and open remaining dispensing manifold valve. Remove protective cap from opened valve.

WARNING: NEVER USE THESE CANS TO CHARGE INTO THE HIGH PRESSURE SIDE OF THE SYSTEM (COMPRESSOR DISCHARGE PORT) OR INTO A SYSTEM THAT IS AT HIGH TEMPERATURE, BECAUSE THE HIGH SYSTEM PRESSURES COULD BE TRANSFERRED INTO THE CHARGING CAN CAUSING IT TO EXPLODE.

(5) Screw a can of R-12 to the opened manifold valve. Be sure gasket is in place and in good condition. Tighten refrigerant can and manifold locking nut to insure a good seal. Do not overtighten since 6 to 8 foot-pounds (8 to 11 N•m) is sufficient if gasket is in good condition.

(6) Turn manifold valve (above the refrigerant can) completely clockwise to puncture the can. This closes the valve and seals the refrigerant in the can.

CAUTION: Do not heat refrigerant 12 above 125°F (52°C).

(7) Place refrigerant can in a large pan of water heated to 125 degrees F (52°C). Place pan of water containing the refrigerant can on an accurate scale so the amount of refrigerant added can be weighed. Open the refrigerant manifold valve.

(8) Purge all air from test hoses. Air in the system will be trapped in the condenser causing abnormally high discharge pressures and interfering with condensing of the refrigerant.

   (a) Loosen both test hoses at the manifold gauge set. Tighten the hoses as soon as the air is purged.

   (b) Loosen charging hose connection at manifold gauge set. This will purge air from the charging hose. Tighten connection as soon as air is purged.

(9) With vehicle windows open and hood up, operate engine at 1300 rpm.

(10) Place air conditioner control on A/C and place the fan switch on high.

(11) If necessary, block the condenser to maintain a discharge pressure of 225 to 250 psig (1550 to 1725

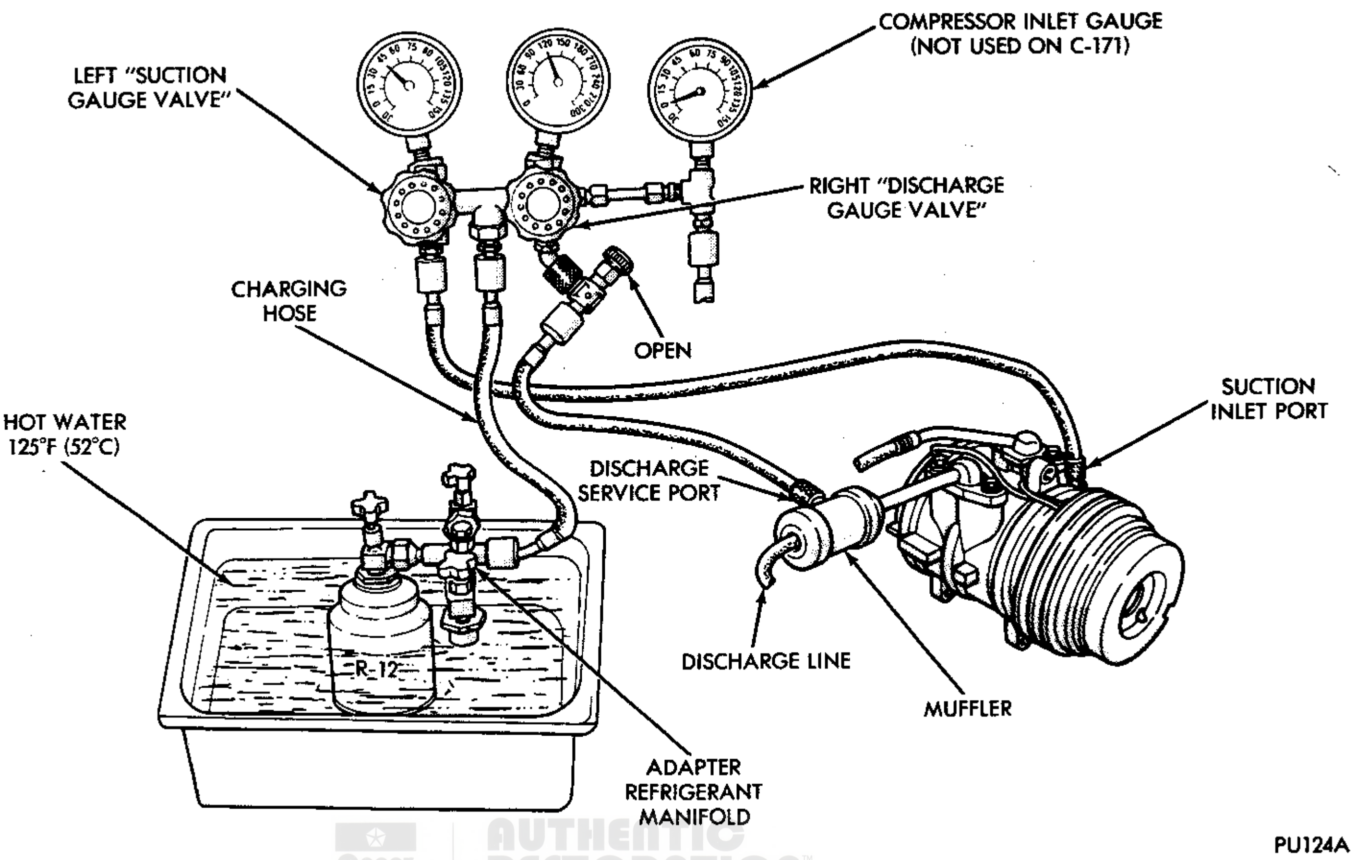

Fig. 1—Adding Partial Charge

kPag). System must be charged through the evaporator suction service ports as follows:

(a) Slowly open the suction service gauge valve. Meter flow of refrigerant by adjusting the suction service gauge valve so the pressure registered at the suction service gauge does not exceed 50 psig (345 kPag). Keep refrigerant container upright.

(b) Add refrigerant gas until there is no foam visible at the sight glass. As soon as all foam clears, note the weight registered on the refrigerant scale.

(c) Watch the refrigerant weighing scale and add 14 oz. (437 g) of refrigerant (equivalent to one can).

Close the suction gauge valve.

CAUTION: Too much refrigerant in the system can cause abnormally high discharge pressures. Care must be used so the exact recommended amount of refrigerant is added after foam clears in the sight glass.

(d) Close dispensing manifold valve. Remove test hoses and adapters from the service ports of compressor, and install protective caps at service ports.

DISCHARGING THE SYSTEM

Since the air-conditioning refrigerant system is pressurized, it will be necessary to completely discharge the system before replacing any refrigerant components. The procedure is as follows:

(1) Install gauge set as described under manifold gauge set installation. Make sure the gauge set valves are closed before attaching the hoses to the refrigerant system.

(2) Install a long hose to the manifold gauge set connector. Run this hose to the oil collector can near the shop exhaust system (Fig. 2).

A good oil collector can may be made from a large empty coffee can with a plastic top. Slit the plastic top in the form of a Y to make an entrance for the refrigerant hose and exit for the gas.

(3) Open the compressor discharge and suction line pressure valves and discharge the refrigerant into the oil collector can. Watch to make sure the hose does not blow out of the collector can.

(4) When the system has been completely discharged, measure the amount of oil collected in the can. The amount of oil measured should be added to the refrigerant system before it is recharged. Add new oil—discard the used oil.

EVACUATING THE SYSTEM

Whenever the system has been opened to the atmosphere, it is absolutely essential that the system be evacuated or "vacuumed" to remove all the air and moisture. Air in the refrigerant system causes high

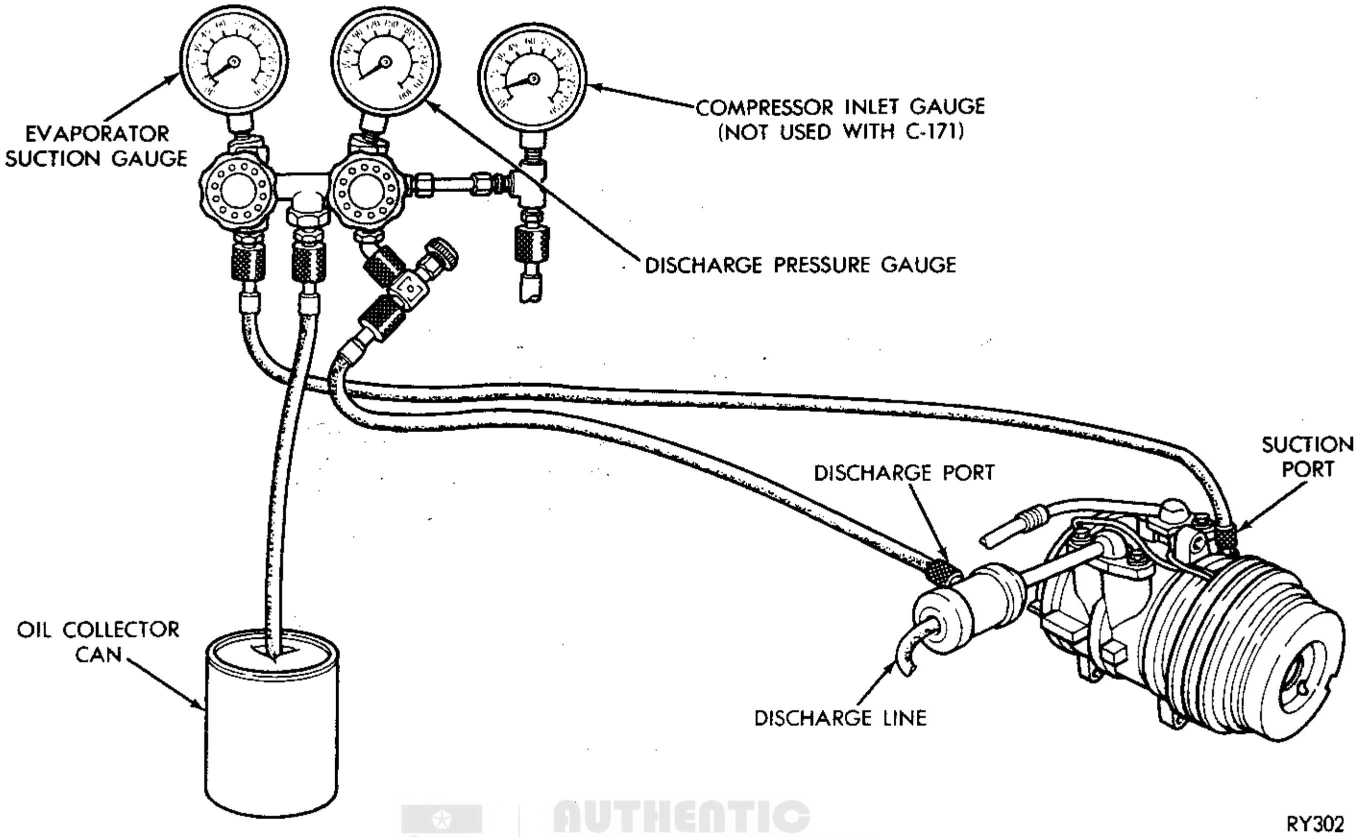

Fig. 2—Discharging the System

compressor discharge pressures, a loss in system performance, and oxidation of the compressor oil into gum and varnish. Moisture in the refrigerant system can cause the expansion valve to malfunction. Under certain conditions it can react with the refrigerant to form destructive acids. It is necessary to adhere to the following procedure to keep air and moisture out of the system.

(1) Connect the manifold gauge set to the compressor and long test hose from manifold gauge set center connection to vacuum pump, Tool C-4081, or C-4289, as shown in Figure 3.

(2) Open both manifold gauge set valves.

(3) Start the vacuum pump and operate until the evaporator suction gauge registers at least 26 inches of vacuum (-88 kPag).

If at least 26 inches of vacuum (-88 kPag) cannot be obtained, either the system has a leak or the vacuum pump is defective. Check the vacuum pump. If the pump proves to be functioning properly, the system has a leak. Charge the system with one pound of refrigerant. Locate and reapir all leaks. Discharge the refrigerant and evacuate the system.

(4) Continue to operate the pump for at least five minutes.

(5) Close manifold valves. Turn off the vacuum pump and observe evaporator suction gauge for two minutes. The vacuum level should remain constant.

If the vacuum level falls off, the system has a leak. Charge the system with 1 pound (450 g) of refrigerant. Locate and repair all leaks. Discharge the system and repeat evacuation procedure.

CHARGING THE SYSTEM

The refrigerant system must have been evacuated using the previous procedure before charging. Charge using only R-12 refrigerant. R-12 is available in bulk tanks or 14 ounce (437 g) cvans. Follow the safety precautions for handling R-12 as listed under air-conditioning.

CHARGING WITH 14 OUNCE (437G) CANS

The special refrigerant dispensing manifold permits charging three cans of refrigerant at one time. When using disposable cans of this type, carefully follow the can manufacturers instructions.

WARNING: NEVER USE THESE CANS TO CHARGE INTO THE HIGH PRESSURE SIDE OF THE SYSTEM (COMPRESSOR DISCHARGE PORT) OR INTO A SYSTEM THAT IS AT HIGH TEMPERATURE, BECAUSE THE HIGH SYSTEM PRESSURES COULD BE TRANSFERRED INTO THE CHARGING CAN CAUSING IT TO EXPLODE.

Keep the refrigerant manifold valves capped when not in use. Keep a supply of extra refrigerant-can-to

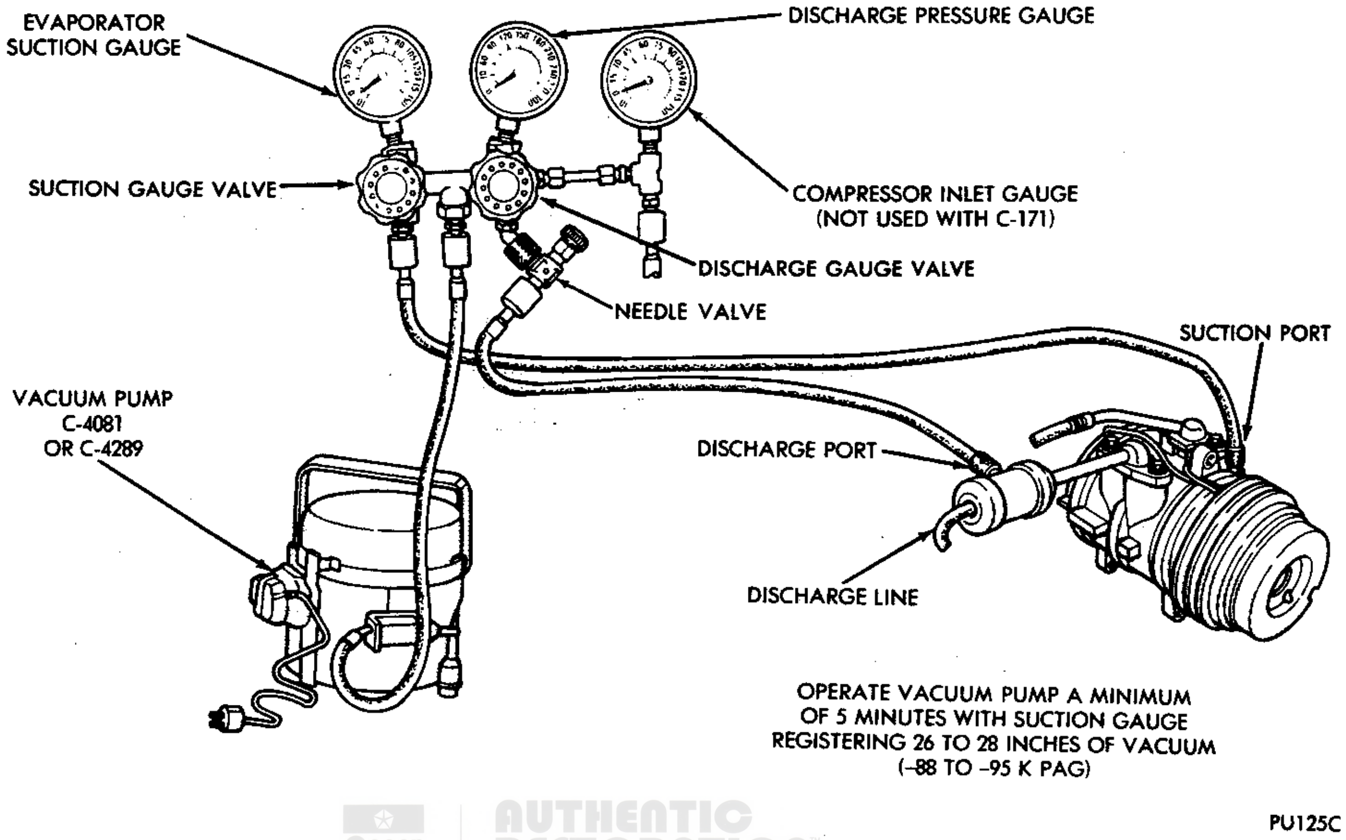

Fig. 3—Evacuating the System

refrigerant-manifold gaskets on hand so the gaskets can be replaced periodically. This will insure a good seal without excessive tightening of the can or the manifold nuts.

(1) Attach center hose from manifold gauge set to refrigerant dispensing manifold. Turn refrigerant manifold valves completely counterclockwise so they are fully open. Remove protective caps from refrigerant manifold.

(2) Screw refrigerant cans into manifold. Be sure manifold-to-can gasket is in place and in good condition. Tighten can and manifold nuts to 6 to 8 foot-pounds (8 to 11 N•m).

(3) Turn three refrigerant manifold valves completely clockwise to puncture the cans and close the-manifold valves (Fig. 4).

(4) Purge the air from the charging line by loosening the charging hose at the manifold gauge set and turning one of the refrigerant valves counterclockwise to release refrigerant. When the refrigerant gas starts escaping from the loose connection, re-tighten the hose.

CAUTION: Do not heat refrigerant 12 above 125°F (52°C).

(5) Fully open all three refrigerant manifold valves and place the cans of refrigerant into a pan containing 125°F (52°C) water. The water will warm the charging can and aid in the transfer of the charge into the system.

(6) Start the engine and move the controls to A/C low blower position.

The damped pressure cycling switch will prevent the clutch from engaging until refrigerant is added to the system. If the clutch does engage, replace the switch before proceeding any further.

(7) Charge through the suction side of the system by slowly opening the suction manifold valve. Adjust the valve as necessary so charging pressure does not exceed 50 psig (345 kPag). Maintain the temperature of the water in the pan by adding warm water as necessary.

(8) Adjust the engine speed to a fast idle of approximately 1300 rpm.

(9) When all three cans of refrigerant are completely empty, close the manifold gauge set valves and refrigerant manifold valves.

Refrigerant Charge	
Truck Model	**Refrigerant**
All	44 oz. max.

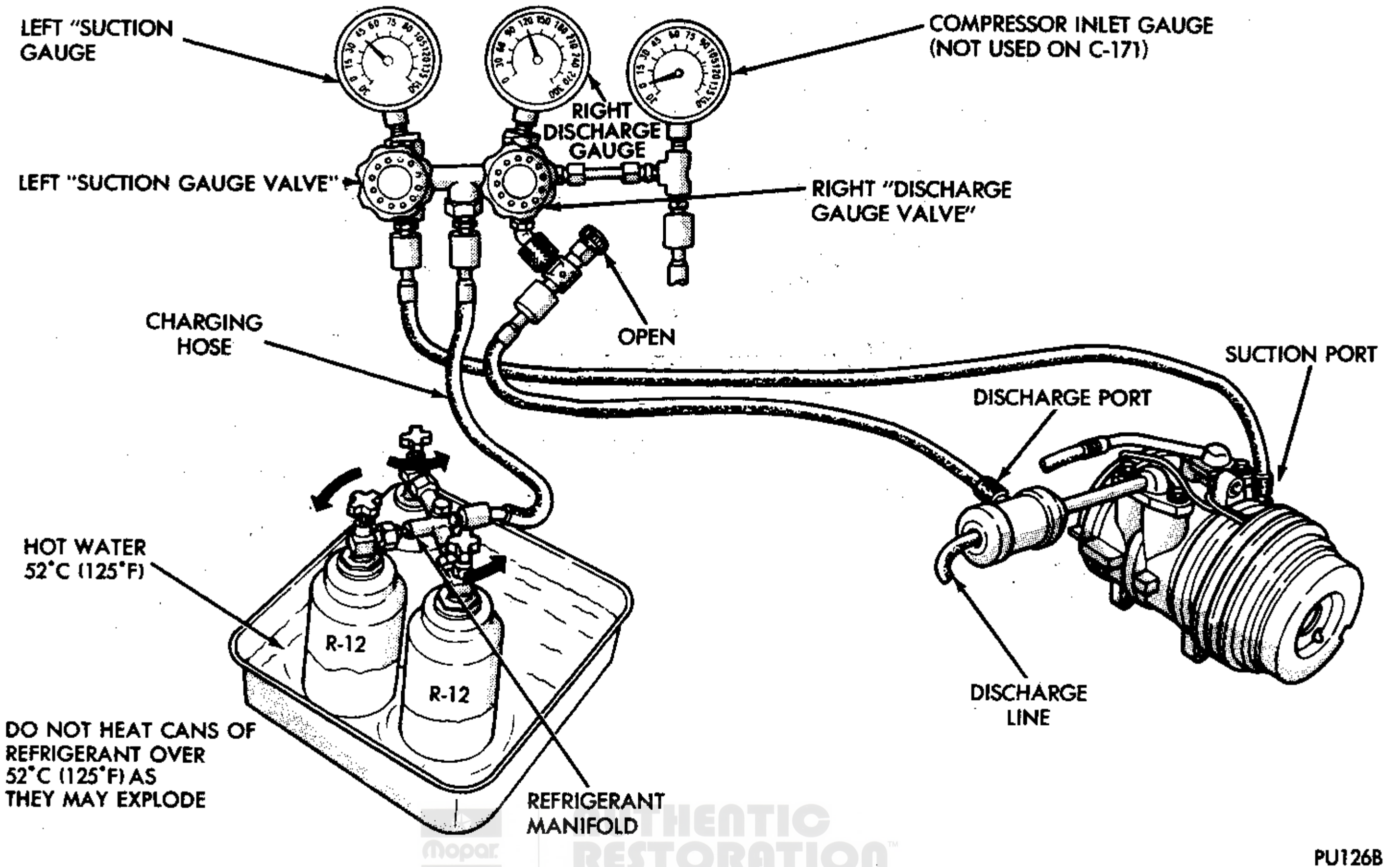

Fig. 4—Complete Charging of the System

SERVICE PROCEDURES

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HANDLING TUBING AND FITTINGS

Kinks in the refrigerant tubing or sharp bends in the refrigerant hose lines will greatly 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 connections are pressure tight. Dirt and moisture can enter the system when it is opened for repair or replacement of lines or components. The following precautions must be observed.

The system must be completely discharged before opening any fitting or connection in the refrigeration system. Open fittings with caution even after the system has been discharged. If any pressure is noticed as a fitting is loosened, allow trapped pressure to bleed off very slowly. Never attempt to rebend formed lines to fit. Use the correct line for the installation you are repairing.

A good rule for the flexible hose lines it to keep the radius of all bends at least 10 times the diameter of the hose. Sharper bends will reduce the flow of refrigerant. The flexible hose lines should be routed so they are at least 3 inches (80 mm) from the exhaust manifold. It is a good practice to inspect all flexible hose lines at least once a year to make sure they are in good condition and properly routed.

Unified plumbing connections with aluminum-N-gaskets cannot be serviced with O-rings. These gaskets are not reusable and do not require lubrication before installing (Fig. 1).

The use of correct wrenches when making connections are very important. Improper wrenches or improper use of wrenches can damage the fittings.

The internal parts of the refrigeration system will remain in a state of chemical stability as long as pure-moisture-free Refrigerant 12 and refrigerant oil is used. Abnormal amounts of dirt, moisture or air can upset the chemical stability and cause operational troubles or even serious damage is present in more then minute quantities.

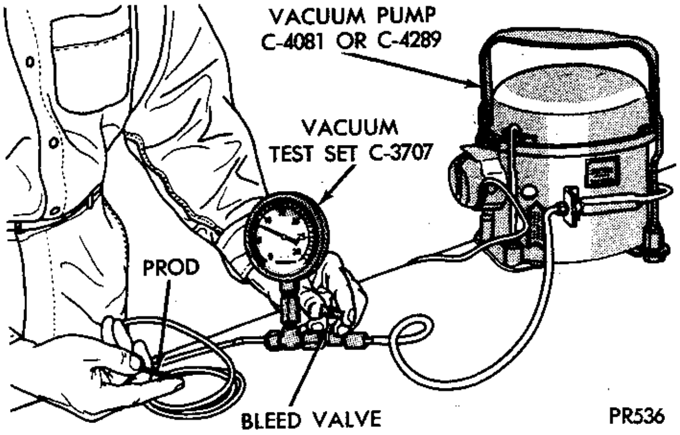

Fig. 1—Adjust Vacuum Test Bleed Valve

When it is necessary to open the refrigeration system, have everything you will need to service the system ready so the system will not be left open 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 ready to be used.

All tools, including the refrigerant dispensing manifold, the mainfold gauge set and test hoses should be kept clean and dry.

COMPRESSOR DRIVE BELT ADJUSTMENT

Satisfactory performance of the air-conditioning system is dependent upon drive belt condition and tension. If the proper tensions are not maintained, belt slippage will greatly reduce air-conditioning performance and drive belt life. To avoid such adverse effects, the following service procedure should be followed:

(1) Any belt that has operated for a minimum of half-hour is considered to be a used belt. Adjust air-conditioning drive belts at the time of new-vehicle preparation. See Chart, "Accessory Belt Drives," "Group 7, Cooling."

(2) Measure drive belt tension at regular service intervals using a belt tension gauge or torque method, and adjust as needed.

(3) On all new-belt installations, new-belt tension specifications should be used when the belt is first installed to obtain proper tension. Thereafter, these replacement belts should be serviced according to the above procedure. Always replace belts in pairs if so equipped, otherwise the old belt will have insufficient tension and the load will be primarily on the new belt. See Chart, "Accessory Belt Drives," "Group 7, Cooling."

COMPRESSOR NOISE

Noises that develop during air-conditioning operation can often be misleading. For example: what sounds like a failed front bearing or connecting rod, may be caused by loose bolts, nuts, mounting brackets, or a loose clutch assembly. Improper belt tension is also often the source of an objectionable noise and can easily be mistaken for internal compressor troubles.

Drive belts are speed sensitive. That is, at different engine speeds, and depending upon belt tension, belts can develop unusual noises that are often mistaken for mechanical problems within the compressor.

ADJUSTMENT PROCEDURES

(1) Select a quiet area for testing. Switch compressor on and off several times to clearly identify compressor noise.

(2) Tighten all compressor mounting bolts, clutch mounting bolt, clutch coil mounting screws and compressor drive belts. Check that plumbing is not rubbing other parts.

(3) Make sure that matched drive belts are equally tensioned. Replace any parts that are defective or missing.

(4) Re-test vehicle; if noise persists, continue trouble shooting system for source of noise.

VACUUM CONTROL SYSTEM ADJUSTMENTS AND TESTS

To keep the vacuum harness in place, common vinyl tape (sometimes called plastic tape of electrician's tape) cannot be used as it will cause the tube to deteriorate directly under the tape, when high underhood temperatures are involved. A compatible nylon type of tape such as MS CH69, (#281) available from Kendall Company, or an equivalent must be used.

The test of the push button switch operation determines whether or not the vacuum and electrical circuits are properly connected and the controls are functioning properly. However, it is possible that a vacuum control system that operates perfectly during high manifold vacuum provided at engine idle may not function properly at high engine speeds. Before starting this test, stop engine and make certain the vacuum source hose at engine intake manifold is tight on its connector.

Start vacuum pump Tool C-4081, or C-4289, and connect the vacuum test set Tool C-3707. Adjust bleed valve on test to obtain a vacuum reading of ex-

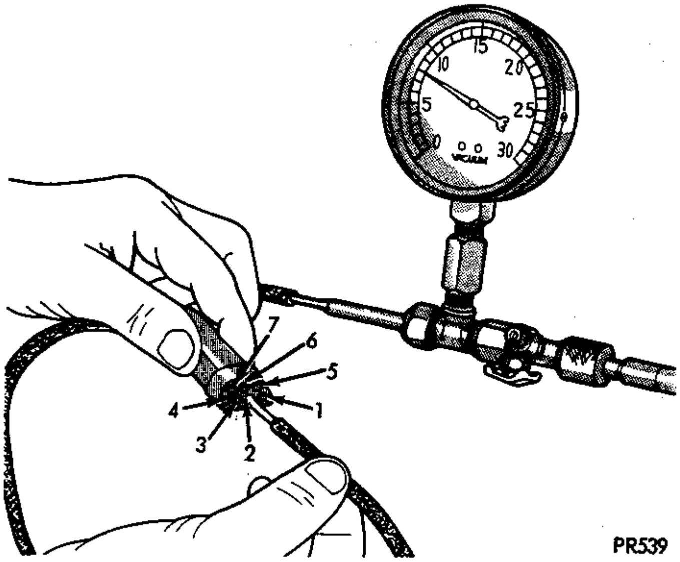

Fig. 2—Vacuum Tube Assembly Test

actly 8 inches of mercury (-27 kPag) with a finger blocking the prod on end of test hose (Fig. 1).

It is essential that the bleed valve be adjusted so the vacuum gauge pointer will return to exactly 8 inches (-27 kPag) when the prod is covered by a finger. Otherwise a false reading will be obtained when the control circuit is tested.

Alternately release and reblock the hose prod several times. Make sure the bleed valve is adjusted so the vacuum gauge pointer returns to exactly 8 inches of vacuum (-27 kPag) when the prod is covered with a finger (Fig. 1).

Disconnect engine vacuum source hose at engine intake manifold and insert vacuum tester hose prod into source hose leading to push button switch. Place vacuum gauge on the cowl so it can be observed from the driver's position as push buttons are operated.

Start the test by depressing the control "Heat" mode pushbutton. Vacuum tester gauge needle will drop until the actuator has operated, and should then return to 7-1/4 to 8 inches (-25 to -27 kPag) depending on vacuum leakage. Continue to depress; "Off," "Max. A/C", "A/C", "Vent", "Defrost", and "Heat" mode pushbutton allowing time for actuators to operate after each button is pushed, and for the vacuum to stabilize. Note the vacuum drop below 8 inches (-27 kPag) after each operation. The maximum allowable vacuum drop below 8 inches (-27 kPag) after each operation is 3/4 inch (-3 kPag). (Bypass the vacuum storage tank if so equipped).

If the vacuum drop is more than 3/4 inch (-3 kPag), first recheck the tester for reading exactly 8 inches (-27 kPag). If correct, inspect the fit of the 7 port hose connector plug on the push button switch. This plug must be positioned all the way onto the 7 ports on the push button switch.

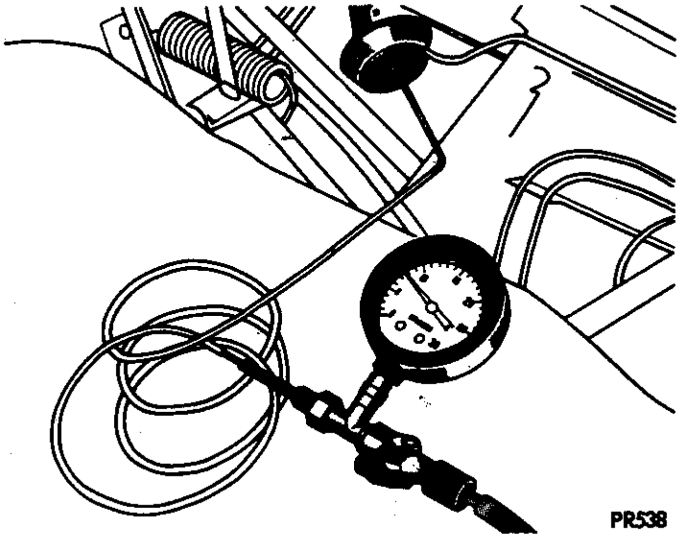

Fig. 3—Vacuum Actuator Test

CAUTION: Do not use lubricant on the switch ports or in the holes in the plug, as lubricant will damage the vacuum valve in the switch. If it is difficult to properly position the connector plug all the way on the switch ports, put a drop or two of clean water in the holes of the connector plug. This will allow the plug to slide completely on the switch ports.

If vacuum drop is now within limits, proceed with the over-all performance test. If vacuum drop is still in excess of 3/4 inch (-3 kPag), remove 7 port connector from switch and seal port No. 6 with a finger to check source hose. Then remove prod from source line and insert it alternately into each connector port except No. 6 (Fig. 2).

Note amount of vacuum drop below 8 inches (-27 kPag) after each actuator has operated. If vacuum test gauge comes back to 8 inches (-27 kPag) at each of the 7 ports, the hoses and actuators are not leaking. The control switch is faulty and must be replaced. If excessive vacuum drop shows up at one or more ports in connector block, isolate faulty hose or actuator.

Inspect hose connections to the actuator involved. Then test whether actuator or hose is at fault; use the test hose on the actuator involved (Fig. 3).

A leak in a hose may be detected with vacuum test set by running the fingers along the hose and watching vacuum gauge reading. The tube can be repaired by cutting out the "leak" and inserting the tube "ends" into a 1/8 inch (3 mm) inside diameter rubber tube. Wet the tube with water to aid assembly.

A vacuum drop in excess of 3/4 inch (-3 kPag) below the 8 inches (-27 kPag) needed in this test will not interfere with the engine operation, other than perhaps to cause a rough idle. It can, however, interfere with the proper operation of the air-conditioning and heating controls at high speeds and during acceleration

CONDENSATE DRAIN TUBE

Condensation which accumulates on the bottom of the evaporator housing is expelled through the molded rubber drain tube into the engine compartment. The tube must be kept open to prevent condensation from collecting in the bottom of the housing.

The squeezed rubber flap at the drain tube tip is designed to keep engine compartment air from entering into the system yet allow condensate drainage. If the tip is not properly formed or has been damaged, the system will not drain properly. Therefore, if the tube is damaged, it should be replaced.

COMPRESSOR SERVICE

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GENERAL INFORMATION

The C-171 is a six cylinder, axial type compressor. The pistons are reciprocated by a swash plate fastened to the drive shaft. When the clutch is energized, the compressor clutch rotates and drives the six pistons in sequence. The electromagnetic clutch is built into the drive pulley assembly (Fig. 1).

The electromagnetic field coil, that does not rotate, is fastened directly to the compressor with a snap ring. The positive lead wire is connected to the engine wiring harness and the ground lead is attached to the compressor housing.

SERVICING THE C-171 COMPRESSOR

The following precautions should be observed when servicing the C-171 compressor.

(1) The A/C refrigerant system must be completely discharged before performing any disassembly or repair service to the compressor.

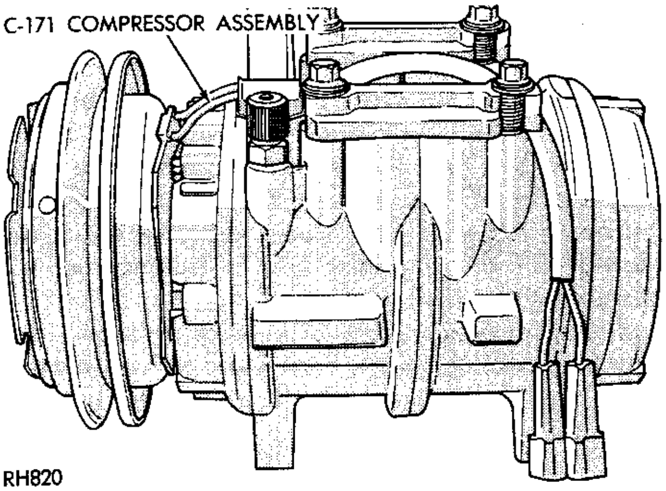

Fig. 1—A/C Clutch Assembly, C-171 Compressor

(2) Cleanliness is extremely important. The work area must be clean and free of air-borne dust and dirt.

(3) Use only wax-free, 500 SUS (Saybolt Uniform Seconds) viscosity refrigerant oil. Refrigerant oil must be kept in a sealed container until ready for use to prevent moisture and dirt from entering. Never use any other oil.

(4) To ensure proper lubrication, the amount of oil used is important. If the compressor is to be removed for repair or replacement, measure the amount of refrigerant oil in the compressor so that the same amount can be added when the new or repaired compressor is installed.

CAUTION: When replacing the compressor assembly, or if at any time it is anadvertently tipped over the crankshaft should be rotated by hand several revolutions to clear oil accumulation from the compressor head before the clutch is energized to avoid damaging the compressor reed valves.

A/C/ CLUTCH

CLUTCH COIL VOLTAGE AND CURRENT DRAW TO TEST THE COIL CIRCUIT

(1) Verify battery state of charge. (Test indicator should be green.)

(2) Connect an ammeter (0-10 ampere scale) in series with the clutch coil terminal. Use a voltmeter (0-20 volt scale) with clip leads measuring voltage across the battery and A/C clutch.

(3) With A/C control in A/C mode and blower at low speed, start the engine and run at normal idle.

(4) The A/C clutch should engage immediately (carbureted engines) or in 11 seconds after the start (EFI engines). The clutch voltage should be within 2 volts

of the battery voltage. If the A/C clutch does not engage, check the fuse.

(5) The A/C coil is acceptable, if the current draw is 2.0 to 3.7 amperes at 11.5 to 12.5 volts at clutch coil with room ambient 21° ± 3°C (70" ± 5°F). Where voltage is more than 12.5 volts, add electrical loads as needed by increasing blower speed and/or switching other electrical accessories on. If coil current reads zero, the coil is open and should be replaced. If the ammeter reading is 4 amperes or more, the coil is shorted and should be replaced. If the coil voltage is not within 2 volts of the battery voltage, check the circuit external to the clutch coil for excessive voltage drop and repair accordingly.

CLUTCH REMOVAL

The procedure for replacing the clutch without discharging the system is as follows:

(1) Loosen and remove drive belts, and disconnect the field coil lead wire.

(2) Remove compressor mounting screws.

(3) Lift compressor up and lay it on the top of the front yoke.

(4) Using a 13 mm socket and spanner wrench, tool C-4563, remove the shaft nut and then lock washer (Fig. 2).

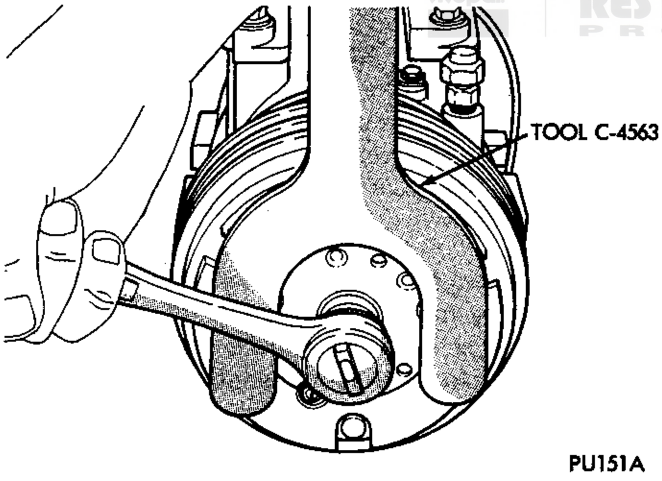

Fig. 2—Removing Clutch Retaining Nut, C-171 Compressor

(5) Screw clutch front plate puller, Tool C-4771, into hub. Tighten enter screw and remove front plate, and shims (Fig. 3).

CAUTION: Do not use screwdrivers between front plate assembly and pulley to pry off front plate because this may damage the front plate assembly.

(6) Remove pulley retaining snap ring with Tool C-4574, and slide pulley assembly off of compressor (Fig. 4).

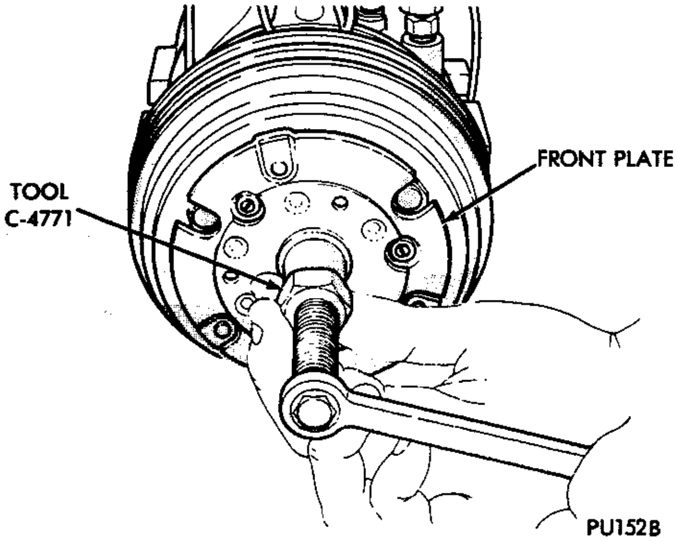

Fig. 3—Removing Clutch Front Plate, C-171 Compressor

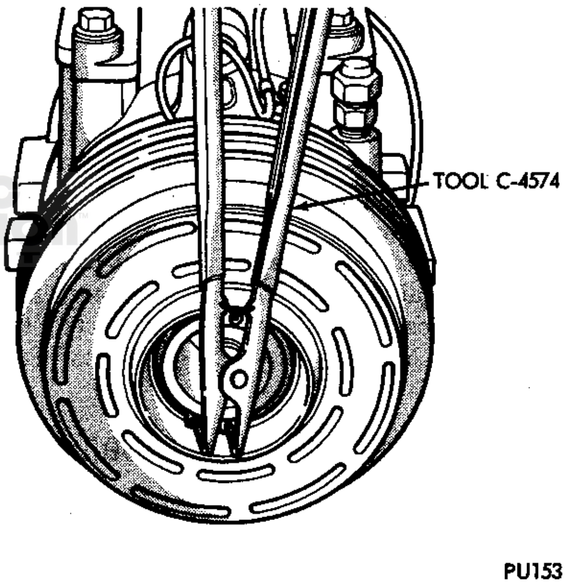

Fig. 4—Removing Pulley Snap Ring, C-171 Compressor

(7) Remove snap ring retaining field coil onto compressor housing. After removing screw and wire clip, slide field coil off of housing (Fig. 5).

(8) Examine frictional faces of the clutch pulley and 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-nose area of the compressor for oil and remove the felt from the front cover. If the compressor felt is saturated with oil, the shaft seal is leaking and will have to be replaced.

(9) Check bearing for roughness or excessive leakage of grease. If grease from bearing has contaminated the faces of the pulley or front plate or if the bearing is rough, the clutch pulley and front plate should be replaced.

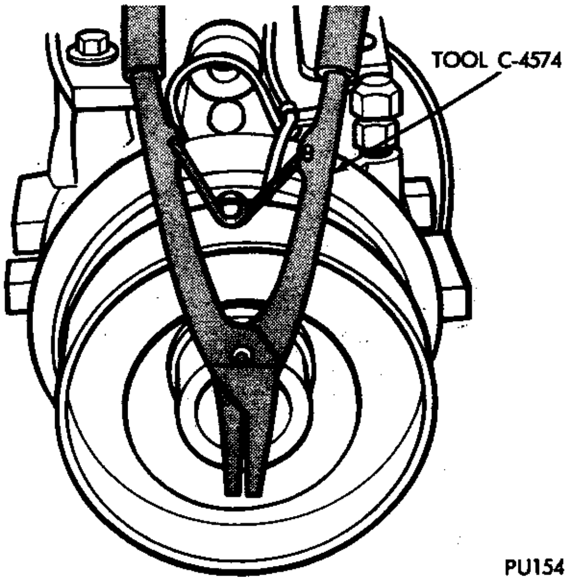

Fig. 5—Removing Clutch Coil, C-171 Compressor

CAUTION: The clutch pulley and the front plate were mated at the factory by a burnishing operation. No attempt should be made to separately replace either part because it will result in clutch slippage due to insufficient contact area.

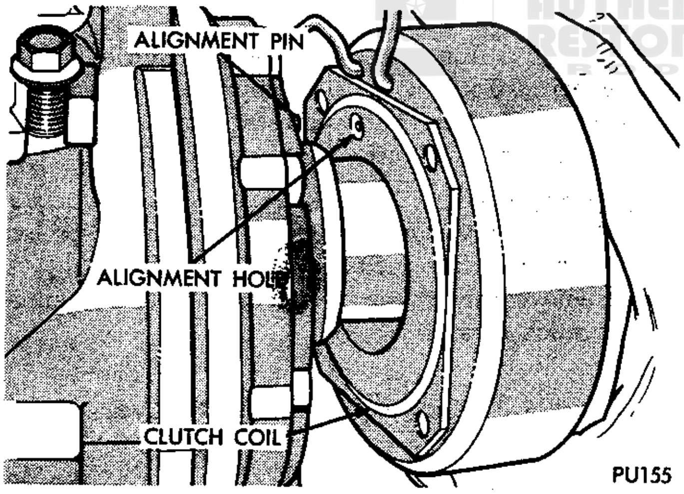

Fig. 6—Installing Clutch Coil, C-171 Compressor

CLUTCH INSTALLATION

(1) Align hole in back of field coil with pin in compressor end housing and position field coil into place (Fig. 6). Make sure that lead wires are properly routed and fasten with the ground wire retaining screw.

(2) Install field coil retaining snap ring (bevel side outward), with snap ring pliers, Tool C-4574. With a screwdriver, press all the way around snap ring to make sure it is properly seated in the groove.

CAUTION: If snap ring is not fully seated it will vibrate out resulting in a clutch failure and severe damage to the front face of the compressor.

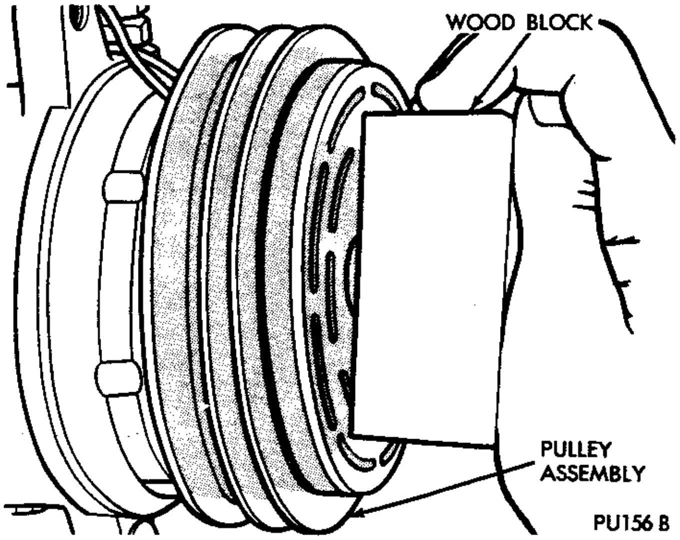

Fig. 7—Installing Pulley Assembly, C-171 Compressor

(3) Install pulley assembly onto compressor. If necessary, tap gently with a block of wood on the grease slinger (Fig. 7).

CAUTION: Do not mar the pulley frictional surface and straighten out the grease slinger if it has been distorted by tapping.

(4) Install pulley assembly retaining snap ring, (bevel side outward) with snap ring pliers Tool C-4574. With a screwdriver, press all the way around the snap ring to make sure it is properly seated in the groove.

(5) If the original front plate assembly and pulley assembly are to be reused, the old shims can be used. If not, place a trial stack of shims, .100 in. (2.54mm) thick, on the shaft against the shoulder.

(6) Install front plate assembly onto shaft making sure the key enters keyway in front plate assembly hub.

(7) With the front plate assembly tight against the shims, measure the air gap between front plate and pulley face with feeler gauges (Fig. 8). The minimum air gap should be between .020 and .035 inch (0.5 and 0.9mm). If proper air gap is not obtained, add or subtract shims until desired air gap is obtained.

(8) Install lockwasher and shaft nut. Tighten to 155 ± 20 in. lbs. (17.5 ± 2 N•m) using torque wrench and spanner wrench tool C-4563.

Shims may compress after tightening shaft nut. Check air gap in four or more places to verify if air gap is still correct. Spin Pulley for final check.

CLUTCH BURNISH

After a new clutch has been installed and voltage and amperage are determined to be satisfactory, cycle the clutch at approximately 5 sec. on and 5 sec. off for 20 cycles with the system in A/C mode, high

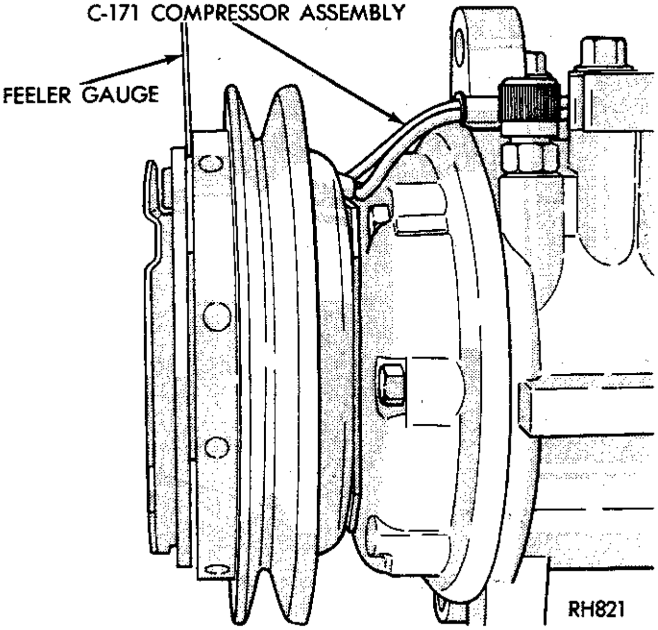

Fig. 8—Measuring Air Gap, C-171 Compressor

blower, engine rpm at 1500-2000. This procedure (burnishing) will "wear-in" the opposing friction surfaces and provide a higher clutch torque capability.

COMPRESSOR

Cleanliness is extremely important. The surfaces around the suction and discharge ports should be cleaned thoroughly before opening the system at these points.

COMPRESSOR REMOVAL

(1) Discharge the system.

(2) Disconnect the suction and discharge lines from the suction and discharge ports. Cap the lines and the ports immediately to prevent moisture and dirt from entering the system.

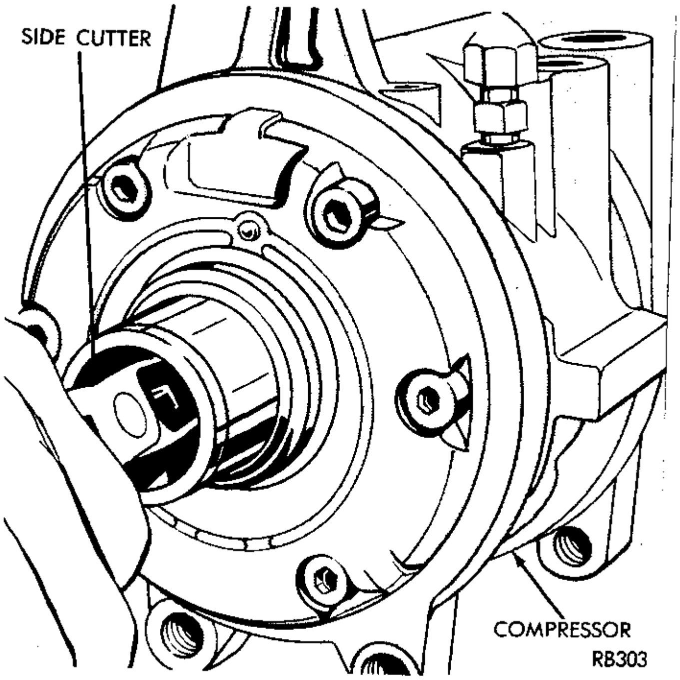

Fig. 1—Crankshaft Key Removal

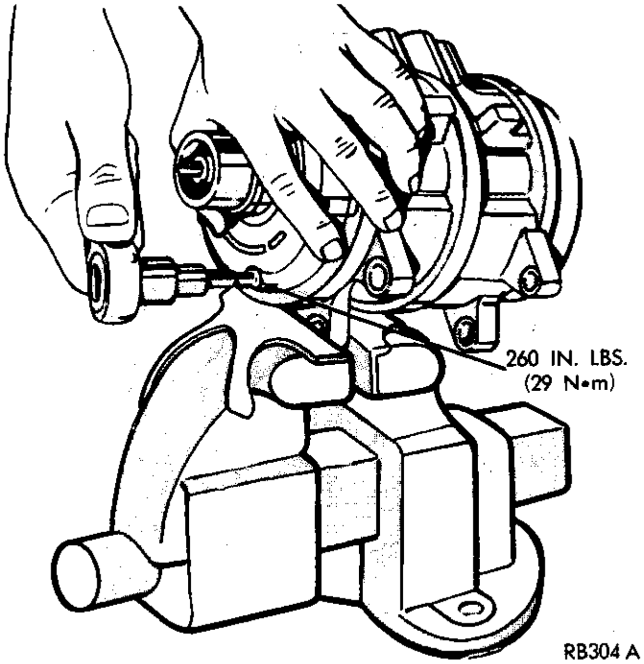

Fig. 2—Removing Compressor thru Bolts

(3) Disconnect clutch wire.

(4) Remove the compressor-to-bracket attaching bolts and remove compressor.

(5) Drain oil from the compressor suction and discharge ports. To service the compressor, it will be necessary to remove the compressor clutch assembly. See "Servicing A/C Clutch".

DISASSEMBLY

(1) Remove key from crankshaft of compressor by gripping with a side cutter and pulling (Fig. 1).

(2) Remove compressor thru bolts using a 6 mm allen wrench (Fig. 2).

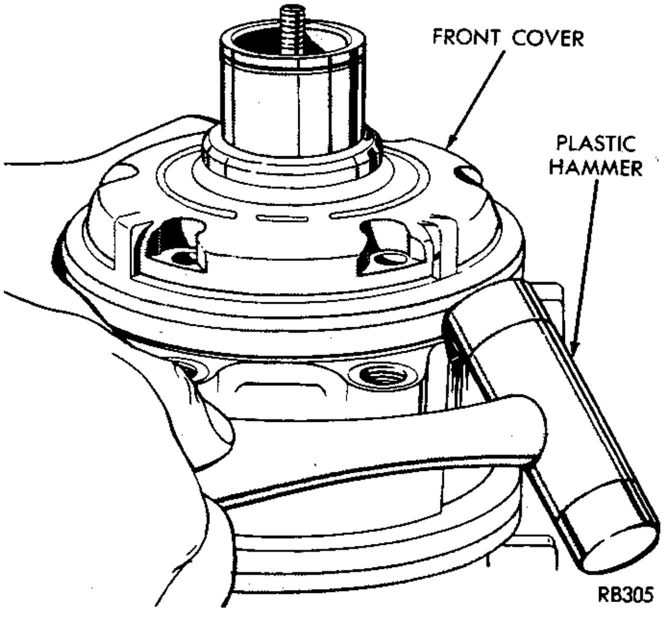

Fig. 3—Removing Front Cover

(3) Remove front cover by tapping on the outside diameter of the cover with a plastic hammer (Fig. 3).

(4) Remove O-ring seal from front cover and discard (Fig. 4). Never re-use cover O-rings or valve plate steel-n-gaskets.

(5) Remove felt from front cover (Fig. 5).

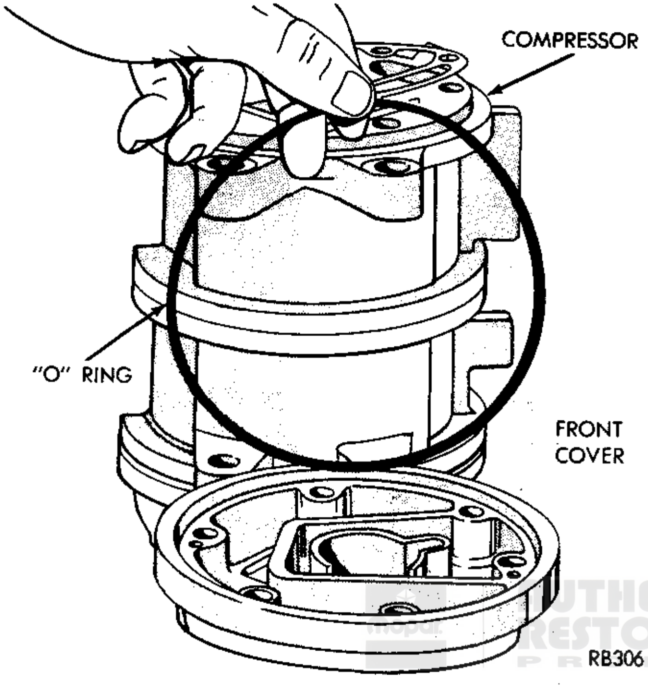

Fig. 4—Removing O-Ring

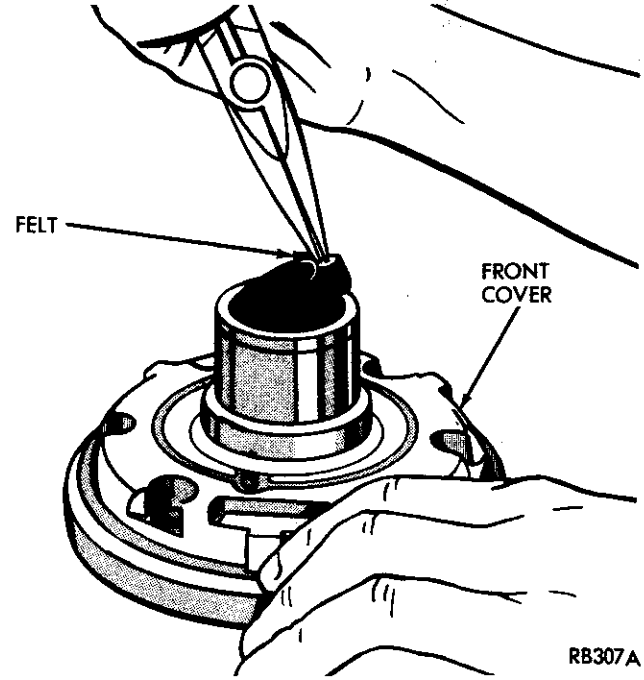

Fig. 5—Removing Felt

(6) Place compressor front cover on a flat surface with neck of cover facing up. Using a brass drift or non-metallic object, press out gas seal plate (Fig. 6).

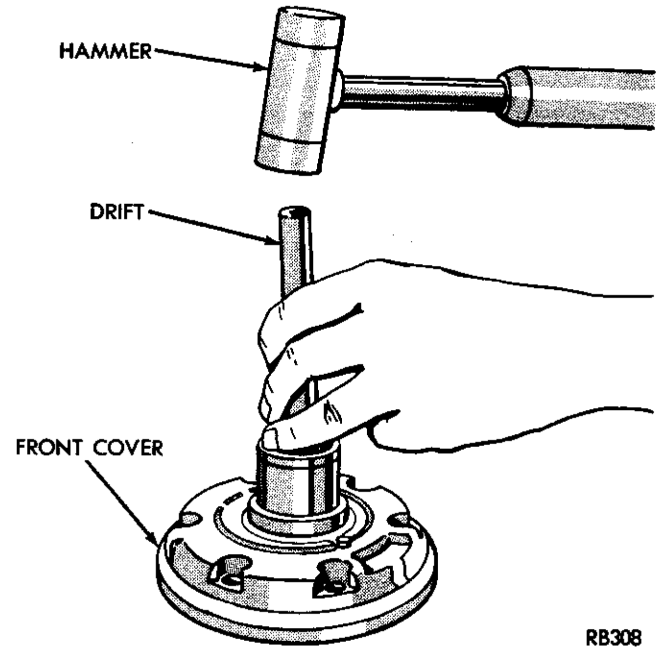

Fig. 6—Removing Gas Seal Plate

(7) Remove shaft seal cartridge from crankshaft (Fig. 7).

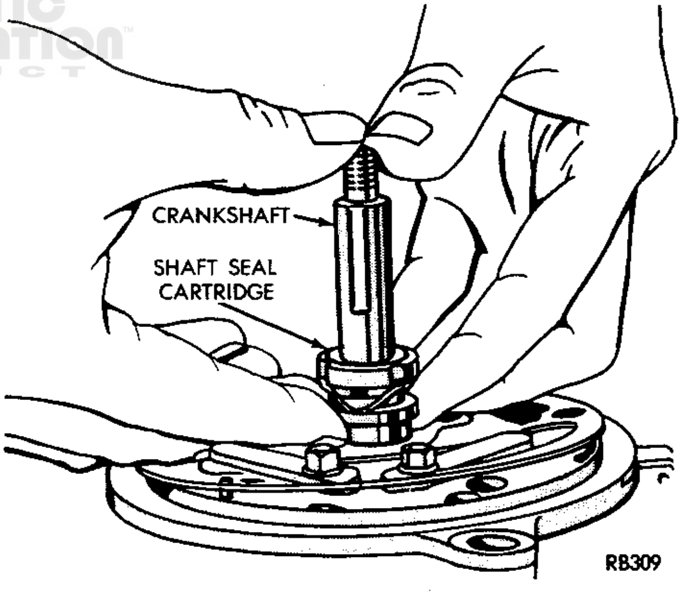

Fig. 7—Removing Shaft Seal Cartridge

(8) Carefully remove dowel pins, valve plate, suction reed valve, and steel-n-gasket. Discard steel-n-gasket. See Figure 8.

(9) Remove rear cover by tapping the outside diameter of the cover with plastic hammer (Fig. 9).

(10) Remove O-ring from rear cover and discard (Fig. 10).

(11) Carefully remove the dowel pins, valve plate, suction reed valve, and steel-n-gasket. Discard steel-n-gasket (Fig. 11).

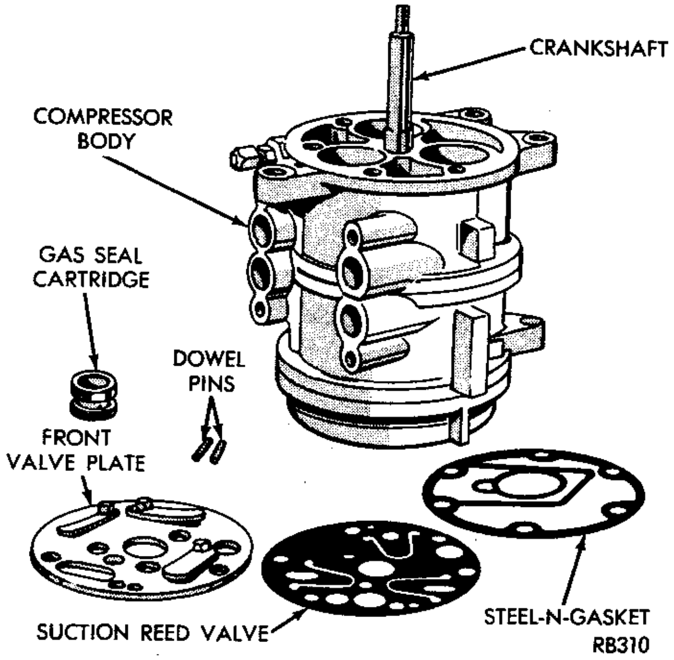

Fig. 8—Disassembly Compressor Front End

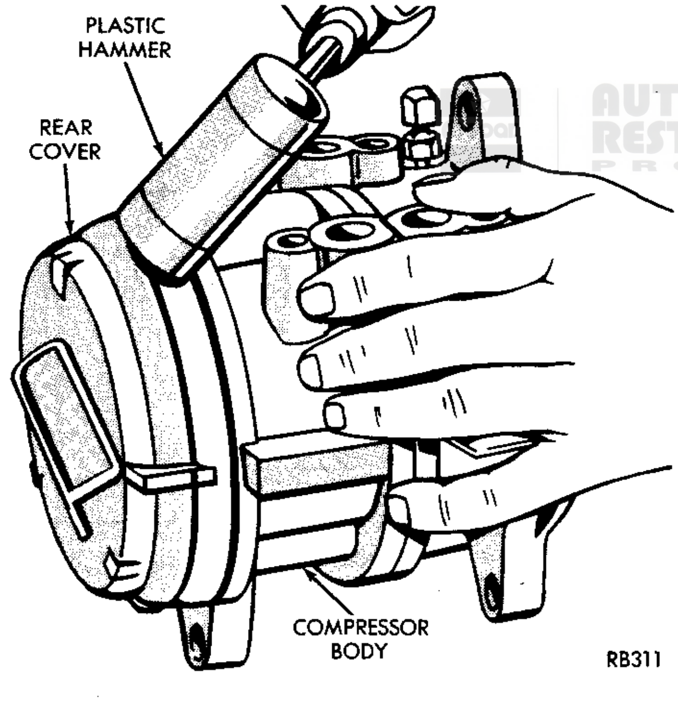

Fig. 9—Removing Rear Cover

When leak is evident because of compressor body center O-ring, the following procedure should be followed.

(12) Carefully separate front and rear compressor housings by tapping the body lugs with a plastic hammer. (Fig. 12).

CAUTION: Do not separate front and rear housings more than one inch (Fig. 13).

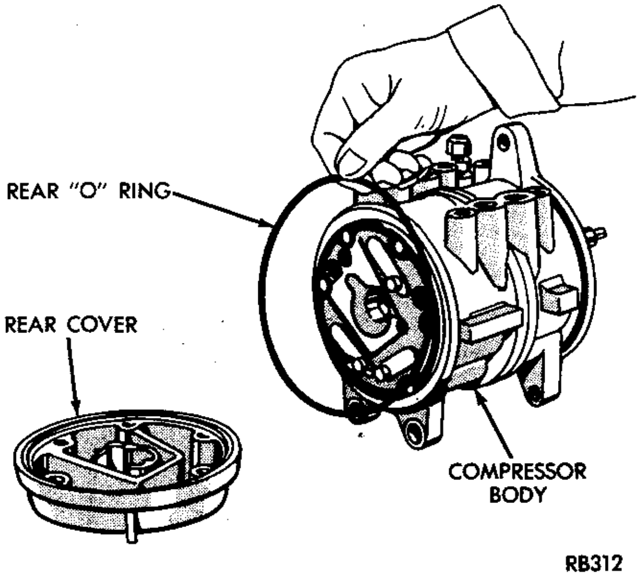

Fig. 10—Removing Rear O-Ring

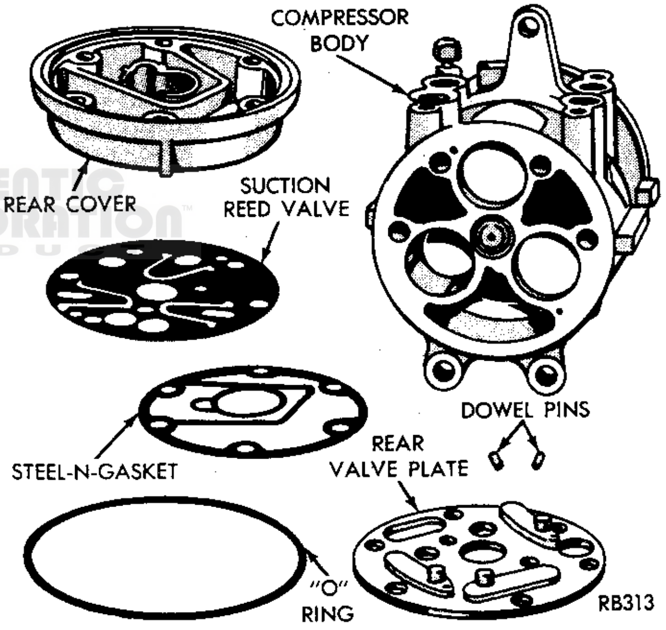

Fig. 11—Disassembling Compressor Rear End

(13) Remove O-ring and inspect for nicks, cuts, or burrs, if found. Cut and discard.

(14) Inspect O-ring sealing surface for scratches, dirt, or porosity, If a scratch or porosity is found, compressor should be replaced.

ASSEMBLY

(1) Install O-ring by carefully stretching and passing a new, dry O-ring over the rear housing to center of compressor body.

(2) Oil new O-ring with refrigerant oil (500 SUS) and position into seal groove.

(3) Mate two body halves by carefully pushing them together making sure O-ring and housings are properly positioned.

(4) Install dowel pins in rear compressor body.

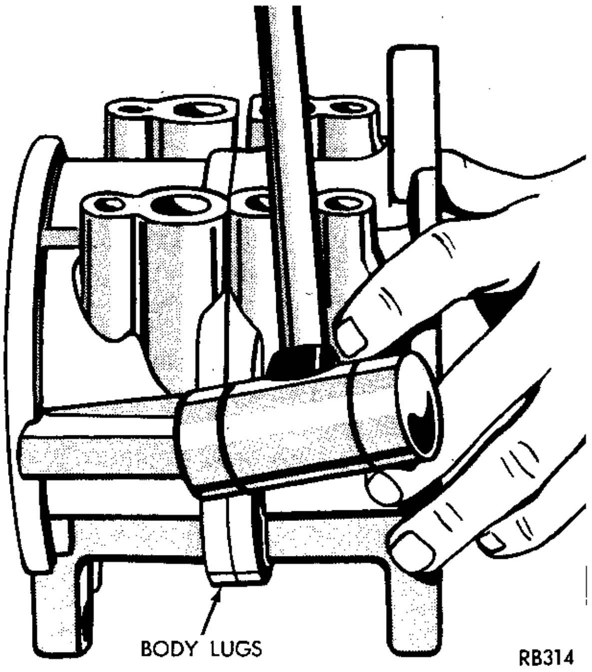

Fig. 12—Separating Body Halves

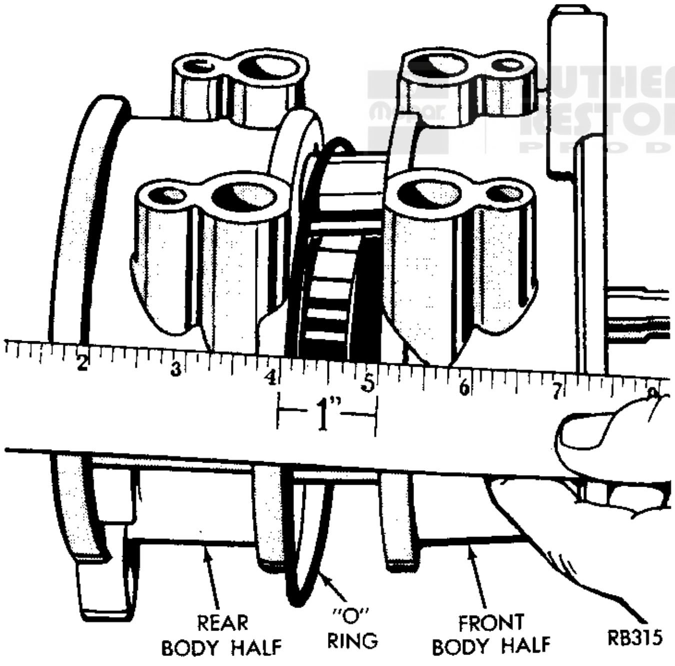

Fig. 13—Compressor Body Half Separation

(5) Install suction reed valve.

(6) Install rear valve plate assembly.

(7) Install steel-n-gasket.

(8) Apply light coating of refrigeration oil to new O-ring and carefully place into sealing groove of rear cover.

(9) Install rear cover to rear compression housing.

(10) Hold front compressor body and rear cover together firmly, rotate compressor assembly and place it on a bench so it is setting firmly on rear cover with crankshaft facing upward.

(11) Carefully install dowel pins in front compressor body.

(12) Install suction reed valve.

(13) Install front valve plate assembly.

(14) Install steel-n-gasket.

(15) Carefully clean crankshaft and coat lightly with refrigerant oil.

(16) Lubricate crankshaft gas seal cartridge lightly with refrigeration oil and install on crankshaft. Cartridge must be properly positioned on slot of crankshaft.

(17) Lubricate crankshaft seal seat cavity of front housing with refrigeration oil.

(18) Lubricate crankshaft seal seat and seal seat O-ring with refrigeration oil. Install O-ring on seal seat and install seal seat in front cover using a socket that contacts the outer diameter of the seal seat plate (Figs. 14 and 15).

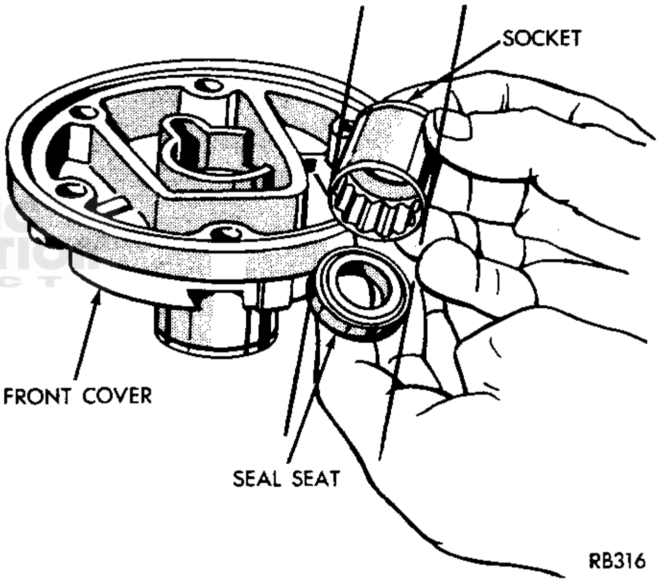

Fig. 14—Match Socket to Outer Seal Diameter

(19) Lubricate front cover O-ring with refrigeration oil and carefully place it in seal groove of front housing.

(20) Carefully install front cover to front compressor body. If cover does not visually align with dowel pins on installation, completely remove cover and make certain the carbon seal of the crankshaft seal cartridge is properly positioned in the seal cartridge and not sticking to the seal seat plate.

(21) Install compressor thru bolts and tighten finger tight, then torque to 260 in. lbs. (29 N•m).

(22) Install key in crankshaft.

(23) Install felt shaft seal into front housing and position at base of housing neck.

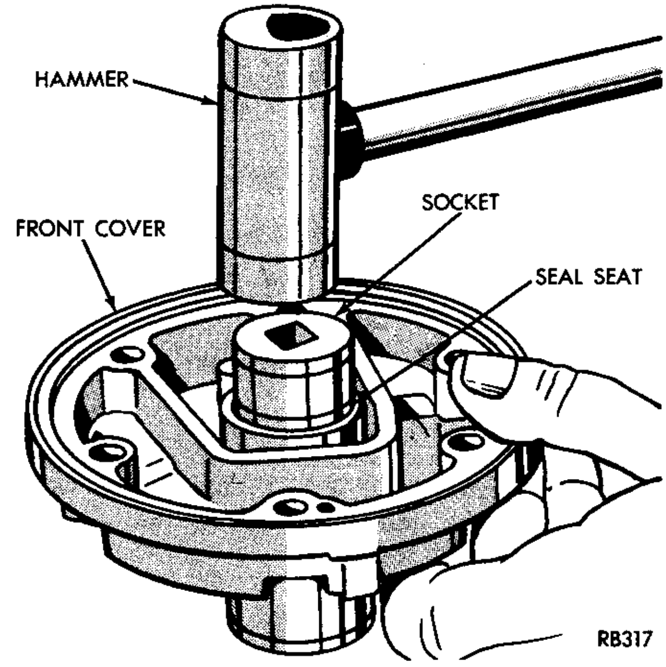

Fig. 15—Installing Seal Seat

(24) Install 266 ml (9 fluid ounces) of refrigeration oil (500 SUS) into the compressor through suction port.

(25) Check compressor operation for smoothness by rotating crankshaft at least 5 full revolutions.

(26) Check front housing clutch coil alignment pin for proper installation.

(27) Install clutch. See "Clutch Installation".

INSTALLATION

(1) Adjust oil level through the compressor suction port to 5 fl. oz. (148 ml) if necessary. (See "Oil Level" below).

(2) Install the compressor on the vehicle and tighten drive belts. See group 7, "Cooling" for correct belt adjustment. Torque compressor mounting bolts to 40 ±10 ft. lbs.

(3) Reconnect clutch wire.

(4) Remove caps from suction and discharge lines and suction and discharge ports. Using new gaskets, install lines onto compressor and tighten to 19 to 26 N•m (170 to 230 inch-pounds).

(5) Evacuate and charge the system.

CAUTION: Clutch should be cycled off and on with engine at fast idle, 15 to 20 times to ensure clutch parts reseat with each other after assembly before clutch engages with high head pressure at the compressor.

OIL LEVEL

When a new compressor is installed at the factory, it contains 7 to 7.25 fl. oz. (207 to 214 ml) of a special wax-free 500 SUS viscosity refrigerant oil. While the air-conditioning system is in operation, the oil is carried through the entire system and returns to the compressor by way of the suction port. Some of this oil will be trapped and retained in various parts of the system. Consequently, once the system has been in operation, the amount of oil left in the compressor will always be less than the original amount. Replacement compressors are also charged with 7 to 7.25 fl. oz. (207-214 ml). When replacing a compressor, remove drain oil, measure the amount, and discard old oil. For the replacement compressor use the same amount of refrigerant oil as recovered from failed compressor. This adjustment is not needed if the system has been flushed, removing retained oil.

EVAPORATOR HEATER ASSEMBLY

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GENERAL INFORMATION

This air-conditioner is designed specifically for conventional cab trucks with the heater-evaporator package designed to fit under the instrument panel (Fig. 1). The system is manually controlled by the operator. Controls have been kept simple for ease of service and operation.

In the blend air reheat air-conditioning unit, all the air entering the system passes through the evaporator and a selected portion passes through the

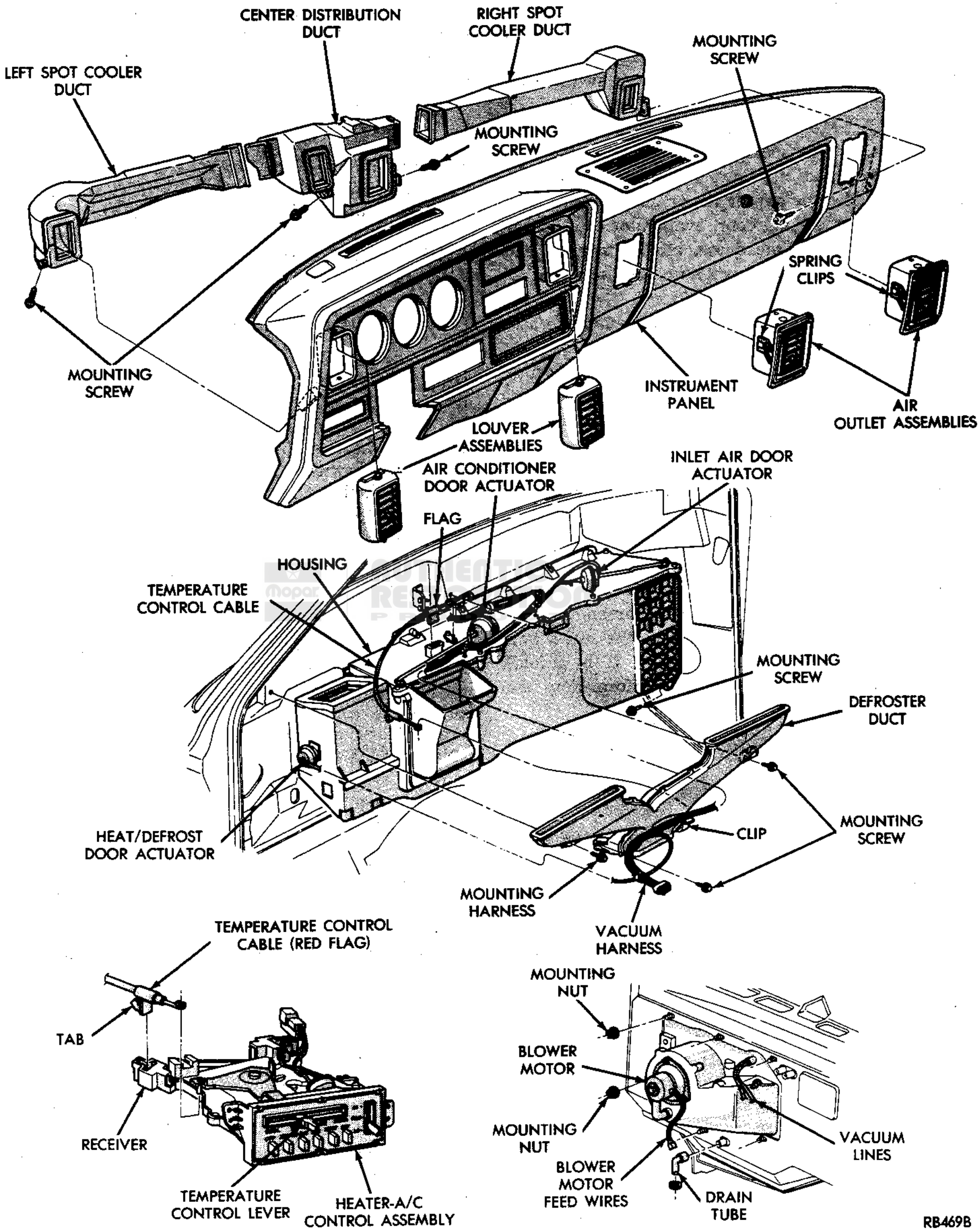


Fig. 1—Heater and Evaporator Assembly

heater core depending on the position of the blend air door. The system controls are located in the center of the instrument panel within easy reach of the driver. The combination electrical and vacuum switch controls the compressor clutch, mode of operation and blower. Modes are Off, Max. A/C, A/C, Vent, Heat, and Defrost. A four speed blower motor switch controls the amount of air flow. The evaporator-heater package includes the blower motor, intake duct, with outside air recirculating door, evaporator coil, heater core, defroster discharge doors, blower motor speed resistors, vacuum harness, vacuum actuators and A/C air outlets to the distribution ducts.

Defrost, Heat, A/C and Vent modes automatically supply 100 percent outside air.

The air distribution ducts supply air from the unit to four panel mounted, fully directional, outlets. Two outlets are part of the faceplate and two are snapped into the panel on the right side.

Satisfactory performance of the combined air-conditioning and heating system is dependent upon correct operation and adjustment of all operating controls, as well as correct function of all refrigeration system components. The inspections, tests and adjustments should be used to locate the cause of a malfunction. The tests in this manual have been arranged in a logical sequence that has proved to be the surest and shortest route to accurate diagnosis. It is recommended that they be followed and performed in the order they are presented.

OPERATION OF ALL CONTROLS

Operation must be tested as described in the following sequence:

(1) Inspect, test, and adjust compressor drive belt.

(2) Start engine and adjust engine speed to 1300 rpm. Use a reliable tachometer.

(3) Move temperature control lever to Cool position and mode lever to A/C position.

(4) The inlet air door should be open to outside air. Open vehicle windows.

(5) Test the blower operation at all four speed positions. If the blower does not operate correctly refer to “Electrical Controls and Circuit.” Leave the blower switch in the “High” (Hi) position.

(6) The compressor should be running and the air-conditioning system in operation.

In addition to the six position push button selector, the A/C Heater control consists of:

Temperature Lever—Controls the temperature of the discharge air in all modes except Max. A/C and Off when the vacuum operated water valve is closed. Moving the lever to the left provides cooler air and moving it to the right provides warmer air.

Blower Switch—The system blower can be operated at four speeds, from low at the bottom, medium 1 at the lower center, medium 2 at the upper center, to high at the top switch position. The blower will be on and operating at the speed selected, in all push button positions except Off.

Air Directional Vanes—Air is deliverd through four panel outlets. The four outlets are adjustable up, down, or to either side and can be shut off by pushing the vanes up. Floor air is deliverd through the lower outlets.

VACUUM CONTROLS AND CIRCUITS

For an explanation of the vacuum and electrical logic that controls the operation of the unit see Fig. 2 and Control Chart.

Modes—The vacuum and electrical logic is determined by the push button switch. The vacuum portion of the switch controls the water valve and positions all doors in the unit except the blend air door. The electrical portion of the switch controls the compressor and blower operation. The following is a breakdown of the vacuum and electrical logic for each mode. See control chart in this section.

OFF

Vacuum application is as indicated in Fig. 2. The inlet air door is closed to outside, open to recirculating air. The mode door is in the A/C position. The Heat/Defrost door is in the Heat position. The heater core coolant flow is shut-off.

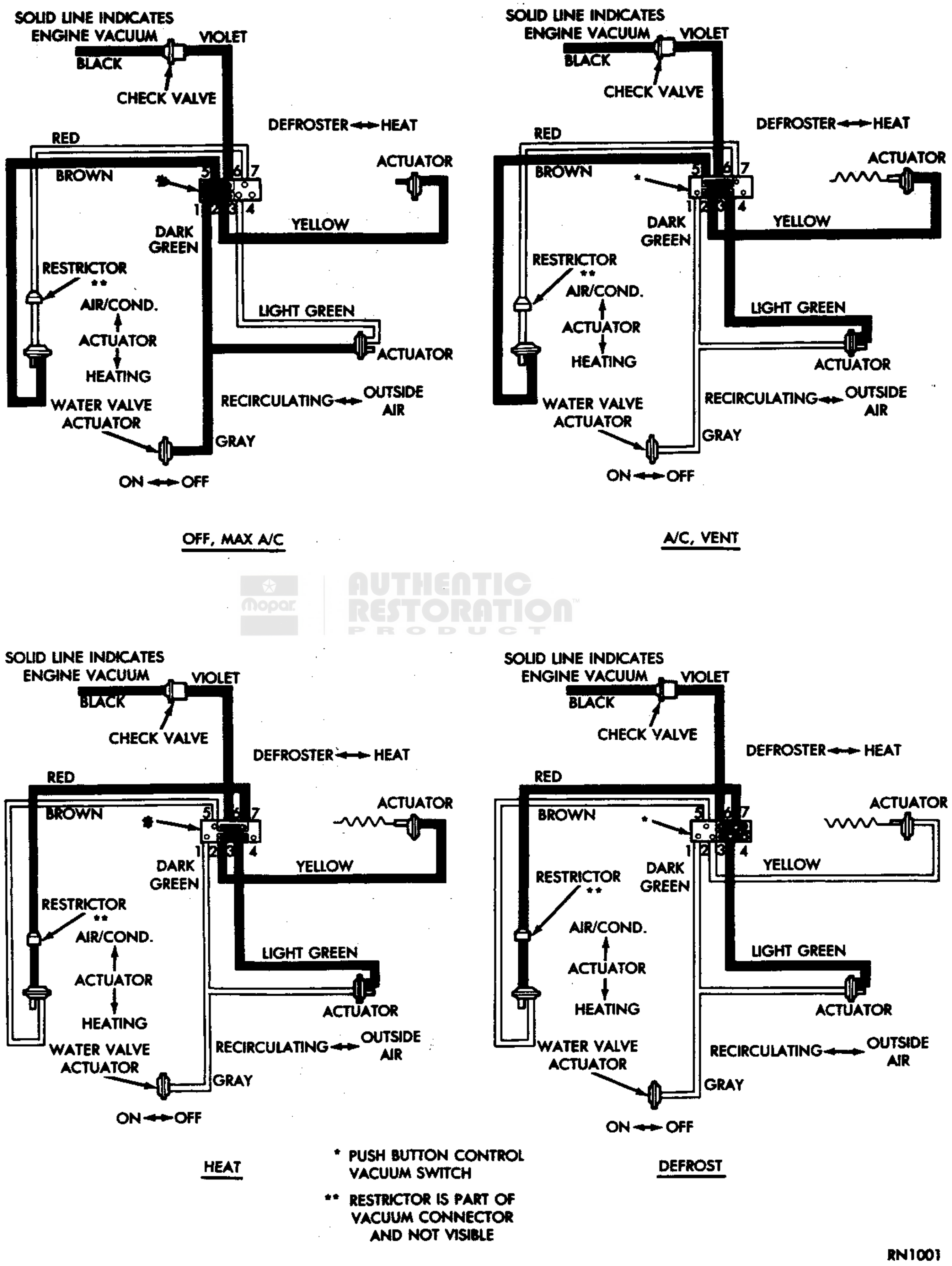
No air flows through the unit and the compressor is idle because the blower and compressor clutch circuits are open.

MAX A/C

All of the doors are in the same position as they are in Off. The Max. A/C mode merely closes the electrical circuits to the blower motor and the compressor clutch. This mode is recommended for initial cool down, extreme outside humidity, or high ambient temperature.

A/C

This mode is recommended for use after the vehicle has been cooled to the desired temperature. The vacuum application at the outside-recirculating air door actuator is transferred to the rod side. This moves the door away from the outside-air inlet and closes the recirculating inlet. The water valve is open. All other vacuum applications and door positions are the same for the Max. A/C position. The blower motor and compressor are on.



OFF, MAX A/C

A/C, VENT

HEAT

DEFROST

* PUSH BUTTON CONTROL VACUUM SWITCH

** RESTRICTOR IS PART OF VACUUM CONNECTOR AND NOT VISIBLE

Fig. 2—Vacuum Circuits, Air Conditioning and Heating

CONTROL CHART						
Control Position	**Off**	**Max. A/C**	**A/C**	**Vent**	**Heat**	**Defrost**
Inlet Air Door (Open To)	Inside	Inside	Outside	Outside	Outside	Outside
Mode Door (Open To)	A/C	A/C	A/C	A/C	Heat	Heat
Heat Defrost (Open To)	Heat	Heat	Heat	Heat	Heat	Defrost
Compressor Clutch	Off	On	On	Off	Off	On
Blower Motor	Off	On	On	On	On	On
Water Valve	Off	Off	On	On	On	On

VENT

The vacuum circuit remains the same as in the A/C position but the compressor clutch electrical circuit is opened, preventing the compressor from operating. The blower motor is used to force outside air into the passenger compartment through the A/C outlets in the instrument panel.

HEAT

In the Heat mode the outside air door is open same as A/C mode.

Vacuum is applied to the top side of the air-conditioning door actuator, closing off the passage to the air-conditioning distribution duct and opening the passage to the heater-defroster duct. Since the heater-defroster door is in the heat position, the full flow of heated air goes through the heater outlets, except for a small amount that bleeds through the defroster outlets. The water valve is open, the blower switch is activated and the compressor is off.

DEFROST

When the defrost mode is selected all conditions are the same as for heater operation, except that no vacuum is applied to the defrost door actuator which is spring loaded to defrost position. The door opens the defroster outlets and partially closes off the heater outlets. The heater outlets are left open far enough to direct about 30 percent of the air to the floor. The other 70 percent is defrost air directed to the windshield area. The compressor clutch will be engaged.

ELECTRICAL CONTROLS AND CIRCUITS

The electrical feed for the air conditioning circuit is from two fuses in the fuse block. One 20 ampere fuse protects the compressor clutch circuit, and one 30 ampere fuse protects the blower motor control circuit. See (Fig. 3) for complete electrical control circuit.

CONTROL TEST

Test operation of controls in the following manner.

(1) Inspect compressor drive belt. Adjust if necessary.

(2) Start engine.

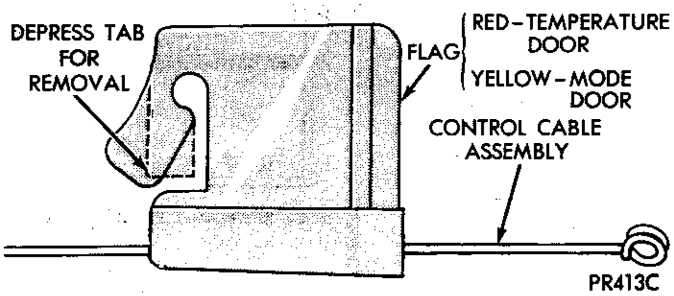


Fig. 3—Flag Tab Depressed for Removal

(3) Move temperature lever to extreme left (cool) position.

(4) Push A/C button.

(5) Refer to Control Chart. Check position of doors, operation of compressor clutch, blower motor and water valve. The water valve is open when there is no vacuum to valve.

(6) Check blower switch by moving it to all four positions and noting air flow change. In case of malfunction refer to Electrical Control Circuit.

(7) Check operation of blend air door by moving temperature lever from full warm toward cool position. Discharge air temperature should change with lever movement if the engine coolant is warm.

(8) Repeat steps 5 and 6 in each push-button position.

If actuation of the doors is slow or incomplete, check for mechanical misalignment, binding or vacuum leaks. The air-conditoning door has a seven second vacuum delay in mode switching from Off, Max A/C, A/C, or Vent to Heat or Defrost. Check temperature control cable for correct adjustment.

FACEPLATE

REMOVAL

(1) Remove map lamp.

(2) Remove six (6) screws which attach faceplate to base panel (5 screws under brow of dash and 1 screw below the Heater-A/C control).

(3) Pull column shift lever in position "1".

(4) Remove faceplate by pulling top edge rearward to clear the brow, disengage attaching clips around bottom of faceplate, and complete removal of faceplate.

(5) Disconnect wires to four wheel drive indicator, if equipped.

INSTALLATION

(1) Connect four wheel drive indicator, if equipped.

(2) Engage attaching clips around bottom of faceplate, roll faceplate into position, and install mounting screws.

(3) Install map lamp.

TEMPERATURE CONTROL CABLE

REMOVAL

(1) Remove faceplate (see “Faceplate Removal”).

(2) Open glovebox past stops.

(3) Remove control unit from instrument panel by removing mounting screws and pulling unit out.

(4) Remove cable from control lever pin and remove flag from retainer (Fig. 3).

(5) Detach cable from unit by removing self-adjust clip from crank arm and flag from retainer.

(6) Remove cable assembly though glovebox opening.

(7) Place a 7mm (1/4 inch) I.D. tube over clip and pry self-adjust clip off core wire if required (Fig. 4).

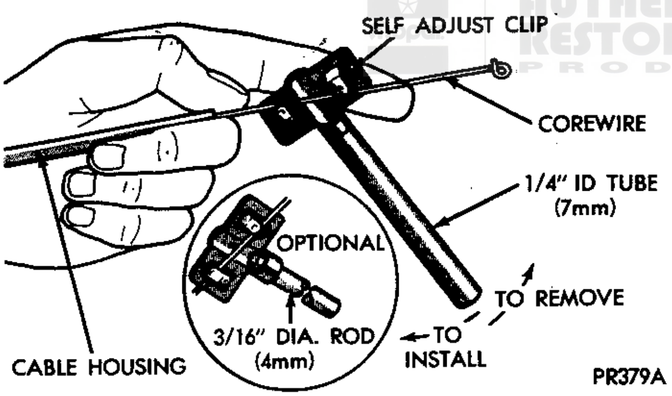


Fig. 4—Removing or Installing Self-Adjust Clip

INSTALLATION

(1) Position self-adjust clip on cable core wire 50mm (2 inches) from the small loop at evaporator assembly flag end. With a 7mm (1/4 inch) I.D. tube, snap self-adjust clip on core wire (Fig. 4).

(2) Install cable assemblies through glovebox opening.

(3) Attach self-adjust clip to crank arm and install flag in receiver on evaporator assembly.

(4) Install flags in retainers and attach cable to control lever on control unit.

(5) Install control unit into instrument panel and secure with mounting screws.

(6) Install faceplate (see “Faceplate Installation”).

EVAPORATOR CONTROL UNIT

REMOVAL

(1) Remove faceplate (see “Faceplate Removal”).

(2) Remove attaching screws.

(3) Pull control unit out, away from instrument panel.

(4) Disconnect blower control switch wiring connector.

(5) Disconnect three (3) wiring connectors to control.

(6) Disconnect illumination light.

(7) Disconnect vacuum harness.

(8) Disconnect temperature control cable (see “Temperature Control Cable Removal”).

(9) Remove control.

INSTALLATION

(1) Connect temperature control cable (see “Temperature Control Cable Installation”).

(2) Install illumination light.

(3) Install three (3) wiring connectors to pushbutton switch and vacuum harness.

(4) Connect blower motor control switch wiring connector.

(5) Place control unit in place in instrument panel and secure with attaching screws.

(6) Install faceplate.

RESISTOR BLOCK

REMOVAL

(1) Remove connector from resistor block.

(2) Remove mounting screws (Fig. 6).

(3) Remove resistor block.

INSTALLATION

(1) Place resistor block on plenum.

(2) Install mounting screws.

(3) Connect wiring connector.

VACUUM ACTUATORS

The mode and air recirculator actuators are serviced through the glovebox opening after opening the glovebox past its stops.

The heater/defroster actuator is serviced under the instrument panel on the left end of the A/C-ULV unit.

AIR-CONDITIONER DISTRIBUTION AND SPOTCOOLER DUCTS

CENTER DISTRIBUTION DUCT

REMOVAL

(1) Disconnect battery negative cable.

(2) Open glove box past stops.

(3) Remove right upper air duct by removing mounting screw and pulling duct out through glovebox opening (Fig. 1).

(4) Remove instrument panel center brace.

(5) Remove right kick pad.

(6) Remove right instrument panel pivot bolt.

(7) Remove instrument panel cluster (see "Instrument Panel", Group 8).

(8) Disconnect shift indicator cable.

(9) Lower steering column.

(10) Remove steering column studs.

(11) Remove radio.

(12) Remove mounting screws and remove scoop connecting heater unit to center distribution duct.

(13) Remove mounting screws and remove center distribution duct by pulling bottom of instrument panel out and dropping duct out (Fig. 1).

INSTALLATION

To install center distribution duct, reverse removal procedure.

RIGHT BI-LEVEL DUCT

REMOVAL

(1) Disconnect battery negative cable.

(2) Open glove box past stops.

(3) Remove right upper air duct by removing mounting screw and pulling duct out through glovebox opening (Fig. 1).

INSTALLATION

To install right bi-level duct, reverse removal procedure.

LEFT BI-LEVEL DUCT

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove instrument panel cluster (see "Instrument Panel", Group 8).

(3) Disconnect shift indicator cable.

(4) Remove heater control (see "Heater Control Removal").

(5) Remove mounting screws and cover that retains instrument panel wiring and let wiring hang free.

(6) Remove mounting screw and slide left air duct out through instrument cluster opening (Fig. 1).

INSTALLATION

To install left bi-level duct, reverse removal procedure.

AIR OUTLET ASSEMBLIES RIGHT SIDE

REMOVAL

Both right side outlets are held in place with spring loaded retaining clips.

(1) With outlet facing out and louver vanes open, grasp adjusting vane with fingers.

(2) Pull smoothly and firmly to unseat clips and complete removal toward rear of vehicle.

INSTALLATION

(1) Position outlet assembly in panel opening, making sure lettering stamped "Top" is up. (ribs on housing match notches on instrument panel).

(2) Press housing assembly until both retaining clips lock into place.

LOUVER ASSEMBLIES (Fig. 1)

REMOVAL

(1) Remove faceplate (see "Faceplate Removal").

(2) Set faceplate with trim surface down, insert a small screwdriver tip into the outlet housing pivot hole.

(3) While forcing down louver assembly pivot pin, pull louver assembly out of rear of faceplate.

INSTALLATION

(1) Position louver assembly, bottom pivot first, into the faceplate outlet housing. The bottom pivot pin is of smaller diameter than the top pivot pin.

(2) While deflecting theupper louver assembly pivot pin, carefully swing the assembly into housing, so the felt pads are not damaged. Insure top and bottom pivot pins are properly engaged.

(3) Install faceplate.

DEFROSTER DUCT

REMOVAL

(1) Disconnect battery negative cable.

(2) Open glove box past stops.

(3) Remove right upper air duct by removing mounting screw and pulling duct out through glovebox opening (Fig. 1).

(4) Remove instrument panel center brace.

(5) Remove right kick pad.

(6) Remove right instrument panel pivot bolt.

(7) Remove instrument panel cluster (see "Instrument panel", Group 8).

(8) Disconnect shift indicator cable.

(9) Lower steering column.

(10) Remove steering column studs.

(11) Remove radio.

(12) Remove mounting screws and remove scoop connecting heater unit to center distribution duct.

(13) Remove mounting screws and remove center distribution duct by pulling bottom of instrument panel out and dropping duct out (Fig. 1).

(14) Remove heater control (see "Heater Control Removal").

(15) Remove mounting screws and cover retains instrument panel wiring and let wiring hang free.

(16) Remove mounting screw and slide left air duct out through the instrument cluster opening (Fig. 1).

(17) Remove screws attaching defroster duct to dash panel (Fig. 1).

(18) Reach in through instrument panel opening and disengage snaps to separate defroster duct into two pieces.

(19) Remove defroster duct halves through instrument cluster opening.

INSTALLATION

To install defroster duct, reverse removal procedure.

EVAPORATOR HEATER ASSEMBLY

REMOVAL

(1) Disconnect battery negative cable. Discharge refrigerant, disconnect refrigerant and heater lines from unit on engine side.

(2) Plug heater hoses and unit and remove condensate tube (Fig. 1).

(3) Move transfer case and/or gear shift levers away from instrument panel.

(4) Remove right cowl side trim panel if so equipped.

(5) Remove glovebox by removing mounting screws at base and swinging out from the bottom to avoid catch and stops.

(6) Remove structural brace through glovebox opening. Remove screws, loosen nuts.

(7) Remove ash receiver.

(8) Remove right half of lower reinforcement by removing screws attaching it to the instrument panel and one to the cowl side trim panel.

(9) Detach radio ground strap.

(10) Remove center distribution duct (see Air-Conditioner Distribution and Spot Cooler Ducts).

(11) Remove floor air distribution duct.

(12) Disconnect temperature control cable from unit through glovebox and tape out of way (see "Temperature Control Cable Removal").

(13) Disconnect vacuum lines from extension on control unit and unclip vacuum lines from defroster duct (see Fig. 1).

(14) Remove wiring connector from resistor block.

(15) Remove blower motor connector on engine side.

(16) Disconnect vacuum lines on engine side, make sure grommet is free from dash panel.

(17) Remove retaining nuts on engine side.

(18) Remove screw that retains package to cowl side sheetmetal.

(19) Remove package. Plastic instrument panel may have to be flexed outward.

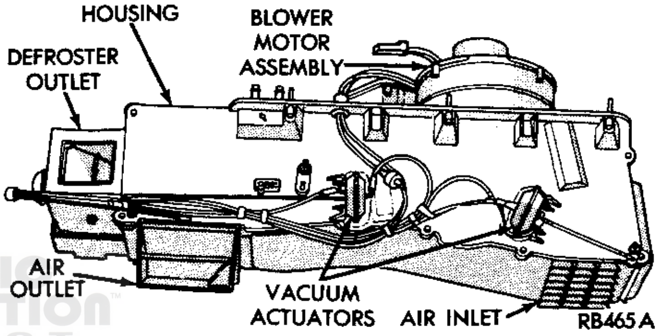


Fig. 5—Evaporator Heater Assembly

INSPECTION

(1) Remove nut that attaches three door arms to doors on the top cover of the unit and remove the three arms (Fig. 6).

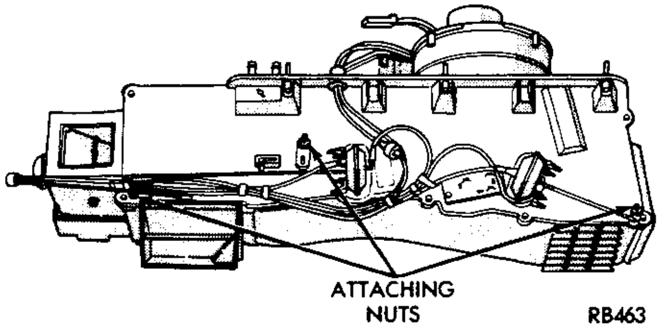


Fig. 6—Removing Door Arms

(2) Remove screws to separate cover from housing.

(3) Slide out evaporator core.

(4) Remove mounting screw and slide out heater core.

(5) Disconnect blower motor feed wire on engine side.

(6) Remove retaining screws to separate blower motor from housing.

(7) Separate fan from motor (Fig. 7).

(8) Inspect all parts.

(9) Assemble evaporator heater unit using necessary new parts by reversing this disassembly procedure.

INSTALLATION

To install evaporator heater unit, reverse removal procedure. Be sure to refill the cooling system and evacuate and recharge the system. Check operation of all controls and performance of the A/C system.

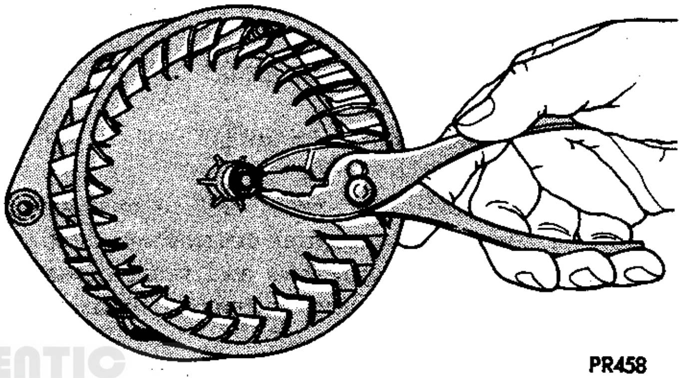


Fig. 7—Removing Blower Wheel

EMISSION CONTROL SYSTEMS

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GENERAL INFORMATION

All Federal models regardless of Gross Vehicle Weight Rating (GVWR) must meet Light Duty Cycle Emission Standards.

Vehicles built for sale in California and Canada having a GVWR of 8,500 lbs. (3855 kg) or less must meet Light Duty Cycle Emission Standards.

Vehicles built for sale in California and Canada having a GVWR of 8,501 lbs. (3856 kg) or more must conform to Heavy Duty Emission Cycle Standards.

Maintenance requirements for Light Duty and Heavy Duty Cycle emission systems differ because of different load and operating conditions.

EMISSION MAINTENANCE REMINDER (EMR) LIGHT

The Emissions Maintenance Reminder System (EMR) is incorporated into the engine controller. The engine controller records the vehicles mileage and stores it into memory every 8 miles. At that time, the engine controller checks for the 60,000, 82,500, and 120,000 mileage trip points. When the current mileage matches one of the above mentioned trip points, the EMR light is activated.

The following parts are to be replaced at the indicated mileage, or when the emissions maintenance reminder light remains on continuously with the key in the ON position, whichever occurs first. After performing the required maintenance, the EMR light must be reset to turn the light off.

60,000 miles:
- (a) Replace EGR Valve.
- (b) Clean EGR passage.
- (c) Replace PCV Valve.

82,500 miles:
- (a) Replace Oxygen Sensor.

120,000 miles:
- (a) Replace EGR Valve.
- (b) Clean EGR passage.
- (c) Replace PCV Valve.

Failure to perform the required maintenance and only reset the EMR light may be a violation of federal law. Only after performing the required maintenance, should the EMR light be reset.

RESETTING EMR LIGHT

(1) Connect DRBII tool to the diagnostic connector.

(2) Refer to DRBII Functional Flow Diagram in the 1990 Powertrain Diagnostic Procedures manual.

(3) Follow the diagram to RESET EMR LIGHT. Reset EMR light.

EVAPORATIVE EMISSION CONTROLS

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VEHICLE EMISSION CONTROL INFORMATION (VECI) LABEL

All vehicles are equipped with a combined Vehicle Emission Control Information (VECI) label. The label, which is located in the engine compartment (Fig. 1), lists the vehicles' engine family and displacement, evaporative family, emission control system, certification application, engine timing specifications, idle speeds (if adjustable), and spark plug gap (Fig. 2). The label also contains an engine vacuum schematic. There are unique labels for vehicles built for sale in the state of California (Fig. 3), the country of Canada (Fig. 4) and Heavy Duty Cycle. Canadian VECI labels are written in both the English and French languages. These labels are permanently attached and cannot be removed without defacing information and destroying it.

If any difference exists between the specifications or vacuum hose routing shown on the label and those shown in the Service Manual, those shown on the label should be used.

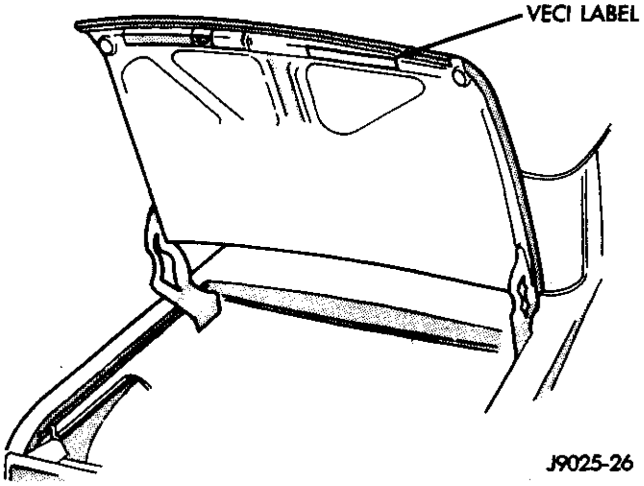

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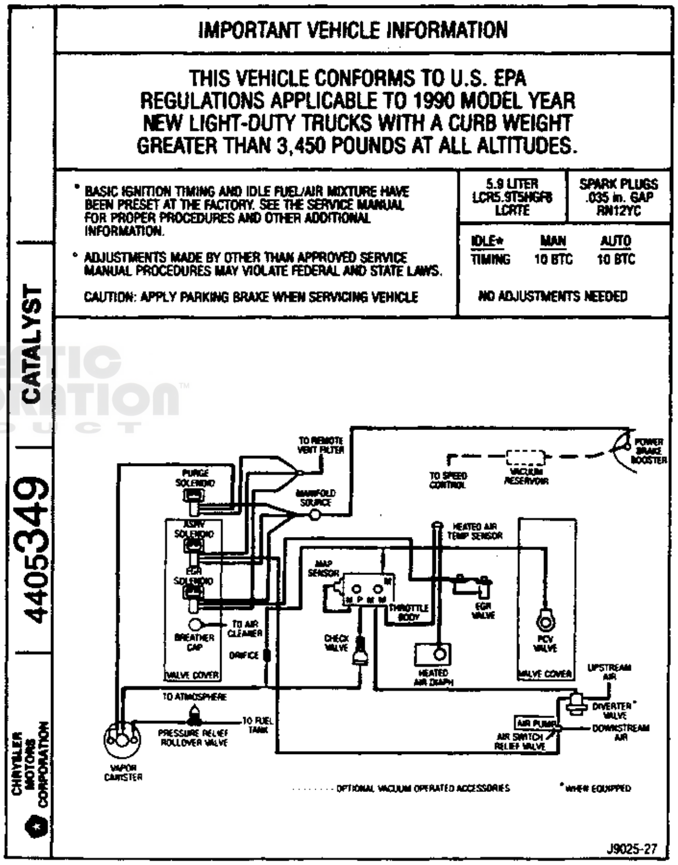
Fig. 1 VECI Label Location


CATALYST

4405349

CHRYSLER MOTORS CORPORATION

IMPORTANT VEHICLE INFORMATION

THIS VEHICLE CONFORMS TO U.S. EPA
REGULATIONS APPLICABLE TO 1990 MODEL YEAR
NEW LIGHT-DUTY TRUCKS WITH A CURB WEIGHT
GREATER THAN 3,450 POUNDS AT ALL ALTITUDES.

- BASIC IGNITION TIMING AND IDLE FUEL/AIR MIXTURE HAVE BEEN PRESET AT THE FACTORY. SEE THE SERVICE MANUAL FOR PROPER PROCEDURES AND OTHER ADDITIONAL INFORMATION.
- ADJUSTMENTS MADE BY OTHER THAN APPROVED SERVICE MANUAL PROCEDURES MAY VIOLATE FEDERAL AND STATE LAWS.

CAUTION: APPLY PARKING BRAKE WHEN SERVICING VEHICLE

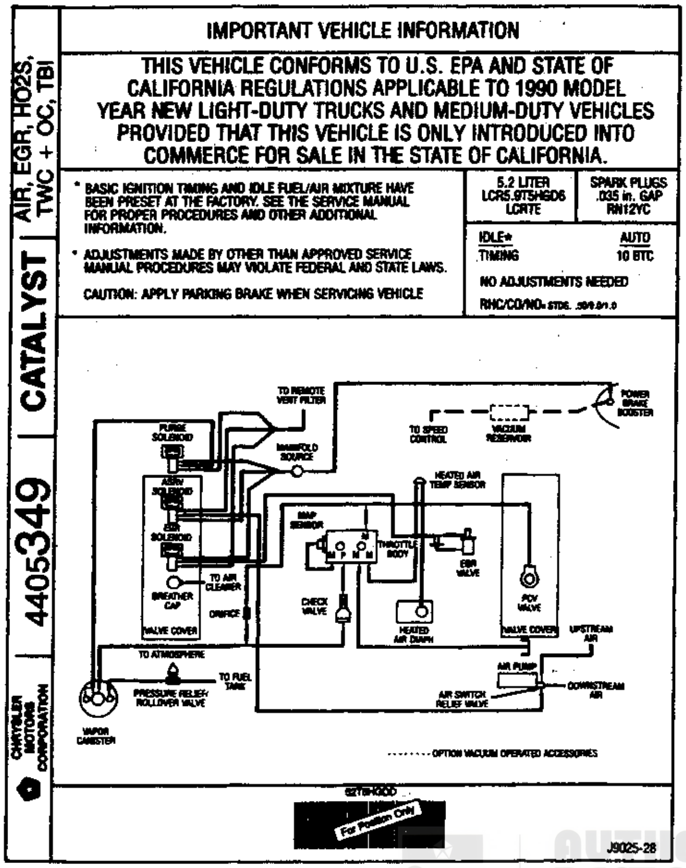
5.9 LITER LCR5.9T5HGF8 LCRTE	SPARK PLUGS .035 in. GAP RN12YC	
IDLE*	MAN	AUTO
TIMING	10 BTC	10 BTC
NO ADJUSTMENTS NEEDED		

.... OPTIONAL VACUUM OPERATED ACCESSORIES

*WHEN EQUIPPED

J9025-27

Fig. 2 Federal VECI Label—Typical



AIR, EGR, HO2S, TWC + OC, TBI | CATALYST | 4405349 | CHRYSLER MOTORS CORPORATION

IMPORTANT VEHICLE INFORMATION

THIS VEHICLE CONFORMS TO U.S. EPA AND STATE OF CALIFORNIA REGULATIONS APPLICABLE TO 1990 MODEL YEAR NEW LIGHT-DUTY TRUCKS AND MEDIUM-DUTY VEHICLES PROVIDED THAT THIS VEHICLE IS ONLY INTRODUCED INTO COMMERCE FOR SALE IN THE STATE OF CALIFORNIA.

- * BASIC IGNITION TIMING AND IDLE FUEL/AIR MIXTURE HAVE BEEN PRESET AT THE FACTORY. SEE THE SERVICE MANUAL FOR PROPER PROCEDURES AND OTHER ADDITIONAL INFORMATION.
- * ADJUSTMENTS MADE BY OTHER THAN APPROVED SERVICE MANUAL PROCEDURES MAY VIOLATE FEDERAL AND STATE LAWS.

CAUTION: APPLY PARKING BRAKE WHEN SERVICING VEHICLE

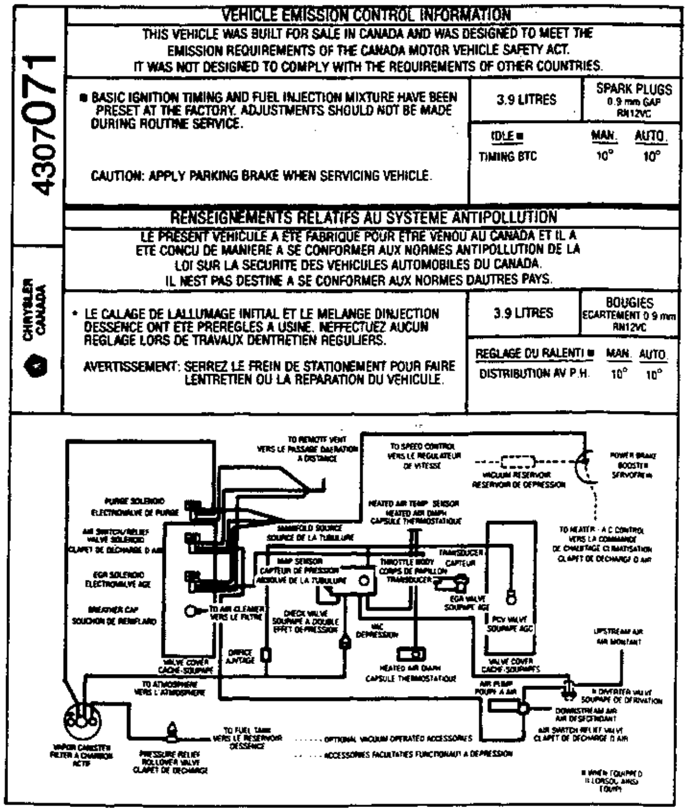
5.2 LITER LCR5.9T5HGD6 LCRTE	SPARK PLUGS .035 in. GAP RN12YC
IDLE*	AUTO
TIMING	10 BTC

NO ADJUSTMENTS NEEDED

RHC/CO/NO- STDS. .39/9.0/1.0

J9025-28

Fig. 3 California VECI Label—Typical



4307071 | CHRYSLER CANADA

VEHICLE EMISSION CONTROL INFORMATION

THIS VEHICLE WAS BUILT FOR SALE IN CANADA AND WAS DESIGNED TO MEET THE EMISSION REQUIREMENTS OF THE CANADA MOTOR VEHICLE SAFETY ACT.
IT WAS NOT DESIGNED TO COMPLY WITH THE REQUIREMENTS OF OTHER COUNTRIES.

- ■ BASIC IGNITION TIMING AND FUEL INJECTION MIXTURE HAVE BEEN PRESET AT THE FACTORY. ADJUSTMENTS SHOULD NOT BE MADE DURING ROUTINE SERVICE.

CAUTION: APPLY PARKING BRAKE WHEN SERVICING VEHICLE.

3.9 LITRES	SPARK PLUGS 0.9 mm GAP RN12VC	
IDLE ■	MAN.	AUTO.
TIMING BTC	10°	10°

RENSEIGNEMENTS RELATIFS AU SYSTEME ANTIPOLLUTION

LE PRESENT VEHICULE A ETE FABRIQUE POUR ETRE VENDU AU CANADA ET IL A ETE CONCU DE MANIERE A SE CONFORMER AUX NORMES ANTIPOLLUTION DE LA LOI SUR LA SECURITE DES VEHICULES AUTOMOBILES DU CANADA.
IL NEST PAS DESTINE A SE CONFORMER AUX NORMES DAUTRES PAYS.

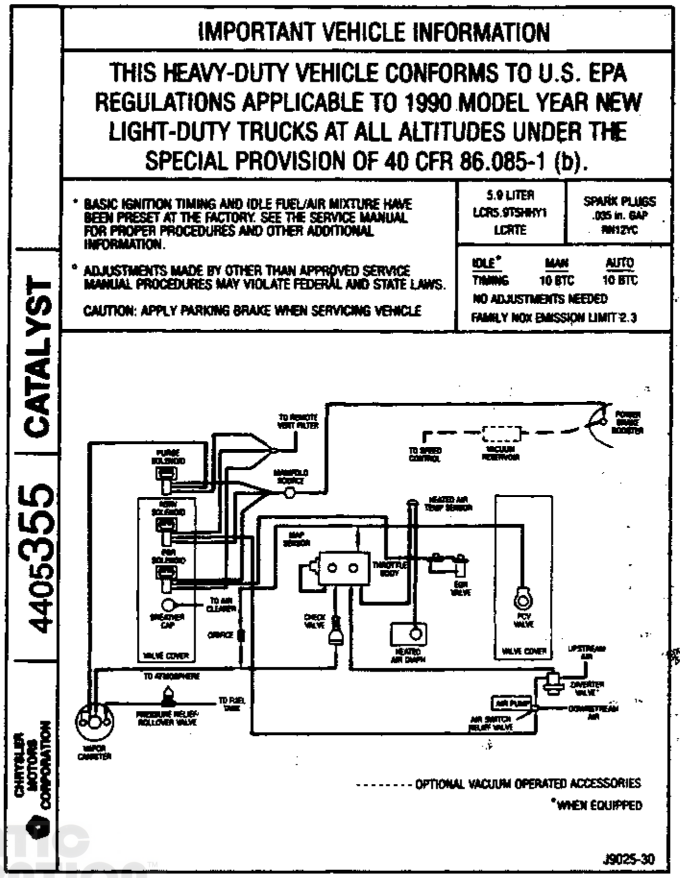
- * LE CALAGE DE LALLUMAGE INITIAL ET LE MELANGE DINJECTION DESSENCE ONT ETE PREREGLES A USINE. NEFFECTUEZ AUCUN REGLAGE LORS DE TRAVAUX DENTRETIEN REGULIERS.

AVERTISSEMENT: SERREZ LE FREIN DE STATIONEMENT POUR FAIRE LENTRETIEN OU LA REPARATION DU VEHICULE.

3.9 LITRES	BOUGIES ECARTEMENT 0.9 mm RN12VC	
REGLAGE DU RALENTI ■	MAN.	AUTO.
DISTRIBUTION AV P.H.	10°	10°

J9025-29

Fig. 4 Canada VECI Label—Typical



CATALYST | 4405355 | CHRYSLER MOTORS CORPORATION

IMPORTANT VEHICLE INFORMATION

THIS HEAVY-DUTY VEHICLE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1990 MODEL YEAR NEW LIGHT-DUTY TRUCKS AT ALL ALTITUDES UNDER THE SPECIAL PROVISION OF 40 CFR 86.085-1 (b).

- * BASIC IGNITION TIMING AND IDLE FUEL/AIR MIXTURE HAVE BEEN PRESET AT THE FACTORY. SEE THE SERVICE MANUAL FOR PROPER PROCEDURES AND OTHER ADDITIONAL INFORMATION.
- * ADJUSTMENTS MADE BY OTHER THAN APPROVED SERVICE MANUAL PROCEDURES MAY VIOLATE FEDERAL AND STATE LAWS.

CAUTION: APPLY PARKING BRAKE WHEN SERVICING VEHICLE

5.9 LITER LCR5.9T5HHY1 LCRTE	SPARK PLUGS .035 in. GAP RN12YC	
IDLE*	MAN	AUTO
TIMING	10 BTC	10 BTC

NO ADJUSTMENTS NEEDED

FAMILY NOX EMISSION LIMIT 2.3

-------- OPTIONAL VACUUM OPERATED ACCESSORIES
*WHEN EQUIPPED

J9025-30

Fig. 5 Heavy Duty Cycle Label—Typical

VACUUM SCHEMATICS

In case of contradictions between the schematics shown in the service manual (Fig. 6 or 7) and the Vehicle Emission Control Information (VECI) label, refer to the VECI label.

EVAPORATION CONTROL SYSTEM

The evaporation control system prevents the emission of gasoline vapors from the fuel tank into the atmosphere. When fuel evaporates in the fuel tank, the vapors pass through vent hoses or tubes to a carbon filled evaporative canister where they are temporarily held until they can be drawn into the intake manifold when the engine is running.

The vapors are drawn into the engine at idle as well as off idle. This system is called a Bi-level Purge System where there is a dual source of vacuum to remove fuel vapor from canister. The source of vacuum at idle is a tee in the PCV system. Refer to the appropriate Engine Vacuum Schematic.

The evaporative canister is a feature on all models for the storage of fuel vapors from the fuel tank.

Only use fuel resistant hose when replacing evaporation control system hoses.

ROLLOVER AND PRESSURE RELIEF VALVE

All vehicles are equipped with a combination pressure relief and rollover valve. The dual function valves relieve fuel tank pressure and prevent fuel flow through the fuel tank vent hoses in the event of vehicle rollover.

The valve incorporates a pressure relief mechanism that releases fuel tank pressure to the atmosphere when the fuel tank pressure increases above the calibrated sealing value. Refer to Group 14 Fuel Tank Section for service.

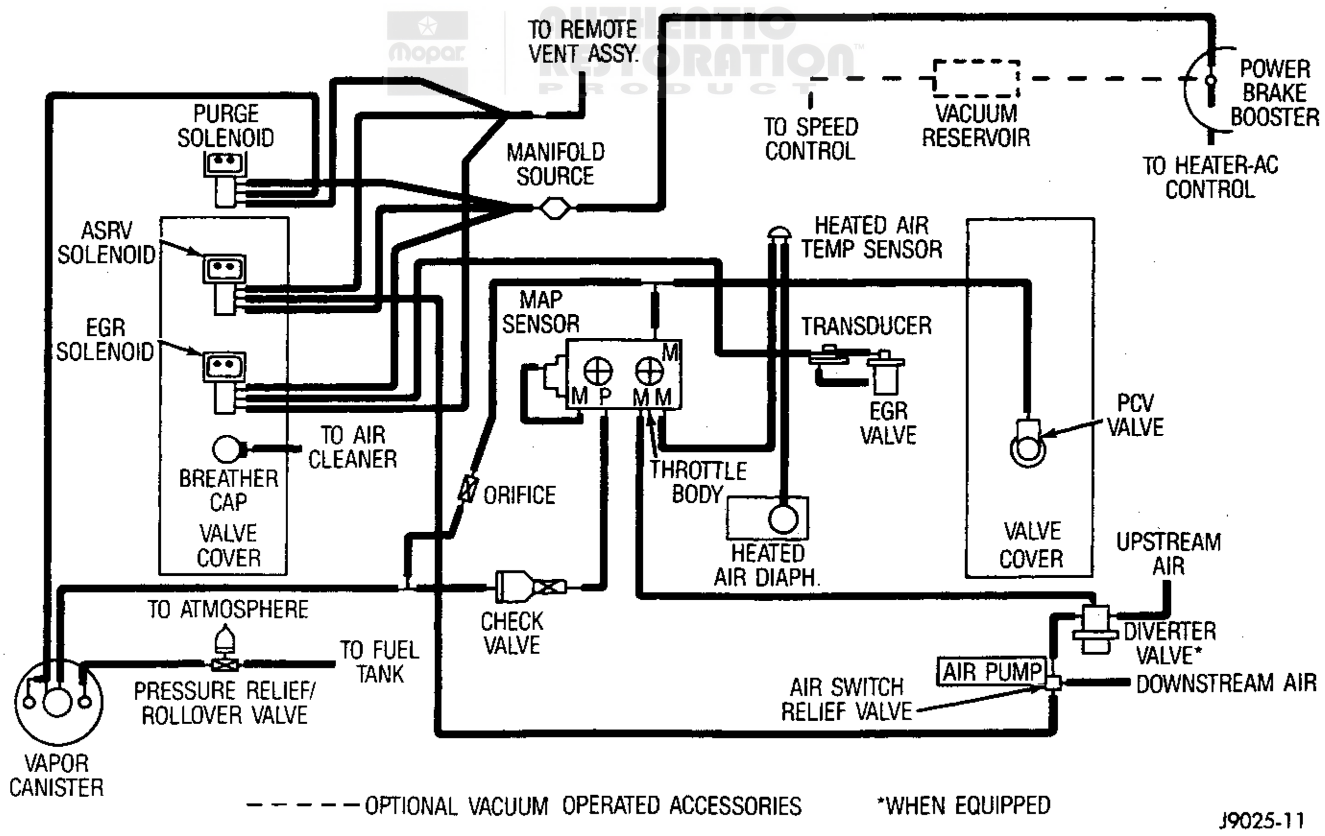


Fig. 6 Engine Vacuum Schematic—3.9L Engine

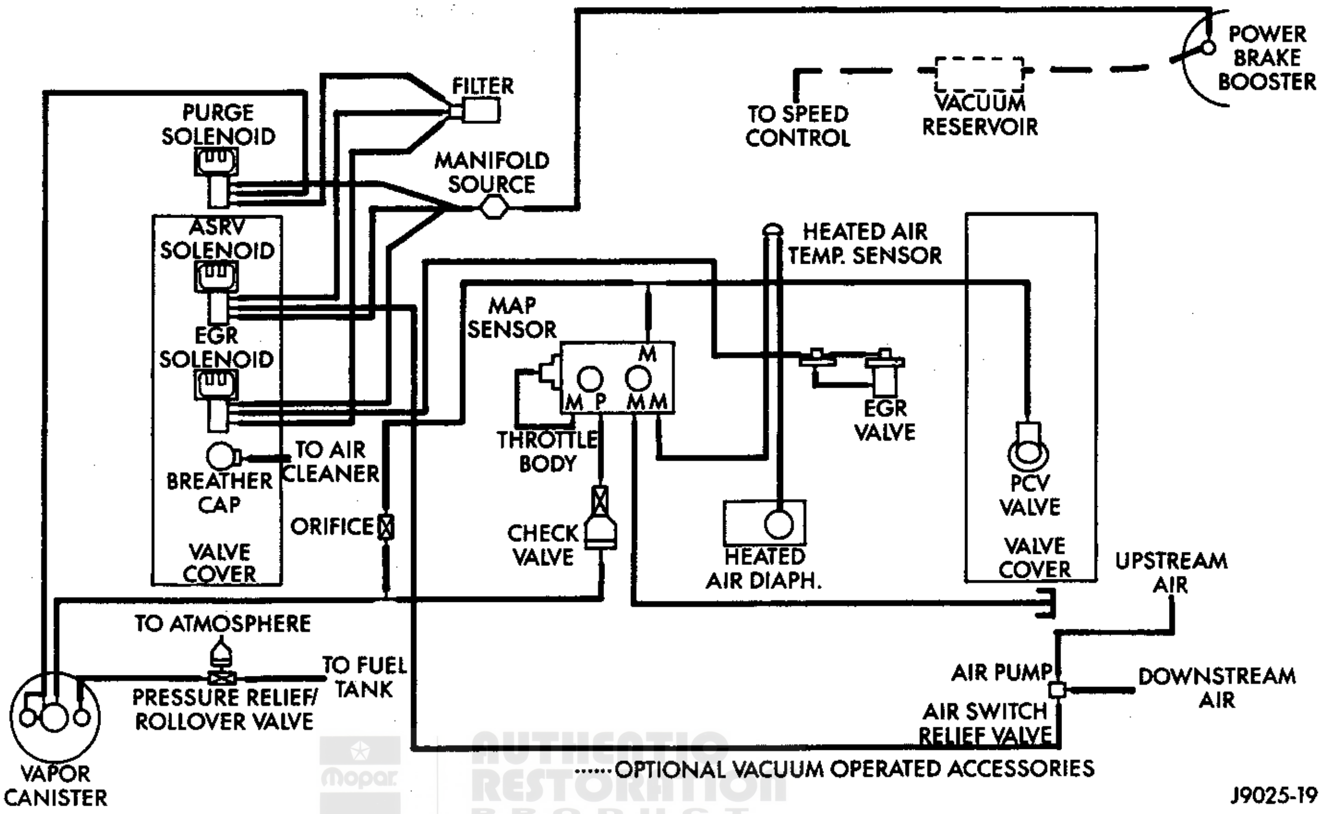


Fig. 7 Engine Vacuum Schematic—5.2L and 5.9L Engine

EVAPORATIVE CANISTER

A sealed, maintenance free, evaporative canister is used on all vehicles. The canister is mounted under the right side of the vehicle behind the wheel well (Fig. 8). The evaporative canister is filled with granules of an activated carbon mixture. Fuel vapors entering the canister are absorbed by the charcoal granules.

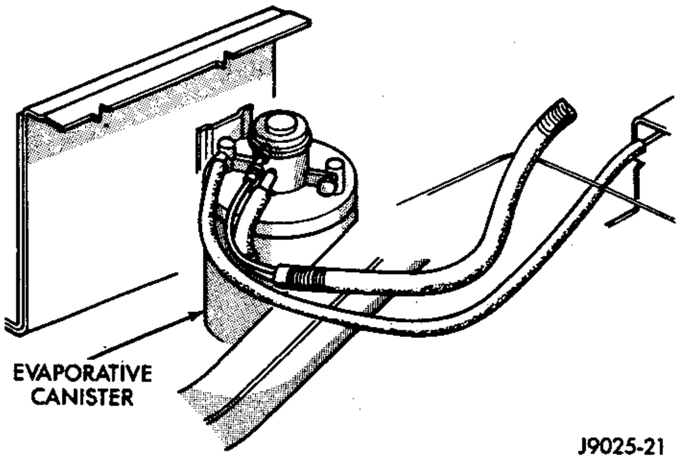


Fig. 8 Evaporative Canister

Fuel tank pressure vents into the canister. Fuel vapors are temporarily held in the canister until they can be drawn into the intake manifold. The canister purge solenoid allows the canister to be purged at predetermined time and engine conditions.

CANISTER PURGE SOLENOID

Vacuum for the evaporative canister is controlled by the Canister Purge Solenoid (Fig. 9). The solenoid is controlled by the Single Board Engine Controller (SBEC). The SBEC controls the solenoid by switching the ground circuit on and off based on engine operating conditions. When energized, the solenoid prevents vacuum from reaching the evaporative canister. When not energized the solenoid allows vacuum to flow through to canister.

During warm-up and for a specified time period after hot starts the engine controller grounds the purge solenoid causing it to energize, preventing vacuum from reaching the evaporative canister valve. When the engine reaches an operating temperature of approximately 27°C (80°F), the SBEC removes the ground to the solenoid. The de-energizing solenoid allows vacuum to flow to the canister and purge fuel vapors through the throttle body.

The purge solenoid will also be energized for short periods during certain idle and off idle conditions, in order to update the fuel delivery calibration.

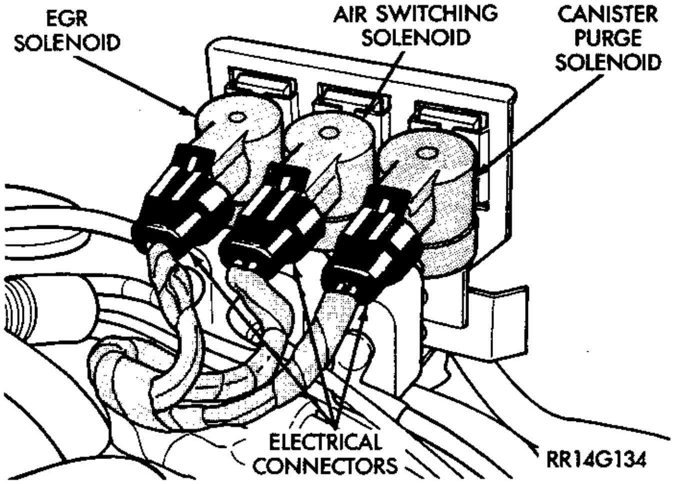


Fig. 9 Canister Purge Solenoid

PRESSURE-VACUUM FILLER CAP

The fuel tank is sealed with a pressure-vacuum relief filler cap (Fig. 10). The relief valves in the cap are a safety feature and operate only to prevent excessive pressure or vacuum in the tank caused by a malfunction in the system or damage to the vent lines.

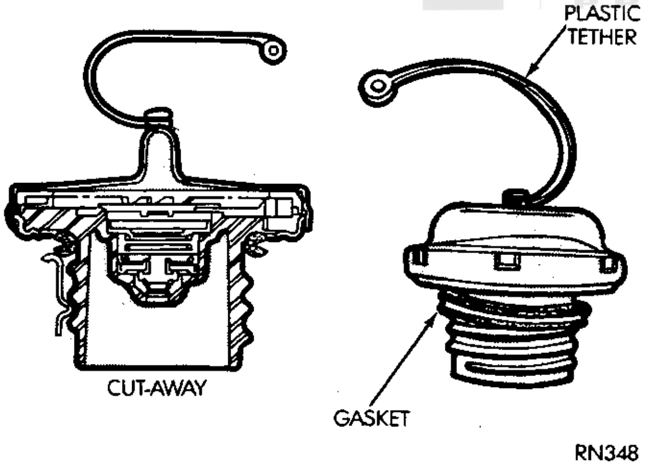


Fig. 10 Pressure Vacuum Filler Cap

The cap has a threaded configuration which allows the seal to be broken and pressure to be relieved without separation of the cap from the filler tube. Approximately two and a half turns are required to remove the cap.

If replacement of the filler cap is necessary, it must be replaced with an identical cap to ensure correct system operation.

CAUTION: To relieve fuel tank pressure, the fuel filler cap must be removed prior to disconnecting any fuel system component.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

All models are equipped with a closed crankcase ventilation system (Fig. 11). This system consists of a crankcase PCV valve mounted on the cylinder head cover, with a hose extending from the valve to the base of the throttle body.

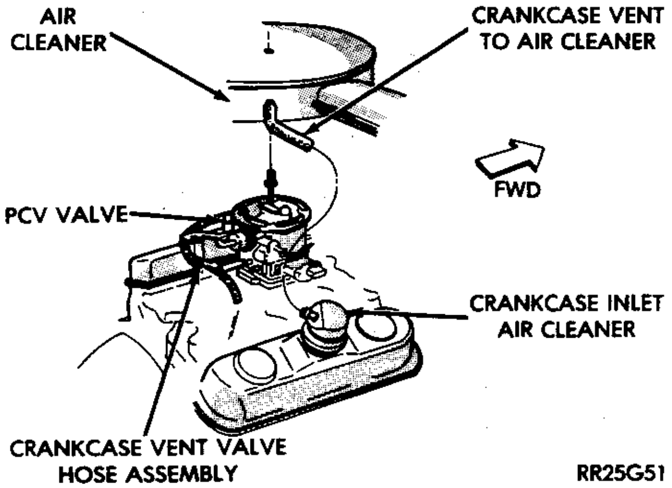


Fig. 11 PCV System

A closed engine crankcase inlet air filter with a hose connecting it to the throttle body air cleaner housing provides the source of air for the system.

VENTILATION SYSTEM OPERATION

The positive crankcase ventilation (PCV) system operates by manifold vacuum (Fig. 12). Filtered air is routed into the crankcase through the air cleaner hose and crankcase inlet air filter forcing crankcase vapors through the PCV valve into a passage in the throttle body. It then becomes part of the calibrated air/fuel mixture to be consumed in the combustion chamber. The PCV system constantly ventilates the crankcase to help prevent sludge formation and vapors from entering the atmosphere.

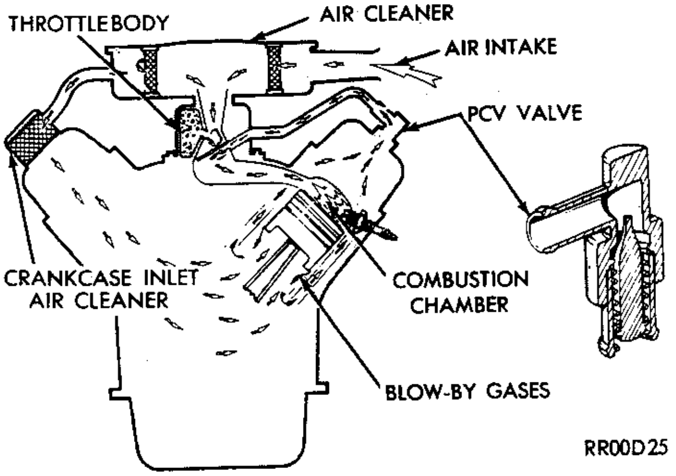


Fig. 12 Typical Closed Crankcase Ventilation System

PCV VALVE

The Positive Crankcase Ventilation valve contains a spring loaded plunger that 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 backfire, the spring forces the plunger back against the seat preventing vapors from flowing through the valve (Fig. 13).

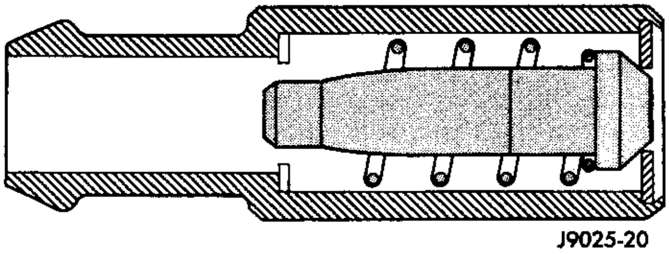


Fig. 13 Engine Off or Engine Backfire—No Vapor Flow

During periods of high manifold vacuum, such as idle or cruising speeds, manifold vacuum is sufficient to completely compress the spring and pull the plunger to the top of the valve (Fig. 14). In this position there is minimal vapor flow through the valve.

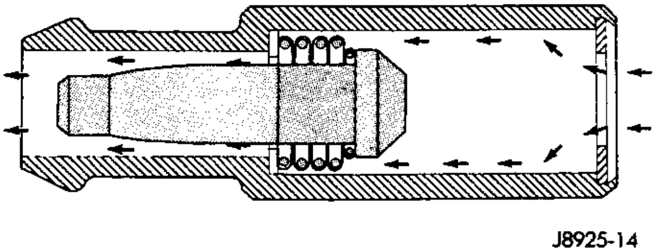


Fig. 14 High Intake Manifold Vacuum—Minimal Vapor Flow

During periods of moderate intake manifold vacuum the plunger is only pulled part way back from the inlet, resulting in maximum vapor flow through the valve (Fig. 15).

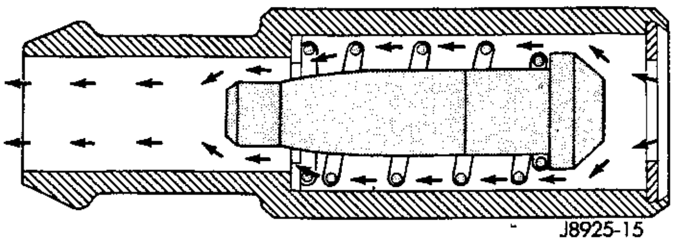


Fig. 15 Moderate Intake Manifold Vacuum—Maximum Vapor Flow

INSPECTION AND SERVICE PROCEDURE

(1) With engine idling, remove the PCV valve from cylinder head cover. If the valve is not plugged, a hissing noise will be heard as air passes through the valve and a strong vacuum felt when a finger is placed over the valve inlet. (Fig. 16).

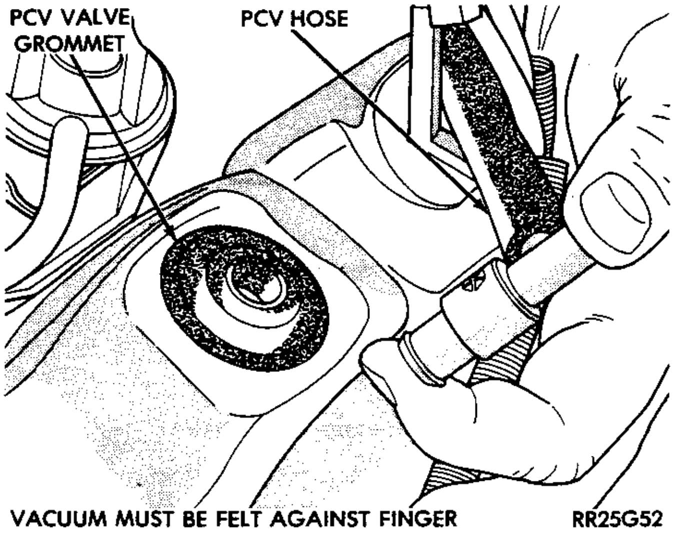


Fig. 16 Check Vacuum at PCV Valve

(2) Install the PCV valve. Remove the crankcase inlet air filter. Hold a piece of stiff paper (parts tag) loosely over the opening of the cylinder head cover. (Fig. 17).

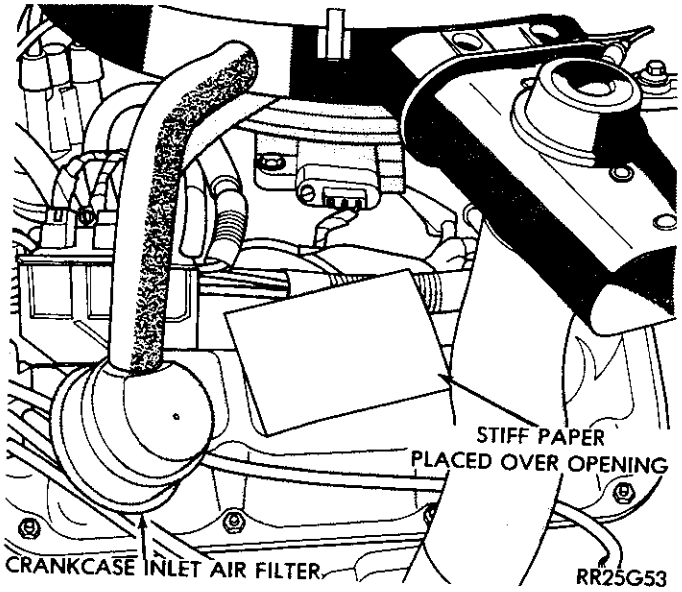


Fig. 17 Check Vacuum at Crankcase Inlet Air Filter Opening

(3) After allowing approximately one minute for crankcase pressure to reduce, the paper should be drawn against the opening in the cylinder head cover with noticeable force.

(4) Turn off engine and remove PCV valve from cylinder head cover. The valve should rattle when shaken (Fig. 18).

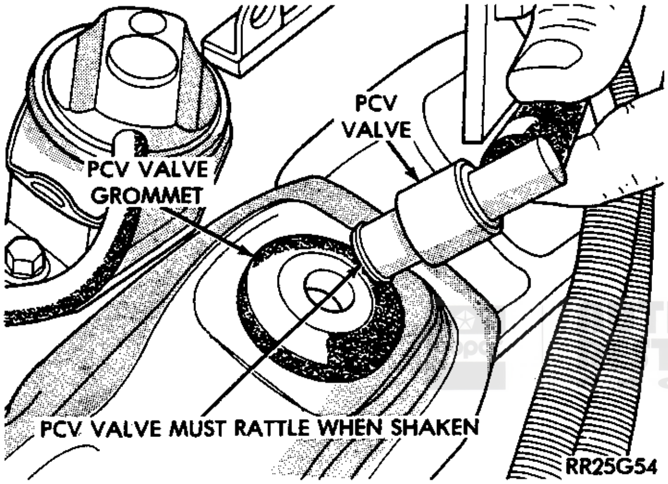


Fig. 18 Shake PCV Valve

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.**

(5) If the paper is not held against the opening in the cylinder head cover after the new valve is installed, the PCV valve hose must be replaced and the passage in the throttle body cleaned.

(6) To clean the throttle body passage, turn a 1/4 inch drill by hand through the passage to dislodge the solid particles then blow out the passage with shop air. If necessary use a smaller drill to avoid removing any metal from the throttle body. **It is not necessary to disassemble the throttle body for this service.**

CRANKCASE INLET AIR FILTER

The crankcase inlet air cleaner (Fig. 19) must be kept clean and lubricated. At the recommended interval remove the crankcase inlet air cleaner and wash it thoroughly in kerosene, or similar solvent. Lubricate or wet the filter by inverting the crankcase inlet air cleaner and filling with SAE 30 engine oil. Position the air cleaner to allow excess oil to drain thoroughly through the vent nipple. More frequent service may be necessary for vehicles operated extensively on short run, stop and go, or extended engine idle service.

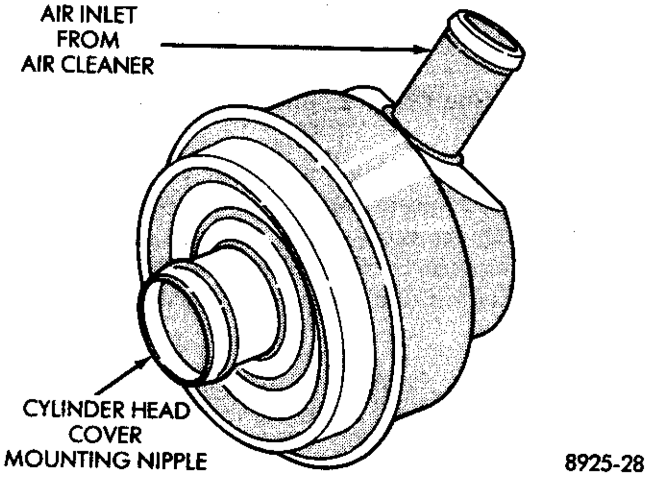


Fig. 19 Crankcase Inlet Air Filter

EXHAUST EMISSION CONTROLS

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HEATED INLET AIR SYSTEM

The heated air inlet system controls and maintains the temperature of the air entering the throttle body. By maintaining the inlet air temperature the air-fuel mixture can be calibrated much leaner to reduce hydrocarbon emissions, improve engine warm-up characteristics, and minimize icing.

The system consists of a diaphragm that operates the blend door in the air cleaner (that opens to either heated air or ambient air), a heated air temperature sensor, and a air duct hose connected to a heat stove on the exhaust manifold (Fig. 1). The air cleaner blend door opens to ambient (outside) air or preheated air from the heat stove or a position in between them.

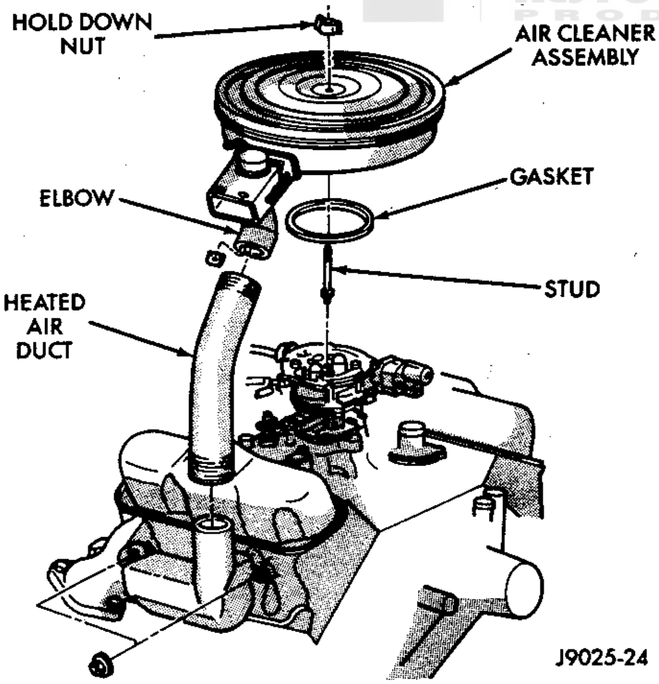

Fig. 1 Heated Air Inlet System

The adjustment of the throttle body inlet air temperature is performed by intake manifold vacuum. The heated air temperature sensor in the air cleaner senses inlet air temperature and controls the flow of vacuum to the air cleaner blend door diaphragm (Fig. 2). The amount of air allowed to enter from the ambient and heat stove inlets is determined by the position of the blend door in the air cleaner snorkel.

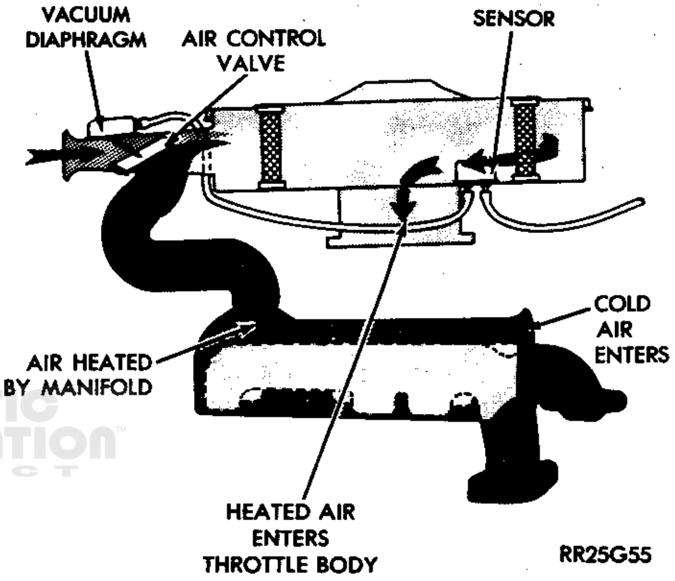

Fig. 2 Heated Air Inlet System Operation

The blend door vacuum diaphragm is opposed by a spring. Throttle body inlet air temperature adjustment will occur only when the intake manifold vacuum is above the operating vacuum of the vacuum diaphragm.

The system is designed to maintain the throttle body inlet air at a calibrated temperature. When the ambient air temperature is 9°C (15°F) or more above the system calibration temperature the air flow will be through the outside (ambient) air inlet.

When the ambient air temperature is 12°C (10°F) or more below the system calibration temperature air flow will be through heat stove inlet of the air cleaner.

At intermediate temperatures the air entering the throttle body is a blend of ambient air and heat stove air. The colder the ambient air the greater the flow of air through the stove, and the warmer the air the greater the flow through the snorkel.

HEATED AIR INLET SYSTEM SERVICE

An improperly operating heated air inlet system can affect driveability and the vehicles exhaust emission.

Perform the following procedure to determine if the air inlet system is functioning properly.

(1) Ensure that the heat stove to air cleaner flexible connector (Fig. 3), air cleaner duct and all vacuum hoses are properly attached and in good condition.

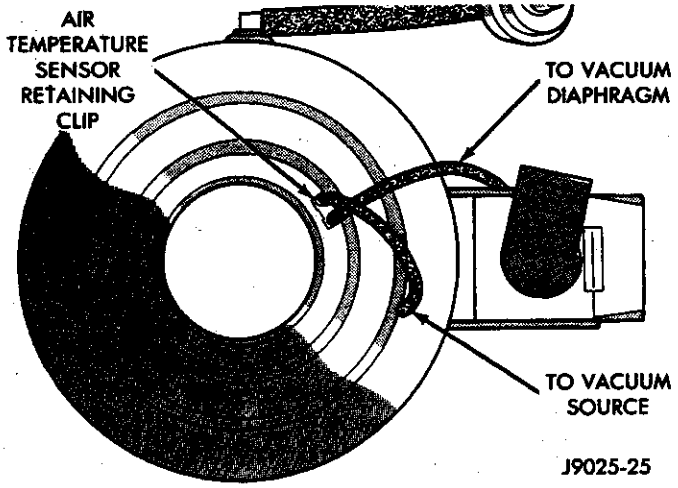

Fig. 3 Typical Vacuum Hose Routing

(2) With a cold engine and ambient temperature less than 42°C (108°F.) the heat control door (valve plate) in the snorkel should be in the **up** or **heat on position.**

(3) With the engine warmed up and running, check the air temperature entering the snorkel or at the sensor. When the air temperature entering the outer end of snorkel is 57°C (135°F) or higher the door should be in the **down** position **(heat off).**

(4) Remove the air cleaner from the engine and allow it to cool down to 42°C (108°F.) With 20 inches of vacuum applied to the sensor the door should be in the **up** or **(heat on position).** If the door does not rise to the **heat on** position, check the vacuum diaphragm for proper operation.

(5) To test the diaphragm, apply 25 inches of vacuum with vacuum pump Tool C-4207 or equivalent (Fig. 4). The diaphragm should not bleed down more than 10 inches in 5 minutes. The door should not lift off the bottom of the snorkel at less than 2.0 inches of vacuum and be in full **up** position with no more than 4.0 inches vacuum.

(6) If the vacuum diaphragm does not perform correctly, replace the vacuum diaphragm and repeat steps 2 and 3.

(7) If the vacuum diaphragm performs correctly but proper temperature is not maintained, replace the sensor and repeat the temperature checks in steps 2 and 3.

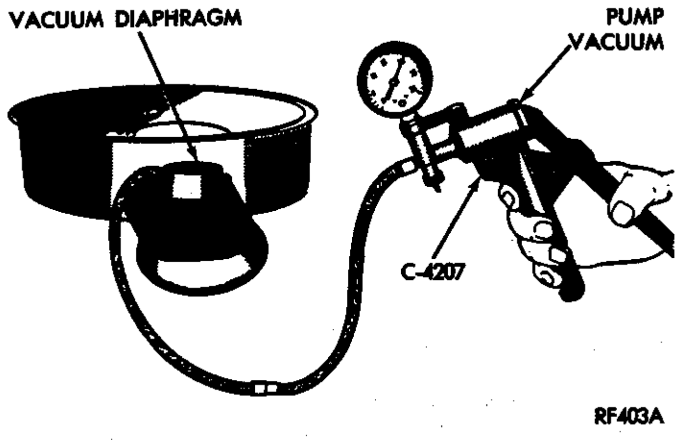

Fig. 4 Testing Vacuum Diaphragm

VACUUM DIAPHRAGM

Removal

(1) Remove the air cleaner housing from vehicle.

(2) Disconnect vacuum hose from blend door diaphragm.

(3) Drill out the retaining rivet (Fig. 5).

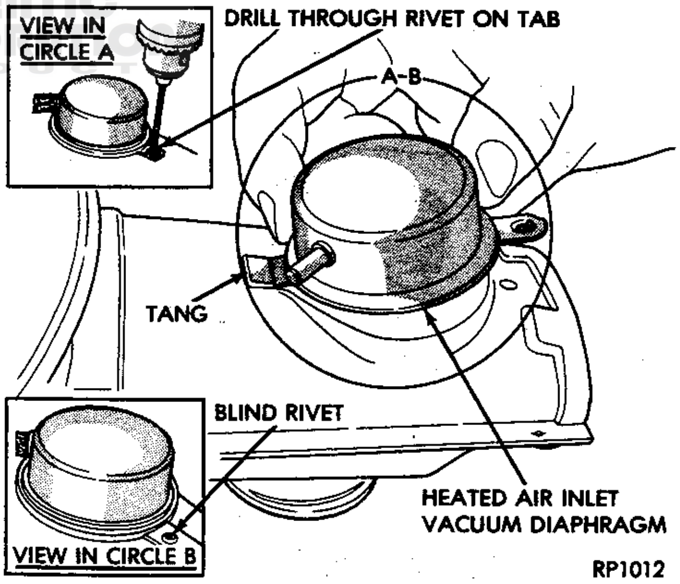

Fig. 5 Removing Diaphragm Rivet

(4) Tip the diaphragm slightly forward to disengage lock. When the diaphragm is free, slide the complete assembly to one side to disengage operating rod from heat control door (Fig. 6).

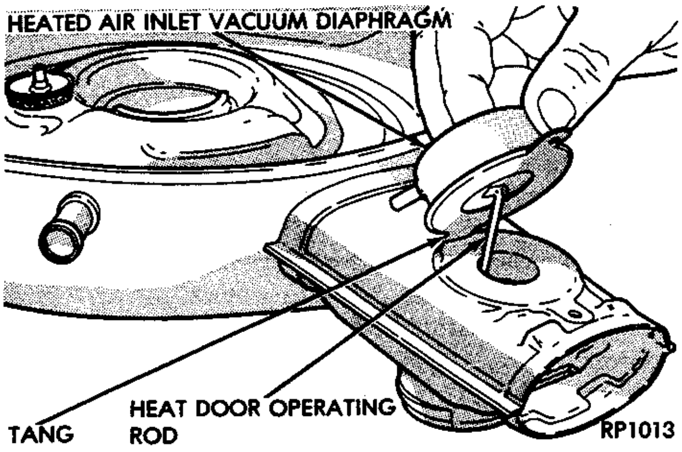

Fig. 6 Servicing Diaphragm

(5) With the vacuum diaphragm removed, check the door for freedom of travel. When the door is raised to the up position, it should fall freely when released. If it does not, observe door to snorkel side walls for interference or obstructions. Inspect the hinge pin for binding. If necessary use compressed air to remove obstructions.

INSTALLATION

(1) Insert operating rod into heat control door. Position diaphragm tang into opening and rivet tab in place (Figs. 6 and 5).

(2) Apply 4 inches of vacuum to diaphragm nipple. The heat control door should operate freely. **Manually operating heat control door could cock the operating rod or diaphragm restricting proper operation of the system.**

(3) Assemble air cleaner.

(4) Install air cleaner assembly on vehicle and test operation.

HEATED AIR TEMPERATURE SENSOR

Removal

(1) With air cleaner housing removed from vehicle remove and discard retainer clip (Fig. 7). A new clip is supplied with a new sensor.

(2) Remove and discard the sensor and gasket.

INSTALLATION

(1) Position gasket onto sensor. Install sensor into position in air cleaner (Fig. 8).

(2) Support sensor outer edges and securely install retainer clip to ensure gasket forms a tight air seal. **Do not attempt to adjust sensor.**

(3) Connect vacuum hoses to sensor.

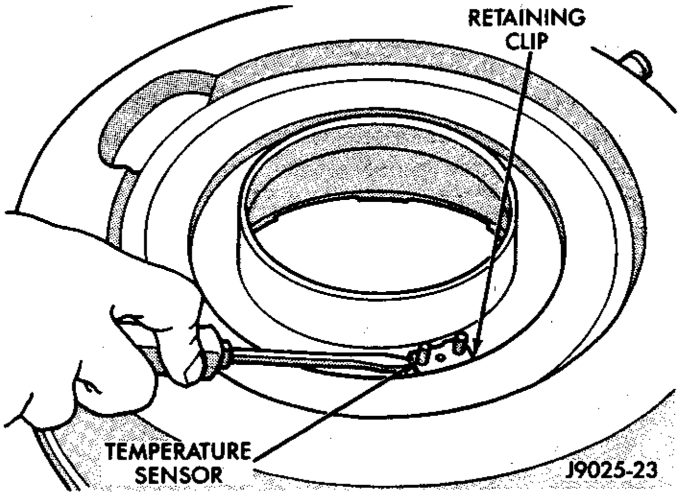

Fig. 7 Removing Sensor Clip

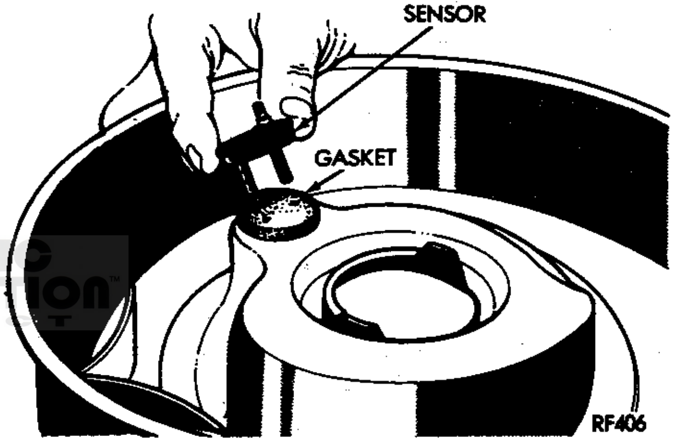

Fig. 8 Air Temperature Sensor Installation

OXYGEN SENSOR (O_2 SENSOR)—SBEC INPUT

The O_2 sensor is located in the exhaust down pipe on 3.9L engines (Fig. 9) and on 5.2L and 5.9L engines above the left exhaust manifold outlet (Fig. 10). The O_2 sensor provides an input voltage to the Single Board Engine Controller (SBEC) relating the oxygen content of the exhaust gas. The SBEC uses this information to fine tune the air-fuel ratio by adjusting injector pulse width.

The O_2 sensor produces voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air-fuel mixture), the sensor produces a low voltage. When there is a lesser amount present (rich air-fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensor acts as a rich-lean switch.

The oxygen sensor is equipped with a heating element that keeps the sensor at proper operating temperature during all operating modes. Maintaining correct sensor temperature at all times allows the system to enter into CLOSED LOOP operation sooner.

In "CLOSED LOOP" operation the SBEC monitors the O_2 sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During "OPEN LOOP" operation the SBEC ignores the O_2 sensor input and adjusts injector pulse width to a preprogrammed value (based on other sensor inputs).

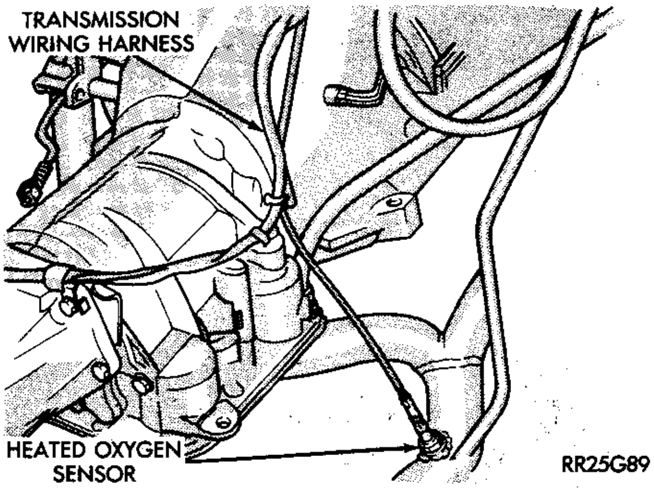

Fig. 9 Heated Oxygen Sensor Location—3.9L Engine

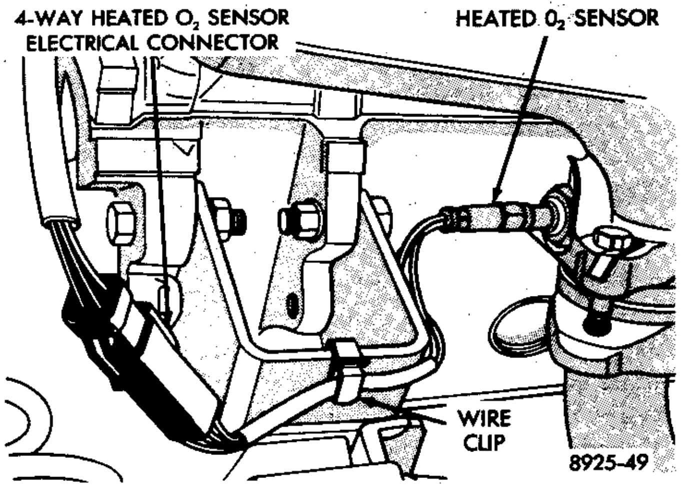

Fig. 10 Heated Oxygen Sensor Location—5.2L and 5.9L Engines

HEATED OXYGEN SENSOR (O_2 SENSOR) SERVICE

On 3.9L engines the oxygen sensor is located in the exhaust systems Y-pipe (Fig. 9). On 5.2L and 5.9L engines the oxygen sensor is located above the outlet of the left exhaust manifold (Fig. 10).

(1) Disconnect engine harness from Oxygen Sensor Connector.

CAUTION: Take care not to pull on oxygen sensor wires when servicing the O_2 sensor.

WARNING: THE EXHAUST PIPE MAY BE EXTREMELY HOT. AVOID CONTACT WITH THE EXHAUST PIPE WHEN SERVICING THE OXYGEN SENSOR.

(2) Remove O_2 sensor with Tool C-4907.

The original O_2 sensor threads were coated with an anti-seize compound. The compound must be removed from the threads in the exhaust manifold prior to sensor installation.

(3) Clean the threads in the exhaust manifold with an 18 mm X 1.5 + 6E tap.

(4) If the original sensor is to be reinstalled, the sensor threads must be coated with an anti-seize compound (Loctite 771-64 or equivalent). New O_2 sensors are packaged with compound on the threads and no additional compound is required.

(5) Tighten sensor to 27 N•m (20 ft. lbs.) torque.

EXHAUST GAS RECIRCULATION (EGR) SYSTEMS

The EGR system reduces oxides of nitrogen (Nox) in engine exhaust and helps prevent spark knock. This is accomplished by allowing a predetermined amount of hot exhaust gas to recirculate and dilute the incoming fuel/air mixture. This dilution reduces peak flame temperature during combustion.

The EGR system consists of the EGR valve, vacuum transducer, EGR solenoid, and connecting hoses (Fig. 11).

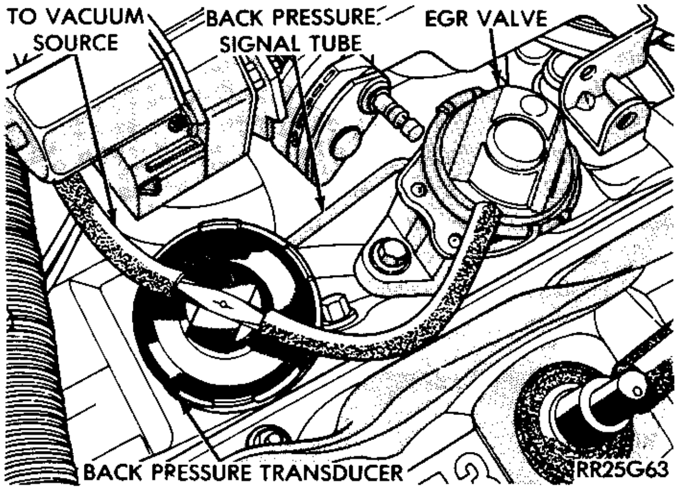

Fig. 11 EGR System

The EGR solenoid (Fig. 12) is controlled by the vehicles Single Board Engine Controller (SBEC). The SBEC monitors engine coolant temperature and other operating conditions to determine when the solenoid is energized. When energized by the SBEC, the solenoid prevents vacuum from reaching the EGR valve transducer. When the solenoid is not energized, vacuum flows through the solenoid to the vacuum transducer. Refer to Modes of Operation in the Dual Point Fuel Injection section of Group 14 for a description of solenoid operation based on engine operating conditions.

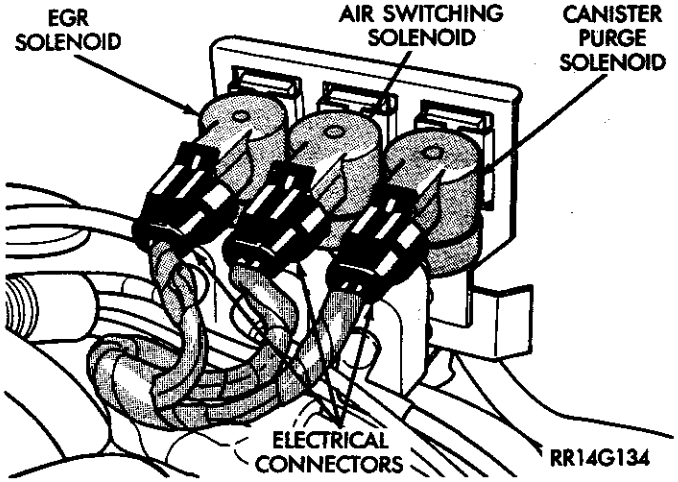

Fig. 12 EGR Solenoid

The vacuum transducer is controlled by exhaust system back-pressure. When back-pressure is high enough it will close a bleed valve in the transducer allowing vacuum to actuate the EGR valve. If back-pressure does not close the bleed valve vacuum will be bled off.

Operation

Engine Vacuum flows through the EGR valve solenoid to the vacuum transducer through a connecting hose. Vacuum flows only when the solenoid is not energized (no voltage applied). The transducer is connected to the EGR valve by a vacuum hose and a back-pressure hose. The transducer is controlled by exhaust back pressure and is ported to the exhaust manifold through a hose connecting it to the bottom of the EGR valve (Fig. 13).

When the solenoid is not energized and exhaust gas back-pressure entering EGR valve inlet is high enough, back pressure holds transducer bleed valve closed. This allows vacuum to activate and operate the EGR valve.

EGR SYSTEM ON-BOARD DIAGNOSTICS (CALIFORNIA VEHICLES ONLY)

All vehicles built for sale in the state of California have an On-Board Diagnostics test that can be performed with the DRBII diagnostic tester to check the EGR system for failures. The SBEC monitors EGR system performance and registers a fault code if the system has failed or is degraded and the dash-mounted check engine light is turned on indicating immediate service is required. The Diagnostic System Check is activated only during selected engine/driving conditions to avoid incorrect diagnosis.

If a malfunction is indicated by a check engine light and a fault code for EGR system, proper operation of the EGR system should be checked using the Service Procedures. If the EGR system is found to be functioning correctly, the on-board diagnostics system should then be checked.

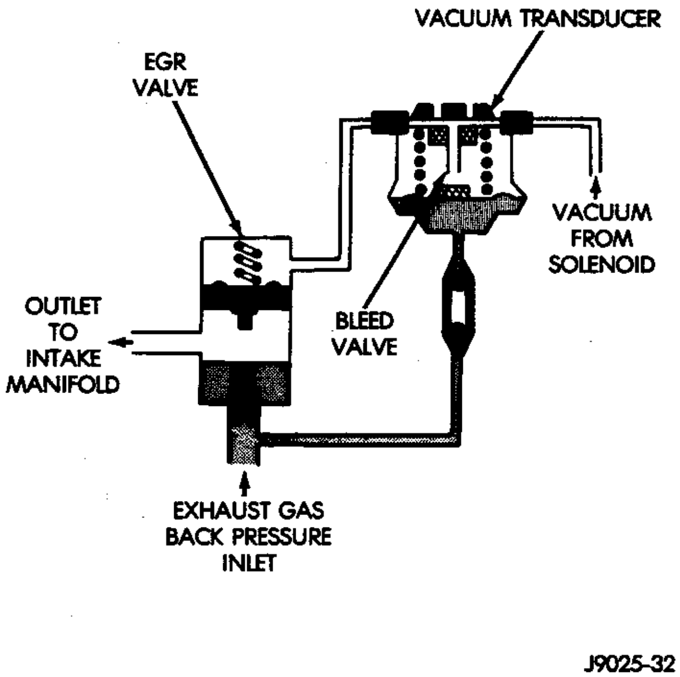

Fig. 13 EGR System Operation

EGR SYSTEM SERVICE

A malfunctioning EGR system can cause engine spark knock, sags or hesitation, rough idle, engine stalling and poor driveability. To ensure proper operation of the EGR system inspect all passages for blockage. Check moving parts for binding. Inspect the complete system for leaks. Replace system components or hoses that are leaking.

Inspect all hoses connections between throttle body, intake manifold, EGR control valve, and EGR solenoid. Replace any vacuum harness components that are leaking or damaged.

Refer to EGR Control System Test and EGR Gas Flow Test to check EGR System operation.

EGR CONTROL SYSTEM TEST

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE TESTING THE EGR SYSTEM.

(1) Engine should be warmed up and operating at normal idle speed. Apply the parking brake.

(2) Allow the engine to idle in neutral with the throttle closed, then quickly accelerate engine speed to approximately 2,000 RPM, while watching the groove (movement indicator) on the EGR valve stem. (Fig. 14).

- Movement of the valve stem indicates that the control system is functioning correctly. Perform the EGR Gas Flow Test.
- If no movement of the valve stem is visible, Refer to the EGR DIAGNOSIS chart in this Group.

EGR GAS FLOW TEST

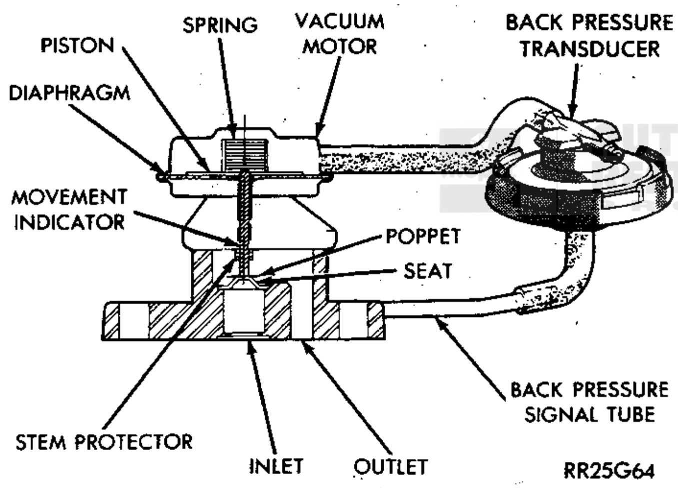

Fig. 14 EGR and Back Pressure Transducer Assembly—Typical

(1) Connect tachometer to engine.

(2) Remove vacuum hose (or rubber elbow) from EGR valve and connect hand held vacuum pump Tool C-4207 or an equivalent to the nipple.

(3) Start engine and slowly apply vacuum to EGR valve vacuum motor.

(4) Engine RPM should momentarily drop as vacuum reaches 3 to 5 inches Hg and continue to drop as more vacuum is applied (engine may even stall).

- If engine RPM momentarily drops (the SBEC will increase RPM through the AIS motor when it senses a drop in RPM), exhaust gas is circulating through the system. Successful completion of the EGR Gas Flow Test and the Control System Test indicates a fully-functional EGR system.
- If engine speed does not drop, a defective EGR valve or plugged EGR passage is indicated. Remove the EGR valve. Inspect for blockage in the passages in the intake manifold below the EGR valve. Intake manifold passages should be checked for deposits and cleaned if necessary. Replace the EGR valve if obstructions are not found in the EGR system.

EGR DIAGNOSIS

All tests must be made with fully warm engine running continuously for at least two minutes.

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING EGR DIAGNOSIS.

EGR DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
EGR Valve Stem Does Not Move On System Test.	Cracked, leaking, disconnected or plugged hoses.	Verify correct hose connections. Replace hose harness if damaged or plugged hoses are found. Disconnect hose harness from EGR vacuum transducer and connect auxiliary vacuum supply. Raise and maintain engine RPM to 2000 RPM. Apply 10 in. of vacuum and check valve movement. If valve does not move replace EGR valve/transducer assembly. If valve opens approximately 3 mm (1/8 inch) apply vacuum to valve nipple and check for a leaking diaphragm. The valve should remain open 30 seconds or longer. If leakage occurs, replace EGR valve/transducer assembly. If valve does not leak check control system.
EGR Valve Stem Does Not Move on System Test. But, Operates Normally on External Vacuum Source.	Defective control system or plugged passages.	Remove throttle body. Inspect EGR vacuum source and associated passages in throttle body for obstructions. Clean passages as necessary. Use low air pressure to inspect for air flow through passages. Recheck for normal EGR operation.
Engine Will Not Idle. Dies Out on Return to Idle or Idle is Very Rough or Slow.	High EGR valve leakage in closed position.	If removal of vacuum hose from EGR valve does not correct rough idle, remove EGR valve/transducer assembly. Inspect poppet and ensure that it is seated. Replace valve/transducer if defective.

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EGR VALVE REMOVAL

(1) Disconnect vacuum hose to EGR valve/transducer assembly.

(2) Remove EGR mounting bolts (Fig. 15).

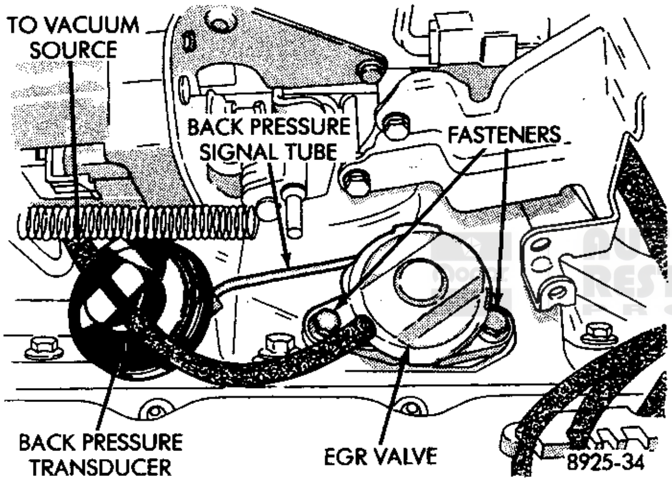

Fig. 15 EGR Mounting

(3) Remove EGR valve and gasket. Discard gasket. Clean intake manifold surface and check for cracks.

INSTALLATION

(1) Place new EGR gasket on intake manifold.

(2) Install EGR valve. Tighten mounting bolts to 23 N•m (200 in. lbs.) torque.

(3) Reconnect vacuum hose to valve/transducer assembly.

EGR DIAGNOSTIC SOLENOID REMOVAL

(1) Remove vacuum hose and electrical connector from solenoids (Fig. 16).

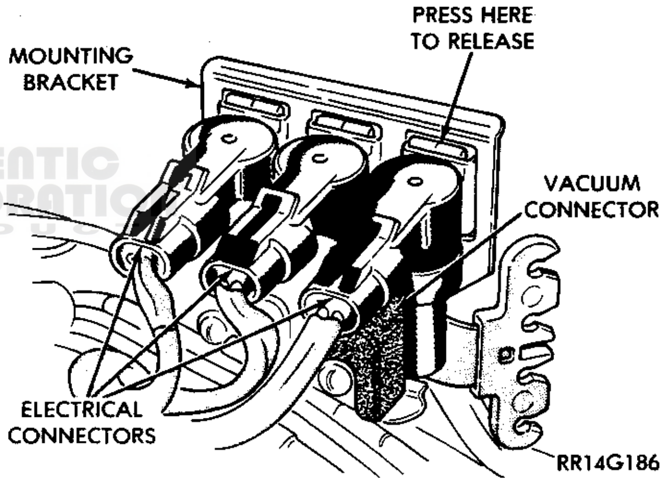

Fig. 16 Servicing the Solenoid Pack

(2) Remove mounting fastener and remove solenoid pack.

(3) Depress tab on top of solenoid to be replaced and slide the solenoid downward out of mounting bracket.

(4) Reverse above procedure to install.

AIR INJECTION SYSTEM

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GENERAL INFORMATION

The air injection system consists of a belt-driven air pump, an air control valve (either a diverter valve, relief valve or switch/relief valve), and rubber hoses and check valves to protect the hoses and injection tubes from hot exhaust gases (Fig. 1, 2 or 3).

The air injection system adds a controlled amount of air to the exhaust gases aiding the oxidation of hydrocarbons and carbon monoxide in the exhaust stream. The system is designed to not interfere with the ability of the EGR system to control nitrous oxide (NOx) emissions. Air is injected at either the exhaust manifold (referred to as upstream) or at a the catalytic convertor (refereed to as downstream) through the air switch/relief valve.

The air switching valve is operated by manifold vacuum. The vacuum supply for the air switch/relief valve is controlled by the air switching solenoid. The solenoid is controlled by the Single Board Engine Controller (SBEC).

Air is injected upstream at the exhaust manifold for a short time during engine warm-up. Once the engine reaches operating temperature, the air flow is switched downstream where it will assist the oxidation process in the catalyst but not interfere with EGR operation.

Heavy Duty Cycle (HDC) vehicles with the 5.9L engine are equipped with a dual air pump system.

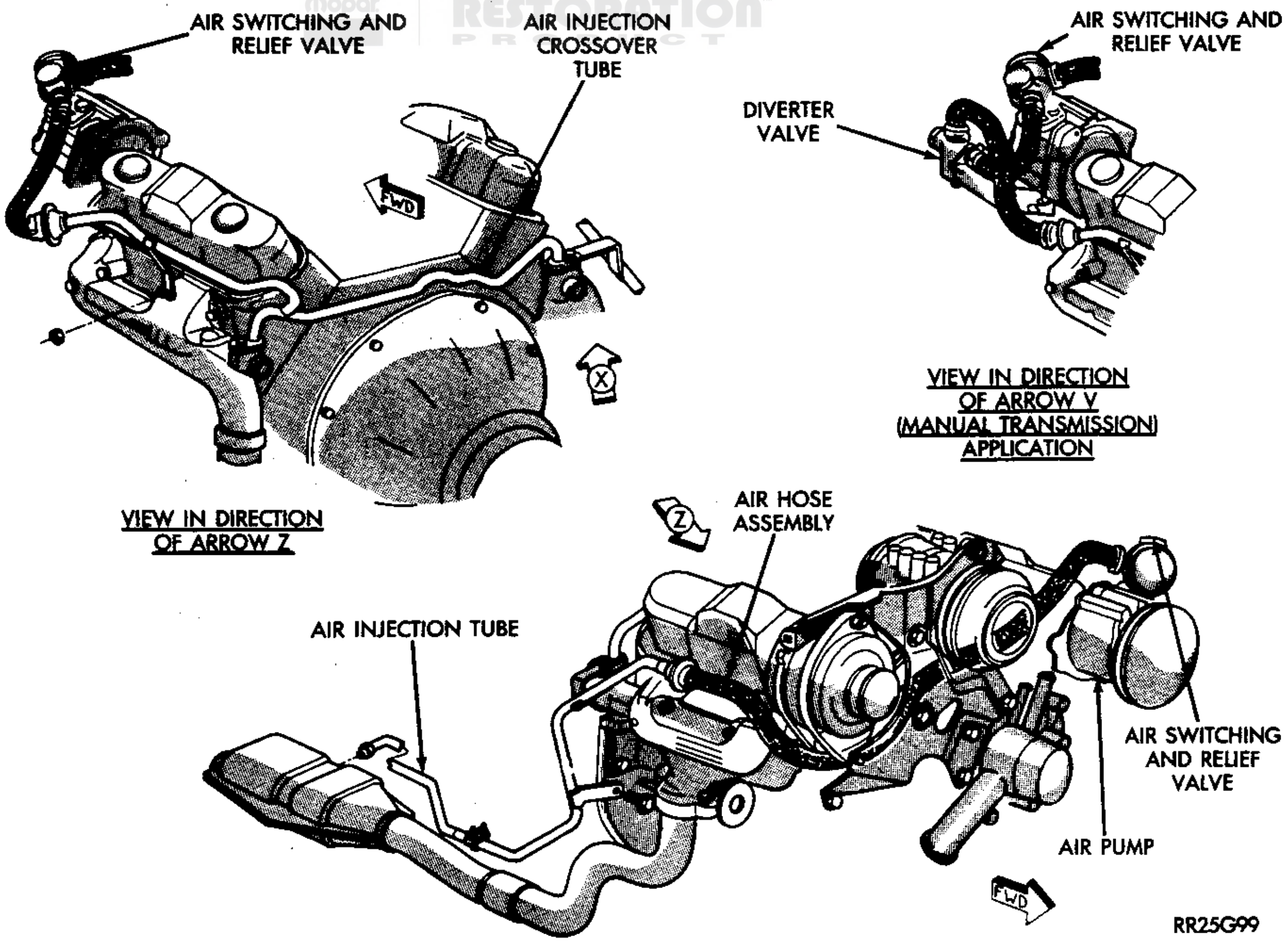

Fig. 1 Air Injection System—3.9L Engine

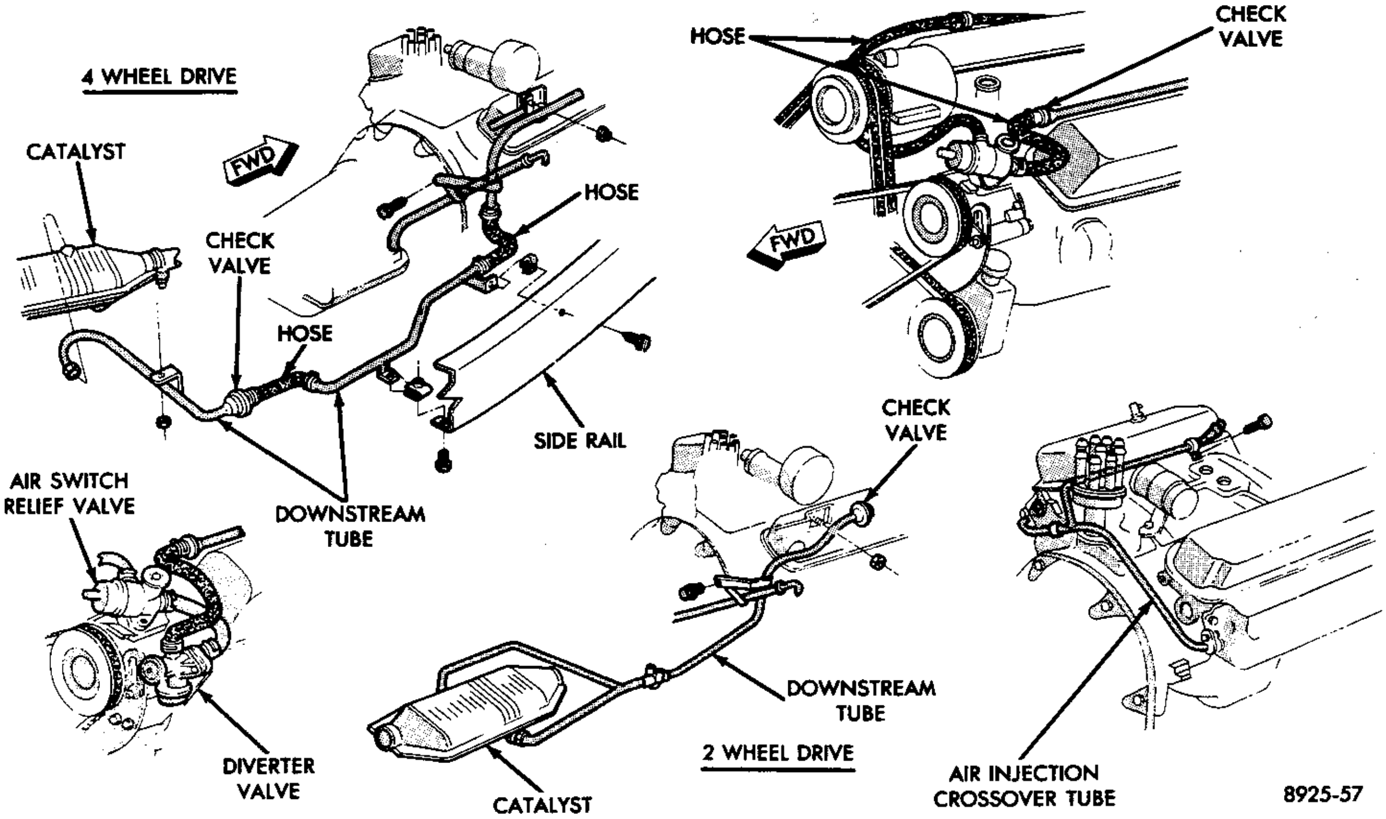

Fig. 2 Air Injection System—5.2L Engine and Light Duty Cycle 5.9L Engines

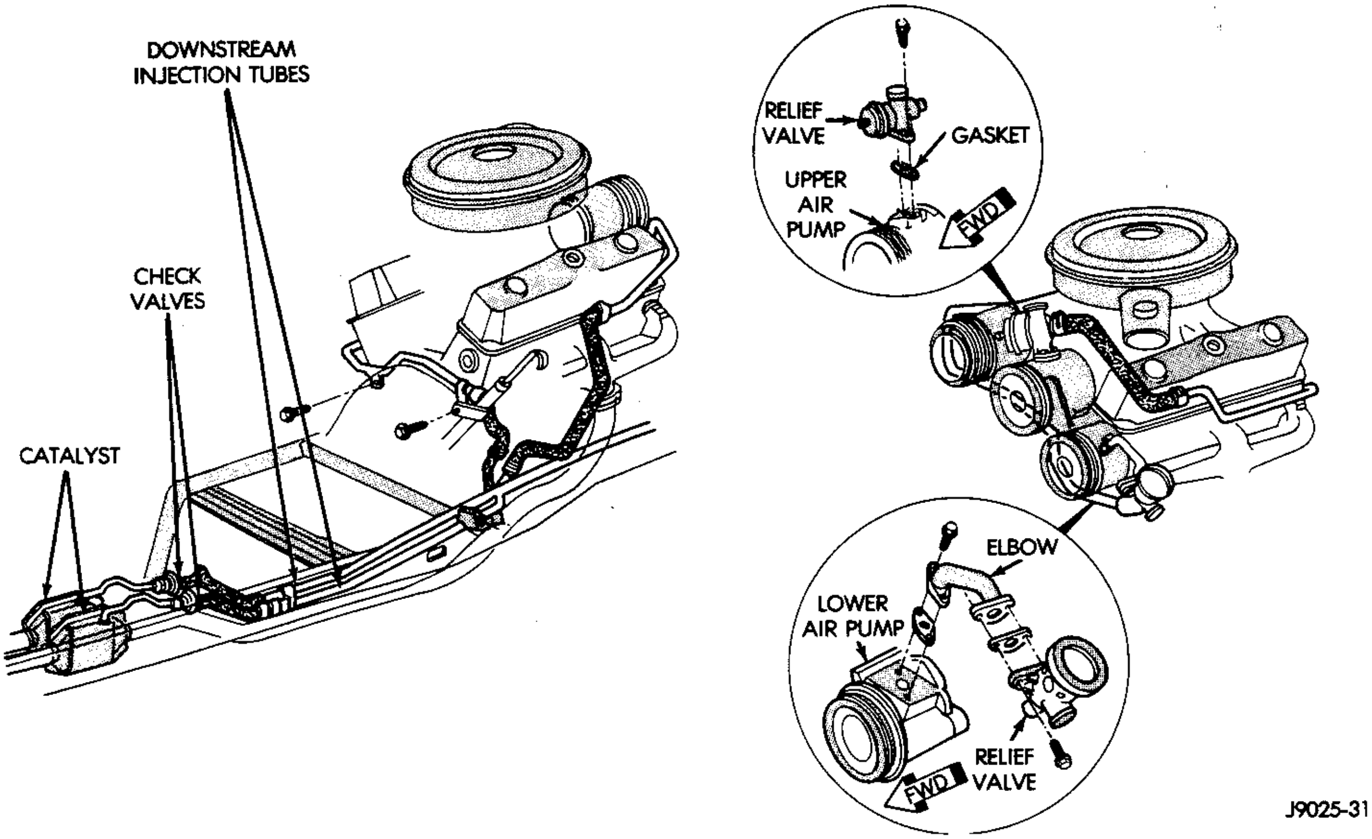

Fig. 3 Air Injection System—5.9L Engine, Heavy Duty Cycle

AIR INJECTION PUMP

The air pump is mounted on the front of the engine and driven by a belt connected to the crankshaft pulley (Fig. 4). Intake air passes through a fan at the front of the pump. Foreign materials are separated from the air by centrifugal force. Air is delivered to the air injection manifold and check valve tube assembly by a rubber hose through the diverter valve and switching valve. Hoses are secured to all fittings by clamps.

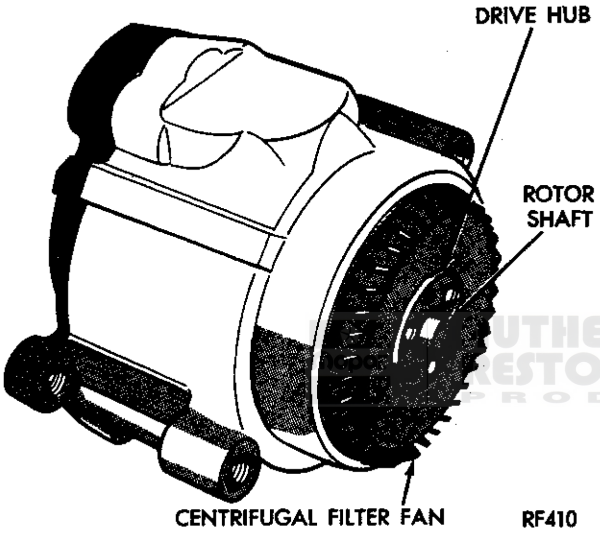

Fig. 4 Air Injection Pump

The air injection system is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the air injection system, disconnect the drive belt and operate the engine. If noise does not exist, proceed with diagnosis.

The only serviceable component of this pump is the centrifugal fan filter. Do not assume the pump is defective if it squeaks when turned by hand.

DO NOT LUBRICATE PUMP. Wipe all oil off of pump housing. Oil in the pump will cause rapid deterioration and failure.

CAUTION: If the engine or underhood compartment is to be cleaned with steam or high pressure detergent, the centrifugal fan filter should be masked off to prevent liquids from entering the pump.

DIVERTER VALVE

A diverter valve is used on some vehicles. The purpose of the diverter valve (Fig. 5) is to prevent backfire in the exhaust system during sudden deceleration.

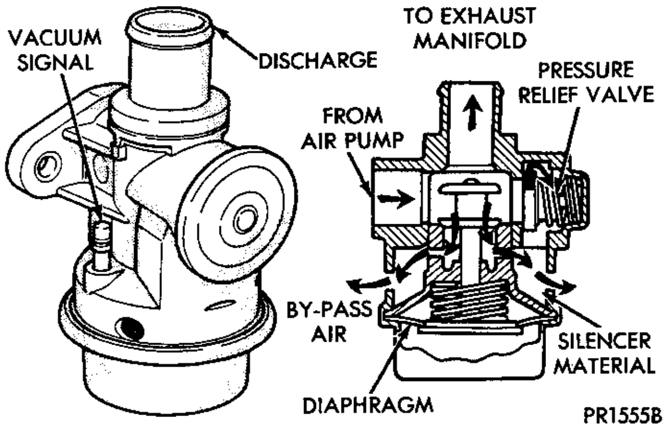

Fig. 5 Diverter Valve

Sudden throttle closure at the beginning of deceleration temporarily creates an air-fuel mixture that is too rich to burn. This mixture becomes burnable when it reaches the exhaust area and combines with injector air. The next firing of the engine will ignite this air-fuel mixture. The diverter valve senses the sudden increase in intake manifold vacuum causing the valve to open, allowing air from the air pump to pass through the valve and silencer to the atmosphere.

A pressure relief valve, incorporated in the same housing as the diverter valve, controls pressure within the system by diverting excessive pump output at higher engine speeds to atmosphere through the silencer.

AIR SWITCH/RELIEF VALVE

The purpose of the switch/relief valve (Fig. 6) is twofold. First, the valve directs air injection flow to either the exhaust port location or to the downstream injection point. In addition, the valve regulates system pressure by controlling the output of the air pump at high speeds. When the pressure reaches a certain level, some of the output is vented to the atmosphere through the silencer.

Air is initially injected at the upstream location as close to the exhaust valves as possible. As the engine temperature increases, exhaust gas recirculation (and the O_2 feedback system) begin functioning. When this happens, the air injection point must be switched to the downstream location for the best possible operation.

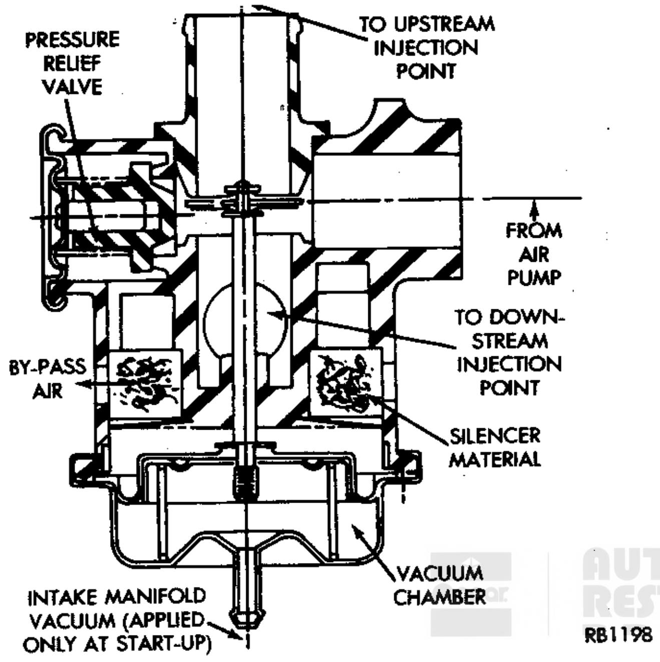

Fig. 6 Switch/Relief Valve

The switch/relief valve is controlled by manifold vacuum. The vacuum supply to the switch/relief valve is controlled by the Single Board Engine Controller (SBEC) through the air switching solenoid (Fig. 7). When the solenoid is energized vacuum is not supplied to the air switch/relief valve. When the solenoid is not energized, vacuum is supplied to the air switch/relief valve.

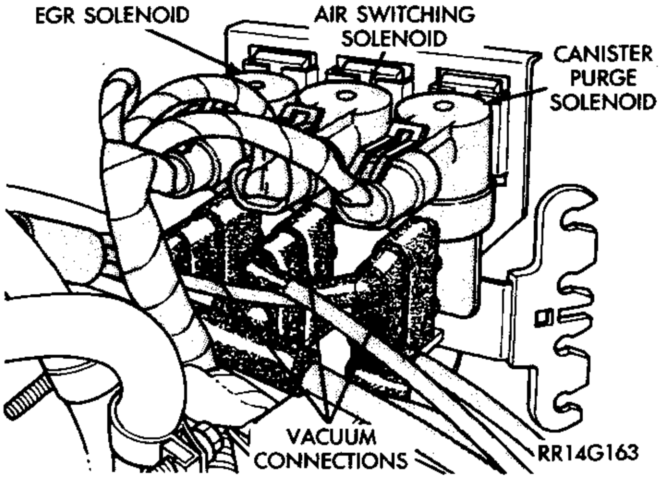

Fig. 7 Air Switching Solenoid

When the engine is cold, a manifold vacuum signal is sent to the switch/relief valve and the valve directs air injection upstream (to the exhaust port location).

When engine temperature rises, the SBEC vacuum solenoid shuts off the manifold vacuum signal to the switch relief valve. A bleed orifice in the vacuum line allows the vacuum signal to go to zero. Without a vacuum signal, the valve switches the air injection to the downstream location.

AIR SWITCHING SYSTEM

At start-up the air switching solenoid is energized and air is injected upstream. When the fuel injection system enters CLOSED LOOP operation air will be injected downstream until an OPEN LOOP idle condition occurs.

CHECK VALVE (AIR INJECTION TUBE)

A check valve is located in the injection tube assemblies that lead to the exhaust manifolds and the catalyst injection points (Fig. 1, 2 or 3).

The check valve has a one-way diaphragm which prevents hot exhaust gases from backing up into the hose and pump. The check valve will protect the system in the event of pump belt failure, abnormally high exhaust system pressure, or air hose ruptures.

COOLANT TEMPERATURE SENSOR

The coolant temperature sensor is located in the coolant crossover passage at the front of the intake manifold (Fig. 8). The sensor monitors engine temperature. The SBEC energizes or de-energizes the air switching solenoid based on engine operating temperature.

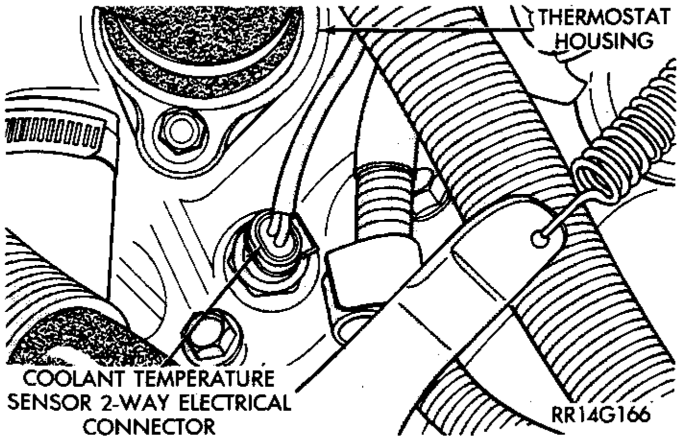

Fig. 8 Coolant Temperature Sensor

AIR PUMP DIAGNOSIS

Condition	Possible Cause	Correction
EXCESSIVE BELT NOISE	(a) Loose belt.	(a) Tighten belt (see Group 7 "Cooling System").
	(b) Seized pump.	(b) Replace pump.
EXCESSIVE PUMP NOISE. CHIRPING	(a) Insufficient break-in.	(a) Recheck for noise after 1600 km. (1,000 miles) of operation.
EXCESSIVE PUMP NOISE CHIRPING, RUMBLING, OR KNOCKING	(a) Leak in hose.	(a) Locate source of leak using soap solution and correct.
	(b) Loose hose.	(b) Reassemble and replace or tighten hose clamp.
	(c) Hose touching other engine parts.	(c) Adjust hose position.
	(d) Switch/relief valve inoperative.	(d) Replace switch/relief valve.
	(e) Check valve inoperative.	(e) Replace check valve.
	(f) Pump mounting fasteners loose.	(f) Tighten mounting screws as specified.
	(g) Pump failure.	(g) Replace pump.
NO AIR SUPPLY (ACCELERATE ENGINE TO 1500 RPM AND OBSERVE AIR FLOW FROM HOSES. IF THE FLOW INCREASES AS THE RPM'S INCREASE, THE PUMP IS FUNCTIONING NORMALLY. IF NOT, CHECK POSSIBLE CAUSE.	(a) Loose drive belt.	(a) Tighten to specifications.
	(b) Leaks in supply hose.	(b) Locate leak and repair or replace as required.
	(c) Leak at fitting(s).	(c) Tighten or replace clamps.
	(d) Check valve inoperative.	(d) Replace check valve.
AIR SUPPLY UPSTREAM WITH NO VACUUM APPLIED TO SWITCH/RELIEF VALVE.	(a) Defective Air Switching Control Solenoid.	(a-1) With the engine running, connect voltmeter to the light blue with red tracer of the air switching solenoid connector and ground. Voltmeter should pulse between 0 and 14 volts. Solenoid is okay. If the voltage pulses between 0-2 volts replace solenoid dual assembly. Voltmeter not pulsating but reads within 1 volt of battery voltage, perform next test. (a-2) Turn the engine off. Disconnect the SBEC 60-way connector. Turn ignition switch to ON position. Connect a voltmeter to cavity 36 and ground. Voltmeter reads within 1 volt of battery voltage. Replace the computer. If voltmeter reads 0 volts (without vacuum actuated electrical switch), repair wire of cavity 36 for open circuit. If voltmeter reads 0 volts with vacuum actuated electrical switch, perform next test. (a-3) Turn ignition switch off. Disconnect the vacuum actuated electrical switch connector. Connect an ohmmeter between the terminals of the switch. Ohmmeter shows continuity, repair wire of SBEC connector cavity 36. Ohmmeter does not show continuity, replace switch. (a-4) Engine running connect voltmeter to green wire of the air switching solenoid connector and ground. Voltmeter reading within 1 volt of battery voltage, replace the computer. If voltmeter reads between 0 and 1 volt, repair wire in cavity 36 of SBEC 60-way connector for short to ground.
	(b) Switch/relief valve inoperative.	(b) Replace switch/relief valve.

J9025-15

SERVICE PROCEDURES

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GENERAL INFORMATION

For satisfactory emission control and engine durability, the air pump must be operating at all times (except when performing diagnosis tests). To ensure proper operation of the air pump the air pump drive belt should be in good condition and adjusted to the specified tension. Inspect the condition of the air pump belt and adjust belt tension to specifications. Refer to Group 7, Cooling System.

Air pump service involves replacing either the centrifugal fan filter or the entire pump. Do not disassemble pump for any reason. **Do not clamp pump in a vise or use a hammer or pry bar on the pump housing.**

AIR INJECTION PUMP

SINGLE PUMP SYSTEM—LIGHT DUTY CYCLE VEHICLE

Removal

(1) Remove air hose from air pump outlet elbow, or control valve.

(2) Loosen air pump pivot and adjusting bolts and remove belt (Fig. 1).

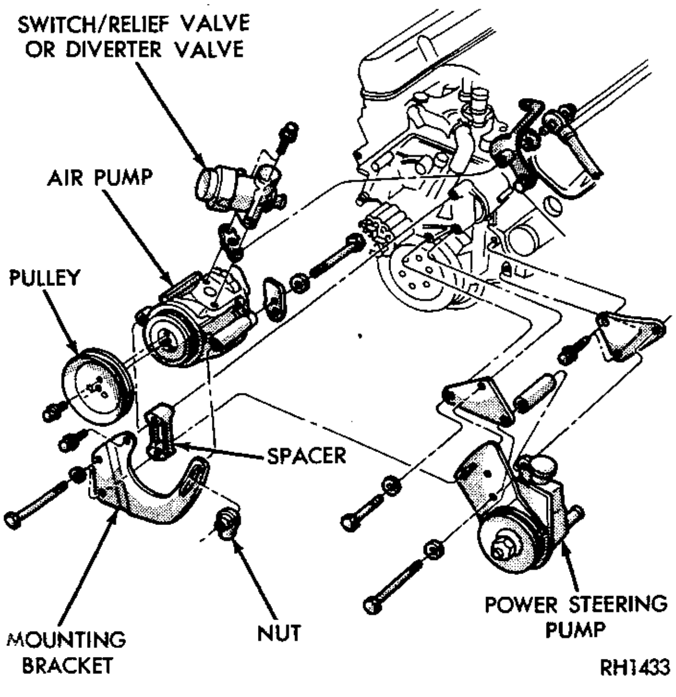

Fig. 1 Single Air Pump Removal/Installation

(3) Remove pivot and adjusting bolts from pump brackets and remove pump pulley and brackets as an assembly.

(4) Remove air pump pulley, brackets and diverter valve, switch/relief valve or outlet elbow from air pump (Fig. 2 and 3).

Installation

(1) Install air pump pulley, diverter valve, switch/relief valve and brackets on air pump. Use new gasket on pump flange. Tighten the air pump pulley screws and outlet elbow mounting screws to 11 N•m (95 in. lbs.) torque. Tighten bracket attachment bolts to 41 N•m (30 ft. lbs.) torque.

(2) Position pump assembly on engine and install the air hose to the diverter valve, switch/relief valve or outlet elbow. Install pump pivot and adjusting bolts loosely.

(3) Install drive belt and adjust. Refer to Group 7, Cooling System. **Do not pry on air pump housing.** Tighten mounting bolts to 41 N•m (30 ft. lbs.) torque.

DUAL AIR PUMP SYSTEM—HEAVY DUTY CYCLE VEHICLE WITH ENGINE

Removal

(1) Remove air hose from the air switch relief valve at each air pump (Fig. 4).

(2) Loosen air pump pivot and adjusting bolts on both pumps. Remove belt.

(3) Remove air pump attaching bolts from lower pump and remove lower pump relief valve and adapter as an assembly.

(4) Remove air pump pivot and adjusting bolts from upper air pump. Remove upper pump and diverter valve as an assembly.

(5) Remove air pump pulley, diverter valve, and adaptor from air pumps.

Installation

(1) Install air pumps pulleys, diverter valves, and adaptors to air pumps.

(2) Install new gasket on pump flange of lower pump. Tighten air pump pulley screws, diverter valve screws and adaptor screws to 11 N•m (95 in. lbs.) torque.

(3) Install lower air pump assembly and tighten attaching bolts to 41 N•m (30 ft. lbs.) torque. Install air hose to diverter valve.

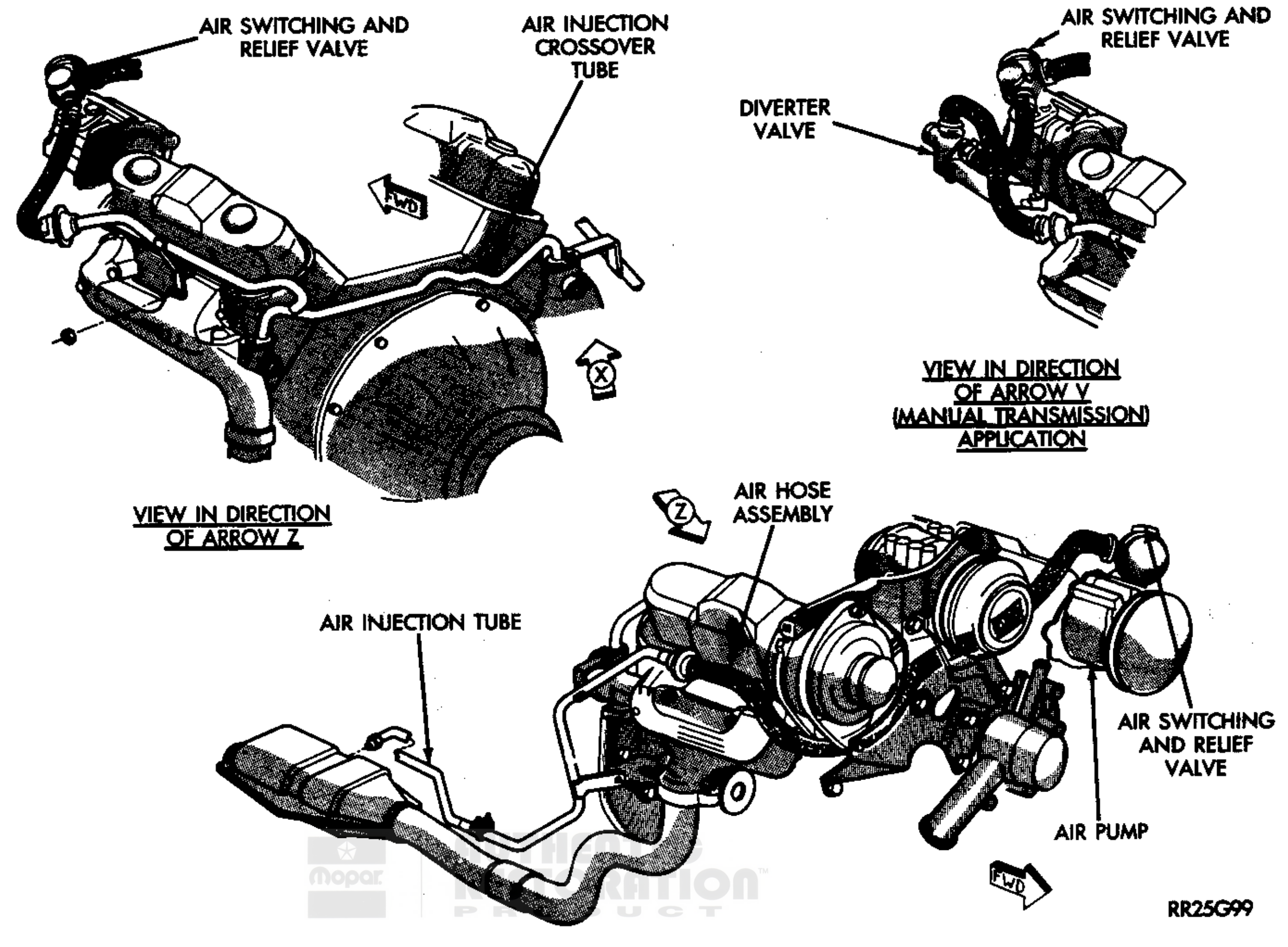

Fig. 2 Air Injection System—3.9L Engine

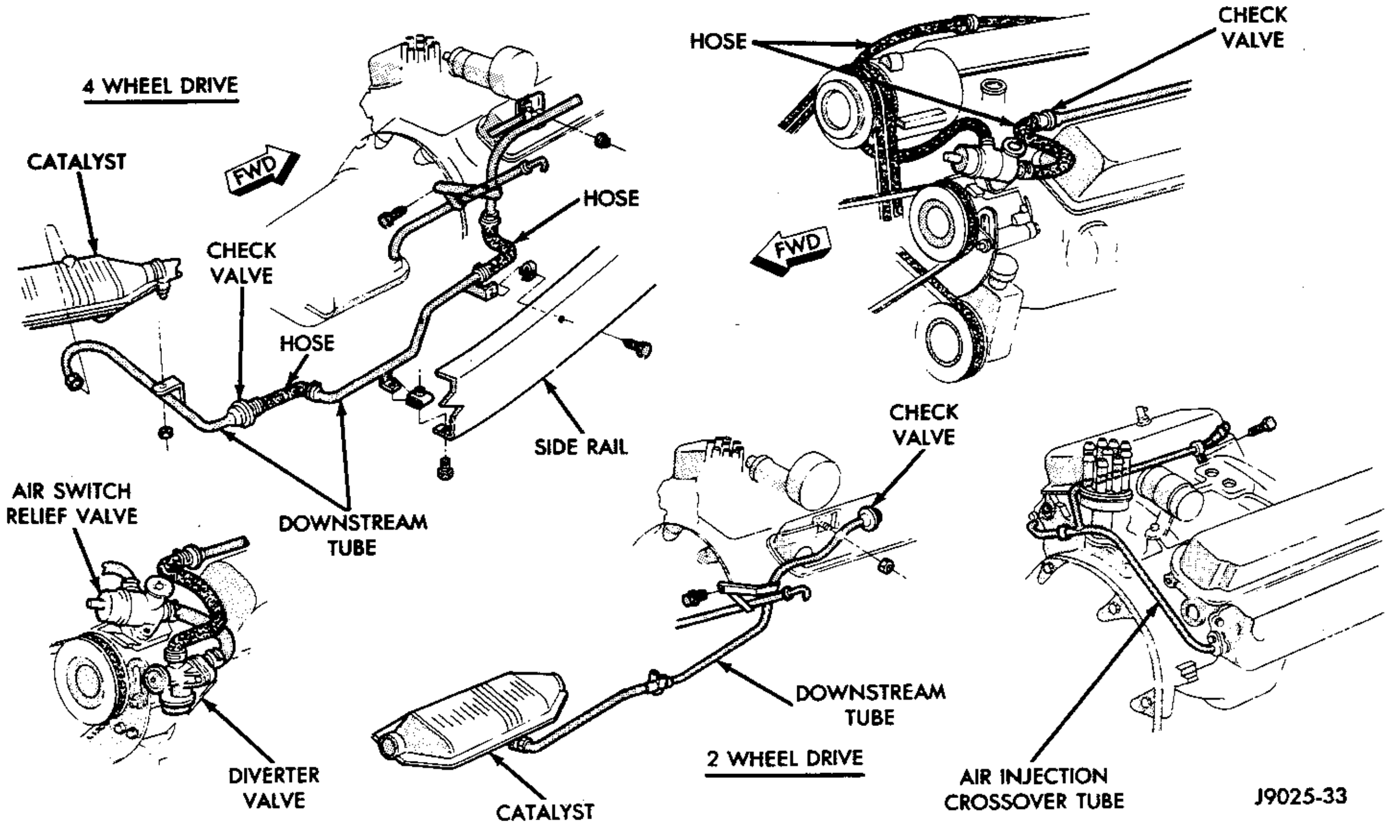

Fig. 3 Air Injection System—5.2L Engine and Light Duty Cycle 5.9L Engines

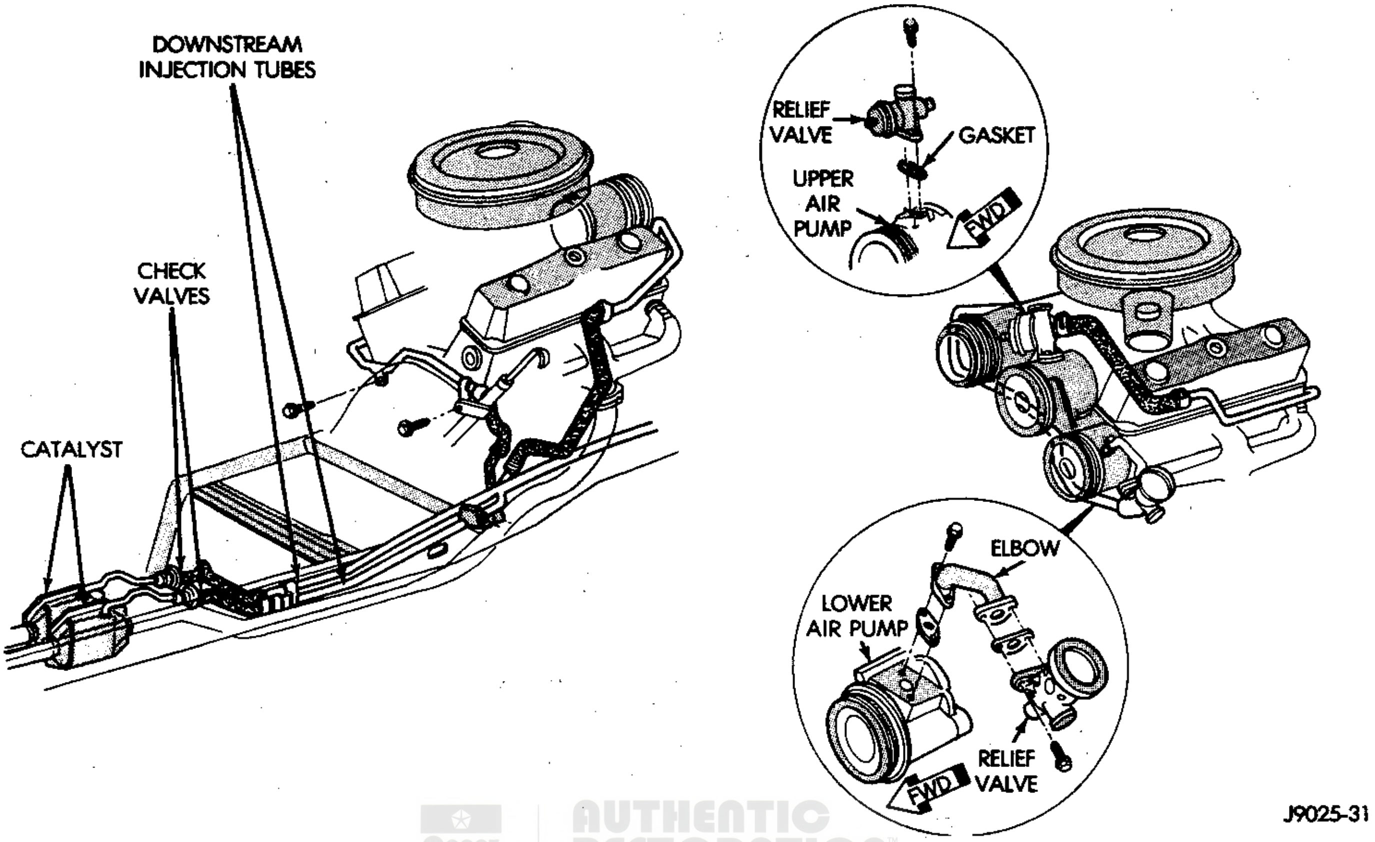

Fig. 4 Dual Air Pump System—5.9L Engine, Heavy Duty Cycle

(4) Install upper air pump assembly and tighten pivot and adjusting bolts loosely. Install air hose to diverter valve.

(5) Install accessory drive belt and adjust belt tension. Refer to Group 7, Cooling System. **Do not pry on air pump housing to adjust belt tension.** Tighten pivot and adjusting bolts to 41 N•m (30 ft. lbs.) torque.

CENTRIFUGAL FILTER FAN

REMOVAL

A damaged filter fan may be removed by inserting needle nose pliers between the plastic filter fins and breaking fan from hub. (Fig. 5). Care should be taken to prevent fragments from entering the air intake hole. Do not insert screwdriver blade between pump and filter. It is seldom possible to remove the fan without destroying it. Do not attempt to remove the metal drive hub.

INSTALLATION

Install the new filter fan by drawing it into position, using the belt pulley and pulley mounting screws. Draw the fan down evenly by alternately tightening the screws, ensuring that the outer edge of the fan slips into the housing (Fig. 6). A slight amount of interference with the housing bore is normal. Do not attempt to install a fan by hammering or pressing it on. After a new fan is installed, it may squeal upon initial operation until its outside diameter sealing lip has worn in. This may require 32-48 km (20-30 miles) of operation.

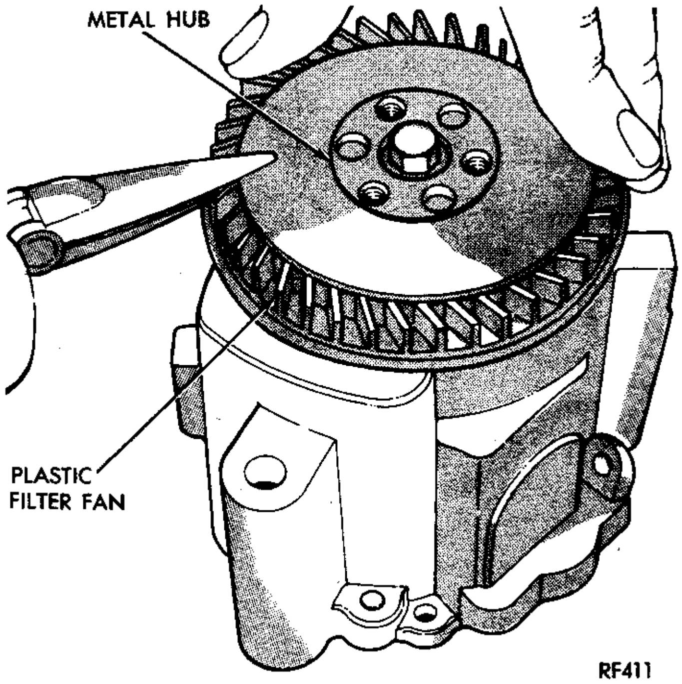

Fig. 5 Removing Centrifugal Filter Fan

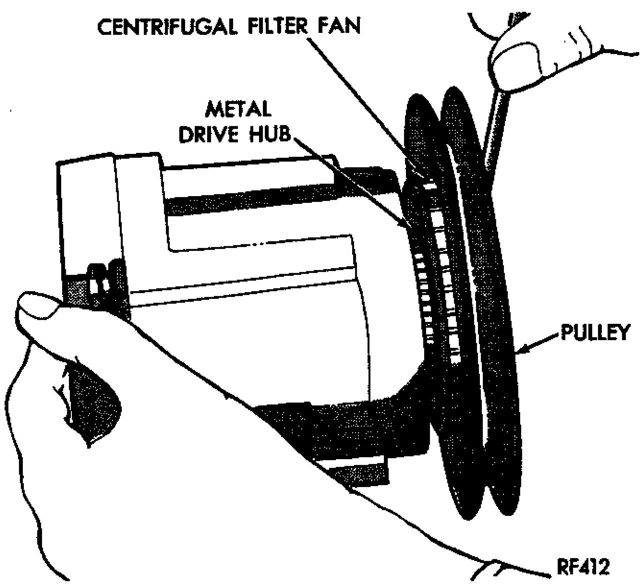

Fig. 6 Installing Centrifugal Filter Fan

DIVERTER VALVE

The diverter valve is not adjustable or serviceable. It must be replaced as a complete unit if it does not operate properly. An improperly operating diverter valve will make excessive noise. Either the relief valve or the diverter valve are not functioning normally if air escapes from the silencer at engine idle speed.

REMOVAL

(1) Remove air and vacuum hoses from the diverter valve (Fig. 2 or 3).

(2) Remove diverter valve mounting screws. Remove valve.

(3) Remove gasket material from diverter valve and mounting surface.

INSTALLATION

(1) Position new gasket on mounting surface.

(2) Position diverter valve on mounting flange and tighten mounting screws to 11 N•m (95 in. lbs.) torque.

(3) Reinstall air and vacuum hoses to diverter valve.

SWITCH/RELIEF VALVE

The switch/relief valve is not serviceable. If vacuum is applied to the valve and air injection is not upstream (to exhaust manifold crossover tube) or if air injection is both upstream and downstream, the valve is improperly operating and must be replaced. The relief valve is not functioning normally if air escapes from the silencer at engine idle speed.

REMOVAL

(1) Remove air and vacuum hoses from the air switch/relief valve (Fig. 2, 3 or 4).

(2) Remove valve mounting screws. Remove valve.

(3) Remove gasket material from valve and mounting flange.

INSTALLATION

(1) Position new gasket on mounting flange.

(2) Position valve on mounting flange and tighten mounting screws to 11 N•m (95 in. lbs.) torque.

(3) Install air and vacuum hoses to valve.

CHECK VALVE (Injection tube assemblies)

The check valve is not repairable and must be replaced with a new check valve. To determine if the valve is not functioning normally, remove the air hose from check valve inlet tube. If exhaust gas escapes from inlet tube, the valve must be replaced. If the exhaust manifold injection tube assembly joint is leaking, remove injection tube assembly and replace gasket material. If tube nut connection is leaking, tighten to 34-47 N•m (25-35 ft. lbs.) torque.

NON THREADED TYPE CHECK VALVE

Removal

(1) Release clamp and disconnect air hose from check valve inlet.

(2) Remove screws or tube nut securing injection tube to exhaust manifolds or exhaust pipe.

(3) Remove the injection tube assembly from engine.

(4) Remove gasket material from exhaust manifold and injection tube flanges.

Installation

(1) Install new gaskets on exhaust manifold flanges and install injection tube assembly. Tighten flange mounting and injection tube bracket screws to 12 N•m (100 in. lbs.) torque. On tube nut joint assemblies, install tube nut and tighten to 34-37 N•m (24-35 ft. lbs.) torque.

THREADED TYPE CHECK VALVE

Removal

Removal of the lower tube assembly may require removal of the upper air pump and A/C compressor. Refer to groups 24 and 25.

(1) Release clamp and disconnect air hose from the check valve inlet.

(2) Unscrew the check valve from the injection tube assembly.

Installation

(1) Install check valve on tube assembly. Tighten to 34 N•m (25 ft. lbs) torque.

(2) Install air hose to the check valve inlet and tighten clamp.


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