

**1979**

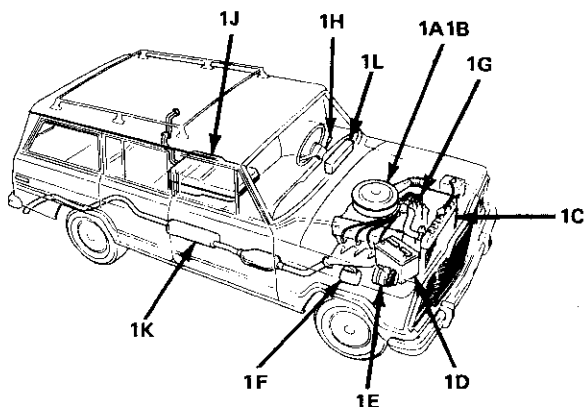


**TECHNICAL  
SERVICE  
MANUAL**

# 1979 JEEP TECHNICAL SERVICE MANUAL

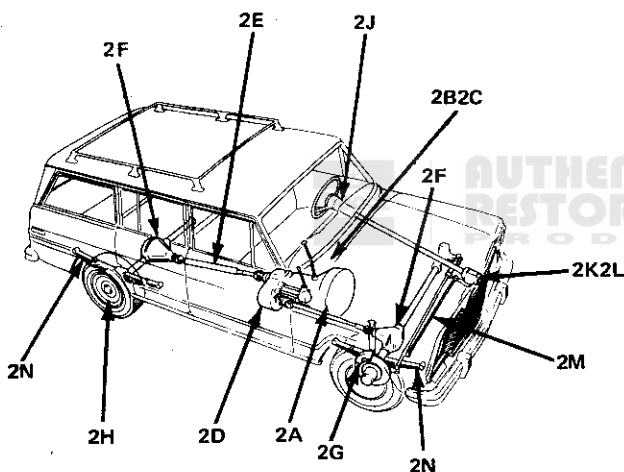
General Information

Maintenance



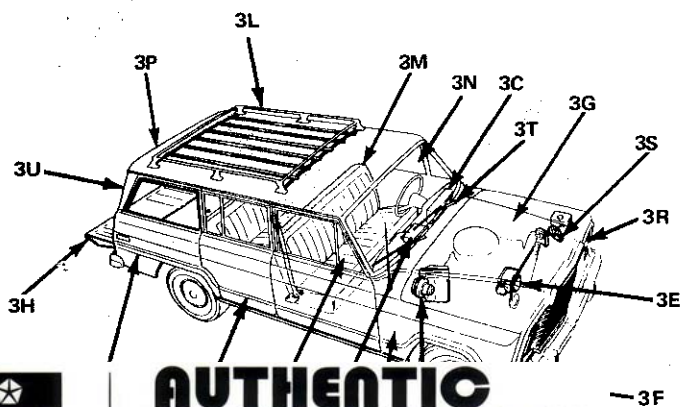
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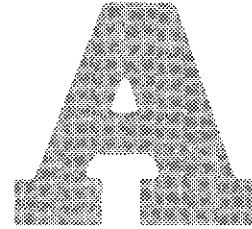
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# GENERAL INFORMATION



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## HOW TO USE THIS MANUAL

### Organization

This manual is divided into three major sections: Section 1—Power Plant, Section 2—Chassis, and Section 3—Body. These sections are comprised of chapters pertaining to the section topic. The Section Index at the front of this manual has a locator tab for each section.

The first page of each chapter in this manual contains a black tab in a position corresponding to the tab on the Chapter Index page for each section. To locate a desired chapter, simply fold back the manual slightly so that the outside edges of the pages are exposed. Find the black tab that aligns with the tab on the Chapter Index page and open to the desired chapter.

Each chapter begins with an alphabetical index of subjects. Locate the desired subject and turn to the appropriate page. If the subject is broad, the chapter is divided into sections and a subject index of each section is also included. An alphabetical index of all subjects is located at the back of this manual.

Each chapter ends with specifications, torque charts and special tools pertinent to that chapter.

### Warnings and Cautions

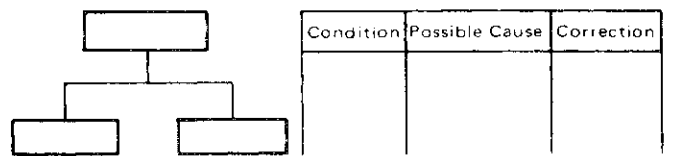
Detailed descriptions of standard workshop safety procedures are not included in this manual. This manual does contain **WARNINGS** for some service procedures that could cause personal injury, and **CAUTIONS** for some procedures that could damage the vehicle or its components. Please understand that these **WARNINGS** and **CAUTIONS** do not cover all conceivable ways which service might be done or all possible hazardous consequences of each conceivable way. Anyone using serv-

ice procedures or tools (whether or not recommended by Jeep Corporation) must satisfy himself that neither personal nor vehicle safety will be jeopardized by the procedures or tools selected.

### Diagnosis And Repair Simplification (DARS) Charts

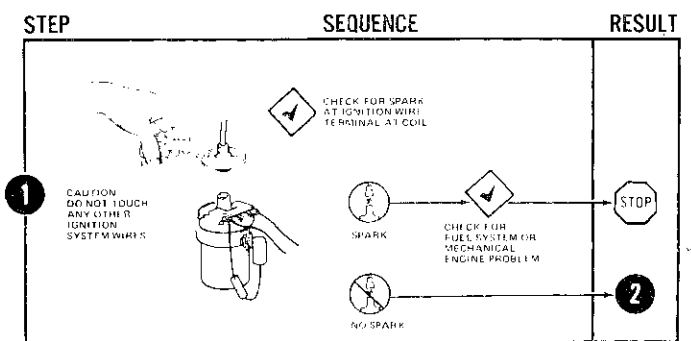
In several places throughout this manual, Jeep Corporation's new Diagnosis and Repair Simplification (DARS) charts provide a graphic method of diagnosis and troubleshooting through the use of pictures and symbols.

The DARS charts are different from the ones you have used before. They are not "go-no go" decision trees or tables.



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Instead, the new DARS charts use pictures plus a few words to help you solve a problem. . .



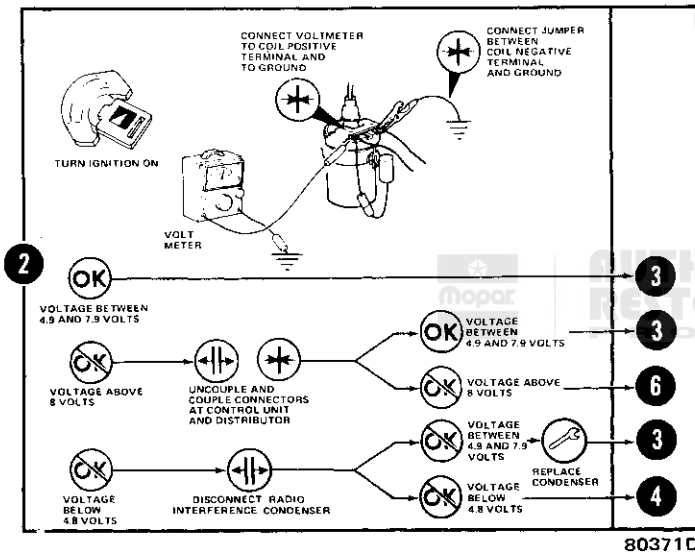
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## A-2 GENERAL INFORMATION

and symbols and words help guide you through each step...



The charts are divided into three sections: **step**, **sequence** and **result**. Always start at the first step and go through the complete sequence from left to right.



A sequence could be checking pressure in all tires and inflating to specified pressures. If the problem is solved, the symbol **OK** will send you to **STOP**. If the problem is not solved, the symbol **OK** will send you through another sequence of checks which ends with a result and tells you the next step to go to.

Work through each step of the DARS charts until the system is repaired **STOP**.

### Service Diagnosis Charts

You will also find Service Diagnosis Charts throughout this manual. These charts list causes of specific problems in descending order of probability. It is more likely that a problem would result from the first listed "possible cause" than the fourth, for instance.

Visual inspection often leads directly to the correct solution. All service procedures should begin with a careful visual inspection of any suspected part or assembly.

### Torque Information

Individual torque charts appear at the end of each chapter. Torque values are expressed two ways, Set-To and In-Use Recheck. The Set-To value is used when assembling components. The In-Use Recheck value is used to check pre-tightened items.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in this chapter for torques not listed in individual torque charts. Note that torque specifications given in the chart are based on use of clean and dry threads. Reduce torque by 10 percent when threads are lubricated with engine oil and by 20 percent if new, plated capscrews are used.

Standard Torque Specifications and Capscrew Markings Chart

CAPSCREW HEAD MARKINGS	CAPSCREW BODY SIZE Inches - Thread	SAE GRADE 1 or 2 (Used Infrequently)		SAE GRADE 5 (Used Frequently)		SAE GRADE 6 or 7 (Used at Times)		SAE GRADE 8 (Used Frequently)	
		Torque		Torque		Torque		Torque	
		Ft-Lb	Nm	Ft-Lb	Nm	Ft-Lb	Nm	Ft-Lb	Nm
<p>Manufacturer's marks may vary. Three-line markings on heads shown below, for example, indicate SAE Grade 5.</p>  	1/4-20	5	6.7791	8	10.8465	10	13.5582	12	16.2698
	-28	6	8.1349	10	13.5582			14	18.9815
	5/16-18	11	14.9140	17	23.0489	19	25.7605	24	32.5396
	-24	13	17.6256	19	25.7605			27	36.6071
	3/8-16	18	24.4047	31	42.0304	34	46.0978	44	59.6560
	-24	20	27.1164	35	47.4536			49	66.4351
	7/16-14	28	37.9629	49	66.4351	55	74.5700	70	94.9073
	-20	30	40.6745	55	74.5700			78	105.7538
	1/2-13	39	52.8769	75	101.6863	85	115.2445	105	142.3609
	-20	41	55.5885	85	115.2445			120	162.6960
	9/16-12	51	69.1467	110	149.1380	120	162.6960	155	210.1490
	-18	55	74.5700	120	162.6960			170	230.4860
	5/8-11	83	112.5329	150	203.3700	167	226.4186	210	284.7180
-18	95	128.8027	170	230.4860			240	325.3920	
3/4-10	105	142.3609	270	366.0660	280	379.6240	375	508.4250	
-16	115	155.9170	295	399.9610			420	569.4360	
7/8- 9	160	216.9280	395	535.5410	440	596.5520	605	820.2590	
-14	175	237.2650	435	589.7730			675	915.1650	
1- 8	235	318.6130	590	799.9220	660	894.8280	910	1233.7780	
-14	250	338.9500	660	894.8280			990	1342.2420	

## Torx-Head Fasteners

Various sizes of internal and external hex-lobular (Torx) head fasteners are used as attaching hardware on numerous components and assemblies in 1979 Jeep vehicles. Due to the ever-changing usage and application of automotive fasteners, Torx-head fasteners may not be identified as such throughout this manual. However, these fasteners may be removed or installed using Tool Set J-25359-02.

## Service Manual Improvements

You are encouraged to report any errors, omissions, or recommendations for improving this publication. A form provided for this purpose is included at the end of this chapter.

## 1979 MODEL JEEP VEHICLES

### CJ Models

Two CJ models are available for 1979: the 83.5-inch wheelbase CJ-5, model 83, and the 93.5-inch wheelbase CJ-7, model 93. See figures A-1 and A-2. Beyond the 10-inch difference in wheelbase, CJ-5 and CJ-7 differ primarily in available options. CJ-7 models are available with an automatic transmission, Quadra-Trac full-time 4-wheel drive, and a molded hardtop. These options are not available on CJ-5 models.

The Renegade Package continues to be offered on CJ models for 1979. It features new 9-inch by 15-inch tires mounted on 8-inch wide, styled-steel wheels along with unique exterior and interior trim.

The Golden Eagle trim package continues to be available on 1979 CJ models. The package includes unique exterior paint and decals, 9-inch by 15-inch tires mounted on 8-inch wide, slotted-steel wheels, rear mounted spare tire, roll bar, and deluxe interior with a clock and tachometer.

Refer to the Power Train Combinations Chart in this section for engine and transmission availability.

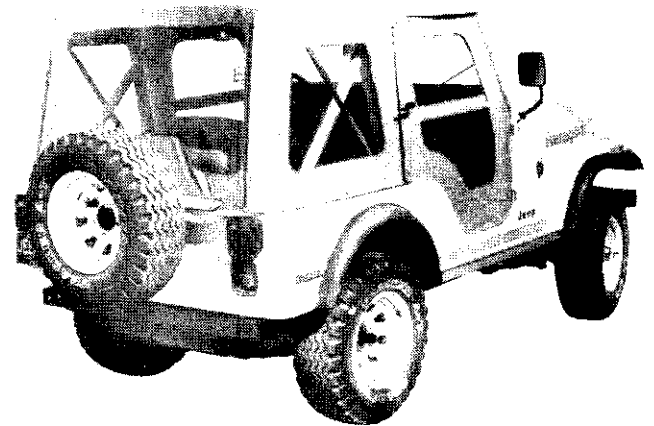
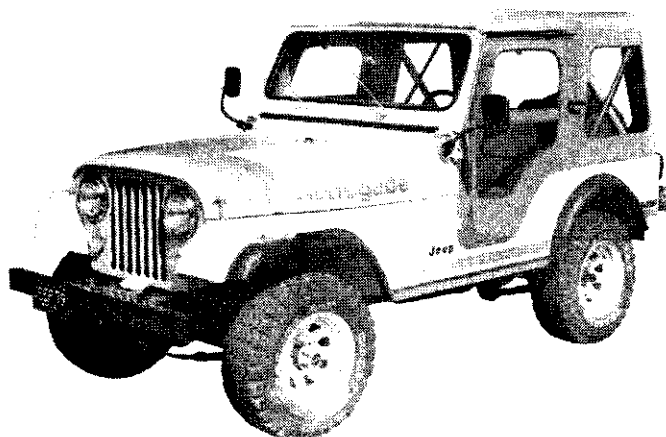


Fig. A-1 CJ-5 Model

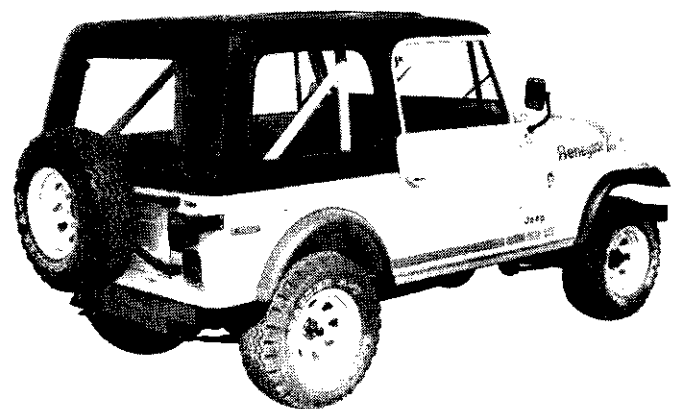
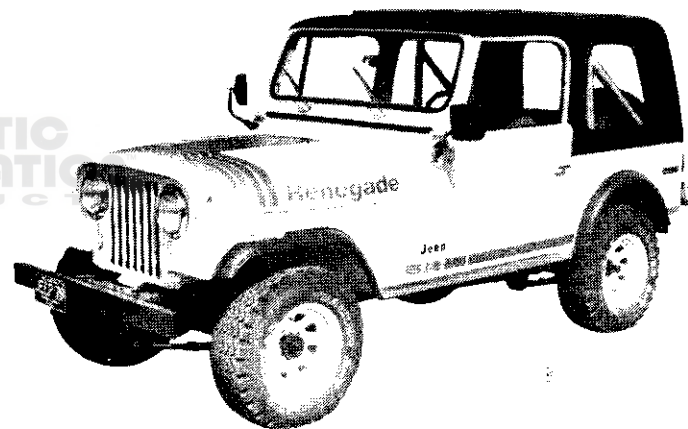


Fig. A-2 CJ-7 Model

### Cherokee Models

For 1979, three Cherokee models are offered: the base 2-door model 16, the Wide Track model 17, and the 4-door model 18. See figures A-3, A-4, and A-5.

## A-4 GENERAL INFORMATION

The 2-door model 16 is a dual purpose vehicle in the sports/utility class featuring an all-steel top, front disc brakes and fold-up rear seat as standard.

The Wide Track model 17 features steel wheel opening extensions to accommodate 10-inch by 15-inch tires mounted on 8-inch wide, styled-steel wheels.

The 4-door model 18 features the convenience of rear doors in a station wagon-type vehicle. The model 18 has the same grille and taillamps as other Cherokee models.

Two trim packages are offered for 1979 Cherokee models. The 'S' package is available on all Cherokee models. The Chief package is available on the model 17. Both trim packages feature deluxe interior trim and carpeting, chrome bumpers, and unique exterior trim.

Refer to the Power Train Combinations Chart in this section for engine and transmission availability.



Fig. A-3 Cherokee Model 16

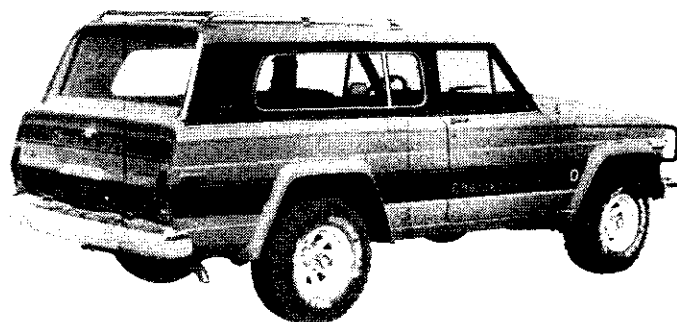
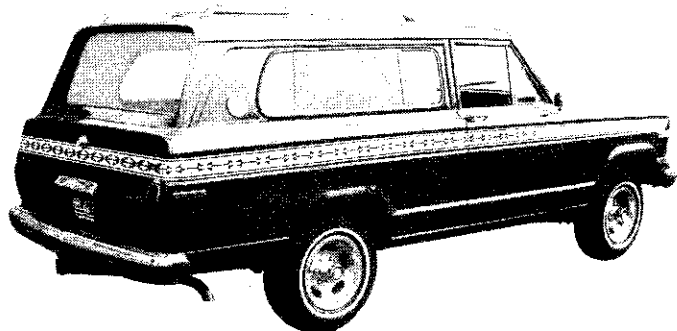


Fig. A-4 Cherokee Model 17

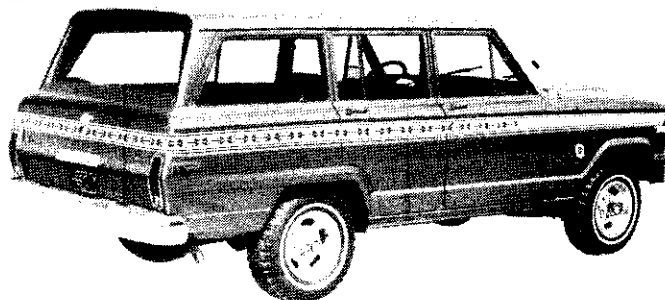
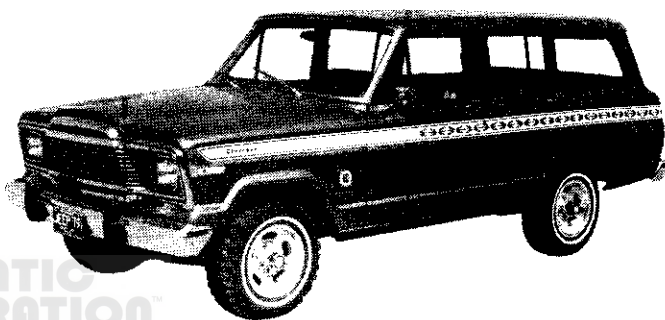


Fig. A-5 Cherokee Model 18

### Wagoneer Model

For 1979, one Wagoneer model is offered: the model 15. The 4-door Wagoneer station wagon features deluxe interior trim and carpeting, chrome bumpers, power steering, and automatic transmission with Quadra-Trac full-time 4-wheel drive as standard. See figure A-6. A luxury trim package, the Limited, is offered. It features a leather and corduroy interior, unique exterior wood-grain with vinyl surround mouldings, and forged aluminum wheels.

Refer to the Power Train Combinations Chart in this section for engine availability.

### Truck Models

Three Truck models are available in two series: the J-10 Series model 25 and model 45 and the J-20 Series model 46. See figures A-7 and A-8.

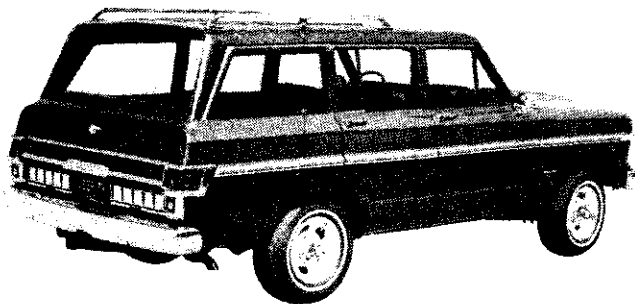


Fig. A-6 Wagoneer Model 15

The J-10 differs from the J-20 Series in Gross Vehicle Weight (GVW) Ratings. For 1979, the J-10 Series GVW for models 25 and 45 has been increased to 6200 while the J-20 model 46 GVW remains at 6800 with optional GVW ratings of 7600 and 8400.

Truck models are also identified by wheelbase. The model 25 has a 119-inch wheelbase; the model 45 and model 46 have a 131-inch wheelbase. The following chart outlines Truck differences by wheelbase and GVW rating.

**Truck Model Identification**

Series	Model Number	Wheelbase (Inches)	Gross Vehicle Weight Rating		
			Standard	Option 1	Option 2
J-10	25	119	6200	—	—
J-10	45	131	6200	—	—
J-20	46	131	6800	7600	8400

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Four trim packages are available on Truck models: Custom, Honcho, 10-4, and Golden Eagle. The Custom package is available on all Trucks and features deluxe interior and exterior trim. The Honcho package is only available on model 25 and features denim interior, unique exterior trim, and 10-inch by 15-inch tires mounted on 8-inch wide, styled-steel wheels. The 10-4 package features unique exterior decals.

The Golden Eagle trim package is available on 1979 J-10 Truck models. The package includes unique exterior paint and decals, 10-inch by 15-inch tires mounted on 8-inch wide, slotted-steel wheels, tubular steel grille guard, rear step bumper, off-road driving lamps and deluxe interior.

Refer to the Power Train Combinations Chart in this section for engine and transmission availability.

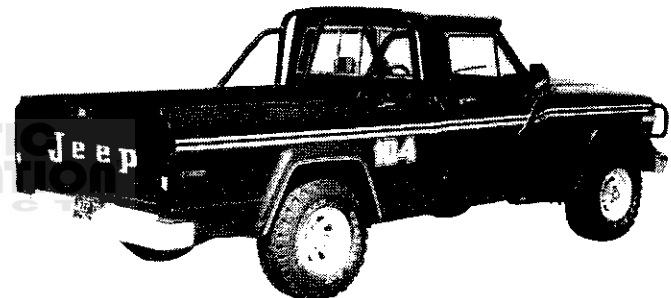
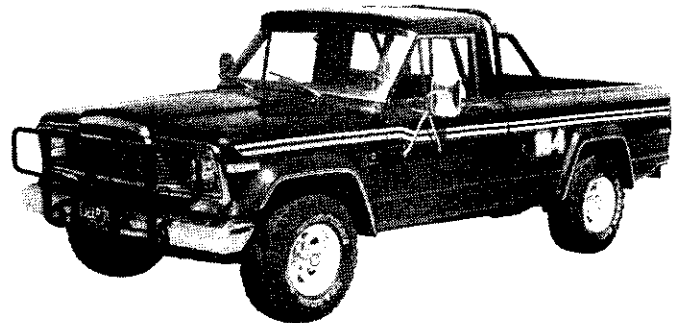


Fig. A-7 J-10 Truck Model 25

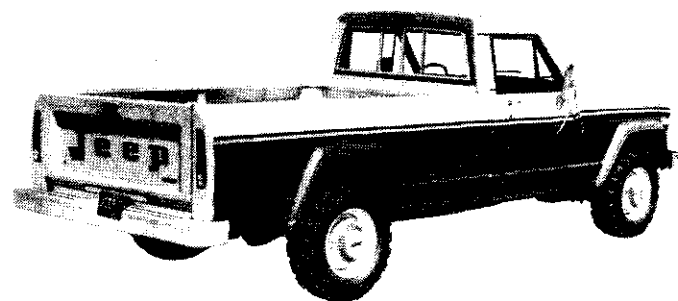
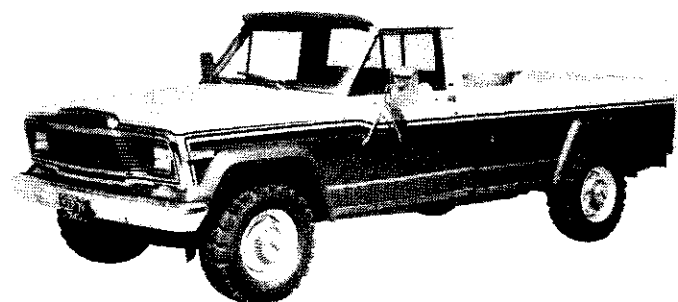


Fig. A-8 J-20 Truck Model 46

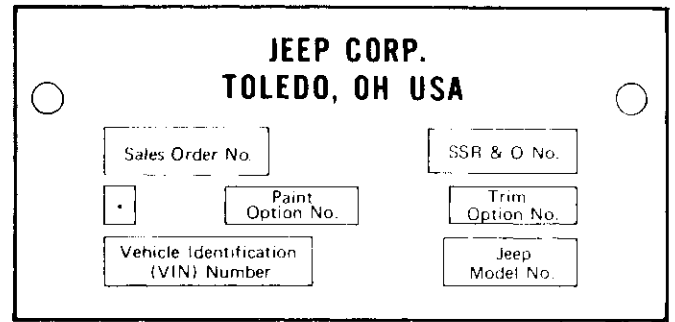


## A-6 GENERAL INFORMATION

### VEHICLE IDENTIFICATION

#### Vehicle Identification Plate

A metal vehicle identification plate is affixed to the left-hand side of the dash panel under the hood (fig. A-9). The plate shows the Sales Order Number; the Vehicle Identification Number (VIN); Special Sales Request & Order (SSR&O) Number; Paint Option Number; Trim Option Number; and the Jeep Model Number.



\*Disregard - for factory use only

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Fig. A-9 Vehicle Identification Plate

#### Vehicle Identification Number (VIN)

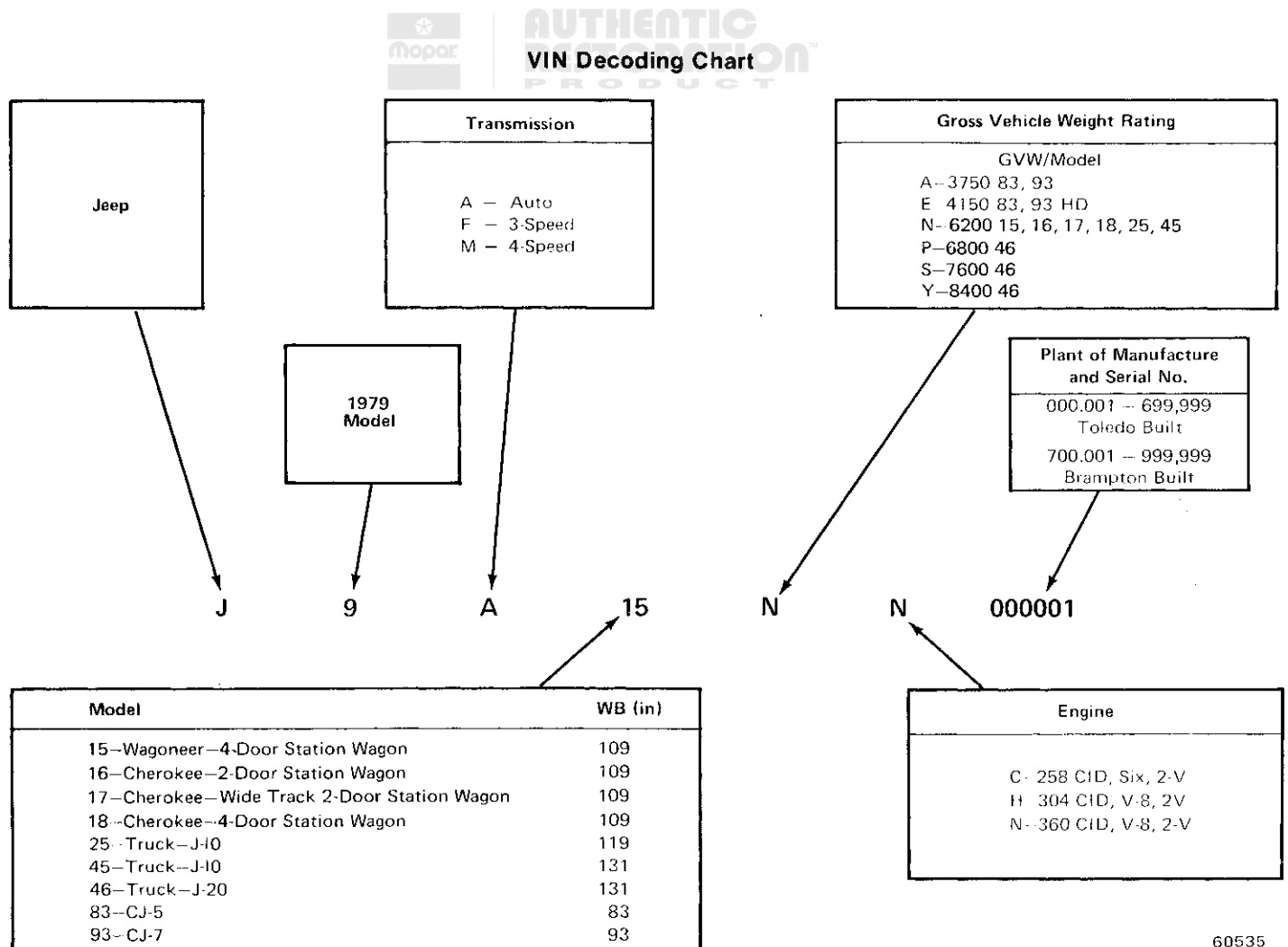
All Vehicle Identification Numbers contain 13 characters in a combination of letters and numbers that provide specific information about the vehicle. VIN's for all Jeep vehicles can be decoded using the following chart.

#### Special Sales Request and Order (SSR&O) Number

Certain Jeep vehicles are built to special order with other than standard parts or equipment. To assist the

dealer in ordering correct replacement parts, an SSR&O number is assigned and a permanent record of the deviation is maintained by the factory. The SSR&O number is embossed on the Vehicle Identification Plate as shown in figure A-9.

Parts ordering procedure for SSR&O parts is detailed in the Jeep Parts Catalog.



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**Paint Option Number**

The Paint Option Number is embossed on the Vehicle Identification Plate in the location shown in figure A-9.

Paint is not available from the factory. All colors shown below are available from Ditzler or Du Pont paint jobbers by requesting the paint intermix formula. All colors are available from Sherwin-Williams in factory package cans. Option No. 999 indicates special paint. To obtain information on special paint, contact your Jeep Parts Distribution Center and provide the Vehicle Identification Number (VIN).

**Paint Option Numbers**

Paint Option Number	Color
P1	Classic Black
6P	Firecracker Red
9A	Alpaca Brown Metallic
9B	Olympic White
9C	Russet Metallic
9E	Wedgewood Blue
9H	Cumberland Green Metallic
9J	Arrowhead Silver Metallic
9K	Sable Brown Metallic
9L	Saxon Yellow
9N	Morocco Buff
9P	Bordeaux Metallic
9T	Ensign Blue
9W	Mandarin Orange

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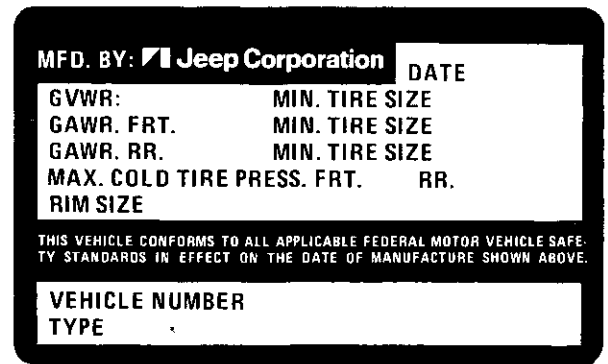
**Trim Option Number**

The Trim Option Number is embossed on the Vehicle Identification Plate as shown in figure A-9. Consult your Jeep Parts Catalog for trim ordering procedure. Special trim is indicated by trim option number 999. To obtain information on special trim, contact your Jeep Parts Distribution Center and provide the Vehicle Identification Number (VIN).

**Safety Certification Sticker**

A safety sticker is placed on all vehicles to show that they meet federal motor vehicle safety certification standards (fig. A-10). It lists the VIN, month and year built, Gross Vehicle Weight Rating (GVWR), and Gross Axle Weight Rating (GAWR).

The sticker is placed on the instrument panel on CJ-5 and CJ-7 models. On Cherokee-Wagoneer-Truck models, it is on the door lock pillar on the driver's side.



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Fig. A-10 Safety Sticker

**KEYS AND LOCKS**

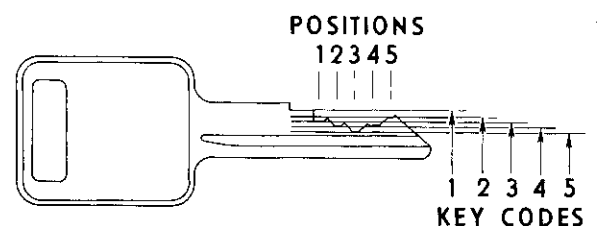
Two square-headed and two oval-headed keys are provided, as applicable, with each vehicle. The square-headed (code D) key operates the ignition switch, front door locks, and Cherokee-Wagoneer tailgates. The oval-headed (code E) key operates the glove box lock. Each key has a code number stamped on the knock-out plug. In the event a key is lost, a new key can be made by converting the key code number to a key biting number. Key biting numbers can be obtained from a key cutting machine manufacturer's cross-reference list or by contacting your Zone office.

**If a key is lost and the key code number is unknown,** the correct number can be identified by the Zone office from the vehicle identification number.

**If the ignition key is lost and the key code number is not available,** a new key can be made by removing a door lock and taking it to a locksmith. The locksmith can determine the key biting by inserting a blank key into the lock cylinder and cutting the blank to match the tumblers.

**If the ignition switch lock is defective and the key is available,** the cylinder and individual tumblers can be ordered and matched to the existing key. To determine the tumbler arrangement, place the key over the template (fig. A-11). Starting from the left, read across the horizontal lines and record first digit (number 1 position) of the key code. Continue this process for subsequent numbers 2 through 5.

**NOTE:** The template shown in figure A-11 may be used to determine the key biting code of a key for which the key code number is unknown.



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Fig. A-11 Key Coding Template

### TOWING

#### General

A conventional towing sling is recommended for use on all Jeep vehicles because of its stability and reduced likelihood of damage. The following instructions apply only to this device. When using other than sling-type towing equipment, be sure to follow the manufacturer's instructions.

A safety chain system that is completely independent of the lifting and towing attachment must be used. Be careful when installing safety chains so that they do not damage the vehicle.

If additional ground clearance is required, a towing dolly may be used. The end of the vehicle to be placed on the dolly should be lifted with the same equipment as when towing.

#### Front Towing—Front End Raised

Do not exceed a towing speed of 30 mph and do not exceed a towing distance of 15 miles. If this limit is not possible, disconnect the rear propeller shaft or place a dolly under the rear wheels.

If the vehicle is equipped with a manual transmission, shift transmission and transfer case into neutral.

If the vehicle is equipped with an automatic transmission, index and disconnect rear propeller shaft.

**WARNING:** *Never tow a Jeep vehicle with Emergency Drive control activated or reduction unit in low range (automatic transmission only).*

#### Rear Towing—Rear End Raised

Do not exceed a towing speed of 30 mph and do not exceed a towing distance of 15 miles. If this limit is not possible, disconnect the front propeller shaft or place a dolly under the front wheels.

If ignition key is available, turn ignition to Off position to unlock steering column. Clamp the steering wheel in the straight-ahead position. Do not use the steering column lock as a substitute for a clamping device.

If the ignition key is not available, place front wheels on a dolly.

If vehicle is equipped with selective drive hubs, set them in the LOCK position.

If vehicle is equipped with a manual transmission, shift transmission and transfer case into Neutral.

If vehicle is equipped with an automatic transmission, index and disconnect front propeller shaft.

**WARNING:** *Never tow a Jeep vehicle with the Emergency Drive control activated or reduction unit in low range (automatic transmission only).*

#### Safety Precautions

- Whenever possible, tow the vehicle from the rear to prevent damage to the transmission or rear axle.
- Secure loose or protruding parts of a damaged vehicle.
- The end of the vehicle being towed should be lifted a minimum of four inches off the ground. Check opposite end for adequate ground clearance.
- Always use a safety chain system that is independent of the lifting and towing attachment.
- Do not allow any of the towing equipment to bear on the fuel tank.
- Do not go under the vehicle while it is lifted by the towing equipment.
- Do not allow passengers to ride in a towed vehicle.
- Always observe all state and local laws regarding such items as warning signals, night illumination, speed, etc.
- Do not attempt a towing operation which could jeopardize the operator, any bystanders or other motorists.

**WARNING:** *Never tow a Jeep vehicle with the Emergency Drive control activated or reduction unit in low range (automatic transmission only).*

#### CJ Models

##### Front (Refer to Figure A-12)

Attach J-hooks over axle outboard of springs.  
Place tow bar under spring shackles.  
Attach safety chains around spring shackles.

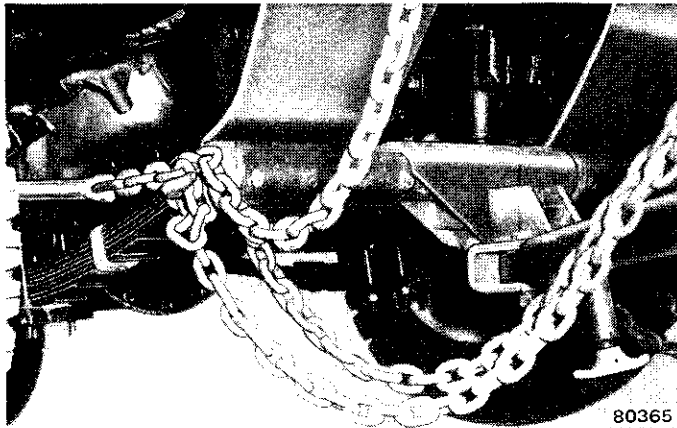


Fig. A-12 Front Towing—CJ Models

**Rear (Refer to Figure A-13)**

- Attach J-hooks around axle outboard of springs.
- Place tow bar under bumper plate.
- Attach safety chains around spring shackles.

**CAUTION:** To prevent damage to driveline members shift the transmission and transfer case into the correct position as outlined in the general towing instructions.

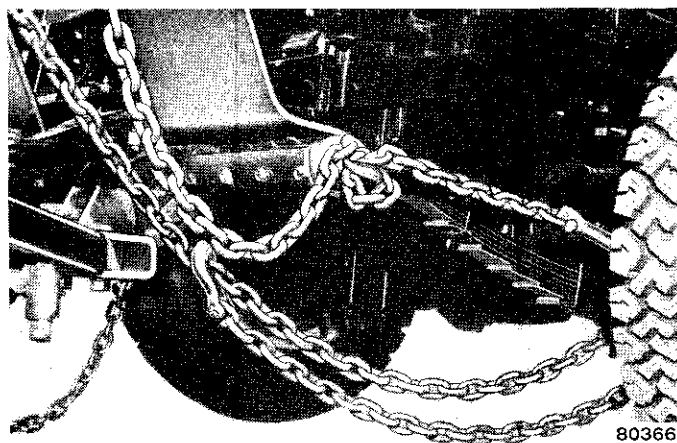


Fig. A-13 Rear Towing—CJ Models

**Cherokee and Wagoneer**

**Front (Refer to Figure A-14)**

- Attach J-hooks around axle outboard of shock absorbers.
- Place tow bar under spring shackles.
- Attach safety chains around spring shackles.

**CAUTION:** To prevent damage to driveline members, shift the transmission and transfer case into the correct position as outlined in the general towing instructions.

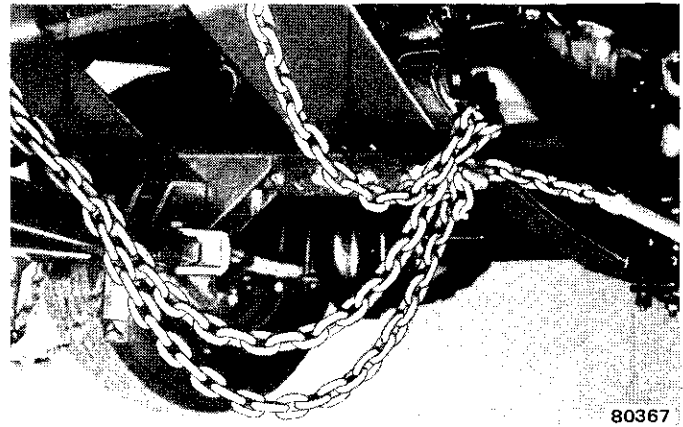


Fig. A-14 Front Towing—Cherokee and Wagoneer Models

**Rear (Refer to Figure A-15)**

- Attach J-hooks around axle outboard of shock absorber brackets.
- Place tow bar under bumper.
- Attach safety chains around frame rails.

**CAUTION:** To prevent damage to driveline members, shift the transmission and transfer case into the correct position as outlined in the general towing instructions.

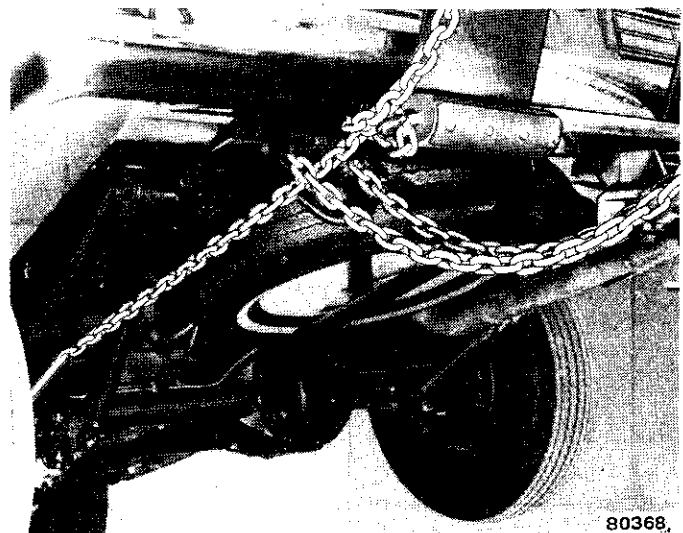


Fig. A-15 Rear Towing—Cherokee and Wagoneer Models

## A-10 GENERAL INFORMATION

### Truck Models

#### Front (Refer to Figure A-16)

Attach J-hooks around axle outboard of shock absorbers.

Place tow bar under spring shackles.

Attach safety chains around spring shackles.

**CAUTION:** To prevent damage to driveline members, shift the transmission and transfer case into the correct position as outlined in the general towing instructions.

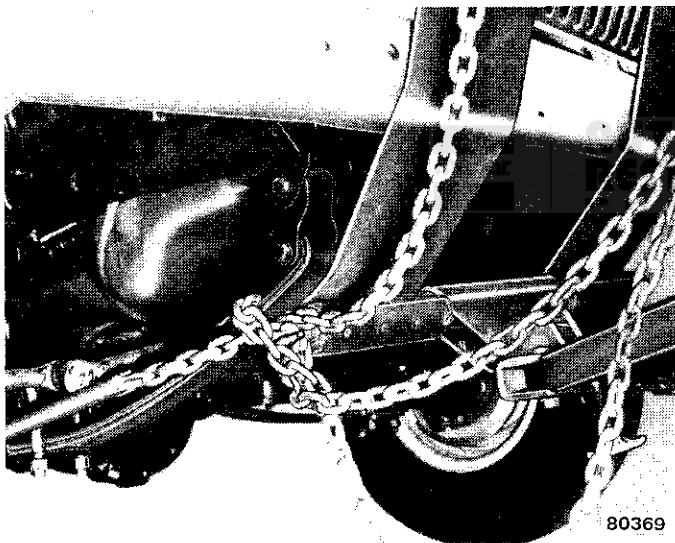


Fig. A-15 Front Towing—Truck Models

#### Rear (Refer to Figure A-16)

Attach J-hooks around axle outboard of shock absorbers.

Place tow bar under frame cross rail.

Attach safety chains around spring shackles.

**CAUTION:** To prevent damage to driveline members, shift the transmission and transfer case into the correct position as outlined in the general towing instructions.

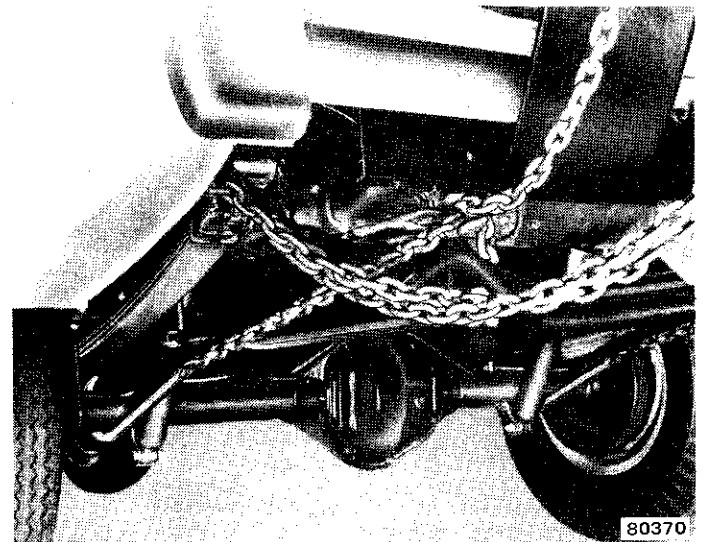


Fig. A-17 Rear Towing—Truck Models

### CONVERSION OF ENGLISH AND METRIC MEASURES

**Cubic Centimeters to Inches:** To change cubic centimeters to cubic inches, multiply cubic centimeters by 0.061 (cc x 0.061 equals cubic inch).

**Cubic Inches to Centimeters:** To change cubic inches to cubic centimeters, multiply cubic inches by 16.39 (cubic inch x 16.39 equals cc).

**Liters to Cubic Inches:** To change liters to cubic inches, multiply liters by 61.02 (liter x 61.02 equals cubic inches).

**Cubic Inches to Liters:** To change cubic inches to liters, multiply cubic inches by 0.01639 (cubic inches x 0.01639 equals liters).

**Cubic Centimeters to Liters:** To change centimeters to liters, divide by 1000 (simply move the decimal point three figures to the left).

**Liters to Cubic Centimeters:** To change liters to cubic centimeters, move the decimal point three figures to the right.

**Miles to Kilometers:** To change miles to kilometers, multiply miles by 1.609 (miles x 1.609 equals kilometers).

**Kilometers to Miles:** To change kilometres to miles, multiply kilometers by 0.6214 (kilometers x 0.6214 equals miles).

**Pounds to Kilograms:** 1 pound equals 0.4536 kg.

**Kilograms to Pounds:** 1 kg equals 2.2046 pounds.

**Metric System-SI**

The International System of Units (Système International d'Unités) officially abbreviated "SI" in all languages – the modern metric system

QUANTITY	EXAMPLES OF APPLICATIONS	METRIC UNIT	SYMBOL	QUANTITY	EXAMPLES OF APPLICATIONS	METRIC UNIT	SYMBOL
Length	Dimensions	meter	m	Celsius Temperature	General use	degree Celsius	°C
	Tire rolling circumference			Thermodynamic Temperature	General use	kelvin	k
	Turning circle/radius			Electric Current	General use	ampere milliampere microampere	A mA µA
	Braking distance			Potential Difference (Electromotive Force)	General use	kilovolt volt millivolt microvolt	kV V mV µV
Area	Greater than 999 meter	kilometer	km	Electric Resistance	General use	megohm kilohm ohm	MΩ kΩ Ω
	Dimensions	millimeter	mm	Electric Capacitance	General use	farad microfarad picofarad	F µF pF
Volume	Depth of surface finish	micrometer	µm	Fuel Consumption	Vehicle performance	liter per 100 kilometer	l/100 km
	Glass & Fabrics	square centimeter	cm <sup>2</sup>	Oil Consumption	Vehicle performance	liter per 1000 kilometer	l/1000 km
Volume Flow	Brake & Clutch linings			Stiffness	Linear stiffness	kilonewton meter	kN/m
	Radiator area etc.			Tire Revolutions	Tire Data	revolution per kilometer	rev/km
Volume	Small areas	square millimeter	mm <sup>2</sup>	Pressure	Tire Coolant Lubricating oil Fuel pump delivery Engine compression Manifold Brake line (hydraulic) Car heating & ventilation Barometric pressure	kilopascal	kPa
	Car Luggage Capacity	cubic meter	m <sup>3</sup>	Luminous Intensity	Bulbs	candela	cd
Volume	Engine Capacity	liter	l	Accumulator Storage Rating	Battery	ampere hour	A-h
	Vehicle fluid capacity	cubic centimeter	cm <sup>3</sup>				
Time Interval	Gas & Liquid	liter per second	l/s				
	Measurement of elapsed time	second minute hour day	s min h d				
Velocity	General use	meter per second	m/s				
	Road speed	kilometer per hour	km/h				
Acceleration & Deceleration	General use	meter per second squared	m/s <sup>2</sup>				
	Electronics	hertz kilohertz megahertz	Hz kHz MHz				
Rotational Speed	General use	revolution per minute revolution per second	rpm rps				
	Vehicle mass	megagram	t				
Mass	Legal load rating	kilogram	kg				
	General use	gram milligram	g mg				
Density	Small masses						
	General use	kilogram per cubic meter gram per cubic centimeter kilogram per liter	kg/m <sup>3</sup> g/cm <sup>3</sup> kg/l				
Force	Pedal effort	newton	N				
	Clutch spring force Handbrake lever effort etc.						
Moment of Force (Torque)	Torque	newton meter	N-m				
	General use	watt	W				
Power, Heat Flow Rate	Bulbs	kilowatt	kW				
	Alternator output Engine performance Starter performance						

U.S.A./METRIC COMPARISON			
QUANTITY	USA	METRIC – SYMBOL	
Length	Inch-Foot-Mile	Meter	m
Weight (mass)	Ounce-Pound	Kilogram	Kg
Area	Square inch/Foot	Square Meter	m <sup>2</sup>
Volume-Dry	Cubic inch/Foot	Cubic Meter	m <sup>3</sup>
	-Liquid	Ounce-Pint-Quart-Gallon	Liter
Velocity	Feet Per Second	Meter per Second	m/s
Road Speed	Miles Per Hour	Kilometer per Hour	km/h
Force	Pound-Force	Newton	N
Torque	Foot-Pounds	Newton meter	N-m
Power	Horsepower	Kilowatt	kW
Pressure	Pounds Per Square Inch	Kilopascal	kPa
Temperature	Degrees Fahrenheit	Degrees Kelvin and Celsius	K °C

# A-12 GENERAL INFORMATION

## Power Train Combinations—1979 CJ Models

Series	GVWR	Engine	Transmission			Transfer Case		Clutch (Inches)	Axle Ratio		Trac-Lok (2)	Axle Model		Brakes (Inches)		Standard Wheels
			3 T-150	4 T-18	A	20	QT		3.07			Front	Rear	Front	Rear	
CJ-5 Model 83 83.5-Inch Wheelbase	Soft Top 3750	6-258-2V (3)	S	O	NA							Dana 30 Open End	AMC/ Jeep	11.7 Inch Disc Std.	11 x 2 Drum	15 x 6 5 Bolt 5.50 B.C.
	Hard Top 4150 (1)	304-2V	S	O	NA			10.5	O(2)	S	O					
CJ-7 Model 93 93.4-Inch Wheelbase	Soft Top 3750	6-258-2V	S	NA		S		10.5				Dana 30 Open End	AMC/ Jeep	11.7 Inch Disc Std.	11 x 2 Drum	15 x 6 5 Bolt 5.50 B.C.
					O(3)		S									
	Hard Top 4150 (1)	304.2V	S	O		S		10.5	O	S	O					
					O		S									

Notes:

(1) 4150 GVW Optional with Specific Suspension components-Mandatory GVW with full enclosures.

(2) Not available with Q.T.  
(3) NA with Altitude Package

Abbreviations:

B.C. - Bolt Circle  
GVWR - Gross Vehicle Weight Rating  
O - Optional Equipment  
QT - Quadra-Trac  
S - Standard Equipment

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## Power Train Combinations—1979 Cherokee-Wagoneer-Truck Models

Series	Engine	Transmission			Transfer Case		Clutch (Inches)	Axle Ratio (2)					Trac-Lok (3)	Axle Model		Brakes		Standard Wheels
		3(T 15 A)	4(T 18)	A	20	QT		3.07	3.54	3.73	4.09	4.88		Front	Rear	Front	Rear	
Cherokee Models 16, 17 & 18 108.7 - Inch Wheelbase 6200 GVWR	6-258-2V (1) (4)	S			S		11.0						O					
				O		S		11.0	O	S					Dana Open End	Dana 44	12 - Inch Disc	11x2 Drum
	360-2V	S(1)			S(1)		11.0(1)						O					
			O(1)		S(1)			O	S									
Wagoneer Model 15 109 - Inch Wheelbase 6200 GVWR	360-2V			S		S							O	Dana Open End	Dana 44	12 - Inch Disc	11x2 Drum	15 x 6 6 Bolt 5.50 B.C.
J - 10 Truck Model 25 119 - Inch Wheelbase Model 45 131 - Inch Wheelbase 6200 GVWR	6-258-2V (1) (4)	S			S		11.0						O					
				O		S		11.0	O	S					Dana Open End	Dana 44	12 - Inch Disc	11x2 Drum
	360-2V	S(1)			S(1)		11.0(1)						O					
			O(1)		S(1)			O	S									
J - 20 Truck Model 46 130.7 - Inch Wheelbase 6800 GVWR 7600 Opt. 8400 Opt.	360-2V	S(1)			S(1)		11.0(1)						O	Dana Open End	Dana 60	12.5 Inch Disc	12x 2.50 Drum	16.5 x 6.75 8 Bolt 6.50 B.C.

Notes:

(1) NA California  
(2) 4.88 Ratio Available Trac-Lok Only  
(3) NA with QT  
(4) Low range NA with QT

Abbreviations:

B.C. - Bolt Circle  
GVWR - Gross Vehicle Weight Rating  
NA - Not Available  
O - Optional Equipment  
S - Standard Equipment

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General Dimensions— Inches (mm)

	CJ Models		Cherokee Models			Wagoner Models	Truck Models		
	CJ-5	CJ-7	Model 16 2-Dr.	Model 17 2-Dr.	Model 18 4-Dr.	Model 15	J-10 Series		J-20 Series
							Model 25	Model 45	Model 46
Wheelbase	83.5(212.0)	93.5(237.5)	108.7(276.1)	108.7(276.1)	108.7(276.1)	108.7(276.1)	118.7(301.5)	130.7(332.0)	130.7(332.0)
Overall Length	138.4(402.3)	147.9(375.7)	183.5(466.1)	183.5(466.1)	183.5(466.1)	183.5(466.1)	192.5(489.0)	204.5(519.4)	204.5(519.4)
Overhang									
Front	23.5(59.7)	23.5(59.7)	29.9(75.9)	29.9(75.9)	29.9(75.9)	29.9(75.9)	29.9(75.9)	29.9(75.9)	29.9(75.9)
Rear	31.4(79.8)	30.9(78.5)	44.9(114.0)	44.9(114.0)	44.9(114.0)	44.9(114.0)	43.9(111.5)	43.9(111.5)	43.9(111.5)
Overall Width	68.6(174.2)	68.6(174.2)	75.6(192.0)	78.9(200.4)	75.6(192.0)	75.6(192.0)	78.9(200.4)	78.9(200.4)	78.9(200.4)
Overall Height									
Open Body	67.6(171.7)	67.6(171.7)	66.9(169.9)	67.6(171.7)	66.9(169.9)	66.7(169.4)	69.3(176.0)	69.1(175.5)	70.7(179.6)
Soft Top	71.4(181.4)	71.3(181.1)	—	—	—	—	—	—	—
Hard Top	71.3(181.1)	70.5(179.1)	—	—	—	—	—	—	—
Step Height									
Front	27.0(68.6)	26.1(66.3)	19.9(50.5)	20.7(52.6)	19.9(50.5)	19.9(50.5)	20.7(52.6)	20.7(52.6)	22.1(56.1)
Rear	—	—	—	—	20.8(52.8)	20.8(52.8)	—	—	—
Front Tread	51.5(130.8)	51.5(130.8)	59.2(150.4)	65.4(166.1)	59.2(150.4)	59.4(150.9)	63.3(160.8)	63.3(160.8)	64.6(164.1)
Rear Tread	50.0(127.0)	50.0(127.0)	57.8(146.8)	62.3(158.2)	57.8(146.8)	57.8(146.8)	63.8(162.1)	63.8(162.1)	65.9(167.4)
Minimum Ground Clearance	6.9(17.5)	6.9(17.5)	7.7(19.6)	8.6(21.8)	7.7(19.6)	7.7(19.6)	7.7(19.6)	7.7(19.6)	8.1(20.6)
Min. Turning Diameter-feet(m)	34.1(10.4)	38.0(11.6)	37.7(11.5)	39.4(12.0)	37.7(11.5)	37.7(11.5)	40.6(12.4)	44.5(13.6)	44.5(13.6)
Effective Leg Room									
Front (Accelerator)	37.9(96.3)	39.1(99.3)	41.9(106.4)	41.9(106.4)	41.9(106.4)	41.3(104.9)	41.3(104.9)	41.3(104.9)	41.3(104.9)
Rear (Minimum)	30.5(77.5)	35.0(88.9)	37.0(94.0)	37.0(94.0)	37.0(94.0)	37.0(94.0)	—	—	—
Hip Room									
Front	55.4(140.7)	53.8(136.7)	60.5(153.7)	60.5(153.7)	60.5(153.7)	60.5(153.7)	60.5(153.7)	60.5(153.7)	60.5(153.7)
Rear	36.0(91.4)	36.0(91.4)	60.9(154.7)	60.9(154.7)	60.9(154.7)	60.9(154.7)	—	—	—
Shoulder Room									
Front	55.4(140.7)	53.8(136.7)	58.3(148.1)	58.3(148.1)	58.3(148.1)	58.3(148.1)	58.3(148.1)	58.3(148.1)	58.3(148.1)
Rear	55.4(140.7)	56.3(143.0)	58.3(148.1)	58.3(148.1)	58.3(148.1)	58.3(148.1)	—	—	—
Effective Head Room									
Front	—	—	38.0(96.5)	38.0(96.5)	38.0(96.5)	38.0(96.5)	40.2(102.1)	40.2(102.1)	40.2(102.1)
Soft Top	39.8(101.1)	40.6(103.1)	—	—	—	—	—	—	—
Hard Top	40.8(103.6)	39.9(101.3)	—	—	—	—	—	—	—
Rear Hard Top	40.9(103.9)	39.6(100.6)	37.2(94.5)	37.2(94.5)	37.2(94.5)	37.2(94.5)	—	—	—
Cargo Floor Height	25.2(64.0)	25.1(63.8)	24.9(63.2)	25.6(65.0)	24.9(63.2)	24.7(62.7)	26.8(68.0)	26.4(67.0)	28.2(71.6)
Cargo Capacity-cubic feet (l)	10.2(288.8)*	13.6(385.1)*	95.1(2692.9)*	95.1(2692.9)*	95.1(2692.9)*	95.1(2692.9)*	68.0(1925.5)	77.7(2200.2)	77.7(2200.2)
Cargo Space									
Overall Length	—	—	—	—	—	—	86.5(219.7)	98.5(250.2)	98.5(250.2)
Length at Floor	40.2(102.1)	46.8(118.9)	81.6(207.3)	81.6(207.3)	81.6(207.3)	81.6(207.3)	84.3(214.1)	96.3(244.6)	96.3(244.6)
Width at Wheelhouse	36.0(91.4)	36.0(91.4)	44.3(112.5)	44.3(112.5)	44.3(112.5)	44.3(112.5)	50.0(127.0)	50.0(127.0)	50.0(127.0)
Width at Floor	36.0(91.4)	36.0(91.4)	60.9(154.7)	60.9(154.7)	60.9(154.7)	60.9(154.7)	68.0(172.7)	68.0(172.7)	68.0(172.7)
Width of Tailgate Opening	35.8(90.9)	34.5(87.6)	54.9(139.4)	54.9(139.4)	54.9(139.4)	54.9(139.4)	57.2(145.3)	57.2(145.3)	57.2(145.3)
Height of Sides and Tailgate	—	—	—	—	—	—	20.5(52.1)	20.5(52.1)	20.5(52.1)

\*With rear seat removed.



# A-14 GENERAL INFORMATION

## Decimal Equivalents

Milli-meter	Decimal	Fraction	Drill Size	Milli-meter	Decimal	Fraction	Drill Size	Milli-meter	Decimal	Fraction	Drill Size	Milli-meter	Decimal	Fraction	Drill Size	Milli-meter	Decimal	Fraction
.1	.0039			1.75	.0689			4.0	.1570		22	6.8	.2677			10.72	.4219	27/64
.15	.0059				.0700		50		.1575			6.9	.2716			11.0	.4330	
.2	.0079			1.8	.0709				.1590		21		.2720		I	11.11	.4375	7/16
.25	.0098			1.85	.0728				.1610		20	7.0	.2756			11.5	.4528	
.3	.0118				.0730		49	4.1	.1614				.2770		J	11.51	.4531	29/64
	.0135		80	1.9	.0748			4.2	.1654			7.1	.2795			11.91	.4687	15/32
.35	.0138				.0760		48		.1660		19		.2811		K	12.0	.4724	
	.0145		79	1.95	.0767			4.25	.1673			7.14	.2812	9/32		12.30	.4843	31/64
.39	.0156	1/64		1.98	.0781	5/64		4.3	.1693			7.2	.2835			12.5	.4921	
.4	.0157				.0785		47		.1695		18	7.25	.2854			12.7	.5000	1/2
	.0160		78	2.0	.0787			4.37	.1719	11/64		7.3	.2874			13.0	.5118	
.45	.0177			2.05	.0807				.1730		17		.2900		L	13.10	.5156	33/64
	.0180		77		.0810		46	4.4	.1732			7.4	.2913			13.49	.5312	17/32
.5	.0197				.0820		45		.1770		16		.2950		M	13.5	.5315	
	.0200		76	2.1	.0827			4.5	.1771			7.5	.2953			13.89	.5469	35/64
	.0210		75	2.15	.0846				.1800		15	7.54	.2968	19/64		14.0	.5512	
.55	.0217				.0860		44	4.6	.1811			7.6	.2992			14.29	.5625	9/16
	.0225		74	2.2	.0866				.1820		14		.3020		N	14.5	.5709	
.6	.0236			2.25	.0885			4.7	.1850		13	7.7	.3031			14.68	.5781	37/64
	.0240		73		.0890		43	4.75	.1870			7.75	.3051			15.0	.5906	
	.0250		72	2.3	.0905			4.76	.1875	3/16		7.8	.3071			15.08	.5937	19/32
.65	.0256			2.35	.0925			4.8	.1890		12	7.9	.3110			15.48	.6094	39/64
	.0260		71		.0935		42		.1910		11	7.94	.3125	5/16		15.5	.6102	
	.0280		70	2.38	.0937	3/32		4.9	.1929			8.0	.3150			15.88	.6250	5/8
.7	.0276			2.4	.0945				.1935		10		.3160		O	16.0	.6299	
	.0292		69		.0960		41		.1960		9	8.1	.3189			16.27	.6406	41/64
.75	.0295			2.45	.0964			5.0	.1968			8.2	.3228			16.5	.6496	
	.0310		68		.0980		40		.1990		8		.3230		P	16.67	.6562	21/32
.79	.0312	1/32		2.5	.0984			5.1	.2008			8.25	.3248			17.0	.6693	
.8	.0315				.0995		39		.2010		7	8.3	.3268			17.06	.6719	43/64
	.0320		67		.1015		38	5.16	.2031	13/64		8.33	.3281	21/64		17.46	.6875	11/16
	.0330		66	2.6	.1024				.2040		6	8.4	.3307			17.5	.6890	
.85	.0335				.1040		37	5.2	.2047				.3320		Q	17.86	.7031	45/64
	.0350		65	2.7	.1063				.2055		5	8.5	.3346			18.0	.7087	
.9	.0354				.1065		36	5.25	.2067			8.6	.3386			18.26	.7187	23/32
	.0360		64	2.75	.1082			5.3	.2086				.3390		R	18.5	.7283	
	.0370		63	2.78	.1094	7/64			.2090		4	8.7	.3425			18.65	.7344	47/64
.95	.0374				.1100		35	5.4	.2126			8.73	.3437	11/32		19.0	.7480	
	.0380		62	2.8	.1102				.2130		3	8.75	.3445			19.05	.7500	3/4
	.0390		61		.1110		34	5.5	.2165			8.8	.3465			19.45	.7656	49/64
1.0	.0394				.1130		33	5.56	.2187	7/32			.3480		S	19.5	.7677	
	.0400		60	2.9	.1141			5.6	.2205			8.9	.3504			19.84	.7812	25/32
	.0410		59		.1160		32		.2210		2	9.0	.3543			20.0	.7874	
1.05	.0413			3.0	.1181			5.7	.2244				.3580		T	20.24	.7969	51/64
	.0420		58		.1200		31	5.75	.2263			9.1	.3583			20.5	.8071	
	.0430		57	3.1	.1220				.2280		1	9.13	.3594	23/64		20.64	.8125	13/16
1.1	.0433			3.18	.1250	1/8		5.8	.2283			9.2	.3622			21.0	.8268	
1.15	.0452			3.2	.1260			5.9	.2323			9.25	.3641			21.03	.8281	53/64
	.0465		56	3.25	.1279				.2340		A	9.3	.3661			21.43	.8437	27/32
1.19	.0469	3/64			.1285		30	5.95	.2344	15/64			.3680		U	21.5	.8465	
1.2	.0472			3.3	.1299			6.0	.2362			9.4	.3701			21.83	.8594	55/64
1.25	.0492			3.4	.1338				.2380		B	9.5	.3740			22.0	.8661	
1.3	.0512				.1360		29	6.1	.2401			9.53	.3750	3/8		22.23	.8750	7/8
	.0520		55	3.5	.1378				.2420		C		.3770		V	22.5	.8858	
1.35	.0531				.1405		28	6.2	.2441			9.6	.3780			22.62	.8906	57/64
	.0550		54	3.57	.1406	9/64		6.25	.2460		D	9.7	.3819			23.0	.9055	
1.4	.0551			3.6	.1417				.2480			9.75	.3838			23.02	.9062	29/32
1.45	.0570				.1440		27	6.35	.2500	1/4	E	9.8	.3858			23.42	.9219	59/64
1.5	.0591			3.7	.1457			6.4	.2520				.3860		W	23.5	.9252	
	.0595		53		.1470		26	6.5	.2559			9.9	.3898			23.81	.9375	15/16
1.55	.0610			3.75	.1476				.2570		F	9.92	.3906	25/64		24.0	.9449	
1.59	.0625	1/16			.1495		25	6.6	.2598			10.0	.3937			24.21	.9531	61/64
1.6	.0629			3.8	.1496				.2610		G		.3970		X	24.5	.9646	
	.0635		52		.1520		24	6.7	.2638				.4040		Y	24.61	.9687	31/32
1.65	.0649			3.9	.1535			6.75	.2657	17/64		10.32	.4062	13/32		25.0	.9843	
1.7	.0669				.1540		23	6.75	.2657				.4130		Z	25.03	.9844	63/64
	.0670		51	3.97	.1562	5/32			.2660		H	10.5	.4134			25.4	1.0000	1

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**1979 Jeep Technical Service Manual**

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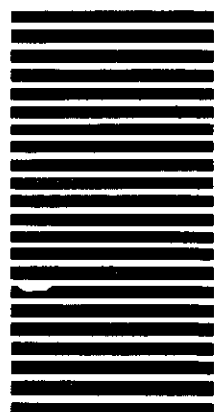
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# MAINTENANCE

# B

## SECTION INDEX

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1979 Jeep Maintenance Schedule	B-2	General	B-1
Description of Services—Chassis Components	B-8	Unscheduled Maintenance	B-15
Description of Services—Engine Components	B-5		

### GENERAL


This section describes the service procedures required to keep Jeep vehicles in good running condition. These services are based on changes in driving conditions, accumulated odometer mileage or time intervals (whichever comes first), or are unscheduled as required by changes in usage, handling or performance. The section is divided into three parts: (1) Maintenance Schedule, (2) Description of Services according to components (listed alphabetically), (3) Unscheduled Maintenance.


### Maintenance Schedule

Two maintenance schedules are listed: one for Engine Maintenance; one for Chassis Maintenance (including body). Each schedule is followed by detailed footnotes.

The services listed are those which experience and testing have indicated are most likely needed at the time or distance intervals shown.

Perform the maintenance services as indicated in the **Engine Maintenance Schedule** and the **Chassis Maintenance Schedule**. The symbol tells you what service is required followed by the time and/or distance interval (mileage) at which the service should be performed, under both normal and heavy-duty operation. For example:

 5 mo/5,000 mi (8 000 km)

 3 mo/3,000 mi (4 800 km)

tells you that the particular component indicated should be replaced every 5 months or 5,000 miles (8 000 km), whichever comes first, **under normal use**, and every 3 months or 3,000 miles (4 800 km), whichever comes first, **under heavy-duty operation**. (Refer to **Legend of Symbols** for definitions of the various symbols.) The num-

bers appearing to the left of each component correspond with those on the **Engine and Chassis Illustrations**.

### Fuel Requirements

#### All Models


All engines require the use of unleaded fuel to reduce exhaust emissions, and to protect the catalytic converters. Use a fuel with an antiknock index (AKI) of at least 87. A lower octane AKI is acceptable at elevations above 1500 feet (450 meters).

### Owner's Responsibility

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

**CAUTION:** *Failure to perform maintenance services at the proper intervals as outlined in the Maintenance Schedule constitutes negligence and may void provisions of the new-vehicle warranty.*

### Heavy-Duty Operation

Heavy-duty operation consists of off-road or dusty conditions for over 30% of use, commercial load-carrying or delivery, snow plowing, pulling trailers weighing over 2,000 pounds (900 kg) loaded, or extended engine idling during normal use. If the vehicle is used in heavy-duty operation, perform the service listed in the **Engine Maintenance Schedule** and the **Chassis Maintenance Schedule** according to the intervals designated by this symbol:  (If no heavy-duty service is indicated for a particular component, perform the service at the normal time and/or distance interval noted.)

**CAUTION:** *Immediately after extended operation in sand, mud or water, thoroughly clean brakes linings,*

## B-2 MAINTENANCE

brake drums and front axle U-joints and yokes, to prevent undue wear and unnecessary part failure.

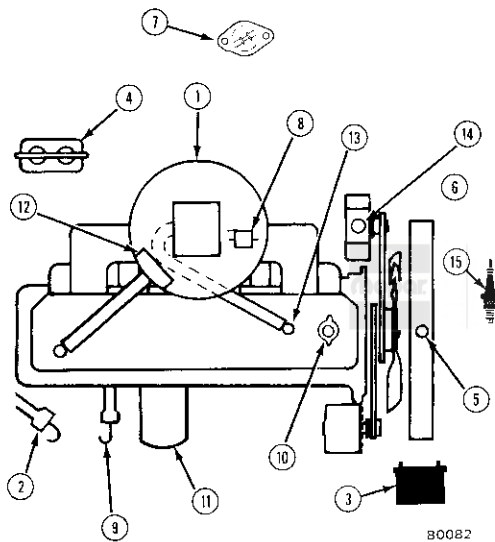
**CAUTION:** If the vehicle is driven through water deep enough to cover the hubs, inspect the wheel bearings and axle differentials for water damage or contamination.

### After First 200 Miles (300 km)

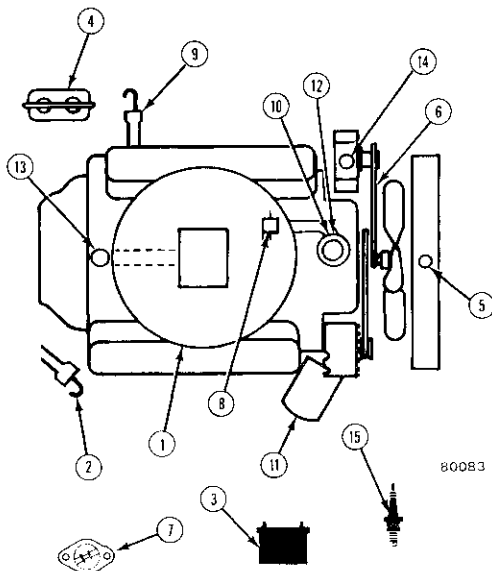
Check and retighten wheel nuts securely, if necessary. Tighten CJ models to 80 foot-pounds (108 N•m), Cherokee, Wagoneer and Truck models to 75 foot-pounds (102 N•m) except 8400 GVWR Truck. On 8400 GVWR Truck, tighten to 130 foot-pounds (176 N•m).

## 1979 JEEP MAINTENANCE SCHEDULE

### ENGINE MAINTENANCE SCHEDULE



Six-Cylinder Engine Illustration













Eight-Cylinder Engine Illustration

Perform the maintenance services at the intervals shown. The symbol tells you what service is required followed by the time and/or distance interval.

For example: Engine Oil (Number 10) should be drained and replaced every 5 months or 5,000 miles (8 000 km), whichever comes first, under normal use, and every 3 months or 3,000 miles (4 800 km), whichever comes first, under heavy-duty operation. (The lettered footnotes provide additional information about certain components or services.)

COMPONENT	INTERVAL
1. AIR CLEANER (FILTER)	30,000 mi (48 000 km)
	15 mo/15,000 mi (24 000 km)
2. AUTOMATIC TRANSMISSION DIPSTICK/FILLER	5 mo/5,000 mi (8 000 km)
	3 mo/3,000 mi (4 800 km)
3. BATTERY	5 mo/5,000 mi (8 000 km)
	3 mo/3,000 mi (4 800 km)
4. BRAKE MASTER CYLINDER	5 mo/5,000 mi (8 000 km)
	3 mo/3,000 mi (4 800 km)
5. COOLANT (RADIATOR)	5 mo/5,000 mi (8 000 km)
	3 mo/3,000 mi (4 800 km)
	25 mo/25,000 mi (40 000 km) <sup>a.</sup>
6. DRIVE BELTS	5,000 mi (8 000 km)
	15,000 mi (24 000 km) <sup>b.</sup>
7. EXHAUST HEAT VALVE	30,000 mi (48 000 km)
	30 mo/30,000 mi (48 000 km)
8. FUEL FILTER	15,000 mi (24 000 km)

**ENGINE MAINTENANCE SCHEDULE (CONTD.)**

<b>9. OIL DIPSTICK</b>	✓ At Each Fuel Fill
<b>10. OIL (FILLER CAP)</b>	 5 mo/5,000 mi (8 000 km) <b>c.</b>  3 mo/3,000 mi (4 800 km)
<b>11. OIL FILTER</b>	 5 mo/5,000 mi (8 000 km)  3 mo/3,000 mi (4 800 km)
<b>12. PCV FILTER</b>	✓ 30,000 mi (48 000 km) <b>d.</b>  30 mo/30,000 mi (48 000 km)
<b>13. PCV VALVE</b>	 30,000 mi (48 000 km)  30 mo/30,000 mi (48 000 km)
<b>14. POWER STEERING PUMP</b>	✓ 5 mo/5,000 mi (8 000 km)  3 mo/3,000 mi (4 800 km)
<b>15. TUNE-UP</b>	✓ 5,000 mi (8 000 km) Check and adjust curb and high idle speeds, as required. <b>e.</b> ----- ✓ 15,000 mi (24 000 km) Check the following items and correct as required (CJ models with eight-cylinder only): choke system, idle mixture, ignition timing, and vacuum fittings, hoses and connections. <b>f.</b> -----  30,000 mi (48 000 km) Complete engine tune-up. <b>g.</b>  30mo/30,000 mi (48 000 km)

**Footnotes**

- a.** Change engine coolant initially at 25 months or 25,000 miles (40 000 km), whichever comes first then at the start of each winter season.
- b.** Check drive belts initially at 5,000 miles (8 000 km), then at 15,000 miles (24 000 km) and every 15,000 miles (24 000 km) thereafter.
- c.** When most driving is on paved roads with trips of less than six miles (10 km), change engine oil every 2,500 miles (4 000 km) and oil filter every 5,000 miles (8 000 km).
- d.** On six-cylinder models, clean PCV filter. On eight-cylinder models, clean oil filler cap filter.
- e.** Perform service initially at 5,000 miles (8 000 km) then at 30,000 miles (48 000 km) and every 30,000 miles (48 000 km) thereafter.
- f.** Not required on California vehicles.
- g.** Tune-up consists of examining the components listed under each system for proper assembly, condition and operation. Correct, adjust or service to specifications if necessary:

**Engine Mechanical Systems**

**Inspect:**

- Air Guard system hoses.
- Condition and tension of fan/alternator, power steering, air pump and air conditioning drive belts.
- Vacuum lines and fittings, Exhaust Gas Recirculation (EGR) lines, hoses and connections.

**Ignition System**

- Coil and spark plug wires.
- Distributor—cap and rotor, vacuum and centrifugal advance mechanisms.
- Transmission controlled spark system (TCS).

Replace spark plugs.






**Fuel System**

**Inspect:**

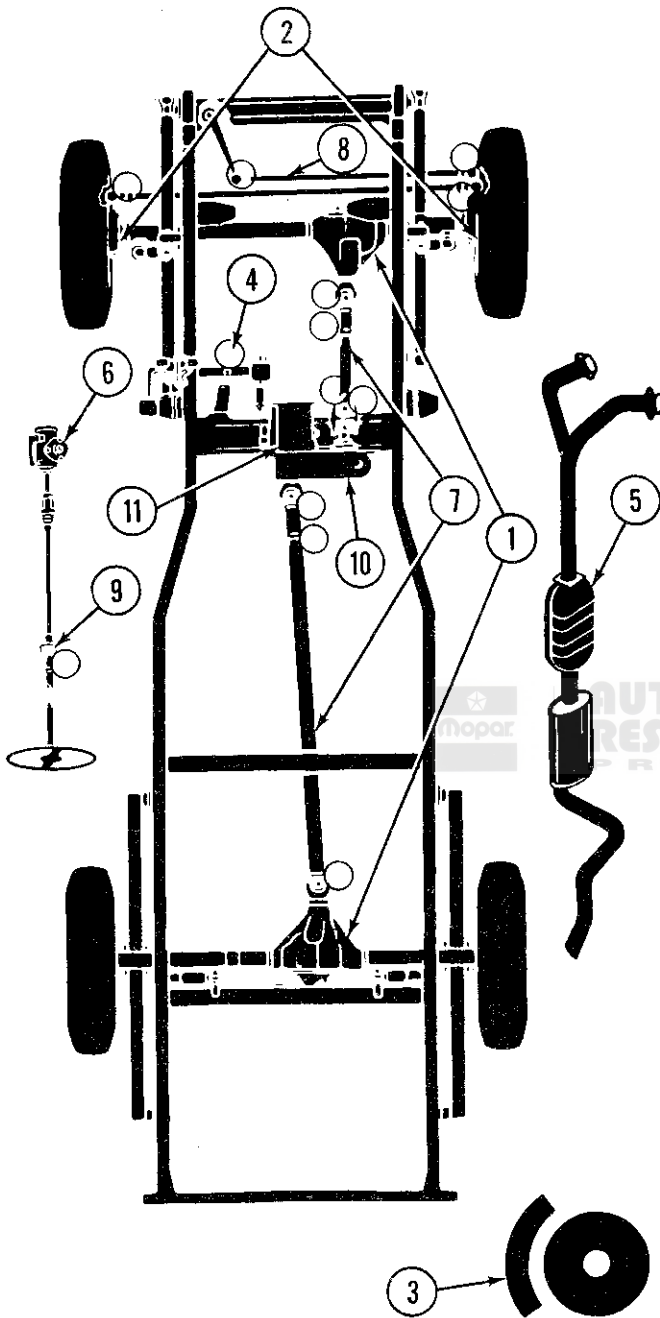
- Fuel tank, cap, lines and connections.
- Air cleaner thermostatic control system (TAC).
- Choke linkage for free movement.
- PCV system hoses.
- Replace charcoal canister air inlet filter.

**Final Adjustments**

- Ignition timing.
- Idle mixture.
- Curb and high idle speeds.

Legend of Symbols	
✓	CHECK OR INSPECTION
	DRAIN AND REPLACE FLUID
	ENGINE TUNE-UP
	HEAVY-DUTY OPERATION
	LUBRICATION
	SERVICE COMPONENT REPLACEMENT

CHASSIS MAINTENANCE SCHEDULE



○ Lubrication points

Chassis Illustration

Legend of Symbols	
✓	CHECK OR INSPECTION
↓	DRAIN AND REPLACE FLUID
↕	ENGINE TUNE-UP
🛢	HEAVY-DUTY OPERATION
🛢	LUBRICATION
🔧	SERVICE COMPONENT REPLACEMENT

Perform the maintenance services at the intervals shown. The symbol tells you what service is required, followed by the time and/or distance interval.

For example: Front Wheel Bearings (Number 2) should be lubricated every 25,000 miles (40 000 km) under normal use, and every 25 months or 25,000 miles (40 000 km) under heavy-duty operation. (The lettered footnotes provide additional information about certain components and services.

COMPONENT	INTERVAL
1. AXLE DIFFERENTIALS (FRONT AND REAR)	✓ 🛢 5,000 mi (8 000 km)
	🛢 3 mo/3,000 mi (4 800 km)
	↓ 🛢 30,000 mi (48 000 km)
2. BEARINGS, FRONT WHEEL	🛢 25,000 mi (40 000 km) a.
	🛢 25 mo/25,000 mi (40 000 km)
3. BRAKE AND CHASSIS INSPECTION	✓ 15,000 mi (24 000 km) b.
	🛢 5 mo/5,000 mi (8 000 km)
BODY LUBRICATION	🛢 15,000 mi (24 000 km) b.
	🛢 5 mo/5,000 mi (8 000 km)
4. CLUTCH LEVER AND LINKAGE CJ	🛢 5,000 mi (8 000 km)
	🛢 3 mo/3,000 mi (4 800 km)
CHEROKEE, WAGONEER, TRUCK	🛢 15,000 mi (24 000 km)
	🛢 5 mo/5,000 mi (8 000 km)
5. EXHAUST SYSTEM INSPECTION	✓ 5,000 mi (8 000 km) c.
	🛢 5 mo/5,000 mi (8 000 km)
6. MANUAL STEERING GEAR	✓ 5,000 mi (8 000 km)
	🛢 3 mo/3,000 mi (4 800 km)
7. PROPELLER SHAFTS (FRONT AND REAR) CJ	🛢 5,000 mi (8 000 km) d.
	🛢 3 mo/3,000 mi (4 800 km)
CHEROKEE, WAGONEER, TRUCK	🛢 10,000 mi (16 000 km) d.
	🛢 5 mo/5,000 mi (8 000 km)
8. STEERING LINKAGE CJ	✓ 5,000 mi (8 000 km) e.
	🛢 3 mo/3,000 mi (4 800 km)
CHEROKEE, WAGONEER, TRUCK	🛢 15,000 mi (24 000 km) e.
	🛢 5 mo/5,000 mi (8 000 km)
9. STEERING SHAFT U-JOINT	🛢 10,000 mi (16 000 km)
	🛢 5 mo/5,000 mi (8 000 km)

**CHASSIS MAINTENANCE SCHEDULE (CONTD.)**

10. TRANSFER CASE ALL	✓	5,000 mi (8 000 km)
		3 mo/3,000 mi (4 800 km)
MODEL 20	↓	30,000 mi (48 000 km)
		30 mo/30,000 mi (48 000 km)
QUADRA-TRAC	↓	15,000 mi (24 000 km)
		10 mo/10,000 mi (16 000 km)
11. TRANSMISSION MANUAL	✓	5,000 mi (8 000 km)
		3 mo/3,000 mi (4 800 km)
AUTOMATIC	↓	30,000 mi (48 000 km)
		30 mo/30,000 mi (48 000 km)
AUTOMATIC	↓	30,000 mi (48 000 km) f.
		10 mo/10,000 mi (16 000 km)

**Footnotes**

- a. Rear wheel bearings do not require periodic or scheduled lubrication.
- b. Check the following items as indicated. Correct to specifications as necessary:

**Brakes**

- Front and rear brake linings for wear.
- Rear brake self-adjusting mechanism for proper operation.
- Master cylinder, calipers, wheel cylinders and differentials warning valves for leaks.
- Brake lines, fittings and hoses for condition and leaks.
- Parking brake for proper operation.
- Overall brake condition and action.

**Steering/Suspension**

- Manual or power steering gear and linkage for leaks, looseness or wear.
- Springs, shock absorbers, steering damper and bushings for leaks, looseness or wear.
- Tire condition.
- Overall steering/suspension condition and action.

**Also:**

- Adjust parking brake, if necessary.
- Adjust tire pressures to specifications.
- Adjust manual transmission clutch free play, if necessary.
- Lubricate Model 20 transfer case linkage.

**Body Lubrication**

Lubricate the following items with the recommended lubricants:

- Ashtray slides.
- Courtesy light buttons.
- Door, hood, liftgate, tailgate latches and hinges.
- Front seat tracks.
- Glove box door latch and hinge.
- Locks.
- Windshield hinges and holddown knobs (CJ only).

c. Check exhaust system for leaks, damage, misalignment or grounding against body sheet metal or frame. Check catalytic converter for bulging or heat damage.

d. Lubricate sleeve yokes (splines) and single and double cardan U-joints.

e. Inspect and replace torn or ruptured grease seals, replace damaged steering components, and lubricate ball joints.

f. Also replace automatic transmission filter.

**MAINTENANCE BY MILEAGE INTERVALS**

Recommended Interval		Component Service						
		Engine		Chassis				
miles	(km)	Component	Service	Component	Service	Model		
5,000	(8 000)	2.	✓	1.	✓	All		
		3.	✓	4.		CJ		
		4.	✓	5.	✓	All		
		5.	✓	6.	✓	All		
		6.	✓	7.		CJ		
		10.	↓	8.		CJ		
		11.	↔	10.	✓	All		
		14.	✓	11.	✓	All		
		15.	✓					
		10,000	(16 000)			7.		C, W, T
						9.		All
		15,000	(24 000)	8.	↔	3.	✓	All
				15.	✓ a.	4.		C, W, T
						7.		C, W, T
						8.		C, W, T
		10.	↓		All b.			
25,000	(40 000)	5.	↓ c.	2.		All		
30,000	(48 000)	1.	↔ c	1.	↓	All		
		7.		10.	↓	All d		
		12.	✓	11.	↓	All		
		13.	↔					
		15.	↔					

**Footnotes**

- a. CJ models with 8-cylinder only (except California vehicles)
- b. Quadra-Trac Only
- c. Change coolant initially at 25 months or 25,000 miles (40 000 km), whichever comes first, then at the start of each winter season.
- d. Model 20 Transfer case only



**DESCRIPTION OF SERVICES—ENGINE COMPONENTS****1. Air Cleaner (Filter)**

Procedures for air cleaner servicing and replacement are located in Chapter 1J—Fuel Systems.

**2. Automatic Transmission (Fluid Check)**

Inspect fluid level at scheduled interval. Check while the transmission is at normal operating temperature. This occurs after at least 15 miles (25 km) of expressway driving or equivalent city driving. At normal operating temperature, the gauge end of the dipstick will be too hot to hold comfortably.

To make an accurate fluid level check perform the following steps:

- (1) Bring transmission up to normal operating temperature as indicated above.
- (2) Place vehicle on level surface.
- (3) Have engine running at idle speed.
- (4) Apply parking brake.
- (5) Move gearshift lever through all positions, leaving it in Park.
- (6) Remove dipstick, located in fill tube at right rear of engine near dash panel, and wipe clean.
- (7) Insert dipstick until cap seats.
- (8) Remove dipstick and note reading. The fluid level should be between the ADD and FULL marks. If at or below the ADD mark, add sufficient fluid to raise level to FULL mark.

Use AMC/Jeep Automatic Transmission Fluid or equivalent labeled, Dexron® or Dexron II®.

**CAUTION:** Do not overfill. Overfilling can cause foaming which can lead to overheating, fluid oxidation, or varnish formation. These conditions can cause interference with normal valve, clutch, and servo operation. Foaming can also cause fluid to escape from the transmission vent where it may be mistaken for a leak.

When checking fluid level, also check fluid condition. If fluid smells burned or is full of metal or friction material particles, a complete transmission overhaul may be needed. Examine the fluid closely. If doubtful about its condition, drain out a sample for a double check.

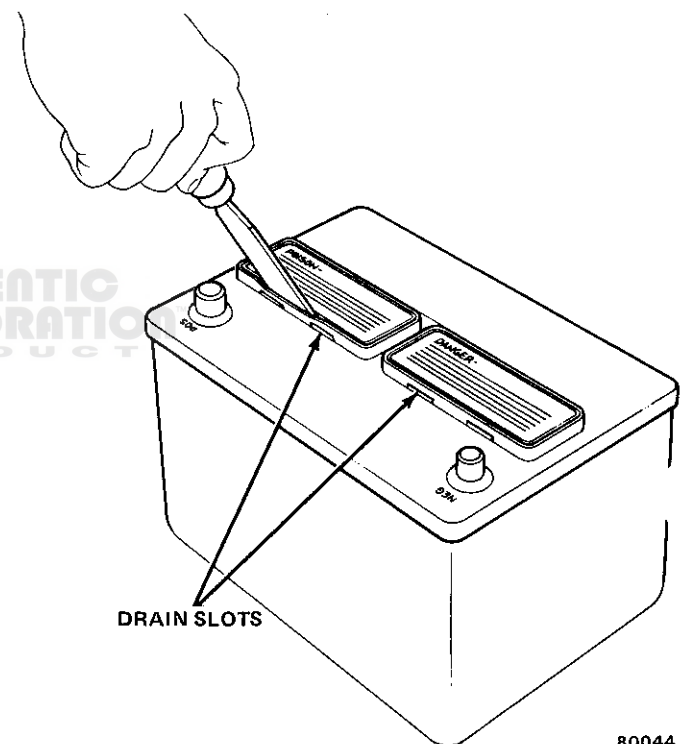
Refer to Chassis Components for procedures on changing automatic transmission fluid and linkage adjustment.

**3. Battery**

**WARNING:** Wear safety glasses, rubber gloves and protective clothing when servicing the battery. Battery fluid contains sulfuric acid and must be kept away from

skin, eyes, clothing and the vehicle painted surfaces. If acid contacts any of these, **flush immediately with large amounts of water. If acid contacts skin or eyes get medical attention.** Do not smoke while checking or servicing the battery and keep open flames or sparks away from battery filler caps since explosive gas is always present.

Check electrolyte level at scheduled interval. Lift the battery cell caps with a nonmetallic tool (fig. B-1), if necessary, and look into each filler well. Maintain the fluid level above the battery plates to the bottom of the filler well ring. Add distilled water or drinking water free of high mineral content. In freezing weather, add water before driving to assure mixing with acid and to prevent freezing.



**Fig. B-1 Removing Battery Filler Caps On Heavy-Duty Battery**

In addition to regular fluid checks, inspect overall battery condition before every winter season according to the following procedure:

- (1) Disconnect battery negative cable and then positive cable.
- (2) Clean cables and terminal posts with a wire-brush terminal cleaner.
- (3) Check battery fluid level and replenish if necessary (fig. B-1).
- (4) Remove battery holddown and clean battery case and battery tray, if necessary, with a solution of baking soda and water; then rinse thoroughly.
- (5) If necessary, tip the battery slightly to drain dirty water through the slots provided.

(6) Position battery in tray and fasten holddown. Do not overtighten.

(7) Attach positive cable and then the negative cable.

(8) Apply a small amount of grease or protective coating to cable ends to minimize corrosion.

#### 4. Brake Master Cylinder

Check fluid level at scheduled interval.

Clean the top of the cover and surrounding housing area. Unsnap the bail and remove the cover. The fluid should be 1/4 inch (6 mm) below the rim of each well in the reservoir. If not, add brake fluid as required and install cover. Use only Jeep Heavy-Duty Brake Fluid or equivalent, meeting SAE Standard J1703, and Federal Standard No. 116, DOT 3 Fluid.

Refer to Chassis Components for procedures on brake and chassis inspection.

#### 5. Coolant

Check coolant level at scheduled interval when then engine is cold. If coolant should be needed, fill radiator to approximately 1-1/2 to 2 inches (38 to 51 mm) below the filler neck when cold, or 1/2 to 1 inch (13 to 25 mm) when hot. Add a mixture of equal parts of ethylene glycol antifreeze and pure water. In an emergency, water alone may be used. Check the freeze protection at the earliest opportunity, as the addition of water will reduce the antifreeze and corrosion protection afforded by the coolant mixture. Do not overfill, as loss of coolant—due to expansion—will result.

Year-round coolant is installed at the factory to last through two years of normal operation, if the coolant is maintained at the original concentration.

In normal operation, flush and refill the cooling system at the **Maintenance Schedule** interval.

When replacing coolant use a 50/50 mixture of high-quality, ethylene glycol antifreeze and water. Use this mixture year-round for protection against corrosion, boiling and engine damage.

#### 6. Drive Belts

Check belts driving fan, air pump, alternator, power steering pump and air conditioning compressor for cracks, fraying, wear, and general condition at scheduled interval. Use Tension Gauge J-23600 to check drive belt tension. Compare reading obtained against the tension specified for used belts in the following chart. If installing a new belt, use the new belt setting shown in the chart. Refer to Chapter 1C—Cooling for replacement or adjustment procedures.

**Drive Belts Tension**

	Initial Newtons New Belt	Reset Newtons Used Belt	Initial Pounds New Belt	Reset Pounds Used Belt
Air Conditioner				
Six-Cylinder	556-689	400-512	125-155	90-115
Eight-Cylinder	556-689	400-512	125-155	90-115
Air Pump				
Six-Cylinder w/PS	289-334	267-311	65-75	60-70
Other Six-Cylinder and all Eight- Cylinder	556-689	400-512	125-155	90-115
Fan — All Engines	556-689	400-512	125-155	90-115
Power Steering — All Engines	556-689	400-512	125-155	90-115

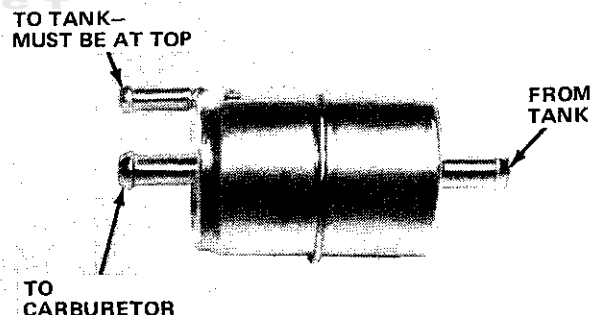
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#### 7. Exhaust Heat Valve

Check exhaust heat valve for free movement and lubricate at scheduled interval.

#### 8. Fuel Filter

Replace the fuel filter at scheduled interval. Be sure to position the fuel return line at the top of the filter (fig. B-2).



80296

**Fig. B-2 Correct Fuel Filter Installation**

For more detailed procedures on fuel filter replacement, refer to Chapter 1J—Fuel Systems.

#### 9. OIL CHECK

Check engine oil level at each fuel fill. Add oil as necessary.

#### 10. OIL CHANGE

Change engine oil after the first 5,000 miles (8 000 km) and every 5,000 miles (8 000 km) thereafter. As periods for oil changes are affected by a variety of conditions, no single mileage figure applies for all types of driving.

Five-thousand miles (8 000 km) is the maximum amount of miles that should elapse between changes; more frequent changes are beneficial, and for this reason, oil should be changed every 5 months even though 5,000 miles (8 000 km) may not have elapsed on the vehicle odometer.

Drain crankcase only after engine has reached normal operating temperature to ensure complete drainage of used oil.

For maximum engine protection under all driving conditions, fill crankcase only with engine oil meeting API Engine Oil Service Classification "SE." These letters must appear on the oil container singly or in combination with other letters. SE engine oils protect against oil oxidation, high-temperature engine deposits, rust and corrosion. •

Single viscosity or multi-viscosity oils are equally acceptable. Oil viscosity number, however, should be determined by the lowest anticipated temperature before the next oil change.

**Engine Oil Viscosity**

Lowest Temperature Anticipated	Recommended Single Viscosity	Recommended Multi-Viscosity
Above +40°F (+5°C)	SAE 30 or 40	SAE 10W-30, 20W-40, or 10W-40
Above 0°F (-18°C)	SAE 20W-20	SAE 10W-30 or 10W-40
Below 0°F (-18°C)	SAE 10W*	SAE 5W-20 or 5W-30

\*Sustained high speeds (above 55 mph, 88 km/h) should be avoided when using SAE 10W engine oil since oil consumption may be greater under this condition. 60542

Crankcase capacity is 5 quarts (4.7 liters) for six-cylinder engines, 4 quarts (3.7 liters) for eight-cylinder engines. Add 1 additional quart (1 liter) when the filter is changed.

**11. Oil Filter**

Change the oil filter every 5,000 miles (8 000 km) or every 5 months, whichever comes first, under normal conditions.

A full-flow oil filter is mounted on the lower center right side of six-cylinder engines and on the lower right side on eight-cylinder engines.

Remove the throwaway filter unit from the adapter with Oil Filter Removal Tool J-22700 or equivalent. To install, turn the replacement unit by hand until the gasket contacts the seat and then tighten an additional one-half turn.

**CAUTION:** Use only a short-type, full-flow oil filter (AMC/Jeep Part No. 8993146 or equivalent) for replacement. Filters exceeding ¼ inches (108 mm) in length

could be punctured by the engine support or frame rail resulting in loss of oil and possible engine damage.

**12. PCV Filter**

Clean the PCV Filter at scheduled interval. Refer to Chapter 1A—General Service and Diagnosis for detailed procedure.

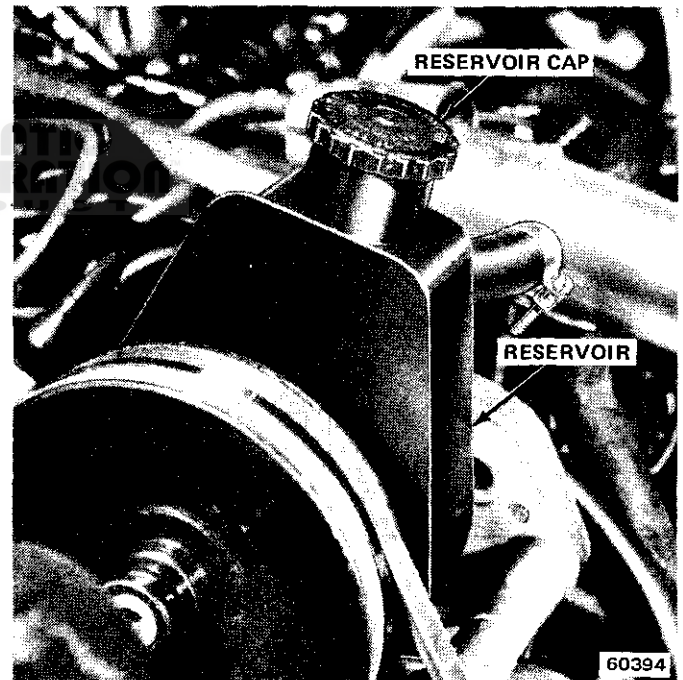
**13. PCV Valve**

Replace PCV valve at scheduled interval. Refer to Chapter 1J—Fuel Systems for detailed procedures.

**14. Power Steering Pump**

Check fluid level at scheduled interval.

Lubricant level can be checked with fluid either hot or cold. If below the FULL HOT or FULL COLD marking on the dipstick attached to the reservoir cap (fig. B-3), add AMC/Jeep Power Steering Fluid or equivalent.



**Fig. B-3 Power Steering Pump Dipstick Location**

**15. Tune-Up**

Certain items (such as the choke system and ignition timing) must be checked and serviced between regularly scheduled complete tune-ups on some models. Refer to the Engine Maintenance Schedule for details.

Perform a complete precision tune-up at the scheduled interval. Perform a precision electronic diagnosis whenever questionable engine performance occurs between scheduled tune-ups.

Refer to Chapter 1A—General Service and Diagnosis for detailed procedures and specifications.

**DESCRIPTION OF SERVICES—CHASSIS COMPONENTS**

**1. Axle Differentials (Front and Rear)**

Check Fluid levels at scheduled interval.

The lubricant level of all differentials should be at the level of the fill hole (fig. B-4). If not, bring to level by adding the recommended lubricant.

Change fluid as recommended in the Chassis Maintenance Schedule. Fluid type and quantity required are listed in the Recommended Fluids and Lubricants chart and the Fluid Capacities chart at the end of this chapter by axle model. To change fluid:

- (1) Remove axle differential housing cover.
- (2) Allow lubricant to drain completely.
- (3) On all differentials (except Trac-Lok), flush the differential with a flushing oil or light engine oil to clean out the housing do not use water, steam, kerosene, or gasoline for flushing). Trac-Lok differentials may be cleaned only by disassembling the unit and wiping with clean, lint-free rags. Do not flush the unit.
- (4) Check condition of differential housing cover gasket. Replace if necessary.
- (5) Install gasket and differential housing cover.
- (6) Tighten cover bolts to 15 to 25 foot-pounds (20 to 34 N•m) torque.
- (7) Remove fill plug and add new lubricant to fill hole level (fig. B-4).
- (8) Install fill plug.

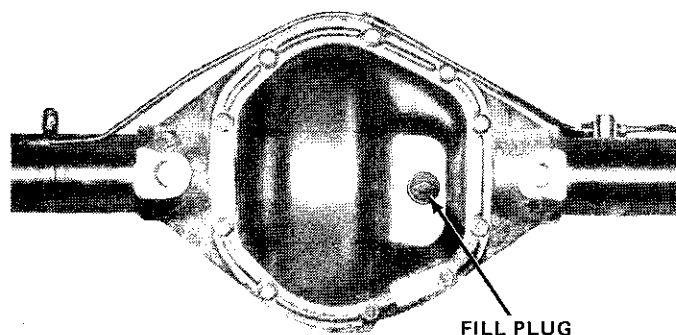
**2. Bearings, Front Wheel**

Lubricate front wheel bearings as scheduled using a high quality wheel bearing lubricant (see Recommended Fluids and Lubricants chart). Be sure to force grease between rollers. Check the bearing races for signs of pitting, brinelling or overheating. Wipe the spindle clean and apply a small amount of grease to prevent rust. Wipe the wheel hub clean and apply a small amount of grease inside the hub.

**CAUTION:** Do not overfill the wheel hub. Too much grease can cause overheating and bearing damage, or it can leak and contaminate brake linings.

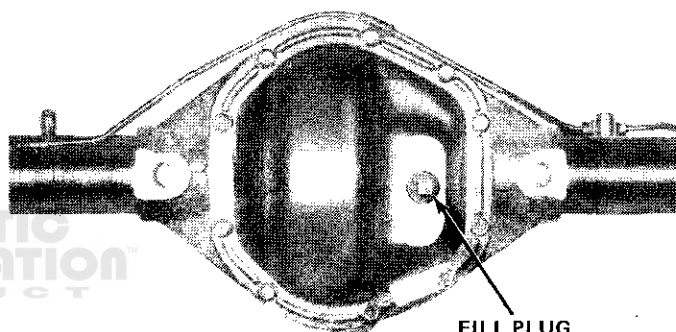
Install the inner bearing and a new grease seal. Assemble the hub assembly and adjust bearings as described in Chapter 2G—Wheels and Tires.

Inspect bearings, and clean and repack if necessary, when they are removed for other services.



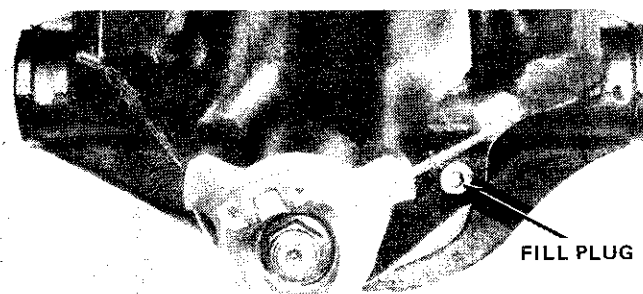
REAR AXLE - CHEROKEE, WAGONEER, TRUCK

72206A



FRONT AXLE - ALL MODELS

72206B



REAR AXLE - CJ MODELS

67486

Fig. B-4 Axle Fill Plug Locations

**3. Body Lubrication; Brake and Chassis Inspection**

**Body Lubrication**

Lubricate the items listed at scheduled interval using lubricant specified in the Recommended Fluids and Lubricants chart at the end of this section. Refer to figures B-5 through B-12 for application of lubricant. When

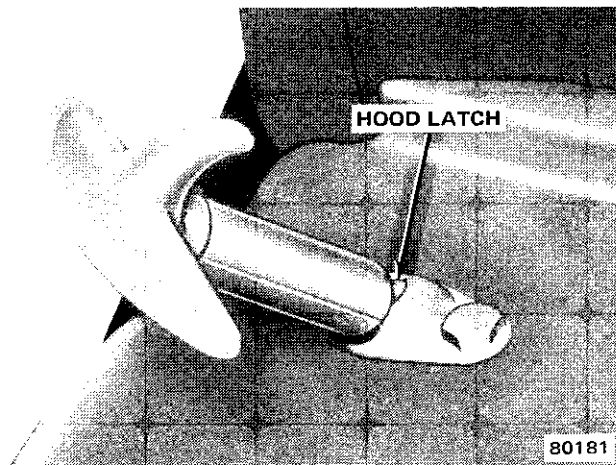


Fig. B-5 Hood Latch—CJ Models

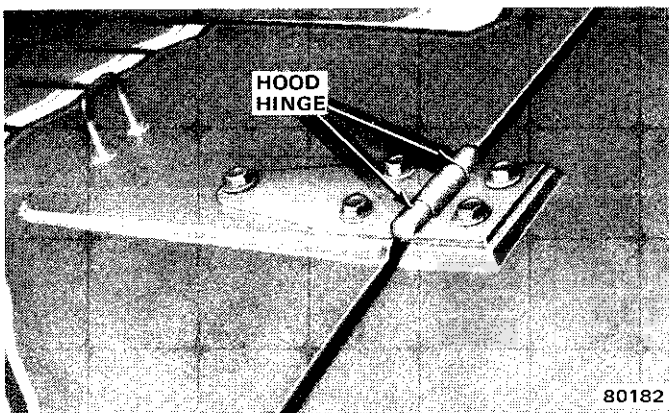


Fig. B-6 Hood Hinge—CJ Models

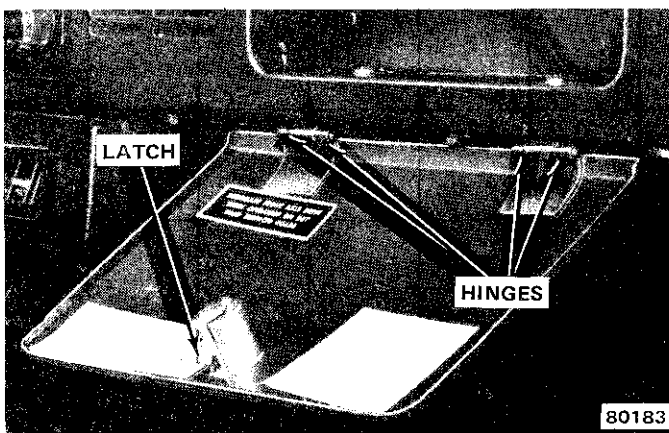


Fig. B-7 Glove Box Latch and Hinge—CJ Models

lubricating weatherstrips and seals, apply the lubricant to a rag and wipe it on the seal to avoid dust-collecting overspray which can soil passenger clothing.

**Brakes**

Inspect linings for wear, cracks, charred surfaces or broken rivets, and for contamination by brake fluid, axle lubricant or other contaminants. Refer to the following inspection procedures.

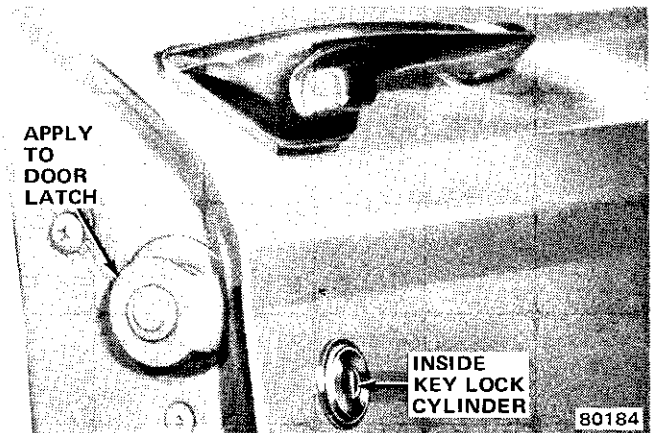


Fig. B-8 Door Latch and Lock—Cherokee-Wagoneer-Truck Models

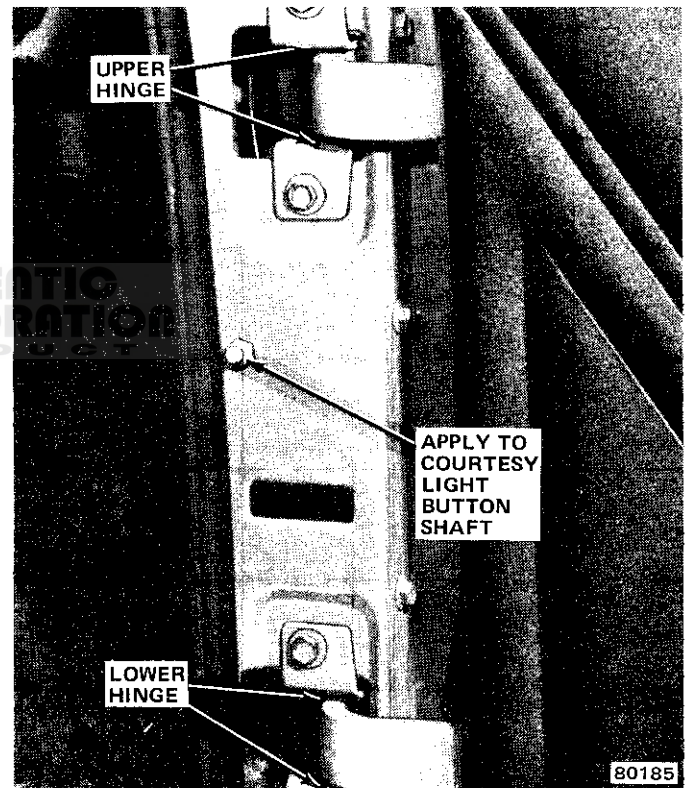


Fig. B-9 Door Hinges and Courtesy Light Button—Cherokee-Wagoneer-Truck Models

**Front Brake Linings—CJ Models**

Check both ends of the outboard lining by looking in at each end of the caliper (fig. B-13). These are the points at which the highest rate of wear normally occurs. At the same time, check the lining thickness of the inboard shoe to make sure that it has not worn prematurely. Look through the inspection port to view the inboard shoe and lining. Whenever the thickness of any lining is worn to the approximate thickness of the metal shoe, all shoe and lining assemblies on both brakes should be replaced.

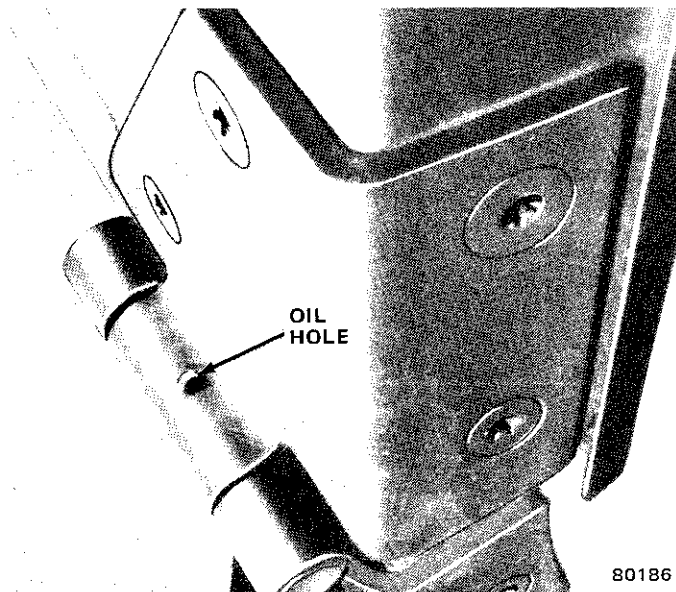


Fig. B-10 Windshield Hinge Lubrication Hole—CJ Models

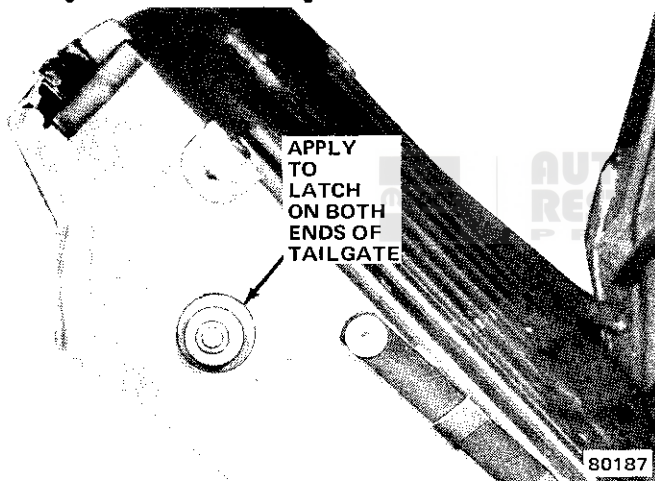


Fig. B-11 Tailgate Lubrication Points—Cherokee and Wagoneer Models

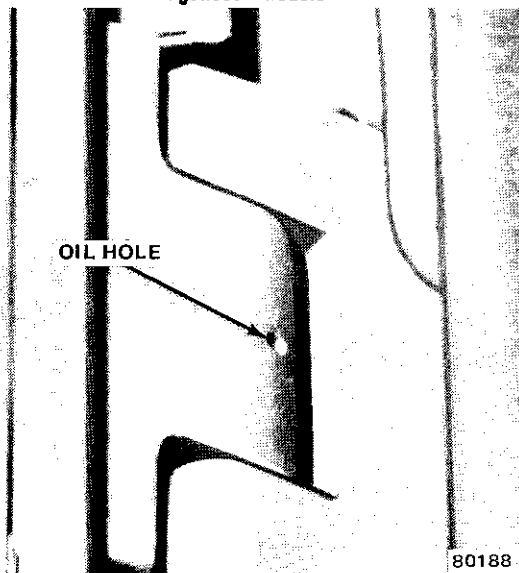


Fig. B-12 Tailgate Hinge Lubrication Hole—Cherokee and Wagoneer Models

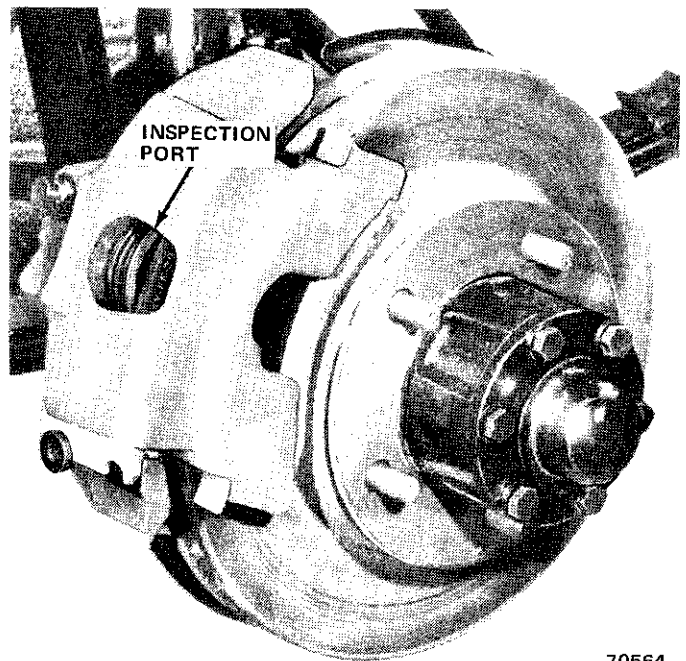


Fig. B-13 Disc Brake Assembly—CJ Models

**Front Brake Linings—Cherokee-Wagoneer-Truck Models**

Check brake lining thickness through caliper inspection port (fig. B-14).

A wear sensor is attached to the brakeshoes. When brakelining wears to the point that replacement is necessary, the sensor contacts the disc, making a screeching or scraping noise to warn the driver that brakeshoes need replacement.

**Rear Brake Linings—All Models**

Replace linings worn to within 1/32-inch (.78 mm) of rivet head.

**Rear Self-Adjusting Mechanism**

Operate the adjuster cable (CJ) or adjuster lever and pivot (Cherokee, Wagoneer and Truck). Check for ease of operation of the adjuster screw assembly. Check condition of the adjuster components for bending, frayed cables, loose or overheated springs, or binding.

**Master Cylinder**

Inspect the cap bail for proper tension and fit. The cap should maintain a tight seal. Check the rubber diaphragm seal for cracks, cuts or distortion. Check fittings and housing for signs of leakage. If internal leaks are suspected or if fluid loss occurs but a leak is not evident, check for leaks at the rear of the master cylinder. Correct as required.

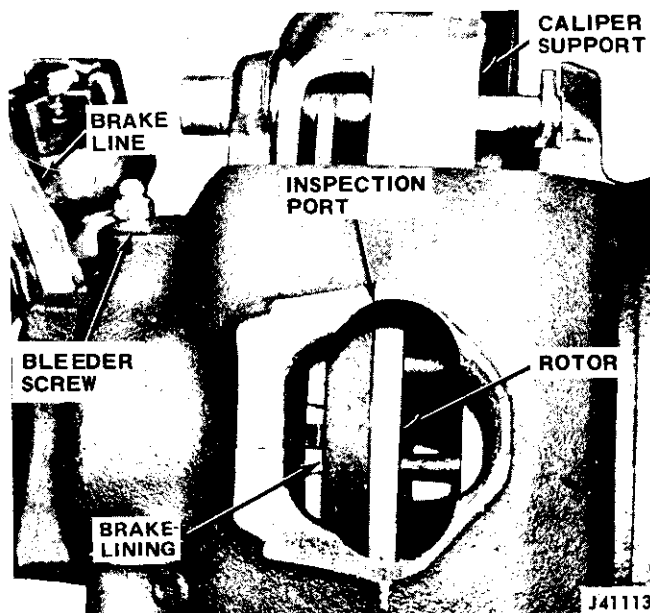


Fig. B-14 Caliper Inspection Port—Cherokee-Wagoneer-Truck Models

#### Disc Brake Calipers

Check dust boot for correct installation, tears or signs of leakage. Check slide surfaces (CJ) or bushings and pins (Cherokee, Wagoneer and Truck) for binding, corrosion or tears.

#### Rear Wheel Cylinders

Pull the dust boot back and inspect for leaks. Check the condition of the pistons and cylinder bores.

#### Differential Warning Valve

Check the valve and housing for signs of leaks, kinked lines or loose fittings.

#### Brake Lines, Fittings and Hoses

Check for cracks, swelling, kinks, distortion or leaks. Also inspect position to be sure no lines are rubbing against exhaust system parts or other components.

#### Parking Brake

Operate the parking brake pedal and release and check for smooth operation and brake holding ability. Inspect cables for binds, kinks or frays. With the brake released, the rear wheels should turn freely. Adjust the parking brake, if necessary, as described in Chapter 2G—Brakes.

#### Overall Brake Condition and Action

Check for improper brake action, performance complaints or signs of overheating, dragging or pulling. Correct as required.

#### Steering Gear and Linkage

Check manual or power steering gear assembly for leaks, housing cracks or loose frame mounting. Inspect

steering damper for leaks or loose mounting. Also, check steering tie rods and connecting rod for bending, looseness or wear.

#### Suspension

Inspect spring bushings and mountings for looseness or wear. Check shock absorbers and bushings for loose mountings, wear or leaks. Correct as required.

#### Tire Condition

Check tires for visible signs of wear which may indicate underinflation or need for front-end alignment, tire rotation or wheel balancing. Also check for bulging, cracks or other road hazard damage. Check and adjust inflation pressures according to the specifications listed in the tire pressure sticker on the glove box door.

#### Overall Steering/Suspension Action

Check for improper steering action or suspension noises, performance complaints or signs of shimmy, pulling, rubbing or undue tire wear.

#### Manual Transmission Clutch Inspection and Adjustment

Inspect clutch by driving vehicle and checking for clutch chatter, grabbing, slippage, and incomplete release. Correct as required:

- (1) Lift clutch pedal upward and against pedal stop.
- (2) On Cherokee and Truck models, adjust clutch push rod lower ball pivot assembly in or out (on push rod) to position bellcrank inner lever parallel to front face of clutch housing. Position should be slightly forward from vertical.
- (3) Loosen jamnut and turn throwout fork adjuster in or out to obtain specified clutch pedal free play, then tighten jamnut.

#### Automatic Transmission Linkage Adjustment—All Models

- (1) Place steering column gearshift lever in Neutral (N) position.
- (2) Raise vehicle.
- (3) Loosen locknut on gearshift rod trunnion enough to permit movement of gearshift rod in trunnion.
- (4) Place outer range selector lever fully into neutral detent position and tighten locknut at trunnion to 9 foot-pounds (12 N•m) torque.
- (5) Lower vehicle and operate steering column gearshift lever in all ranges. Vehicle should start only in Park or Neutral and column gearshift lever should engage properly in all detent positions. Readjust linkage if operation is not satisfactory.

Also lubricate Model-20 transfer case shift lever and linkage using AMC/Jeep All Purpose Lubricant or equivalent.

#### 4. Clutch Lever and Linkage

Lubricate at scheduled interval. Apply AMC/Jeep All-

Purpose Lubricant, or equivalent, or multi-purpose chassis lubricant (lithium base) to the one lube fitting on the clutch bellcrank.

### 5. Exhaust System Inspection

Inspect the exhaust system at scheduled interval for the following conditions. Correct as required.

- Exhaust system leaks, damage, misalignment.
- Grounding against body sheet metal or frame.
- Catalytic converter "bulging" or heat damage.

### 6. Manual Steering Gear

Check at scheduled interval by removing the side cover bolt opposite the adjuster screw (fig. B-15). Lubricant should be to level of bolt hole. If not, add make-up fluid such as AMC/Jeep All-Purpose Lubricant or multi-purpose lithium base chassis lubricant.

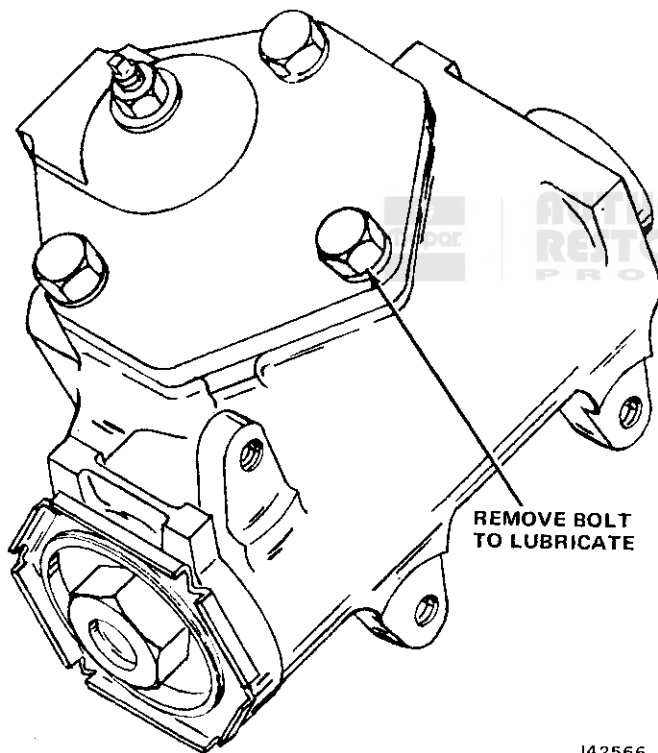


Fig. B-15 Manual Steering Gear Fill Hole Location

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### 7. Propeller Shafts (Front and Rear)

Lubricate propeller shafts, single and double cardan U-joints, during the scheduled chassis lubrication with AMC/Jeep All-Purpose Lubricant or multi-purpose lithium base chassis lubricant grease.

**NOTE:** Undercoating or rustproofing compounds could unbalance the propeller shafts and cause drive train vibrations. Remove any such compounds using the appropriate solvent.

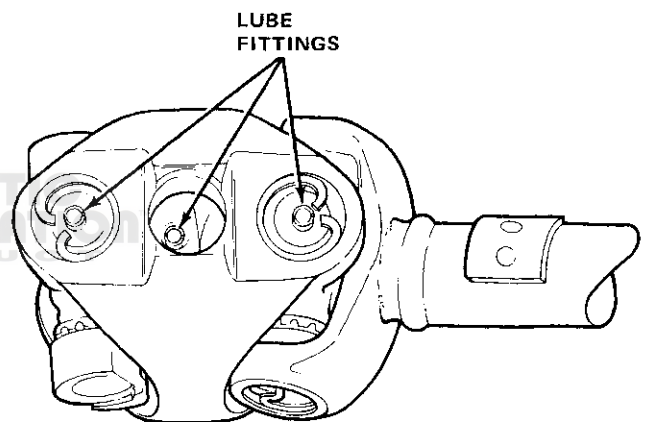
### Sleeve Yokes (Splines)

Apply grease gun pressure to sleeve yoke grease fitting until lubricant appears at pressure relief hole in expansion plug at sleeve yoke end of spline. At this point, cover pressure relief hole with finger and continue to apply pressure until grease appears at sleeve yoke seal. This will ensure complete lubrication of spline.

### Double Cardan Joint

Lubricate the constant velocity center bearing at the transfer case end of the front propeller shaft as follows:

- (1) Raise vehicle on frame-contact type hoist (front wheels must be free to rotate).
- (2) Clean dirt from around double cardan joint (fig. B-16).
- (3) Lubricate joint using needle-type Lubrication Adapter J-225512-2.



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Fig. B-16 Double Cardan Joint

### 8. Steering Linkage

Lubricate steering linkage at scheduled interval.

Clean the 4 lube fittings on tie-rod ends and connecting rod ends, and lubricate with AMC/Jeep All-Purpose Lubricant, or equivalent, or multi-purpose lithium base chassis lubricant.

Also, inspect and replace as needed torn or ruptured grease seals, replace damaged steering components and lubricate ball joints.

### 9. Steering Shaft U-Joint

Lubricate steering shaft U-joint at scheduled interval. (On Cherokee, Wagoneer and Truck models only.)

### 10. Transfer Case

Fluid levels in the Quadra-Trac transfer case and the low range reduction unit, if equipped, must be checked



at the same time, as scheduled (fig. B-17). Lubricant should be level with each fill plug hole. If not, bring up to level with Jeep Quadra-Trac Lubricant or equivalent.

Fluid levels in the Model 20 transfer case and manual transmission must be checked at the same time as scheduled. Fill plug for the Model 20 transfer case is located on the back of the unit.

To check lubricant level, remove the transfer case fill plug. Lubricant should be level with the fill plug hole. If not, bring up to level with make-up lubricant and install fill plug. Refer to Recommended Fluids and Lubricants chart and Fluid Capacities chart at the end of this section.

**Quadra-Trac Fluid Change**

Drain and refill Quadra-Trac transfer case at scheduled interval.

**Without Reduction Unit**

Use Jeep Quadra-Trac Lubricant or equivalent only. Remove fill plug and drain plug and allow the transfer case to drain completely (fig. B-17). Install drain plug. Fill to fill-hole level with specified lubricant. Install fill plug. Refer to Fluid Capacities chart for quantity.

**With Reduction Unit**

Use Jeep Quadra-Trac Lubricant or equivalent only. Remove the fill plugs from the transfer case and reduction unit (fig. B-17). Remove the transfer case drain plug. After it has drained *completely*, install the drain plug.

Loosen the five bolts on the reduction unit housing (it has no drain plug), so that the unit can be pulled back far enough for drainage. After it has drained completely, position the housing and tighten bolts.

First, install the reduction unit and then add one pint specified lubricant. Install fill plug. Next, fill the transfer case to fill-hole level with the specified lubricant. Install fill plug. Refer to Fluid Capacities chart for approximate quantities.

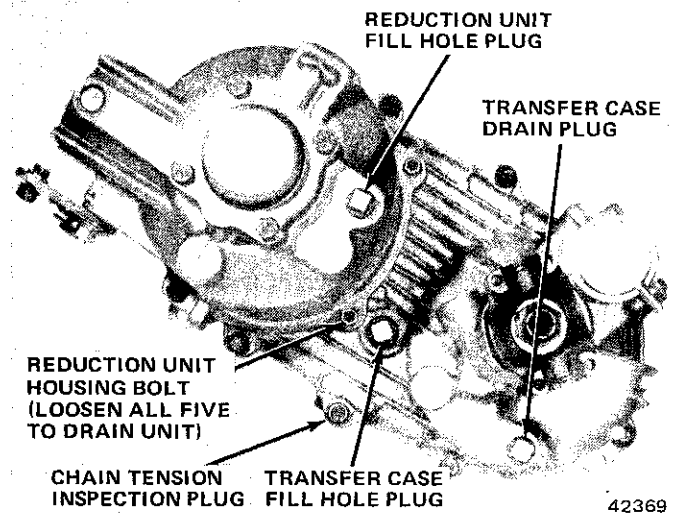
**CAUTION:** *Fill plugs, drain plugs, and reduction housing bolts should not be overtightened. Tighten plugs and 3/8-16 bolts to 15 to 25 foot-pounds (20 to 34 N•m) torque and 5/16-18 bolts to 10 to 20 foot-pounds (14 to 27 N•m) torque. Overtightening may result in thread stripping or breakage of the aluminum unit.*

After draining and refilling, it may be necessary to drive the vehicle in circles (in an open area) both clockwise and counterclockwise for about 15 minutes to allow the fresh lubricant to enter the differential unit and to force the clutches to operate.

**Model 20**

Model 20 transfer case should be drained and refilled the same time as the manual transmission. Refer to the Chassis Maintenance Schedule for the recommended interval.

See Recommended Fluids and Lubricants at the end of this chapter for fluid type, and the Fluid Capacities



**Fig. B-17 Quadra-Trac® Transfer Case and Low Range Reduction Unit Fill Plugs**

chart for quantity. To change fluid:

- (1) Remove fill plugs then drain plugs.
- (2) Allow units to drain completely.
- (3) Install drain plugs.
- (4) Fill to level of fill holes.
- (5) Install fill plugs.

**11. Transmission**

Refer to Engine Components for procedure on checking fluid level for automatic transmission.

Fluid levels in the Model 20 transfer case and manual transmission must be checked at the same time, as scheduled. Fill plugs for all manual transmissions are located on the right side of the assembly.

To check lubricant level, remove the transmission fill plug. Lubricant should be level with each fill plug hole. If not, bring up to level with make-up lubricant and install fill plug. Refer to Recommended Fluids and Lubricants chart and Fluid Capacities chart at the end of this chapter.

**Automatic Transmission Fluid Changes**

Drain and refill the automatic transmission every 30,000 miles for vehicles in normal service and every 10,000 miles for vehicles in heavy-duty service. Change fluid immediately after vehicle operation, before it cools.

- (1) Remove transmission pan screws, pan, and gasket.
- (2) Remove and discard oil filter (fig. B-18).
- (3) Remove and discard O-ring seal from pick-up pipe.
- (4) Install new O-ring seal on pick-up pipe and install strainer and pipe assembly.
- (5) Clean pan thoroughly and position new gasket on pan. Use petroleum jelly, or equivalent, to position gasket.
- (6) Install pan. Secure with attaching screws and tighten to 10 to 13 foot-pounds (14 to 18 N•m) torque .
- (7) Pour approximately 5 quarts (4.71 liters) of Dex-

ron® or Dexron II® automatic transmission fluid into filler pipe. Be sure container spout, funnel, or other items in contact with fluid are clean.

(8) Start engine and allow it to idle a few minutes.

(9) Apply brake pedal and parking brake. Shift transmission into all positions then place the selector lever in P (Park).

(10) With transmission warm, check fluid level. Add fluid, if necessary, to bring level to FULL mark.

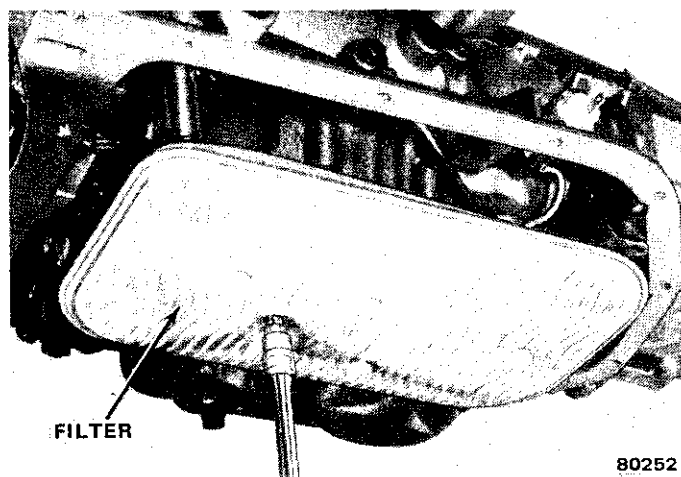


Fig. B-18 Removing Automatic Transmission Filter

### Manual Transmission Fluid Change

Manual transmission (3- or 4-speed) and Model 20 transfer case lubricating fluid should be changed at the same time, as scheduled. See Recommended Fluids and Lubricants at the end of this chapter for fluid type, and the Fluid Capacities chart for quantity. To change fluid:

- (1) Remove fill plugs then drain plugs.
- (2) Allow units to drain completely.
- (3) Install drain plugs.
- (4) Fill to level of fill holes.
- (5) Install fill plugs.

## UNSCHEDULED MAINTENANCE

### General

Services detailed in this subsection are not listed in the Maintenance Schedule for performance at a specified interval. They are to be performed as required to restore vehicle to original specifications. Unscheduled maintenance services include such items as fuel system cleaning; engine carbon deposit removal; retightening loose parts and connections; replacement of manual transmission clutch components, brake linings, shock absorbers, light bulbs, wiper blades, belts or hoses; replacement of interior trim, bright metal trim, painted parts and other appearance items or rubber-like parts. Need for these unscheduled services is usually indicated by a change in performance, handling, or the appearance of the vehicle or a particular component. Owners, users and service mechanics should be alert for indications that service or replacement is needed.

### Catalytic Converter

The catalytic converter(s) used on 1979 Jeep models 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. Refer to the catalyst replacement procedure in Chapter 1K—Exhaust Systems.

### Fluid Capacities

Capacities, Approximate Refill	U.S. Measure	Imperial Measure	Metric Measure
<b>Engine Oil</b> (includes 1 quart for filter change)			
258 CID engines	6.0 quarts	5.0 quarts	5.7 liters
304 CID & 360 CID engines	5.0 quarts	4.2 quarts	4.7 liters
<b>Cooling System</b> (Includes 1 quart for heater)			
258 CID engine	10.5 quarts	8.7 quarts	9.9 liters
304 CID engine	13.0 quarts	10.8 quarts	12.3 liters
360 CID engine	14.0 quarts	11.6 quarts	13.2 liters
<b>Transfer Case</b>			
Model 20	3.2 pints	2.6 pints	1.5 liters
(a) Quadra-Trac	2.0 quarts	3.3 pints	1.9 liters
(a) Quadra-Trac with Reduction Unit	2.5 quarts	4.2 pints	2.4 liters
<b>Transmission</b>			
Manual 3-Speed—CJ Models	2.8 pints	2.3 pints	1.3 liters
Manual 3-Speed—Cherokee, Wagoneer, & Truck	2.8 pints	2.3 pints	1.3 liters
Manual 4-Speed—All Models	6.5 pints	5.5 pints	3.1 liters
Automatic—Change Only	5.0 quarts	4.2 quarts	4.7 liters
Automatic—At Overhaul	11.0 quarts	9.2 quarts	10.4 liters
<b>Axles</b>			
AMC Model Rear Axle—CJ Models	4.8 pints	4.0 pints	2.3 liters
Model 30—Front Axle—CJ Models	2.5 pints	2.1 pints	1.2 liters
(b) Model 44—Front or Rear Axle—All but CJ Models	3.0 pints	2.5 pints	1.4 liters
(b) Model 60-3(FF) Rear Axle—Trucks over 6500 GVW	6.0 pints	5.0 pints	2.8 liters
<b>Gas Tank (Approximate Gallons)</b>			
CJ Models	14.8 gallons	12.3 gallons	55.9 liters
Cherokee & Wagoneer	21.5 gallons	17.9 gallons	81.4 liters
Truck	18.2 gallons	15.2 gallons	68.8 liters

(a) Drain and replace with Quadra-Trac lubricant (b) Capacities of conventional and Trac-Lok rear axles are identical.

**Recommended Fluids and Lubricants**

ENGINE	
COMPONENT	SPECIFICATION
Distributor rotor tip*	AMC Silicone Dielectric Compound or equivalent.
Engine coolant	High quality ethylene glycol (permanent antifreeze) and clean water mixture.
Engine oil	API classification "SE." Refer to oil viscosity chart for correct SAE grade.
Exhaust manifold heat valve	AMC/Jeep Heat Valve Lubricant or equivalent.
CHASSIS	
COMPONENT	SPECIFICATION
Automatic transmission	AMC/Jeep Automatic Transmission Fluid or equivalent labeled Dexron® or Dexron II®.
Brake master cylinder*	AMC/Jeep Brake Fluid or equivalent marked FMVSS No. 116, DOT-3 and SAE J-1703.  CAUTION: Use only recommended brake fluids.
Clutch lever and linkage	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Conventional axle differentials	AMC/Jeep Rear Axle Lubricant or gear lubricant of SAE 80W-90 (API-GL5) quality.
Drum brake support plate ledges*	AMC/Jeep Brake Support Plate Lubricant or equivalent molydisulfide lubricant.
Front suspension ball joints, steering linkage, propeller shafts, single and double cardan joints and yokes	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Front wheel bearings	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Gearshift linkage-transmission and transfer case	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Manual steering gear*	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.

CHASSIS (Continued)	
COMPONENT	SPECIFICATION
Manual transmission	SAE 80W-90 gear lubricant (API-GL4).
Model 20 transfer case	SAE 80W-90 gear lubricant (API-GL4).
Parking brake pedal mechanism*	3-M Spray Lube 8902 or equivalent.
Power steering pump and gear*	AMC/Jeep Power Steering Fluid or equivalent.
Quadra-Trac transfer case	Quadra-Trac lubricant only.
Steering shaft U-joint	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Trac-Lok axle differential	AMC/Jeep Rear Axle Lubricant or limited-slip gear lubricant of SAE 80W-90 (API-GL5) quality.
BODY	
COMPONENT	SPECIFICATION
Ashtray slides	3-M Spray Lube 8902 or equivalent.
Front seat tracks	3-M Spray Lube 8902 or equivalent.
Hinges: door, hood, liftgate, tailgate, glove box	3-M Spray Lube 8902 or equivalent.
Key lock cylinders	Powdered graphite, AMC/Jeep Silicone Lubricant Spray or light oil.
Latches: door, hood, liftgate, tailgate, glove box	3-M Spray Lube 8902 or equivalent.
Weatherstrips: door, window, liftgate, tailgate	AMC/Jeep Silicone Lubricant Spray or equivalent.
Windshield hinges and holddown knobs (CJ)	3-M Spray Lube 8902 or equivalent.

**\*No routine drain and refill or application of lubricant is required. Specification is for maintaining fluid levels or reassembling components. Refer to the Maintenance Schedules for intervals.**

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# SECTION 1

# POWER PLANT



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PRODUCTS

## CHAPTER INDEX

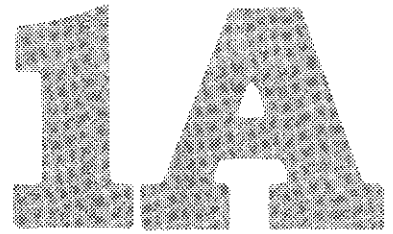
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# GENERAL SERVICE AND DIAGNOSIS



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## GENERAL INFORMATION

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This chapter contains **general** information which applies to all Jeep engines: 258 CID six-cylinder, 304 CID eight-cylinder, and 360 CID eight-cylinder. Refer to Chapter 1B—Engines for **specific** procedures for engine replacement, engine disassembly, internal component repairs and replacement and mechanical specifications.

The section of this chapter titled Power Plant Diagnosis presents information and procedures useful in locating problems not normally encountered in routine maintenance and routine tune-ups.

The section of this chapter titled Power Plant Tune-

Up presents a systematic approach to the performing of a complete, precision tune-up required at the intervals outlined in the Mechanical Maintenance Schedule in Chapter B.

It is frequently helpful to know at a glance which emission-related components are installed on a particular vehicle. This information is contained in two emission component charts. Vehicles designated 49-state are certified for sale in all states except California. Vehicles designated California are the only ones certified for sale in the state of California.

### Emission Components—California Light Duty

CID & Venturis	Vehicle	Trans.	Air Guard	Cat. Conv.	EGR	EGR CTO	FTVC	PCV	TAC Type	Spark Delay	Spark CTO	CTO Temp.	Non Linear	Carb. Vent	Elec. Choke	Solenoid
258 2V	CJ-5	M3	•	•	•	•	•	•	Vac	—	• <sup>1</sup>	217° <sup>1</sup>	—	•	—	—
		M4	•	•	•	•	•	•	Vac	—	• <sup>1</sup>	217° <sup>1</sup>	—	•	—	—
	CJ-7	M3	•	•	•	•	•	•	Vac	—	• <sup>1</sup>	217° <sup>1</sup>	—	•	—	—
		M4	•	•	•	•	•	•	Vac	—	• <sup>1</sup>	217° <sup>1</sup>	—	•	—	—
		A	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	•
360 2V	Cherokee	A	•	•	•	•	•	•	Vac	—	•	149°	—	•	•	•
	Wagoneer	A	•	•	•	•	•	•	Vac	—	•	149°	—	•	•	•
	Truck	A	•	•	•	•	•	•	Vac	—	•	149°	—	•	•	•

<sup>1</sup> Used with Heavy-Duty Cooling Option only.

Trans. —Transmission Type (manual or automatic)  
 Cat. Conv. —Catalytic Converter  
 CTO —Coolant Temperature Override  
 EGR —Exhaust Gas Recirculation

PCV —Positive Crankcase Ventilation  
 TAC —Thermostatically Controlled Air Cleaner (vacuum or mechanical)  
 TCS —Transmission Controlled Spark  
 • —On all models in series specified

## 1A-2 GENERAL SERVICE AND DIAGNOSIS

### Emission Components—49-State Light Duty

CID & Venturis	Vehicle	Trans.	Air Guard	Cat. Conv.	EGR	EGR CTO	FTVC	PCV	TAC Type	Spark Delay	Spark CTO	CTO Temp.	Non Linear	Carb. Vent.	Elec. Choke	Solenoid	
258 2V	CJ-5	M3	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	—	
		M4	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	—	
	CJ-7	M3	•	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	—
		M4	•	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	—
		A	•	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	•
	Cherokee	M3	•	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	•
		A	•	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	•
	Wagoneer	A	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	•	
	Truck	M3	•	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	•
		M4	•	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	•
		A	•	•	•	•	•	•	•	Vac	—	•	149°	—	•	—	•
	304 2V	CJ-5	M3	•	•	•	•	•	•	Vac	—	• <sup>Ⓢ</sup>	217° <sup>Ⓢ</sup>	7 in.	•	•	—
M3			•	•	•	•	•	•	•	Vac	—	• <sup>Ⓢ</sup>	217° <sup>Ⓢ</sup>	7 in.	•	•	—
A		•	•	•	•	•	•	•	Vac	—	• <sup>Ⓢ</sup>	217° <sup>Ⓢ</sup>	7 in.	•	•	—	
360 2V	Cherokee	M3	•	•	•	•	•	•	Vac	•	• <sup>Ⓢ</sup>	220° <sup>Ⓢ</sup>	—	•	•	—	
		M4	•	•	•	•	•	•	Vac	•	• <sup>Ⓢ</sup>	220° <sup>Ⓢ</sup>	—	•	•	—	
		A	•	•	•	•	•	•	Vac	—	•	149°	—	•	•	•	
	Wagoneer	A	•	•	•	•	•	•	Vac	—	•	149°	—	•	•	•	
	Truck	M3	•	•	•	•	•	•	•	Vac	•	• <sup>Ⓢ</sup>	220° <sup>Ⓢ</sup>	7 in.	•	•	—
		M4	•	•	•	•	•	•	•	Vac	•	• <sup>Ⓢ</sup>	220° <sup>Ⓢ</sup>	7 in.	•	•	—
A		•	•	•	•	•	•	•	Vac	—	•	149°	—	•	•	•	

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## POWER PLANT DIAGNOSIS

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### GENERAL

Power plant diagnosis is helpful in finding the causes of problems not remedied by normal tune-ups. These problems may be classified as **mechanical** (a strange noise, for instance), or **performance** (engine idles rough and stalls, for instance). Refer to the Service Diagnosis

—Mechanical chart and the Service Diagnosis—Performance chart.

Other tests and diagnostic procedures may be necessary to pinpoint a particular problem. Information is provided under Diagnosis With Scope Analyzer, Compression Test, Cylinder Leakage Test, Blown Cylinder Head Gasket Diagnosis and Intake Leak Diagnosis.

Service Diagnosis—Mechanical

Condition	Possible Cause	Correction
EXTERNAL OIL LEAKS	<ul style="list-style-type: none"> <li>(1) Fuel pump gasket broken or improperly seated.</li> <li>(2) Cylinder head cover gasket broken or improperly seated.</li> <li>(3) Oil filter gasket broken or improperly seated.</li> <li>(4) Oil pan side gasket broken or improperly seated.</li> <li>(5) Oil pan front oil seal broken or improperly seated.</li> <li>(6) Oil pan rear oil seal broken or improperly seated.</li> <li>(7) Timing case cover oil seal broken or improperly seated.</li> <li>(8) Oil pan drain plug loose or has stripped threads.</li> <li>(9) Rear oil gallery plug loose.</li> <li>(10) Rear camshaft plug loose or improperly seated.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Replace gasket.</li> <li>(2) Replace gasket; check cylinder head cover gasket flange and cylinder head gasket surface for distortion.</li> <li>(3) Replace oil filter.</li> <li>(4) Replace gasket; check oil pan gasket flange for distortion.</li> <li>(5) Replace seal; check timing case cover and oil pan seal flange for distortion.</li> <li>(6) Replace seal; check oil pan rear oil seal flange; check rear main bearing cap for cracks, plugged oil return channels, or distortion in seal groove.</li> <li>(7) Replace seal.</li> <li>(8) Repair as necessary and tighten.</li> <li>(9) Use appropriate sealant on gallery plug and tighten.</li> <li>(10) Seat camshaft plug or replace and seal, as necessary.</li> </ul>
EXCESSIVE OIL CONSUMPTION	<ul style="list-style-type: none"> <li>(1) Oil level too high.</li> <li>(2) Oil too thin.</li> <li>(3) Valve stem oil deflectors are damaged, missing, or incorrect type.</li> <li>(4) Valve stems or valve guides worn.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Lower oil level to specifications.</li> <li>(2) Replace with specified oil.</li> <li>(3) Replace valve stem oil deflectors.</li> <li>(4) Check stem-to-guide clearance and repair as necessary.</li> </ul>
EXCESSIVE OIL CONSUMPTION (Continued)	<ul style="list-style-type: none"> <li>(5) Piston rings broken, missing.</li> <li>(6) Incorrect piston ring gap.</li> <li>(7) Piston rings sticking or excessively loose in grooves.</li> <li>(8) Compression rings installed upside down.</li> <li>(9) Cylinder walls worn, scored, or glazed.</li> <li>(10) Piston ring gaps not properly staggered.</li> <li>(11) Excessive main or connecting rod bearing clearance.</li> </ul>	<ul style="list-style-type: none"> <li>(5) Replace missing or broken rings.</li> <li>(6) Check ring gap, repair as necessary.</li> <li>(7) Check ring side clearance, repair as necessary.</li> <li>(8) Repair as necessary.</li> <li>(9) Repair as necessary.</li> <li>(10) Repair as necessary.</li> <li>(11) Check bearing clearance, repair as necessary.</li> </ul>



## 1A-4 GENERAL SERVICE AND DIAGNOSIS

### Service Diagnosis—Mechanical (Continued)

Condition	Possible Cause	Correction
NO OIL PRESSURE	(1) Low oil level.	(1) Add oil to correct level.
	(2) Oil pressure gauge or sending unit inaccurate.	(2) Refer to Oil Pressure Indicator in Chapter 1L.
	(3) Oil pump malfunction.	(3) Refer to Oil Pump in Chapter 1B
	(4) Oil pressure relief valve sticking.	(4) Remove and inspect oil pressure relief valve assembly.
	(5) Oil passages on pressure side of pump obstructed.	(5) Inspect oil passages for obstructions.
	(6) Oil pickup screen or tube obstructed.	(6) Inspect oil pickup for obstructions.
	(7) Loose oil inlet tube.	(7) Tighten or seal inlet tube.
LOW OIL PRESSURE	(1) Low oil level.	(1) Add oil to correct level.
	(2) Oil excessively thin due to dilution, poor quality, or improper grade.	(2) Drain and refill crankcase with recommended oil.
	(3) Oil pressure relief spring weak or sticking.	(3) Remove and inspect oil pressure relief valve assembly.
	(4) Oil pickup tube and screen assembly has restriction or air leak.	(4) Remove and inspect oil inlet tube and screen assembly. (Fill pickup with lacquer thinner to find leaks.)
	(5) Excessive oil pump clearance.	(5) Check clearances; refer to Oil Pump in Chapter 1B.
	(6) Excessive main, rod, or camshaft bearing clearance.	(6) Measure bearing clearances, repair as necessary.
HIGH OIL PRESSURE	(1) Improper grade oil.	(1) Drain and refill crankcase with correct grade oil.
	(2) Oil pressure gauge or sending unit inaccurate.	(2) Refer to Oil Pressure Indicator in Chapter 1L.
HIGH OIL PRESSURE (Continued)	(3) Oil pressure relief valve sticking closed.	(3) Remove and inspect oil pressure relief valve assembly.
	(4) Oil pressure relief valve anti-lock port blocked (eight-cylinder only).	(4) Check for obstruction; repair as necessary.
MAIN BEARING NOISE	(1) Insufficient oil supply.	(1) Check for oil low level or low oil pressure.
	(2) Main bearing clearance excessive.	(2) Check main bearing clearance, repair as necessary.
	(3) Crankshaft end play excessive.	(3) Check end play, repair as necessary.
	(4) Loose flywheel or torque converter.	(4) Tighten flywheel or converter attaching bolts.
	(5) Loose or damaged vibration damper.	(5) Repair as necessary.

Service Diagnosis—Mechanical (Continued)

Condition	Possible Cause	Correction
CONNECTING ROD BEARING NOISE	<ul style="list-style-type: none"> <li>(1) Insufficient oil supply.</li> <li>(2) Bearing clearance excessive or bearing missing.</li> <li>(3) Crankshaft connecting rod journal out-of-round.</li> <li>(4) Misaligned connecting rod or cap.</li> <li>(5) Connecting rod bolts tightened improperly.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Check for low oil level or low oil pressure.</li> <li>(2) Check clearance, repair as necessary.</li> <li>(3) Check journal measurements, repair or replace as necessary.</li> <li>(4) Repair as necessary.</li> <li>(5) Tighten bolts to specified torque.</li> </ul>
PISTON NOISE	<ul style="list-style-type: none"> <li>(1) Piston-to-cylinder wall clearance excessive.</li> <li>(2) Cylinder walls excessively tapered or out-of-round.</li> <li>(3) Piston ring broken.</li> <li>(4) Loose or seized piston pin.</li> <li>(5) Connecting rods misaligned.</li> <li>(6) Piston ring side clearance excessively loose or tight.</li> <li>(7) Carbon build-up on piston is excessive.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Check clearance, repair as necessary.</li> <li>(2) Check cylinder wall measurements, rebore cylinder.</li> <li>(3) Replace all rings on that piston.</li> <li>(4) Check piston-to-pin clearance, repair as necessary.</li> <li>(5) Check rod alignment, straighten or replace.</li> <li>(6) Check ring side clearance, repair as necessary.</li> <li>(7) Clean carbon from piston.</li> </ul>
VALVE TRAIN NOISE	<ul style="list-style-type: none"> <li>(1) Insufficient oil supply.</li> <li>(2) Push rods worn or bent.</li> <li>(3) Rocker arms or bridged pivots worn.</li> <li>(4) Dirt or chips in hydraulic tappets.</li> <li>(5) Excessive tappet leak-down.</li> <li>(6) Tappet face worn.</li> <li>(7) Broken or cocked valve springs.</li> <li>(8) Stem-to-guide clearance excessive.</li> <li>(9) Valve bent.</li> <li>(10) Loose rocker arms.</li> <li>(11) Valve seat runout excessive.</li> <li>(12) Missing valve lock.</li> <li>(13) Push rod rubbing or contacting cylinder head.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Check for:                             <ul style="list-style-type: none"> <li>(a) Low oil level.</li> <li>(b) Low oil pressure.</li> <li>(c) Plugged pushrods.</li> <li>(d) Wrong hydraulic tappets.</li> <li>(e) Plugged oil gallery in block.</li> <li>(f) Excessive tappet to bore clearance</li> </ul> </li> <li>(2) Replace worn or bent push rods.</li> <li>(3) Replace worn rocker arms or bridged pivots.</li> <li>(4) Clean tappets.</li> <li>(5) Replace valve tappet.</li> <li>(6) Replace tappet; check corresponding cam lobe for wear.</li> <li>(7) Properly seat cocked springs; replace broken springs.</li> <li>(8) Check stem-to-guide clearance, ream guide, install oversize valve.</li> <li>(9) Replace valve.</li> <li>(10) Tighten bolts to specified torque.</li> <li>(11) Regrind valve seat/valves.</li> <li>(12) Install valve lock.</li> <li>(13) Remove cylinder head and remove obstruction in head.</li> </ul>

## 1A-6 GENERAL SERVICE AND DIAGNOSIS

### Service Diagnosis—Performance

Condition	Possible Cause	Correction
<b>HARD STARTING (ENGINE CRANKS NORMALLY)</b>	(1) Binding linkage, choke valve or choke piston.	(1) Repair as necessary.
	(2) Restricted choke vacuum and hot air passages.	(2) Clean passages.
	(3) Improper fuel level.	(3) Adjust float level.
	(4) Dirty, worn or faulty needle valve and seat.	(4) Repair as necessary.
	(5) Float sticking.	(5) Repair as necessary.
	(6) Exhaust manifold heat valve stuck.	(6) Lubricate or replace.
	(7) Faulty fuel pump.	(7) Replace fuel pump.
	(8) Incorrect choke cover adjustment.	(8) Adjust choke cover.
	(9) Inadequate unloader adjustment.	(9) Adjust unloader.
	(10) Faulty ignition coil.	(10) Test and replace as necessary.
	(11) Improper spark plug gap.	(11) Adjust gap.
	(12) Incorrect initial timing.	(12) Adjust timing.
	(13) Incorrect valve timing.	(13) Check valve timing; repair as necessary.
<b>ROUGH IDLE OR STALLING</b>	(1) Incorrect curb or fast idle speed.	(1) Adjust curb or fast idle speed.
	(2) Incorrect initial timing.	(2) Adjust timing to specifications.
	(3) Improper idle mixture adjustment.	(3) Adjust idle mixture.
	(4) Damaged tip on idle mixture screw(s).	(4) Replace mixture screw(s).
	(5) Improper fast idle cam adjustment.	(5) Adjust fast idle.
	(6) Faulty EGR valve operation.	(6) Test EGR system and replace as necessary.
	(7) Faulty PCV valve air flow.	(7) Test PCV valve and replace as necessary.
	(8) Exhaust manifold heat valve inoperative.	(8) Lubricate or replace heat valve as necessary.
	(9) Choke binding.	(9) Locate and eliminate binding condition.
	(10) Improper choke setting.	(10) Adjust choke.
	(11) Faulty TAC unit.	(11) Repair as necessary.

Service Diagnosis—Performance (Continued)

Condition	Possible Cause	Correction
<b>FAULTY LOW-SPEED OPERATION</b>	(12) Vacuum leak.	(12) Check manifold vacuum and repair as necessary.
	(13) Improper fuel level.	(13) Adjust fuel level.
	(14) Faulty distributor rotor or cap.	(14) Replace rotor or cap.
	(15) Leaking engine valves.	(15) Check cylinder leakdown rate or compression, repair as necessary.
	(16) Incorrect ignition wiring.	(16) Check wiring and correct as necessary.
	(17) Faulty coil.	(17) Test coil and replace as necessary.
	(18) Clogged air bleed or idle passages.	(18) Clean passages.
	(19) Restricted air cleaner.	(19) Clean or replace air cleaner.
	<b>FAULTY LOW-SPEED OPERATION (Continued)</b>	(1) Clogged idle transfer slots.
(2) Restricted idle air bleeds and passages.		(2) Clean air bleeds and passages.
(3) Restricted air cleaner.		(3) Clean or replace air cleaner.
(4) Improper fuel level.		(4) Adjust fuel level.
(5) Faulty spark plugs.		(5) Clean or replace spark plugs.
<b>FAULTY ACCELERATION</b>	(6) Dirty, corroded, or loose secondary circuit connections.	(6) Clean or tighten secondary circuit connections.
	(7) Faulty ignition cable.	(7) Replace ignition cable.
	(8) Faulty distributor cap.	(8) Replace cap.
	(1) Improper pump stroke.	(1) Adjust pump stroke.
	(2) Incorrect ignition timing.	(2) Adjust timing.
	(3) Inoperative pump discharge check ball or needle.	(3) Clean or replace as necessary.
	(4) Faulty elastomer valve. (Eight-cylinder only.)	(4) Replace valve.
	(5) Worn or damaged pump diaphragm or piston.	(5) Replace diaphragm or piston.
(6) Leaking main body cover gasket.	(6) Replace gasket.	
(7) Engine cold and choke too lean.	(7) Adjust choke.	
(8) Improper metering rod adjustment (YF Model carburetor or BBD Model carburetor)	(8) Adjust metering rod.	

Service Diagnosis—Performance (Continued)

Condition	Possible Cause	Correction
FAULTY HIGH SPEED OPERATION	(9) Faulty spark plug(s).	(9) Clean or replace spark plug(s).
	(10) Leaking engine valves.	(10) Check cylinder leakdown rate or compression, repair as necessary.
	(11) Faulty coil.	(11) Test coil and replace as necessary.
	(1) Incorrect ignition timing.	(1) Adjust timing.
	(2) Defective TCS system.	(2) Test TCS system; repair as necessary.
	(3) Faulty distributor centrifugal advance.	(3) Check centrifugal advance and repair as necessary.
	(4) Faulty distributor vacuum advance.	(4) Check vacuum advance and repair as necessary.
FAULTY HIGH SPEED OPERATION (Continued)	(5) Low fuel pump volume.	(5) Replace fuel pump.
	(6) Wrong spark plug gap; wrong plug.	(6) Adjust gap; install correct plug.
	(7) Faulty choke operation.	(7) Adjust choke.
	(8) Partially restricted exhaust manifold, exhaust pipe, muffler or tailpipe.	(8) Eliminate restriction.
	(9) Clogged vacuum passages.	(9) Clean passages.
	(10) Improper size or obstructed main jet.	(10) Clean or replace as necessary.
	(11) Restricted air cleaner.	(11) Clean or replace as necessary.
	(12) Faulty distributor rotor or cap.	(12) Replace rotor or cap.
	(13) Faulty coil.	(13) Test coil and replace as necessary.
	(14) Leaking engine valve(s).	(14) Check cylinder leakdown rate or compression, repair as necessary.
	(15) Faulty valve spring(s).	(15) Inspect and test valve spring tension and replace as necessary.
(16) Incorrect valve timing.	(16) Check valve timing and repair as necessary.	
(17) Intake manifold restricted.	(17) Remove restriction or replace manifold.	
(18) Worn distributor shaft.	(18) Replace shaft.	

Service Diagnosis—Performance (Continued)

Condition	Possible Cause	Correction
MISFIRE AT ALL SPEEDS	(1) Faulty spark plug(s). (2) Faulty spark plug cable(s). (3) Faulty distributor cap or rotor. (4) Faulty coil. (5) Trigger wheel too high. (6) Primary circuit shorted or open intermittently. (7) Leaking engine valve(s). (8) Faulty hydraulic tappet(s). (9) Faulty valve spring(s). (10) Worn lobes on camshaft. (11) Vacuum leak. (12) Improper carburetor settings.	(1) Clean or replace spark plug(s). (2) Replace as necessary. (3) Replace cap or rotor. (4) Test coil and replace as necessary. (5) Set to specifications. (6) Trace primary circuit and repair as necessary. (7) Check cylinder leakdown rate or compression, repair as necessary. (8) Clean or replace tappet(s). (9) Inspect and test valve spring tension, repair as necessary. (10) Replace camshaft. (11) Check manifold vacuum and repair as necessary. (12) Adjust carburetor.
MISFIRE AT ALL SPEEDS (Continued)	(13) Fuel pump volume or pressure low. (14) Blown cylinder head gasket. (15) Intake or exhaust manifold passage(s) restricted. (16) Wrong trigger wheel.	(13) Replace fuel pump. (14) Replace gasket. (15) Pass chain through passages. (16) Install correct wheel.
POWER NOT UP TO NORMAL	(1) Incorrect ignition timing. (2) Faulty distributor rotor. (3) Trigger wheel positioned too high or loose on shaft. (4) Incorrect spark plug gap. (5) Faulty fuel pump. (6) Incorrect valve timing. (7) Faulty coil. (8) Faulty ignition. (9) Leaking engine valves. (10) Blown cylinder head gasket.	(1) Adjust timing. (2) Replace rotor. (3) Reposition or replace trigger wheel. (4) Adjust gap. (5) Replace fuel pump. (6) Check valve timing and repair as necessary. (7) Test coil and replace as necessary. (8) Test cables and replace as necessary. (9) Check cylinder leakdown rate or compression and repair as necessary. (10) Replace gasket.

# 1A-10 GENERAL SERVICE AND DIAGNOSIS

## Service Diagnosis—Performance (Continued)

Condition	Possible Cause	Correction
INTAKE BACKFIRE	(11) Leaking piston rings.	(11) Check compression and repair as necessary.
	(12) Worn distributor shaft.	(12) Replace shaft.
	(1) Improper ignition timing.	(1) Adjust timing.
	(2) Faulty accelerator pump discharge.	(2) Repair as necessary.
	(3) Improper choke operation.	(3) Repair as necessary.
	(4) Defective EGR CTO.	(4) Replace EGR CTO.
EXHAUST BACKFIRE	(5) Defective TAC unit.	(5) Repair as necessary.
	(6) Lean fuel mixture.	(6) Check float level or manifold vacuum for vacuum leak. Remove sediment from bowl.
	(1) Vacuum leak.	(1) Check manifold vacuum and repair as necessary.
	(2) Faulty diverter valve.	(2) Test diverter valve and replace as necessary.
PING OR SPARK KNOCK	(3) Faulty choke operation.	(3) Repair as necessary.
	(4) Exhaust leak.	(4) Locate and eliminate leak.
	(1) Incorrect ignition timing.	(1) Adjust timing.
	(2) Distributor centrifugal or vacuum advance malfunction.	(2) Check advance and repair as necessary.
PING OR SPARK KNOCK	(3) Excessive combustion chamber deposits.	(3) Use combustion chamber cleaner.
	(4) Carburetor set too lean.	(4) Adjust carburetor.
	(5) Vacuum leak.	(5) Check manifold vacuum and repair as necessary.
	(6) Excessively high compression.	(6) Check compression and repair as necessary.
	(7) Fuel octane rating excessively low.	(7) Try alternate fuel source.
	(8) Heat riser stuck in heat ON position.	(8) Free-up or replace heat riser.
SURGING (CRUISING SPEEDS TO TOP SPEEDS)	(9) Sharp edges in combustion chamber.	(9) Grind smooth.
	(1) Low fuel level.	(1) Adjust fuel level.
	(2) Low fuel pump pressure or volume.	(2) Replace fuel pump.
SURGING (CRUISING SPEEDS TO TOP SPEEDS)	(3) Metering rod(s) not adjusted properly (YF Model Carburetor or BBD Model Carburetor).	(3) Adjust metering rod.

## Service Diagnosis—Performance (Continued)

Condition	Possible Cause	Correction
	(4) Improper PCV valve air flow.	(4) Test PCV valve and replace as necessary.
	(5) Vacuum leak.	(5) Check manifold vacuum and repair as necessary.
	(6) Clogged main jet(s).	(6) Clean main jet(s).
	(7) Undersize main jet(s).	(7) Replace main jet(s).
	(8) Blocked air bleeds.	(8) Clean air bleeds.
	(9) Clogged fuel filter screen.	(9) Replace fuel filter.
	(10) Restricted air cleaner.	(10) Clean or replace air cleaner.

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**DIAGNOSIS WITH SCOPE ANALYZER**

The scope analyzer is an ignition tester that provides quick and accurate diagnosis of ignition system performance. All phases of the ignition cycle are shown graphically on an oscilloscope (cathode ray tube) as they occur in engine operation.

The manufacturers of scope analyzer equipment provide descriptions of test procedures possible with their equipment. This section is not intended to cover all uses of scope equipment, but to point out differences in scope pattern between the conventional point system and the SSI (Solid State Ignition) system used on Jeep engines (fig. 1A-1).

The upper section shows a typical scope pattern of a conventional point system from firing line to firing line and areas of the pattern significant to diagnosis. The scope pattern shows time duration horizontally and voltage vertically.

Compare the scope pattern of the point system with the typical pattern of the SSI system.

Note the somewhat longer duration of the spark line shown on the SSI pattern. This longer spark provides superior combustion with the leaner air-fuel mixtures now used.

The SSI waveform pattern is below the zero line in the coil section but otherwise is similar to that of the point system in this area.

Other than the differences described, scope ignition diagnosis procedures for point and SSI systems are essentially the same.

**COMPRESSION TEST**

- (1) Clean spark plug recesses with compressed air.
- (2) Remove spark plugs.
- (3) Remove coil wire from distributor and connect to ground.
- (4) Block throttle in wide open position.

- (5) Insert compression gauge and crank engine for three revolutions. Record reading on third revolution.

**CYLINDER LEAKAGE TEST**

Satisfactory engine performance depends upon a mechanically sound engine. In many cases, unsatisfactory performance or rough idle is caused by combustion chamber leakage. A compression test alone may not reveal this fault. The cylinder leakage test provides an accurate means of testing engine condition. Cylinder leakage testing will point out exhaust and intake valve leaks, leaks between cylinders, leaks into the water jacket or any causes of compression loss.

- (1) Check coolant level and add as required. Do not install radiator cap.

- (2) Start and run engine until it reaches normal operating temperature, then turn ignition Off.

- (3) Remove spark plugs.

- (4) Remove oil filler cap.

- (5) Remove air cleaner.

- (6) Position carburetor fast idle speed screw on top step of fast idle cam.

- (7) Calibrate tester according to manufacturer's instructions.

**NOTE:** Shop air source for testing should maintain 70 psi minimum and 200 psi maximum (80 psi recommended).

- (8) Perform test procedures on each cylinder according to tester manufacturer's instructions.

**NOTE:** While testing, listen for air escaping through carburetor, tailpipe or oil filler cap opening. Check for bubbles in radiator coolant.

- (9) All gauge indications should be even, with no more than 25% leakage. For example, at 80 psi input pressure, a minimum of 60 psi should be maintained in the cylinder. Refer to Cylinder Leakage Test Diagnosis.



# 1A-12 GENERAL SERVICE AND DIAGNOSIS

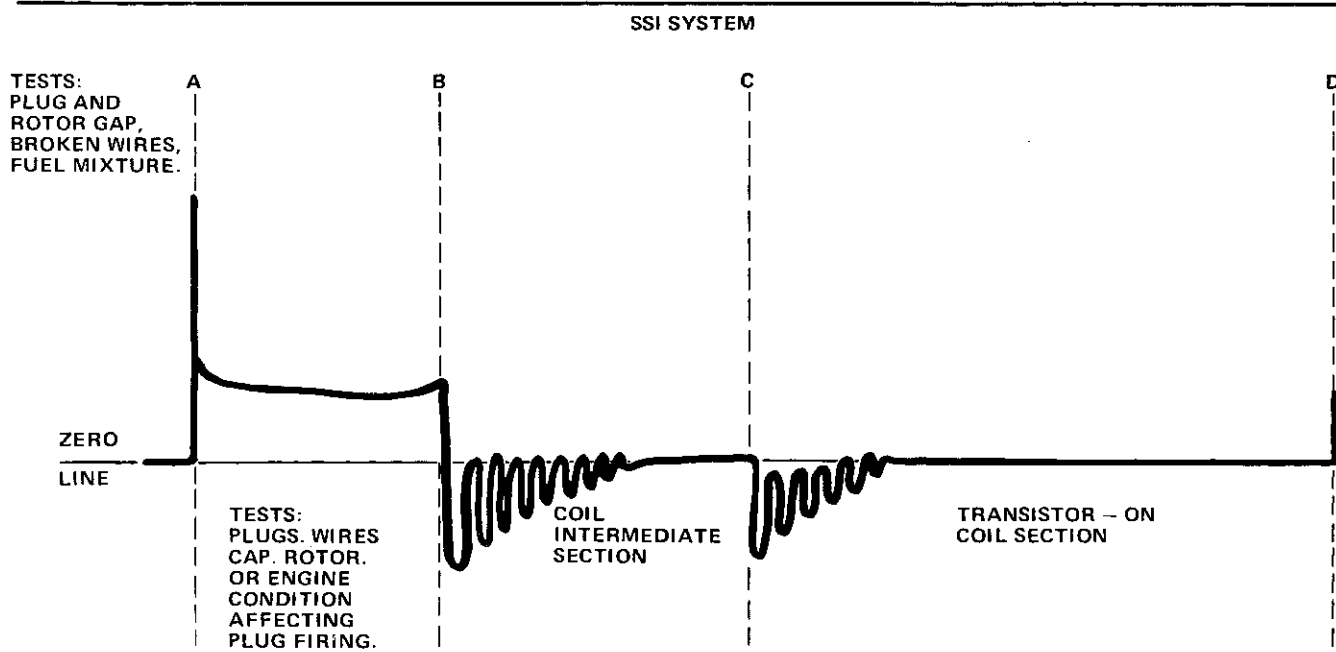
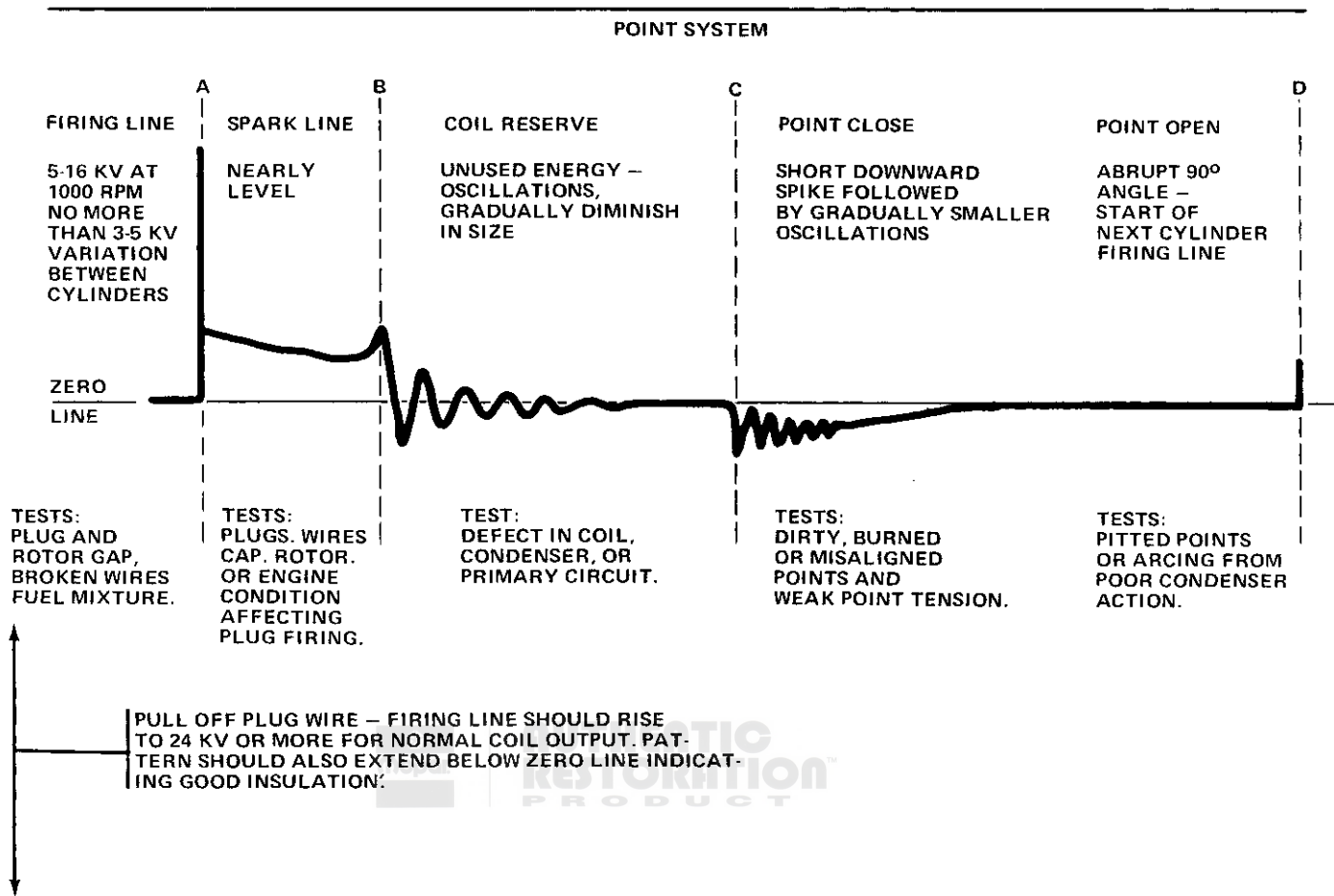


Fig. 1A-1 Scope Diagnosis Pattern—Ignition Primary

## Cylinder Leakage Test Diagnosis

Condition	Possible Cause	Correction
Air escapes through carburetor.	(1) Intake valve leaks.	(1) Refer to Valve Reconditioning under Cylinder Head
Air escapes through tailpipe.	(2) Exhaust valve leaks.	(2) Refer to Valve Reconditioning under Cylinder Head recondition.
Air escapes through radiator.	(3) Head gasket leaks or crack in cylinder block.	(3) Remove cylinder head and inspect.
More than 25% leakage on adjacent cylinder.	(4) Head gasket leaks or crack in cylinder block or head between adjacent cylinders.	(4) Remove cylinder head and inspect.
More than 25% leakage and air escapes through oil filler cap opening only.	(5) Stuck or broken piston ring(s); cracked piston; worn rings and/or cylinder wall.	(5) Inspect for broken ring(s) or piston. Measure ring gap and cylinder diameter, taper, and out-of-round.

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## BLOWN CYLINDER HEAD GASKET DIAGNOSIS

A blown cylinder head gasket usually results in a loss of power, loss of coolant or engine miss. A blown cylinder head gasket may develop between adjacent cylinders or between a cylinder and adjacent water jacket.

A cylinder head gasket blown between two adjacent cylinders is indicated by a loss of power or engine miss.

A cylinder head gasket blown between a cylinder and an adjacent water jacket is indicated by foaming of coolant or overheating and loss of coolant.

Replace a blown cylinder head gasket using the procedures outlined in Chapter 1B—Engines.

## Cylinder-to-Cylinder Leak Test

To determine if the cylinder head gasket is blown between cylinders, perform a compression test as outlined under Compression Test. A cylinder head gasket blown between two cylinders will result in approximately a 50 to 70% reduction in compression in the two affected cylinders.

## Cylinder-to-Water Jacket Leak Test

(1) Remove radiator cap and start engine. Allow engine to warm up until thermostat opens.

(2) If large compression leak exists, bubbles will be visible in coolant.

(3) If bubbles are not visible, install radiator pressure tester and pressurize system. If cylinder is leaking into water jacket, needle will pulsate every time cylinder fires.

## INTAKE LEAK DIAGNOSIS

An intake manifold leak is characterized by lower than normal manifold vacuum. One or more cylinders may be "dead."

## Exterior Leak

Two tests are possible, one with engine oil and one with acetylene.

(1) Start engine.

(2) Apply oil to gasketed areas of intake manifold. If oil is drawn into manifold, or if smoke is evident in exhaust, manifold is leaking.

(3) Open acetylene valve of oxyacetylene torch. **Do not ignite.** Pass torch tip over gasketed areas. If engine speed increases, manifold is leaking.

## Interior Leak—Eight-Cylinder Only

(1) Start engine. Remove PCV valve from intake manifold.

(2) Plug PCV valve inlet in manifold. Leave PCV valve hanging free.

(3) Remove oil filler cap. Block filler tube with palm of hand. If vacuum is felt by hand, intake manifold or cylinder head vacuum is leaking into crankcase.

(4) Remove intake manifold. Check for casting flaws.

(5) Inspect cylinder head for casting flaws. Pay particular attention to area around intake valves and intake ports.

(6) With valve closed, fill port with gasoline and check for leaks. Alternate method: wrap shop cloth around air nozzle and apply air pressure to port. Listen for leaks.

# POWER PLANT TUNE-UP

	Page		Page
Engine Assembly	1A-14	General	1A-14
Exhaust System	1A-21	Ignition System	1A-14
Fuel Systems	1A-18	Specifications	1A-21

## GENERAL

A complete precision tune-up is required at the intervals outlined in the Maintenance Schedule in Chapter B. A tune-up accomplishes several things. First, it assures that the engine is performing as efficiently and as economically as it was designed to perform. Second, it assures that exhaust and fuel system emissions are within the limits defined by Federal regulations.

A complete precision tune-up includes all of the items listed in the Engine Maintenance Schedule. Some items on the chart are highly-specialized emission control devices. These devices are discussed as systems in their respective chapters of this book. They are mentioned here for reference only.

### Engine Maintenance Schedule

Complete Precision Tune-Up  
Every 30,000 Miles (48000 km) - All Models

A precision electronic diagnosis should be purchased whenever questionable engine performance occurs between the scheduled complete precision tune-ups.

Air-Guard System Hoses - inspect and correct if required  
Carburetor Air Cleaner Element - replace  
Choke Linkage - inspect for free movement (correct if required)  
Coil and Spark Plug Wires - inspect and replace if required  
Distributor Advance Mechanisms - check and correct if required  
Distributor Cap and Rotor - inspect and replace if required  
\* Drive Belts - inspect condition and tension and correct if required  
EGR Discharge Port (6-cylinder-2V) - clean if required  
EGR Valve (all Heavy Duty) - inspect and clean  
Engine Oil Filler Cap (filter type) - clean and soak  
Fuel Filter Element - replace  
Fuel System, Cap, Tank, Lines and Connections - inspect for integrity and correct if required  
Inlet Filter at Charcoal Canister - replace  
Heat Valve (exhaust manifold) - inspect and lubricate  
Idle Speed (curb and fast) and mixture - check and reset if required  
Ignition Timing - check and set if required  
PCV Filter (6-cylinder) - clean  
PCV Hoses - inspect and replace if required  
PCV Valve - replace  
Spark Plugs - replace  
TAC System Hoses - inspect and correct if required  
Vacuum Fittings, Hoses and Connections - inspect and correct if required

\* May be required more often during extended high temperature or extensive use of air conditioning.

For convenience in performing a precision tune-up, the necessary services are grouped together by systems.

## ENGINE ASSEMBLY

### Oil Filler Cap

On eight-cylinder engines, a polyurethane foam filter in the oil filler cap routes air into the PCV system. To clean the filter, apply light air pressure in the direction opposite normal flow (through the filler tube opening). If the filter is deteriorated, replace the filler cap.

### Drive Belts

Inspect belts for defects such as fraying or cracking. Check belt tension. Belt adjustment, arrangement and tension specifications are covered in Chapter 1C—Cooling.

### Vacuum Fittings, Hoses and Lines

Inspect vacuum fittings for looseness and corrosion. Inspect rubber hoses for brittleness and cracking. Pay particular attention to hose ends which are slipped onto nipples. Engine performance may be adversely affected by vacuum leaks in such unlikely places as Cruise Command hoses or power brake booster hose.

## IGNITION SYSTEM

### Spark Plugs

Remove and examine spark plugs for burned electrodes and dirty, fouled, cracked or broken porcelains. Keep plugs arranged in the order removed from the engine. An isolated plug displaying an abnormal condition indicates that a problem exists in the cylinder from which it was removed. Replace plugs at mileage intervals recommended in the Engine Maintenance Schedule. Plugs with lower mileage may be cleaned under some circumstances. Refer to Spark Plug Condition. After cleaning, file the center electrode flat with a point file. Set the gap 0.033 to 0.037 inch (fig. 1A-2).

Always use a torque wrench when installing spark plugs. Distortion from overtightening will change the gap clearance of the plug. Tighten to 25 to 30 foot-pounds (34 to 41 N•m) torque.

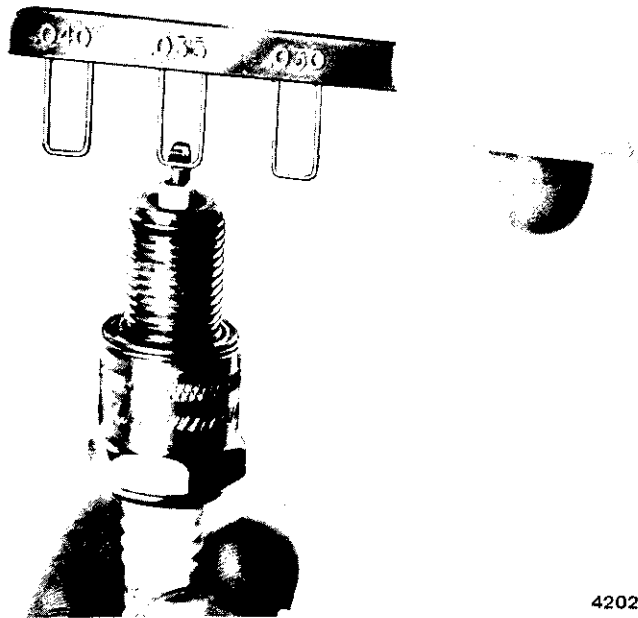


Fig. 1A-2 Spark Plug Gap Check

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**Spark Plug Condition**

Refer to figure 1A-3. Compare spark plugs with the illustrations and the following descriptions.

**A—Gap Bridging**

Gap bridging may be traced to flying deposits in the combustion chamber. Fluffy deposits may accumulate on the plugs during in-town driving. When the engine is suddenly put under heavy load, this material can melt and bridge the gap.

**B—Scavenger Deposits**

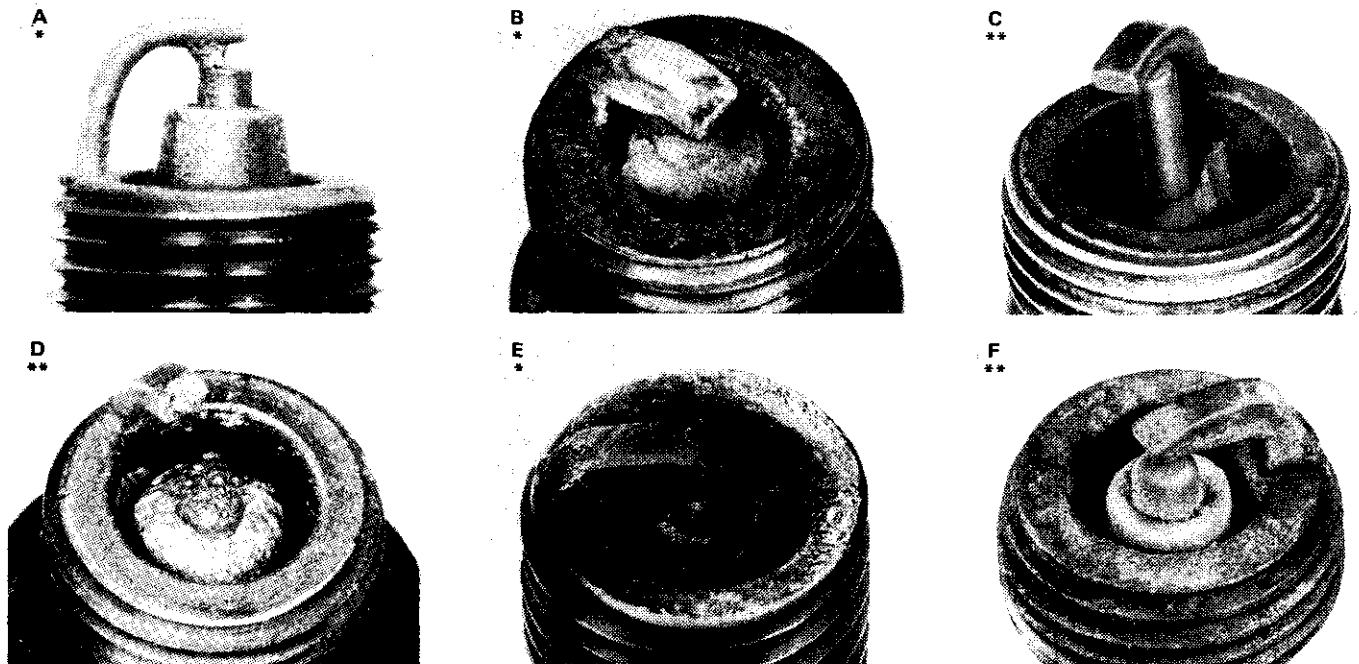
Fuel scavenger deposits shown may be white or yellow. They may appear to be harmful but this is a normal appearance caused by additives in certain fuel brands. Such additives are designed to change the chemical nature of deposits to lessen misfire tendencies. Notice that accumulation on the ground electrode and shell areas may be heavy, but the material is easily removed. Such plugs can be considered normal in condition and can be cleaned using standard procedures.

**C—Chipped Insulator**

Chipped insulators usually result from bending the center electrode while gapping of the plug. Under certain conditions, severe detonation can also split insulator firing ends.

**D—Pre-ignition Damage**

Pre-ignition damage is caused by excessive temperatures. First the center electrode melts and, somewhat later, the ground electrode. Insulators appear relatively clean of deposits. Check for correct plug heat range, overadvanced ignition timing and similar reasons for overheating.



\* LOW MILEAGE PLUGS WITH THIS CONDITION MAY BE CLEANED

\*\* PLUGS WITH THIS CONDITION MUST BE REPLACED

Fig. 1A-3 Spark Plug Conditions

**E—Cold Fouling (or Carbon Fouling)**

Cold fouling is basically a carbon deposit. Dry, black appearance of one or two plugs in a set may be caused by sticking valves or bad ignition leads. Fouling of the entire set may be caused by a clogged air cleaner, a sticking exhaust manifold heat valve or a faulty choke.

**F—Overheating**

Overheating is indicated by a dead white or gray insulator which appears blistered. Electrode gap wear rate will be considerably in excess of 0.001 inch per 1000 miles. This may suggest that a cooler heat range should be used. Overadvanced ignition timing, detonation and cooling system problems can also cause plug overheating.

**NOTE:** Some fuel refiners are using a manganese additive (MMT) in unleaded fuel. During combustion, MMT fuel covers the entire tip of the spark plug with a rust-colored deposit. This rust color may be misdiagnosed as water in the combustion chamber. Spark plug performance is not affected by MMT deposits.

**Spark Plug Wires**

To remove wires from spark plugs, twist the rubber protector boot slightly to break the seal. Grasp the boot and pull it from the plug with steady, even pressure. Do not pull on the wire itself as this will damage the wire.

To remove wires from the distributor cap or coil tower, loosen the boot first, then grasp the upper part of the boot and the wire and gently pull straight up.

**Wire Test**

Do not puncture the spark plug wires with a probe while performing any test. This may cause a separation in the conductor. Remove the suspected wire and use an ohmmeter to test for resistance according to the length of the particular wire.

**Resistance Values**

Inches	Ohms
0 to 15	3,000 to 10,000
15 to 25	4,000 to 15,000
25 to 35	6,000 to 20,000
Over 35	8,000 to 25,000

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When installing spark plug wires and the coil high tension wire, be certain a good tight connection is made at the spark plug, distributor cap tower and coil tower. The protector boots at the spark plugs and distributor cap must fit tightly. A partially seated wire creates an additional gap in the circuit and the resulting spark jump will cause terminal corrosion and wire damage.

**Ignition Coil**

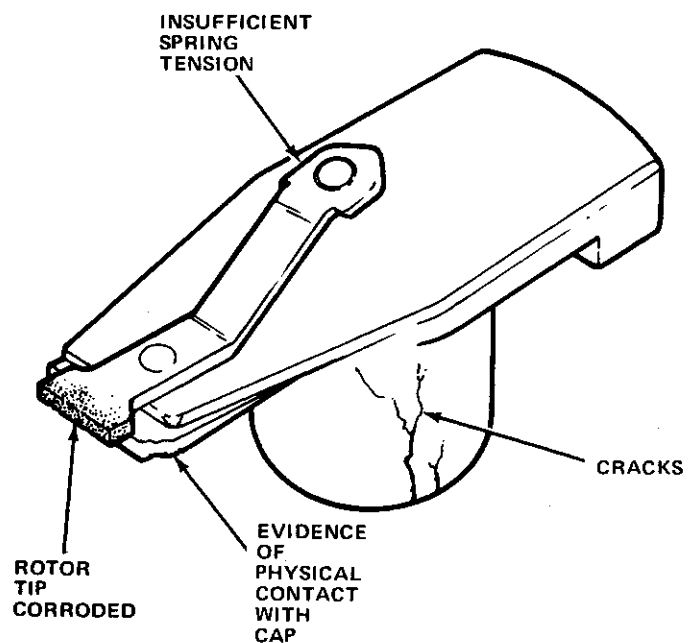
Always check a suspected defective ignition coil on the vehicle. Since a coil may break down after it has reached operating temperature, it is important that the coil be at operating temperature when tests are made. Perform the tests following the instructions of the particular test equipment manufacturer.

**Distributor**

The distributor used on all engines is the solid state type. Other than cap and rotor inspection as outlined in Chapter B, there is no scheduled maintenance for this distributor. Refer to Chapter 1G—Ignition System for distributor service procedures.

**Distributor Rotor**

Visually inspect the rotor for cracks, evidence of burning or corrosion on the metal tip, or evidence of mechanical interference with the cap (fig. 1A-4). Some burning is normal on the end of the metal tip. The grease applied to the rotor tip for radio interference suppression will appear charred. This is normal. Do not remove charred grease. Inspect the spring for insufficient tension. Replace a rotor displaying any of the conditions shown.



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**Fig. 1A-4 Rotor Inspection**

**Distributor Cap**

Remove the distributor cap and wipe clean with a dry rag. Perform a visual inspection for cracks, carbon runners, broken towers, burned or eroded terminals and damaged rotor button (fig. 1A-5). Replace cap displaying

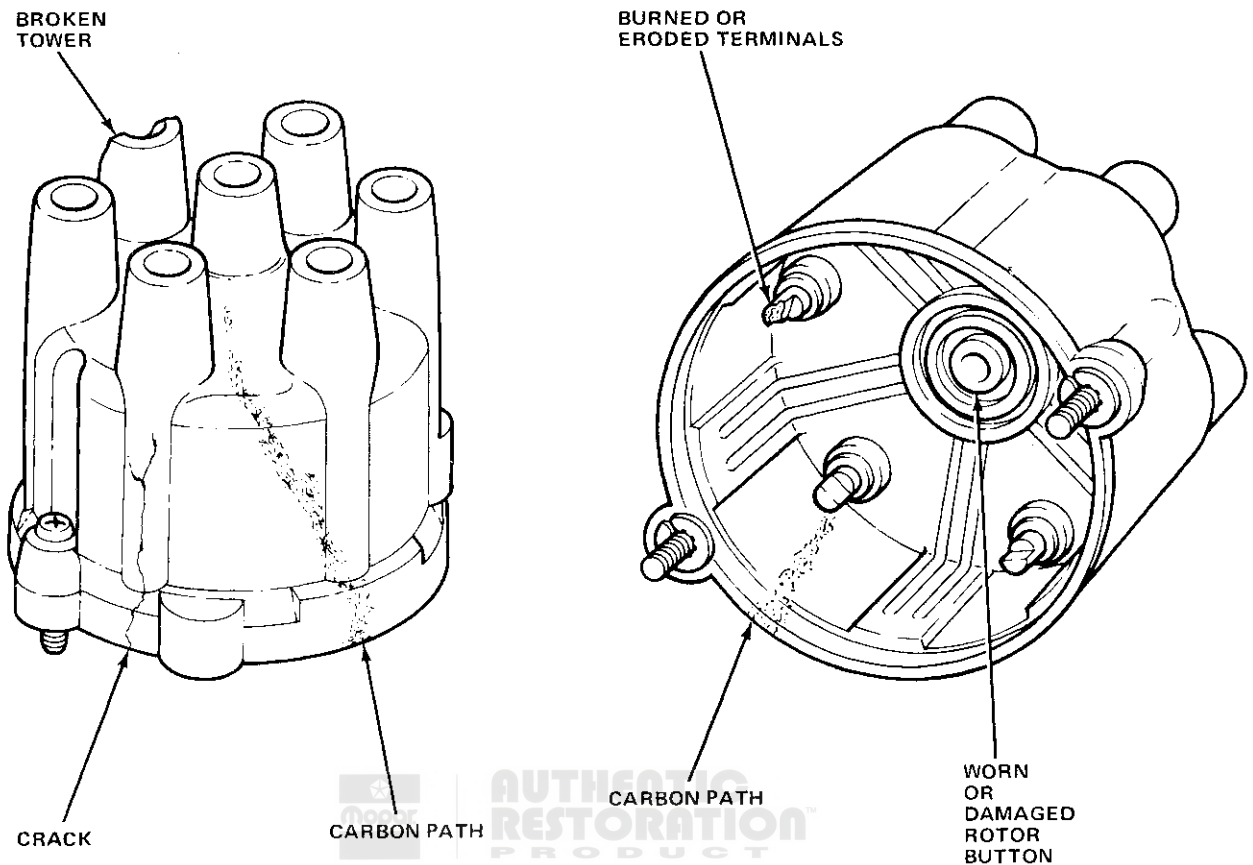


Fig. 1A-5 Distributor Cap Inspection

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any of these conditions. When replacing the cap, move one ignition wire at a time to the replacement cap. If necessary, refer to Distributor Wiring Sequence in Specifications. Make sure each wire is installed in the tower corresponding to the tower from which it was removed. Push the wires firmly into place.

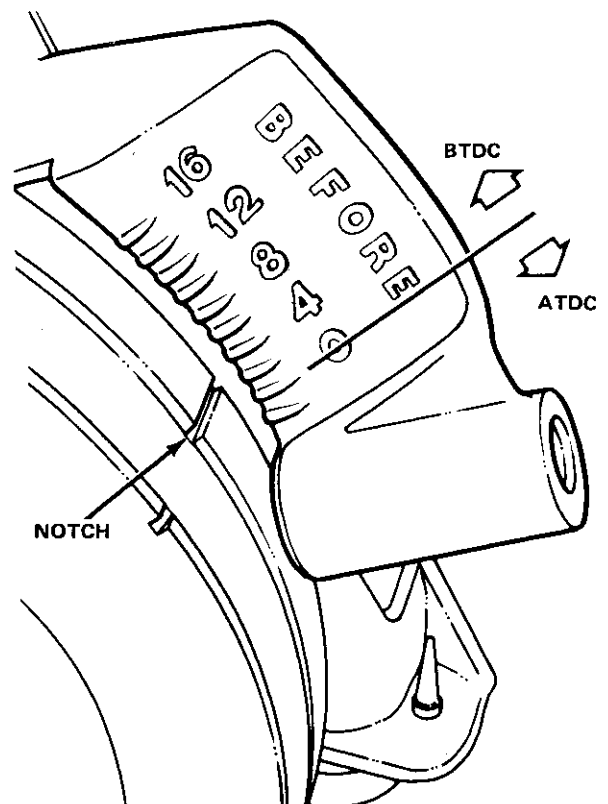
Replace the cap if the inserts inside the cap are excessively burned. The vertical face of the insert will show some evidence of burning through normal operation. Check the inserts for evidence of mechanical interference with the rotor tip.

**Initial Ignition Timing**

A graduated degree scale located on the timing case cover is used for timing the ignition system. A milled notch on the vibration damper is used to reference the No. 1 firing position of the crankshaft with the timing marks on the scale as shown in figures 1A-6 and 1A-7.

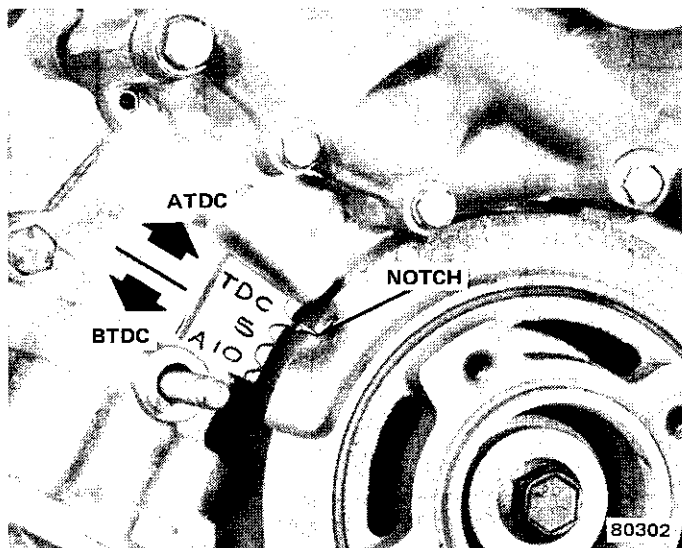
**Magnetic Timing Probe**

A socket is cast into the timing case cover for use with a special magnetic timing probe which senses the milled notch on the vibration damper. The probe is inserted through the socket until it touches the vibration damper and is automatically spaced away from the damper by



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Fig. 1A-6 Timing Mark Location—Six-Cylinder Engine



**Fig. 1A-7 Timing Mark Location—Eight-Cylinder Engine**

damper eccentricity. Ignition timing can then be read from a meter or computer printout, depending on the manufacturer's equipment.

The socket is located at 9.5° ATDC, and the equipment is calibrated for this reading. **Do not use the probe location to check timing using a conventional timing light.**

### Timing Procedure

- (1) Disconnect distributor vacuum hose.
- (2) Connect ignition timing light and properly calibrated tachometer.

**NOTE:** *If the timing light has an advance control feature, turn the control of the Off position.*

- (3) Start engine.
- (4) Adjust idle speed to 500 rpm.
- (5) Adjust initial ignition timing to setting specified on the Tune-Up Specifications—On Vehicle chart by loosening distributor holddown clamp and rotating distributor.
- (6) Tighten distributor holddown clamp and verify ignition timing.

### Distributor Advance Mechanism

#### Adjustable Advance Control Timing Light Procedure

- (1) Disconnect TCS solenoid vacuum valve wires, if equipped.
- (2) Increase engine speed to 2000 rpm.
- (3) Turn advance control of ignition timing light until ignition timing has returned to initial setting. Degree reading on advance meter should be as specified in Tune-Up Specifications—On Vehicle chart.

(4) If total advance at 2000 rpm is less than specified, disconnect vacuum advance hose at distributor.

(5) Check maximum centrifugal degrees advance at engine rpm specified. Refer to Distributor Curves in Specifications.

If the centrifugal advance degrees are as specified, replace the vacuum unit.

### Distributor Advance—On Tester

Distributor advance also may be tested with the distributor out of the vehicle. Follow distributor test equipment manufacturer's instructions.

Information given in the Distributor Curves is for on-vehicle testing. If the distributor advance is checked on a distributor tester, convert the information in the Distributor Curves from engine rpm to distributor rpm and from engine degrees to distributor degrees. Divide engine rpm by 2 to obtain distributor rpm. Divide engine degrees advance by 2 to obtain distributor degrees advance. For instance, if the Distributor Curve indicates 8 to 12 degrees advance at 2000 rpm, the corresponding on-tester specifications would be 4 to 6 degrees advance at 1000 rpm.

**NOTE:** *The inches of vacuum reading is the same, regardless if test is on-engine or off-engine.*

## FUEL SYSTEMS

### General Inspection

Fuel systems depend on hoses and tubing to carry liquid fuel, fuel vapors and vacuum. Fuel vapor and vacuum leaks upset the operation of the engine and may reduce the effectiveness of emission control devices. Liquid fuel leaks not only waste fuel but also create a fire hazard. Carefully inspect hoses and tubing for cracks, dents, corrosion and unintentional bends. Inspect fittings for corrosion or looseness. Inspect fuel tank for leaks caused by loose mounting straps, broken seams, dents or corrosion. Check filler neck grommets and hoses.

### Air Cleaner

Replace the dry-type air cleaner element at each precision tune-up. Under extreme conditions, more frequent replacement is recommended.

### Fuel Filter

All Jeep vehicles have two fuel filters. The in-tank filter is designed to be maintenance-free. The in-line filter between the fuel pump and carburetor requires periodic replacement. When installing the replacement filter, be careful to position the fuel return nipple at the top of the filter.

## Engine Idle Speed and Mixture Setting Procedures

### General

The engine and related systems must be performing properly before making idle speed and mixture adjustments.

Plastic limiter caps are installed over the mixture adjusting screws on all carburetors (fig. 1J-8 and 1J-9). The limiter permits adjustment of the mixture within a narrow range, effectively controlling exhaust emissions at idle. Remove the limiter cap only when instructed in the following mixture adjustment procedures. To remove, carefully insert a No. 10 sheet metal screw into the center of the cap and turn clockwise. Another method is to melt the cap along one side with a soldering iron and pry off with a screwdriver.

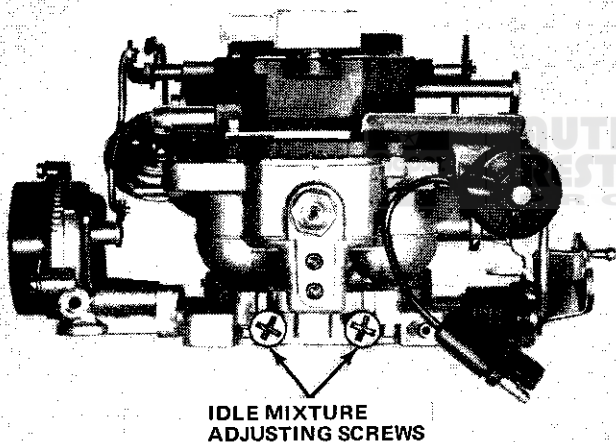


Fig. 1J-8 Carter Model BBD Carburetor

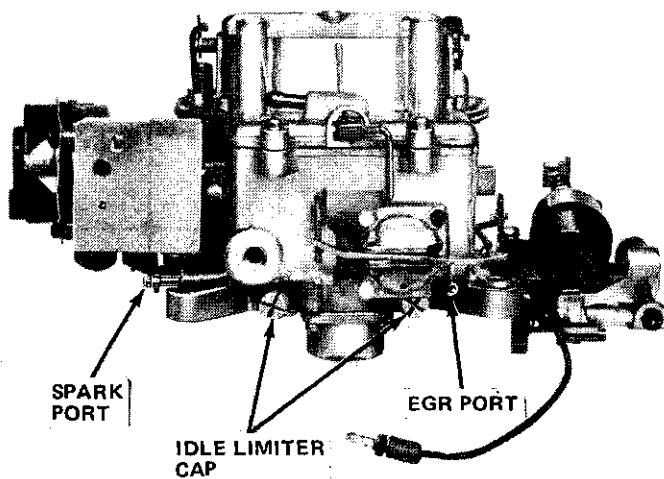


Fig. 1J-9 Motorcraft Model 2100 Carburetor

The idle drop (tachometer) method is the only recommended mixture setting procedure.

### Precautions

- Because automatic transmission vehicles are adjusted in Drive, set the parking brake firmly and do not accelerate the engine.
- Bring the engine up to operating temperature before setting idle and mixture.
- Perform procedures with the air cleaner installed.
- Do not idle the engine more than 3 minutes at a time.
- If the mixture setting procedure takes more than 3 minutes, run the engine at 2000 rpm (in Neutral) for 1 minute.
- Be sure the curb idle setting is correct before adjusting mixture.
- Be careful of fan, belts and other moving objects while working under the hood with the engine running. Do not stand in direct line with the fan blades.

### Idle Setting Procedure

- (1) Warm engine to operating temperature.
- (2) Turn curb idle adjusting screw to obtain specified curb idle speed. If carburetor is equipped with solenoid:
  - (a) Turn nut on solenoid plunger (BBD), or hex screw on solenoid carriage (Model 2100) to obtain specified idle speed.
  - (b) Tighten locknut, if equipped.
  - (c) Disconnect solenoid wire and adjust curb idle screw to obtain 500 rpm idle speed.
  - (d) Connect solenoid wire.

**NOTE:** When setting idle speed, put manual transmission in Neutral. Put automatic transmission in Drive.

**WARNING:** Set parking brake firmly. Do not accelerate engine.

### Mixture Setting Procedure—Idle Drop (Tachometer)

**NOTE:** This procedure applies to all vehicles in 1979.

- (1) Observe precautions listed above.
- (2) Warm engine to operating temperature.
- (3) Adjust each idle mixture screw to full rich stop (clockwise). Note position of screw head slot(s) inside limiter cap(s).
- (4) Remove idle limiter caps by installing No. 10 sheet metal screw and turning clockwise or by melting cap with soldering iron. Discard caps.
- (5) Set idle mixture screws to position noted in step (3) if screw position changed while removing limiter cap(s).
- (6) Connect tachometer and start engine.



## 1A-20 GENERAL SERVICE AND DIAGNOSIS

**NOTE:** Use a tachometer with an expanded scale of 400—800 or 0—1000 rpm. Inspect tachometer periodically to ensure accuracy within 2%.

(7) Position gear selector as listed in Specifications.

(8) Adjust idle speed as listed in Specifications. Use Set-To value. If equipped with solenoid, set idle as follows:

(a) With solenoid energized, set specified curb idle speed.

(b) Disconnect solenoid wire and adjust idle using engine-off throttle stop screw to obtain 500 rpm.

(c) Connect solenoid wire.

(9) Starting from full rich position established in step (3), turn mixture screws leaner (clockwise) until perceptible loss of rpm is noted.

(10) Turn mixture screws richer (counterclockwise) until highest rpm reading is obtained. Do not turn screw(s) any further than point at which highest rpm is first obtained. This is referred to as lean best idle.

**NOTE:** Engine speed will increase above curb idle speed an amount that corresponds approximately to the lean drop specification to be applied in step (11).

(11) As final adjustment, turn both idle mixture screws clockwise in small, equal amounts until specified drop is achieved.

**NOTE:** If the final rpm differs more than  $\pm 30$  rpm from the originally set curb idle speed, set curb idle to specification and perform steps (10) and (11) again.

(12) Install replacement (blue) limiter caps to mixture screws with limiter ear positioned against full rich stop. Be careful to not disturb mixture setting while installing caps.

### Idle Drop

Engine	Transmission	Emission Package	Idle Drop (RPM)
258 2V	Manual	49 - State	50
		49 - State (Cherokee & J-10)	25
	Automatic	49 - State	50
		California	25
304 2V	Manual	49 - State	20
	Automatic	California (CJ)	100
360 2V	Manual	49 - State	50
	Automatic	All	20

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### Choke Linkage

Check all choke linkage including the fast idle cam for free movement at the mileage intervals specified in the Mechanical Maintenance Schedule.

Free-up carburetor linkage by applying Jeep Carburetor and Combustion Area Cleaner, or equivalent. Never use oil to lubricate carburetor linkage.

For correct choke system adjustments, refer to Chapter 1J—Fuel Systems.

### PCV Air Inlet Filter

#### Six-Cylinder Engine

A polyurethane foam PCV air inlet filter is located in a filter retainer in the air cleaner. Rotate the retainer to remove it from the air cleaner (fig. 1A-10). Clean the filter at the mileage intervals recommended in the Maintenance Schedule. Wash with kerosene or detergent and water. Squeeze excess liquid from filter. Do not wring or twist. After cleaning, lightly oil the filter with clean engine oil.

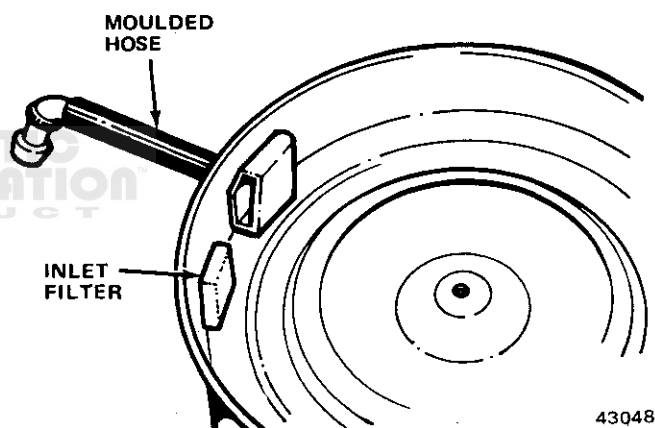


Fig. 1A-10 PCV Air Inlet Filter—Six-Cylinder

#### Eight-Cylinder Engine

A polyurethane foam PCV air inlet filter is located in the sealed oil filler cap. To clean the filter, apply light air pressure in direction opposite normal flow (through the filler tube opening of the cap). Do not oil the filter. If the filter is deteriorated, replace the filler cap.

### Fuel Tank Vapor Emission Control System

The fuel tank, filler cap, fuel lines and vent lines must be maintained in good condition to prevent raw fuel vapors (hydrocarbons) from entering the atmosphere.

Inspect the filler cap for evidence of fuel leakage stains at the filler neck opening. Remove the cap and check the condition of the sealing gasket. Replace the filler cap if the gasket is damaged or deteriorated.

Inspect the fuel tank for evidence of fuel leakage stains. Trace stain to its origin and repair or replace the tank as required.

Inspect the fuel and vent lines for leakage or damage. Repair or replace as required. Be sure all connections are tight.

If liquid fuel is present at the fuel vapor storage canister, inspect the liquid check valve and replace if necessary.

**Charcoal Canister Filter**

The filter pad located at the bottom of the canister is the only serviceable item of the canister assembly. Replace at the intervals described in the Maintenance Schedule, located in Chapter B of this manual.

**Thermostatically Controlled Air Cleaner (TAC) System**

Inspect valve for proper operation. If necessary, refer to Chapter 1J—Fuel Systems for functional test.

Inspect hoses for cracks and brittleness. Replace as necessary.

**EXHAUST SYSTEM**

**Air Guard System**

Inspect hoses for defects. Replace as necessary.

**Exhaust Manifold Heat Valve**

The exhaust manifold heat valve is an often overlooked, but highly important, emission related component. This valve can affect the gas mileage, performance, driveability and emission levels.

Inspect the exhaust manifold heat valve for correct operation and lubricate with Jeep Heat Valve Lubricant, or equivalent. Refer to Chapter 1K—Exhaust Systems for service procedures.

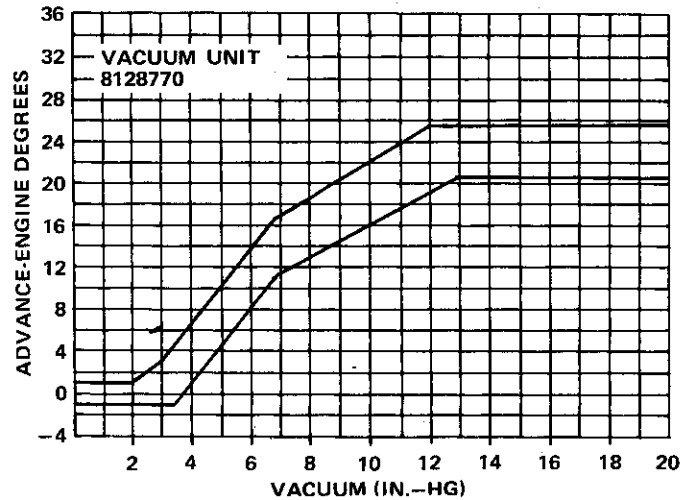
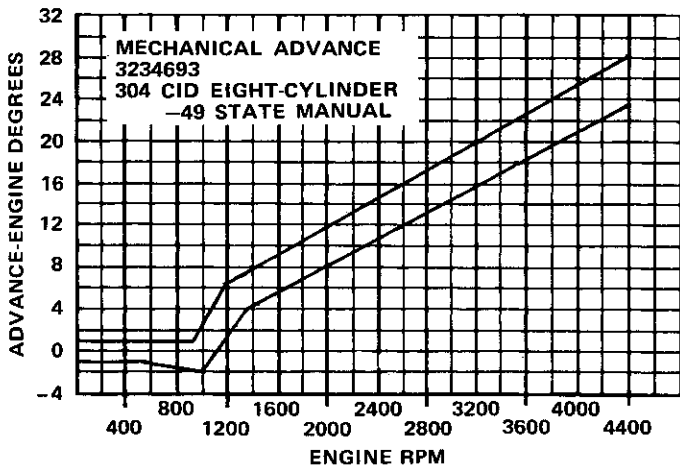
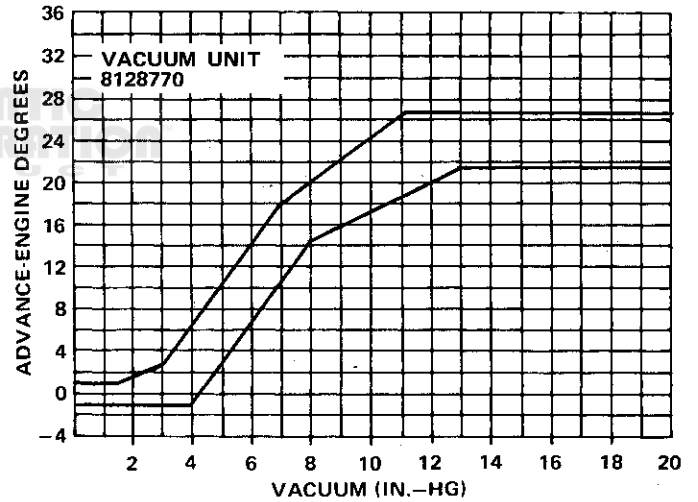
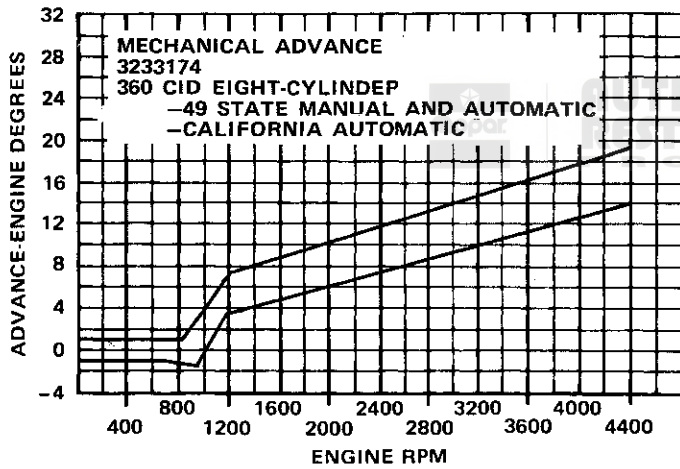
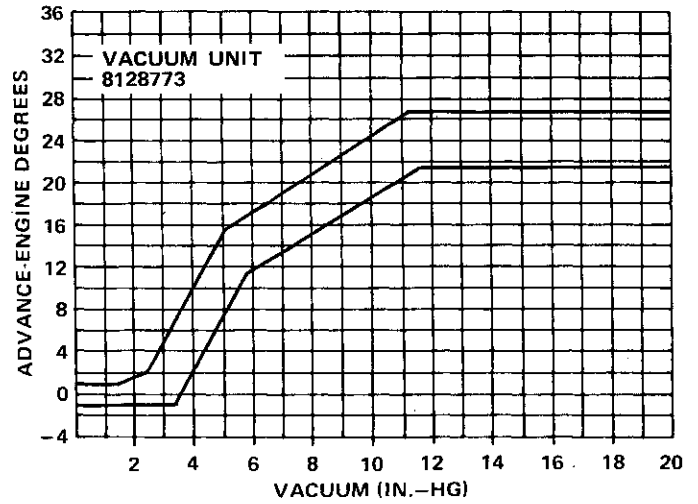
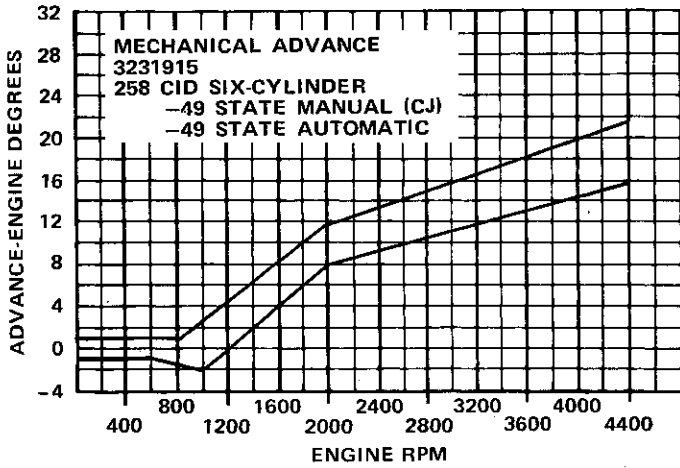
**SPECIFICATIONS**



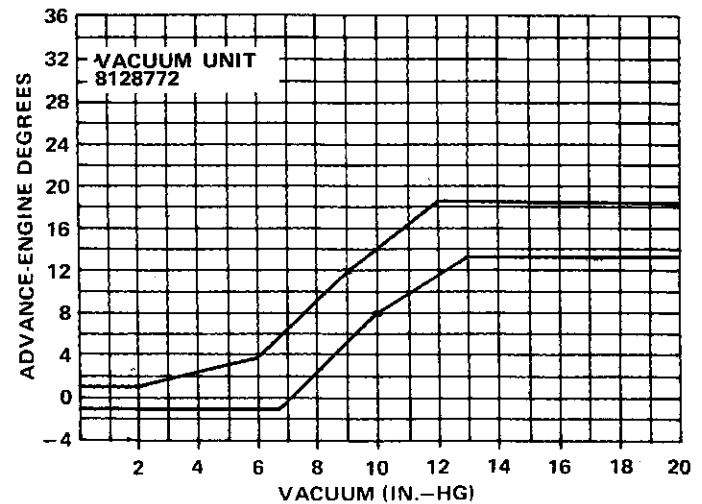
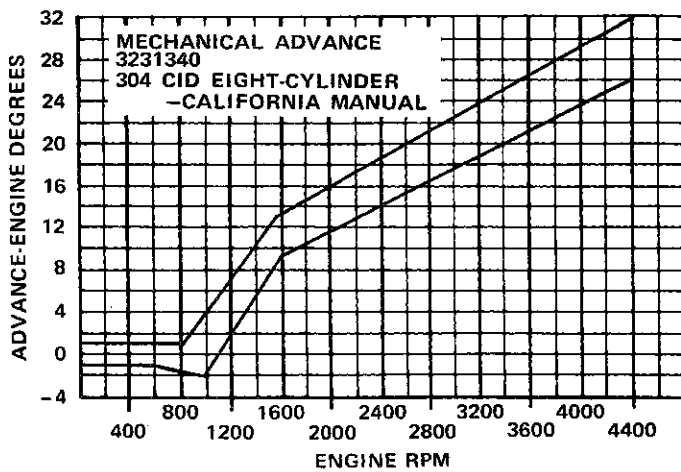
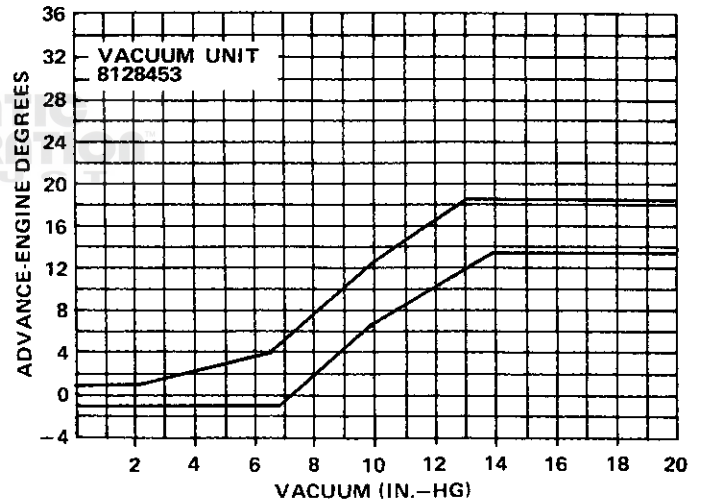
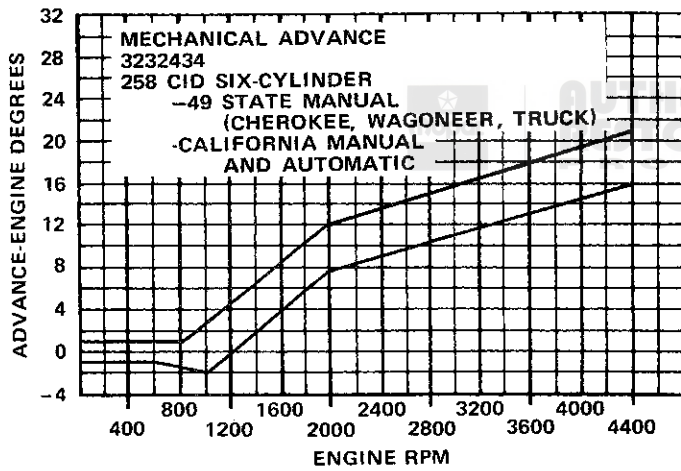
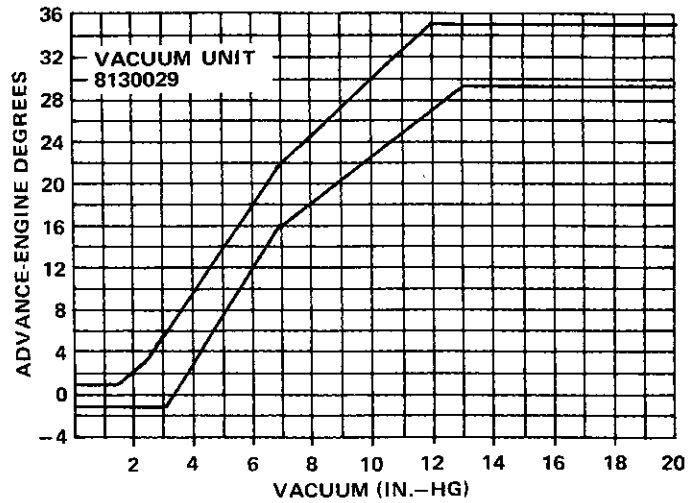
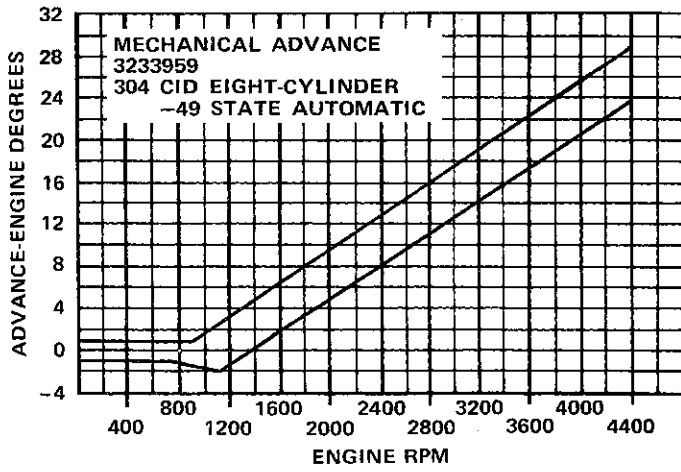
CID and Venturi	Model	Transmission	Curb Idle RPM		Initial Timing at Curb Idle		Distributor Model Number	Vacuum Unit Number	Tot. Degrees Advance at 2000 RPM	Centrifugal Advance	Spark Plug
			Set To	OK Range	Set To	OK Range					
258 2V	CJ	Manual (49)	700	600 800	6°	4° 8°	3231915	8128773	29.1 to 37.8	Refer to Distributor Curves	N13L (Alt. RN13L) Gap 0.033 to 0.038
		Manual (California)					3232434		8128453		
		Automatic (49)	600	500 700	4°	2° 6°	3231915	8128773	29.1 to 37.8		
		Automatic (California)					3232434		8128453		
	Cherokee Wagoneer Truck	Manual (49)	800	700 900*	8°	6° 10°	3233174	8128770	27.5 to 37.0		
		Automatic (49)									
304 2V	CJ	Manual (49)	700	600 800	5°	3° 7°	3234693	8128770	28.7 to 37.5		
		Manual (California)	750	650 850			3231340		8128772	25.3 to 34.5	
		Automatic (49)	600	550 750	3233959	8130029	34.4 to 44.5				
360 2V	Cherokee Wagoneer Truck	Manual (49)	800	700 900*	8°	6° 10°	3233174	8128770	27.5 to 37.0		
		Automatic (49)	600	500 700							
		Automatic (California)									

\* J-20 OK Range 750 to 950

Distributor Curves—On-Vehicle

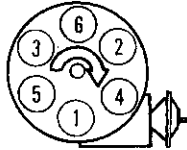
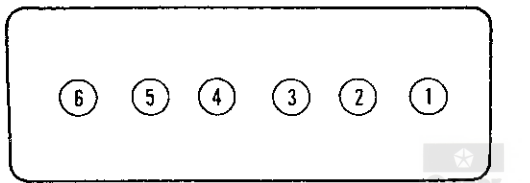


Distributor Curves—On-Vehicle



# 1A-24 GENERAL SERVICE AND DIAGNOSIS

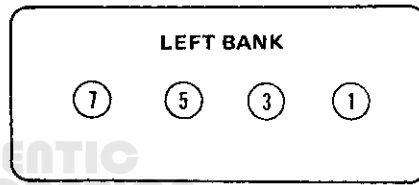
## Distributor Wiring Sequence and Firing Order



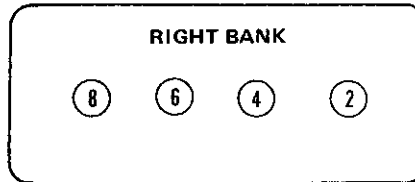
CLOCKWISE ROTATION  
1-5-3-6-2-4

SIX-CYLINDER ENGINES

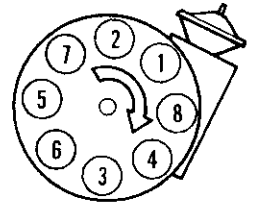
FRONT



CLOCKWISE ROTATION  
1-8-4-3-6-5-7-2



EIGHT CYLINDER ENGINES



FRONT

42189

# ENGINES

# 1B

## SECTION INDEX

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Eight-Cylinder Engine	1B-36		

## SIX-CYLINDER ENGINE

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Connecting Rod and Piston Assembly	1B-22	Oil Filter	1B-19
Crankshaft	1B-28	Oil Pan	1B-21
Cylinder Block	1B-32	Oil Pump	1B-19
Cylinder Bore Reconditioning	1B-33	Pistons	1B-25
Cylinder Head and Cover	1B-16	Rocker Arm Assembly	1B-5
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Intake and Exhaust Manifolds	1B-14		

### GENERAL

The 258 CID (4.2 liter) is a six-cylinder, in-line, overhead valve engine (fig. 1B-1 and 1B-2) which operates only on no-lead gasoline. Cylinders are numbered from front to rear. Firing order is 1-5-3-6-2-4. Crankshaft rotation is clockwise, viewed from the front. The crankshaft is supported by seven two-piece bearings. The camshaft is supported by four one-piece, line bored bearings.

The six-cylinder engine features a quench-head design. The combustion chamber shape, both in the head and in the piston crown, compresses the combustion mixture closer to the spark plug. In most applications, this permits the use of more ignition timing advance for better fuel economy.

### Identification

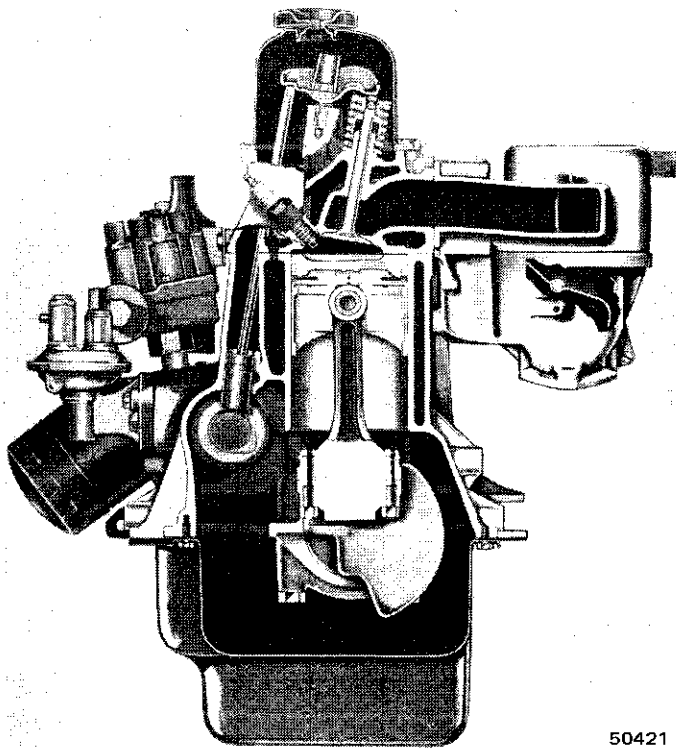
#### Build Date Code

The engine Build Date Code is located on a machined surface on the right side of the block between the No. 2 and No. 3 cylinders (fig. 1B-3).

The numbers of the code identify the year, month and day that the engine was built.

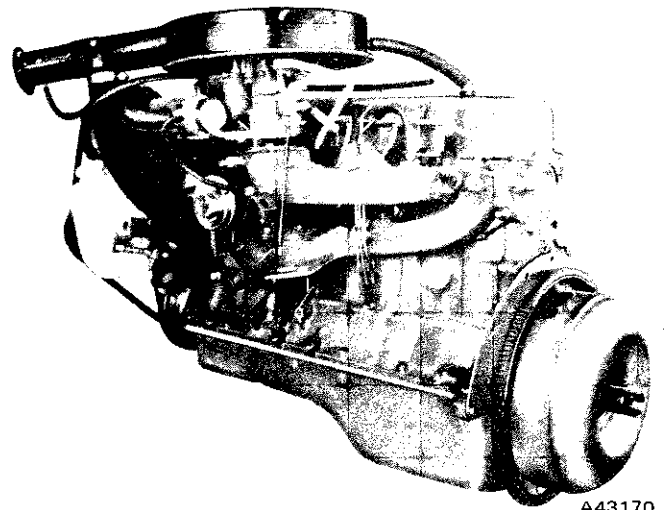
The code letter identifies the cubic inch displacement, carburetor type and compression ratio. The letters are decoded as follows:

The example code shown in the Engine Build Date Code chart identifies a 258 CID (4.2 liter) with 2V carburetor and 8.00:1 compression ratio built on March 18, 1979.



50421

Fig. 1B-1 Engine Assembly—Sectional View



A43170

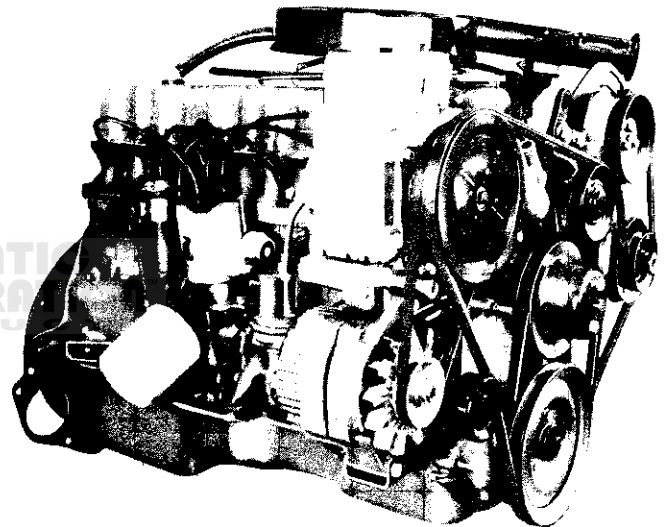


Fig. 1B-2 Six-Cylinder Engine Assembly—Typical

### Oversize or Undersize Components

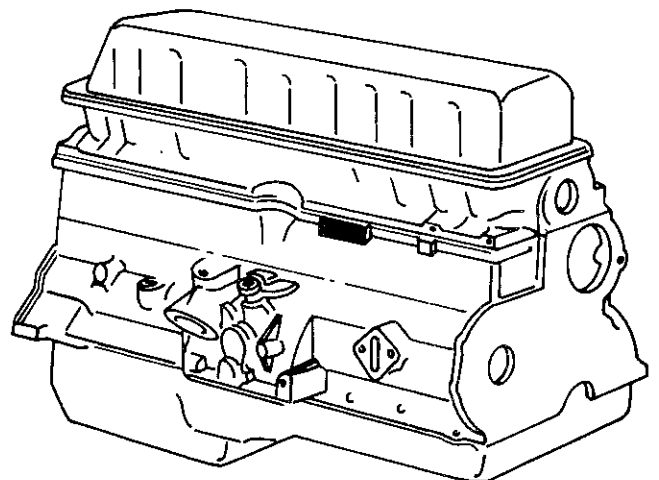
Some engines may be built with oversize or undersize components such as oversize cylinder bores, undersize crankshaft main bearing journals, undersize connecting rod journals or oversize camshaft bearing bores. These engines are identified by a letter code stamped on a boss between the ignition coil and distributor (fig. 1B-4). The letters are decoded as follows:

### SHORT ENGINE ASSEMBLY (SHORT BLOCK)

A service replacement short engine assembly (short block) may be installed whenever the original engine block is worn or damaged beyond repair. It consists of engine block, piston and rod assemblies, crankshaft, camshaft, timing gears and chain.

**NOTE:** Short engine assemblies have an S stamped on the same surface as the build date code for identification.

Installation includes transfer of component parts from the worn or damaged original engine. Follow the appropriate procedures for cleaning, inspection and torque tightening as outlined in this chapter.



80002

Fig. 1B-3 Engine Build Date Location

**Engine Build Date Code**

Letter Code	CID	Carburetor	Compression Ratio
C	258	2V	8.0:1

1st Character (Year)	2nd and 3rd Characters (Month)	4th Character (Engine Type)	5th and 6th Characters (Day)
2 - 1978 3 - 1979	01 - 12	C	01 - 31

EXAMPLE: 3 03 C 18

60257

**Oversize or Undersize Components**

Code Letter	Definition	
B	All cylinder bores	- 0.010-inch (.254) oversize
M	All crankshaft main bearing journals	- 0.010-inch (.254) undersize
P	All connecting rod bearing journals	- 0.010-inch (.254) undersize
C	All camshaft bearing bores	- 0.010-inch (.254) oversize

EXAMPLE: The code letters PM mean that the crankshaft main bearing journals and connecting rod journals are 0.010-inch undersize.

60258

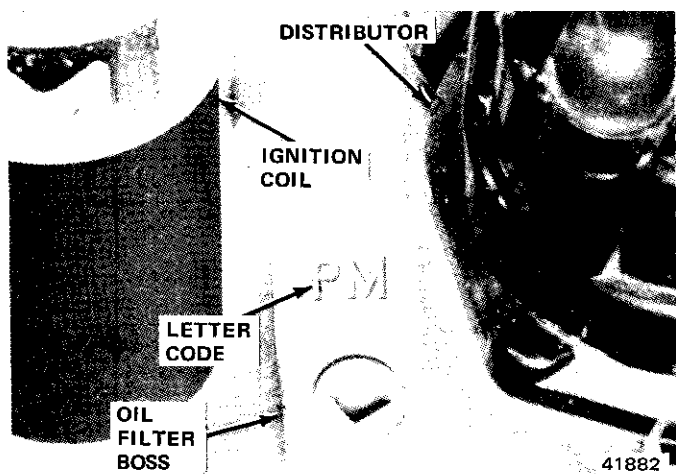


Fig. 1B-4 Oversize or Undersize Letter Code Location

**ENGINE MOUNTING**

Resilient rubber cushions support the engine and transmission at three points: at each side on the center-line of the engine and at the rear between the transmission extension housing and the rear support crossmember (fig. 1B-5). Replacement of a cushion may be accomplished by supporting the weight of the engine or transmission at the area of the cushion.

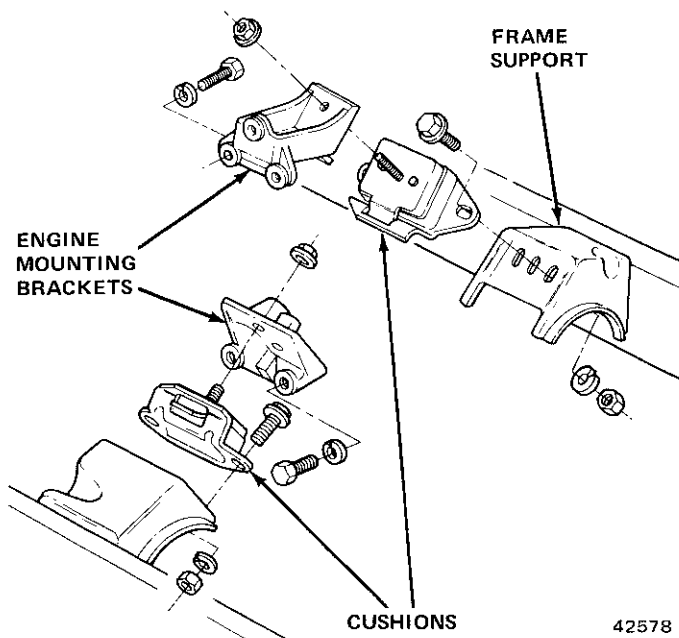


Fig. 1B-5 Engine Mounting—Typical

**ENGINE HOLDING FIXTURE**

If it is necessary to remove the front engine mounting brackets or cushions, an engine holding fixture may be fabricated (fig. 1B-6).

The engine also may be supported by a jack under the oil pan skid plate. Use a board between jack and skid plate to distribute weight evenly.

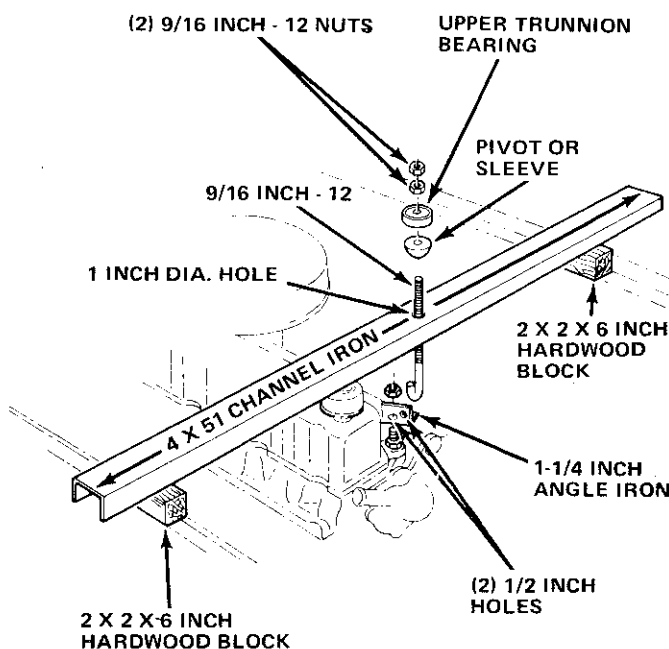


Fig. 1B-6 Engine Holding Fixture



**ENGINE REMOVAL**

The engine is removed without the transmission and bellhousing. Raise the vehicle slightly to gain working clearance.

- (1) Drain cooling system.
- (2) On all models except CJ, remove hood. Mark hinge locations for alignment during installation.
- (3) Remove battery on Cherokee-Wagoneer-Truck models. On CJ models, disconnect negative battery cable.
- (4) Remove air cleaner. Disconnect and plug fuel line to fuel pump. Disconnect fuel return line from tubing at flexible hose connection to frame.
- (5) Disconnect heater hoses at front of engine on CJ models and at heater on other models.
- (6) Disconnect accelerator cable from engine.
- (7) Disconnect harness wiring from engine and alternator and lay aside.
- (8) Identify vacuum lines from dash panel and disconnect from engine.
- (9) Disconnect shroud, if equipped, from radiator.
- (10) Remove radiator, fan and shroud. Install bolt in pulley after fan is removed to keep pulley in alignment with bolt holes in water pump.
- (11) Disconnect cable from starter motor. Remove starter motor.
- (12) Remove motor mount cushion-to-frame attaching nuts.
- (13) Disconnect exhaust pipe.
- (14) If equipped with manual transmission:
  - (a) Remove bellhousing screws.
  - (b) Remove clutch linkage and shield.
- (15) If equipped with automatic transmission:
  - (a) Remove transmission cover.
  - (b) Mark converter and flex plate for alignment during installation.
  - (c) Remove converter drive screws. Rotate crankshaft for access to each screw.
  - (d) Remove converter housing-to-engine screws. Remove oil pan screws which retain transmission cooler lines.
- (16) Support transmission with jack.
- (17) If equipped with power steering, disconnect hoses at steering gear. Tie hoses to engine to prevent draining.
- (18) If equipped with air conditioning:
  - (a) Turn compressor service fitting valve stem to seat.
  - (b) Loosen service fitting.
  - (c) Allow compressor refrigerant to escape.
  - (d) Remove fittings from compressor.
- (19) Attach engine lift device. Pull engine forward to disengage from transmission. Lift upward to remove.

**ENGINE INSTALLATION**

- (1) Remove right mount from engine.

(2) Lower engine into compartment. Engage engine to transmission.

(3) Install bellhousing screws and remove transmission jack.

(4) Install motor mounts to block. Lower engine and tighten all motor mount screws and nuts.

(5) If equipped with manual transmission:

(a) Install clutch housing shield and clutch linkage.

(b) Adjust clutch, if necessary.

(6) If equipped with automatic transmission:

(a) Align marks on converter and flex plate. Install converter drive screws.

(b) Install transmission cover.

(c) Install transmission cooler lines to engine oil pan screws.

(7) Install exhaust pipe.

(8) Install starter motor. Connect cable to starter motor.

(9) Remove lifting device.

(10) Connect fuel supply and return lines.

(11) If equipped with power steering, connect hoses to steering gear.

(12) Connect electrical wires and attach vacuum hoses.

(13) Attach heater hoses.

(14) Install fan. If equipped with shroud, position shroud on fan blades.

(15) Install radiator and attach shroud to radiator.

(16) Connect radiator hoses. If equipped with automatic transmission, connect cooler lines to radiator.

(17) Install accelerator linkage.

(18) If equipped with air conditioning:

(a) Connect service valves to compressor.

(b) Open valve to mid-position.

(c) Open service port slightly. Allow small amount of refrigerant to escape to purge compressor of air.

(d) Tighten port cap.

(19) Install battery, if removed, and connect cables.

(20) Install coolant.

(21) Start engine. While engine is warming up, install hood.

(22) Check for fuel, oil or water leaks. Turn engine off and check fluid levels.

(23) Install air cleaner and road-test vehicle.

**VALVE TRAIN****General**

The six-cylinder engine has overhead valves operated by push rods and rocker arms. A chain-driven camshaft is mounted in the cylinder block. Hydraulic valve tappets provide automatic valve lash adjustments.

## Rocker Arm Assembly

The intake and exhaust rocker arms of each cylinder pivot on a bridged pivot which is secured with two capscrews as shown in figure 1B-7. The bridged pivot maintains correct rocker arm-to-valve tip alignment. Each rocker arm is actuated by a hollow steel push rod with a hardened steel ball at each end. The hollow push rods channel oil to the rocker arm assemblies.

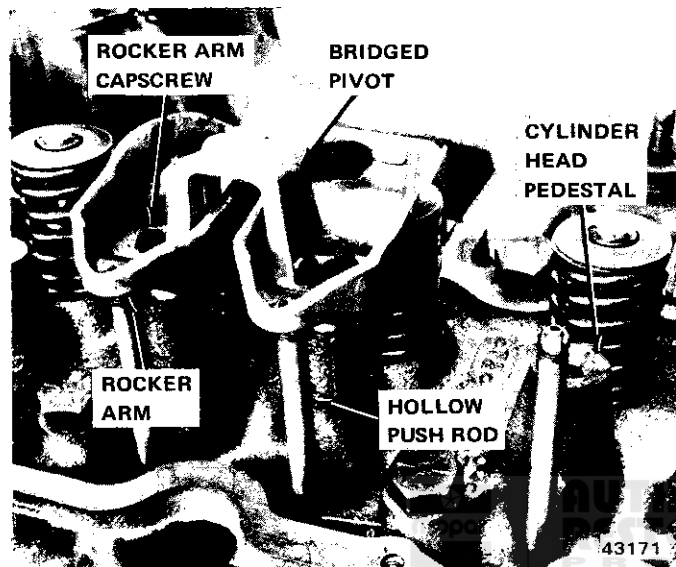


Fig. 1B-7 Rocker Arm Assembly

### Removal

- (1) Remove cylinder head cover and gasket.
- (2) Remove two capscrews at each bridged pivot. Alternately loosen capscrews one turn at a time to avoid damaging bridge.
- (3) Remove bridged pivots and corresponding pairs of rocker arms and place on bench in same order as removed.
- (4) Remove push rods and place on bench in same order as removed.

### Cleaning and Inspection

Clean all parts with a cleaning solvent and use compressed air to blow out oil passages in the rocker arms and push rods.

Inspect the pivot surface of each rocker arm and bridged pivot. Replace any parts which are scuffed, pitted or excessively worn. Inspect valve stem tip contact surface of each rocker arm and replace any rocker arm which is deeply pitted. Inspect each push rod end for excessive wear and replace as required. If any push rod is excessively worn due to lack of oil, replace the push rod and inspect the corresponding lifter.

It is not normal to find a wear pattern along the length of the push rod. Check the cylinder head for obstruction if this condition exists.

### Installation

- (1) Install each push rod in location from which it was removed. **Make certain bottom end of each rod is centered in plunger cap of hydraulic valve lifter.**
- (2) Install bridged pivots and pair of rocker arms to cylinders from which they were removed.
- (3) Loosely install capscrews to each bridged pivot.
- (4) At each bridged pivot, tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten to 19 foot-pounds (26 N•m) torque.
- (5) Install cylinder head cover and gasket.

### Valves

**NOTE:** The following procedures apply only after the cylinder head has been removed from the engine. Refer to Cylinder Head for removal procedures.

### Removal

- (1) Compress each valve spring with Spring Compressor Tool J-21931-01 and remove valve locks, retainers, springs and valve stem oil deflectors.
- (2) Remove valves and place in rack in same order as removed from cylinder head.

### Cleaning and Inspection

- (1) Clean all carbon buildup from combustion chambers, valve ports, valve stems and head.
- (2) Clean all dirt and gasket cement from cylinder head machined surface.
- (3) Inspect for cracks in combustion chambers and valve ports.
- (4) Inspect for cracks in gasket surface at each coolant passage.
- (5) Inspect valves for burned, cracked or warped heads. Inspect for scuffed or bent valve stems. Replace valves displaying any of the above damage.

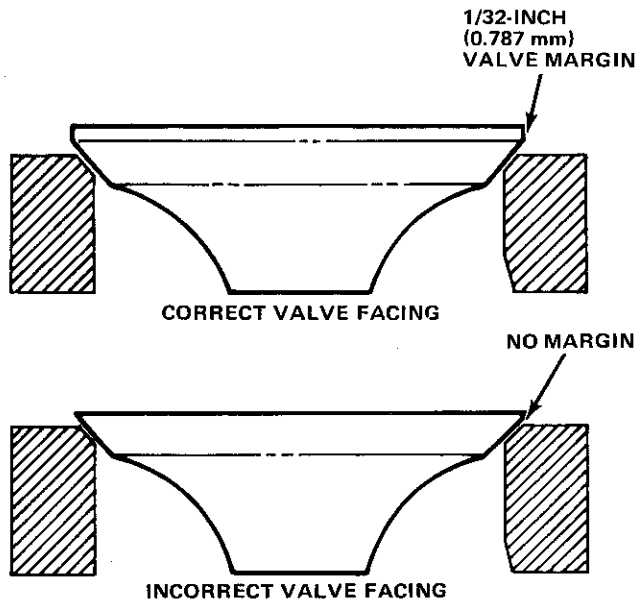
### Valve Refacing

Use a valve refacing machine to reface intake and exhaust valves to the specified angle. After refacing, at least 1/32-inch (0.787 mm) margin must remain. If not, replace the valve. Examples of correct and incorrect valve refacing are shown in figure 1B-8.

The valve stem tip can be resurfaced and rechamfered when worn. Do not remove more than 0.020 inch (0.508 mm).

### Valve Seat Refacing

Install a pilot of the correct size in the valve guide and reface the valve seat to the specified angle with a good dressing stone. Remove only enough metal to provide a smooth finish

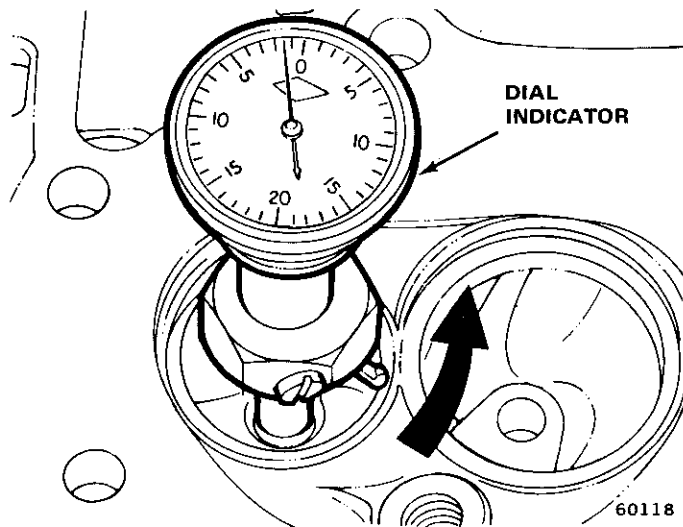


60117

Fig. 1B-8 Valve Refacing

Use tapered stones to obtain the specified seat widths when required.

Control seat runout to a maximum of 0.0025 (0.064 mm) inch (fig. 1B-9).



60118

Fig. 1B-9 Checking Valve Seat Runout

**Valve Stem Oil Deflector Replacement**

Nylon valve stem oil deflectors are installed on each valve stem to prevent rocker arm lubricating oil from entering the combustion chamber through the valve guides. Replace the oil deflectors whenever valve service is performed or if the deflectors have deteriorated.

Valve stem oil deflector replacement requires removal of valve spring(s). Refer to Valve Springs for procedure.

**Valve Guides**

The valve guides are an integral part of the cylinder head and are not replaceable. When the stem-to-guide clearance is excessive, ream the valve guides to accommodate the next larger oversize valve. Oversize service valves are available in 0.003-inch (0.076 mm), 0.015-inch (0.381 mm), and 0.030-inch (0.762 mm) sizes.

**Valve Guide Reamer Sizes**

Reamer Tool Number	Size
J-6042-1	0.003-inch
J-6042-5	0.015-inch
J-6042-4	0.030-inch

60260

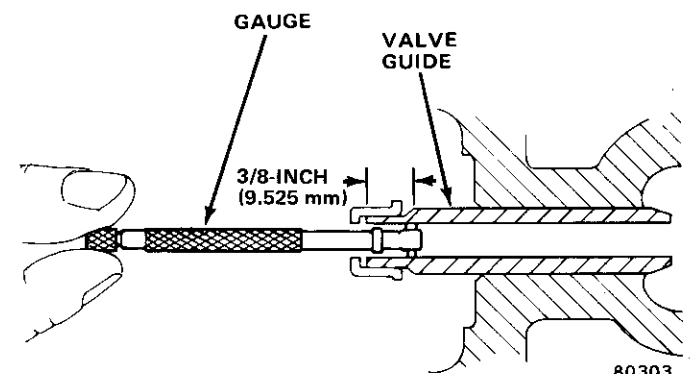
**NOTE:** Ream valve guides in steps, starting with the 0.003-inch (0.076 mm) oversize reamer and progressing to the size required.

**Valve Stem-to-Guide Clearance**

Valve stem-to-guide clearance may be checked by either of the following two methods.

**Preferred Method:**

- (1) Remove valve from head and clean valve guide with solvent and bristle brush.
- (2) Insert telescoping gauge into valve guide approximately 3/8-inch (9.525 mm) from valve spring side of head (fig. 1B-10) with contacts crosswise to cylinder head. Measure telescoping gauge with micrometer.
- (3) Repeat measurement with contacts lengthwise to cylinder head.
- (4) Compare crosswise to lengthwise readings to determine out-of-roundness. If measurements differ by more than 0.0025-inch (0.064 mm), ream guide to accommodate oversize valve.
- (5) Compare valve guide diameter with diameter listed in Specifications. If measurement differs more than 0.003-inch (0.076 mm), ream guide to accommodate oversize valve.



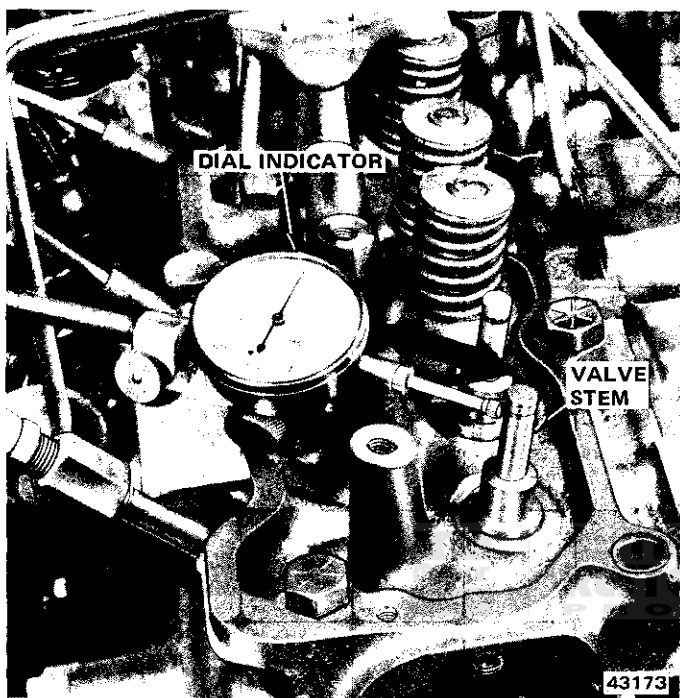
80303

Fig. 1B-10 Valve Stem-to-Guide Clearance Measurement with Telescoping Gauge

**Alternate Method:**

(1) Use dial indicator to measure lateral movement of valve stem with valve installed in its guide and just off valve seat (fig. 1B-11).

(2) Correct clearance is 0.001- to 0.003-inch (0.025 mm to 0.076 mm). If indicated movement exceeds this amount, ream guide to accommodate oversize valve.



**Fig. 1B-11 Valve Stem-to-Guide Clearance Measurement with Dial Indicator**

**Installation**

(1) Thoroughly clean valve stems and valve guide bores.

(2) Lightly lubricate stem and install valve in same valve guide from which it was removed.

(3) Install replacement valve stem oil deflector on valve stem.

**NOTE:** If oversize valves are used, oversize oil deflectors are required.

(4) Position valve spring and retainer on cylinder head and compress valve spring with compressor tool. Install valve locks and release tool.

(5) Tap valve spring from side-to-side with hammer to be certain spring is properly seated at cylinder head.

**Valve Springs**

**Valve Spring and Oil Deflector Removal**

**NOTE:** This procedure is for removal of valve springs and oil deflectors with the cylinder head installed on the engine. Refer to Valves for removal procedure with the head removed.

The valve spring is held in place on the valve stem by a retainer and a set of conical-type valve locks. The locks can be removed only by compressing the valve spring.

(1) Remove cylinder head cover and gasket.

(2) Remove rocker arms and bridged pivot assembly.

(3) Remove push rods.

**NOTE:** Retain push rods, bridged pivots and rocker arms in same order and position as removed.

(4) Remove spark plug from cylinder.

(5) Install 14-mm (thread size) air adapter in spark plug hole.

**NOTE:** An adapter can be made by welding an air hose connection to the body of a spark plug from which the porcelain has been removed.

(6) Connect air hose to adapter and maintain at least 90 psi in cylinder to hold valves against their seats.

**NOTE:** On vehicles equipped with air conditioning, use a flexible air adapter when servicing No. 1 cylinder.

(7) Use Valve Spring Remover and Installer Tools J-22534-1, J-22534-4 and J-22534-5 to compress spring and remove locks (fig. 1B-12).



**Fig. 1B-12 Valve Spring Removal**

(8) Remove valve spring and retainer.

(9) Remove valve stem oil deflector.

**Valve Spring Tension Test**

Use Valve Spring Tester J-8056 to test each valve spring for the specified tension value (fig. 1B-13). Replace valve springs that are not within specifications.

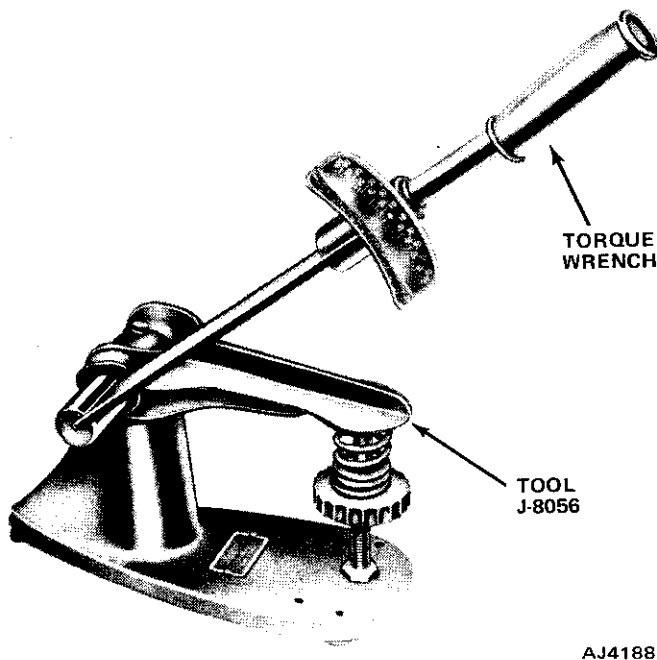


Fig. 1B-13 Valve Spring Tester

#### Oil Deflector and Valve Spring Installation

(1) Use 7/16-inch deep socket and small hammer to gently tap oil deflector onto valve stem.

**CAUTION:** Install the deflector carefully to prevent damage from sharp edges of the valve lock grooves.

(2) Install valve spring and retainer.

(3) Compress valve spring with tools J-22534-1, J-22534-4 and J-22534-5 and insert valve locks. Release spring tension and remove tools.

**NOTE:** Tap spring from side-to-side to be certain spring is seated properly at cylinder head.

(4) Disconnect air hose, remove adapter from spark plug hole and install spark plug.

(5) Install push rods. Make certain bottom end of each rod is centered in plunger cap of hydraulic valve tappet.

(6) Install rocker arms and bridged pivots. At each bridged pivot, tighten capscrews alternately, one turn at a time, to avoid damaging bridge.

(7) Install cylinder head cover and gasket.

#### Camshaft and Bearings

The camshaft is supported by form steel-shelled, lab-bitt-lined bearings pressed into the block and line reamed. The step-bored camshaft bearing bores are larger at the front bearing than at the rear to permit easy removal and installation of the camshaft. Camshaft bearing are lubricated under pressure.

**NOTE:** It is not advisable to replace camshaft bearings unless equipped with special removal and installation tools.

Camshaft end play is maintained by the load placed on the camshaft by the oil pump and distributor drive gear. The helical cut of the gear holds the camshaft sprocket thrust face against the cylinder block face. Camshaft end play is zero during engine operation.

#### Measuring Cam Lobe Lift

(1) Remove cylinder head cover and gasket.

(2) Remove rocker arms and bridged pivot assemblies.

(3) Remove spark plugs.

(4) Install dial indicator on end of push rod. Use piece of rubber tubing to hold dial indicator plunger squarely on push rod (fig. 1B-14).

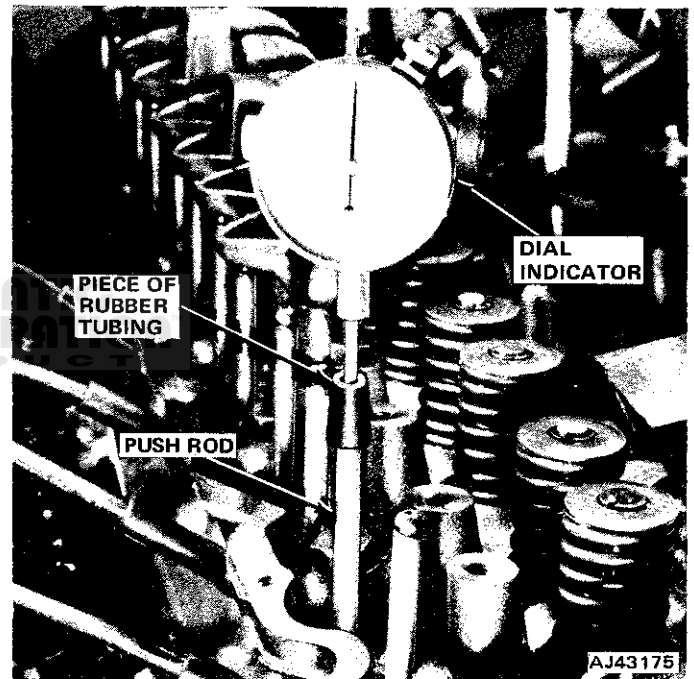


Fig. 1B-14 Cam Lobe Lift Measurement

(5) Rotate crankshaft until cam lobe base circle (push rod down) is under valve tappet. Set dial indicator to zero.

(6) Rotate crankshaft until push rod reaches its maximum upward travel. Read travel at dial indicator. Correct cam lobe lift is and 0.242- to 0.254-inch (6.147 mm to 6.451 mm).

#### Checking Valve Timing

(1) Disconnect ignition wires and remove spark plugs.

(2) Remove cylinder head cover and gasket.

(3) Remove rocker arms and bridged pivot from No. 1 cylinder.

(4) Rotate crankshaft until No. 6 piston is at TDC on compression stroke.

(5) Rotate crankshaft counterclockwise (viewed from front of engine) 90°.

(6) Install dial indicator with end of push rod touching No. 1 cylinder intake valve push rod end. Set dial indicator to zero.

(7) Rotate crankshaft clockwise (viewed from front of engine) until dial indicator shows 0.016-inch (0.406 mm) lift.

(8) Timing mark on vibration damper should index with TDC mark on timing case cover. If timing mark is more than 1/2 inch off TDC in either direction, valve timing is incorrect.

### Camshaft Removal

- (1) Drain cooling system.
- (2) Remove radiator.
- (3) Remove air conditioning condenser and receiver assembly as charged unit, if equipped.
- (4) Remove fuel pump.
- (5) Remove distributor and ignition wires.
- (6) Remove cylinder head cover and gasket.
- (7) Remove rocker arms and bridged pivot assemblies.
- (8) Remove push rods.

**NOTE:** *Keep push rods, bridged pivots and rocker arms in the same order as removed.*

- (9) Remove cylinder head and gasket.
- (10) Remove hydraulic tappets.
- (11) Remove timing case cover. Refer to Timing Case Cover Removal.
- (12) Remove timing chain and sprockets. Refer to Timing Chain Removal.
- (13) Remove front bumper or grille as required.
- (14) Remove camshaft.

### Camshaft Inspection

Inspect the camshaft bearing journals for an uneven wear pattern or rough finish. If either condition exists, inspect camshaft bearings. Inspect loaded (bottom) side of bearing. This is the most probable location of bearing damage. Replace camshaft and bearings as required. Refer to Bearing Replacement for procedure.

Inspect the distributor drive gear for damage or excessive wear. Replace if necessary.

Inspect each cam lobe and the matching hydraulic valve tappet for wear. If the face of the tappet(s) is worn concave, the matching camshaft lobe(s) will also be worn. Replace both the camshaft and the tappet(s).

If the camshaft appears to be bearing heavily against the timing case cover, check the relief holes in the rear cam journal. These holes relieve oil pressure between the end of the camshaft and the rear bearing plug.

### Camshaft Installation

(1) Lubricate camshaft with Jeep Engine Oil Supplement, or equivalent.

(2) Install camshaft carefully to prevent damaging camshaft bearings.

(3) Install timing chain, crankshaft sprocket and camshaft sprocket with timing marks aligned. Refer to Timing Chain Installation.

(4) Install camshaft sprocket retaining screw and tighten.

(5) Install timing case cover with replacement oil seal. Refer to Timing Case Cover Installation.

(6) Install vibration damper.

(7) Install damper pulley, if removed.

(8) Install engine fan and hub assembly.

(9) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling.

(10) Install fuel pump.

(11) Rotate crankshaft until No. 1 piston is at TDC position on compression stroke.

(12) Install distributor and ignition wires. Install distributor with rotor aligned with No. 1 terminal of cap when distributor housing is fully seated on block.

(13) Install hydraulic tappets. Lubricate tappets and all valve train components with Jeep Engine Oil Supplement (EOS), or equivalent.

**NOTE:** *The EOS must remain in the engine for at least 1,000 miles (1,609 km) but need not be drained until the next scheduled oil change.*

(14) Install cylinder head and gasket.

(15) Install push rods.

(16) Install rocker arms and bridged pivot assemblies. Tighten capscrews for each bridge a turn at a time to avoid damaging the bridge.

(17) Install cylinder head cover and gasket.

(18) Install air conditioning condenser and receiver assembly, if equipped.

**CAUTION:** *Open both service valves before the air conditioning system is operated.*

(19) Install radiator, connect hoses and fill cooling system to specified level. Refer to Chapter 1C—Cooling.

(20) Install front bumper or grille, if removed.

(21) Check ignition timing and adjust as required.

### Camshaft Bearing Replacement

Camshaft bearing replacement requires that the engine be removed from the vehicle. Remove timing case cover, crankshaft and camshaft rear bearing plug. When installing bearings, use a screw-type tool that provides steady pressure. Do not use a driver-type tool to install bearings. Care must be taken to align oil holes in bearings with oil galleries in the block. It is not necessary to line ream camshaft bearings after installation.

**Hydraulic Valve Tappets**

The hydraulic valve tappet consists of tappet body, plunger, plunger return spring, check valve assembly metering disc, plunger cap and lockring (fig. 1B-15).

The tappet operates in a guide bore which intersects with the main oil gallery.

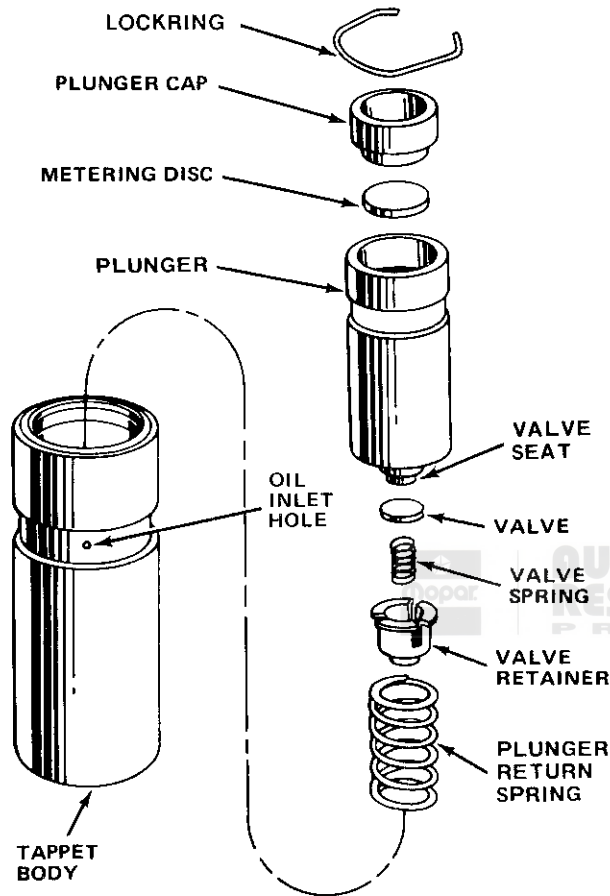


Fig. 1B-15 Hydraulic Tappet Components

The operating cycle of the hydraulic tappet begins when the tappet is on the heel of the cam lobe (engine valve closed). A groove in the tappet body aligns with the tappet oil gallery, admitting pressurized oil into the tappet (fig. 1B-16). A hole and groove arrangement admits the oil to the inside of the plunger. Oil is forced past the plunger check valve and fills the chamber between the plunger and tappet body. When the chamber is full, additional oil in the plunger body unseats the metering disc, and a spurt of oil flows up the pushrod to lubricate the rocker assembly. These events all take place while the tappet is on the heel of the cam lobe. As the cam turns, the lobe begins exerting force on the tappet body. This force is transmitted by the trapped oil in the tappet chamber to the plunger and finally to the pushrod and rocker assembly. The engine valve opens. While the valve is open, the trapped oil is subjected to considerable pressure and some of it escapes between the plunger and

the tappet body (leak-down). The cycle is completed as the cam lobe rotates back to the starting position and another charging cycle begins. In this way, zero valve lash is maintained.

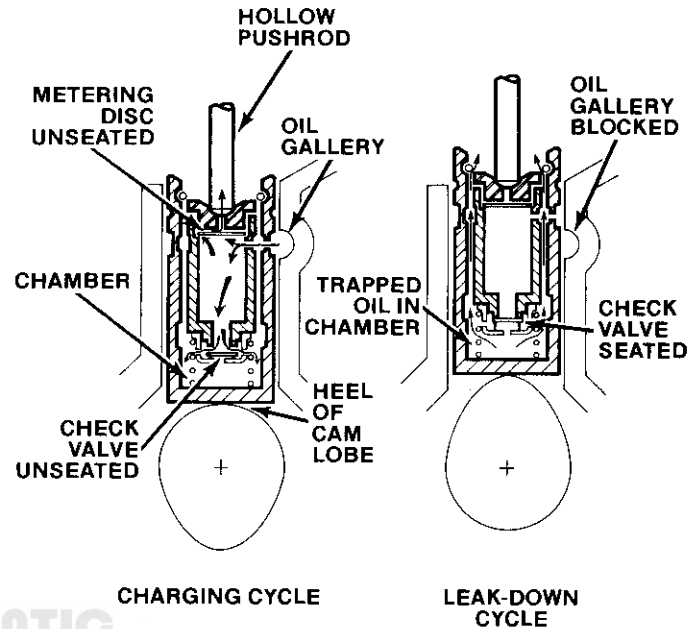


Fig. 1B-16 Hydraulic Tappet Operation

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**Removal**

- (1) Drain cooling system.
- (2) Remove cylinder head cover and gasket.
- (3) Remove rocker arms and bridged pivot assemblies. Remove two capscrews at each bridged pivot. Alternately loosen each capscrew, one turn at a time, to avoid damaging bridge.
- (4) Remove push rods.

**NOTE:** Retain push rods in the same order as removed.

- (5) Remove cylinder head and gasket.
- (6) Remove tappets through push rod openings of block with Hydraulic Valve Tappet Remover and Installer Tool J-21884 (fig. 1B-17).

**Cleaning and Inspection**

**NOTE:** Retain tappet components in the same order as removed.

- (1) Release lockring and remove plunger cap, metering disc, plunger and plunger return spring from tappet body.
- (2) Clean components of hydraulic tappet assembly in cleaning solvent to remove all varnish or gum deposits.
- (3) Check for signs of scuffing on side and face of tappet body.

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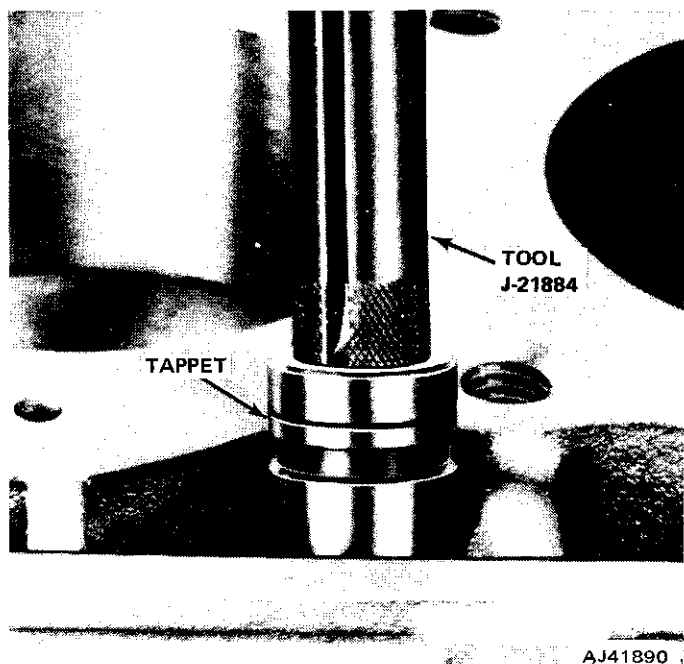


Fig. 1B-17 Hydraulic Tappet Removal

(4) Inspect tappet face for concave wear by laying straightedge across face. If face is concave, corresponding lobe on camshaft is worn, and replacement of camshaft and tappets is necessary.

(5) Install plunger return spring, plunger, metering disc and plunger cap in tappet body.

(6) Compress plunger assembly using push rod on plunger cap, and install lockring.

#### Hydraulic Tappet Leak-Down Test

After cleaning and inspection, leak-down test the tappet to ensure its zero-lash operating ability. Figure 1B-18 illustrates tool J-5790 which can be used to test tappet leak-down accurately.

(1) Swing weighted arm of tester away from ram of tester.

(2) Place 0.312- to 0.313-inch (7.925 to 7.950 mm) diameter ball bearing on plunger cap of tappet.

(3) Lift ram and place tappet with ball bearing inside tester cup.

(4) Lower ram, then adjust nose of ram until it contacts ball bearing. Do not tighten hex nut on ram.

(5) Fill tester cup with Valve Tappet Test Oil J-5268 until tappet is completely covered.

(6) Swing weighted arm onto ram and pump up and down on tappet to remove air. When air bubbles cease, swing weighted arm away and allow plunger to rise to normal position.

(7) Adjust nose of ram to align pointer with SET mark on scale of tester and tighten hex nut.

(8) Slowly swing weighted arm onto ram. Rotate cup by turning handle at base of tester clockwise one revolution every two seconds.

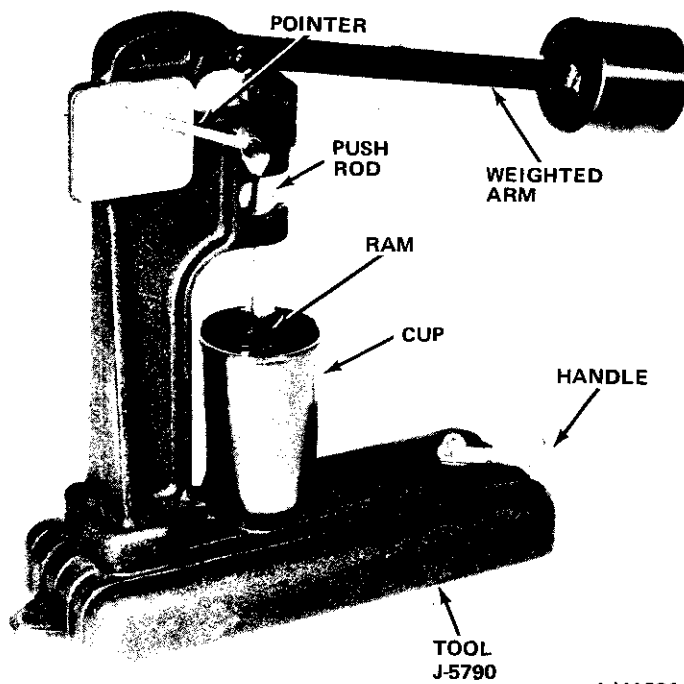


Fig. 1B-18 Hydraulic Tappet Leak-Down Tester

(9) Time leak-down from instant pointer aligns with START mark on scale until pointer aligns with 0.125 mark. Good tappet will take 20 to 110 seconds to leak down. Discard tappets outside this range.

**NOTE:** Do not charge the tappet assemblies with engine oil. They will charge themselves within 3 to 8 minutes of engine operation.

#### Installation

(1) Dip tappet assembly in Jeep Engine Oil Supplement (EOS), or equivalent.

(2) Use Hydraulic Valve Tappet Remover and Installer Tool J-21884 to install each tappet in same bore from which it was removed.

(3) Install cylinder head and replacement gasket and tighten screws. Refer to Cylinder Head Installation for tightening sequence.

(4) Install push rods in same order as removed.

(5) Install rocker arms and bridged pivot assemblies. Loosely install capscrews to each bridged pivot. At each bridged pivot, tighten capscrews alternately, one turn at a time, to avoid damaging or breaking bridge.

(6) Pour remaining EOS over entire valve train.

**NOTE:** The EOS must remain in the engine for at least 1,000 miles but need not be drained until the next scheduled oil change.

(7) Install cylinder head cover and gasket.

(8) Refill coolant.



**Timing Case Cover**

The timing case cover is provided with a seal and oil slinger to prevent oil leakage at the vibration damper hub (fig. 1B-19). A hole is provided in the cover for the use of a timing probe during production. A graduated degree scale cast into the cover is used for ignition timing.

It is important that the timing case cover be properly aligned with the crankshaft to prevent eventual damage to the oil seal. The oil seal may be replaced without removing the timing case cover.

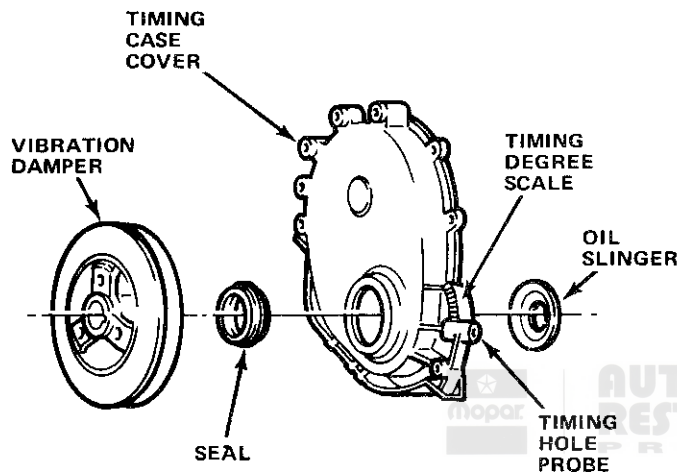


Fig. 1B-19 Timing Case Cover

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**Removal**

- (1) Remove drive belt(s), engine fan and hub assembly, damper pulley and vibration damper. Refer to Vibration Damper Removal for procedure.
- (2) Remove oil pan-to-timing case cover screws and cover-to-block screws.
- (3) Remove timing case cover and gasket from engine.
- (4) Cut off oil pan gasket end tabs flush with front face of cylinder block and remove gasket tabs.
- (5) Clean timing case cover, oil pan and cylinder block gasket surfaces.
- (6) Remove crankshaft oil seal from timing case cover.

**Installation**

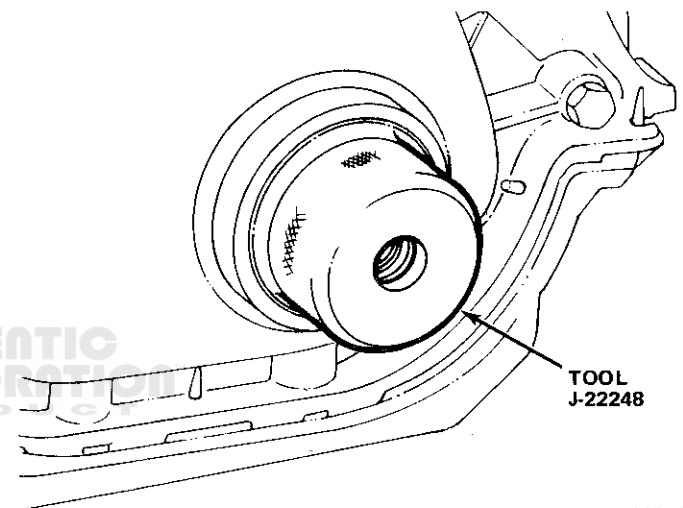
- (1) Apply seal compound (Perfect Seal, or equivalent) to both sides of replacement timing case cover gasket and position gasket on cylinder block.
- (2) Cut end tabs off replacement oil pan gasket corresponding to pieces cut off original gasket. Install these pieces on oil pan and cement in place.
- (3) Coat seal end tabs generously with Permatex No. 2, or equivalent, and position seal on timing case cover (fig. 1B-20).



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Fig. 1B-20 Oil Pan Front Seal Installation

- (4) Position timing case cover on engine. Place Timing Case Cover Alignment Tool and Seal Installer J-22248 in crankshaft opening of cover (fig. 1B-21).



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Fig. 1B-21 Timing Case Cover Alignment

- (5) Install cover-to-block screws and oil pan-to-cover screws. Tighten cover-to-block screws to 5 foot-pounds (7 N•m) torque and oil pan-to-cover screws to 11 foot-pounds (15 N•m) torque.
- (6) Remove cover aligning tool and position replacement oil seal on tool with seal lip facing outward. Apply light film of Perfect Seal, or equivalent, on outside diameter of seal.
- (7) Insert draw screw from tool J-9163 into seal installing tool. Tighten nut against tool until tool bottoms against cover (fig. 1B-22).
- (8) Remove tools and apply light film of engine oil on seal lip.
- (9) Install vibration damper and tighten retaining screw to 80 foot-pounds (108 N•m) torque.
- (10) Install damper pulley.
- (11) Install engine fan and hub assembly.
- (12) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling.

**Timing Case Cover Oil Seal Replacement (Cover not Removed)**

- (1) Remove drive belts.
- (2) Remove vibration damper pulley.

- (3) Remove vibration damper.
- (4) Remove oil seal with tool J-9256 (fig. 1B-23).

(5) Position replacement oil seal on Timing Case Cover Alignment Tool and Seal Installer J-22248 with seal lip facing outward. Apply light film of Perfect Seal, or equivalent, on outside diameter of seal.

(6) Insert draw screw from tool J-9163 into seal installing tool. Tighten nut against tool until tool bottoms against cover.

(7) Remove tools. Apply light film of engine oil on seal lip.

(8) Install vibration damper and tighten retaining bolt to 80 foot-pounds (108 N•m) torque.

(9) Install damper pulley, if removed.

(10) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling.

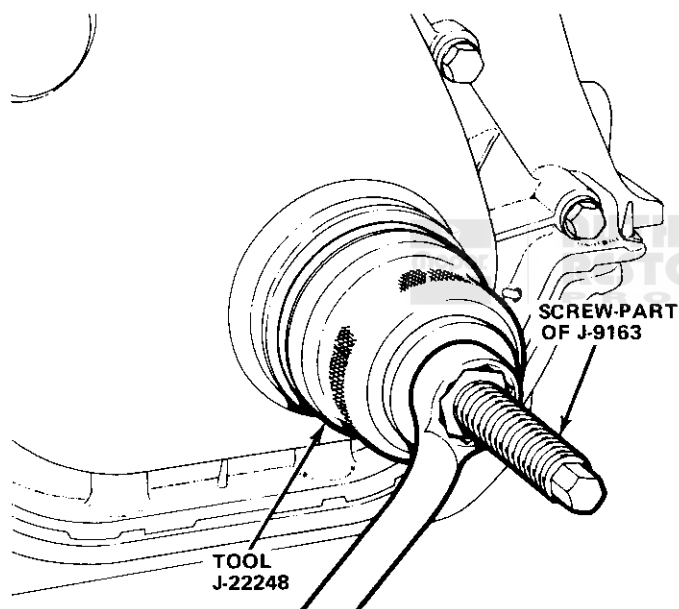


Fig. 1B-22 Timing Case Cover Oil Seal Installation

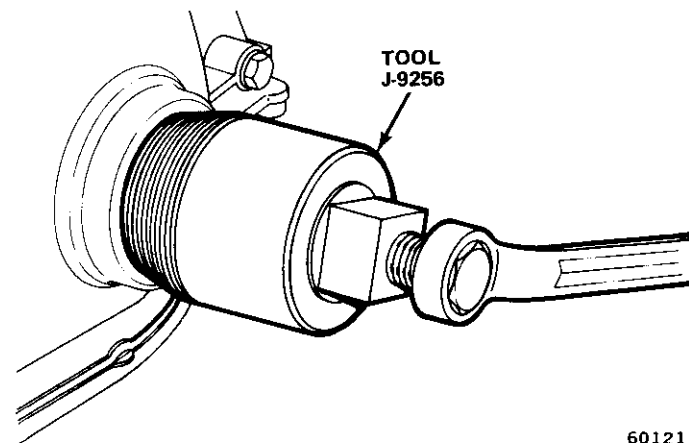


Fig. 1B-23 Timing Case Cover Oil Seal Removal

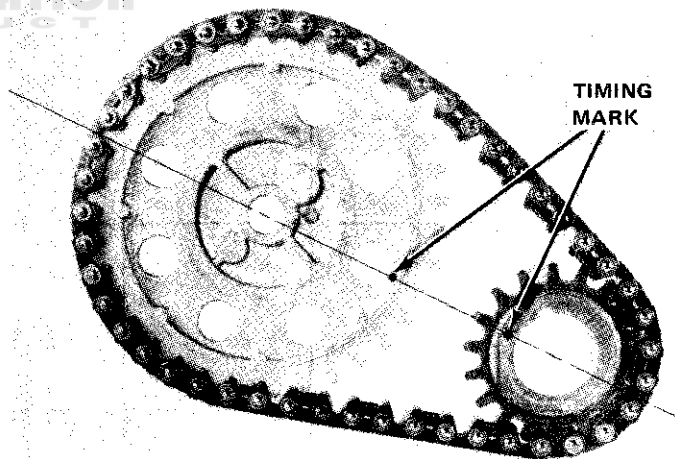
### Timing Chain

Installation of the timing chain with the timing marks of the crankshaft and camshaft sprockets properly aligned assures correct valve timing. A worn timing chain will adversely affect valve timing. Replace the timing chain if it deflects more than 1/2 inch (13 mm).

The correct timing chain has 48 pins. A chain with more than 48 pins will cause excessive slack.

### Removal

- (1) Remove drive belt(s).
- (2) Remove engine fan and hub assembly.
- (3) Remove vibration damper pulley.
- (4) Remove vibration damper.
- (5) Remove timing case cover.
- (6) Remove oil seal from timing case cover.
- (7) Remove camshaft sprocket retaining screw and washer.
- (8) Rotate crankshaft until 0 timing mark on crankshaft sprocket is closest to and on centerline with timing pointer of camshaft sprocket (fig. 1B-24).
- (9) Remove crankshaft sprocket, camshaft sprocket and timing chain as an assembly. Disassemble chain and sprockets.



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Fig. 1B-24 Timing Sprocket Alignment

### Installation

(1) Assemble timing chain, crankshaft sprocket and camshaft sprocket with timing marks aligned (fig. 1B-24).

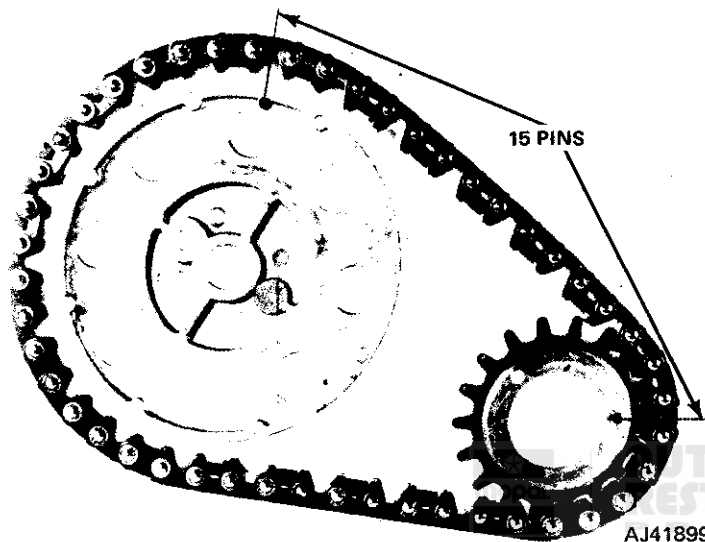
(2) Install assembly to crankshaft and camshaft.

(3) Install camshaft sprocket retaining screw and washer and tighten to 50 foot-pounds (68 N•m) torque.

**NOTE:** To verify correct installation of the timing chain, locate timing mark of the camshaft sprocket at approximately one o'clock position. This places timing mark of crankshaft sprocket where it meshes with chain

(fig. 1B-25). Count number of chain pins between timing mark of both sprockets. There must be 15 pins.

- (4) Install timing case cover and replacement oil seal.
- (5) Install vibration damper.
- (6) Install damper pulley.
- (7) Install engine fan and hub assembly.
- (8) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling.



**Fig. 1B-25 Timing Chain Installation**

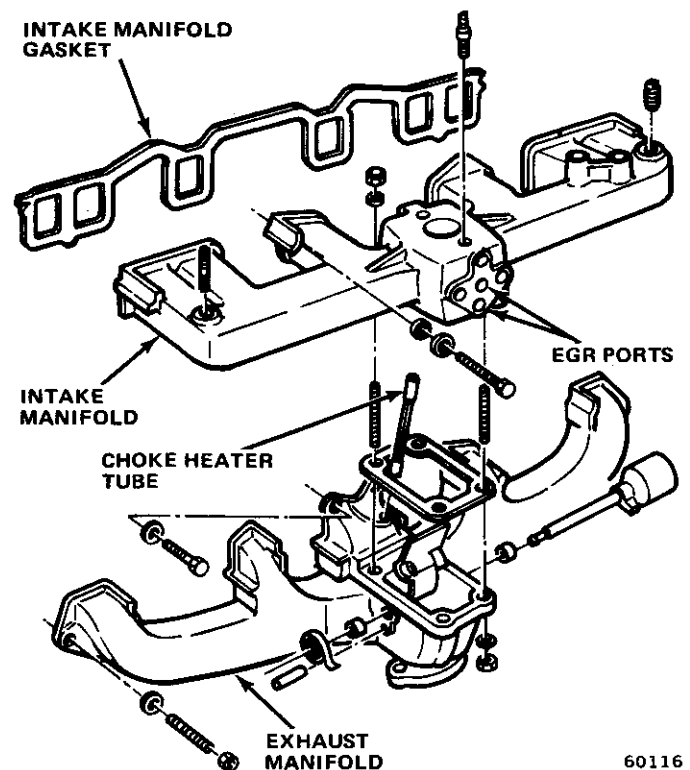
## INTAKE AND EXHAUST MANIFOLDS

The intake and exhaust manifolds are attached to the cylinder head on the left side of the engine. A gasket is used between the intake manifold and the cylinder head. No gasket is used between the exhaust manifold and cylinder head. An asbestos gasket is used at the mating surfaces between the intake manifold and exhaust manifold (fig. 1B-26).

An exhaust gas recirculation (EGR) valve is mounted on the side of the intake manifold. The intake manifold has a metal plate incorporated into the area above the exhaust manifold heat valve to create a hot spot that improves fuel vaporization during warmup and shortens choke operation time.

### Intake and Exhaust Manifold Assembly Removal

- (1) Remove air cleaner. Disconnect fuel line and carburetor air horn vent hose and solenoid wire, if equipped.
- (2) Disconnect accelerator cable from accelerator bellcrank.
- (3) Disconnect PCV vacuum hose from intake manifold.



**Fig. 1B-26 Intake and Exhaust Manifold Assembly**

- (4) Remove spark CTO vacuum tubes and disconnect TCS solenoid vacuum valve wiring, if equipped.
- (5) Disconnect vacuum hose from EGR valve.
- (6) Disconnect Air Guard hoses at air pump and air injection manifold check valve. Disconnect diverter vacuum hose and remove diverter valve with hoses.
- (7) Remove air pump/power steering mounting bracket, if equipped.
- (8) Remove air pump.
- (9) Detach power steering pump and set aside, if equipped. Do not remove hoses.
- (10) Remove air conditioning drive belt idler assembly from cylinder head, if equipped.
- (11) Disconnect exhaust pipe from manifold flange.
- (12) Remove manifold attaching screws, nuts and clamps. Remove intake and exhaust manifold as an assembly. Discard gasket.
- (13) Clean mating surfaces of manifolds and cylinder head.

### Intake and Exhaust Manifold Assembly Installation

- (1) Position replacement intake manifold gasket on cylinder head and install manifold assembly. Tighten manifold attaching screws and nuts in sequence to 23 foot-pounds (31 N•m) torque (fig. 1B-27).
- (2) Install flange gasket and connect exhaust pipe to manifold flange.
- (3) Connect fuel line and air horn vent hose to carburetor. Connect solenoid wire, if equipped.

- (4) Install AC drive belt idler assembly, if removed.
- (5) Install air pump, if removed.
- (6) Install air pump/power steering pump mounting bracket, if removed.
- (7) Install diverter valve. Connect hoses to air pump and check valve.
- (8) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling.
- (9) Install spark CTO vacuum tubes. Connect TCS wiring, if removed.
- (10) Connect vacuum hose to EGR valve.
- (11) Connect accelerator cable and PCV hose.
- (12) Install air cleaner.
- (13) Start engine and check for vacuum and exhaust leaks.

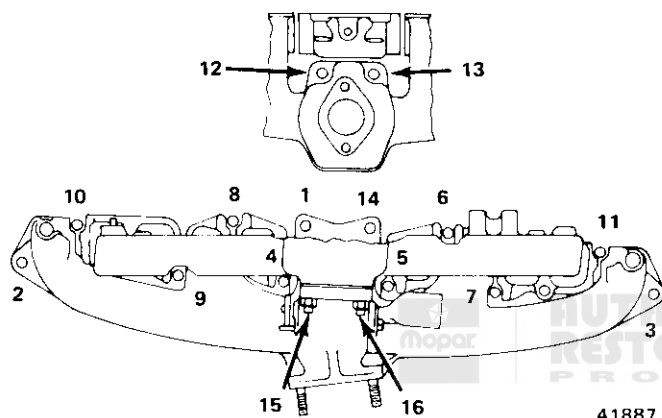


Fig. 1B-27 Manifold Torque Sequence

### Intake Manifold Replacement

**NOTE:** It is necessary to remove intake and exhaust manifold assembly from the engine before separating the manifolds. It is not necessary to remove the carburetor from the vehicle. After removing the carburetor from the intake manifold, it may be set to one side with vacuum lines still attached.

- (1) Remove air cleaner.
- (2) Disconnect choke heater tube from choke coil housing. Disconnect clean air tube from carburetor, and solenoid wire, if equipped.
- (3) Disconnect carburetor control shaft from carburetor.
- (4) Remove carburetor from intake manifold and set aside. Remove carburetor insulator block.
- (5) Remove carburetor mounting studs from intake manifold.
- (6) Remove intake and exhaust manifold assembly from engine. Refer to Intake and Exhaust Manifold Assembly Removal for procedures.
- (7) Remove accelerator control bracket.
- (8) Separate manifolds.
- (9) Remove EGR valve studs and install in replacement manifold.

(10) Install replacement gasket between manifolds. Install accelerator control bracket. Tighten nuts to 5 foot-pounds (7 N•m) torque.

**CAUTION:** Do not overtighten. Manifolds must be held together loosely enough to slide when manifolds are attached to cylinder head.

- (11) Install vacuum fittings.
- (12) Install manifold assembly to head. Refer to Intake and Exhaust Manifold Assembly Installation for procedure.
- (13) Install carburetor studs, replacement gaskets and spacer.
- (14) Install carburetor and connect linkage and hoses.
- (15) Torque carburetor mounting nuts to 14 foot-pounds (19 N•m) torque.
- (16) Install EGR valve.
- (17) Connect clean air tube and choke heater tube to carburetor.
- (18) Tighten intake manifold-to-exhaust manifold nuts. Start engine and check for leaks.
- (19) Install air cleaner.

### Exhaust Manifold Replacement

**NOTE:** It is necessary to remove intake and exhaust manifold assembly from the engine before separating the manifolds. It is not necessary to remove the carburetor from the vehicle. After removing the carburetor from the intake manifold, it may be set to one side with vacuum lines still attached.

- (1) Remove air cleaner.
  - (2) Disconnect choke heater tube from choke coil housing. Disconnect clean air tube from carburetor.
  - (3) Disconnect carburetor control shaft from carburetor.
  - (4) Remove carburetor from intake manifold and set aside.
  - (5) Remove intake and exhaust manifold assembly from engine. Refer to Intake and Exhaust Manifold Assembly Removal for procedure.
  - (6) Remove accelerator control bracket.
  - (7) Separate manifolds.
  - (8) Remove distributor CTO tube clamp and install on replacement manifold.
  - (9) Remove air injection manifold and screws and install on replacement manifold.
  - (10) Install replacement gasket between manifolds. Install accelerator control bracket. Tighten nuts to 5 foot-pounds (7 N•m) torque.
- CAUTION:** Do not overtighten. Manifolds must be held together loosely enough to slide when manifolds are attached to cylinder head.
- (11) Install choke clean air tube into bottom of exhaust manifold and install tube clip.

(12) Install manifold assembly to cylinder head. Refer to Intake and Exhaust Manifold Assembly Installation for procedure.

(13) Install carburetor spring bracket.

(14) Install carburetor to intake manifold.

(15) Torque carburetor mounting nuts to 14 foot-pounds (19 N•m).

(16) Install carburetor control shaft. Install throttle return spring.

(17) Install choke heater tube and clean air tube to carburetor.

(18) Start engine and check for leaks.

(19) Install air cleaner.

## CYLINDER HEAD AND COVER

The cylinder head incorporates hardened exhaust valve seats and exhaust valves with flash chrome stems.

### Cylinder Head Cover

#### Removal

(1) Remove air cleaner and PCV molded hose.

(2) Disconnect distributor vacuum advance line at spark CTO tube. Disconnect fuel line at fuel pump. Swivel fuel line to allow removal of cylinder head cover.

(3) Disconnect PCV valve from grommet in cylinder head cover.

(4) Remove cylinder head cover screws. Strike cover with rubber mallet to break loose from head.

(5) Inspect cylinder head cover for cracks.

#### Installation—Silicone Method

A room temperature vulcanizing (RTV) silicone rubber adhesive is required for this procedure. Use Jeep Gasket-in-a-Tube, or equivalent.

(1) Clean gasket surface of adhesive and gasket material.

(2) Wipe gasket surface of cylinder head with oily rag. This prevents adhesion but permits sealing.

(3) Apply 1/8-inch bead of silicone along entire length of cover flange.

(4) Before silicone begins to cure, install cover to cylinder head. Be careful to not touch rocker arms with silicone.

(5) Apply dab of silicone to each screw hole. Insert screw through silicone.

(6) Tighten all screws by hand. Then tighten screws to 50 inch-pounds (6 N•m) torque.

(7) Connect PCV valve to grommet in cylinder head cover, connect canister hose.

(8) Install air cleaner and connect PCV hose.

#### Installation—Gasket Method

(1) Position gasket on cylinder head cover flange. Cement several places for ease of handling. Use quick-drying adhesive such as Jeep Part Number 8127960, or equivalent.

(2) Position cylinder head cover and gasket on engine and install screws. Tighten screws to 50 inch-pounds (6 N•m) torque.

**CAUTION:** Do not overtighten screws as this may crack cover and split cover gasket.

(3) Connect fuel and distributor vacuum advance lines.

(4) Connect PCV valve to grommet in cylinder head cover. Connect canister hoses.

(5) Install air cleaner and connect PCV hose.

## Cylinder Head

#### Removal

(1) Drain coolant and disconnect hoses at thermostat housing.

(2) Remove air cleaner.

(3) Remove cylinder head cover and gasket.

(4) Remove rocker arms and bridged pivot assemblies. Alternately loosen each capscrew one turn at a time to avoid damaging bridge.

(5) Remove push rods.

**NOTE:** Retain push rods, bridged pivots and rocker arms in same order as removed.

(6) Disconnect power steering pump bracket and Air Guard pump. Lay pumps and brackets aside. Do not disconnect hoses.

(7) Remove intake and exhaust manifold assembly from cylinder head.

(8) If equipped with air conditioning, perform the following:

(a) Remove air conditioning drive belt idler bracket from cylinder head.

(b) Loosen alternator drive belt. Remove alternator bracket-to-head mounting screw.

(c) Remove screws from compressor mounting bracket and set compressor aside.

(9) Disconnect ignition wires and remove spark plugs.

(10) Disconnect temperature sending unit wire and battery ground cable.

(11) Remove ignition coil and bracket assembly.

(12) Remove cylinder head screws, cylinder head and gasket.

#### Cleaning and Inspection

(1) Thoroughly clean machined surfaces of cylinder head and block. Remove all dirt and gasket cement.

(2) Remove carbon deposits from combustion chambers and top of pistons.

(3) Use straightedge and feeler gauge to check flatness of cylinder head and block mating surfaces. Refer to Specifications.

**Installation**

(1) If cylinder head is to be replaced and original valves used, measure valve stem diameter. Only standard size valves can be used with service replacement head unless replacement head valve guides are reamed to accommodate oversized valve stems. Remove all carbon buildup and reface valves as outlined under Valve Refacing.

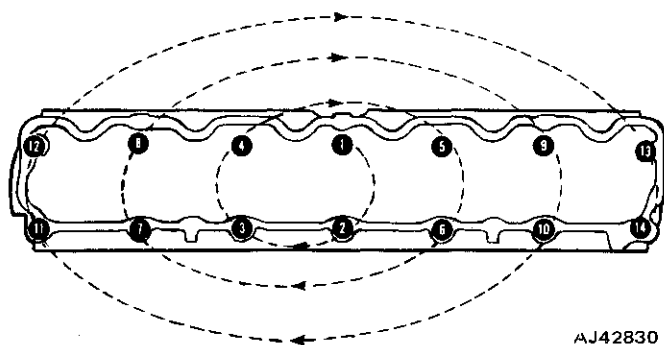
(2) Install valves in cylinder head using replacement valve stem oil deflectors.

(3) Transfer all attached components from original head which are not included with replacement head. Do not install temperature sending unit until coolant is installed. This permits trapped air to escape from block and head.

**CAUTION:** Do not apply sealing compound on head and block mating surfaces. Do not allow sealing compound to enter cylinder bore.

(4) Apply an even coat of Perfect Seal sealing compound, or equivalent, to both sides of replacement head gasket and position gasket on block with word TOP facing upward.

(5) Install cylinder head. Tighten screws in sequence to 105 foot-pounds (142 N•m) torque (fig. 1B-28).



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**Fig. 1B-28 Cylinder Head Torque Sequence**

- (6) Connect battery negative cable.
- (7) Install ignition coil and bracket assembly.
- (8) Install spark plugs and connect ignition wires.
- (9) Attach air conditioning compressor mounting bracket to cylinder head, if removed.
- (10) Install intake and exhaust manifold assembly. Refer to figure 1B-26 for the correct torque tightening sequence.
- (11) Install alternator bracket screw to head. Install alternator belt and adjust tension.

(12) Install power steering bracket and pump. Adjust belt tension.

(13) Install Air Guard pump bracket screws to head. Adjust belt tension.

(14) Install each push rod to its original location.

(15) Install rocker arms and bridged pivot assemblies to original locations. Loosely install capscrews to each bridged pivot. At each bridged pivot, tighten capscrews alternately one turn at a time to avoid damaging bridge. Tighten screws to 19 foot-pounds (26 N•m) torque.

(16) Install cylinder head cover. Use replacement gasket or silicone rubber material.

(17) Connect hoses to thermostat housing and fill cooling system to specified level. Install temperature sending unit.

**NOTE:** The head gasket is made of aluminum-coated embossed steel and does not require that the head screws be retorqued.

(18) Install fuel and vacuum advance lines.

(19) Operate engine with radiator cap off. Check for leaks and continue running engine until thermostat opens. Add coolant, if required. To bleed air from system refer to Chapter 1C—Cooling-Bleeding Air from System.

(20) Install air cleaner.

**LUBRICATION SYSTEM**

**General**

A gear-type positive displacement pump is mounted at the underside of the block opposite the No. 4 main bearing (fig. 1B-29). The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and the pump body, then is forced through the outlet to the block. An oil gallery in the block channels oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery up to the main oil gallery which extends the entire length of the block.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals (except No. 4) to the connecting rod journals. Each connecting rod bearing cap has a small squirt hole. Oil passes through the squirt hole and is thrown off as the rod rotates. This oil throw-off lubricates the camshaft lobes, distributor drive gear, cylinder walls and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. Oil is provided to the camshaft bearings through galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the

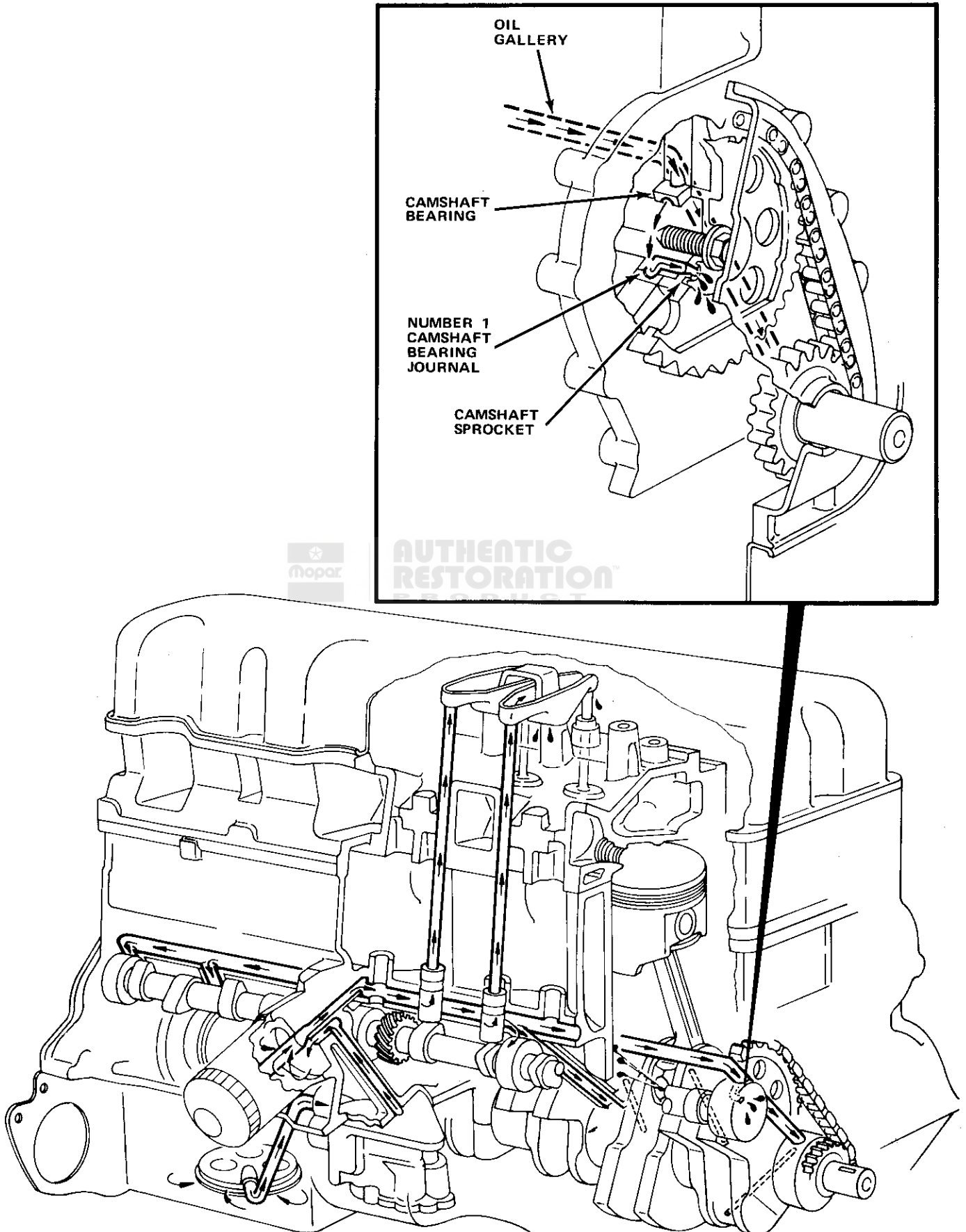


Fig. 1B-29 Lubrication System

timing chain. Rotation of the sprocket lubricates the crankshaft sprocket and chain. Oil drains back to the oil pan under the No. 1 main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets. Oil passes from the tappet through the hollow push rod to a hole in the corresponding rocker arm. Oil from the rocker arms lubricates the valve train components, then passes down through the push rod guide holes in the cylinder head past the valve tappet area, and returns to the oil pan.

### Oil Filter

A full flow oil filter, mounted on the lower right side of the engine, is accessible through the hood opening. A bypass valve incorporated in the filter mounting boss on the cylinder block provides a safety factor if the filter becomes inoperative as a result of dirt or sludge accumulation (fig. 1B-30).

Tool J-22700 will facilitate removal of the oil filter. Before installation, apply a thin film of oil to the replacement filter gasket. Install filter until gasket con-

tacts the seat of the adapter. Tighten by hand only, following the instruction on the replacement filter. If the instructions are not printed on the filter, tighten the filter until the gasket contacts the seat and then tighten an additional 3/4 of a turn.

**CAUTION:** Use the short, 4.25-inch (107.95 mm) filter on six-cylinder CJ models. If the long, 5.44-inch (138.18 mm) filter is used, it may contact the engine support bracket or frame rail. This can puncture the filter resulting in a loss of oil and possible engine damage.

Operate engine at fast idle and check for leaks.

### Oil Pump

The positive-displacement gear-type oil pump is driven by the distributor shaft, which is driven by a gear on the camshaft. Crankcase oil is drawn into the pump through an inlet tube and screen assembly which is pressed into the pump body (fig. 1B-30). The pump incorporates a non-adjustable pressure relief valve to regulate maximum pressure. A setting of 75 pounds

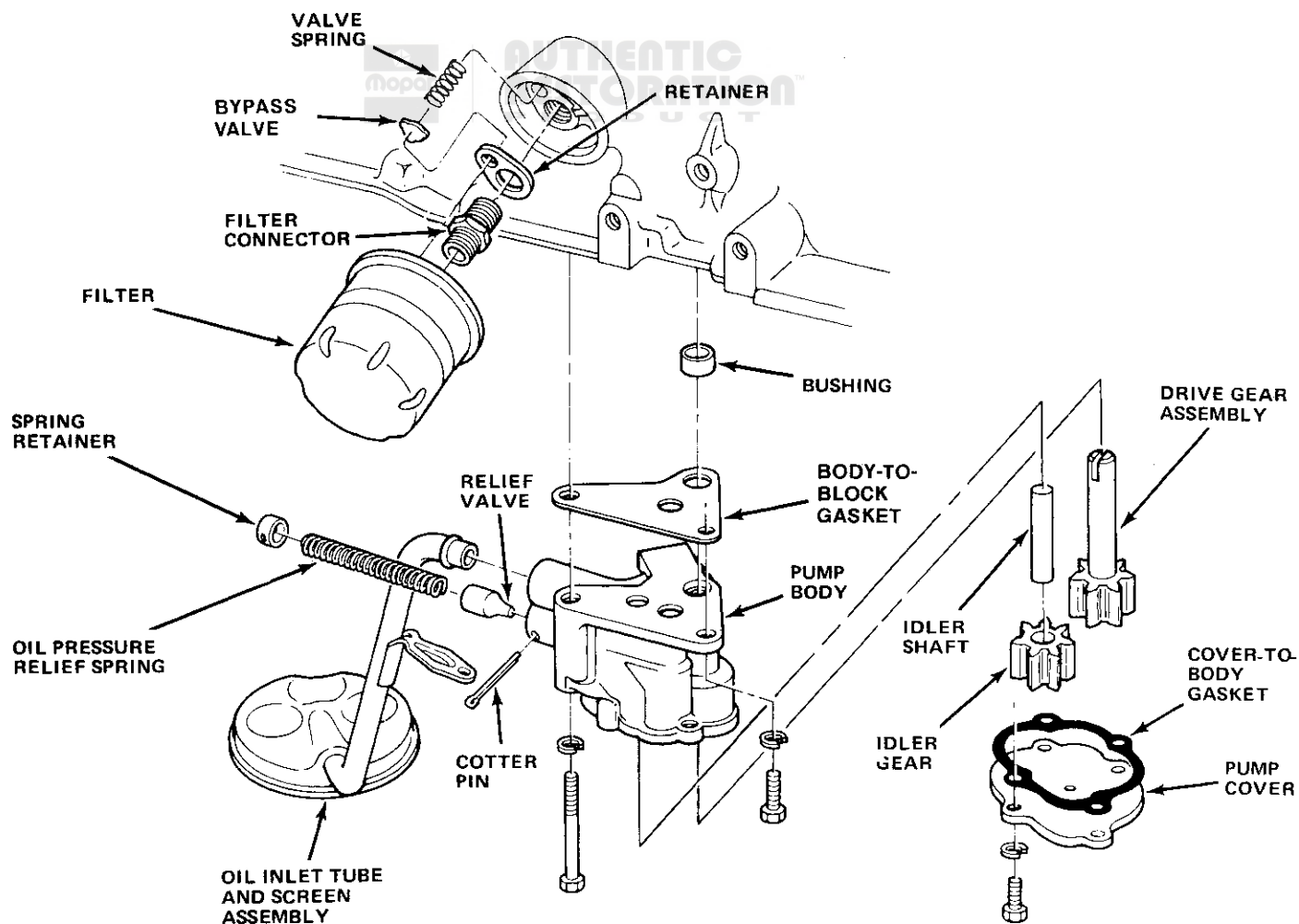


Fig. 1B-30 Oil Filter and Oil Pump Assembly



p.s.i. (517 kPa) maximum pressure is built into the tension of the spring. In the relief position, the valve permits oil to bypass through a passage in the pump body to the inlet side of the pump.

## Removal

**NOTE:** Oil pump removal or replacement will not affect distributor timing as the distributor drive gear remains in mesh with the camshaft gear.

- (1) Drain engine oil.
- (2) Remove oil pan. Refer to Oil Pan Removal.
- (3) Remove oil pump retaining screws, oil pump and gasket.

**CAUTION:** Do not disturb position of oil inlet tube and screen assembly in pump body. If tube is moved within pump body, a replacement tube and screen assembly must be installed to assure an airtight seal.

## Disassembly and Inspection

- (1) Remove cover retaining screws, cover and gasket from pump body.
- (2) Measure gear end clearance.

### • Preferred Method:

- (a) Place strip of Plastigage across full width of each gear end (fig. 1B-31).
- (b) Install pump cover and gasket. Tighten screws to 70 inch-pounds (8 N•m).
- (c) Remove pump cover and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope. Correct clearance by this method is 0.002 to 0.008 inch (0.002 inch preferred) [0.051 to 0.203 mm (0.051 mm preferred)].

### • Alternate Method:

- (a) Place straightedge across ends of gears and pump body.
- (b) Select feeler gauge which fits snugly but freely between straightedge and pump body (fig. 1B-32). Correct clearance by this method is 0.004 to 0.008 inch (0.007 inch preferred) [0.102 to 0.203 mm (0.178 mm preferred)]. If gear end clearance is excessive, replace oil pump assembly.

- (3) Measure gear-to-body clearance by inserting a feeler gauge between gear tooth and pump body inner wall directly opposite the point of gear mesh. Select a feeler gauge which fits snugly but freely (fig. 1B-33). Rotate gears to check each tooth in this manner. Correct clearance is 0.0005 to 0.0025 inch (0.0005 preferred) [0.013 to 0.064 mm (0.013 mm preferred)].

If gear-to-body clearance is more than specified, replace idler gear, idler shaft and drive gear assembly.

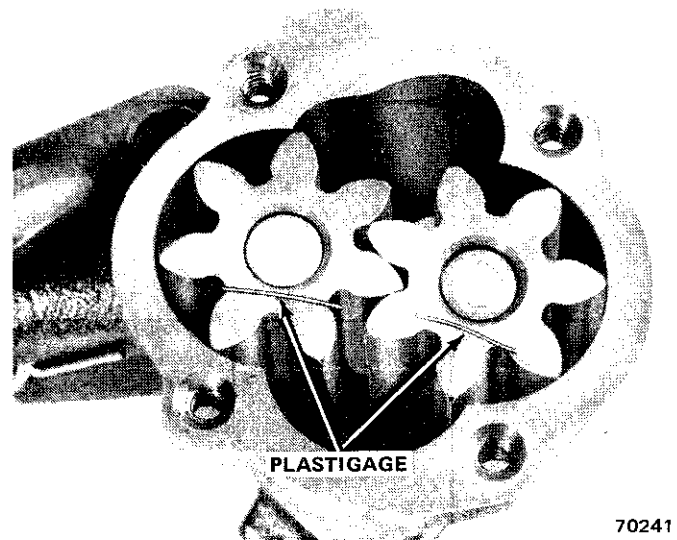


Fig. 1B-31 Oil Pump Gear End Clearance—Plastigage Method

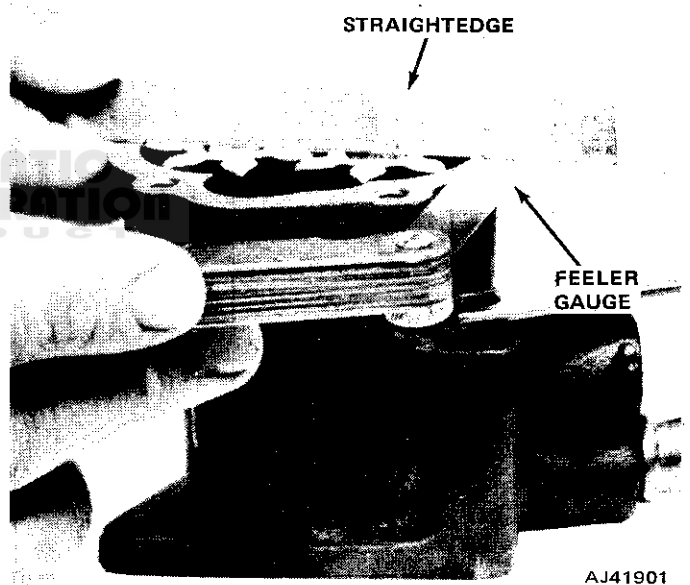


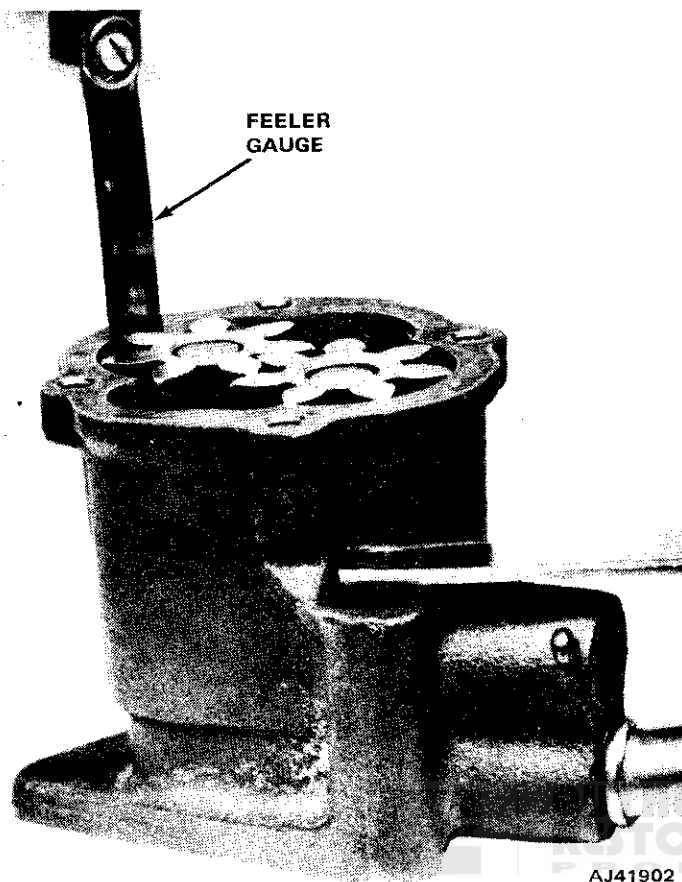
Fig. 1B-32 Oil Pump Gear End Clearance Measurement—Feeler Gauge Method

- (4) Remove cotter pin and slide spring retainer, spring and oil pressure relief valve out of pump body. Check for sticking condition during disassembly. Clean or replace as necessary.

**NOTE:** The oil inlet tube must be moved to allow removal of the relief valve. Install a replacement pickup tube assembly.

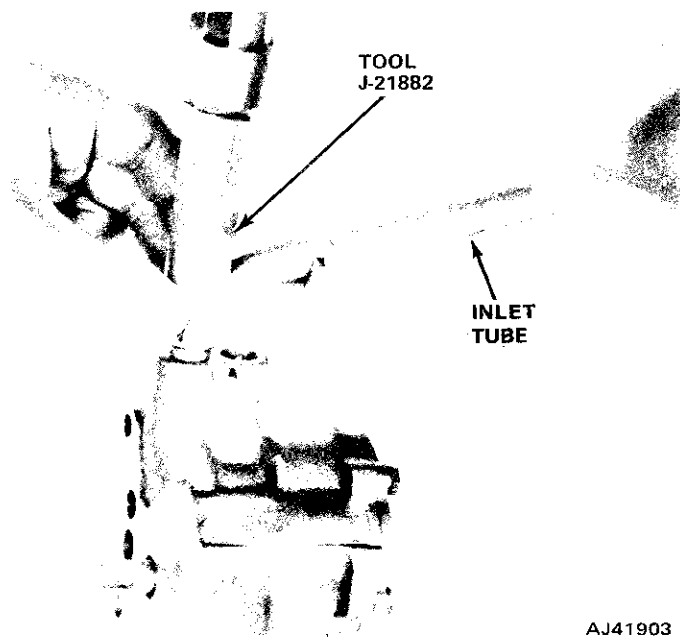
## Assembly and Installation

- (1) Install oil pressure relief valve, spring, retainer and cotter pin.



**Fig. 1B-33 Oil Gear-to-Body Clearance Measurement**

(2) If position of inlet tube in pump body has been disturbed, install replacement tube and screen assembly. Apply light film of Permatex No. 2, or equivalent, around end of tube. Use tool J-21882 to drive tube into body, making sure support bracket is properly aligned (fig. 1B-34).



**Fig. 1B-34 Oil Pump Inlet Tube Installation**

(3) Install idler shaft, idler gear and drive gear assembly.

**NOTE:** To ensure self-priming of the oil pump, fill pump with petroleum jelly before installing the oil pump cover. Do not use grease.

(4) Install pump cover and replacement gasket. Tighten cover screws to 70 inch-pounds (8 N•m) torque.

**NOTE:** Check for binding before installing the oil pump.

(5) Install oil pump and replacement gasket. Tighten short screws to 10 foot-pounds (14 N•m) torque and long screws to 17 foot-pounds (23 N•m) torque.

(6) Install oil pan, using replacement gaskets and seals. Refer to Oil Pan Installation. Fill crankcase with clean oil to specified level.

## Oil Pan

### Removal

- (1) Raise vehicle and drain engine oil.
- (2) Remove starter motor.
- (3) On CJ Models:
  - (a) Place jack under transmission bellhousing.
  - (b) Disconnect engine right support cushion bracket from block and raise engine to allow sufficient clearance for oil pan removal.
- (4) Remove oil pan.
- (5) Remove oil pan front and rear neoprene oil seals and side gaskets.
- (6) Thoroughly clean gasket surfaces of oil pan and engine block. Remove all sludge and dirt from oil pan sump.

### Installation

- (1) Install replacement oil pan front seal to timing case cover. Apply generous amount of Jeep Gasket-in-a-Tube (RTV silicone), or equivalent, to end tabs.
- (2) Cement replacement oil pan side gaskets into position on engine block. Apply generous amount of Jeep Gasket-in-a-Tube (RTV silicone), or equivalent, to gasket ends.
- (3) Coat inside curved surface of replacement oil pan rear seal with soap. Apply generous amount of Jeep Gasket-in-a-Tube (RTV silicone), or equivalent, to side gasket contacting surface of seal end tabs.
- (4) Install seal in recess of rear main bearing cap, making certain it is fully seated.
- (5) Apply engine oil to oil pan contacting surface of front and rear oil pan seals.
- (6) Install oil pan and tighten drain plug securely.
- (7) Lower engine and connect right support cushion bracket to block. Remove jack.
- (8) Install starter motor.
- (9) Lower vehicle and fill crankcase with clean oil.

### Oil Pressure Gauge

Refer to Chapter 1L—Power Plant Instrumentation for operation, diagnosis and replacement of oil pressure gauge.

### CONNECTING ROD AND PISTON ASSEMBLY

**NOTE:** The following procedure is used to service connecting rod and piston assemblies with engine in the vehicle.

#### Removal

- (1) Remove cylinder head.
- (2) Position pistons near bottom of stroke and use ridge reamer to remove ridge from top end of cylinder walls.
- (3) Drain engine oil.
- (4) Remove oil pan and gaskets.
- (5) Remove connecting rod bearing caps and inserts and retain in same order as removed.

**NOTE:** Connecting rods and caps are stamped with the corresponding cylinder number.

- (6) Remove connecting rod and piston assemblies through top of cylinder bores.

**NOTE:** Be careful that connecting rod screws do not scratch the connecting rod journals or cylinder walls. Short pieces of rubber hose slipped over the screws will provide protection during removal.

#### Installation

- (1) Clean cylinder bores thoroughly. Apply light film of clean engine oil to bores with clean, lint-free cloth.
- (2) Install piston rings on pistons. Refer to Piston Rings for sequence.
- (3) Lubricate piston and rings with clean engine oil.
- (4) Use Piston Ring Compressor Tool J-5601 to install connecting rod and piston assemblies through top of cylinder bores (fig. 1B-35).

**NOTE:** Be careful that connecting rod screws do not scratch the connecting rod journals or cylinder walls. Short pieces of rubber hose slipped over the screws will provide protection during installation.

- (5) Install connecting rod bearing caps and inserts in same order as removed.

**NOTE:** Oil squirt holes in connecting rods must face camshaft.

- (6) Install oil pan using replacement gaskets and seals. Tighten drain plug.
- (7) Install gasket and cylinder head.
- (8) Fill crankcase with clean oil to specified dipstick level.

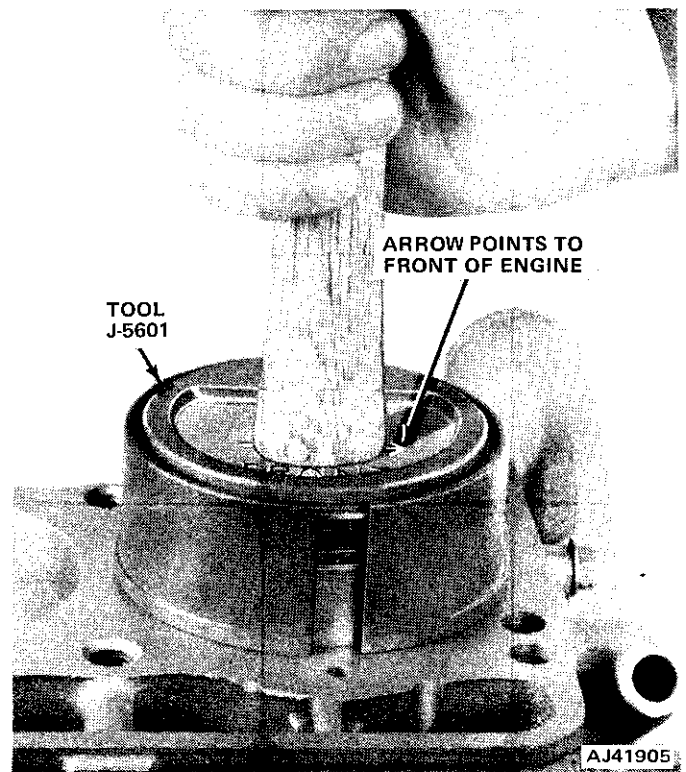


Fig. 1B-35 Piston Installation

### CONNECTING RODS

The connecting rods are malleable iron, balanced assemblies with bearing inserts at the crankshaft journal end. The piston pin is a 2,000 pound (907.2 kg) press-fit.

A squirt hole in the crankshaft end of the connecting rod provides lubrication for the camshaft lobes, distributor drive gear, cylinder walls and piston pins. The squirt hole faces the camshaft when the connecting rod is installed.

Misaligned or bent connecting rods cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearing or crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, check rod alignment. Replace misaligned or bent rods.

#### Side Clearance Measurement

Slide snug-fitting feeler gauge between connecting rod and crankshaft rod journal flange. Correct clearance is 0.005 to 0.014 inch (0.127 to 0.356 mm). Replace connecting rod if side clearance is not to specifications.

#### Connecting Rod Bearings

The connecting rod bearings are steel-backed aluminum-alloy.

Each bearing is selectively fitted to its respective journal to obtain the desired operating clearance. In production, the select fit is obtained by using various-sized,

**Connecting Rod Bearing Fitting Chart**

Crankshaft Connecting Rod Journal Color and Diameter in Inches (Journal Size)	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
Yellow -2.0955 to 2.0948 (Standard)	Yellow - Standard	Yellow - Standard
Orange -2.0948 to 2.0941 (0.0007 Undersize)	Yellow - Standard	Black - .001-inch Undersize
Black -2.0941 to 2.0934 (0.0014 Undersize)	Black - .001-Inch Undersize	Black - .001-inch Undersize
Red -2.0855 to 2.0848 (0.010 Undersize)	Red - .010-Inch Undersize	Red - .010-inch Undersize

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color-coded bearing inserts as shown in the bearing fitting chart. The bearing color code appears on the edge of the insert.

**NOTE:** Bearing size is not stamped on inserts used in production.

The rod journal size is identified **in production** by a color coded paint mark on the adjacent cheek or counterweight toward the flanged (rear) end of the crankshaft. The color codes used to indicate journal size are shown in the bearing fitting chart.

When required, upper and lower bearing inserts of different sizes may be used as a pair. A standard size insert is sometimes used in combination with a 0.001-inch (0.025 mm) undersize insert to reduce clearance 0.0005 inch (0.013 mm).

**NOTE:** Never use a pair of bearing inserts with more than 0.001-inch (0.025 mm) difference in size.

Example:

**Bearing Insert Pairs**

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.001-inch undersize	0.002-inch undersize

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**Service replacement bearing inserts** are available as pairs in the following sizes: standard, 0.001-, 0.002-, 0.010- and 0.012-inch undersize. The bearing size is stamped on the back of service replacement inserts.

**NOTE:** The 0.002- and 0.012-inch undersize inserts are not used in production.

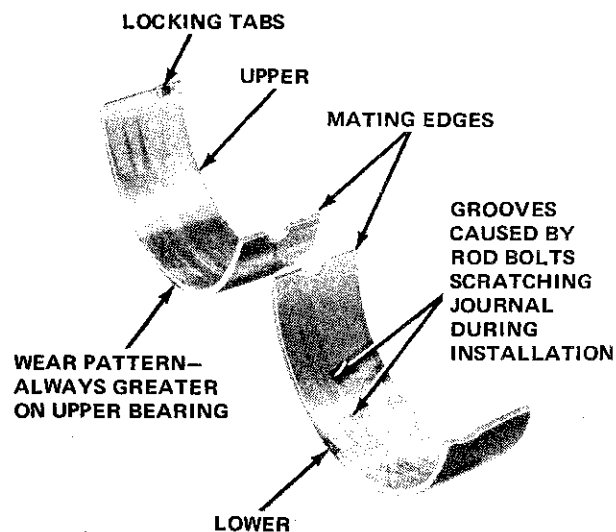
**Removal**

- (1) Drain engine oil.
- (2) Remove oil pan and gaskets.
- (3) Rotate crankshaft as required to position two connecting rods at a time at bottom of stroke.
- (4) Remove connecting rod bearing cap. Remove lower bearing insert.
- (5) Remove upper bearing insert by rotating it out of connecting rod.

**NOTE:** Do not mix bearing caps. Each connecting rod and its matching cap is stamped with the cylinder number on a machined surface adjacent to the oil squirt hole which faces the camshaft side of the engine block.

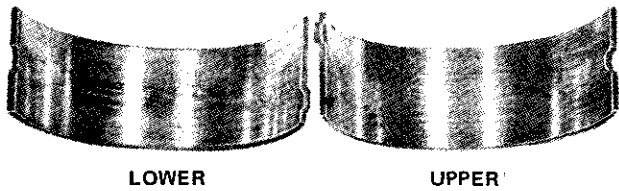
**Inspection**

- (1) Clean inserts.
- (2) Inspect linings and backs of inserts for irregular wear pattern. Note any scraping, stress cracks or discoloration (fig. 1B-36). If bearing has spun in rod, replace bearing and connecting rod and inspect crankshaft journal for scoring.
- (3) Inspect for material imbedded in linings which may indicate piston, timing gear, distributor gear or oil pump gear problems. Figures 1B-37 and 1B-38 show common score patterns.
- (4) Inspect fit of bearing locking tab in rod cap. If inspection indicates that insert may have been caught between rod and rod cap, replace upper and lower bearing inserts.
- (5) Inspect insert in area of locking tab. Abnormal wear indicates bent tabs or improper installation of inserts (fig. 1B-39).
- (6) Replace bearing inserts that are damaged or worn.



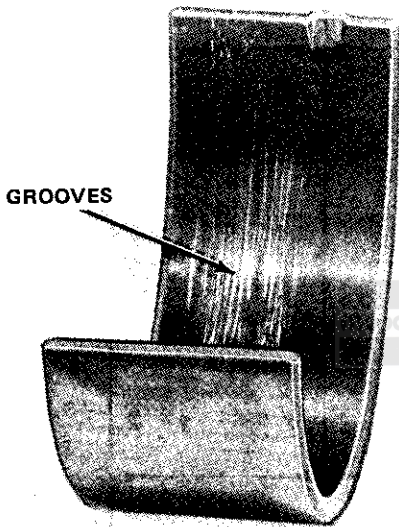
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**Fig. 1B-36 Connecting Rod Bearing Inspection**



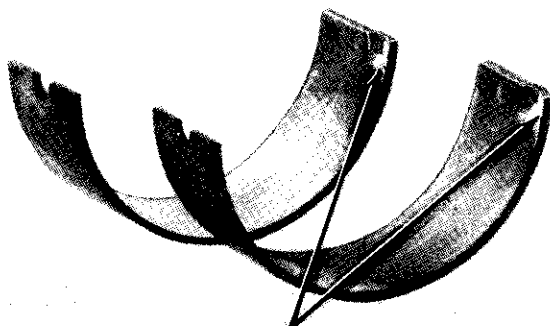
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Fig. 1B-37 Scoring Caused by Insufficient Lubrication



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Fig. 1B-38 Scoring Caused by Dirt



ABNORMAL CONTACT AREA  
DUE TO LOCKING TABS NOT  
FULLY SEATED OR BENT TABS

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Fig. 1B-39 Locking Tab Inspection

**Measuring Bearing Clearance with Plastigage**

- (1) Wipe journal clean.
- (2) Lubricate upper insert and install in rod.
- (3) Install lower insert in bearing cap. Lower insert must be dry. Place strip of Plastigage across full width of lower insert at center of bearing cap.

**NOTE:** *Plastigage must not crumble in use. If brittle, obtain fresh stock.*

- (4) Install bearing cap to connecting rod and tighten nuts to 28 foot-pounds (38 N•m) torque.

**NOTE:** *Do not rotate crankshaft. Plastigage will shift, resulting in inaccurate reading.*

- (5) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope (fig. 1B-40). Correct clearance is 0.001 to 0.0025 inch (0.025 to 0.064 mm).

**NOTE:** *Plastigage should maintain the same size across the entire width of the insert. If size varies, it may indicate a tapered journal, bent connecting rod or dirt trapped between the insert and rod.*

- (6) If correct clearance is indicated, bearing fitting is not necessary. Remove Plastigage from crankshaft and bearing and proceed to installation.

- (7) If oil clearance exceeds specification, install 0.001-inch undersize bearing inserts and check clearance as described in steps (1) through (5).

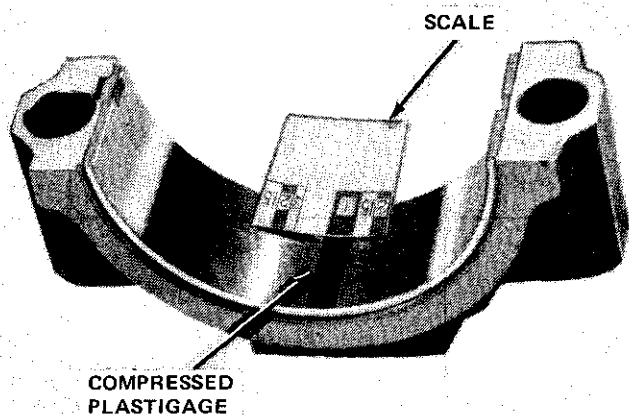
The clearance indicated with 0.001-inch undersize bearing installed will determine if 0.001-inch undersize inserts or some other combination is needed to provide correct clearance. For example, if the initial clearance was 0.003 inch (0.076 mm), 0.001-inch undersize inserts would reduce clearance by 0.001 inch (0.025 mm). Oil clearance would be 0.002 inch (0.051 mm) and within specification. A 0.002-inch undersize insert and a 0.001 inch undersize insert would reduce this clearance an additional 0.0005 inch (0.013 mm). Oil clearance would then be 0.0015 inch (0.038 mm).

**CAUTION:** *Never use inserts which differ more than one bearing size as a pair. For example, do not use a standard upper and 0.002-inch undersize lower.*

- (8) If oil clearance exceeds specification when 0.002-inch undersize inserts are installed, measure connecting rod journal with micrometer. If journal size is correct (not under 2.0934 inch or 53.172 mm), inside diameter of connecting rod is incorrect and rod must be replaced. If journal size is incorrect, replace crankshaft or grind journal to accept a suitable undersize bearing.

**Measuring Bearing Clearance with Micrometer**

- (1) Wipe connecting rod journal clean.
- (2) Use micrometer to measure maximum diameter of rod journal at four points. Take two readings 90° apart at each end of journal.



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Fig. 1B-40 Bearing Clearance Measurement with Plastigage

(3) Check for taper and out-of-round condition. Correct tolerance is 0.0005-inch (0.013 mm) maximum for both taper and out-of-round. If any rod journal is not within specifications, the crankshaft must be replaced.

(4) Compare reading obtained with journal diameters listed in Connecting Rod Bearing Fitting Chart and select inserts required to obtain specified bearing clearance.

**Installation**

(1) Lubricate bearing surface of each insert with clean engine oil.

(2) Install bearing inserts, cap and retaining nuts. Tighten to 33 foot-pounds (45 N•m) torque.

**CAUTION:** Be careful when rotating the crankshaft with bearing caps removed. Be sure the connecting rod bolts do not accidentally come in contact with the rod journals and scratch the finish. Bearing failure would result. Short pieces of rubber hose slipped over the connecting rod bolts will provide protection during installation.

(3) Install oil pan using replacement gaskets and seals. Tighten drain plug.

(4) Fill crankcase with clean oil to specified level.

**PISTONS**

Aluminum alloy autothermic pistons are used. Steel reinforcements provide strength and control expansion. The ring belt area above the piston pin provides for two compression rings and one oil control ring.

The piston pin boss is offset from the centerline of the piston to place it nearer the thrust side of the piston, minimizing piston slap.

An arrow on the top surface of the piston ensures correct installation in the bore. The arrow points toward the front of engine when installed (fig. 1B-41).

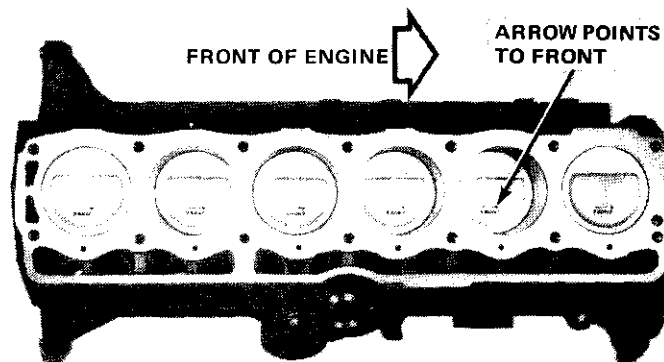


Fig. 1B-41 Pistons Correctly Positioned in Bores

**Piston Fitting**

**Micrometer Method**

(1) Measure inside diameter of cylinder bore 2-5/16 inches (58.725 mm) below top of bore.

(2) Measure outside diameter of piston.

**NOTE:** Pistons are cam ground and must be measured at right angle to piston pin at centerline of pin (fig. 1B-42).

(3) Difference between cylinder bore diameter and piston diameter is piston-to-bore clearance.

**Feeler Gauge Method**

(1) Remove rings from piston.

(2) Insert long 0.0005-inch (0.013 mm) feeler gauge into cylinder bore.

(3) Insert piston, top first, into bore alongside feeler gauge. With entire piston inserted in bore, piston should not bind against feeler gauge.

(4) Repeat steps (2) and (3) with long 0.002-inch (0.051 mm) feeler gauge. Piston should bind.

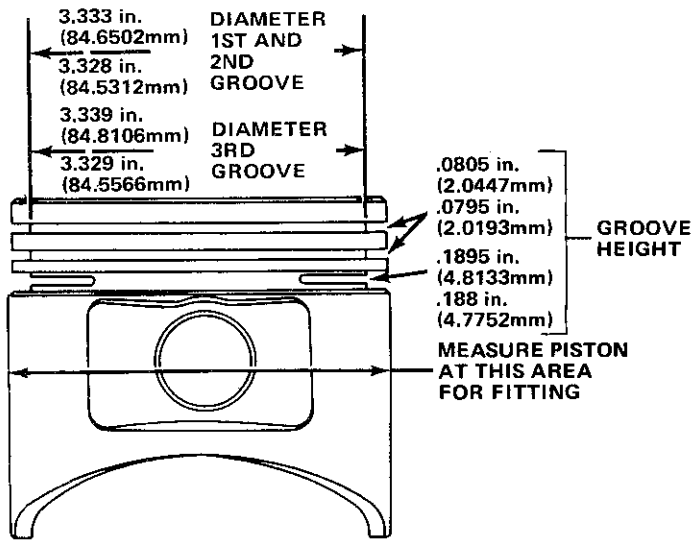
If piston binds on 0.0005-inch (0.013 mm) gauge, piston is too large or bore is too small. If piston does not bind on 0.002-inch (0.051 mm) gauge, piston may be enlarged by knurling or shot-peening. Replace pistons that are 0.004-inch (0.102 mm) or more undersize.

**Piston Rings**

The two compression rings are made of cast iron. The oil control ring is a three-piece steel design.

**Ring Fitting**

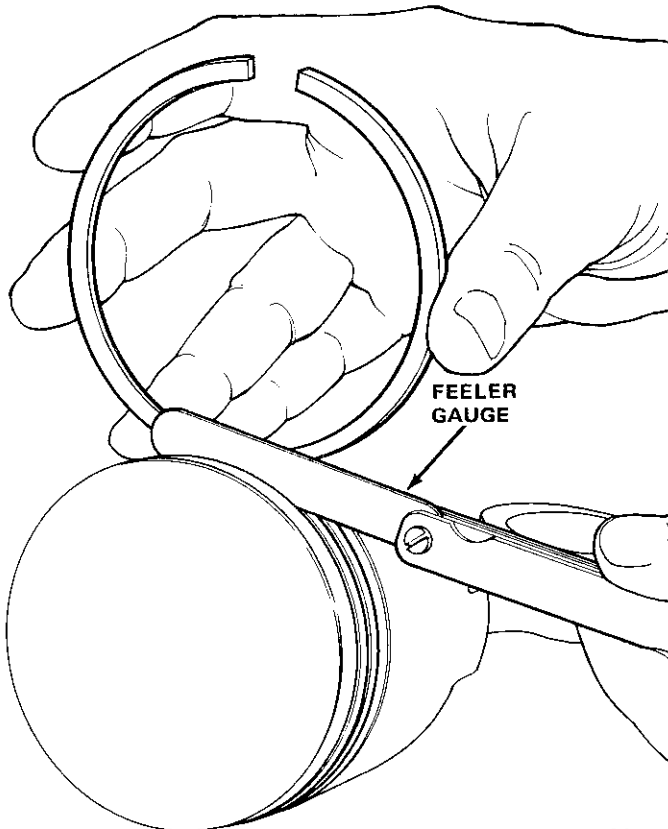
(1) Clean carbon from all ring grooves. Oil drain openings in oil ring grooves and pin boss must be open. Do not remove metal from grooves or lands. This will change ring groove clearances and will damage ring-to-land seating.



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Fig. 1B-42 Piston Measurement

(2) Check ring side clearance with feeler gauge fitted snugly between ring land and ring. Rotate ring in groove. It must move freely at all points (fig. 1B-43). Refer to Specifications for correct ring side clearance.



80051

Fig. 1B-43 Ring Side Clearance

(3) Place ring in bore and push down with inverted piston to position near lower end of ring travel. Measure ring gap (joint clearance) with feeler gauge fitting snugly in ring opening (fig. 1B-44). Refer to Specifications for correct ring gap clearance.



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Fig. 1B-44 Ring Gap Clearance

**Installation**

Refer to figure 1B-45 for position of ring gaps when installing rings.

(1) Install oil control rings as indicated by instructions in package. It is not necessary to use tool to install upper and lower rails (fig. 1B-46). Insert expander ring first, then side rails.

(2) Install lower compression ring using ring installer to expand ring around piston (fig. 1B-47).

**NOTE:** Be sure upper and lower compression rings are installed properly. Ring gap should not be above piston pin. Figure 1B-48 shows typical ring markings indicating the top side of the ring.

(3) Install upper compression ring using ring installer to expand ring around piston (fig. 1B-47). Position ring gap 180° from lower compression ring.

**Piston Pins**

Piston pins are press fit into the connecting rod and require no locking device.

**Removal**

(1) Using Piston Pin Remover J-21872 and arbor press, place piston on Remover Support J-21872-1 (fig. 1B-49).

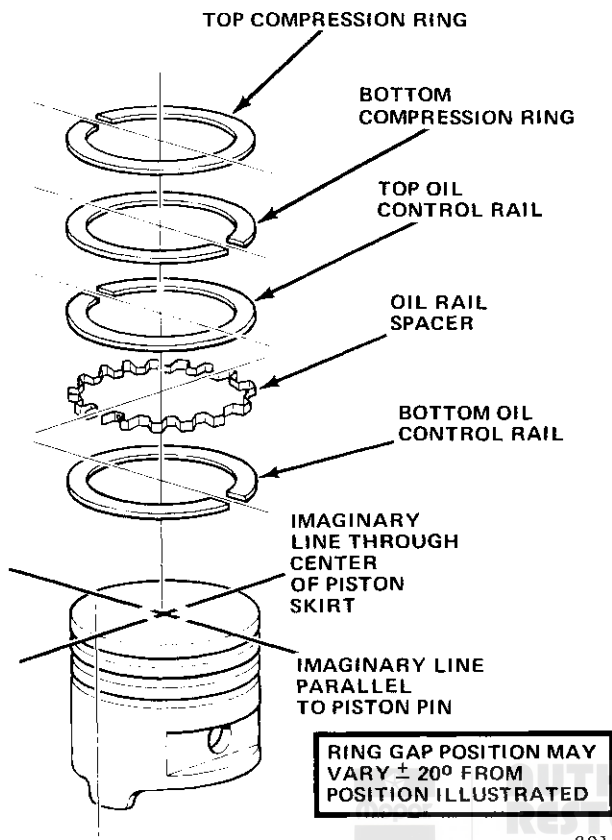


Fig. 1B-45 Piston Ring Gap Position

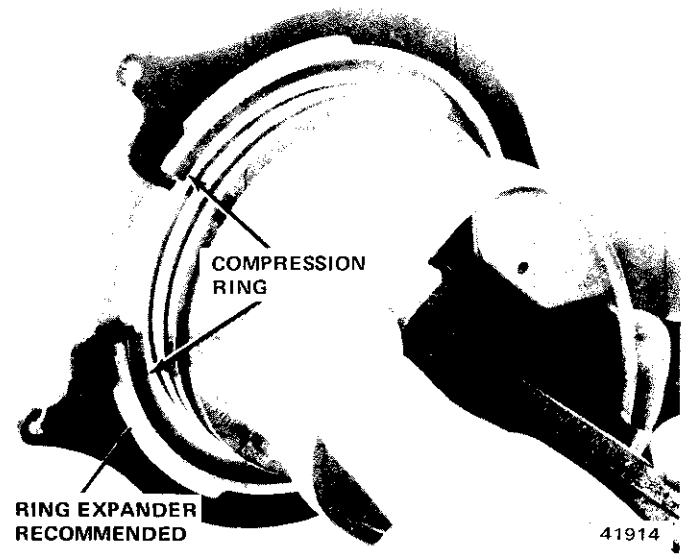


Fig. 1B-47 Compression Ring Installation

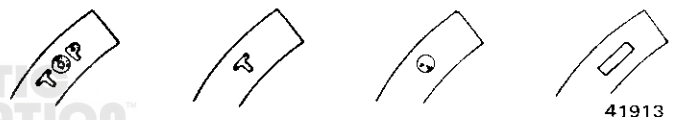


Fig. 1B-48 Typical Piston Ring Markings

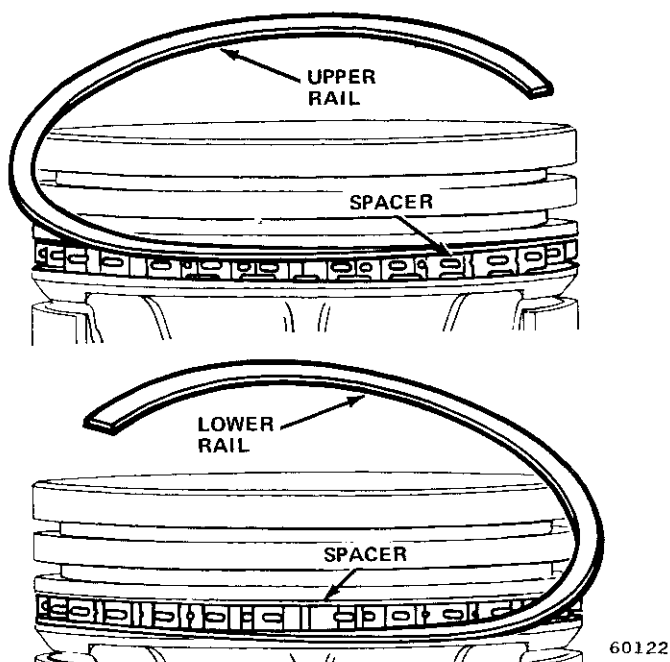


Fig. 1B-46 Oil Control Ring Rail Installation

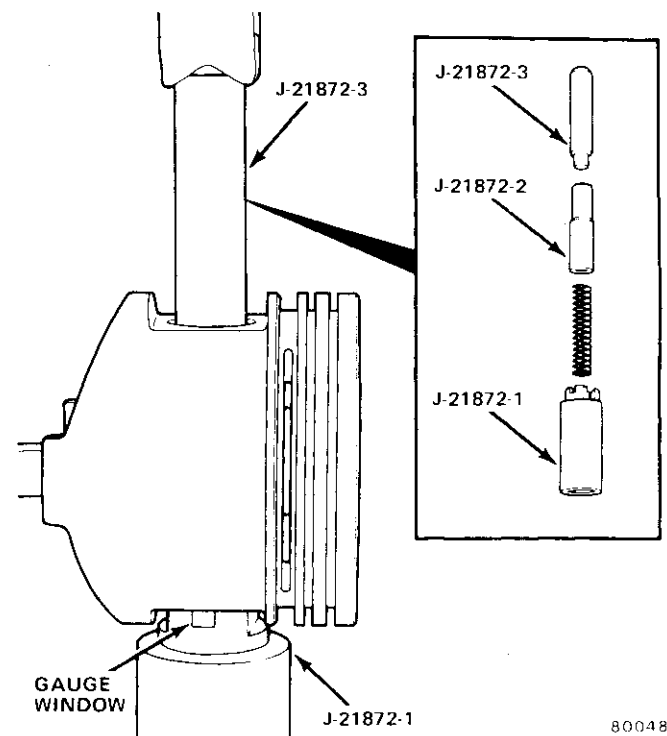


Fig. 1B-49 Piston Pin Removal or Installation



(2) Use Piloted Driver J-21872-3 to press pin completely out of piston. Note position of pin through gauge window of remover support.

### Pin Inspection

(1) Inspect pin and pin bore for nicks and burrs. Remove as necessary.

**NOTE:** Never reuse piston pin after it has been installed in and removed from a connecting rod.

(2) With pin removed from piston, clean and dry piston pin bore and replacement piston pin.

(3) Position piston so that pin bore is in vertical position. Insert pin in bore. At room temperature, the replacement pin should slide completely through pin bore without pushing.

(4) Replace piston if pin jams in pin bore.

### Installation

(1) Insert Pin Pilot J-21872-2 through piston and connecting rod pin bores (fig. 1B-50).

(2) Position pin pilot, piston and connecting rod on Support J-21872-1.

(3) Insert piston pin through upper piston pin bore and into connecting rod pin bore.

(4) Position Piloted Driver J-21872-3 inside piston pin.

(5) Use arbor press to press piston pin through connecting rod and piston until pin pilot indexes with mark on support.

**NOTE:** The piston pin requires a 2,000 pound (907.2 kg) press-fit. If little effort is required to install piston pin in connecting rod, or if rod moves along pin, replace connecting rod.

(6) Remove piston and connecting rod assembly from press. Pin should be centered in rod,  $\pm 0.0312$  inch (0.792 mm).

## CRANKSHAFT

The nodular iron crankshaft is counterweighted and balanced. The crankshaft has twelve counterweights. Both have seven main bearing journals and six connecting rod journals. End thrust is controlled by the No. 3 main bearing.

An oil slinger is provided at the rear main journal, inboard of the rear oil seal. The component parts and crankshaft are individually balanced. Then the complete assembly is balanced as a unit.

Service replacement dampers, crankshafts, flywheels, torque converters and clutch components are balanced individually and may be replaced as required without balancing the complete assembly.

## Removal or Replacement

If the crankshaft is damaged to the extent that reconditioning is not feasible, it must be replaced. Removal and installation procedures are outlined under Cylinder Block.

## Crankshaft End Play Measurement

The crankshaft end play is controlled at the No. 3 main bearing insert which is flanged for this purpose.

(1) Attach dial indicator to cylinder block adjacent to No. 3 main bearing (fig. 1B-50).

(2) Pry shaft forward with flat-bladed screwdriver, set dial indicator, push rod on face of crankshaft counterweight and set to zero.

(3) Pry shaft fore and aft. Read dial indicator. The end play is the difference between the high and low readings. The correct crankshaft end play is 0.0015 to 0.0065 inch (0.002 to 0.0025 desired) [0.038 to 0.165 mm (0.051 to 0.064 mm desired)].

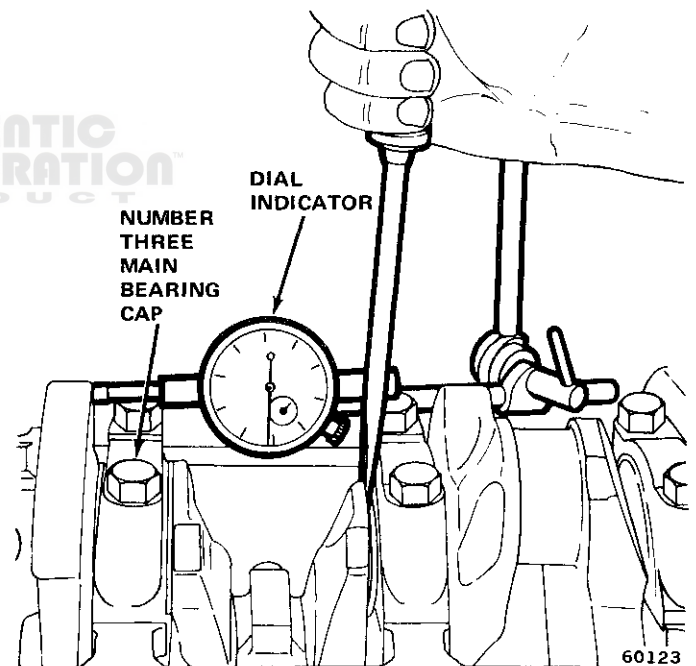


Fig. 1B-50 Measuring Crankshaft End Play

(4) If end play is out of specifications, inspect crankshaft thrust faces for wear. If no wear is apparent, replace thrust bearing and check end play. If end play is still out of specifications, replace crankshaft.

**NOTE:** When replacing the thrust bearings, pry the crankshaft fore and aft to align the faces of the thrust bearings before final torque tightening.

## Crankshaft Main Bearings

The main bearings are steel-backed, micro-babbitt, precision type. The main bearing caps are numbered (front to rear) from 1 through 7, and an arrow indicates

forward position. The upper main bearing inserts are grooved while the lower inserts are smooth.

Each bearing is selectively fitted to its respective journal to obtain the desired operating clearance. **In production**, the select fit is obtained by using various sized color coded bearing inserts as shown in Main Bearing Fitting chart. The bearing color code appears on the edge of the insert.

**NOTE:** *Bearing size is not stamped on inserts used in production.*

The main bearing journal size is identified **in production** by a color-coded paint mark on the adjacent cheek toward the flanged (rear) end of the crankshaft, except for the rear main journal which is on the crankshaft rear flange.

When required, upper and lower bearing inserts of different sizes may be used as a pair. A standard size insert is sometimes used in combination with a 0.001-inch undersize insert to reduce clearance by 0.0005 inch (0.013 mm).

Example:

**Bearing Insert Pairs**

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.001-inch undersize	0.002-inch undersize

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**CAUTION:** *Never use a pair of bearing inserts with greater than 0.001-inch difference in size.*

**CAUTION:** *When replacing inserts, all the odd size inserts must be either all on the top (in block) or all on the bottom (in main cap).*

**Service replacement bearing inserts** are available as pairs in the following sizes: standard, 0.001-, 0.002-, 0.010- and 0.012-inch undersize. The size is stamped on the back of service replacement inserts.

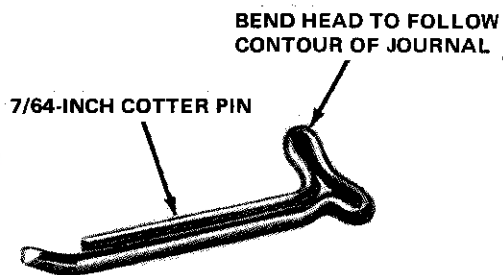
**NOTE:** *The 0.012-inch undersize insert is not used in production.*

**Removal**

- (1) Drain engine oil.
- (2) Remove oil pan.
- (3) Remove main bearing cap and insert.
- (4) Remove lower insert from bearing cap.
- (5) Loosen other bearing caps and insert small cotter pin in crankshaft oil hole. Bend cotter pin as shown in figure 1B-51.
- (6) With pin in place, rotate crankshaft so that upper bearing insert rotates in direction of its locking tab.

**NOTE:** *Since there is no hole in the number 4 main journal, use a tongue depressor or similar soft-faced tool to remove the bearing (fig. 1B-52). After moving the insert approximately one inch (25.40 mm), the insert can be removed by applying pressure under the tab.*

- (7) In the same manner, remove remaining bearings one at a time for inspection.



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**Fig. 1B-51 Upper Main Bearing Removal Tool**

**Inspection**

- (1) Wipe lower insert clean and inspect for abnormal wear pattern and for dirt or metal imbedded in lining. Normal main bearing wear pattern is shown in figure 1B-53.

**NOTE:** *If the crankshaft journal is scored, remove the engine for crankshaft repair.*

**Main Bearing Fitting Chart**

Crankshaft Main Bearing Journal Color Code and Diameter in Inches (Journal Size)	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
Yellow -2.5001 to 2.4996 (Standard)	Yellow - Standard	Yellow - Standard
Orange -2.4996 to 2.4991 (0.0005 Undersize)	Yellow - Standard	Black - .001-inch Undersize
Black -2.4991 to 2.4986 (0.001 Undersize)	Black - .001-inch Undersize	Black - .001-inch Undersize
Green -2.4986 to 2.4981 (0.0015 Undersize)	Black - .001-inch Undersize	Green - .002-inch Undersize
Red -2.4901 to 2.4896 (0.010 Undersize)	Red - .010-inch Undersize	Red - .010-inch Undersize

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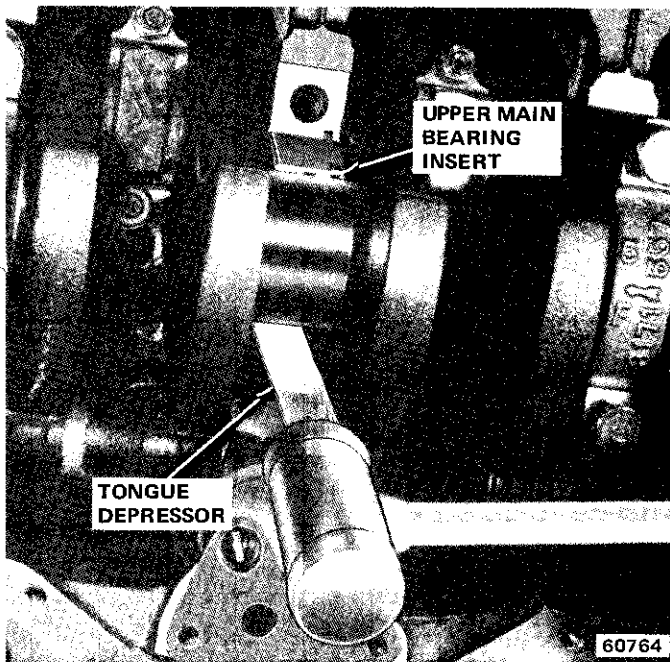


Fig. 1B-52 Removing No. 4 Main Bearing Insert

- (2) Inspect back of insert for fractures, scrapings or irregular wear pattern.
- (3) Inspect locking tabs for damage.
- (4) Replace bearing inserts that are damaged or worn.

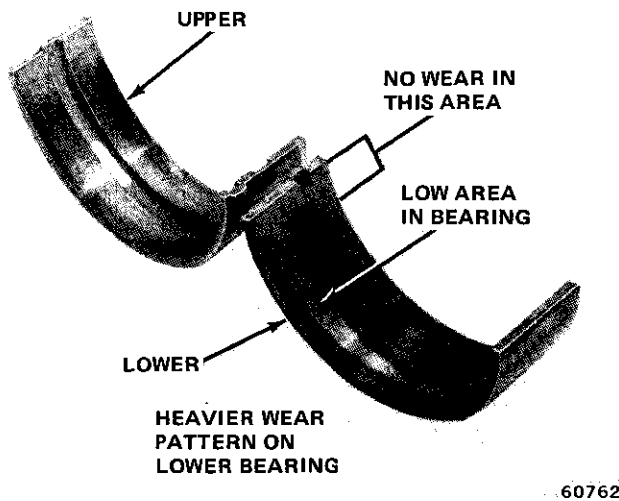


Fig. 1B-53 Normal Main Bearing Wear Pattern

**Measuring Bearing Clearance with Plastigage (Crankshaft Installed)**

**NOTE:** Check clearance of one bearing at a time. All other bearings must remain tightened.

- (1) Remove main bearing cap and insert.
- (2) Clean insert and exposed portion of crankshaft journal.

(3) Place strip of Plastigage across full width of bearing insert.

(4) Install bearing cap and tighten screws to 80 foot-pounds (108 N•m) torque.

(5) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope (fig. 1B-54). Correct clearance is 0.001 to 0.003 inch (0.025 to 0.076 mm). The Plastigage should maintain same size across entire width of insert. If size varies, it may indicate tapered journal or dirt trapped behind insert.

**NOTE:** Do not rotate crankshaft. Plastigage will shift, resulting in inaccurate reading. Plastigage must not crumble. If brittle, obtain fresh stock.

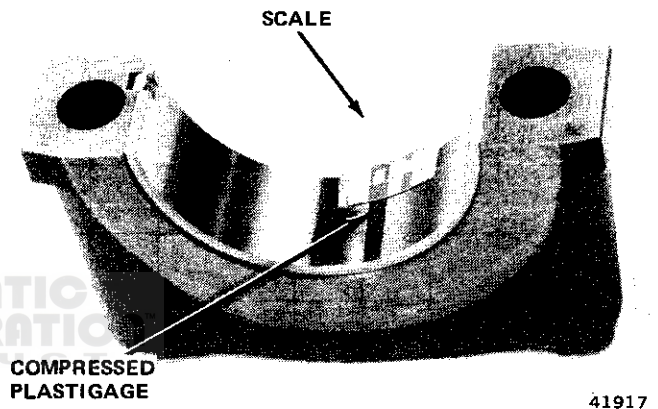


Fig. 1B-54 Checking Main Bearing Clearance with Plastigage

(6) If correct clearance is indicated, bearing fitting is not necessary. Remove Plastigage from crankshaft and bearing and proceed to Installation.

(7) If oil clearance exceeds specification, install pair of 0.001-inch (0.025 mm) undersize bearing inserts and check clearance as described in steps (4) through (6). The clearance indicated with the 0.001-inch undersize inserts installed will determine if the 0.001-inch undersize inserts or some other combination will provide correct clearance. For example, if the clearance was 0.0035 inch originally (0.089 mm), a pair of 0.001-inch undersize inserts would reduce clearance by 0.001 inch (0.025 mm). Oil clearance would be 0.0025 inch (0.064 mm) and within specification. A 0.002-inch undersize bearing half and a 0.001-inch undersize half would reduce this clearance an additional 0.0005 inch (0.013 mm) and oil clearance would be 0.002 inch (0.051 mm).

**CAUTION:** Never use a pair of inserts which differ more than one bearing size as a pair. For example, do not use a standard upper and 0.002-inch undersize lower.

(8) If oil clearance exceeds specification using 0.002-inch undersize bearings, measure crankshaft journal with micrometer. If journal size is correct, crankshaft bore of cylinder block may be misaligned which requires

cylinder block replacement or machining to true bore. If journal size is less than 2.4981 inch (63.4517 mm), replace crankshaft or grind to accept suitable undersize bearing.

#### Measuring Main Bearing Journal with Micrometer (Crankshaft Removed)

- (1) Clean main bearing journal.
- (2) Measure maximum diameter of journal with micrometer. Take two readings 90° apart at each end of journal.
- (3) Compare reading obtained with journal diameters listed in Main Bearing Fitting Chart and select inserts required to obtain specified bearing clearance.

#### Installation

- (1) Lubricate bearing surface of each insert with clean engine oil.
- (2) Loosen all main bearing caps and install main bearing upper insert(s).
- (3) Install main bearing cap(s) and lower insert(s). Tighten screws to 40 foot-pounds (54 N•m) torque. Then tighten to 60 foot-pounds (81 N•m). Finally, tighten to 80 foot-pounds (108 N•m). Rotate crank after tightening each main cap to make sure crankshaft rotates freely.

**NOTE:** When installing a crankshaft kit (crankshaft plus bearing inserts), check each bearing for fit, using Plastigage.

- (4) Install oil pan, using replacement gaskets and seals. Tighten drain plug.
- (5) Fill crankcase with clean oil to specified dipstick level.

#### Rear Main Bearing Oil Seal

The rear main bearing crankshaft oil seal consists of two pieces of neoprene with a single lip that effectively seals the rear of the crankshaft. To ensure leak-free operation, replace the upper and lower seal halves in pairs.

#### Removal

- (1) Drain engine oil.
- (2) Remove oil pan.
- (3) Remove rear main bearing cap and discard lower seal.
- (4) Loosen all remaining bearing capscrews.
- (5) Use brass drift and hammer to tap upper seal until seal protrudes enough to permit pulling it out completely.
- (6) Remove oil pan front and rear neoprene oil seals and oil pan side gaskets.
- (7) Clean gasket surfaces of oil pan and engine block. Remove all sludge and dirt from oil pan sump.
- (8) Clean main bearing cap thoroughly to remove all sealer.

#### Installation

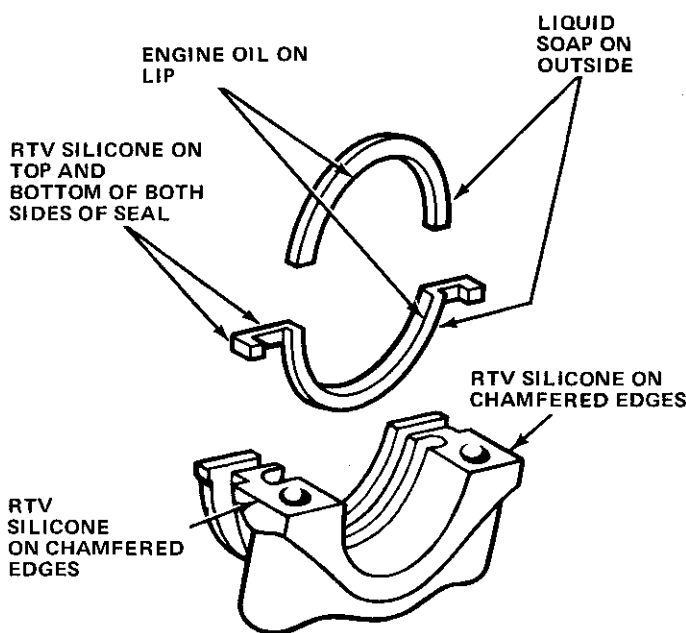
- (1) Wipe seal surface of crankshaft clean and lightly coat with engine oil.
- (2) Coat lip of seal with engine oil.
- (3) Install upper seal into engine block.

**NOTE:** Lip of seal must face toward front of engine.

- (4) Coat both sides of lower seal end tabs with RTV silicone (Jeep Gasket-in-a-Tube, or equivalent), being careful to not apply sealer to lip of seal.
- (5) Coat outer curved surface of lower seal with soap and lip of seal with engine oil.
- (6) Install seal into cap recess and seat it firmly.
- (7) Coat both chamfered edges of rear main bearing cap with RTV silicone (fig. 1B-55).

**CAUTION:** Do not apply sealer to cylinder block mating surfaces of rear main bearing cap as bearing clearance would be affected.

- (8) Install rear main bearing cap.
- (9) Tighten all main bearing capscrews to 80 foot-pounds (108 N•m) torque.
- (10) Install oil pan using replacement gaskets and seals. Tighten drain plug.
- (11) Fill crankcase with clean oil to specified dipstick level.



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Fig. 1B-55 Rear Main Oil Seal and Cap Installation

#### Vibration Damper

The vibration damper is balanced independently and then rebalanced as part of the complete crankshaft assembly.

Do not attempt to duplicate the damper balance holes when installing a service replacement. The vibration damper is not repairable and is serviced only as a complete assembly.

**Removal**

- (1) Remove drive belt(s).
- (2) Remove three retaining capscrews and separate vibration damper pulley from vibration damper.
- (3) Remove vibration damper retaining screw and washer.
- (4) Use Vibration Damper Remover Tool J-21791 to remove damper from crankshaft (fig. 1B-56).

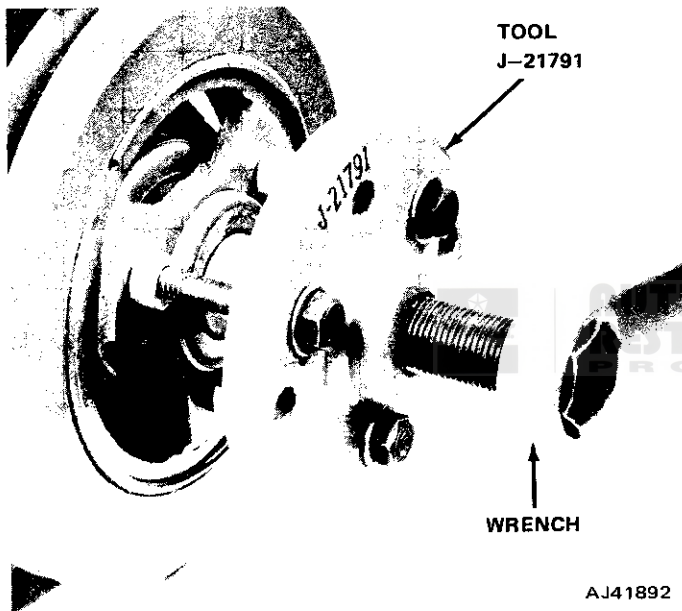


Fig. 1B-56 Vibration Damper Removal

**Installation**

- (1) Align key slot of the vibration damper with crankshaft key and tap damper onto crankshaft.
- (2) Install vibration damper retaining screw and washer. Tighten screw to 80 foot-pounds (108 N•m) torque.
- (3) Install damper pulley and retaining capscrews. Tighten screws to 20 foot-pounds (27 N•m) torque.
- (4) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling.

**Flywheel and Starter Ring Gear Assembly**

The starter ring gear can be replaced only on vehicles with manual transmission. The starter ring gear is welded to and balanced as part of the converter drive plate on vehicles with automatic transmissions. The entire drive plate and ring assembly must be replaced on automatic transmission equipped vehicles.

**Ring Gear Replacement (Manual Transmission)**

- (1) Position flywheel on arbor press with steel blocks equally spaced under gear.
- (2) Press flywheel through ring gear.

**NOTE:** Ring gear can also be removed by breaking with chisel.

- (3) Apply heat to expand inside diameter of replacement ring gear.
- (4) Press flywheel onto replacement ring gear.

**NOTE:** On manual transmission equipped cars, the flywheel is balanced as an individual component and also as part of the crankshaft assembly. Do not attempt to duplicate original flywheel balance holes when installing a service replacement. Service flywheels are balanced during manufacture.

**CYLINDER BLOCK**

**Disassembly**

- (1) Remove engine as outlined under Engine Removal.
- (2) Place engine assembly on engine stand.
- (3) Remove intake and exhaust manifolds.
- (4) Remove cylinder head cover and gasket.
- (5) Remove rocker arms and bridged pivot assemblies. Back off each capscrew a turn at a time to avoid breaking the bridge.
- (6) Remove push rods.
- (7) Remove cylinder head and gasket.
- (8) Remove valve tappets.
- (9) Remove drive pulley and vibration damper.
- (10) Removing timing case cover.
- (11) Remove timing chain and sprockets.
- (12) Remove camshaft.
- (13) Position pistons, one at a time, near bottom of stroke and use a ridge reamer to remove any ridge from top end of cylinder walls.
- (14) Remove oil pan and gaskets.
- (15) Remove oil pump.
- (16) Remove connecting rod bearing caps and inserts and retain in same order as removed.

**NOTE:** Connecting rods and caps are stamped with the number of the cylinder to which they were assembled.

- (17) Remove piston and connecting rod assemblies through top of cylinder bores.

**NOTE:** Be careful that connecting rod bolts do not scratch the connecting rod journals or cylinder walls. Short pieces of rubber hose slipped over the rod bolts will prevent damage to the cylinder bores or crankshaft.

- (18) Remove main bearing caps and inserts.
- (19) Remove crankshaft.

## Cylinder Bore Reconditioning

### Measuring Cylinder Bore

Use a bore gauge to measure the cylinder bore (fig. 1B-57). If a bore gauge is not available, use an inside micrometer.

(1) Measure cylinder bore crosswise to block near top of bore. Repeat measurement at bottom of bore.

(2) Determine taper by subtracting smaller dimension from larger dimension.

(3) Turn measuring device 120° and repeat step (1). Then turn another 120° and repeat measurements.

(4) Determine out-of-round by comparing difference between readings taken 120° apart.

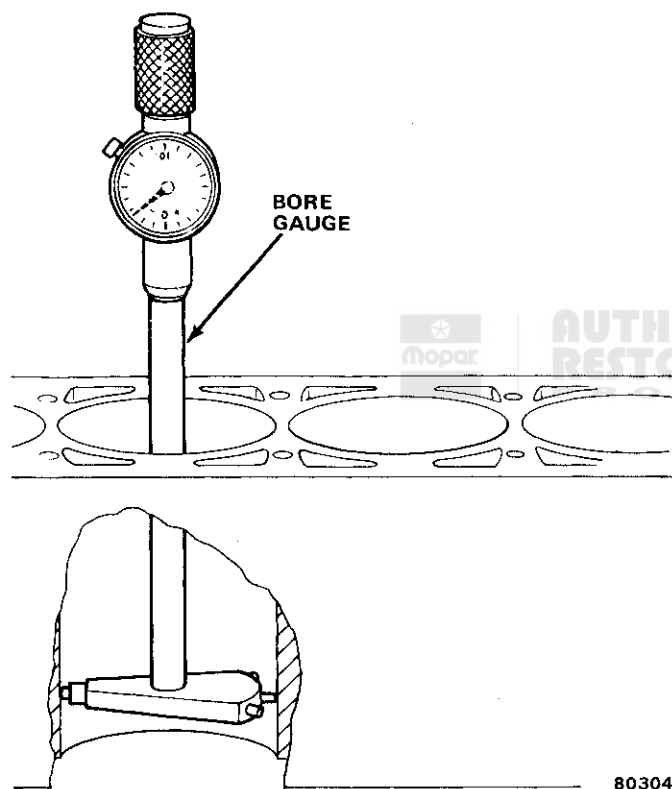


Fig. 1B-57 Measuring Cylinder Bore with Bore Gauge

If cylinder taper does not exceed 0.005 inch (0.013 mm) and out-of-round does not exceed 0.003 inch (0.076 mm), cylinder bore may be trued by honing. If cylinder taper or out-of-round condition exceeds these limits, bore and then hone cylinder for oversize piston.

### Resurfacing Cylinder Bore

**CAUTION:** Do not use rigid type hones to remove cylinder glaze. A slight amount of taper always exists in cylinder walls after engine has been in service.

(1) Use expanding hone to true cylinder bore and to remove glaze for faster ring seating. Move hone up and down at sufficient speed to produce uniform 60° angle crosshatch pattern on cylinder walls. Do not use more

than ten strokes per cylinder (a stroke is one down and one up movement).

**CAUTION:** Protect engine bearings and lubrication system from abrasives.

(2) Scrub cylinder bores clean with solution of hot water and detergent.

(3) Immediately apply light engine oil to cylinder walls. Wipe with clean, lint-free cloth.

### Assembly

(1) Install upper main bearing inserts in cylinder block.

(2) Install crankshaft.

(3) Install main bearing caps and inserts. Apply oil to insert before installing. Tighten screws to 80 foot-pounds torque in steps of 40, 60 and 80 foot-pounds torque (54, 81, 108 N•m). Plastigage all bearings if replacement bearings or crankshaft have been installed.

(4) Clean cylinder bores thoroughly. Apply light film of clean engine oil to bores with clean, lint-free cloth.

(5) Install piston rings on piston. Refer to Piston Rings for sequence.

(6) Lubricate piston and rings with clean engine oil.

(7) Use Piston Ring Compressor Tool J-5601 to install connecting rod and piston assemblies through top of cylinder bores (fig. 1B-34).

**NOTE:** Be careful that connecting rod bolts do not scratch the connecting rod journals or cylinder walls. Short lengths of rubber hose slipped over the connecting rod bolts will provide protection during installation.

(8) Apply oil to inserts. Install connecting rod bearing caps and inserts in same order as removed. Tighten retaining nuts to 33 foot-pounds (45 N•m) torque.

**NOTE:** Oil squirt holes in connecting rods must face camshaft.

(9) Install oil pump using replacement pick-up tube and screen.

(10) Install engine oil pan using replacement gaskets and seals. Tighten drain plug.

(11) Install camshaft and timing chain.

(12) Install timing case cover.

(13) Install vibration damper and drive pulley.

(14) Install valve tappets.

(15) Install gasket and cylinder head.

(16) Install push rods.

(17) Install rocker arms and bridged pivot assemblies. Loosely install capscrews to each bridged pivot. At each bridged pivot, tighten capscrews alternately, one turn at a time to avoid damaging or breaking the bridge.

(18) Install cylinder head cover, using replacement gasket or silicone rubber material.

(19) Install intake and exhaust manifolds.

(20) Remove engine from engine stand.

(21) Install engine assembly as outlined under Engine Installation.

**SPECIFICATIONS**

**Six-Cylinder Engine Specifications**

	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified
Type	In Line, OHV, Six-Cylinder			
Bore	3.75	95.25		
Stroke				
258	3.895	98.93		
Displacement				
258	258 cubic inches	4.2 liters		
Compression Ratio		8.0:1		
Compression Pressure				
258	150 psi	1034.3 kPa		
Maximum Variation Between Cylinders	20 psi	137.9 kPa		
Firing Order	1-5-3-6-2-4			
Taxable Horsepower	33.75 Bhp	25.2 kW		
Fuel	unleaded			
<b>Camshaft</b>				
Fuel Pump Eccentric Diameter	1.615-1.625	41.02-41.28		
Tappet Clearance	Zero Lash (Hydraulic tappets)			
End Play	Zero (engine operating)			
Bearing Clearance	0.001-0.003	0.025-0.076		
Bearing Journal Diameter				
No. 1	2.029-2.030	51.54-51.56		
No. 2	2.019-2.020	51.28-51.31		
No. 3	2.009-2.010	51.03-51.05		
No. 4	1.999-2.000	50.78-50.80		
Base Circle Runout	0.001 (max)	0.03 (max)		
Cam Lobe Lift	0.248	6.30		
Intake Valve Timing				
Opens	14.58° BTDC			
Closes	68.79° ABDC			
Exhaust Valve Timing				
Opens	55.59° BBDC			
Closes	27.78° ATDC			
Valve Overlap	42.36°			
Intake Duration	263.37°			
Exhaust Duration	263.37°			
<b>Connecting Rods</b>				
Total Weight (less bearings)				
258	695-703 grams			
Total Length (center-to-center)				
258	5.873-5.877	149.17-140.28		
Piston Pin Bore Diameter	0.9288-0.9298	23.59-23.62		
Connecting Rod Bore (less bearings)	2.2085-2.2080	56.09-56.08		
Bearing Clearance	0.001-0.0025 (0.0015-0.002 preferred)	0.03-0.06 (0.044 preferred)		
Side Clearance	0.005-0.014	0.13-0.36		
Maximum Twist	0.001 per inch	0.025 per 25.4 mm		
Maximum Bend	0.0005 per inch	0.0127 per 25.4 mm		
<b>Crankshaft</b>				
End Play	0.0015-0.0065	0.038-0.165		
Main Bearing Journal Diameter	2.4986-2.5001	63.464-63.502		
Main Bearing Journal Width				
No. 1	1.086-1.098	27.58-27.89		
No. 3	1.271-1.273	32.28-32.33		
No. 2-4-5-6-7	1.182-1.188	30.02-30.18		
Main Bearing Clearance	0.001-0.003 (0.0025 preferred)	0.03-0.08 (0.064 preferred)		
Connecting Rod Journal Diameter	2.0934-2.0955	53.17-53.23		
Connecting Rod Journal Width	1.070-1.076	27.18-27.33		
Connecting Rod Bearing Clearance	0.001-0.0025 (0.0015-0.002 preferred)	0.03-0.06 (0.038-0.051 preferred)		
Maximum Out-of-Round (All Journals)	0.0005	0.013		
Maximum Taper (All Journals)	0.0005	0.013		
<b>Cylinder Block</b>				
Deck Height	9.487-9.493	240.97-241.12		
Deck Clearance	0.0148 (below block)	0.3759 (below block)		
Cylinder Bore (standard)	3.7501-3.7533	95.253-95.334		
Maximum Cylinder Taper	0.005	0.13		
Maximum Cylinder (Out-of-Round)	0.003	0.08		
Tappet Bore Diameter	0.905-0.906	22.99-23.01		
Cylinder Block Flatness	0.001/1-0.002/6 0.0008 (max)	0.03/25-0.05/152 0.20 (max)		
<b>Cylinder Head</b>				
Combustion Chamber Volume	67.84-70.84cc			
Valve Arrangement	EI-IE-IE-EI-EI-IE			
Valve Guide ID (Integral)	0.3735-0.3745	9.487-9.512		
Valve Stem-to-Guide Clearance	0.001-0.003	0.03-0.08		
Intake Valve Seat Angle	30°			
Exhaust Valve Seat Angle	44.5°			
Valve Seat Width	0.040-0.060	1.02-1.52		
Valve Seat Runout	0.0025	0.064		
Cylinder Head Flatness	0.001/1-0.002/6 0.008 (max)	0.03/25-0.05/152 0.20 (max)		
<b>Lubrication System</b>				
Engine Oil Capacity	4 quarts (Add 1 quart with filter change)	3.8 liters (Add 0.9 liter with filter change)		
Normal Operating Pressure	13psi at 600 rpm; 37-75 psi (max) at 1600+ rpm	89.6 kPa at 600 rpm; 255.1-517.1 kPa (max) at 1600+ rpm		
Oil Pressure Relief	75 psi (max)	517.1 kPa (max)		
Gear-to-Body Clearance	0.0005-0.0025 (0.0005 preferred)	0.0127-0.0635 (0.0127 preferred)		
Gear End Clearance, Plastigage	0.002-0.008 (0.002 preferred)	0.0508-0.2032 (0.0508 preferred)		
Gear End Clearance, Feeler Gauge	0.004-0.008 (0.007 preferred)	0.1016-0.2032 (0.1778 preferred)		
<b>Pistons</b>				
Weight (less pin)	498-502 grams			
Piston Pin Bore Centerline-to-Piston Top	1.599-1.603	40.61-40.72		
Piston-to-Bore Clearance	0.0009-0.0017 (0.0012-0.0013 preferred)	0.023-0.043 (0.030-0.033 preferred)		
Piston Ring Gap Clearance — Compression (both)	0.010-0.020	0.25-0.51		

**Six-Cylinder Engine Specifications (Continued)**

	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified		(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified
Piston Ring Gap Clearance —			Push Rod Diameter . . . . .	.313-.312	7.95-7.93
Oil Control Steel Rails . . . . .	0.010-0.025	0.25-0.64	Hydraulic Tappet Diameter . . . . .	0.904-0.9045	22.96-22.97
Piston Ring Side Clearance			Tappet-to-Bore Clearance . . . . .	0.001-0.002	0.03-0.05
No. 1 Compression . . . . .	0.0015-0.003 (0.0015 preferred)	0.038-0.076 (0.038 preferred)	<b>Valves</b>		
No. 2 Compression . . . . .	0.0015-0.003 (0.0015 preferred)	0.038-0.076 (0.038 preferred)	Valve Length (Tip-to-Gauge Dim. Line) . . . . .	4.7895-4.8045	121.653-122.034
Oil Control . . . . .	0.001-0.008 (0.003 preferred)	0.03-0.20 (0.08 preferred)	Valve Stem Diameter . . . . .	0.3715-0.3725	9.436-9.462
Piston Ring Groove Height			Stem-to-Guide Clearance . . . . .	0.001-0.003	0.03-0.08
Compression (both) . . . . .	0.0795-0.0805	2.019-2.045	Intake Valve Head Diameter . . . . .	1.782-1.792	45.26-45.52
Oil Control . . . . .	0.188-0.1895	4.78-4.80	Intake Valve Face Angle . . . . .	29°	
Piston Ring Groove Diameter			Exhaust Valve Head Diameter . . . . .	1.401-1.411	35.59-35.84
No. 1 and No. 2 . . . . .	3.328-3.333	84.53-84.66	Exhaust Valve Face Angle . . . . .	44°	
Oil Control . . . . .	3.329-3.339	84.56-84.81	Maximum Allowable Removed for Tip Refinishing . . . . .	0.010	0.25
Piston Pin Bore Diameter . . . . .	0.9308-0.9313	23.642-23.655	<b>Valve Springs, Exhaust</b>		
Piston Pin Diameter . . . . .	0.9304-0.9309	23.632-23.645	Valve Open . . . . .	80-88 at 1.625	
Piston-to-Pin Clearance . . . . .	0.0003-0.0005 loose (0.0005 preferred)	0.008-0.013 loose (0.013 preferred)	Valve Closed . . . . .	210-226 at 1.188	
Piston-to-Pin Connecting Rod . . . . .	2000 lb. press-fit	907.2 kg press-fit	I.D. . . . .	1.000-1.020	
<b>Rocker Arms, Push Rods and Tappets</b>			<b>Valve Springs, Intake</b>		
Rocker Arm Ratio . . . . .	1.6:1		Free Length . . . . .	1.99 approx.	50.55 approx.
Push Rod Length . . . . .	9.640-9.660	244.856-245.364	Spring Tension		
			Valve Closed . . . . .	64-72 lbs. at 1.786	29.0-32.7 bg. at 45.24
			Valve Open . . . . .	188-202 lbs. at 1.411	85.3-91.6 bg. at 36.51
			Inside Diameter . . . . .	0.948-0.968	24.08-24.59

60263B

**Torque Specifications**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft.lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Air Injection Tube-to-Manifold . . . . .	20	15-20	27	20-27
Air Pump-to-Bracket . . . . .	20	15-22	27	20-30
Air Pump Brackets-to-Engine (A. Compressor or Pedestals) . . . . .	25	18-28	34	24-38
Air Pump Adjusting Strap-to-Pump . . . . .	20	15-22	27	20-30
Alternator Pivot Bolt or Nut . . . . .	28	20-35	38	27-47
Alternator Adjusting Bolt . . . . .	18	15-20	24	20-27
Alternator Mounting Bracket-to-Engine . . . . .	28	23-30	38	31-41
Alternator Pivot Mounting Bolt-to-Head . . . . .	33	30-35	45	41-47
Block Heater Nut . . . . .	20 in-lbs.	17-25 in-lbs.	2	2-3
Camshaft Sprocket Screw . . . . .	50	45-55	68	61-75
Carburetor Hold-Down Nuts . . . . .	14	12-20	19	16-27
Coil Bracket-to-Cylinder Head . . . . .	14	10-18	19	14-24
Connecting Rod Bolt Nuts . . . . .	33	30-35	45	41-47
Cylinder Head Capscrews . . . . .	105	95-115	142	129-156
Cylinder Head Cover Screws . . . . .	50 in-lbs.	42-58 in-lbs.	6	5-7
Crankshaft Pulley-to-Damper . . . . .	20	15-25	27	20-34
Clutch Housing Spacer to Block Screws . . . . .	12	9-15	16	12-20
Clutch Housing-to-Block Screws (top) . . . . .	27	22-30	37	30-41
Clutch Housing-to-Block Screws (bottom) . . . . .	43	37-47	58	50-64
Distributor Clamp Bracket Screw . . . . .	13	10-18	18	14-24
EGR Valve . . . . .	13	9-18	18	12-24
Exhaust Manifold Bolts . . . . .	23	18-28	31	24-38
Exhaust Pipe-to-Manifold . . . . .	20	15-25	27	20-34
Fan and Hub Assembly Bolts . . . . .	18	12-25	24	16-34

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**Torque Specifications (Continued)**

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Drive Plate-to-Converter Screw . . . . .	22	20-25	30	27-34
Flywheel or Drive Plate-to-Crankshaft . . . . .	105	95-120	142	129-163
Front Support Bracket-to-Block Screw . . . . .	35	25-40	47	34-54
Front Support Cushion-to-Bracket . . . . .	33	27-38	45	36-52
Front Support Cushion-to-Bracket-to-Frame . . . . .	37	30-45	50	41-61
Fuel Pump Screws . . . . .	16	13-19	22	18-26
Idle Arm Bracket-to-Sill . . . . .	50	35-60	68	47-81
Idle Pulley Bracket-to-Front Cover Nut . . . . .	7	4-9	9	5-12
Idle Pulley Bearing Shaft-to-Bracket Nut . . . . .	33	28-38	45	38-52
Intake Manifold Screws . . . . .	23	18-28	31	24-38
Main Bearing Capscrews . . . . .	80	75-85	108	102-115
Oil Filter Adapter . . . . .	48	42-55	65	57-75
Oil Pump Cover Screws . . . . .	70 in-lbs.	60-80 in-lbs.	8	7-9
Oil Pump Attaching Screws (Short) . . . . .	10	8-13	14	11-18
Oil Pump Attaching Screws (Long) . . . . .	17	12-20	23	16-27
Oil Pan Screws—1/4 inch—20 . . . . .	7	5-9	9	7-12
Oil Pan Screws—5/16 inch—18 . . . . .	11	9-13	15	12-18
Power Steering Pump Adapter Screw . . . . .	23	18-28	31	24-38
Power Steering Pump Bracket Screw . . . . .	43	37-47	58	50-64
Power Steering Pump Mounting Screw . . . . .	28	25-35	38	34-47
Power Steering Pump Pressure Line Nut . . . . .	38	30-45	52	41-61
Power Steering Pump Pulley Nut . . . . .	58	40-65	79	54-88
Rear Crossmember-to-Side Sill Nut . . . . .	30	20-35	41	27-47
Rear Support Cushion-to-Bracket . . . . .	43	40-55	65	54-75
Rear Support Bracket-to-Transmission . . . . .	33	27-38	45	37-52
Rear Support Cushion-to-Crossmember . . . . .	18	12-25	24	16-34
Rocker Arm Assembly-to-Cylinder Head . . . . .	19	16-26	26	22-35
Spark Plug . . . . .	28	22-33	38	30-45
Timing Case Cover-to-Block Screws . . . . .	5	4-8	7	5-11
Timing Case Cover-to-Block Studs . . . . .	16	13-19	22	18-26
Thermostat Housing Screw . . . . .	13	10-18	18	14-24
Vibration Damper Screw, Lubricated . . . . .	80	70-90	108	95-122
Water Pump Screws . . . . .	13	9-18	18	12-24

All Torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

60264B

# EIGHT-CYLINDER ENGINE

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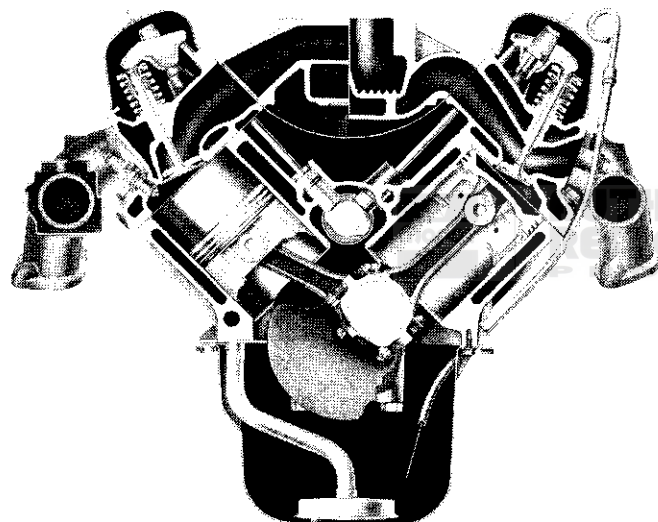
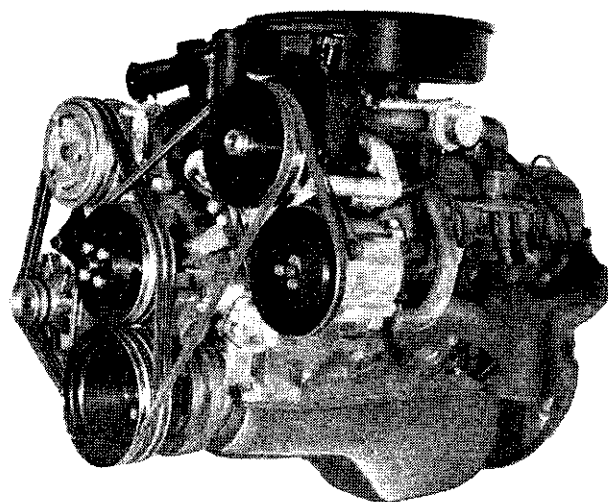
**GENERAL**

The 304 (5 liter) and 360 (6 liter) CID engines are 90-degree V-8 designs incorporating overhead valves (fig. 1B-58 and 1B-59). 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 cylinder firing order is 1-8-4-3-6-5-7-2.

The crankshaft, supported by five two-piece main bearings, rotates in a counterclockwise direction as viewed from the rear. The camshaft is supported by five one-piece, line-bored bearings.

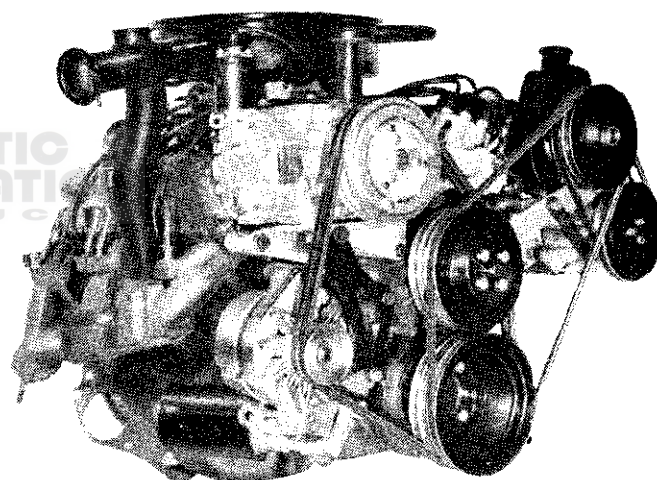
Bridged pivot assemblies control movement of intake and exhaust rocker arms and are paired by cylinders.

Due to the similarity of these engines, service procedures have been consolidated and typical illustrations are used.



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Fig. 1B-58 Sectional View of Eight-Cylinder Engine Assembly



60487

Fig. 1B-59 Typical Eight-Cylinder Engine Assembly

**Identification**

The cubic-inch displacement numbers are cast into both sides of the cylinder block. These numbers are located between the engine mounting bracket bosses.

**Build Date Code**

The engine Build Date Code is located on a tag attached to the right bank cylinder head cover (fig. 1B-60).

The code numbers identify the year, month, and day that the engine was built. The code letter identifies the cubic inch displacement, carburetor type and compression ratio.

The example code identifies a 304 CID (5 liter) with 2V carburetor and 8.4:1 compression ratio built on May 15, 1979.

**Engine Build Date Code**

Letter Code	CID	Carburetor	Compression Ratio
H	304	2V	8.4:1
N	360	2V	8.25:1

1st Character (Year)	2nd and 3rd Characters (Month)	4th Character (Engine Type)	5th and 6th Characters (Day)
2 - 1978 3 - 1979	01 - 12	H or N	01 - 31

EXAMPLE: 3 05 H 15

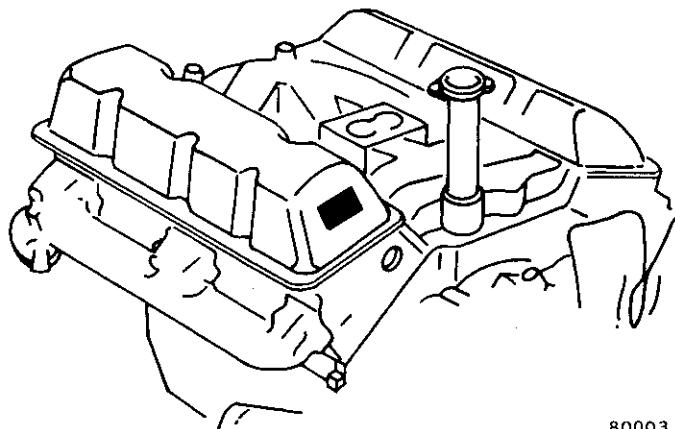


Fig. 1B-60 Engine Build Date Location

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**Oversize or Undersize Components**

It is sometimes necessary to machine all cylinder bores to 0.010-inch (0.254 mm) oversize, all crankshaft main bearing journals, all connecting rod journals to 0.010-inch (0.254 mm) undersize, or all camshaft bearing bores 0.010-inch (0.254 mm) oversize. These engines have a single or double letter code stamped adjacent to the Build Date Code on the tag attached to the right bank cylinder head cover. The letters are coded as follows:

**Oversize or Undersize Components**

Single Letter B	cylinder bore 0.010-inch (.254mm) oversize
Single Letter M	main bearings 0.010-inch (.254mm) undersize
Single Letter F	connecting rod bearings 0.010-inch (.254mm) undersize
Double Letters PM	main and connecting rod bearings 0.010-inch (.254mm) undersize
Single Letter C	camshaft bearing bores 0.010-inch (.254mm) oversize

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**SHORT ENGINE ASSEMBLY (SHORT BLOCK)**

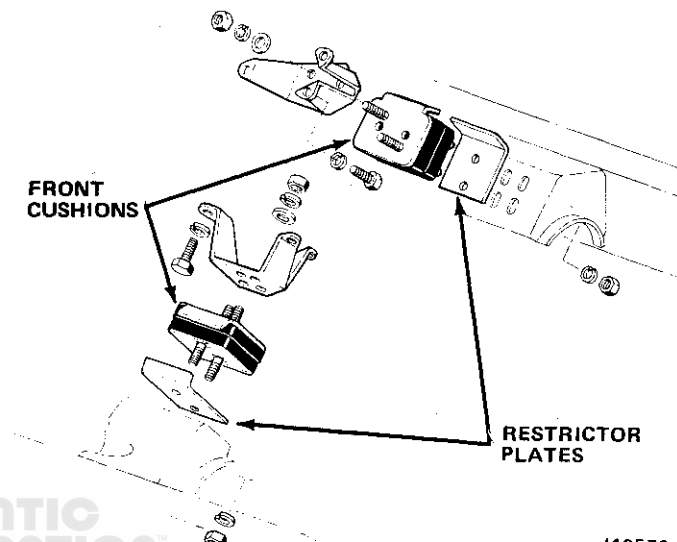
A service replacement short engine assembly may be installed whenever the original engine block is damaged beyond repair. The short engine assembly consists of engine block, piston and rod assemblies, crankshaft, camshaft, timing gears and chain. When installing a short engine assembly, always install a replacement engine oil pump pickup tube and screen assembly.

**NOTE:** Short engine assemblies include a replacement engine build date tag. Remove previous tag and attach replacement tag to right cylinder head cover.

Installation includes transfer of component parts from the worn or damaged original engine. Follow the appropriate procedures for cleaning, inspection and torque tightening as outlined in this chapter.

**ENGINE MOUNTING**

Resilient rubber mounting cushions support the engine and transmission at three points. A cushion is located at each side on the centerline of the engine. The rear is supported by a cushion between the transmission extension housing and the rear support crossmember (fig. 1B-61).



J42579

Fig. 1B-61 Typical Engine Mounting

Removal or replacement of any cushion may be accomplished by supporting the weight of the engine or transmission in the area of the cushion.

**ENGINE HOLDING FIXTURE**

If necessary to remove the front engine mounts to perform service such as oil pan removal, fabricate an engine holding fixture as illustrated in figure 1B-62.

**ENGINE REMOVAL**

The engine is removed without the transmission and bellhousing.

- (1) On Cherokee, Wagoneer and Truck models, mark hood hinge locations at hood panel for alignment during installation. Remove hood from hinges. On CJ models, hood will tilt far enough rearward for access to engine.
- (2) Remove air cleaner assembly.
- (3) Drain cooling system and disconnect upper and lower radiator hoses. Disconnect heater hoses.
- (4) If equipped with automatic transmission, disconnect cooler lines from radiator and engine assembly.

**NOTE:** If vehicle is equipped with a radiator shroud, separate the shroud from the radiator to facilitate removal and installation of the radiator and engine fan.

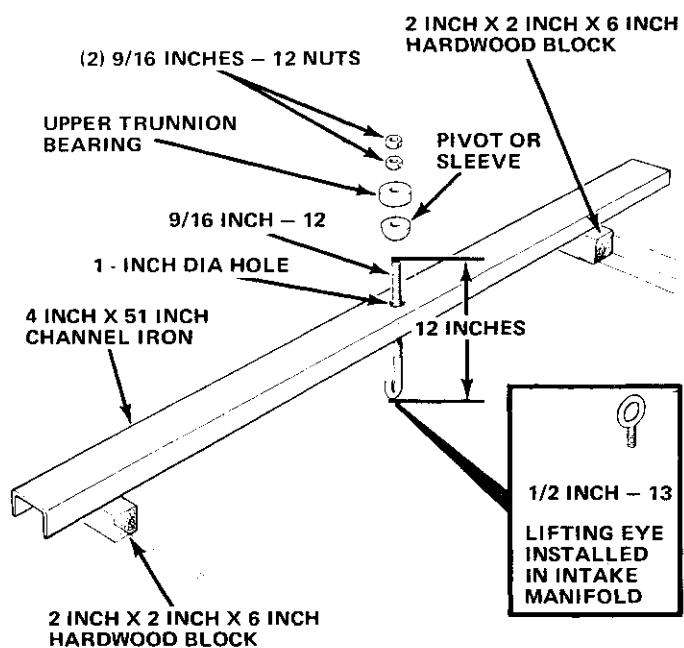


Fig. 1B-62 Engine Holding Fixture

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- (5) Remove radiator.
- (6) Remove radiator fan. If equipped with power steering, remove fluid from pump reservoir and disconnect hoses.
- (7) If equipped with air conditioning, turn both service valves clockwise to the front-seated position. Bleed compressor refrigerant charge by slowly loosening service valve fittings. Remove service valves from compressor.
- (8) Remove Cruise Command vacuum servo bellows and mounting bracket as an assembly, if equipped.
- (9) On Cherokee, Wagoneer and Truck models, remove battery. On CJ models, disconnect negative battery cable.
- (10) Disconnect wire harness from engine and move aside.
- (11) Disconnect following lines, if equipped:
  - Fuel supply and return lines at chassis tubing
  - Vacuum line at power brake unit
  - Vacuum line for heater damper doors at intake manifold
- (12) If equipped with automatic transmission, disconnect transmission filler tube bracket from right cylinder head. Do not remove filler tube from the transmission.
- (13) Remove both engine front support cushion-to-frame retaining nuts.
- (14) Support weight of engine with lifting device.
- (15) On CJ models, remove left front support cushion and bracket from cylinder block.
- (16) On CJ models equipped with manual transmission, remove transfer case shift lever boot, floormat if equipped, and transmission access cover.

(17) On vehicles equipped with automatic transmission, remove upper screws securing transmission bellhousing to engine.

If equipped with manual transmission, remove upper screws securing clutch housing to engine.

(18) Disconnect exhaust pipes at exhaust manifolds and support bracket.

(19) Remove starter motor.

(20) Support transmission with floor jack.

(21) If equipped with automatic transmission, remove engine adapter plate inspection cover. Mark assembled position of converter and flex plate and remove the converter-to-flex plate capscrews.

(22) Remove remaining screws securing transmission bellhousing to engine.

If equipped with manual transmission, remove clutch housing lower cover and remaining screws securing clutch housing to engine.

(23) Remove engine by lifting upward and forward.

**CAUTION:** If equipped with power brakes, be careful to avoid damaging the power unit while removing the engine.

## ENGINE INSTALLATION

(1) Lower engine slowly into engine compartment and align with transmission housing. On manual transmissions, be sure clutch shaft is aligned properly with splines of clutch driven plate.

(2) Install transmission housing screws. Tighten screws to specified torque (automatic transmission: 28 foot-pounds (38 N•m), manual transmission: 27 foot-pounds 37 N•m).

(3) Remove floor jack which was used to support transmission.

(4) If equipped with automatic transmission, align marks previously made on converter and flex plate, install converter-to-flex plate capscrews and tighten to specified torque.

(5) Install inspection cover (automatic transmission) or the clutch housing lower cover (manual transmission).

(6) Install starter motor.

(7) On CJ models, install left front support cushion and bracket to cylinder block. Tighten screws to 28 foot-pounds (38 N•m) torque.

(8) Lower engine onto supports. Remove lifting device.

(9) Install front support cushion retaining nuts. Tighten nuts to 33 foot-pounds (45 N•m) torque.

(10) Connect exhaust pipes at exhaust manifolds and support bracket.

(11) If equipped with automatic transmission, connect transmission filler tube bracket to right cylinder head.

(12) Install battery, if removed.

(13) Install Cruise Command vacuum servo bellows and mounting bracket, if removed.

(14) Connect all wires, lines, linkage and hoses to engine.

(15) Install air conditioning condenser and receiver assembly, if removed.

(16) Connect receiver outlet to disconnect coupling. Connect condenser and evaporator lines to compressor.

(17) Purge compressor of air.

**CAUTION:** Both service valves must be open before the air conditioning system is operated.

(18) If equipped with power steering, connect hoses and fill pump reservoir to specified level.

(19) Install radiator fan and tighten retaining screws to 18 foot-pounds (24 N•m) torque.

(20) Install radiator and connect upper and lower hoses. If equipped with automatic transmission, connect cooler lines.

(21) Fill cooling system to specified level.

(22) Install air cleaner assembly.

(23) Start engine. Check all connections for leaks.

Stop engine.

(24) If removed, install and align hood assembly.

(25) If removed, install transmission access cover, floor mat and transfer case shift lever boot.

## VALVE TRAIN

### General

All eight-cylinder engines have overhead valves operated by push rods and rocker arms. A chain-driven camshaft is mounted in the cylinder block. Hydraulic valve tappets provide automatic valve lash adjustment.

### Rocker Arm Assembly

The intake and exhaust rocker arms of each cylinder pivot on a bridged pivot assembly which is secured to the cylinder head by two capscrews as shown in figure 1B-63. The bridged pivot maintains correct rocker arm-to-valve tip alignment. Each rocker arm is actuated by a hollow steel push rod with a hardened steel ball at each end. The hollow push rods channel oil to the rocker arm assemblies.

### Removal

(1) Remove cylinder head cover.

(2) Remove two capscrews at each bridged pivot. Alternately loosen capscrews one turn at a time to avoid damaging bridge.

(3) Remove bridged pivots and corresponding pairs of rocker arms and place on bench in same order as removed.

(4) Remove rocker arms and place on bench in same order as removed.

(5) Remove push rods and place on bench in same order as removed.

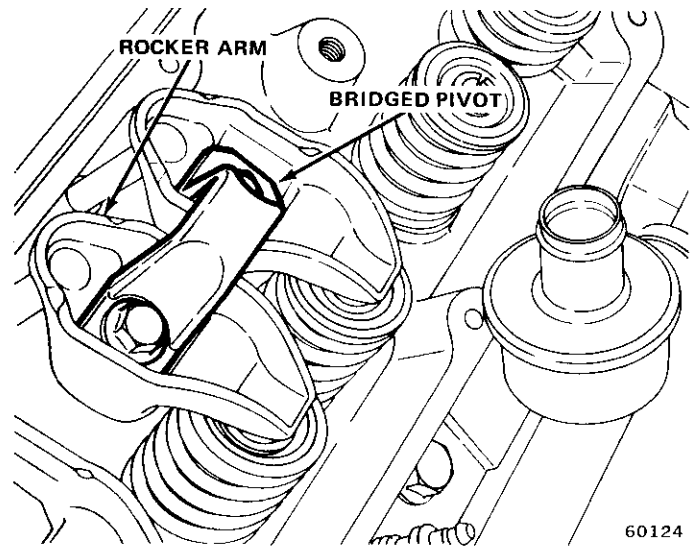


Fig. 1B-63 Rocker Arm Assembly

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### Cleaning and Inspection

Clean all parts with a good cleaning solvent. Use compressed air to clean out the oil passages in the rocker arms and push rods.

Inspect the pivot surface of each rocker and pivot assembly. Replace parts which are scuffed, pitted or excessively worn. Inspect the valve stem contact surface of each rocker arm and replace if deeply pitted. Inspect each push rod end for scuffing or excessive wear. **If any push rod is excessively worn from lack of oil, replace the push rod as well as the corresponding hydraulic valve tappet and rocker arm.**

It is not normal to find a pattern along the length of the push rod. Check the cylinder head for obstruction if this condition exists.

### Installation

(1) Install push rods. **Be sure bottom end of each rod is centered in plunger cap of hydraulic valve tappet.**

(2) Install bridged pivot and pair of rocker arms to cylinder from which they were removed.

(3) Loosely install two capscrews to each bridged pivot. Tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten to 19 foot-pounds (26 N•m) torque.

(4) Reseal and install cylinder head cover.

(5) Install retaining screws and washers. Tighten screws to 50 inch-pounds (6 N•m) torque.

### Valves

The following procedures apply only after the cylinder head has been removed from the engine. If head has not been removed, refer to Cylinder Head for removal procedures.

**Removal**

- (1) Compress each valve spring with C-clamp type spring compressor tool. Remove valve locks and retainers.
- (2) Release compressor and remove valve spring.
- (3) Remove valve stem oil deflectors.
- (4) Remove valves one at a time and place in rack in same order as in cylinder head.

**Cleaning and Inspection**

Clean all carbon buildup from the combustion chambers, valve ports, valve stems and heads.  
 Remove all dirt and gasket cement from the cylinder head gasket mating surface.  
 Inspect for cracks in the combustion chambers and valve ports and in the gasket surface at each coolant passage.  
 Inspect for burned or cracked valve heads and scuffed valve stems. Replace any valve which is bent, warped or scuffed.

**Valve Refacing**

Use a valve refacing machine to reface intake and exhaust valves to specified angle. After refacing, at least 1/32-inch (0.787 mm) margin must remain. If not, replace the valve. Examples of correct and incorrect valve refacing are shown in figure 1B-65.

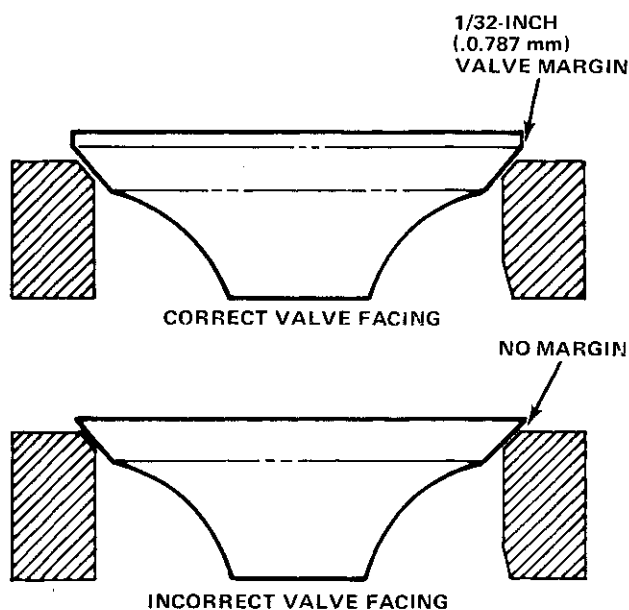


Fig. 1B-65 Valve Refacing

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Resurface and re chamfer the valve stem tip when worn. **Never remove more than 0.020 inch (0.508 mm).**

**Valve Seat Refacing**

Install a pilot of the correct size in the valve guide and reface the valve seat to the specified angle with a good dressing stone. Remove only enough metal to provide a smooth finish. This is especially important on exhaust valve seats. The seat hardness varies in depth. Use tapered stones to obtain the specified seat widths when required. Maximum seat runout is 0.0025 inch (0.064 mm) (fig. 1B-65).

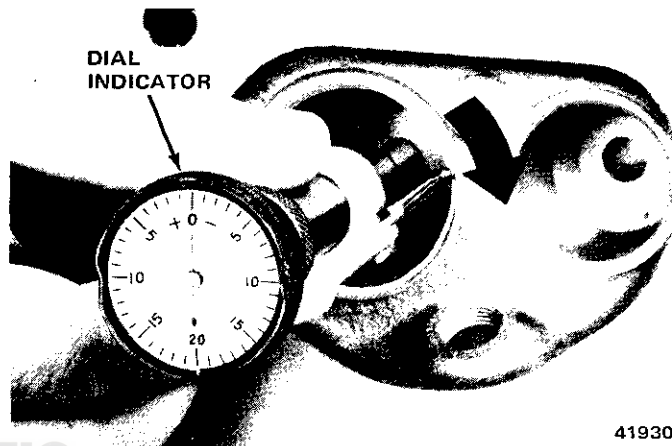


Fig. 1B-65 Valve Seat Runout

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**Valve Stem Oil Deflector Replacement**

Nylon valve stem oil deflectors are installed on each valve stem to prevent the rocker arm lubrication oil from entering the combustion chamber through the valve guides. Replace oil deflectors whenever valve service is performed or if the deflectors are deteriorated.  
 Oil deflector replacement requires removal of valve springs. Refer to Valve Springs for procedure.

**Valve Guides**

The valve guides are an integral part of the cylinder head and are not replaceable. When the stem-to-guide clearance is excessive, ream the valve guides to the next larger size. Service valves are available in 0.003-inch, 0.015-inch and 0.030-inch oversize.

The following oversize valve guide reamers may be used:

**Valve Guide Reamer Sizes**

Reamer Tool Number	Size
J-6042-1	0.003-inch
J-6042-5	0.015-inch
J-6042-4	0.030-inch

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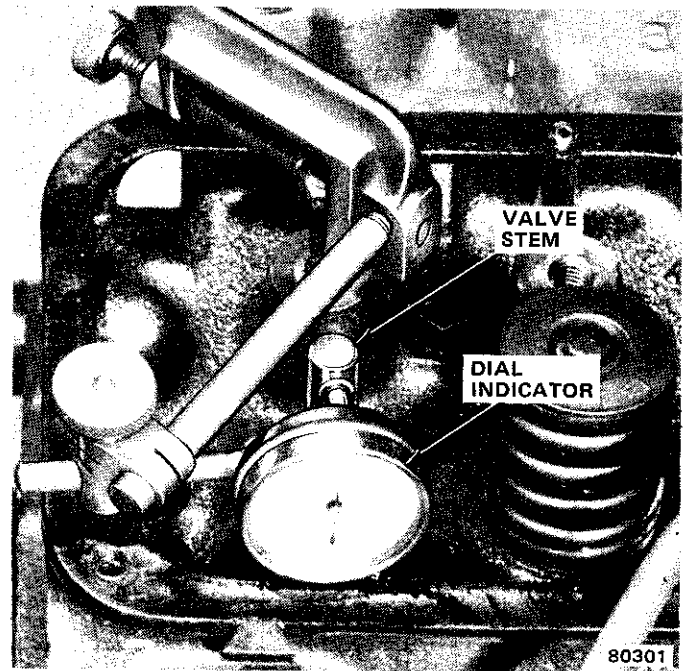
**NOTE:** Ream guides in steps. Start with the 0.003-inch oversize reamer and progress to the size required.

**Valve Stem-to-Guide Clearance**

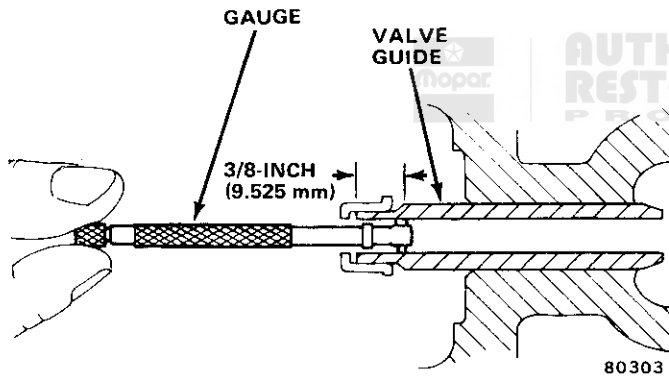
Valve stem-to-guide clearance can be checked by two methods:

**Preferred Method**

- (1) Remove valve from head and clean valve guide with solvent and bristle brush.
- (2) Insert telescoping gauge into valve guide approximately 3/8 inch (9.525 mm) from valve spring side of head (fig. 1B-66) with contacts crosswise to head. Measure telescoping gauge with micrometer.
- (3) Repeat measurement with contacts lengthwise to cylinder head.
- (4) Compare lengthwise to crosswise readings to determine out-of-roundness. If measurements differ by more than 0.0025 inch (0.0635 mm), ream guide to accommodate oversize valve.
- (5) Compare valve guide diameter with diameter listed in Specifications. If measurements differ by more than 0.003 inch (0.076 mm), ream guide to accommodate oversize valve.



**Fig. 1B-67 Valve Stem-to-Guide Clearance Measurement with Dial Indicator**



**Fig. 1B-66 Measuring Valve Guide with Telescope Gauge**

**Alternate Method**

Use a dial indicator to measure the lateral movement of the valve stem with the valve installed in its guide and just off the valve seat (fig. 1B-67). Correct clearance is 0.001 to 0.003 inch (0.025 mm to 0.076 mm).

**Installation**

- (1) Thoroughly clean valve stems and valve guide bores.
- (2) Lightly lubricate stem and install valve in same valve guide from which it was removed.
- (3) Install replacement valve stem oil deflector on valve stem.
- (4) Position valve spring and retainer on cylinder head and compress valve spring with compressor tool. Install valve locks and release tool.
- (5) Tap valve spring from side to side with light hammer to seat spring properly at cylinder head.

**Valve Springs**

Valve springs and oil deflectors can be removed without removing the cylinder head. Refer to Valves for removal procedure with the cylinder head removed.

**Valve Spring and Oil Deflector Removal**

The valve spring is held in place on the valve stem by a retainer and a set of valve locks. The locks can be removed only by compressing the valve spring.

- (1) Remove cylinder head cover.
- (2) Remove rocker arm assemblies from valves requiring valve spring or oil deflector removal. Remove two capscrews at each bridged pivot. Alternately loosen capscrews one turn at a time to avoid damaging bridge.
- (3) Remove push rods.

**NOTE:** *Keep rocker arms, bridged pivots and push rods in the same order as removed.*

- (4) Remove spark plug from cylinder which requires valve spring or oil deflector removal.
- (5) Install 14mm (thread size) air adapter in spark plug hole.

**NOTE:** *An adapter can be made by welding an air hose connection to the body of a spark plug from which the porcelain has been removed.*

- (6) Connect air hose to adapter and maintain at least 90 psi (620 kPa) in cylinder to hold valves against their seats.
- (7) Use Valve Spring Remover and Installer Tools J-22534-1, J-22534-4, and J-22534-5 to compress valve spring. Remove valve locks (fig. 1B-68).

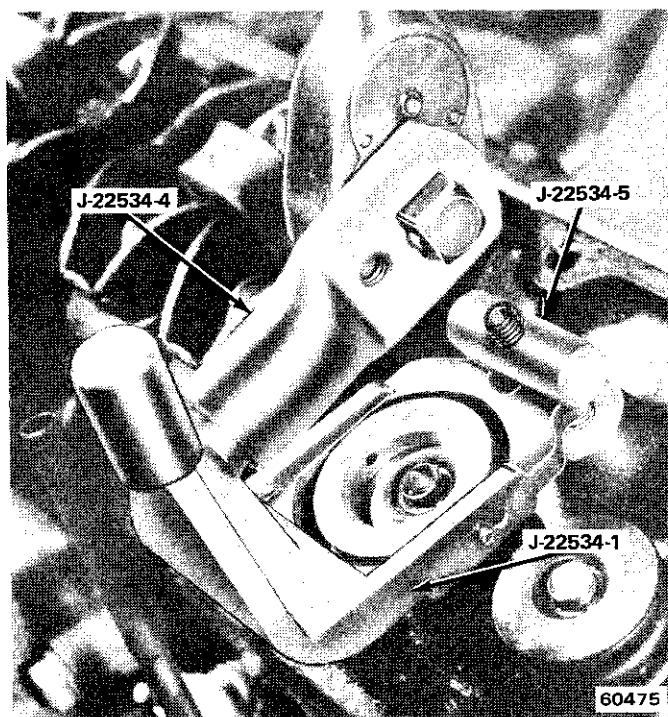


Fig. 1B-68 Valve Spring Removal

- (8) Remove valve spring and retainer from cylinder head.
- (9) Remove oil deflector.

**Valve Spring Tension Test**

Use Valve Spring Tester J-8056 to test each valve spring for the specified tension values (fig. 1B-69). Replace springs which are not within specifications. Replace springs that bind due to warpage.

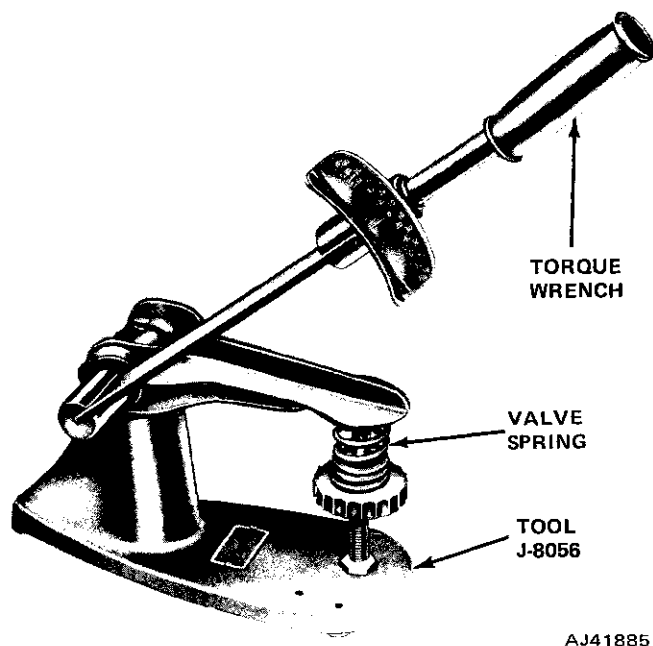


Fig. 1B-69 Valve Spring Tester

**Installation**

(1) Use 7/16-inch deep socket and hammer to gently tap valve stem oil deflector onto valve stem.

**NOTE:** A close-coil valve spring is used on all valves. The close-coil end must face the cylinder head when installing the springs.

- (2) Install valve spring and retainer.
- (3) Compress valve spring with Valve Spring Remover and Installer Tools J-22534-1, J-22534-4 and J-22534-5. Insert valve locks. Release spring tension and remove tool.
- (4) Tap valve spring from side to side with light hammer to be certain spring is seated properly at cylinder head.
- (5) Disconnect air hose, remove air adapter from spark plug hole and install spark plug.
- (6) Install push rods, making certain bottom end of each rod is centered in plunger cap of hydraulic valve tappet.
- (7) Install rocker arms and bridged pivot. At each bridged pivot, tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten capscrews to 19 foot-pounds (25 N•m) torque.
- (8) Reseal and install cylinder head cover.
- (9) Install retaining screws and washers. Tighten screws to 50 inch-pounds (6 N•m) torque.

**Camshaft and Bearings**

**General**

The 304 CID (5 liter) engine uses the same camshaft as the 360 CID (6 liter) engine. The camshaft is supported by five steel-shelled, babbitt-lined bearings pressed into the block and line reamed. The step bored camshaft journals are larger at the front bearing than at the rear to permit easy removal and installation of the camshaft. All camshaft bearings are lubricated under pressure.

**NOTE:** Do not replace camshaft bearings unless special removal and installation tools are available.

Camshaft end play is maintained by the load placed on the camshaft by the oil pump and distributor drive gear. The helical cut of the gear holds the camshaft sprocket thrust face against the cylinder block face to hold camshaft end play to zero during engine operation. The rear camshaft bearing journal has two holes drilled through it to relieve pressure that could develop between the journal and camshaft plug and force the camshaft forward.

**Cam Lobe Lift Measurement**

- (1) Remove cylinder head cover and gasket.
- (2) Remove rocker arms and bridged pivot assemblies. Alternately loosen capscrews one turn at a time to avoid damaging bridge.



- (3) Remove spark plugs.
- (4) Use piece of rubber tubing to secure dial indicator on end of push rod (fig. 1B-70).

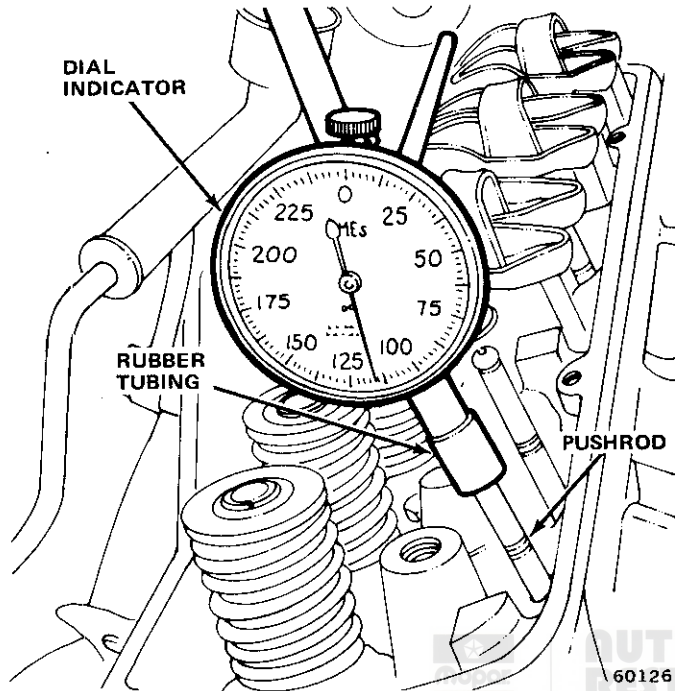


Fig. 1B-70 Cam Lobe Lift Measurement

- (5) Rotate crankshaft until cam lobe base circle (push rod down) is under valve tappet.
- (6) Set dial indicator to zero.
- (7) Rotate crankshaft until point of maximum push rod upward movement occurs.
- (8) Read travel at dial indicator. Correct lift is 0.260 to 0.270 inch (6.604 mm to 6.858 mm) for 304 (5 liter) and 360 (6 liter) CID engines.

**NOTE:** Rocker arm ratio is 1.6:1. Multiply cam lift by 1.6 to determine valve lift.

#### Valve Timing

- (1) Remove spark plugs.
- (2) Remove cylinder head covers and gaskets.
- (3) Remove rocker arms and bridged pivot assemblies from No. 1 cylinder.
- (4) Rotate crankshaft until No. 6 piston is at top dead center (TDC) on compression stroke. This places No. 1 piston at TDC on exhaust stroke in valve overlap position.
- (5) Rotate crankshaft counterclockwise 90° as viewed from front.
- (6) Install dial indicator on No. 1 intake valve push rod end.
- (7) Set dial indicator to zero.

(8) Crank engine slowly in direction of normal rotation (clockwise viewed from front) until dial indicator indicates 0.020 inch (0.508 mm).

(9) This should place milled timing mark on vibration damper in line with TDC marking on timing case cover. If more than 1/2-inch (13 mm) variation exists in either direction, remove timing case cover and inspect timing chain installation.

Check for incorrect camshaft sprocket indexing. The sprocket keyway should align with the centerline of the first lobe of the camshaft.

#### Camshaft Removal

- (1) Drain radiator and cylinder block.
- (2) Remove radiator assembly.
- (3) If equipped with air conditioning, remove condenser and receiver assembly as charged unit.
- (4) Remove cylinder head covers and gaskets.
- (5) Remove rocker arms and bridged pivot assemblies. Remove two capscrews from each bridged pivot. Alternately loosen capscrews one turn at a time to avoid damaging bridge.
- (6) Remove push rods.

**NOTE:** Keep push rods, rocker arm assemblies and tappets in the same order as removed.

- (7) Remove intake manifold assembly.
- (8) Remove drive belts.
- (9) Remove fan and hub assembly.
- (10) Remove distributor.
- (11) Remove damper pulley and vibration damper.
- (12) Remove timing case cover.
- (13) Install crankshaft screw with two or more flat washers to provide means of rotating crankshaft.
- (14) Rotate crankshaft until timing mark on crankshaft sprocket is closest to and on centerline with timing mark on camshaft sprocket. Refer to Figure 1B-80.
- (15) Remove retaining screw from camshaft. Remove retaining screw from crankshaft.
- (16) Remove distributor drive gear and fuel pump eccentric from the camshaft (fig. 1B-71).
- (17) Remove crankshaft sprocket, camshaft sprocket and timing chain as assembly.
- (18) Remove hood latch support bracket, front bumper or grille as required and remove camshaft.

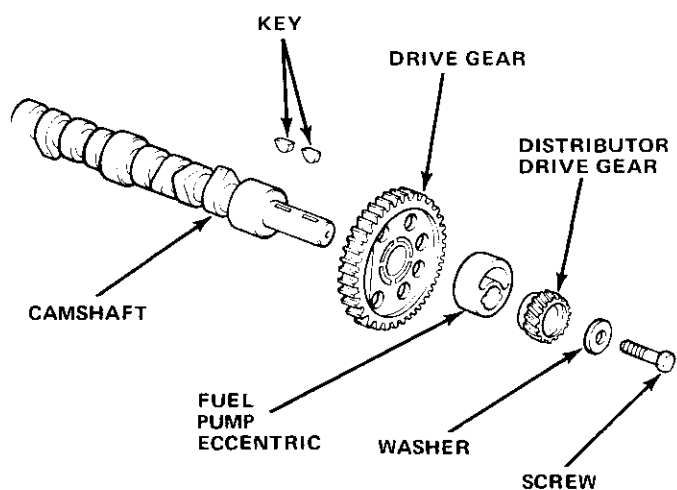
#### Camshaft Inspection

Inspect the camshaft bearing journals for an uneven wear pattern or rough finish. Replace camshaft if either condition exists.

Inspect the distributor drive gear for damage or excessive wear.

Inspect fuel pump eccentric for excessive wear.

Inspect each cam lobe and the matching hydraulic valve tappet for wear. If the face of the tappet(s) is worn concave and the matching camshaft lobe(s) is also worn, replace both camshaft and tappet(s).



70451

Fig. 1B-71 Camshaft Drive Gear

### Camshaft Installation

- (1) Lubricate entire camshaft generously with Jeep Engine Oil Supplement (EOS), or equivalent.
- (2) Carefully install camshaft into engine block.
- (3) Assemble timing chain, crankshaft sprocket and camshaft sprocket with timing marks aligned. Refer to Timing Chain Installation.
- (4) Install oil slinger on crankshaft.
- (5) Install fuel pump eccentric and distributor drive gear to camshaft (fig. 1B-72). Tighten retaining screw to 30 foot-pounds (41 N•m) torque.

**NOTE:** The fuel pump eccentric has the word "REAR" stamped on it to indicate proper installed position. The camshaft screw washer fits into a recess in the distributor drive gear.

- (6) Install replacement timing case cover gasket.
- (7) Install timing case cover.
- (8) Install replacement oil seal. Apply light film of engine oil to lips of seal.
- (9) Install vibration damper.
- (10) Install damper pulley and retaining screws. Tighten screws to 30 foot-pounds (41 N•m) torque.
- (11) Install hydraulic valve tappets lubricated with Jeep Engine Oil Supplement, or equivalent.

**NOTE:** Do not drain the EOS from the engine for at least 1,000 miles (1 609 km) or until the next scheduled oil change.

- (12) Install intake manifold assembly.
- (13) Install push rods.
- (14) Install rocker arms and bridged pivot assemblies. At each bridged pivot, tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten capscrews to 19 foot-pounds (26 N•m) torque.
- (15) Reseal and install cylinder head covers.
- (16) Install fuel pump.

- (17) Rotate crankshaft until No. 1 piston is at TDC position on compression stroke.

**NOTE:** After No. 1 intake valve has closed, TDC can be reached by rotating the crank clockwise as viewed from the front until the timing mark on the damper aligns with TDC on the timing case cover.

- (18) Install distributor so that rotor is aligned with No. 1 terminal of cap when fully seated on block.
- (19) Install distributor cap.
- (20) Install ignition wires.
- (21) If removed, install air conditioning condenser and receiver assembly.

**CAUTION:** Both service valves must be open before the air conditioning system is operated.

- (22) Install hood latch support bracket, front bumper or grille, if removed.
- (23) Install radiator.
- (24) Fill cooling system to specified level.
- (25) Install and tighten drive belts to proper tension. Refer to Chapter 1C.

### Hydraulic Valve Tappets

The hydraulic valve tappet consists of a tappet body, plunger, plunger return spring, check valve assembly, metering disc, plunger cap and lockring (fig. 1B-72).

The tappet operates in a guide bore which has an oil passage drilled into the adjoining oil gallery.

The operating mode of the hydraulic tappet begins when the tappet is on the heel of the cam lobe (engine valve closed). A groove in the tappet body aligns with the tappet oil gallery, admitting pressurized oil into the tappet (fig. 1B-73). A hole and groove arrangement admits the oil to the inside of the plunger. Oil is forced past the plunger check valve and fills the chamber between the plunger and tappet body. When the chamber is full, additional oil in the plunger body unseats the metering disc, and a spurt of oil flows up the pushrod to lubricate the rocker assembly. These events all take place while the tappet is on the heel of the cam lobe. As the cam turns, the lobe begins exerting force on the tappet body. This force is transmitted by the trapped oil in the tappet chamber to the plunger and finally to the pushrod and rocker assembly. The engine valve opens. While the valve is open, the trapped oil is subjected to considerable pressure and some of it escapes between the plunger and the tappet body (leak-down). The cycle is completed as the cam lobe rotates back to the starting position and another charging cycle begins. In this way, zero valve lash is maintained.

### Removal

- (1) Remove cylinder head cover.
- (2) Remove rocker arms and bridged pivot assemblies. Remove two capscrews at each bridged pivot. Alternately loosen capscrews one turn at a time to avoid damaging bridge.

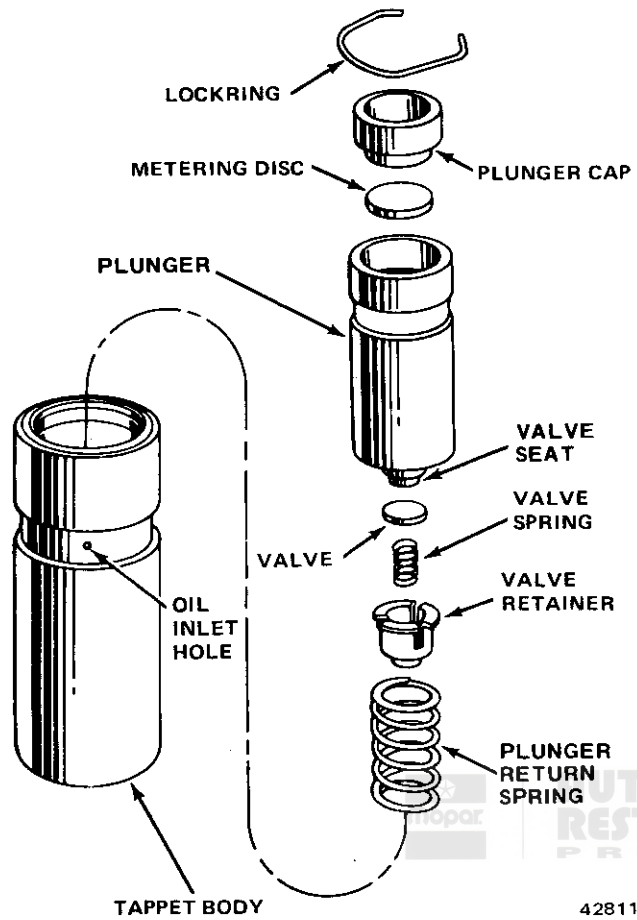


Fig. 1B-72 Hydraulic Tappet Assembly

42811

(3) Remove push rods.

**NOTE:** Keep rocker arm assemblies and push rods in the same order as removed.

(4) Remove intake manifold.

(5) Remove tappet from guide bore in engine block.

**Cleaning and Inspection**

(1) Release lockring.

(2) Remove plunger cap, metering disc, plunger assembly and plunger return spring from tappet body.

**NOTE:** Keep the tappets and all components in the same order as removed.

(3) Clean all components of the hydraulic tappet assembly in cleaning solvent to remove all varnish or gum deposits.

(4) Visually inspect each tappet assembly for signs of scuffing on barrel and face of tappet. Inspect tappet face for wear using straightedge across tappet face. If tappet face is concave, corresponding lobe on camshaft is worn, requiring replacement of camshaft and tappets.

(5) Replace entire assembly if any component shows evidence of wear or damage.

(6) Install plunger return spring, plunger, metering disc and plunger cap in tappet body.

(7) Use push rod on plunger cap to compress plunger assembly and install lockring.

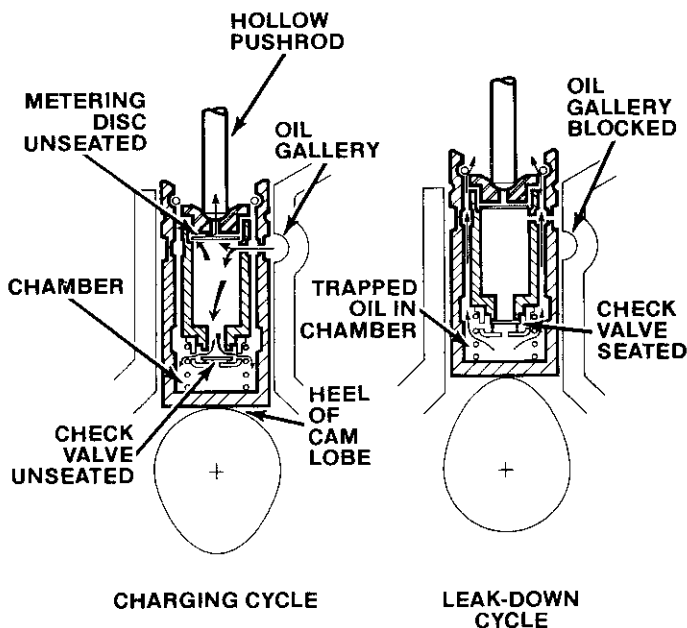


Fig. 1B-73 Hydraulic Tappet Operation

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**Hydraulic Tappet Leak-Down Test**

After cleaning and inspection, use Tester J-5790 to test tappets for leak-down to ensure zero-lash operating ability (fig. 1B-74).

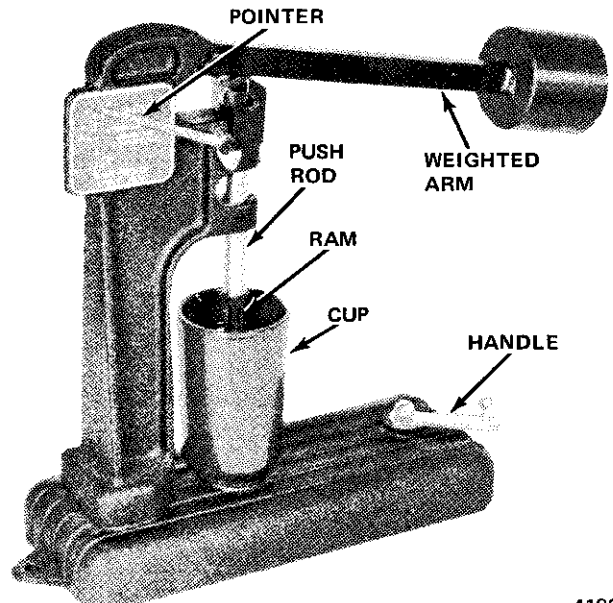


Fig. 1B-74 Hydraulic Tappet Leak-Down Tester J-5790

41891

- (1) Swing weighted arm of tester away from ram of tester.
- (2) Place 0.312 to 0.313 (7.92 mm to 7.95 mm) diameter ball bearing on plunger cap of tappet.
- (3) Lift ram and place tappet with ball bearing inside tester cup.
- (4) Lower ram, then adjust nose of ram until it contacts ball bearing.
- (5) Fill tester cup with valve tappet test oil J-5268 until tappet is completely covered.
- (6) Swing weighted arm onto ram and pump up and down on tappet to remove air. When air bubbles cease, swing weighted arm away and allow plunger to rise to normal position.
- (7) Adjust nose of ram to align pointer with SET mark on scale of tester and tighten hex nut.
- (8) Slowly swing weighted arm onto ram. Rotate cup by turning handle at base of tester clockwise one revolution every two seconds.
- (9) Time leak-down from instant pointer aligns with START mark on scale until pointer aligns with 0.125 mark.
- (10) Acceptable tappet will take 20 to 110 seconds to leak down. Replace tappets outside this range.

**NOTE:** Do not charge the tappet assemblies with engine oil as they will charge themselves within three to eight minutes of engine operation.

### Installation

- (1) Dip each tappet assembly in Jeep Engine Oil Supplement (EOS), or equivalent. Install tappet in same bore from which it was removed.
- (2) Install push rods in same order as removed.
- (3) Install rocker arm and bridged pivot assemblies. At each bridged pivot, tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten to 19 foot-pounds (26 N•m) torque.
- (4) Pour remaining EOS over entire valve train mechanism.

**NOTE:** Do not drain the EOS from the engine for at least 1,000 miles (1 609 km) or until the next scheduled oil change.

- (5) Reseal and install cylinder head cover. Tighten retaining screws to 5C inch-pounds (6 N•m) torque.
- (6) Install intake manifold using replacement gasket and end seals. Tighten manifold retaining screws to 43 foot-pounds (58 N•m) torque.
- (7) Install all lines, hoses, linkage and wires disconnected from intake manifold.

### Timing Case Cover

The timing case cover is die-cast aluminum with a crankshaft oil seal to prevent oil leakage at the vibration damper hub (fig. 1B-75). The oil seal may be installed from either side of the timing case cover. It is not neces-

sary to remove the cover whenever oil seal replacement is required.

A graduated scale cast in the cover is used for ignition timing. A hole is provided for checking ignition timing with a magnetic timing probe.

The engine oil pump, oil passages and coolant passages are incorporated within the timing case cover casting. The timing case cover casting is used to mount the fuel pump, distributor and water pump.

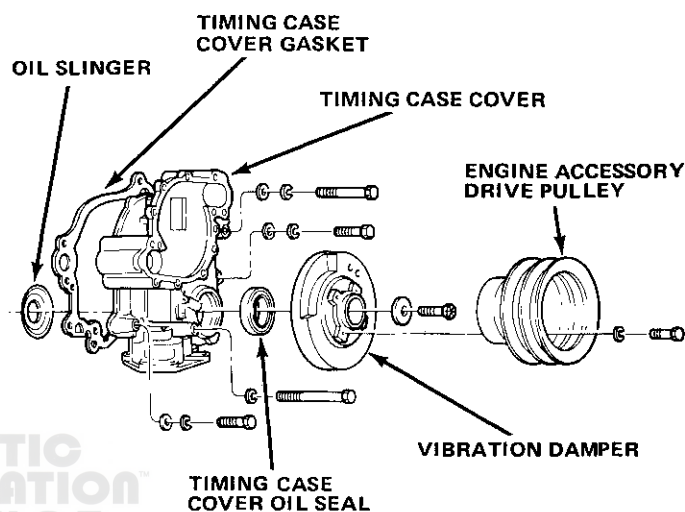


Fig. 1B-75 Timing Case Cover Assembly

41933

### Removal

- (1) Drain cooling system and cylinder block.
- (2) Disconnect radiator hoses and bypass hose.
- (3) Remove all drive belts.
- (4) Remove fan and hub assembly.
- (5) If equipped with air conditioning, remove compressor and bracket assembly from engine and move aside. Do not disconnect air conditioning hoses.
- (6) Remove alternator, alternator mounting bracket and back idler pulley.
- (7) Disconnect heater hose at water pump.
- (8) Remove power steering pump and bracket assembly, if equipped. Remove air pump and mounting bracket as assembly. Do not disconnect power steering hoses.
- (9) Remove distributor cap. Note rotor and housing position.
- (10) Remove distributor.
- (11) Remove fuel pump.
- (12) Remove vibration damper pulley and retaining screws.
- (13) Remove vibration damper using tool J-21791.
- (14) Remove two front oil pan screws.
- (15) Remove screws which secure timing case cover to engine block.

**NOTE:** The cover retaining screws are of various lengths and must be installed in the same location as removed.

- (16) Remove cover by pulling forward until free of locating dowel pins.
- (17) Clean gasket surface of cover.
- (18) Remove oil seal.

**NOTE:** Always replace the oil seal whenever the timing case cover is removed. Refer to Oil Seal Replacement.

**Installation**

- (1) Remove lower locating dowel pin from engine block.

**NOTE:** The dowel pin is required for correct cover alignment. Dowel must be installed after the cover is in position.

- (2) Use sharp knife or razor blade to cut both sides of oil pan gasket flush with engine block.

- (3) Apply Permatex No. 2, or equivalent, to both sides of replacement timing case cover gasket. Install gasket on timing case cover.

- (4) Install replacement front oil pan seal to bottom of timing case cover.

**NOTE:** There are two methods of sealing timing case cover to oil pan where oil pan gaskets were cut off. If replacement oil pan gaskets are used, perform step (5). If room temperature vulcanizing (RTV) silicone is used, perform step (6).

- (5) If oil pan gaskets are used:

- (a) Using original gasket pieces as guide, trim replacement gaskets to correspond to amount cut off in step (2).

- (b) Align tongues of replacement oil pan gasket pieces with oil pan seal and cement into place on cover (fig. 1B-76).

- (c) Apply Permatex No. 2, or equivalent, to cut off edges of original oil pan gaskets.

- (d) Place timing case cover into position and install front oil pan screws.

- (e) Tighten screws slowly and evenly until cover aligns with upper locating dowel.

- (f) Install lower dowel through cover and drive into corresponding hole in engine block.

- (g) Install each cover retaining screw in same location as removed. Tighten to 25 foot-pounds (34 N•m) torque.

- (h) Proceed to step (7).

- (6) If RTV is used:

- (a) Apply coating of RTV silicone 1/8-inch (3.175 mm) thick on timing case cover flanges (fig. 1B-76). Use Jeep Gasket-in-a-Tube, or equivalent. Flanges must be clean and dry.

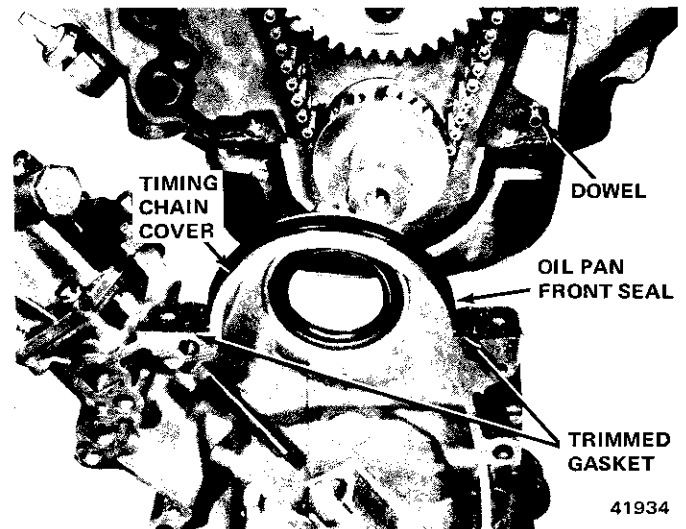


Fig. 1B-76 Oil Pan Front Seal Installation

- (b) Place cover into position. Align with top dowel.

- (c) Loosely install cover retaining screws in same locations as removed, excluding oil pan screws.

- (d) Install lower dowel through cover and drive into corresponding hole in engine block.

- (e) Tighten cover retaining screws to 25 foot-pounds (34 N•m) torque.

- (f) Apply small bead of RTV to joint between pan and cover and force into place with finger.

- (g) Apply drop of Loctite, or equivalent, to oil pan screws and install until snug. Do not torque-tighten as oil pan would be distorted.

- (h) Proceed to step (7).

- (7) Install vibration damper. Tighten retaining screw to 90 foot-pounds (122 N•m) torque.

- (8) Install damper pulley and retaining screws.

- (9) Install fuel pump.

- (10) Install distributor with rotor and housing in same position as it was prior to removal.

- (11) Install distributor cap and connect heater hose.

- (12) Install power steering pump, air pump and mount bracket, if removed.

- (13) Install alternator, alternator mount bracket, and back idler pulley assembly.

- (14) Install air conditioning compressor and bracket assembly, if removed.

- (15) Install fan and hub assembly.

- (16) Install all drive belts and tighten to specified tension. Refer to Chapter 1C—Cooling.

- (17) Connect radiator hoses and bypass hose.

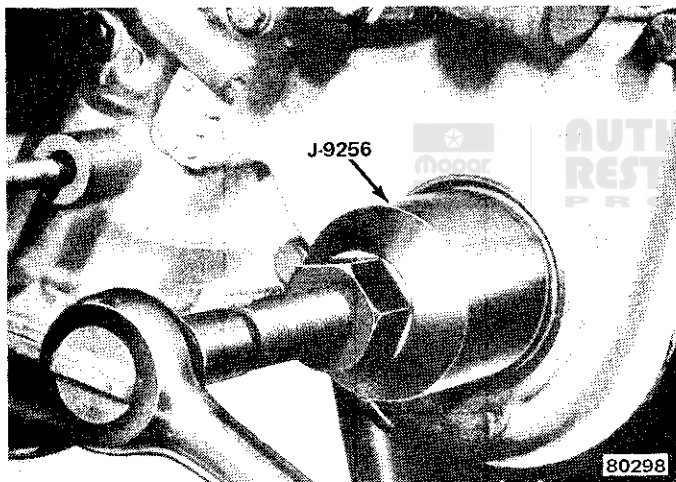
- (18) Fill cooling system to specified level.

- (19) Start engine and check for oil or coolant leaks.

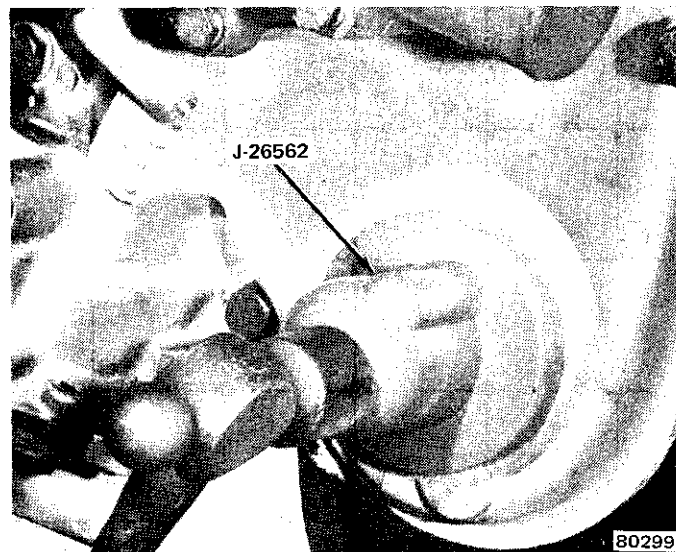
- (20) Adjust initial ignition timing to specified setting. Refer to Chapter 1A—General Service and Diagnosis.

**Oil Seal Replacement**

- (1) Loosen all drive belts.
- (2) Remove vibration damper pulley.
- (3) Remove vibration damper, screw and washer.
- (4) Install damper screw to crankshaft to prevent damper puller from damaging crankshaft threads.
- (5) Remove vibration damper with tool J-21791. Remove damper screw.
- (6) Remove oil seal using Remover J-9256 (fig. 1B-77).
- (7) Wipe crankshaft sealing area clean.
- (8) Apply Permatex No. 2, or equivalent, to outer metal surface of replacement seal.
- (9) Install seal using Installer J-2656 (fig. 1B-78).
- (10) Apply light coating of engine oil to sealing surface of damper.
- (11) Install damper, flat washer and screw. Tighten screw to 90 foot-pounds (122 N•m) torque.
- (12) Install pulley and belts. Tighten belts to specifications. Refer to Chapter 1C—Cooling.



**Fig. 1B-77 Removing Timing Case Cover Oil Seal**



**Fig. 1B-78 Installing Timing Case Cover Oil Seal**

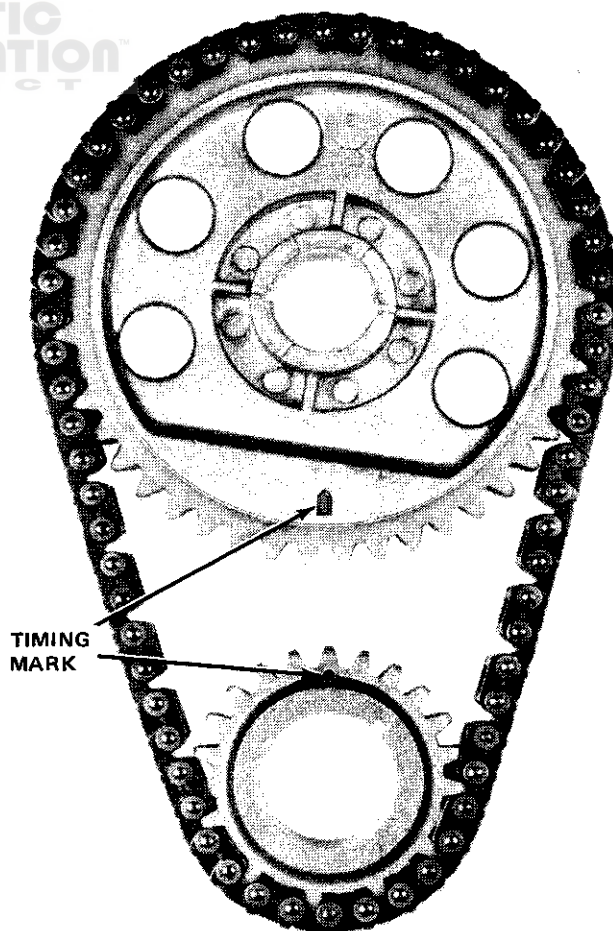
**Timing Chain**

The timing chain consists of 62 links joined by 62 pins. It is a single-row design.

To ensure correct valve timing, install the timing chain with the timing marks of the crankshaft and camshaft sprockets properly aligned. A worn timing chain will adversely affect valve timing. If the timing chain deflects more than 1/2 inch (13 mm), it should be replaced.

**Removal**

- (1) Remove timing case cover and gasket.
- (2) Remove crankshaft oil slinger.
- (3) Remove camshaft sprocket retaining screw and washer.
- (4) Remove distributor drive gear and fuel pump eccentric.
- (5) Rotate crankshaft until zero timing mark on crankshaft sprocket is closest to and on centerline with zero timing mark on camshaft sprocket (fig. 1B-79).
- (6) Remove crankshaft sprocket, camshaft sprocket and timing chain as assembly.



**Fig. 1B-79 Timing Chain and Sprocket Alignment**

## Installation

(1) Assemble timing chain, crankshaft sprocket and camshaft sprocket with timing marks aligned (fig. 1B-80).

(2) Install chain and sprocket assembly to crankshaft and camshaft.

(3) Install fuel pump eccentric and distributor drive gear.

(4) Install camshaft sprocket, washer and retaining screw. Tighten screw to 30 foot-pounds (41 N•m) torque.

**NOTE:** Install the fuel pump eccentric with the stamped word *REAR* facing the camshaft sprocket.

(5) To verify correct installation of timing chain:

(a) Rotate crankshaft until timing mark on camshaft sprocket is on horizontal line at 3 o'clock position.

(b) Beginning with pin directly adjacent to camshaft sprocket timing mark, count number of pins downward to timing mark on crankshaft sprocket.

(c) There must be 20 pins between these two points. **The crankshaft sprocket timing mark must be between pins 20 and 21 (fig. 1B-80).**

(6) Install crankshaft oil slinger.

(7) Remove original oil seal from timing case cover.

(8) Install replacement oil seal in timing case cover.

(9) Install timing case cover using replacement gasket. Tighten retaining screws to 25 foot-pounds (34 N•m) torque.

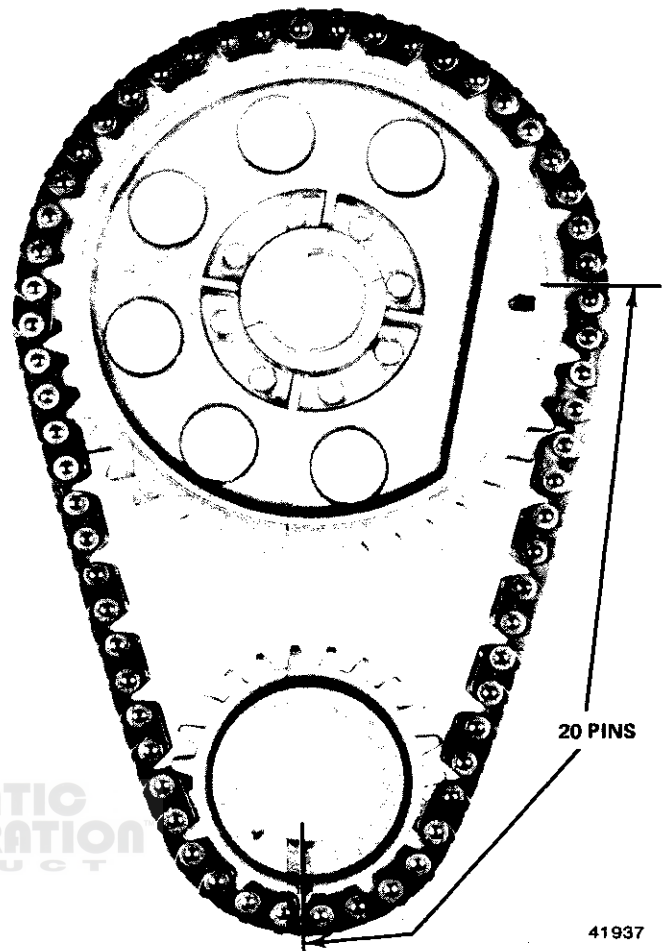


Fig. 1B-80 Correct Timing Chain Installation

## INTAKE AND EXHAUST MANIFOLDS

### Intake Manifold

The cast iron intake manifold is designed to enclose and seal the tappet area between the cylinder heads. A one-piece metal gasket, used to seal the intake manifold to the cylinder heads and block, also serves as an oil splash baffle.

The intake manifold contains coolant passages, a crankcase ventilator passage and an exhaust crossover passage. Passages are also incorporated within the intake manifold for the Exhaust Gas Recirculation (EGR) system.

Induction system passages distribute a uniform fuel and air mixture to the combustion chamber of each cylinder. The left side of the carburetor supplies fuel-air mixture through passages in the intake manifold to numbers 1, 7, 4 and 6 cylinder intake ports. The right side supplies 3, 5, 2, and 8.

### Removal

(1) Drain coolant from radiator and cylinder block.

(2) Remove air cleaner assembly.

(3) Disconnect ignition wires.

(4) Remove ignition wire plastic separators from cylinder head cover brackets.

(5) Disconnect radiator upper hose and bypass hose from intake manifold.

(6) Disconnect and move aside wire from temperature gauge sending unit.

(7) Disconnect ignition coil bracket and move coil and bracket assembly aside.

(8) Remove TCS solenoid vacuum valve and solenoid control switch, if equipped, from right side cylinder head cover.

(9) Disconnect heater hose from rear of manifold.

(10) Code and disconnect all hoses, lines and wires from carburetor.

(11) Disconnect accelerator linkage from carburetor and intake manifold.

(12) Disconnect air delivery hoses at air injection manifold.

(13) Disconnect diverter valve from air pump output hose and move valve and delivery hoses aside.

(14) Remove carburetor.

(15) Remove intake manifold, metal gasket and end seals.

(16) Clean mating surfaces of engine block, cylinder head and intake manifold.

## Installation

**NOTE:** When installing replacement intake manifold, transfer all components such as EGR valve and back-pressure sensor, EGR CTO, thermostat/housing and temperature gauge sending unit from original manifold. Clean and tighten as required.

(1) Apply non-hardening sealer or silicone sealer such as Jeep Gasket-in-a-Tube, or equivalent, to both sides of replacement manifold gasket.

(2) Position gasket by aligning locators at rear of cylinder head. While holding rear in place, align front locators.

(3) Install two end seals. Apply Permatex No. 2, Jeep Gasket-in-a-Tube, or equivalent, to seal ends.

(4) Install intake manifold and retaining screws. Make sure all screws are properly started before tightening. Tighten to 43 foot-pounds (58 N•m) torque.

(5) Install diverter valve and connect air pump output hose.

(6) Connect air delivery hoses to air injection manifold(s).

(7) Identify and connect all disconnected hoses, lines, linkages and wires to intake manifold and carburetor.

(8) Install TCS solenoid vacuum valve and solenoid control switch, if equipped, to right side rocker arm cover.

(9) Install ignition coil and bracket assembly.

(10) Connect radiator upper hose and bypass hose.

(11) Install ignition wire plastic separators to cylinder head cover brackets.

(12) Connect ignition wires.

(13) Install air cleaner assembly.

(14) Add coolant as necessary.

## Exhaust Manifold

The swept-flow design of the cast iron manifold provides efficient removal of exhaust gases and minimizes cylinder back pressure. The mating surface of the exhaust manifold and the cylinder head are machined smooth to eliminate the need for a gasket.

All eight-cylinder engines are equipped with an Air Guard system and have air injection manifolds attached at number 1, 3, and 5 exhaust ports of the left exhaust manifold and numbers 2, 4, 6, and 8 of the right exhaust manifold (California models only). Refer to Chapter 1K—Exhaust Systems for description of the Air Guard system.

## Removal

(1) Disconnect ignition wires.

(2) Disconnect air delivery hose at injection manifold.

(3) Disconnect exhaust pipe at exhaust manifold.

(4) Remove exhaust manifold retaining screws.

(5) Separate exhaust manifold from cylinder head.

(6) Remove air injection manifold, attaching screws and washers.

## Installation

(1) Clean mating surfaces of exhaust manifold and cylinder head. **Do not nick or scratch.**

(2) Install air injection manifold to exhaust manifold.

(3) Install exhaust manifold and retaining screws. Tighten two center screws to 25 foot-pounds (34 N•m) torque. Tighten four outer screws to 15 foot-pounds (20 N•m) torque.

**NOTE:** The correct screws and washers must be used to allow the manifold to expand and prevent cracking.

(4) Connect exhaust pipe using replacement seal, if required. Tighten nuts to 20 foot-pounds (27 N•m) torque.

(5) Connect air delivery hose to air injection manifold.

(6) Connect ignition wires.

## CYLINDER HEAD AND COVER

### Cylinder Head Cover

The cylinder head covers are installed with a formed-in-place RTV (room temperature vulcanizing) silicone gasket.

## Removal

(1) Remove air cleaner assembly.

(2) Disconnect air delivery hose at air injection manifold.

(3) Left side:

(a) Disconnect power brake vacuum hose at intake manifold, if equipped.

(b) Disconnect throttle stop solenoid wire, if equipped.

(4) Right side:

(a) Remove thermostatically controlled air cleaner (TAC) hot air hose.

(b) Remove heater hose from choke cover clamp.

(5) Disconnect ignition wires and remove plastic wire separator from cylinder head cover bracket.

(6) Remove retaining screws and washers. Strike cover with rubber mallet to break loose from cylinder head. Remove cover and gasket.

## Installation

(1) Inspect for bent or cracked cover and repair as required.

(2) Clean cylinder head cover and cylinder head gasket surface of original gasket material.



(3) Apply bead of Jeep Gasket-in-a-Tube, or equivalent, to cylinder head and cylinder head cover gasket surface.

**NOTE:** *If the original silicone gasket is not badly damaged during removal, it is not necessary to clean and reseal cover completely. Use Jeep Gasket-in-a-Tube, or equivalent, to repair small gaps in silicone gasket.*

- (4) Position cylinder head cover on engine.
- (5) Install retaining screws and tighten to 50-inch pounds (6 N•m) torque.
- (6) Connect ignition wires and install plastic wire separator to cylinder head cover bracket.
- (7) Right side:
  - (a) Install heater hose to choke cover clamp.
  - (b) Install TAC hot air hose.
- (8) Left side:
  - (a) Connect power brake vacuum hose at intake manifold.
  - (b) Connect throttle stop solenoid wire.
- (9) Connect air delivery hose to air injection manifold.
- (10) Install air cleaner assembly.

### Cylinder Head

#### Removal

- (1) Drain cooling system and cylinder block.
- (2) Remove ignition wires and spark plugs.
- (3) Remove cylinder head cover and gasket.
- (4) Remove rocker arm assemblies. Remove two capscrews at each bridged pivot. Alternately loosen capscrews one turn at a time to avoid damaging bridge.
- (5) Remove push rods.

**NOTE:** *Keep rocker arm assemblies and push rods in the same order as removed.*

- (6) Remove intake manifold.
- (7) Disconnect exhaust manifold from head. It is not necessary to remove manifold from exhaust pipe.
- (8) Loosen all drive belts.
- (9) Right side:
  - (a) If equipped with air conditioning, remove compressor mount bracket and battery negative cable from cylinder head.
  - (b) Disconnect alternator support brace from cylinder head.
- (10) Left side: Disconnect air pump and power steering mount bracket, if equipped, from cylinder head.
- (11) Remove cylinder head retaining screws.
- (12) Remove cylinder head and gasket.

#### Cleaning and Inspection

Thoroughly clean the gasket surfaces of the cylinder head and block to remove all dirt and gasket cement. Remove carbon deposits from the combustion chambers

and the top of each piston.

Use a straightedge and feeler gauge to check the flatness of the cylinder head and block mating surfaces. Refer to Specifications for flatness tolerances.

If the cylinder head is to be replaced and the original valves reused, remove the valves and measure the stem diameter.

**NOTE:** *Service replacement heads have standard-size valve guides. If oversize valves from original head are to be installed in replacement head, ream valve guides to appropriate oversize.*

If the original valves are used, remove all carbon buildup and reface the valves as outlined under Valve Refacing. Install the valves in the cylinder head using replacement valve stem oil deflectors. If oversize valves are used, oversize deflectors are required. Transfer all attached components from the original head which are not included with the replacement head.

#### Installation

**NOTE:** *The 304 CID engine uses an aluminum coated embossed steel gasket and the 360 CID engine uses an aluminum coated laminated steel and asbestos gasket. Retightening is not necessary with either gasket.*

(1) Apply even coat of non-hardening sealing compound to both sides of replacement head gasket.

**NOTE:** *Do not apply sealing compound to head and block surfaces. Do not allow sealer to enter cylinder bores.*

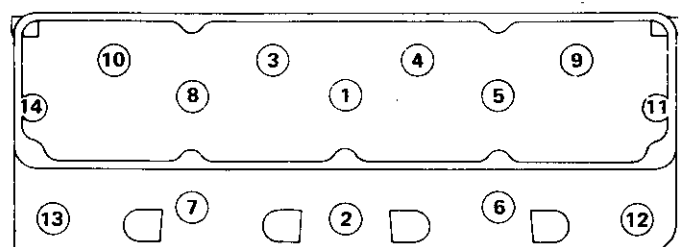
(2) Position gasket on block with stamped word TOP facing upward.

(3) Install cylinder head and gaskets.

**NOTE:** *Wire brush the threads of screws prior to installation. Dirt will affect the torque readings. Blow coolant from screw holes to prevent trapping coolant.*

(4) Tighten cylinder head capscrews evenly to 80 foot-pounds (108 N•m) torque following sequence outlined in figure 1B-81. Then follow sequence again and tighten screws to 110 foot-pounds (149 N•m) torque.

(5) Left side: connect air pump mount bracket to cylinder head and power steering pump, if removed.



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Fig. 1B-81 Cylinder Head Torque Sequence

- (6) Right side:
  - (a) Connect alternator support bracket to cylinder head.
  - (b) Install air conditioning compressor mounting bracket, if removed, and battery negative cable to cylinder head.
- (7) Adjust all drive belts to specified tension. Refer to Chapter 1C—Cooling.
- (8) Install exhaust manifold and tighten retaining screws to 25 foot-pounds (34 N•m) torque.
- (9) Install intake manifold. Tighten manifold retaining screws to 43 foot-pounds (58 N•m) torque.
- (10) Install all disconnected lines, hoses, linkage and wires.
- (11) Install rocker arm assemblies and push rods in same order as removed. Loosely install capscrews to bridged pivots. At each bridge, tighten capscrews alternately one turn at a time to avoid damaging bridge. Tighten capscrews to 19 foot-pounds (26 N•m) torque.
- (12) Reseal and install cylinder head cover. Tighten retaining screws to 50 inch-pounds (6 N•m) torque.
- (13) Install spark plugs and connect ignition wires.
- (14) Fill cooling system to specified level.

## LUBRICATION SYSTEM

Oil is drawn from the sump of the oil pan through a tube and screen assembly to a horizontal oil gallery located at the lower right side of the engine block (fig. 1B-82). A passage in the timing case cover channels oil into the oil pump. Pressure is developed when oil is driven between the gears and pump body.

The oil is forced from the pump through a passage in the oil pump cover to the oil filter (fig. 1B-83).

The oil passes through the filtering elements and on to an outlet passage in the oil pump cover. From the oil pump cover passage, the oil enters an adjoining passage in the timing case cover and is channeled into a gallery which extends up the left front of the cylinder block. This gallery channels oil directly to the right main oil gallery which intersects with a short passage that channels oil to the left main oil gallery.

The left and right main oil galleries extend the length of the cylinder block. The left oil gallery channels oil to each hydraulic tappet on the left bank. The right oil gallery channels oil to each hydraulic tappet on the right bank. In addition, passages extend down from the right oil gallery to the five camshaft bearings and on to the five upper main bearing inserts. The crankshaft is drilled to allow oil to flow from each main journal to adjacent connecting rod bearing rod journals. A squirt hole in each connecting rod bearing cap distributes oil to the cylinder walls, pistons and piston pins as the crankshaft rotates.

A small passage within the front camshaft bearing journal channels oil through the camshaft sprocket to the timing case cover area where the case and sprockets throw off oil to lubricate the distributor gears and fuel

pump eccentric (see insert, fig. 1B-82). This oil returns to the oil pan by passing under the front main bearing cap.

Oil for the rocker arm assemblies is metered through the hydraulic valve tappets and routed through hollow push rods to a hole in the push rod end of the corresponding rocker arm. This oil lubricates the valve train, then returns to the oil pan through channels at both ends of the cylinder head.

## Oil Filter

A full flow oil filter mounted on the oil pump at the lower right-hand side of the engine is accessible from below the chassis.

A bypass valve in the filter mounting base provides a safety factor in the event the filter becomes inoperative as a result of dirt or sludge accumulation (fig. 1B-84). Oil Filter Remover Tool J-22700 will facilitate removal.

Before installation, apply a thin film of oil to the filter gasket. **Do not use grease.** Install filter until gasket contacts the seat of the oil pump cover. Tighten by hand only, following instructions on replacement filter. If instructions are not printed on filter, tighten filter until gasket contacts seat and then tighten an additional 3/4 of a turn. Operate engine at fast idle and check for leaks.

## Oil Pump

The positive-displacement gear-type oil pump is driven by the distributor shaft, which is driven by a gear on the camshaft (fig. 1B-84). The pump is incorporated in the timing case cover. A cavity in the cover forms the body of the pump. A pressure relief valve regulates maximum pressure.

Oil pump removal or replacement will not affect distributor timing. The distributor drive gear remains in mesh with the camshaft gear.

## Oil Pressure Relief Valve

The oil pressure relief valve is not adjustable. A setting of 75 pounds (517 kPa) maximum pressure is built into the tension of the spring.

In the relief position, the valve permits oil to bypass through a passage in the pump cover to the inlet side of the pump (fig. 1B-84).

## Removal

- (1) Remove retaining screws and separate oil pump cover, gasket and oil filter as an assembly from pump body (timing case cover).

- (2) Remove drive gear assembly and idler gear by sliding them out of body.

- (3) Remove oil pressure relief valve from pump cover for cleaning by removing retaining cap and spring. Clean cover thoroughly. Check operation of relief valve by inserting poppet valve and checking to see that it slides back and forth freely. If not, replace pump cover and poppet valve.

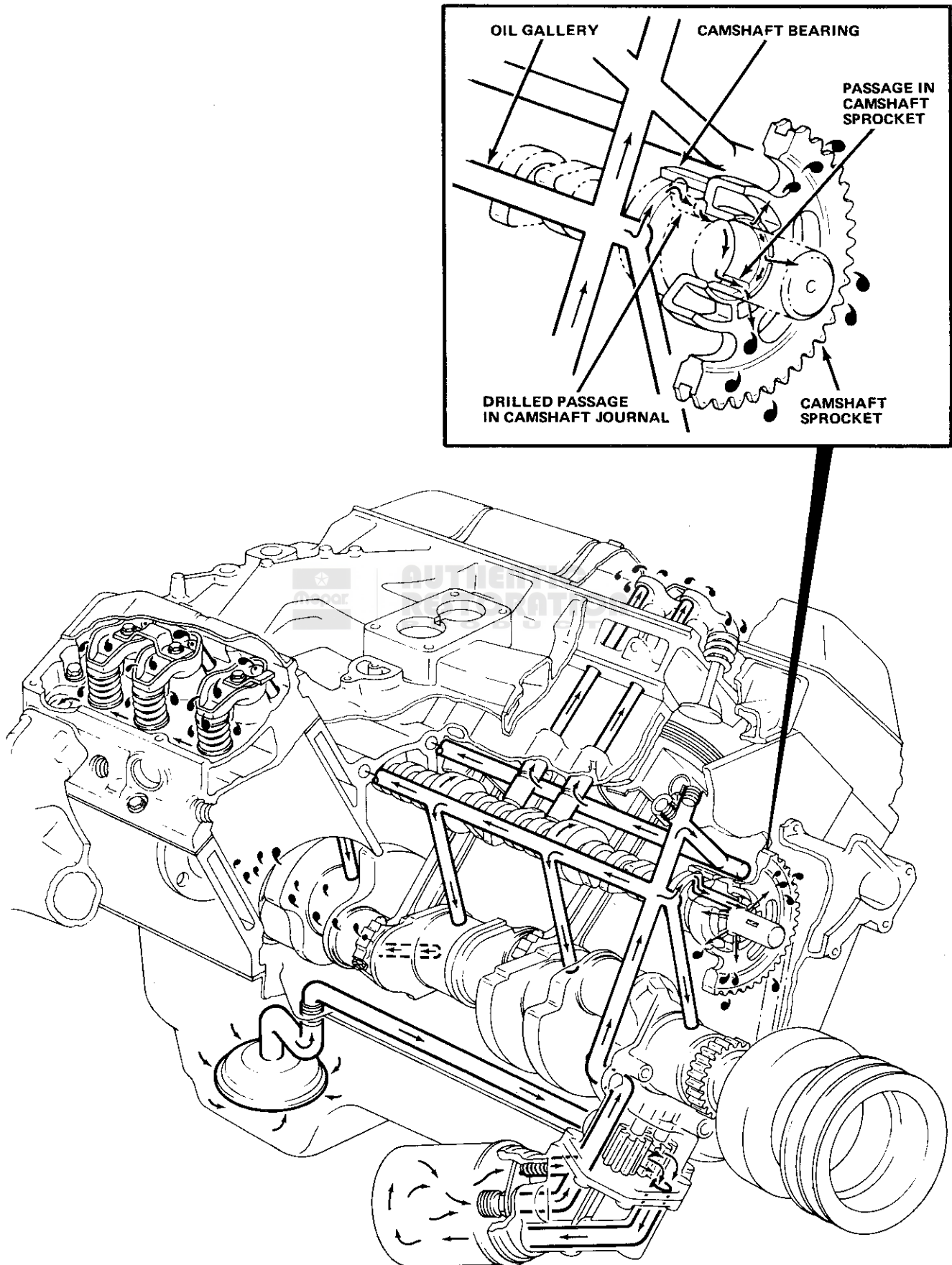


Fig. 1B-82 Lubrication System

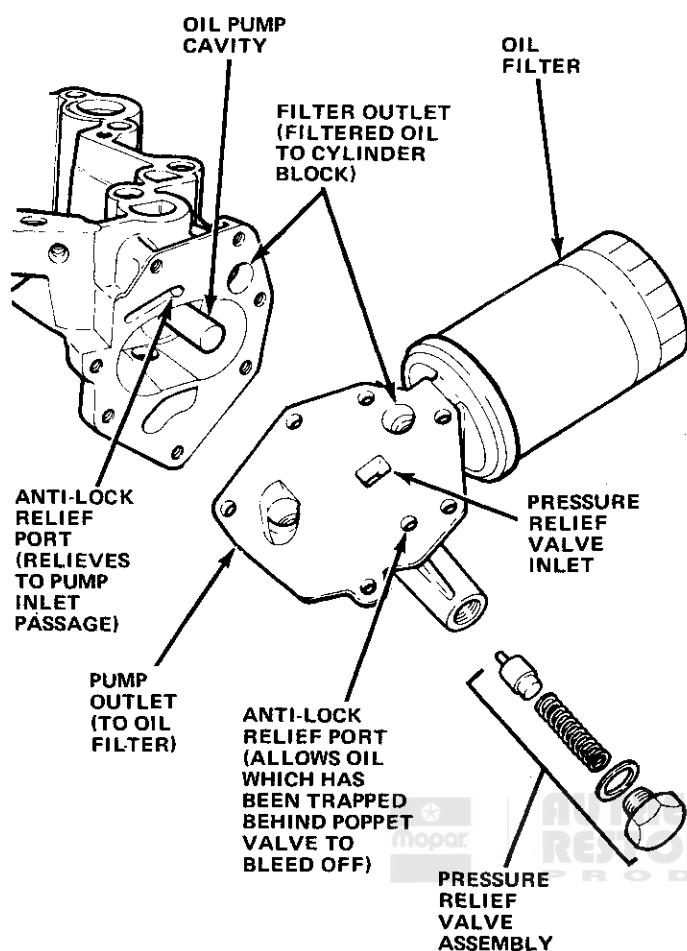


Fig. 1B-83 Oil Pump Cover

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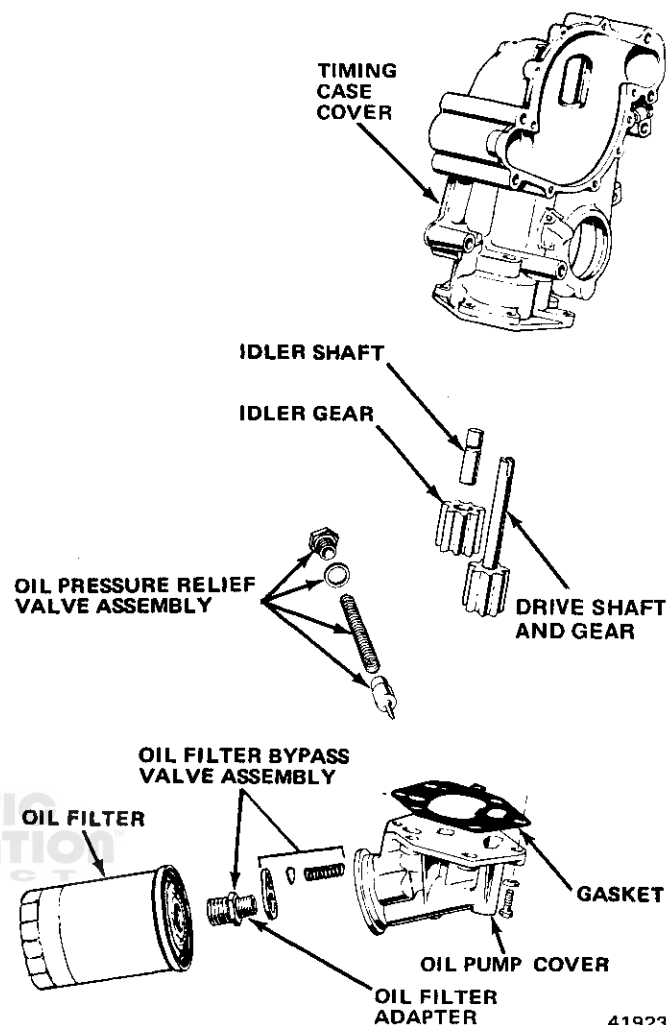


Fig. 1B-84 Oil Pump and Filter Assembly

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**Gear End Clearance Measurement**

This check indicates the distance between the end of the pump gear and the pump cover. The ideal clearance is as close as possible without binding gears. The pump cover gasket is 0.009-inch to 0.011-inch (0.229 mm to 0.279 mm) thick. Symptoms of excessive pump clearance are fair to good pressure when cold, low or no pressure after starting a hot engine.

**Preferred Method:**

(1) Place strip of Plastigage across full width of each gear (fig. 1B-85).

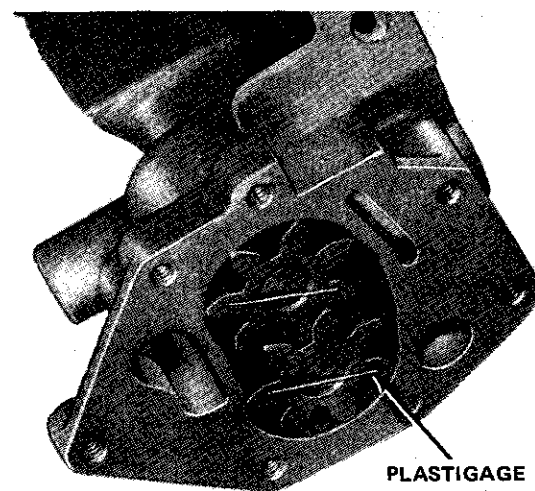
(2) Install pump cover and gasket. Tighten screws to 55 inch-pounds (6 N•m) torque.

(3) Remove pump cover and determine amount of clearance by measuring width of compressed Plastigage with the scale on the Plastigage envelope. Correct clearance by this method is 0.002 to 0.008 inch (0.002 preferred) [0.051 mm to 0.203 mm (0.051 mm preferred)].

**Alternate Method:**

(1) Place straightedge across gears and pump body.

(2) Select feeler gauge which will fit snugly but freely between straightedge and pump body (fig. 1B-86). Correct clearance by this method is 0.004 to 0.008 inch



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Fig. 1B-85 Oil Pump Gear End Clearance Measurement—  
Plastigage Method

(0.008 inch preferred) [0.102 mm to 0.203 mm (0.203 mm preferred)].

**NOTE:** Make certain gears are up into body as far as possible.

If gear end clearance is excessive, measure gear length. If gear length is correct, install thinner gasket. If gear length is incorrect, replace gears and idler shaft.

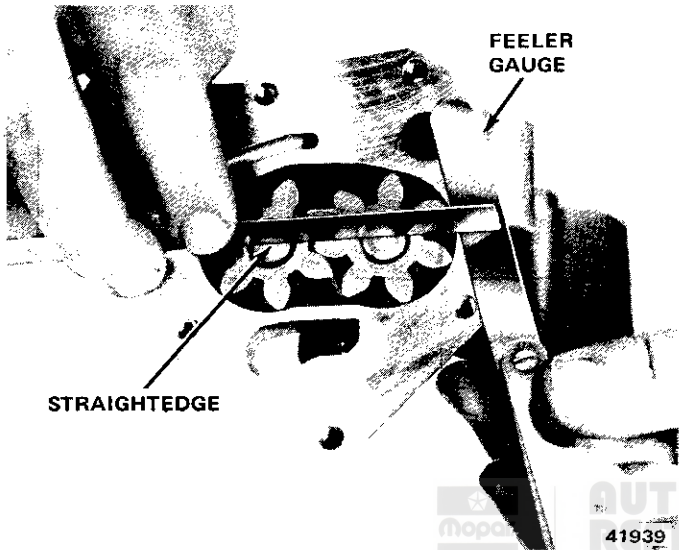


Fig. 1B-86 Oil Pump Gear End Clearance Measurement—Feeler Gauge Method

### Gear-to-Body Clearance

(1) Insert feeler gauge between gear tooth and pump body inner wall directly opposite point of gear mesh. Select feeler gauge which fits snugly but freely (fig. 1B-87).

(2) Rotate gears to check each tooth in this manner. Correct clearance is 0.0005 to 0.0025 inch (0.0005 inch preferred) or 0.013 mm to 0.064 mm (0.013 mm preferred).

(3) If gear-to-body clearance is more than specified, measure gear diameter with micrometer. If gear diameter is correct, check gear end clearance and correct. If gear clearance is acceptable and relief valve is functioning properly, replace timing case cover. If gear diameter is incorrect, replace gears and idler shaft.

**NOTE:** If oil pump shaft or distributor drive shaft has broken, inspect for loose oil pump gear-to-shaft fit or worn front cover. Oversize pump shafts are not available.

### Installation

(1) Install oil pressure relief valve in pump cover with spring and retaining cap.

(2) Install idler shaft, idler gear and drive gear assembly.

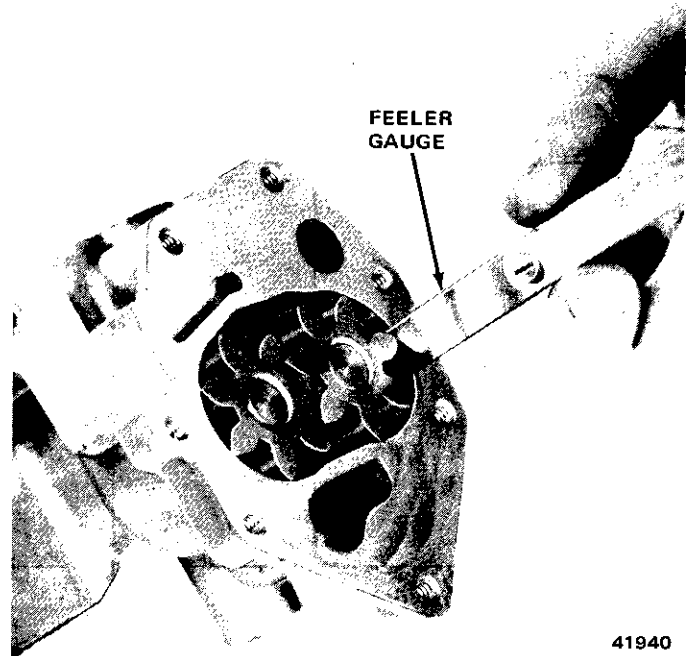


Fig. 1B-87 Gear-to-Body Clearance Measurement

**NOTE:** To ensure self-priming of the oil pump, fill pump with petroleum jelly prior to the installation of the oil pump cover. Do not use grease of any type.

(3) Install pump cover and oil filter assembly with a replacement gasket. Tighten retaining screws to 55 inch-pounds (6 N•m) torque.

### Oil Pan

#### Removal

- (1) Drain engine oil.
- (2) Remove starter.
- (3) On CJ models:
  - (a) Remove frame cross bar.
  - (b) Remove automatic transmission cooler lines, if equipped.
  - (c) Cut corner of engine mount on right side with hacksaw to provide clearance for pan removal, if required.
- (4) On all models, bend tabs down on dust shield, if equipped with manual transmission.
- (5) Remove oil pan attaching screws. Remove oil pan.
- (6) Remove oil pan front and rear neoprene oil seals.
- (7) Thoroughly clean gasket surfaces of oil pan and engine block. Remove all sludge and dirt from oil pan sump.

#### Installation

(1) Install replacement oil pan front seal to timingcase cover. Apply generous amount of Jeep Gasket-in-a-Tube (RTV silicone), or equivalent, to end tabs.

(2) Coat inside curved surface of replacement oil pan rear seal with soap or RTV silicone. Apply generous amount of RTV silicone to gasket contacting surface of seal end tabs.

(3) Install seal in recess of rear main bearing cap, making certain it is fully seated.

(4) Apply RTV silicone to oil pan contacting surface of front and rear oil pan seals.

(5) Cement replacement oil pan side gaskets into position on engine block. Apply generous amount of RTV silicone to gasket ends.

(6) Install oil pan. Tighten 1/4-20 oil pan screws to 7 foot-pounds (9 N•m) torque and 5/16-18 oil pan screws to 11 foot-pounds (15 N•m) torque.

(7) Tighten drain plug securely.

(8) Install starter and connect starter cable.

(9) On CJ models:

(a) Install frame cross bar.

(b) Install oil cooler lines, if removed.

(10) Fill crankcase to specified level with clean oil.

### Oil Pressure Gauge

Refer to Chapter 1L—Power Plant Instrumentation for a description of operation, diagnosis and replacement procedure.

### CONNECTING ROD AND PISTON ASSEMBLY

Use these procedures to service connecting rods and pistons with the engine in the vehicle.

#### Removal

(1) Remove cylinder head cover(s).

(2) Remove two capscrews at each bridged pivot. Alternately loosen capscrews one turn at a time to avoid damaging bridge. Remove bridged pivot and rocker arms.

(3) Remove push rods.

(4) Remove intake manifold assembly.

(5) Remove exhaust manifold(s). It is not necessary to disconnect manifold from exhaust pipe.

(6) Remove cylinder head and gasket.

(7) Position pistons, one at a time, near bottom of stroke. Use ridge reamer to remove any ridge from top end of cylinder walls.

(8) Drain engine oil.

(9) Remove oil pan.

(10) Remove connecting rod bearing caps and inserts. Keep in same order as removed.

**NOTE:** Connecting rods and caps are stamped with the number of the cylinder to which they were assembled.

(11) Remove connecting rod and piston assemblies through top of cylinder bores. Be careful that connecting rod screws do not scratch connecting rod journals or cylinder walls. Short pieces of rubber hose slipped onto rod screws will provide protection during disassembly.

#### Installation

(1) Thoroughly clean cylinder bores. Apply light film of clean engine oil to bores with clean, lint-free cloth.

(2) Arrange piston ring gaps. Refer to Piston Rings for procedure.

(3) Lubricate piston and ring surfaces with clean engine oil.

(4) Use piston ring compressor tool to install connecting rod and piston assemblies through top of cylinder bores. Be careful that connecting rod screws do not scratch connecting rod journals or cylinder walls. Short lengths of rubber hose slipped over connecting rod screws will provide protection during installation.

**NOTE:** Squirt holes in connecting rods must face inward (fig. 1B-88).

(5) Install connecting rod bearing caps and inserts in same order as removed. Tighten retaining nuts to 33 foot-pounds (45 N•m) torque.

(6) Install engine oil pan using replacement gaskets and seals.

(7) Install cylinder heads and replacement gaskets.

(8) Install push rods.

(9) Install rocker arms and bridged pivot assemblies. Loosely install capscrews to each bridged pivot. At each bridged pivot, alternately tighten capscrews one turn at a time to avoid damaging bridge. Tighten capscrews to 19 foot-pounds (26 N•m) torque.

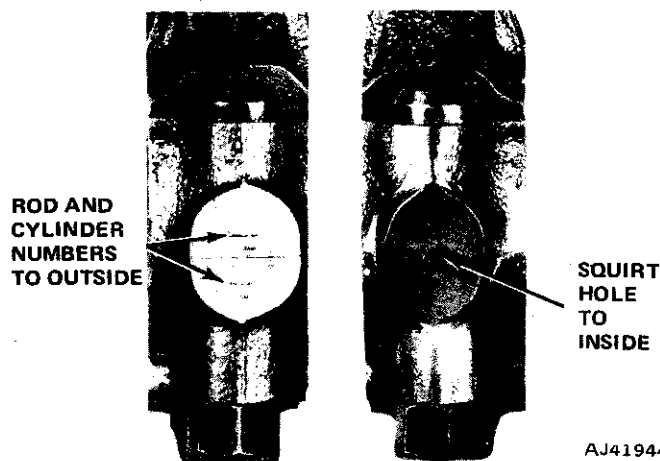
(10) Install intake manifold gasket and manifold assembly.

(11) Install exhaust manifolds.

(12) Reseal and install cylinder head cover(s).

(13) Fill crankcase with clean oil to specified level.

(14) Start engine check for leaks.



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Fig. 1B-88 Rod Number and Squirt Hole Location

**CONNECTING RODS**

The connecting rods are malleable iron and are independently balanced. The crankshaft end of the connecting rod incorporates a two-piece bearing insert. The number stamped onto the removable bearing cap and onto the adjacent machined surface of the rod corresponds to the cylinder in which the rod was assembled (fig. 1B-88). The piston end of the rod is a 2000-pound (907 kg) press-fit to the piston pin.

Have the connecting rod alignment checked by a competent machine shop whenever engine wear patterns or damage indicates probable rod misalignment. Always replace bent connecting rods.

**Connecting Rod Side Clearance Measurement**

- (1) Rotate crankshaft to position connecting rod journal at bottom of stroke.
- (2) Insert snug fitting feeler gauge between connecting rods (fig. 1B-89).
- (3) Compare feeler gauge measurement to specified clearance. Replace rods not to specifications.

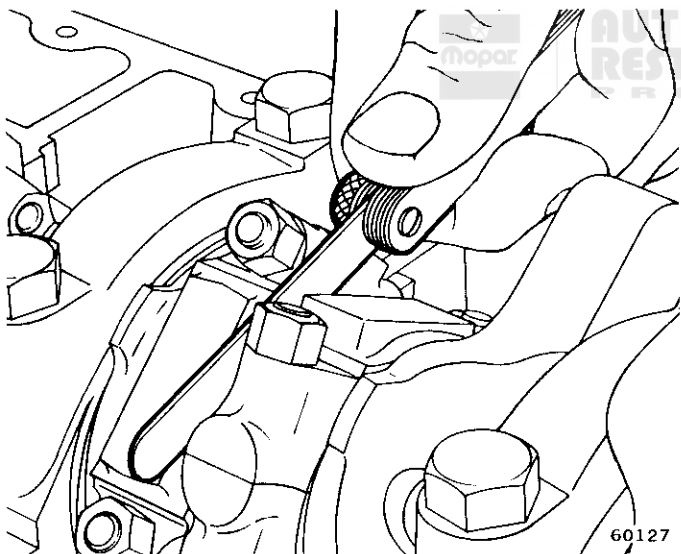


Fig. 1B-89 Connecting Rod Side Clearance Measurement

**Connecting Rod Bearings**

The connecting rod bearings are precision-type steel-backed aluminum alloy. The connecting rod bearings are selectively fitted to their respective journals to obtain the desired operating clearance. **In production**, the select fit is obtained by using various sized color coded bearing inserts as shown in the bearing fitting chart. The bearing color code appears on the edge of the insert.

**NOTE:** *Bearing size is not stamped on production inserts.*

The rod journal size is identified **in production** by a color coded paint mark on the adjacent cheek or counterweight toward the flanged (rear) end of the crankshaft. Use color codes shown in the bearing fitting chart to identify journal size and select the correct bearing inserts to obtain proper clearances.

When required, different sized upper and lower bearing inserts may be used as a pair. A standard size insert is sometimes used in combination with a 0.001-inch undersize insert to reduce clearance by 0.0005 inch or 1/2 thousandth of an inch (0.013 mm).

**CAUTION:** *Never use a pair of bearing inserts with greater than 0.001-inch difference in size.*

Example:

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.001-inch undersize	0.002-inch undersize

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**Service replacement bearing inserts** are available in pairs in the following sizes: standard, 0.001-inch undersize, 0.002-inch undersize, 0.010-inch undersize and 0.012-inch undersize. The size is stamped on the back of service replacement inserts.

**NOTE:** *The 0.002-inch and 0.012-inch undersize inserts are not used in production.*

**Connecting Rod Bearing Fitting Chart**

Crankshaft Connecting Rod Journal Color Code and Diameter in Inches (Journal Size)	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
<b>304 - 360 CID Engines</b>		
Yellow — 2.0955 to 2.0948 (Standard)	Yellow — Standard	Yellow — Standard
Orange — 2.0948 to 2.0941 (0.0007 Undersize)	Yellow — Standard	Black — .001-inch Undersize
Black — 2.0941 to 2.0934 (0.0014 Undersize)	Black — .001-inch Undersize	Black — .001-inch Undersize
Red — 2.0855 to 2.0848 (0.010 Undersize)	Red — .010-inch Undersize	Red — .010-inch Undersize

**Removal**

Use this procedure to service connecting rod bearings with the engine in the vehicle.

- (1) Drain engine oil.
- (2) Remove oil pan.
- (3) Rotate crankshaft as required to position two connecting rods at a time at bottom of their stroke.
- (4) Remove bearing caps and lower inserts.
- (5) Remove upper insert by rotating insert out of connecting rod.

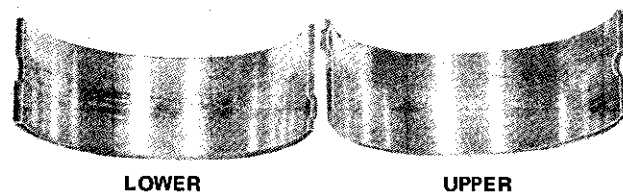
**NOTE:** Do not mix bearing caps. Connecting rod and matching cap are stamped with the cylinder number (fig. 1B-88). The numbers are located on a machined surface opposite the squirt holes.

**Inspection**

- (1) Clean inserts.
- (2) Inspect linings and backs of inserts for irregular wear pattern. Note any scraping, stress cracks or distortion (fig. 1B-90). If bearing has spun in rod, replace bearing and connecting rod and inspect crankshaft journal for scoring.
- (3) Inspect for material imbedded in linings which may indicate piston, timing gear, distribution gear or oil pump gear problems. Figures 1B-91 and 1B-92 show common score problems.
- (4) Inspect fit of bearing locking tab in rod cap. If inspection indicates that insert may have been caught between rod and rod cap, replace upper and lower bearing inserts.

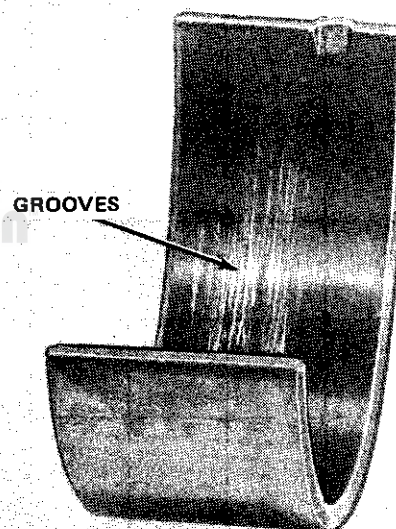
- (5) Inspect insert area of locking tab. Abnormal wear indicates bent tabs or improper installation of inserts (fig. 1B-93).

- (6) Replace bearing inserts that are damaged or worn.



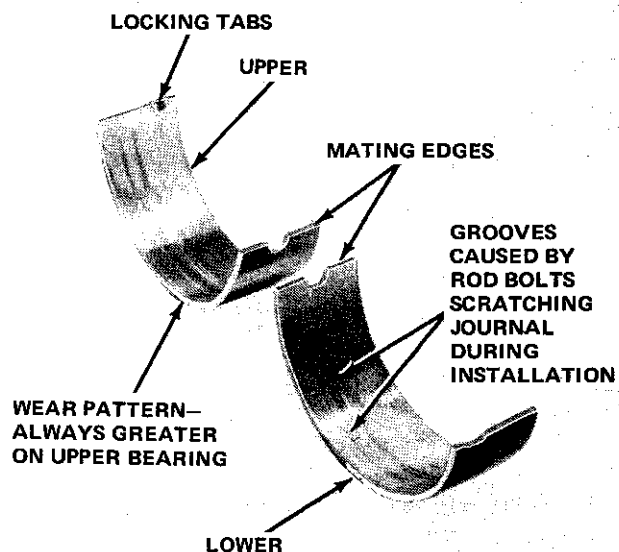
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**Fig. 1B-91 Scoring Caused by Insufficient Lubrication**



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**Fig. 1B-92 Scoring Caused by Dirt**



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**Fig. 1B-90 Connecting Rod Bearing Inspection**



ABNORMAL CONTACT AREA DUE TO LOCKING TABS NOT FULLY SEATED OR BENT TABS

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**Fig. 1B-93 Locking Tab Inspection**

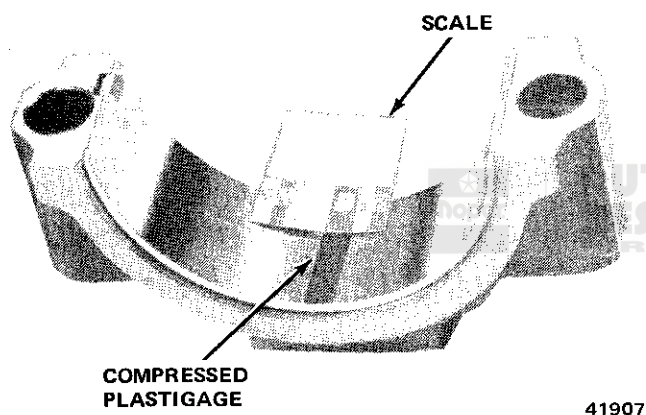


## Measuring Bearing Clearance with Plastigage

- (1) Wipe bearing inserts and rod journal clean.
- (2) Lubricate upper insert and install in rod.
- (3) Place strip of Plastigage across full width of lower insert at center of bearing cap. Lower insert must be dry.
- (4) Install bearing cap to connecting rod and tighten retaining nuts to 33 foot-pounds (45 N•m) torque.

**NOTE:** Do not rotate crankshaft. Plastigage will shift, resulting in inaccurate reading. Plastigage must not crumble. If brittle, obtain fresh stock.

- (5) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope (fig. 1B-94).



**Fig. 1B-94** Connecting Rod Bearing Clearance Measurement with Plastigage

- (6) If correct clearance is indicated, bearing fitting is not necessary. Remove Plastigage from crankshaft and bearing and proceed to Installation.

**NOTE:** Traces of Plastigage left on bearing surfaces will dissolve in hot oil when engine is running.

- (7) If oil clearance exceeds specification, install 0.001-inch undersize bearing inserts and check clearance as described in steps (1) through (5).

The clearance indicated with 0.001-inch undersize bearing installed will determine if 0.001-inch undersize inserts or some other combination are needed to provide correct clearance. For example, if the initial clearance was 0.003 inch (0.076 mm), 0.001-inch undersize inserts would reduce clearance by 0.001 inch (0.025 mm). Oil clearance would be 0.002 inch (0.051 mm) and within specifications. A 0.002-inch undersize insert and a 0.001-inch undersize insert would reduce this clearance an additional 0.0005 inch (0.013 mm). Oil clearance would then be 0.0015 inch (0.038 mm).

**CAUTION:** Never use inserts which differ more than one bearing size as a pair. For example, do not use a standard upper and 0.002-inch undersize lower.

- (8) If oil clearance exceeds specification when 0.002-inch undersize inserts are installed, measure connecting rod journal with micrometer. If journal size is correct, inside diameter of connecting rod is incorrect and rod must be replaced.

**NOTE:** Journal may have been ground 0.010-inch (0.254 mm) undersize.

If journal size is incorrect, replace crankshaft or grind journal to accept a suitable undersized bearing.

## Measuring Connecting Rod Journal with Micrometer

- (1) Wipe connecting rod journal clean.
- (2) Use micrometer to measure journal diameter at two points 90° apart at each end of journal. Note difference between maximum and minimum diameters.
- (3) Refer to Specifications for maximum allowable taper and out-of-round. If any rod journal is outside specifications, replace crankshaft or recondition crankshaft and fit with undersize bearing inserts.
- (4) Compare maximum reading obtained with journal diameters listed in bearing fitting chart.
- (5) Select inserts required to obtain specified bearing clearance.

**NOTE:** Always check clearance with Plastigage after installing replacement bearings. Check clearance of each journal when installing crankshaft kit (crankshaft supplied with bearings).

## Installation

- (1) Rotate crankshaft to position connecting rod journal at bottom of stroke.
- (2) Lubricate bearing surface of each insert with clean engine oil.
- (3) Install bearing inserts, cap and retaining nuts. Tighten to 33 foot-pounds (45 N•m) torque.

**CAUTION:** Be careful when rotating the crankshaft with bearing caps removed. Be sure the connecting rod screws do not accidentally come in contact with the rod journals and scratch the finish, which can cause bearing failure. Short pieces rubber hose slipped over rod screws will provide protection during installations.

- (4) Install oil pan using replacement gaskets and seals. Tighten drain plug securely.
- (5) Fill crankcase to specified level with clean oil.

## PISTONS

Aluminum alloy autothermic pistons are steel reinforced for strength and controlled expansion.

The pistons are cam-ground and are not perfectly round. The ring belt area contains three piston rings, two compression rings, and one oil control ring above the piston pin.

The piston pin boss is offset from the piston centerline to place it nearer the thrust side of the piston, minimizing piston slap.

To ensure correct installation of the pistons in the bore, two notches are cast in the top perimeter of the piston on 304 (5 liter) and 360 (6 liter) CID engines. The notches must face forward (fig. 1B-95).

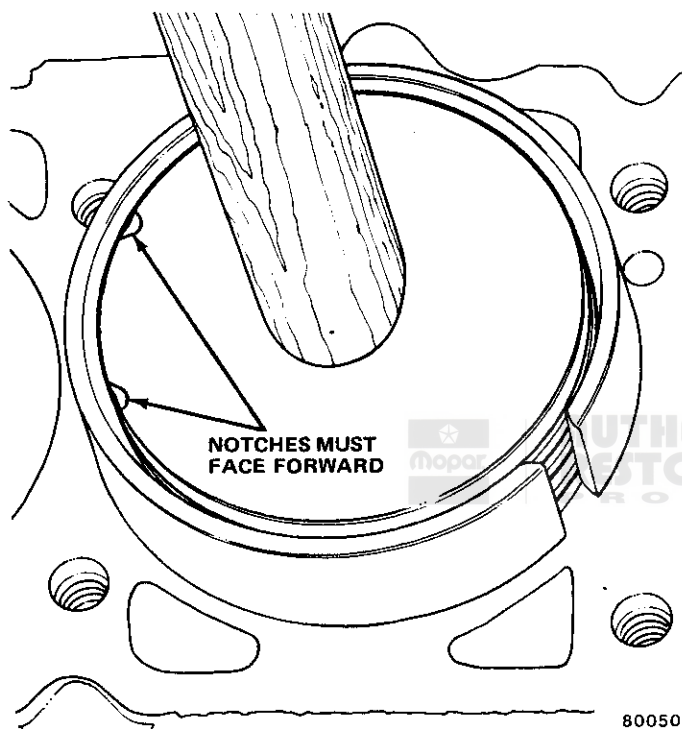


Fig. 1B-95 Installing Piston Assembly into Bore

### Piston Fitting

#### Micrometer Method

(1) Use inside micrometer to measure cylinder bore inside diameter at point 2 5/16 inch (59 mm) below top of bore crosswise to block.

(2) Measure outside diameter of piston.

**NOTE:** *Pistons are cam ground and must be measured at right angle to piston pin at centerline of pin (fig. 1B-97).*

(3) Difference between cylinder bore diameter and piston diameter dimension is piston-to-bore clearance.

#### Feeler Gauge Method

(1) Remove rings from piston.

(2) Insert long 0.0005-inch (0.013 mm) feeler gauge into bore.

(3) Insert piston (top first) into bore alongside feeler gauge. With entire piston inserted in bore, piston should not bind against feeler gauge.

(4) Repeat steps (2) and (3) with long 0.002-inch (0.051 mm) feeler gauge. Piston should bind.

If piston binds on the 0.0005-inch (0.013 mm) gauge, piston is too large or bore is too small. If piston does not bind on the 0.002-inch (0.051 mm) gauge, piston may be enlarged by knurling or shot-peening. Replace pistons that are 0.004-inch (0.102 mm) or more undersize.

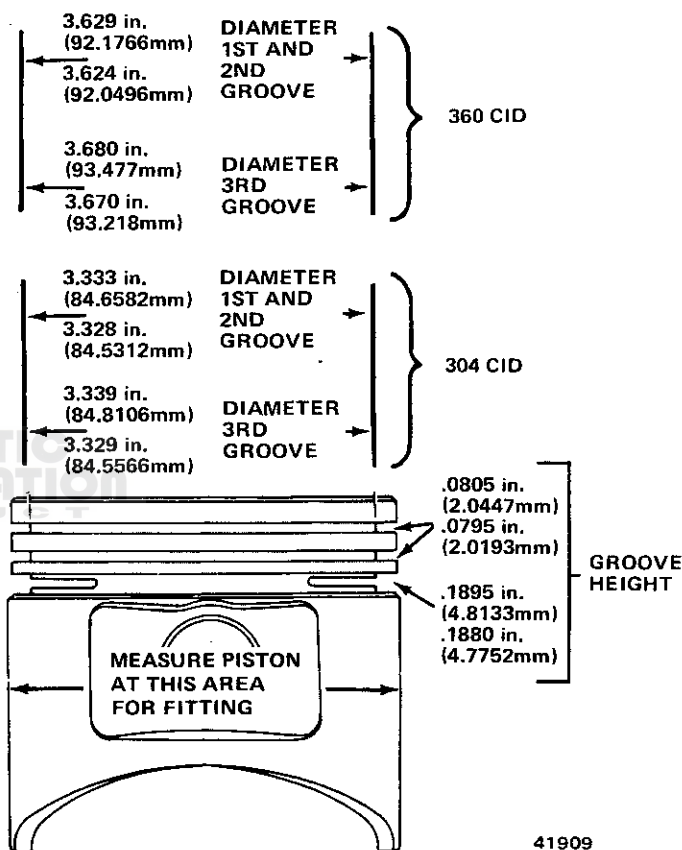


Fig. 1B-97 Piston Measurements

### Piston Rings

The top compression ring is made of moly-filled iron. The second compression ring is made of cast-iron. The oil control is a three-piece steel design.

#### Ring Fitting

(1) Clean carbon from all ring grooves. Be sure oil drain openings in oil ring grooves and pin boss are open.

**CAUTION:** *Do not remove metal from grooves or lands. This will change ring groove clearances and will damage ring-to-land seating.*

(2) Check ring side clearance with feeler gauge fitted snugly between ring land and ring. Roll ring around groove in which it is to operate. It must fit freely at all points (fig. 1B-97). Refer to Specifications for correct ring side clearance.

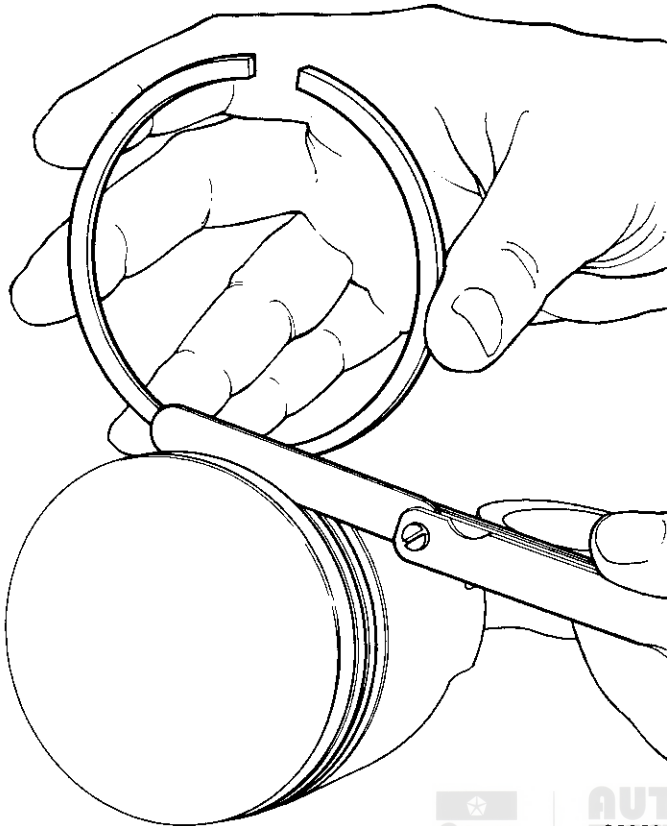


Fig. 1B-97 Ring Side Clearance Measurement

(3) Place ring in bore. Use inverted piston to push ring down near lower end of ring travel area. Measure ring gap or joint clearances with feeler gauge fitted snugly in ring opening (fig. 1B-98).

**NOTE:** Fit every ring except oil control ring in its respective bore and check end gap.

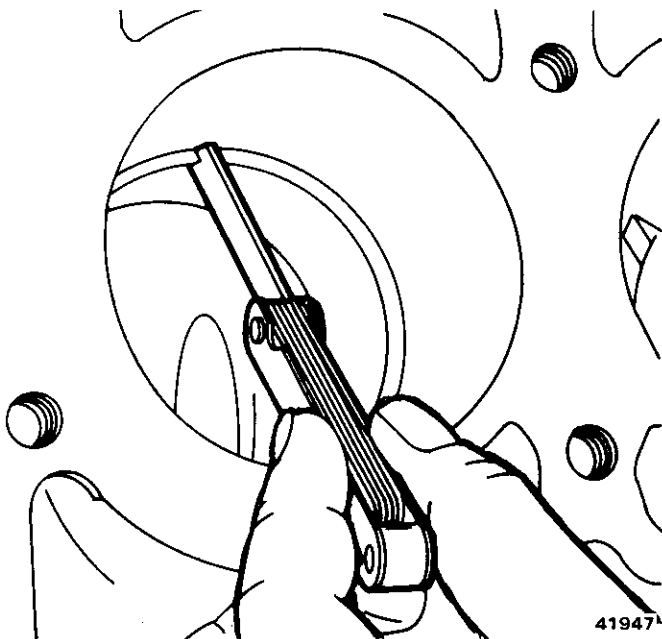


Fig. 1B-98 Ring Gap Measurement

**Installation**

Correct ring gap spacing is shown in figure 1B-99.

(1) Install oil control rings as indicated by instructions in package. Roll upper and lower rails into place without use of tool (fig. 1B-100).

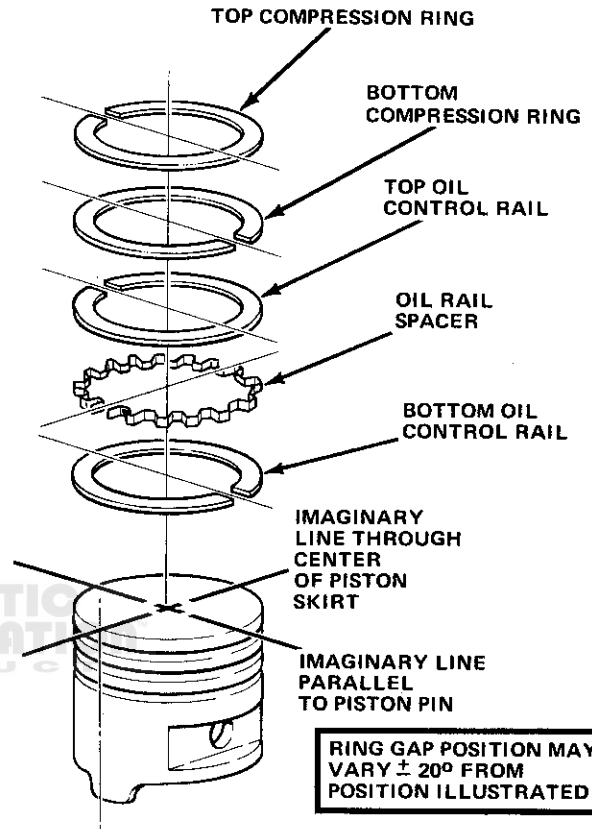


Fig. 1B-99 Ring Gap Spacing

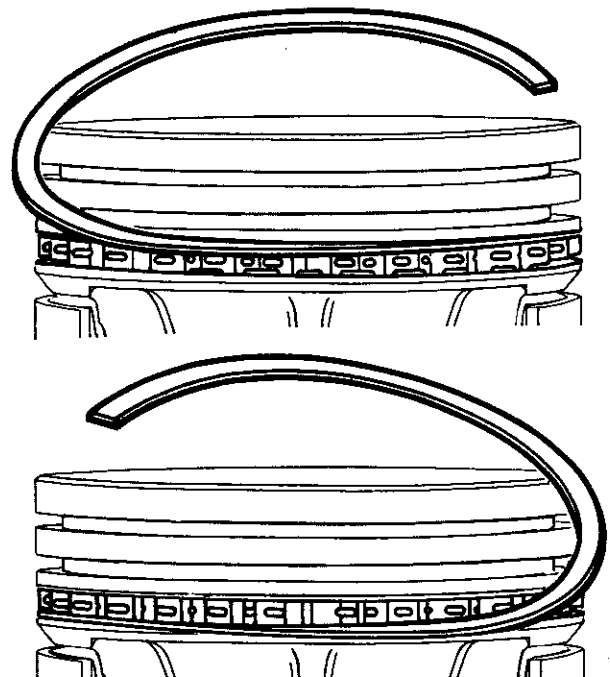


Fig. 1B-100 Installing Upper and Lower Rails

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(2) Install lower compression ring using ring installer to expand ring around piston.

**NOTE:** Be sure upper and lower compression rings are installed right side up. Figure 1B-101 shows typical ring markings to indicate the top side of the ring.

(3) Install upper compression ring using ring installer to expand ring around piston (fig. 1B-102).

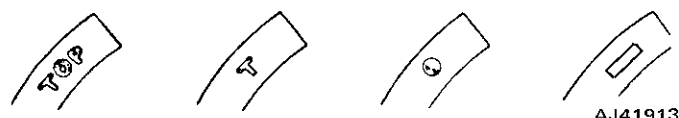


Fig. 1B-101 Typical Piston Ring Markings



Fig. 1B-102 Compression Ring Installation

### Piston Pins

The piston pins are pressed into the rods with 2000 pounds (907 kg) pressure and require no locking device.

### Removal

(1) Using Piston Pin Remover J-21872 and an arbor press, place piston on Remover Support J-21872-1 (fig. 1B-103).

(2) Use Piloted Driver J-21872-3 to press pin completely out of piston. Note position of pin through gauge window of remover support.

### Pin Fitting

(1) Inspect pin and pin bore for nicks and burrs. Replace as necessary.

**NOTE:** Never reuse piston pin after it has been installed in and removed from a connecting rod.

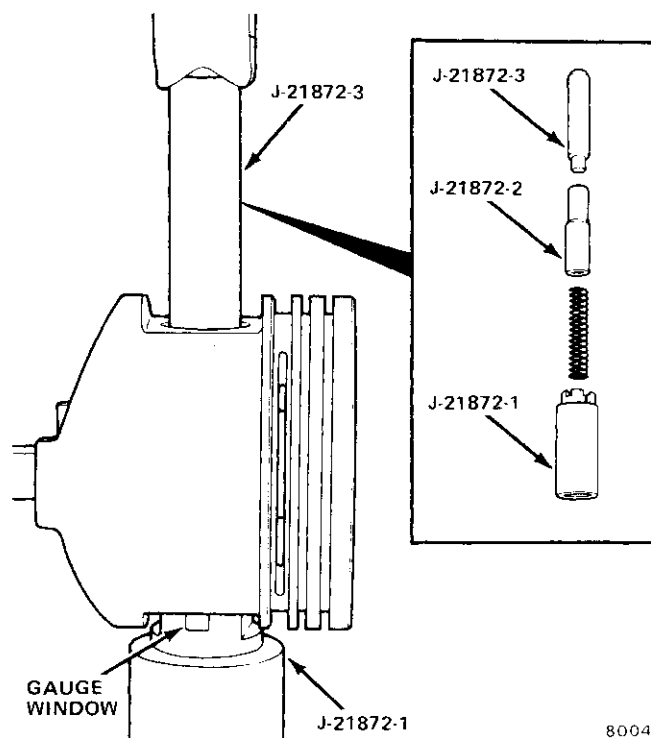


Fig. 1B-103 Piston Pin Removal and Installation

(2) With pin removed from piston, clean and dry piston pin bore and piston pin.

(3) Position piston so that pin bore is in vertical position. Insert pin in bore. At room temperature, replacement pin should slide completely through pin bore without pushing.

(4) Replace piston if pin jams in bore.

### Installation

(1) Position piston and connecting rod so that piston notch will face forward and rod squirt hole will face inward when assembly is installed in engine.

(2) Place Pin Pilot J-21872-2 through piston and connecting rod pin bores (fig. 1B-103).

(3) Place pin pilot, piston and connecting rod on Support J-21872-1.

(4) Place piston pin through upper piston pin bore and into connecting rod pin bore.

(5) Place Piloted Driver J-21872-3 inside piston pin.

(6) Use arbor press to press piston pin through connecting rod and piston until pin pilot indexes with mark on support.

**NOTE:** The piston pin requires 2000-pounds (907 kg) pressure for installation. If little effort is required to install piston pin in connecting rod, or if rod moves along pin, replace connecting rod.

(7) Remove piston and connecting rod assembly from press. Pin should be centered in rod  $\pm 1/32$  inch (0.787 mm).

### CRANKSHAFT

The crankshaft is counterweighted and balanced independently. The component parts of the crankshaft assembly are individually balanced, then the complete assembly is balanced as a unit. Service replacement dampers, crankshafts, flywheels and torque converters may be replaced without rebalancing the assembly.

There are five main bearings and four connecting rod journals. The end thrust is controlled by No. 3 main bearing.

The rear main bearing oil seal is protected from excessive oil by a slinger which is a machined part of the crankshaft.

**NOTE:** Mark the torque converter and converter flexplate prior to removal. Install in the same position during assembly.

### Removal or Replacement

Replace the crankshaft if it is damaged beyond reconditioning. Use the procedures outlined under Cylinder Block to remove or replace the crankshaft.

### Crankshaft End Play Measurement

Crankshaft end play is controlled at the No. 3 main bearing which is flanged for this purpose.

- (1) Attach dial indicator to crankcase adjacent to No. 3 main bearing.
- (2) Set dial indicator push rod on face of adjacent counterweight (fig. 1B-104).

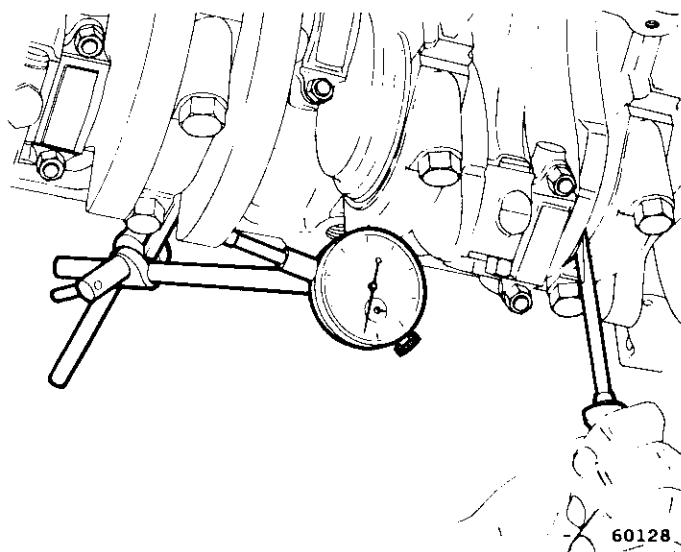


Fig. 1B-104 Crankshaft End Play Measurement

- (3) Pry crankshaft fore and aft.
- (4) Read dial indicator. End play is difference between high and low readings.

(5) If end play is outside of specifications, inspect crankshaft thrust faces for wear. If no wear is apparent, replace thrust bearing and check end play. If end play is still outside of specifications, replace crankshaft.

**NOTE:** When replacing the thrust bearings, pry the crankshaft fore and aft to align the thrust faces of the bearings before final torque tightening.

### Crankshaft Main Bearings

The main bearings are steel-backed aluminum-tin with overplated copper-lead as an optional lining. The main bearing caps are numbered 1 through 5, front to rear, with an arrow to indicate forward position. The upper main bearing inserts are grooved. The lower insert surfaces are smooth.

Each bearing is select fitted to its respective journal to obtain the desired operating clearance. **In production**, the select fit is obtained by using various-sized color-coded bearing inserts as shown in the Main Bearing Fitting Chart. The bearing color code appears on the edge of the insert.

**NOTE:** Bearing size is not stamped on production inserts.

The main bearing journal size is identified **in production** by a color-coded paint mark on the adjacent cheek toward the flanged (rear) end of the crankshaft except for the rear main journal. The paint mark for the rear main journal is on the crankshaft rear flange.

Use the Bearing Fitting Chart to select proper bearing inserts to obtain the specified bearing clearance. The correct clearance is 0.0015 to 0.0020 inch (0.038 mm to 0.051 mm) on No. 1 through No. 4 main bearings and 0.0023 to 0.0027 inch (0.058 mm to 0.069 mm) for the rear main bearing.

When required, use different sized upper and lower bearing inserts as a pair. Use a standard size upper insert in combination with a 0.001-inch undersize lower insert to reduce clearance by 0.0005 inch or 1/2 thousandth of an inch (0.013 mm).

Example:

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.001-inch undersize	0.002-inch undersize

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**NOTE:** When servicing upper and lower inserts of different sizes, install undersize inserts either all on the top (upper) or all on the bottom (lower). Never use bearing inserts with greater than 0.001-inch difference in pairs.

**Main Bearing Fitting Chart**

Crankshaft Main Bearing Journal Color Code and Diameter in Inches (Journal Size)	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
Yellow -2.7489 to 2.7484 (Standard)	Yellow - Standard	Yellow - Standard
Orange -2.7484 to 2.7479 (0.0005 Undersize)	Yellow - Standard	Black - .001-inch Undersize
Black -2.7479 to 2.7474 (0.001 Undersize)	Black - .001-inch Undersize	Black - .001-inch Undersize
Green -2.7474 to 2.7469 (0.0015 Undersize)	Black - .001-inch Undersize	Green - .002-inch Undersize
Red -2.7389 to 2.7384 (0.010 Undersize)	Red - .010-inch Undersize	Red - .010-inch Undersize

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**Service replacement bearing inserts** are available as pairs in the following sizes: standard, 0.001-inch undersize, 0.002-inch undersize, 0.010-inch undersize, and 0.012-inch undersize. The bearing size is stamped on the back of service replacement inserts.

**NOTE:** The 0.012-inch undersize insert is not used in production.

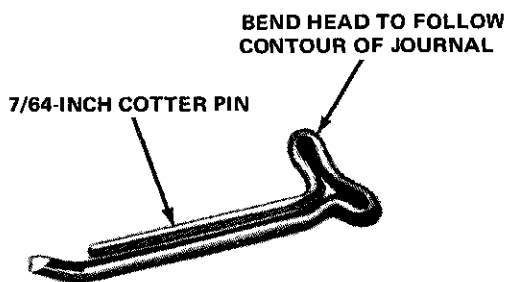
**Removal**

This procedure may be used with engine in vehicle.

- (1) Drain engine oil and remove pan.
- (2) Remove main bearing cap and insert.
- (3) Remove lower insert from bearing cap.
- (4) Remove upper insert by loosening all other bearing caps and inserting cotter pin about 1/2-inch (14 mm) long in crankshaft oil hole. Bend cotter pin as shown in figure 1B-105.
- (5) With pin in place, rotate shaft so that upper bearing insert is rotated in direction of its locking tab.
- (6) Remove and inspect remaining bearings in same manner.

lining. A normal main bearing wear pattern is shown in figure 1B-106.

**NOTE:** If the crankshaft journal is scored, remove the engine for crankshaft repair.

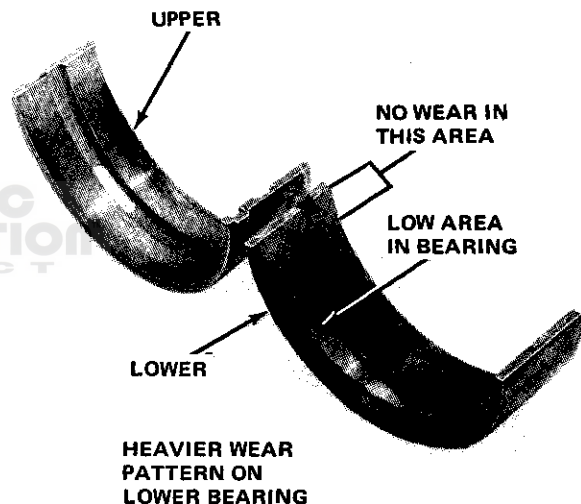


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**Fig. 1B-105 Upper Main Bearing Removal Tool**

**Inspection**

- (1) Wipe lower insert clean and inspect for abnormal wear pattern and for dirt or metal imbedded in



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**Fig. 1B-106 Normal Main Bearing Wear Pattern**

- (2) Inspect back of insert for fractures, scrapings or irregular wear pattern.
- (3) Inspect locking tab for damage.
- (4) Replace damaged or worn bearing inserts.

**Measuring Main Bearing Clearance with Plastigage (Crankshaft Installed)**

- (1) Support weight of crankshaft with jack placed under counterweight adjacent to main bearing being checked.

**NOTE:** Check clearance of one bearing at a time. ALL other bearings must remain tightened.

- (2) Remove main bearing cap and insert.
- (3) Wipe insert and exposed portion of crankshaft journal clean.
- (4) Place strip of Plastigage across full width of bearing insert.

**NOTE:** *Plastigage must not crumble. If brittle, obtain fresh stock.*

(5) Install bearing cap and tighten retaining screws to 100 foot-pounds (136 N•m) torque.

**NOTE:** *Do not rotate crankshaft. Plastigage will shift, resulting in inaccurate reading.*

(6) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope. Correct clearance is 0.0017 to 0.0020 inch (0.043 mm to 0.051 mm) on No. 1 through No. 4 main bearings and 0.0025 to 0.003 inch (0.064 mm to 0.076 mm) for the rear main bearing (fig. 1B-107).

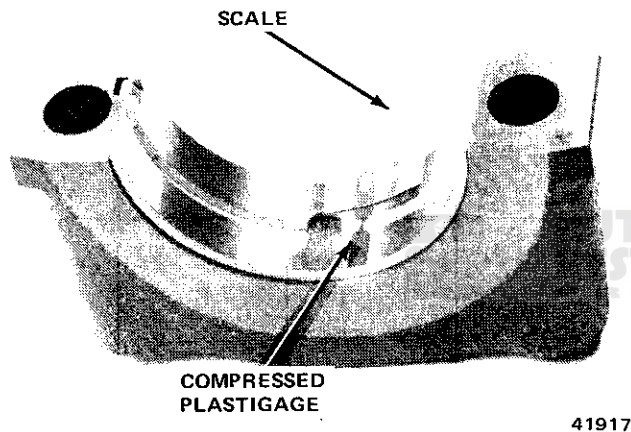


Fig. 1B-107 Checking Main Bearing Clearance with Plastigage

**NOTE:** *The Plastigage should maintain the same size across the entire width of the insert. If size varies, this may indicate a tapered journal or dirt trapped behind the insert.*

(7) If correct clearance is indicated, bearing fitting is not necessary. Remove Plastigage from crankshaft and bearing. Proceed to Installation.

**NOTE:** *Small pieces of Plastigage may remain on bearing surface. They will dissolve in hot engine oil after assembly.*

(8) If oil clearance exceeds specification, install pair of 0.001-inch undersize bearing inserts and check clearance as described in steps (3) through (6).

(9) The clearance indicated with the 0.001-inch undersize bearing installed will determine if the 0.001-inch undersize inserts or some other combination will provide correct clearance. For example, if the clearance was 0.0035-inch (0.089 mm) originally, a pair of 0.001-inch undersize inserts would reduce clearance by 0.001-inch (0.025 mm). Oil clearance would be 0.0025 inch (0.064 mm) and within specification. A 0.002-inch undersize

insert half and a 0.001-inch undersize half would reduce this clearance an additional 0.0005-inch (0.013 mm) and oil clearance would be 0.002-inch (0.051 mm).

**CAUTION:** *Never use a pair of inserts which differ more than one bearing size as a pair. For example, do not use a standard upper and 0.002-inch undersize lower.*

(10) If oil clearance exceeds specification using 0.002-inch undersize bearings, measure crankshaft journal with micrometer. If journal size is correct, crankshaft bore of cylinder block may be misaligned which requires cylinder block replacement. If journal size is incorrect, replace or grind crankshaft to standard undersize.

### Measuring Main Bearing Journal with Micrometer (Crankshaft Removed)

- (1) Wipe main bearing journal clean.
- (2) Measure journal diameter with micrometer. Note difference between maximum and minimum diameters.
- (3) Refer to Specifications for maximum allowable taper and out-of-round.
- (4) Compare maximum reading obtained with journal diameters listed in Main Bearing Fitting Chart.
- (5) Select inserts required to obtain specified bearing clearance. Correct clearance is 0.0015 to 0.0020 inch (0.038 mm to 0.051 mm) on No. 1 through No. 4 main bearings and 0.0023 to 0.0027 inch (0.058 mm to 0.069 mm) for the rear main bearing.

### Installation

- (1) Lubricate bearing surface of each insert with clean engine oil.
- (2) Loosen all main bearing caps.
- (3) Install main bearing upper insert(s).
- (4) Install main bearing cap(s) and lower insert(s). Tighten retaining screws evenly to 100 foot-pounds (136 N•m) torque in steps of 30, 60, 90 and 100 foot-pounds (41, 81, 122 and 136 N•m) torque. Turn crankshaft at each step to determine if crank rotates freely. If crank does not rotate freely, check inserts for proper installation and size.
- (5) After installation, turn crankshaft to check for free operation.
- (6) Install oil pan using replacement gaskets and seals. Tighten drain plug securely.
- (7) Fill crankcase to specified level with clean oil.

### Rear Main Bearing Oil Seal

The rear main bearing oil seal consists of a two-piece neoprene single lip seal. Correct installation of the seal is required for leak-free engine operation.

**Removal**

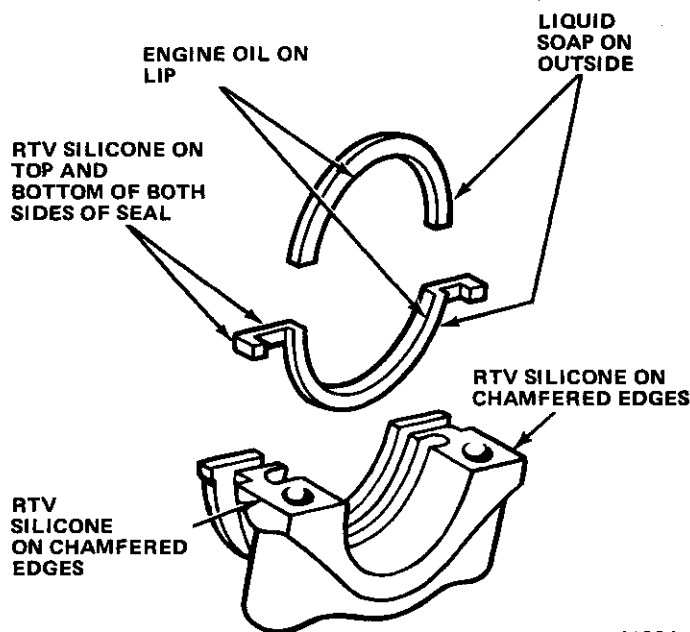
- (1) Drain engine oil.
- (2) Remove starter motor.
- (3) Remove oil pan.
- (4) Remove oil pan front and rear neoprene oil seals.
- (5) Remove oil pan side gaskets.
- (6) Thoroughly clean gasket surfaces of oil pan and engine block. Remove all sludge and dirt from oil pan sump.
- (7) Remove rear main bearing cap.
- (8) Remove and discard lower seal.

**NOTE:** To ensure leak-free operation, replace the upper and lower seal halves in pairs.

- (9) Clean main bearing cap thoroughly to remove all sealer.
- (10) Loosen all remaining main bearing capscrews.
- (11) Use brass drift and hammer to tap upper seal until sufficient seal is protruding to permit pulling seal out completely.

**Installation**

- (1) Wipe crankshaft seal surface clean. Oil lightly.
- (2) Coat block contacting surface of replacement upper seal with soap and lip of seal with engine oil (fig. 1B-108).



**Fig. 1B-108 Rear Main Oil Seal Installation**

- (3) Install upper seal into engine block.

**NOTE:** The lip of the seal must face to the front of the engine.

- (4) Coat both sides of replacement lower seal end tabs with Jeep Gasket-in-a-Tube (RTV silicone), or equivalent. Be careful to not apply sealer to lip of seal.
- (5) Coat outer curved surface of lower seal with soap and lip of seal with engine oil.
- (6) Install seal into cap recess and seat firmly.
- (7) Apply Jeep Gasket-in-a-Tube (RTV silicone), or equivalent, on both chamfered edges of rear main bearing cap.

**CAUTION:** Do not apply sealer to the cylinder block mating surface of the rear main cap as bearing clearance could be affected.

- (8) Tighten all main bearing capscrews to 100 foot-pounds (136 N•m) torque.
- (9) Install oil pan using replacement gaskets and seals. Tighten drain plug securely.
- (10) Install starter motor.
- (11) Fill crankcase to specified level with clean oil.

**Vibration Damper**

The vibration damper is balanced independently and then rebalanced as part of the complete crankshaft assembly.

**Do not attempt to duplicate original damper balance holes when installing a service replacement.** The vibration damper is not repairable and is serviced only as a complete assembly.

**Removal**

- (1) Loosen damper retaining screw.
- (2) Loosen alternator drive belt.
- (3) Loosen air conditioning drive belt, if equipped, and move aside.
- (4) Loosen power steering drive belt, if equipped, and move aside.
- (5) Remove damper drive pulley retaining screws. Remove damper pulley from vibration damper.
- (6) Remove damper retaining screw and washer.
- (7) Use Vibration Damper Removal Tool J-21791 to remove damper from crankshaft (fig. 1B-109).

**Installation**

- (1) Polish damper hub with crocus cloth to prevent seal damage.
- (2) Apply light film of engine oil to seal contacting surface of vibration damper.
- (3) Align key slot of vibration damper with crankshaft.
- (4) Position damper onto crankshaft.
- (5) Lubricate screw threads and washer with engine oil.
- (6) Install damper retaining screw and washer and tighten to 90 foot-pounds (122 N•m) torque.



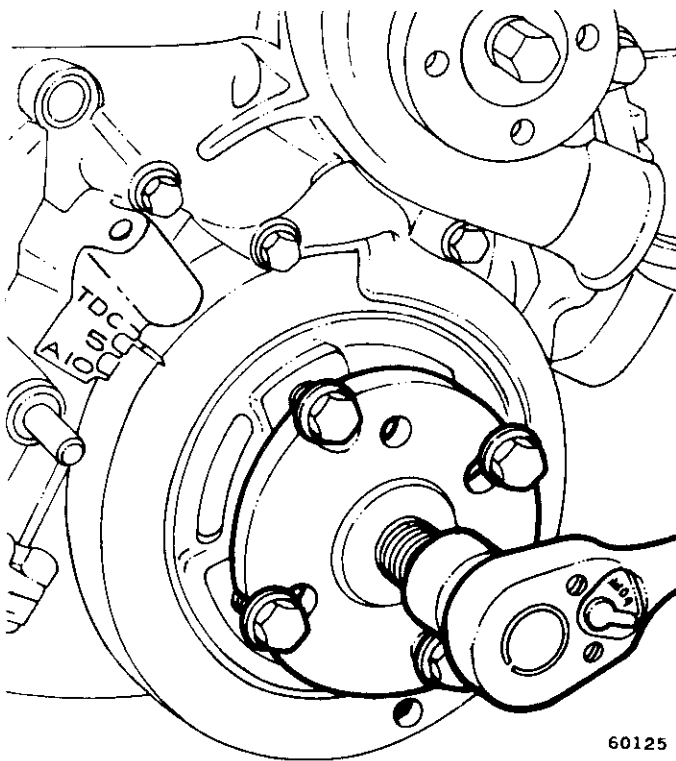


Fig. 1B-109 Vibration Damper Removal

**NOTE:** If crankshaft turns before torque is reached, proceed with belt installation. With belts installed, tighten damper retaining screw to 90 foot-pounds (122 N•m) torque.

(7) Install damper pulley and retaining screws. Tighten screws to 30 foot-pounds (41 N•m) torque.

(8) Install drive belts and tighten to specified tension. Refer to Chapter 1C—Cooling.

### Flywheel and Starter Ring Gear Assembly

The starter ring gear is a separate item only on vehicles with manual transmission. On automatic transmission vehicles, the starter ring gear is welded to and balanced as part of the torque converter drive plate and is not removeable separately.

### Ring Gear Replacement—Manual Transmission (Flywheel Removed)

(1) Place flywheel on arbor press with steel blocks equally spaced under gear.

(2) Press flywheel through ring gear.

**NOTE:** The ring gear can also be removed by breaking it with a chisel.

(3) Apply heat to expand inside diameter of replacement ring gear.

(4) Press replacement ring gear onto flywheel.

**NOTE:** On manual transmission, the flywheel is balanced as an individual component and also as part of the crankshaft assembly. Do not attempt to duplicate original flywheel balance holes when installing a service replacement.

## CYLINDER BLOCK

### Disassembly

- (1) Drain engine oil.
  - (2) Remove engine assembly from vehicle as outlined in Engine Removal.
  - (3) Use engine stand to support engine assembly.
  - (4) Remove distributor.
  - (5) Remove cylinder head covers and gaskets.
  - (6) Remove rocker arms and bridged pivot assemblies. Alternately loosen capscrews one turn at a time to avoid damaging bridge.
  - (7) Remove push rods.
  - (8) Remove intake manifold assembly.
  - (9) Remove valve tappets.
  - (10) Remove cylinder heads and gaskets.
  - (11) Position pistons, one at a time, near bottom of stroke. Use ridge reamer to remove any ridge from top end of cylinder walls.
  - (12) Loosen all drive belts. Remove power steering pump, air pump and air conditioning compressor, if equipped.
  - (13) Remove damper pulley and vibration damper.
  - (14) Remove timing case cover.
  - (15) Remove oil pan.
  - (16) Remove camshaft.
  - (17) Remove connecting rod bearing caps and inserts and keep in same order as removed.
- NOTE:** Connecting rods and caps are stamped with the number of the cylinder to which they were assembled.
- (18) Remove connecting rod and piston assemblies through top of cylinder bores. Be careful that connecting rod screws do not scratch connecting rod journals or cylinder walls. Short pieces of rubber hose slipped over rod screws will provide protection during removal.
  - (19) Remove oil pickup tube and screen assembly.
  - (20) Remove main bearing caps and inserts.
  - (21) Remove crankshaft.

### Cylinder Bore Reconditioning

#### Measuring Cylinder Bore

Use a bore gauge to measure the cylinder bore (fig. 1B-110). If a bore gauge is not available use an inside micrometer.

(1) Measure cylinder bore crosswise to block near top of bore. Repeat measurement at bottom of bore.

- (2) Determine taper by subtracting smaller dimension from larger dimension.
- (3) Turn measuring device 120° and repeat step (1). Then turn another 120° and repeat again.
- (4) Determine out-of-roundness by comparing difference between readings taken 120° apart.

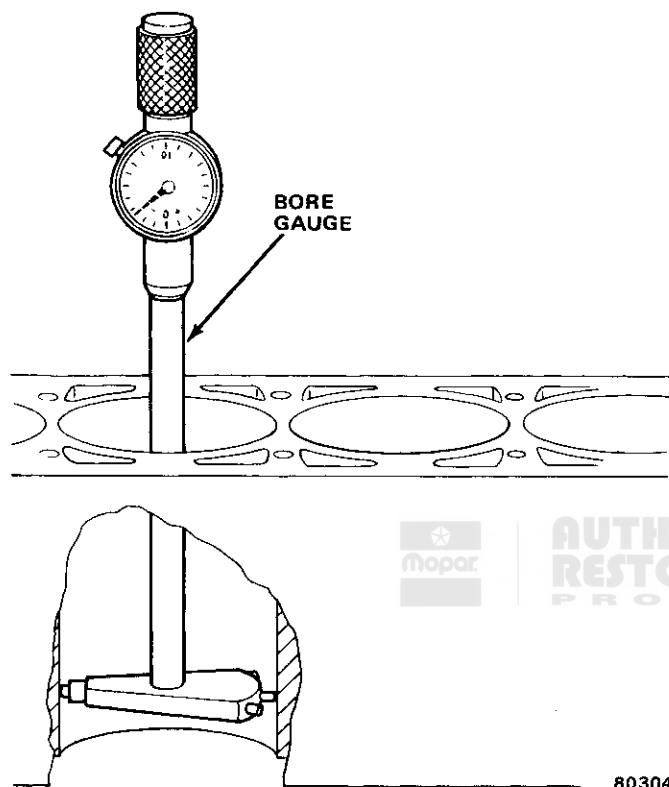


Fig. 1B-110 Measuring Cylinder Bore with Bore Gauge

If cylinder taper does not exceed 0.005 (0.127 mm) inch and out-of-round does not exceed 0.003 inch (0.076 mm), true the cylinder bore by honing. If the cylinder taper or out-of-round condition exceeds these limits, bore and then hone cylinder for an oversize piston.

#### Resurfacing Cylinder Bore

**CAUTION:** Do not use rigid type hones to remove cylinder glaze. A slight amount of taper always exists in cylinder walls after the engine has been in service.

- (1) Use expanding hone to true cylinder bore and to remove glaze for faster ring seating. Move hone up and down at sufficient speed to produce uniform 60° angle crosshatch pattern on the cylinder walls. Do not use more than ten strokes per cylinder. A stroke is one down-and-up motion.

**CAUTION:** Protect engine bearings and lubrication system from abrasives.

- (2) Scrub cylinder bores clean with solution of hot water and detergent.

- (3) Immediately apply light engine oil to cylinder walls. Wipe with clean, lint-free cloth.

**NOTE:** If crankshaft remains in block, cover connecting rod journals with clean cloths during cleaning operation.

#### Assembly

- (1) Install and lubricate upper main bearing inserts and rear main upper seal. Lubricate seal lip.

- (2) Install crankshaft.

- (3) Install main bearing caps and inserts. If replacement bearings are installed, Plastigage each bearing.

- (4) Install replacement oil pickup tube and screen assembly. Do not attempt to install original pickup tube. Be sure plastic button is inserted in bottom of replacement screen.

- (5) Install camshaft.

- (6) Position piston rings on pistons. Refer to Piston Rings for sequence.

- (7) Lubricate piston and ring surfaces with clean engine oil.

- (8) Use piston ring compressor tool to install connecting rod and piston assemblies through top of cylinder bores. Be careful that connecting rod screws do not scratch connecting rod journals or cylinder walls. Short lengths of rubber hose slipped over connecting rod screws will provide protection during installation.

- (9) Install connecting rod bearing caps and inserts in same order as removed. Tighten nuts to 33 foot-pounds (45 N•m) torque.

- (10) Install camshaft and timing chain.

- (11) Install timing case cover and gaskets. Refer to Timing Case Cover.

- (12) Install engine oil pan using replacement gaskets and seals. Tighten drain plug securely.

- (13) Install vibration damper and damper pulley.

- (14) Install cylinder head and replacement gaskets.

- (15) Install valve tappets.

- (16) Install intake manifold and replacement gaskets.

- (17) Install push rods.

- (18) Install rocker arms and bridged pivot assemblies. Loosely install capscrews to each bridged pivot. At each bridged pivot, alternately tighten capscrews one turn at a time to avoid damaging bridge. Tighten capscrews to 19 foot-pounds (26 N•m) torque.

- (19) Turn crankshaft to bring No. 1 cylinder to TDC on compression stroke.

- (20) Reseal and install cylinder head covers.

- (21) Install power steering pump, air pump and air conditioning compressor.

- (22) Install distributor.

- (a) Point rotor to No. 1 spark plug wire position.

# 1B-70 ENGINES

(b) Turn oil pump shaft with long screw driver to allow distributor shaft to engage oil pump.

(c) With rotor pointing to No. 1 spark plug wire position, rotate housing counterclockwise until leading edge of trigger wheel segment is aligned with center of sensor. Tighten distributor clamp.

(d) When engine is installed and running, check ignition timing as outlined in Chapter 1A—General Service and Diagnosis.

(23) Remove engine from stand.

(24) Install engine assembly as outlined in Engine Installation.

## SPECIFICATIONS

### Eight-Cylinder Engine Specifications

	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified		(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified
<b>Bore</b>					
304	3.75	95.25			
360	4.08	103.63			
<b>Stroke</b>					
304	3.44	87.38			
360	3.44	87.38			
<b>Displacement</b>					
304	304 cu.in.	5 liter			
360	360 cu.in.	6 liter			
<b>Compression Ratio</b>					
304		8.40:1			
360		8.25:1			
<b>Compression Pressure</b>					
304	140 psi (min)	965 kPa (min)			
360	140 psi (min)	965 kPa (min)			
Maximum Variation Between Cylinders	20 psi	138 kPa (min)			
<b>Taxable Horsepower</b>					
304	45.00	33.56 kW			
360	53.27	39.72 kW			
Fuel		unleaded			
<b>Camshaft</b>					
Fuel Pump Eccentric Diameter	2.182-2.192	55.423-55.677			
Tappet Clearance	Zero lash (hydraulic tappets)				
End Play	Zero (engine operating)				
Bearing Clearance	0.001-0.003 (0.0017-0.0020 preferred)	0.0254-0.0762 (0.0432-0.0508 preferred)			
<b>Bearing Journal Diameter</b>					
No. 1	2.1195-2.1205	53.835-53.861			
No. 2	2.0895-2.0905	53.073-53.099			
No. 3	2.0595-2.0605	52.311-52.337			
No. 4	2.0295-2.0305	51.549-51.575			
No. 5	1.9995-2.0005	50.787-50.813			
Maximum Base Circle Runout	0.001	0.0254			
<b>Cam Lobe Lift</b>					
304/360	0.266	6.7564			
<b>Intake Valve Timing</b>					
Opens 304/360	14.75°	BTDC			
Closes 304/360	68.75°	BTDC			
<b>Exhaust Valve Timing</b>					
Opens 304/360	56.75°	BBDC			
Closes 304/360	26.75°	ATDC			
<b>Valve Overlap</b>					
304/360	41.50°				
<b>Intake Duration</b>					
304/360	263.50°				
<b>Exhaust Duration</b>					
304/360	263.50°				
<b>Connecting Rods</b>					
Total Weight (Less Bearings)				681-689 grams	
304/360					
Total Length (Center-to-Center)					
304/360	5.873-5.877	149.17-149.28			
Bearing Clearance	0.001-0.003 (0.0020-0.0025 preferred)	0.03-0.08 (0.051-0.064 preferred)			
Side Clearance	0.006-0.018	0.15-0.46			
Maximum Twist	0.0005	0.013			
	per inch	per 25.4 mm			
Maximum Bend	0.001	0.03			
	per inch	per 25.4 mm			
<b>Crankshaft</b>					
End Play	0.003-0.008	0.08-0.20			
<b>Main Bearing Journal Diameter</b>					
No. 1, 2, 3, 4	2.7474-2.7489	69.784-69.822			
Rear Main	2.7464-2.7479	69.759-69.797			
<b>Main Bearing Journal Width</b>					
304/360					
No. 1	1.2635-1.2695	32.093-32.25			
No. 2	1.246-1.248	31.65-31.70			
No. 3	1.273-1.275	32.33-32.39			
No. 4	1.246-1.248	31.65-31.70			
No. 5	1.215-1.217	30.86-30.91			
<b>Main Bearing Clearance</b>					
No. 1, 2, 3, 4	0.001-0.003 (0.0017-0.0020 preferred)	0.03-0.08 (0.04-0.05 preferred)			
<b>Rear Main</b>					
No. 5	0.002-0.004 (0.0025-0.003 preferred)	0.05-0.10 (0.06-0.08 preferred)			
<b>Connecting Rod Journal Diameter</b>					
304/360	2.0934-2.0955	53.172-53.266			
<b>Connecting Rod Journal Width</b>					
304/360	1.998-2.004	50.75-50.90			
<b>Connecting Rod Bearing</b>					
Clearance	0.001-0.003 (0.0020-0.0025 preferred)	0.03-0.08 (0.051-0.064 preferred)			
Maximum Taper (All Journals)	0.0005	0.013			
Maximum Out-of-Round (All Journals)	0.0005	0.013			
<b>Cylinder Block</b>					
Deck Height	9.205-9.211	233.81-233.96			
<b>Deck Clearance</b>					
304/360	0.0145 (below block)	0.368 (below block)			

	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified		(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified
Maximum Cylinder Taper	0.005	0.13	No. 2	0.0015-0.003 (0.0015 preferred)	0.038-0.076 (0.038 preferred)
Maximum Cylinder Out-of-Round	0.003	0.08	Oil Control	0.0011-0.008	0.028-0.203
Tappet Bore Diameter	0.9055-0.9065	22.999-23.025	360		
Cylinder Block Flatness	0.001/1- 0.002/6 0.008 (max)	0.03/25- 0.05/152 0.20 (max)	No. 1	0.0015-0.003 (0.0015 preferred)	0.038-0.076 (0.038 preferred)
<b>Cylinder Head</b>			No. 2	0.0015-0.0035 (0.0015 preferred)	0.038-0.089 (0.038 preferred)
Combustion Chamber Volume			Oil Control	0.000-0.007	0.000-0.18
304	57.42-60.42 cc		<b>Piston Ring Groove Height</b>		
360	58.62-61.62 cc		No. 1 and No. 2	0.0795-0.0805	2.019-2.045
Valve Arrangement	E1-I-E-E1-I-E		Oil Control	0.1880-0.1895	4.775-4.813
Valve Guide ID (Integral)	0.3735-0.3745	9.487-9.512	<b>Piston Ring Groove Diameter</b>		
Valve Stem-to-Guide Clearance	0.001-0.003	0.03-0.08	304		
Intake Valve Seat Angle		30°	No. 1 and No. 2	3.328-3.333	84.53-84.66
Exhaust Valve Seat Angle		44.5°	Oil Control	3.329-3.339	84.56-84.81
Valve Seat Width	0.040-0.060	1.02-1.52	360		
Valve Seat Runout	0.0025 (max)	0.064 (max)	No. 1 and No. 2	3.624-3.629	92.05-92.18
Cylinder Head Flatness	0.001/1- 0.002/6 0.008 (max)	0.03/25- 0.05/152 0.20 (max)	Oil Control	3.624-3.635	92.05-92.33
<b>Lubrication System</b>			<b>Piston Pin Diameter</b>		
Engine Oil Capacity	4 quarts (add 1 quart with filter change)	3.8 liters (add 0.9 liters with filter change)	304/360	0.9308-0.9313	23.649-23.655
Normal Operating Pressure	13 psi at 600 rpm 37-75 psi at 1600+ rpm	90 kPa at 600 rpm 255-517 kPa at 1600+ rpm	<b>Piston Pin Bore Diameter</b>		
Oil Pressure Relief	75 psi (max)	517 kPa (max)	304/360	0.9288-0.9298	23.592-23.617
Gear-to-Body Clearance	0.0005-0.0025 (0.0005 preferred)	0.013-0.064 (0.013 preferred)	Piston-to-Pin Clearance	0.0003-0.0005 (0.005 preferred) loose	0.008-0.013 (0.013 preferred) loose
Gear End Clearance	0.0005-0.006 (0.002 preferred)	0.051-0.152 (0.051 preferred)	<b>Rocker Arms, Push Rods, and Tappets</b>		
<b>Pistons</b>			Rocker Arm Ratio	1.6:1	
Weight (Less Pin)			Push Rod Length	7.790-7.810	197.87-198.37
304	506-510 grams		Push Rod Diameter	0.312-0.315	7.93-8.00
360	601-605 grams		Hydraulic Tappet Diameter	0.9040-0.9045	22.962-22.974
<b>Piston Pin Bore CL-to Piston Top</b>			Tappet-to-Bore Clearance	0.001-0.0025	0.025-0.064
304/360	1.599-1.603	40.62-40.72	<b>Valves</b>		
<b>Piston-to-Bore Clearance</b>			Valve Length		
304	0.0010-0.0018 (0.0014 preferred)	0.025-0.46 (0.035 preferred)	(Tip-to-Gauge Dim. Line)	4.7895-4.8045	121.653-122.034
360	0.0012-0.0020 (0.0016 preferred)	0.030-0.051 (0.041 preferred)	Valve Stem Diameter	0.3715-0.3725	9.436-9.462
<b>Piston Ring Gap Clearance</b>			Stem-to-Guide Clearance	0.001-0.003	0.03-0.08
No. 1 and No. 2	0.010-0.020 (0.010-0.012 preferred)	0.25-0.51 (0.25-0.305 preferred)	<b>Intake Valve Head Diameter</b>		
<b>Oil Control Steel Rail</b>			304	1.782-1.792	45.26-45.52
304	0.010-0.025	0.25-0.64	360	2.020-2.030	51.31-51.56
360	0.015-0.045 (0.010-0.020 preferred)	0.38-1.14 (0.25-0.51 preferred)	Intake Valve Face Angle		29°
<b>Piston Ring Side Clearance</b>			<b>Exhaust Valve Head Diameter</b>		
No. 1	0.0015-0.0035 (0.0015 preferred)	0.038-0.089 (0.038 preferred)	304	1.401-1.411	35.59-35.84
			360	1.675-1.685	42.55-42.80
			Exhaust Valve Face Angle		44°
			<b>Valve Springs</b>		
			Free Length	1.99	50.55
			<b>Spring Tension</b>		
			Valve Closed	64-72 lbs. at 1.786	29.0-32.7 kg. at 45.36
			Valve Open	202-220 lbs. at 1.356	91.6-99.8 kg. at 34.44
			Inside Diameter (All)	0.948-0.968	24.08-24.59

## 1B-72 ENGINES

### Torque Specifications

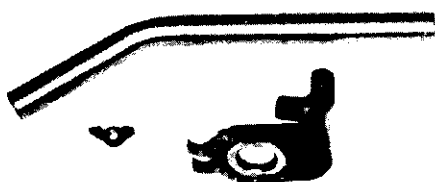
Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft.lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Air Injection Tube-to-Manifold	38	30-45	52	41-61
Air Pump-to-Bracket Pivot Screw	20	15-22	27	20-30
Air Pump Brackets-to-Engine—AC Compressor or Pedestals	25	18-28	34	24-38
Air Pump Adjusting Strap-to-Pump	20	15-22	27	20-30
Alternator Pivot Bolt or Nut	28	20-35	38	27-47
Alternator Adjusting Bolt	18	15-20	24	20-27
Alternator Mounting Bracket Bolt-to-Engine	28	23-30	38	31-41
Alternator Pivot Mounting Bolt-to-Head	33	30-35	45	41-47
Block Heater Nut, T-Screw Type	20 in.lbs.	17-25 in.lbs.	2	2-3
Camshaft Gear Retainer Screw	30	25-35	41	34-47
Carburetor Adapter-to-Manifold Screws—2V	14	12-15	19	16-20
Carburetor Holddown Nuts	14	12-15	19	16-20
Connecting Rod Bolt Nuts	33	30-35	45	41-47
Crankshaft Pulley-to-Damper	23	18-28	31	24-38
Cylinder Head Capscrews	110	100-120	149	136-163
Cylinder Head Cover Screws	50 in.lbs.	42-58 in.lbs.	6	5-7
Distributor Clamp Screw	13	10-18	18	14-24
Drive Plate-to-Converter Screw	22	20-25	30	27-34
EGR Valve-to-Manifold	13	9-18	18	12-24
Exhaust Manifold Screws				
Center (2)	25	20-30	34	27-41
Outer (4)	15	12-18	20	16-24
Exhaust Pipe-to-Manifold Nuts	20	15-25	27	20-34
Fan and Hub Assembly Bolts	18	12-25	24	16-34
Flywheel or Drive Plate-to-Crankshaft	105	95-115	142	129-156
Front Support Cushion Bracket-to-Block Screw	35	25-40	47	34-54
Front Support Cushion-to-Bracket-to-Frame	37	30-45	50	41-61
Fuel Pump Screws	16	13-19	22	18-26
Idler Pulley Bearing Shaft-to-Bracket Nut	33	28-38	45	38-52
Idler Pulley Bracket-to-Front Cover Nut	7	4-9	9	5-12
Intake Manifold Screws	43	37-47	58	50-64
Main Bearing Capscrews	100	90-105	136	122-142
Oil Pump Cover Screws	55 in.lbs.	45-65 in.lbs.	6	5-7
Oil Pan Screws				
1/4 inch - 20	7	5-9	9	7-12
5/16 inch - 18	11	9-13	15	12-18
Oil Relief Valve Cap	28	22-35	38	30-47
Power Steering Pump Adapter Screw	23	18-28	31	24-38
Power Steering Pump Bracket Screw	43	37-47	58	50-64
Power Steering Pump Mounting Screw	28	25-35	38	34-47
Rear Crossmember-to-Side Sill Nut	30	20-35	41	27-47
Rear Insulator Bracket-to-Trans. Screw	33	27-38	45	37-52
Rear Support Insulator-to-Bracket Nut	48	40-55	65	54-75
Rear Support Cushion-to-Crossmember Screw Nut	18	12-25	24	16-34
Rocker Arm Capscrew	19	16-26	26	22-35
Spark Plugs	28	22-33	38	30-45
Starter Motor to Converter Housing Screws	18	13-25	24	18-34
Thermostat Housing Screw	13	10-18	18	14-24
Throttle Valve Rod Adjusting Screw	40 in.lbs.	30-50 in.lbs.	5	3-6
Timing Case Cover-to-Block	25	18-33	34	24-45
Vibration Damper Screw (Lubricated)	90	80-100	122	108-136
Water Pump Screws	48 in.lbs.	40-55 in.lbs.	5	5-6

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in Chapter A of this manual for any torque specifications not listed above.

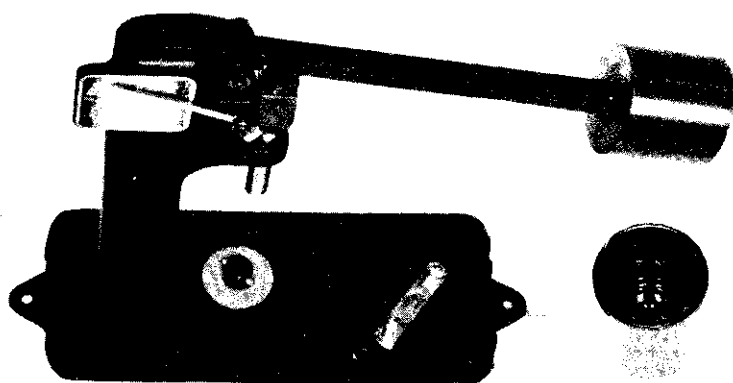
Tools



J-22534-1  
VALVE SPRING  
REMOVER AND  
INSTALLER



J-21791  
VIBRATION DAMPER  
REMOVER



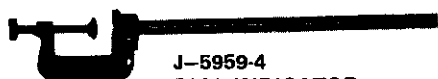
J-5790  
HYDRAULIC VALVE LIFTER TESTER



J-21872  
PISTON PIN REMOVER AND INSTALLER



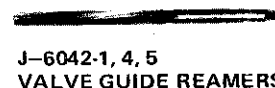
J-26562  
TIMING CASE COVER  
OIL SEAL INSTALLER



J-5959-4  
DIAL INDICATOR  
CLAMP AND ROD



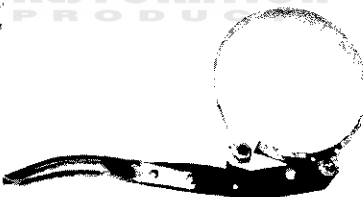
J-26562  
OIL SEAL INSTALLER



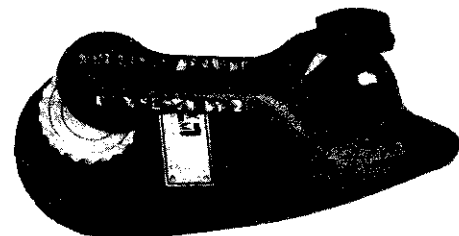
J-6042-1, 4, 5  
VALVE GUIDE REAMERS



J-8520  
DIAL INDICATOR SET  
(0-1 INCH -.001 INCH GRADUATION)



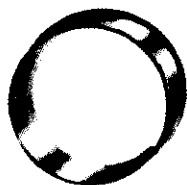
J-22700  
OIL FILTER WRENCH



J-8056  
VALVE AND CLUTCH  
SPRING TESTER



J-22248  
TIMING CASE COVER  
ALIGNMENT TOOL AND  
SEAL INSTALLER



J-5601  
PISTON RING  
COMPRESSOR 3-3/4"



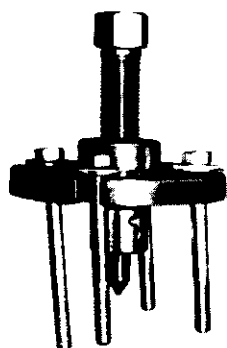
SCREW, TIMING CASE  
COVER CRANKSHAFT  
SEAL INSTALLER  
PART OF TOOL J-9163



J-21882  
OIL PUMP INLET  
TUBE INSTALLER



J-9256 TIMING CASE COVER  
OIL SEAL REMOVER



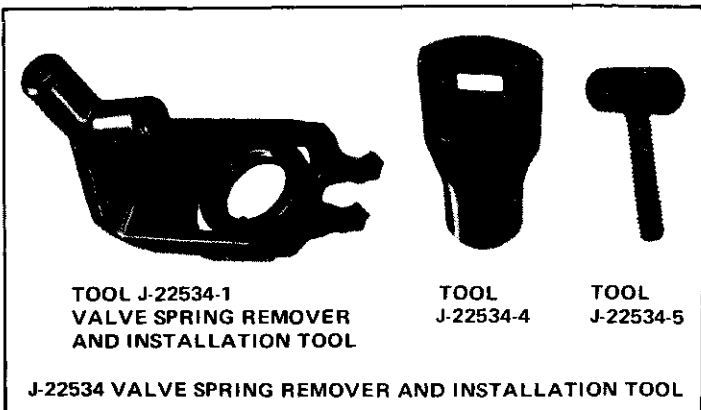
J-21791 VIBRATION  
DAMPER REMOVER



J-6042-1, 4, 5  
VALVE GUIDE REAMERS



J-21884 HYDRAULIC VALVE TAPPET  
REMOVER AND INSTALLER



TOOL J-22534-1  
VALVE SPRING REMOVER  
AND INSTALLATION TOOL

TOOL  
J-22534-4

TOOL  
J-22534-5

J-22534 VALVE SPRING REMOVER AND INSTALLATION TOOL

## NOTES



**AUTHENTIC  
RESTORATION  
PRODUCT**

# COOLING SYSTEMS

# 1C

## SECTION INDEX

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Coolant Temperature Override Switch	1C-4	Testing	1C-12
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Cooling System Operation	1C-4	Tools	1C-25
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General	1C-1	Water Pump Pulley	1C-18

### GENERAL

The cooling system regulates engine operating temperature by allowing the engine to reach normal operating temperature as quickly as possible, maintaining normal operating temperature, and preventing over-

heating (fig. 1C-1 and 1C-2). The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid.

The cooling system is pressurized and uses a centrifugal water pump to circulate coolant through the system.

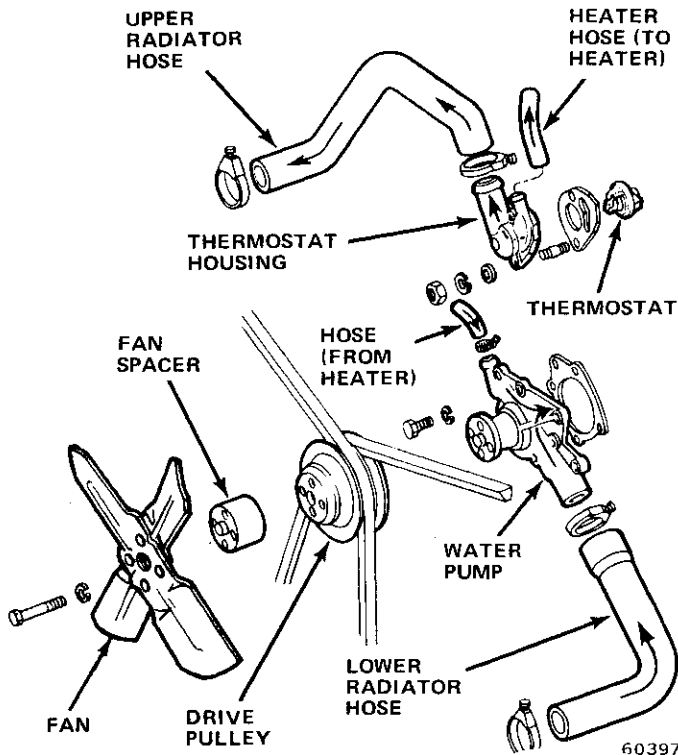


Fig. 1C-1 Six-Cylinder Cooling System

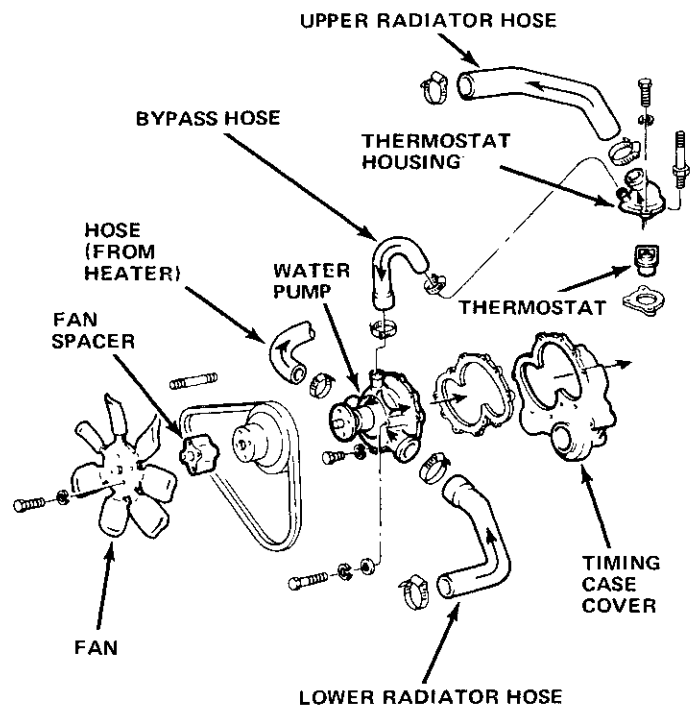


Fig. 1C-2 Eight-Cylinder Cooling System



### COMPONENTS

#### Coolant

The coolant is a mixture of low mineral content water and ethylene glycol-based antifreeze. The addition of antifreeze to water alters several physical characteristics of water that are important to cooling system performance. The freezing point is lowered, the boiling point is raised and tendencies for corrosion and foaming are reduced. The lowered freezing point protects the engine and cooling system components from damage caused by the expansion of water as it freezes. The raised boiling point contributes to more efficient heat transfer. Reduced corrosion and reduced foaming permit unobstructed coolant flow for more efficient cooling. During heat-soak conditions after engine shutdown, the higher boiling point helps prevent coolant loss due to boilover. The higher boiling point also helps minimize damage caused by cavitation.

**NOTE:** *Cavitation is the formation of a partial vacuum by moving a solid body (pump impeller) swiftly through a liquid (coolant). The vacuum reduces the boiling point of the liquid and allows the formation of vapor bubbles, which burst when contacting a hard surface. If enough bubbles do this in a localized area, metal can be eroded, causing leakage.*

#### Water Pump

A centrifugal water pump circulates the coolant through the water jackets, passages, radiator core and hoses of the system. The pump is driven by the engine vibration damper pulley, through a v-type belt. The steel water pump impeller is pressed onto the rear of the shaft which rides in bearings pressed into the cast iron housing. The housing has a small hole to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant. No additional lubrication is necessary.

#### Hoses

Rubber hoses route coolant to the heater core and radiator. On some vehicles with eight-cylinder engines, the heater return hose is routed through a bracket attached to the carburetor choke housing.

The lower radiator hose on all models is spring-reinforced to prevent collapsing caused by water pump suction.

#### Thermostat

A pellet-type thermostat controls operating temperature of the coolant by controlling coolant flow to the radiator. The temperature-sensitive pellet keeps the water control valve closed below 195°F (91°C), causing coolant to be recirculated within the engine. Above

195°F (91°C), coolant is allowed to flow to the radiator. This provides quick warmup and overall temperature control. The words TO RAD are stamped on the thermostat to indicate the proper installed position. The same thermostat is used for winter and summer. Engines should not be operated without a thermostat except for servicing or testing. Operating without a thermostat causes longer engine warmup time, poor warmup performance and crankcase condensation which can lead to sludge formation.

#### Radiator

The radiator, a tube and spacer type, is composed of two tanks soldered to the cooling tubes. The filler neck has an overflow tube that routes overboil to the road or to the coolant recovery bottle.

The radiator used on all models is of the downflow type. A top tank and a bottom tank are soldered to vertical cooling tubes. The radiator cap and filler neck are located on the top, or inlet, tank. The bottom, or outlet, tank contains the drain cock. It also contains the oil cooler on vehicles with automatic transmission.

Some radiators have a plastic shroud or metal ring attached to funnel air more directly through the radiator for improved cooling at idle and low road speeds.

#### Radiator Pressure Cap

The radiator cap consists of a pressure valve and a vacuum valve. The cap performs several functions:

- Prevents coolant loss when vehicle is in motion.
- Keeps impurities out of the system to minimize corrosion.
- Allows atmospheric pressure to equalize the vacuum that occurs in the system during cooldown.
- Seals cooling system pressure up to 14 psi (96.5 kpa), which raises the coolant boiling point approximately 2-1/2°F per pound of pressure (.20°C per kilopascal of pressure).

#### Fan

**WARNING:** *Do not stand in line with fan when engine is running, particularly at speeds above idle.*

A water pump-driven fan is used to pull cooling air through the radiator. This is particularly important at low road speeds. At higher speeds, the motion of the vehicle forces air through the radiator.

Two types of fans are used. The rigid fan, having 4 or 7 blades, is attached to the water pump by a spacer. The spacer positions the fan close to the radiator for efficiency. The seven blade Tempatrol fan has a fluid coupling attaching the fan blade to the water pump (fig. 1C-3). The fluid coupling is torque and temperature sensitive and automatically increases or decreases fan speed for proper cooling. Regulation is accomplished by a thermostatic coil in the fluid coupling which reacts to changing temperature of airflow through the radiator. The

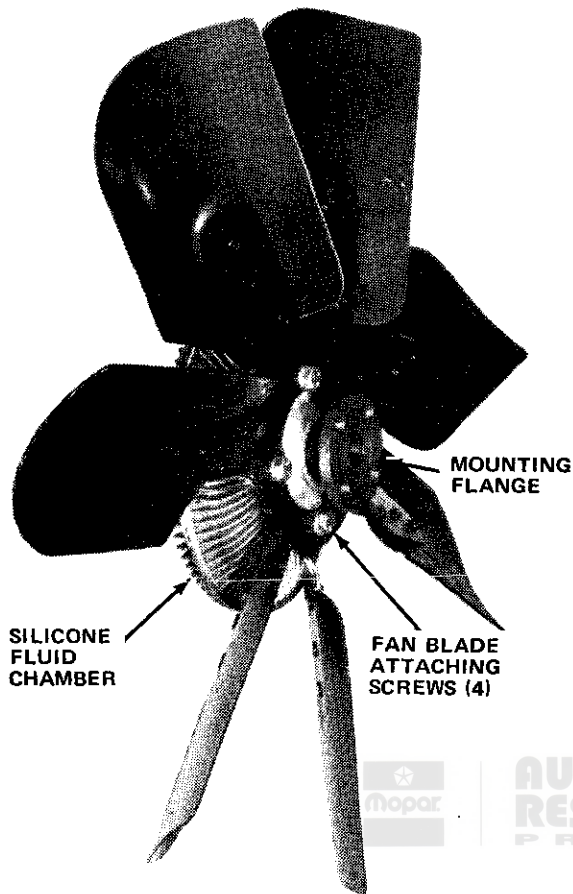


Fig. 1C-3 Tempatrol Fan

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bimetal coil controls the flow of silicone fluid in the coupling, providing speed control in proportion to the cooling demands of the engine.

On some vehicles, additional airflow is provided by a fan shroud.

### Coolant Recovery System

Some Cherokee, Wagoneer and Truck models are equipped with a coolant recovery system. The coolant recovery system consists of a pressure radiator cap, an overflow hose, and a plastic coolant recovery bottle (fig. 1C-4).

The radiator cap used with the recovery system has a gasket to prevent air leakage at the filler neck. The cap is round to discourage unnecessary removal and has a mark on top which should be aligned with the overflow hose to indicate proper installed position. The rubber overflow hose fits into the top of the plastic bottle and protrudes to the bottom. The overflow hose must always be submerged in coolant. The bottle has a molded-in tube for overflow. This same tube allows atmospheric pressure to enter during recovery operation. The bottle is fitted with a plastic cap.

### Temperature Gauge

All models are equipped with a temperature gauge which indicates coolant temperature. Refer to Chapter 1L—Power Plant Instrumentation for operation, diagnosis and repair.

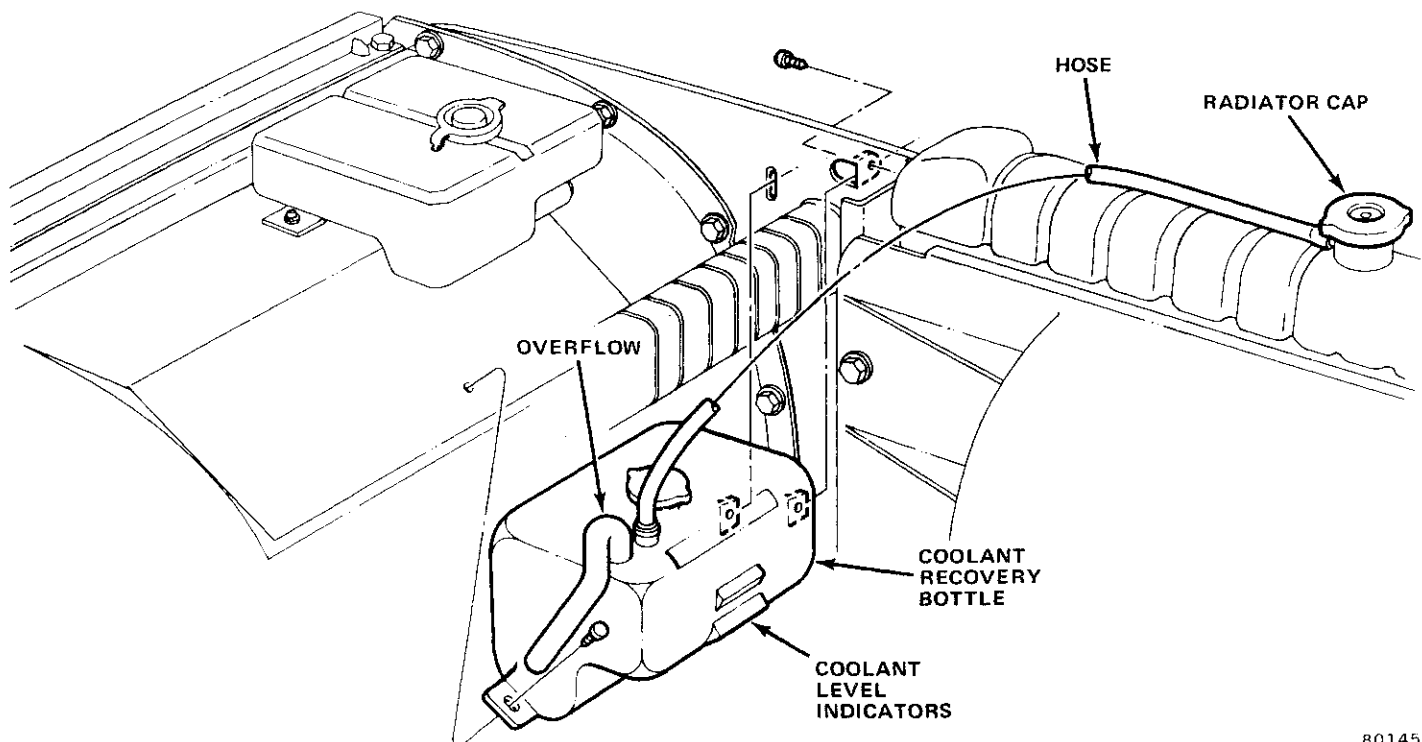


Fig. 1C-4 Coolant Recovery System

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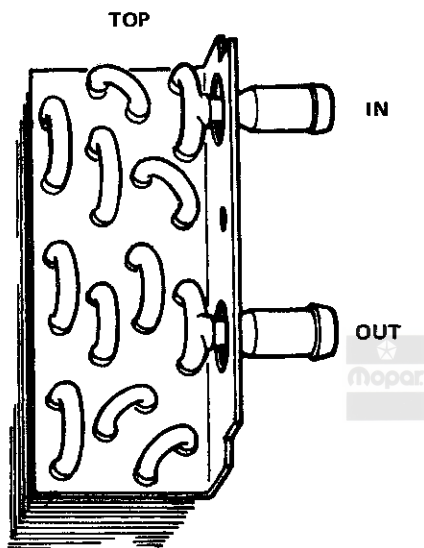
## 1C-4 COOLING SYSTEMS

### Engine Block Heater

A factory-installed engine block heater is optional. It consists of a 600W, 120V heater element fitted into a core plug hole in the block, a power cord and nylon straps used for installation.

### Heater Core

The heater core is a fin and tube design with the heater core tubes running through the core area and secured on each end with end caps (fig. 1C-5).



90187

Fig. 1C-5 Heater Core Tube Location

### Spark Coolant Temperature Override (CTO) Switch

There are three types of CTO switches for 1979.

- (1) Standard Cooling CTO Switch (Standard Cooling).
- (2) Single Function CTO Switch (Heavy-Duty Cooling).
- (3) Dual Range CTO Switch (Heavy-Duty Cooling).

The CTO switch is located at the left rear of the block on six-cylinder engines and at the thermostat housing (standard cooling) or right front of the intake manifold (heavy-duty cooling) on eight-cylinder engines.

### COOLING SYSTEM OPERATION

With the engine running, the belt-driven water pump circulates coolant throughout the system. On six-cylinder engines, coolant is forced directly into the cylinder block water jackets surrounding the cylinders. It travels up through passages in the head gasket and cylinder head, around the combustion chambers and valves, and

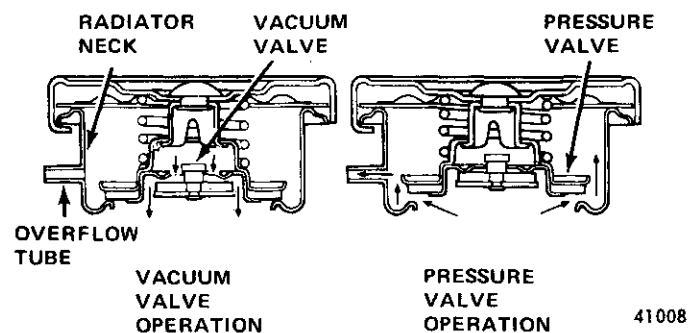
forward to the front of the cylinder head. Below 195°F (91°C), the thermostat is closed and coolant flows through the bypass port in the cylinder head, down through the block and back to the water pump where it is recirculated. A bypass port in the thermostat housing allows coolant flow to the heater core.

On eight-cylinder engines, coolant is forced from the center of the engine timing case cover through side outlets into both banks of the cylinder block. It flows through the water jackets around all cylinders and up through holes in the block and head gaskets into the cylinder heads to cool the combustion chambers and valves. Coolant then flows through the heads to passages at the front of the heads and through the intake manifold to the thermostat. In the right head, coolant is forced into an intake manifold passage at the rear corner and out to the heater core, through the heater core, and back to the water pump. Below 195°F (91°C), the thermostat is closed and coolant flows out the bypass port through the hose to the water pump, where it is recirculated.

On all engines, the recirculation cycle continues until coolant temperature reaches 195°F (91°C) and the thermostat begins to open. Coolant then flows to the radiator inlet tank, through the cooling tubes, and into the outlet tank. The radiator fan and vehicle motion cause air to flow past the cooling fins, removing heat from the coolant. As the coolant flows through the outlet tank, it passes the automatic transmission oil cooler, if equipped, and cools the automatic transmission fluid. Coolant is then drawn through the lower radiator hose into the water pump inlet to restart the cycle.

The thermostat continues to open, allowing more coolant flow to the radiator until it reaches maximum open position at 219°F ( $\pm 3^\circ$ ), [104°C ( $\pm 1^\circ$ )].

Heat causes the system pressure to rise, which raises the boiling point of the coolant. The pressure cap maintains pressure up to 14 psi (96.5 kPa). Above 14 psi (96.5 kPa), the relief valve in the cap allows pressurized coolant to vent through the filler neck overflow tube (fig. 1C-6) to the coolant recovery system bottle or to the road.



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Fig. 1C-6 Radiator Cap Operation

**NOTE:** *Immediately after shutdown, the engine enters a condition known as heat soak, when the coolant is no longer circulating but engine temperature is still high. If coolant temperature rises above the boiling point, expansion and pressure may push some coolant out of the radiator overflow tube. If this does not happen frequently, it is considered normal.*

As engine temperature drops, the coolant loses heat and contracts, forming a partial vacuum in the system. The radiator cap vacuum valve allows atmospheric pressure to enter the system to equalize the pressure.

During operation, the coolant temperature is monitored by the temperature sending unit. The sending unit electrical resistance varies as temperature changes, causing the temperature gauge to read accordingly.

The sender responds to temperature changes, so under high load or on hot days, the coolant will be hotter and the gauge will indicate higher temperatures. Unless the gauge needle is past the high end of the band or coolant loss occurs, this is normal.

### Coolant Recovery Operation

As engine temperature increases, the coolant expands. The radiator cap pressure vent valve (normally open) slowly transfers expanding coolant to the coolant recovery bottle. Any air trapped in the system will be expelled during this period.

If ambient temperature is high, the system continues heating until vapor bubbles form. These vapor bubbles pass rapidly through the radiator cap vent valve, causing it to close. Further expansion of the coolant pressurizes the system up to 14 psi (96.5 kPa). Above 14 psi (96.5 kPa) the relief valve in the cap allows pressurized coolant to vent to the coolant recovery system.

After shutdown engine temperature drops. The coolant loses heat and contracts, forming a partial vacuum in the system. The radiator cap vacuum valve then opens and allows atmospheric pressure to push coolant from the recovery bottle into the system to equalize the pressure. Air is not admitted as long as the recovery bottle tube remains submerged.

### CTO Operation

#### Standard Cooling CTO Switch

The standard cooling CTO switch directs manifold vacuum to the vacuum advance during engine warmup to improve driveability. As engine reaches operating temperature, the CTO switches from directing manifold vacuum to directing carburetor ported vacuum to the vacuum advance.

#### Single Function CTO Switch

The single function CTO switch directs carburetor ported vacuum to the vacuum advance during normal engine operation. During high heat soak periods (e.g., prolonged idling) the CTO switch directs manifold vacuum to the vacuum advance. Engine idle speed is increased, thereby improving engine cooling efficiencies and reducing idle boiling tendencies.

#### Dual Range CTO Switch

The dual range CTO switch operates like the standard cooling CTO switch during engine warmup. During high heat soak periods (e.g., prolonged idling) the dual range CTO switch directs manifold vacuum to the vacuum advance. Engine idle speed is increased, thereby improving engine cooling efficiencies and reducing idle boiling tendencies.

### COOLING SYSTEM DIAGNOSIS

If the cooling system requires frequent addition of coolant in order to maintain the proper level, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold. Small leaks, which may show up as dampness or dripping, can easily escape detection if they are rapidly evaporated by engine heat. Telltale stains of a grayish white or rusty color, or dye stains from antifreeze, may appear at joints in the cooling system. These stains are almost always a sure sign of small leaks even though there appears to be no damage.

Air may be drawn into the cooling system through leakage at the water pump seal or through leaks in the coolant recovery system. Combustion pressure may be forced into the cooling system through a leak at the cylinder head gasket even though the passage is too small to allow water to enter the combustion chamber.

## 1C-6 COOLING SYSTEMS

### Service Diagnosis

Condition	Possible Cause	Correction
HIGH TEMPERATURE INDICATION-OVERHEATING	<ul style="list-style-type: none"> <li>(1) Coolant level low.</li> <li>(2) Fan belt loose.</li> <li>(3) Radiator hose(s) collapsed.</li> <li>(4) Radiator blocked to airflow.</li> <li>(5) Faulty radiator cap.</li> <li>(6) Vehicle overloaded.</li> <li>(7) Ignition timing incorrect.</li> <li>(8) Idle speed low.</li> <li>(9) Air trapped in cooling system.</li> <li>(10) Vehicle in heavy traffic.</li> <li>(11) Incorrect cooling system component(s) installed.</li> <li>(12) Faulty thermostat.</li> <li>(13) Water pump shaft broken or impeller loose.</li> <li>(14) Radiator tubes clogged.</li> <li>(15) Cooling system clogged.</li> <li>(16) Casting flash in cooling passages.</li> <li>(17) Brakes dragging.</li> <li>(18) Excessive engine friction.</li> <li>(19) Antifreeze concentration over 68%.</li> <li>(20) Missing air seals between hood and radiator.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Replenish coolant level.</li> <li>(2) Adjust fan belt.</li> <li>(3) Replace hose(s).</li> <li>(4) Remove restriction (bugs, fog lamps, etc.)</li> <li>(5) Replace cap.</li> <li>(6) Reduce load or shift to lower gear.</li> <li>(7) Adjust ignition timing.</li> <li>(8) Adjust idle speed.</li> <li>(9) Purge air.</li> <li>(10) Operate at fast idle intermittently in neutral gear to cool engine.</li> <li>(11) Install proper component(s).</li> <li>(12) Replace thermostat.</li> <li>(13) Replace water pump.</li> <li>(14) Flush radiator.</li> <li>(15) Flush system.</li> <li>(16) Repair or replace as necessary. Flash may be visible by removing cooling system components or removing core plugs.</li> <li>(17) Repair brakes.</li> <li>(18) Repair engine.</li> <li>(19) Lower antifreeze content.</li> <li>(20) Replace air seals.</li> </ul>

**NOTE:** Immediately after shutdown, the engine enters a condition known as heat soak. This is caused by the cooling system being inoperative while engine temperature is still high. If coolant temperature rises above boiling point, expansion and pressure may push some coolant out of the radiator overflow tube. If this does not occur frequently, it is considered normal.

Service Diagnosis (Continued)

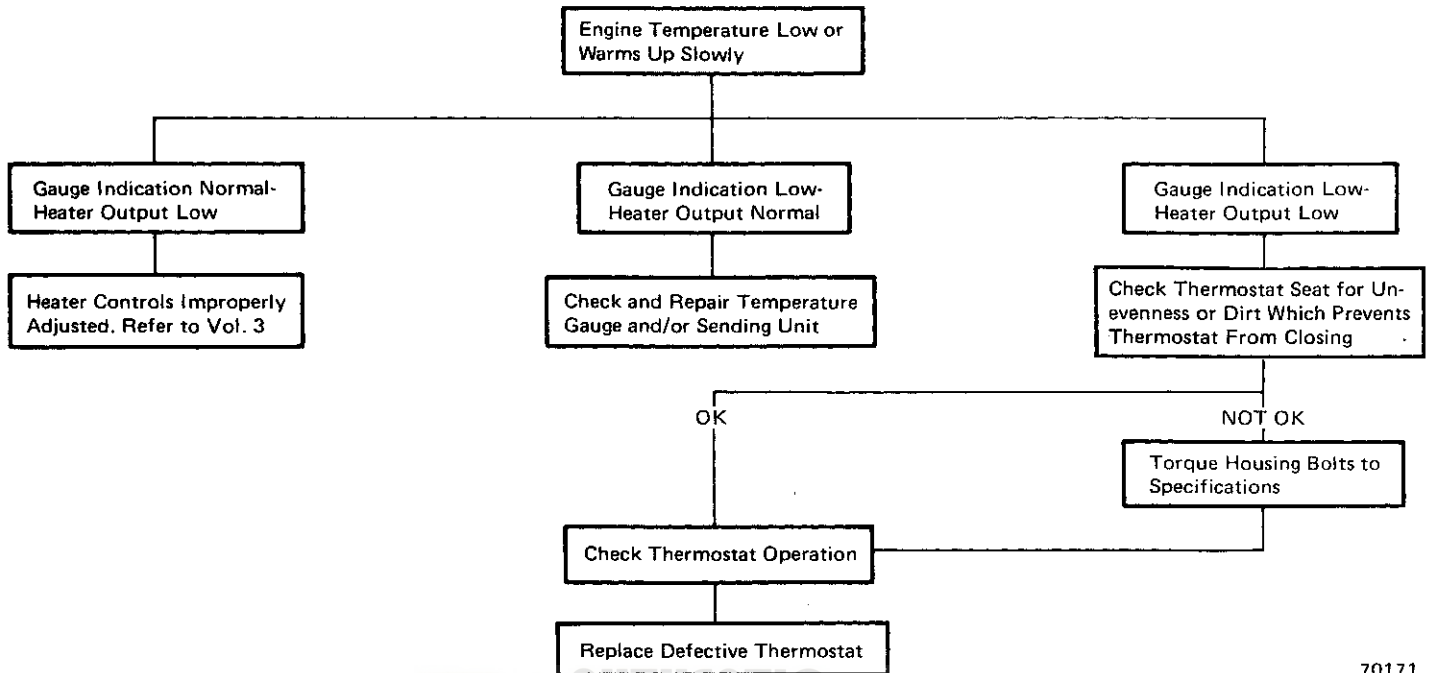
Condition	Possible Cause	Correction
<b>COOLANT LOSS— BOILOVER</b>	(21) Faulty gauge.	(21) Repair or replace gauge.
	(22) Loss of coolant flow caused by leakage or foaming.	(22) Repair leak, replace coolant.
	Refer to Overheating Causes in addition to the following:	
	(1) Overfilled cooling system.	(1) Reduce coolant level to proper specification.
	(2) Quick shutdown after hard (hot) run.	(2) Allow engine to run at fast idle prior to shutdown.
	(3) Air in system resulting in occasional "burping" of coolant.	(3) Purge system.
	(4) Insufficient antifreeze allowing coolant boiling point to be too low.	(4) Add antifreeze to raise boiling point.
	(5) Antifreeze deteriorated because of age of contamination.	(5) Replace coolant.
<b>COOLANT ENTRY INTO CRANKCASE OR CYLINDER</b>	(1) Faulty head gasket.	(1) Replace head gasket.
	(2) Crack in head, manifold or block.	(2) Replace as necessary.
<b>COOLANT RECOVERY SYSTEM INOPERATIVE</b>	(1) Coolant level low.	(1) Replenish coolant to FULL mark.
	(2) Leak in system.	(2) Pressure test to isolate leak and repair as necessary.
	(3) Pressure cap not tight or gasket missing or leaking.	(3) Repair as necessary.

# 1C-8 COOLING SYSTEMS

## Service Diagnosis (Continued)

Condition	Possible Cause	Correction
NOISE	(4) Pressure cap defective.	(4) Replace cap.
	(5) Overflow tube clogged or leaking.	(5) Repair as necessary.
	(6) Overflow tube kinked .	(6) Repair as necessary.
	(7) Recovery bottle vent plugged.	(7) Remove restriction.
	(1) Fan contacting shroud.	(1) Reposition shroud and check engine mounts.
	(2) Loose water pump impeller.	(2) Replace pump.
	(3) Dry fan belt.	(3) Apply silicone or replace belt.
LOW TEMPERATURE INDICATION— UNDERCOOLING	(4) Loose fan belt.	(4) Adjust fan belt.
	(5) Rough surface on drive pulley.	(5) Replace pulley.
	(6) Water pump bearing worn.	(6) Remove belt to isolate. Replace pump.
	(7) Belt alignment.	(7) Check for improper pulley locations. Shim power steering pump.
	(1) Thermostat stuck open.	(1) Replace thermostat.
	(2) Faulty gauge.	(2) Repair or replace gauge.
	NO COOLANT FLOW THROUGH HEATER CORE	(1) Plugged return pipe in water pump.
(2) Heater hose collapsed or plugged.		(2) Remove obstruction or replace hose.
(3) Plugged heater core.		(3) Remove obstruction or replace core.
(4) Plugged outlet in thermostat housing.		(4) Remove flash or obstruction.
(5) Heater bypass hole in cylinder head plugged.		(5) Remove obstruction.
(6) Heater tubes assembled on core incorrectly.		(6) Mount tubes correctly.

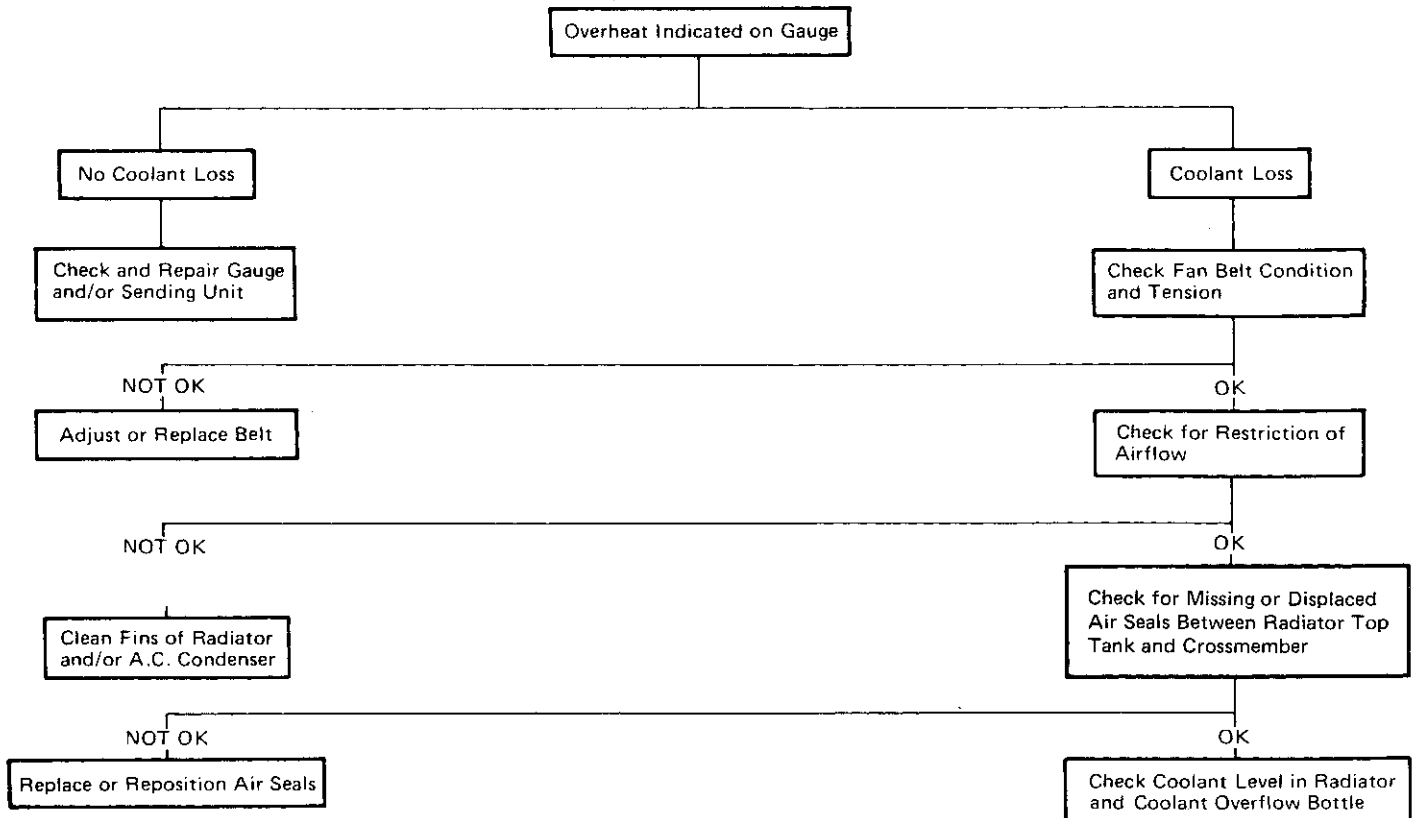
**Low Engine Temperature Diagnosis Guide**



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**Engine Overheating Diagnosis Guide**

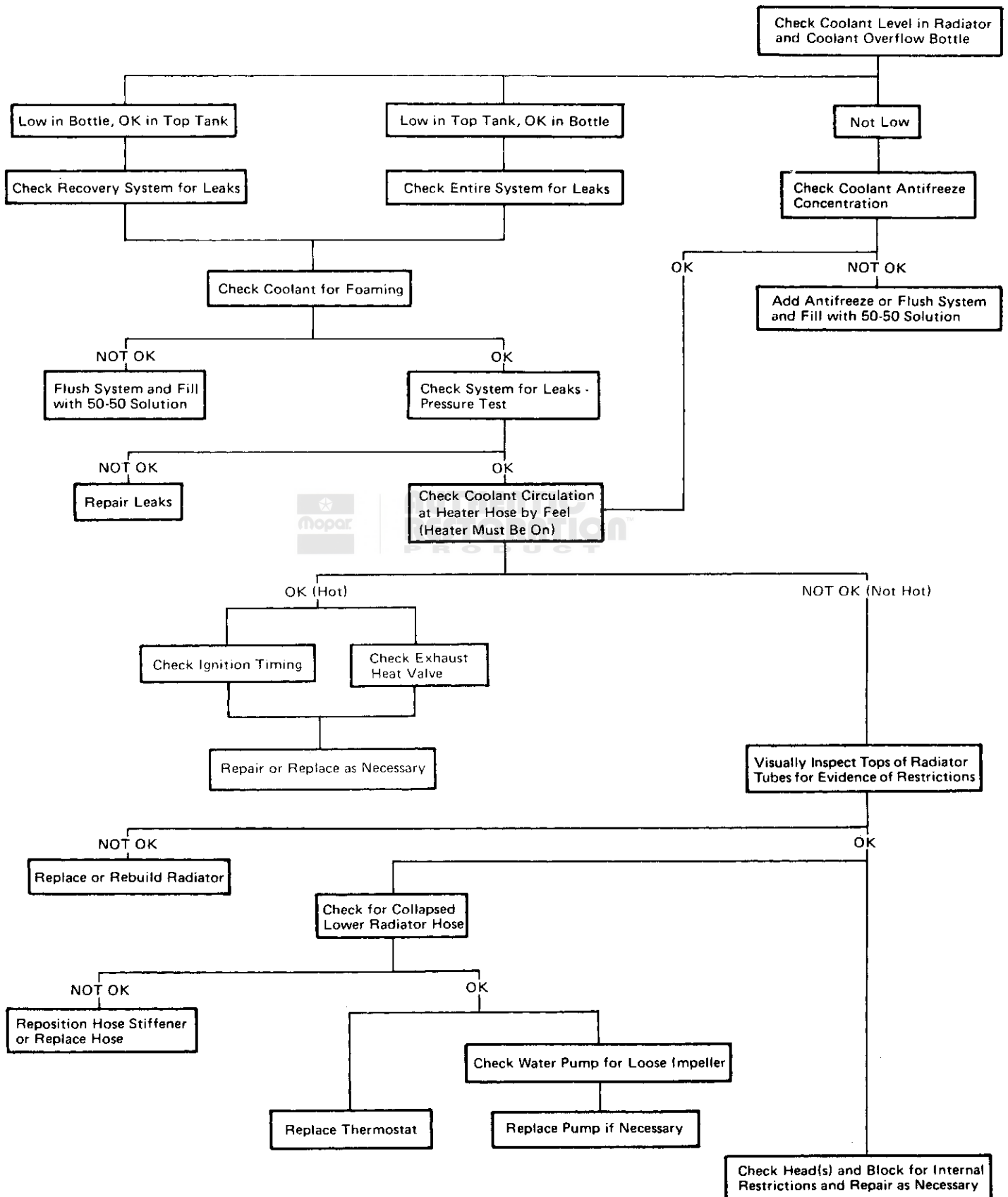


NEXT PAGE

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Engine Overheating Diagnosis Guide (Continued)



**TROUBLESHOOTING**

**Cooling System Leakage**

**NOTE:** *Engine must be warm.*

(1) Carefully remove radiator pressure cap from filler neck and check coolant level.

**NOTE:** *The cap must be pushed down to disengage from the stop tabs.*

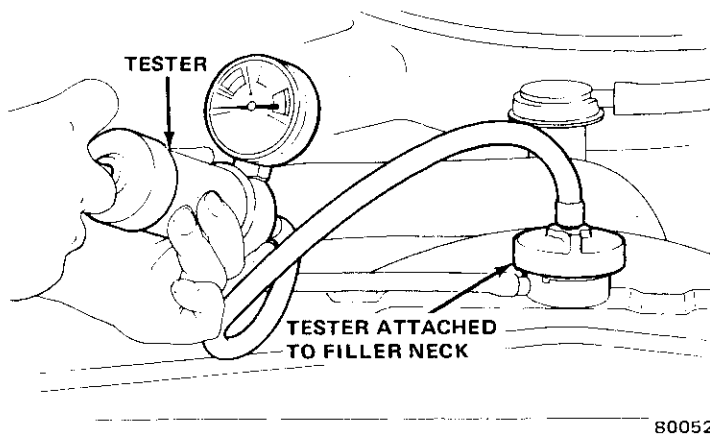
(2) Wipe inside of filler neck and examine lower inside sealing seat for nicks, cracks, paint, dirt and solder bumps.

(3) Inspect overflow tube for internal obstructions. Run a wire through tube to be sure it is clear.

(4) Inspect cams on outside of filler neck. If cams are bent, seating of pressure cap valve and tester seal will be affected. Bent cams can be reformed if done carefully.

(5) Attach pressure tester to filler neck (fig. 1C-7). **Do not force.**

(6) Operate tester pump to apply 15 psi (103.4 kPa) pressure to system. If hoses swell excessively while testing, replace as necessary.



**Fig. 1C-7 Cooling System Pressure Test**

(7) Observe needle:

(a) **Holds Steady:** If needle holds steady for two minutes, there are no serious leaks in the system.

**NOTE:** *There may be an internal leak that does not show up under normal system pressure. If it is certain that coolant is being lost and no leaks can be found, check for interior leakage or perform Combustion Leakage Check.*

(b) **Drops Slowly:** Indicates presence of small leaks or seepage. Examine all points for seepage or slight leakage with a flashlight. Check radiator, hose,

gaskets and heater. Seal tiny leaks with Jeep Sealer Lubricant, or equivalent. Repair leaks and check system.

(c) **Drops Quickly:** Indicates that serious leakage is present. Examine system for serious external leakage. If no leaks are visible, check for internal leakage.

**NOTE:** *Large radiator leaks should be repaired by a reputable radiator repair shop.*

**Checking for Internal Leakage**

(1) Remove oil pan drain plug and drain a small amount of oil. Water, being heaviest, should drain first. Run engine to churn oil, then examine dipstick for water globules.

(2) Check transmission dipstick for water globules.

(3) Check transmission oil cooler for leakage. Refer to Oil Cooler Leakage.

(4) Run engine without pressure cap on radiator until thermostat opens.

(5) Attach Pressure Tester to filler neck. If pressure builds up quickly, a leak exists as a result of a faulty head gasket or crack. Repair as necessary.

**CAUTION:** *Do not allow pressure to build up over 15 psi (103.4 kPa). Turn engine OFF. To release pressure, rock tester from side to side. While removing tester, do not turn tester more than 1/2 turn if system is under pressure.*

(6) If there is no immediate pressure increase, operate Pressure Tester until gauge reads within system range. Vibration of gauge hand indicates compression or combustion leakage into cooling system.

(7) Isolate compression leak by shorting each spark plug. Gauge hand should stop or decrease vibration when spark plug of leaking cylinder is shorted.

**NOTE:** *Do not operate engine with spark plug disconnected for more than a minute or catalytic converter may be damaged.*

**Combustion Leakage (Without Pressure Tester)**

(1) Drain sufficient coolant to allow thermostat removal.

(2) Disconnect water pump drive belt.

(3) **Six-Cylinder Engine:** Disconnect upper radiator hose from thermostat housing, remove thermostat, and install thermostat housing to cylinder head.

**Eight-Cylinder Engine:** Disconnect thermostat housing from engine and remove thermostat.

(4) Add coolant to engine to bring level within 1/4 inch (6.3 mm) of top of thermostat housing or intake manifold.

(5) Start engine and accelerate rapidly to about 3000 rpm three times while watching coolant. If any

## 1C-12 COOLING SYSTEMS

internal engine leaks to the cooling system exist, bubbles will appear in the coolant. If bubbles do not appear, there are no internal leaks.

**CAUTION:** Do not run engine too long, to avoid overheating. Open drain cock immediately after test to eliminate boilover.

### Oil Cooler Leakage

Oil cooler leaks can be detected by the presence of transmission fluid in the coolant. If fluid appears in the coolant, check the fluid level of the automatic transmission. If the fluid level is low, check the oil cooler as follows:

- (1) Remove transmission-to-cooler lines at radiator.
- (2) Plug one fitting in cooler.
- (3) Remove radiator cap and make sure radiator is full.
- (4) Apply shop line pressure (50 to 200 psi) (345 to 1379 kPa) to other fitting.

Bubbles in coolant at filler neck indicate a leak in oil cooler. If an oil cooler leak is discovered, remove radiator for oil cooler repair. Unsolder outlet tank for access to oil cooler.

**CAUTION:** Because of high oil pressure, conventional soldering must not be used for oil cooler repair. All repairs must be silver-soldered or brazed.

## TESTING

### Coolant Freezing Point Test

Coolant freezing point, or freeze protection, should be checked with an antifreeze hydrometer to determine protection level. Refer to Coolant.

### Radiator Pressure Cap Test

- (1) Remove cap from radiator.
- (2) Make sure seating surfaces are clean.
- (3) Wet rubber gasket with water and install cap on tester (fig. 1C-8).
- (4) Operate tester pump and observe needle at its highest point. Cap release pressure should be 12 to 15 pounds (82.7 to 103.4 kPa).

**NOTE:** Cap is OK when pressure holds steady or holds within the 12 to 15 pound (82.7 to 103.4 kPa) range for 30 seconds or more. If needle drops quickly, replace cap.

### Thermostat Test

- (1) Remove thermostat. Refer to Thermostat Replacement.
- (2) Insert 0.003-inch (0.0762 mm) feeler gauge, with wire or string attached, between valve and seat (fig. 1C-9).

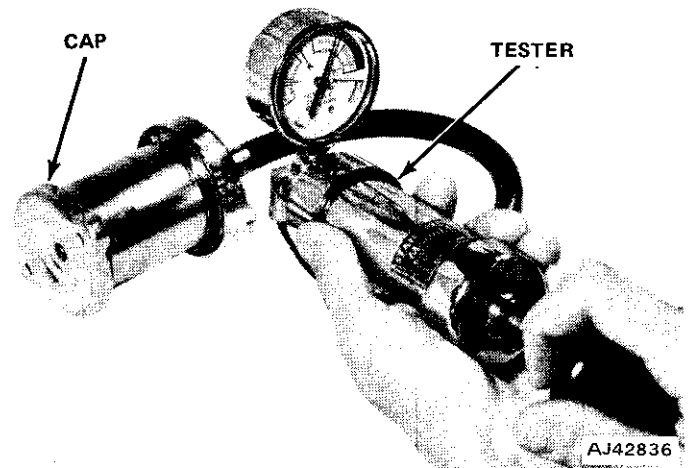


Fig. 1C-8 Radiator Cap Pressure Test

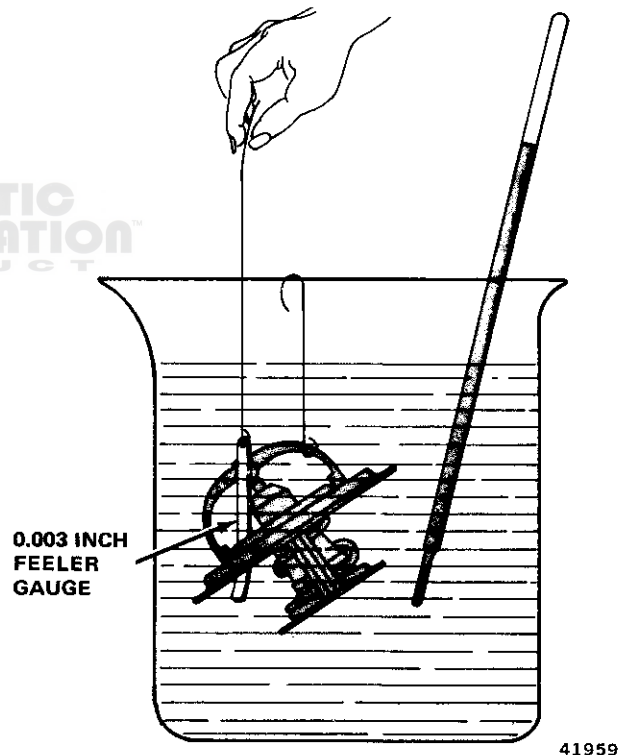


Fig. 1C-9 Testing Thermostat

(3) Submerge thermostat in container of pure antifreeze, suspended so it does not touch sides or bottom of container.

(4) Suspend thermometer in solution so it does not touch container.

**WARNING:** Do not breathe fumes.

(5) Heat solution.

(6) Apply slight tension on feeler gauge while solution is heated. When valve opens 0.003-inch (0.0762 mm), feeler gauge will slip free from valve. Note temperature

at which this occurs. Valve must be open 0.003 inch at 192°F to 199°F (0.0762 mm at 89°C to 92°C). It must be fully open a minimum of 0.360-inch at 219°F ( $\pm 3^\circ\text{F}$ ) [9.14 mm at 104°C ( $\pm 1^\circ\text{C}$ )] . If faulty, replace thermostat.

(7) Install thermostat.

### Water Pump Tests

#### Loose Impeller

- (1) Drain radiator.
- (2) Loosen fan belt.
- (3) Disconnect lower radiator hose from water pump.
- (4) Bend stiff clothes hanger or welding rod as shown in figure 1C-10.
- (5) Position rod in water pump inlet and attempt to turn fan. If impeller is loose and can be held with rod while fan is turning, pump is defective. If impeller turns, pump is OK.
- (6) Connect hose and replenish coolant, or proceed with further repairs.

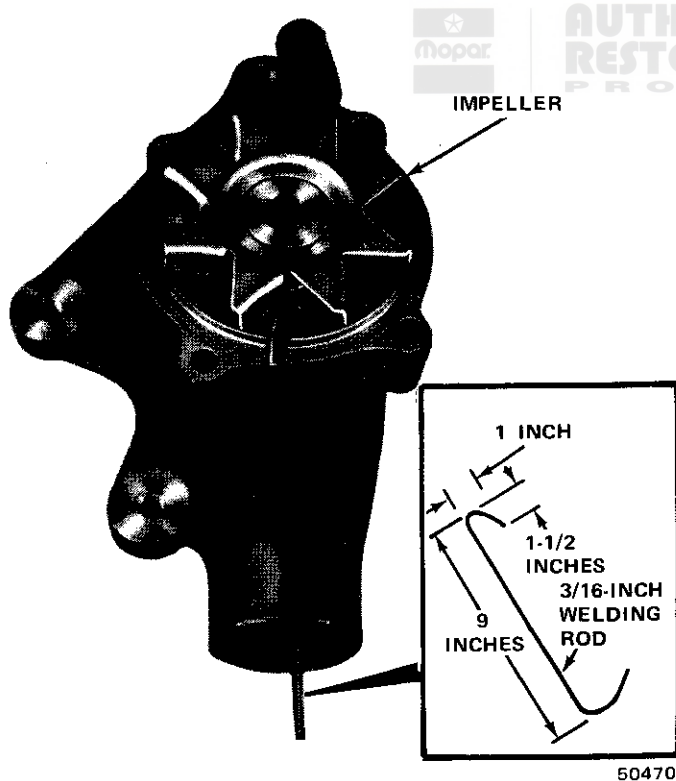


Fig. 1C-10 Checking Water Pump for Loose Impeller—Typical

#### Check for Inlet Restrictions

Poor heater performance may be caused by a casting restriction in the water pump heater hose inlet.

- (1) Drain sufficient coolant from radiator to permit removal of heater hose from water pump.

- (2) Remove heater hose.
- (3) Check inlet for casting flash or other restrictions.

**NOTE:** Remove pump from engine before removing restriction to prevent contamination of coolant with debris. Refer to Water Pump Removal.

#### Tempatrol Fan Test

- (1) Start engine and allow it to warm up to operating temperature.
- (2) Operate throttle linkage on carburetor to gradually increase engine speed until definite decrease of audible fan airflow is heard.
- (3) Maintain this engine speed until definite increase of audible fan airflow is heard.

The Tempatrol unit is operating satisfactorily if the time interval between decrease and increase of the audible fan airflow does not exceed three minutes.

**NOTE:** The cooling system must be in good condition prior to performing the above test to ensure against excessively high radiator air temperatures.

If a Tempatrol unit is suspected of causing an overheating condition, it may be tested while the vehicle is being driven. Disconnect the bimetal spring (fig. 1C-11) and rotate it 90° counterclockwise. This defeats the temperature-controlled, free-wheel feature and the Tempatrol performs like a conventional fan. If this cures the overheating condition, the Tempatrol is defective.

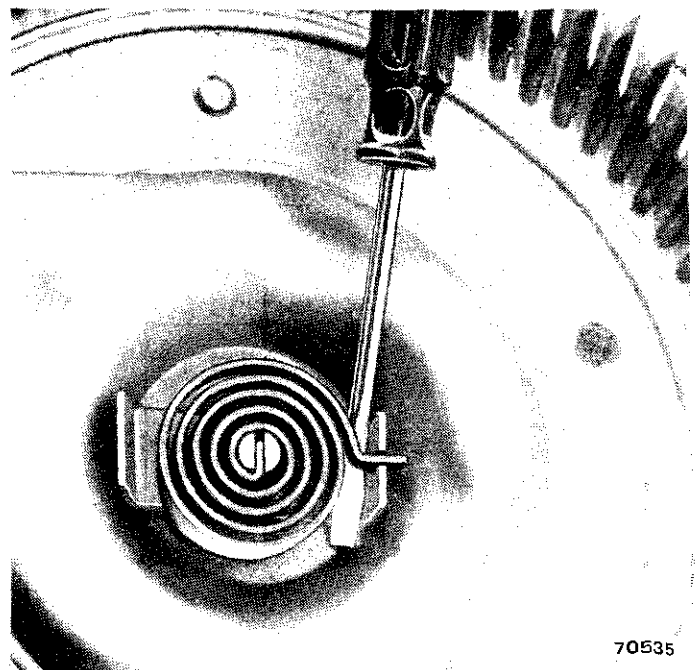


Fig. 1C-11 Disconnecting Tempatrol Spring

## 1C-14 COOLING SYSTEMS

The Tempatrol may be disconnected as described above as a **temporary** cure for overheating while driving with a snow plow mounted on the vehicle. A snow plow restricts airflow past the radiator. If the Tempatrol bimetal spring is not heated, the unit will free-wheel and will not pull enough air through the radiator for proper cooling.

**NOTE:** After snow plow removal, the bimetal spring end should be reconnected for proper fan operation.

### ADJUSTMENTS

#### Drive Belts

Inspect drive belts frequently for defects such as fraying or cracking.

**CAUTION:** Do not use any commercial belt dressing or oil-based lubricant on any drive belt. Do not dress the sides of any drive belt with a file or other abrasive. Each belt has 5 or 6 tensile members wrapped around it. If these members are cut, the belt could fail.

Drive belts are adjusted by moving the driven component in its mount to achieve desired tension. In some cases, a belt may drive several components. It is necessary to loosen and move only one component.

#### Fan and Alternator Belt Adjustment

##### Six-Cylinder Without Air Conditioning and All Eight-Cylinder

**NOTE:** Eight-cylinder engines equipped with air conditioning use a matched pair of belts to drive the AC compressor and alternator. Replace these belts in sets only. Do not replace individual belts. When checking belt tension, check one belt, not both together, or incorrect tension will be indicated.

(1) Loosen alternator pivot mount bolt and alternator adjusting bolt.

(2) Adjust belt using pry bar on six-cylinder engines (fig. 1C-12) or a 1-inch, open-end wrench on eight-cylinder engines (fig. 1C-13). Tighten adjusting screw enough to retain alternator position.

(3) Check belt tension using Tension Gauge J-23600 (fig. 1C-14). Correct if necessary.

(4) Tighten adjusting screw to 18 foot-pounds (24 N•m) torque and mounting screw to 28 foot-pounds (38 N•m) torque.

##### Six-Cylinder Engine with Air Conditioning

- (1) Loosen alternator lower adjusting screw.
- (2) Loosen alternator bracket adjusting screw.
- (3) Loosen alternator upper pivot screw.
- (4) Adjust alternator using a suitable pry bar.

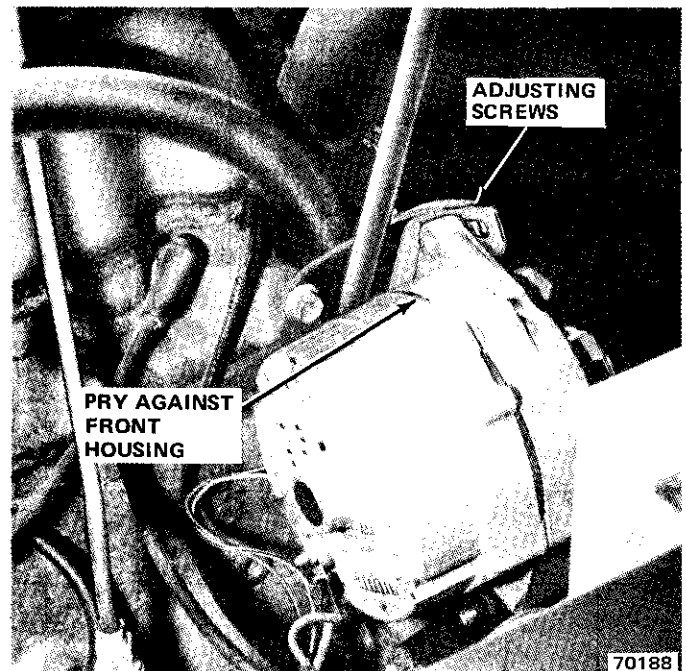


Fig. 1C-12 Alternator Drive Belt Adjustment—Six-Cylinder

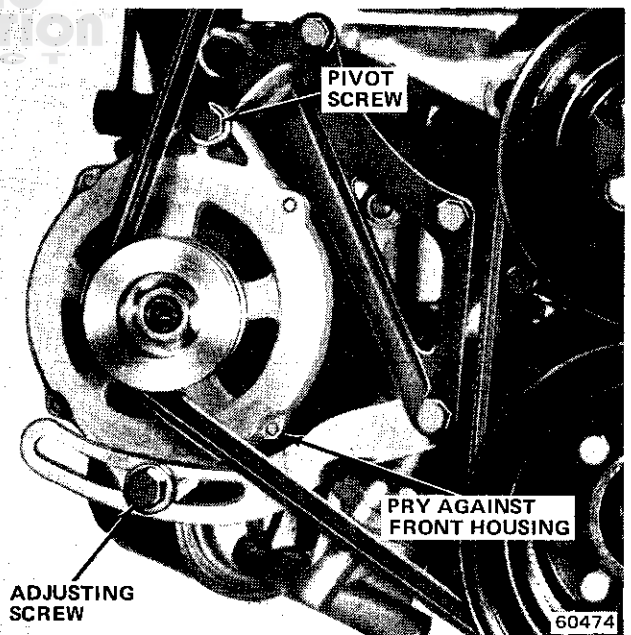


Fig. 1C-13 Alternator Drive Belt Adjustment—Eight-Cylinder

Tighten adjusting screw enough to retain alternator position (fig. 1C-15).

(5) Check belt tension using Tension Gauge J-23600 (fig. 1C-14). Correct if necessary.

(6) Tighten adjusting screw to 18 foot-pounds (24 N•m) torque, mounting screws to 28 foot-pounds (38 N•m) torque, and back idler, if equipped, to 33 foot-pounds (45 N•m) torque.

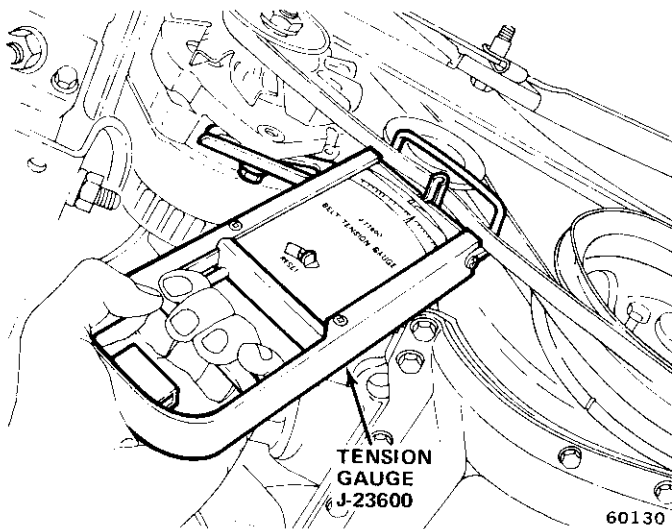


Fig. 1C-14 Checking Alternator Drive Belt Tension—Typical

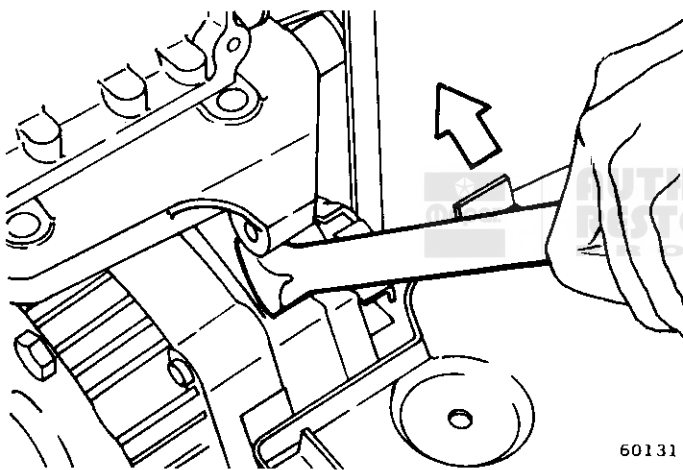


Fig. 1C-15 Alternator Drive Belt Adjustment—  
Six-Cylinder with Air Conditioning

### Air Conditioning Belt Adjustment

Air conditioning drive belts pass around the crankshaft damper pulley, the compressor pulley and either the alternator or an idler pulley. Adjustment of the alternator is covered under Fan and Alternator Belt Adjustment. The idler pulley is manufactured with a square socket which accepts a 1/2 inch drive wrench. To adjust, loosen clamp screw and pivot screw, apply pressure to socket with suitable wrench and tighten screws.

### Power Steering Drive Belt

Power steering pumps require care when adjusting the drive belt. **Do not pry on the pump housing to adjust the drive belt.**

#### Six-Cylinder

The six-cylinder power steering pump is sandwiched between two bracket halves (fig. 1C-16). To adjust,

loosen the clamping screw and pivot screws. Insert a suitable wrench in the bracket socket and tighten belt. Tighten clamping screw and pivot screws.

#### Eight-Cylinder

The eight-cylinder power steering pump is screwed to a small bracket that pivots in a large cast bracket (fig. 1C-17).

(1) Before adjusting power steering pump belt, loosen air pump drive belt.

(2) Loosen power steering pump clamping nuts. Pump must be loose enough to move by hand.

(3) Using wrench on adjusting lug, tighten pump drive belt. Tighten clamping nuts.

(4) Adjust tension of air pump drive belt.

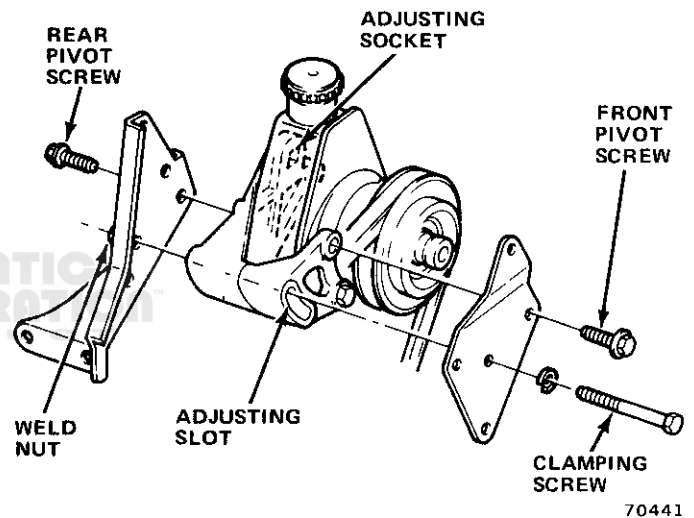


Fig. 1C-16 Six-Cylinder Power Steering Pump Drive Belt Adjustment

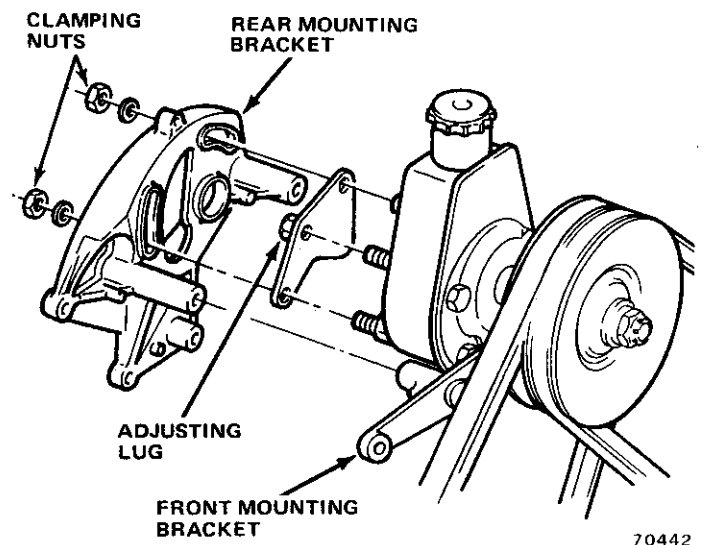


Fig. 1C-17 Eight-Cylinder Power Steering Pump Drive Belt Adjustment

### Hoses

Check hoses at regular intervals. If a hose is cracked or feels brittle when squeezed, it should be replaced. If a hose swells excessively when under pressure, it should be replaced.

In places where specific routing clamps are not provided, make sure hoses are positioned to clear exhaust pipes, fan blades and drive belts. Improperly positioned hoses may be damaged, resulting in coolant loss and overheating.

The lower radiator hose on all vehicles is fitted with an internal spring to prevent hose collapse. When performing a hose inspection, check for proper position of the spring.

### Shroud Position

In some extreme cases, the engine fan may contact the shroud. An examination for proper engine mounting should locate the trouble. If not, examine the shroud position. To compensate for normal engine movement, loosen the shroud mounting screws and relocate shroud to prevent fan-to-shroud contact.

### COOLANT

Maintain coolant level with a mixture of ethylene glycol-based antifreeze and low mineral content water.

**CAUTION:** Antifreeze concentration should always be maintained to meet local requirements, or 50 percent, whichever is greater. Maximum protection against freezing is provided with 68 percent antifreeze, which prevents freezing to  $-90^{\circ}\text{F}$  ( $-68^{\circ}\text{C}$ ). A higher percentage will freeze at a higher point. For example, pure antifreeze freezes at  $-8^{\circ}\text{F}$  ( $-22^{\circ}\text{C}$ ). Antifreeze concentration **MUST ALWAYS** be at least 50 percent, year-round and in all climates. If concentration is lower, engine parts can be eroded by cavitation.

**CAUTION:** Coolant additives which claim to improve engine cooling should not be used.

### Coolant Level—Without Coolant Recovery

Coolant level when cold should be 1-1/2 inches to 2 inches (3.8 cm to 5.0 cm) below the rear of the radiator filler neck sealing surface, and at normal operating temperature it should be 1/2 inch to 1 inch (1.2 cm to 2.5 cm) below this surface.

**WARNING:** When removing the cap from a hot engine, coolant can rush out and scald hands. If necessary to check level, allow engine to idle for a few moments. Use a heavy towel wrapped over cap and turn cap slowly to the first notch to relieve pressure, then push down to disengage locking tabs and remove cap. If engine is overheated, operate engine above curb idle speed for a

few moments with hood up, then shut engine Off and let it cool 15 minutes before removing cap. Pressure can be reduced during cooling by spraying the radiator with cool water.

### Coolant Level—With Coolant Recovery

Check coolant level in the recovery bottle only at normal operating temperatures. It should be between the FULL and ADD marks on the coolant recovery bottle (fig. 1C-4).

**NOTE:** Do not add coolant unless level is below ADD mark at operating temperature.

When adding coolant during normal maintenance, add only to the recovery bottle, not to the radiator.

**NOTE:** 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.

### Draining Coolant

**NOTE:** DO NOT WASTE reusable coolant. If solution is clean and is being drained only to service the cooling system, collect coolant in a clean container for re-use.

The coolant can be drained from the radiator by loosening the drain cock on the bottom tank.

Coolant can be drained from the engine block by removing the drain plugs.

- Six-Cylinder—Two located on left side of block, which may be replaced by one or two CTO switches.
- Eight-Cylinder—Centrally located on each side of block.

**WARNING:** DO NOT remove block drain plugs with system under pressure as serious burns from coolant may occur.

### Filling

Before filling, install all drain plugs and tighten radiator drain cock. Add the proper mixture of coolant to meet local requirements for freeze protection.

**CAUTION:** The antifreeze concentration must always be at least 50 percent, year-round and in all climates. If concentration is lower, engine parts can be eroded by cavitation.

Fill the radiator to the proper coolant level. On vehicles with coolant recovery system, fill the radiator to the top and install the radiator cap. Add sufficient coolant to the recovery bottle.

After refilling the system or when air pockets are suspected, bleed the cooling system of excess air.

### Bleeding Air from System

Trapped air will hamper or stop coolant flow or cause burping of engine coolant out of the radiator.

The coolant control valve must be open to the heater core, the heater control must be in the HEAT position and the heater temperature control must be in the full WARM or HIGH position.

On vehicles without coolant recovery system, bleed air by operating the engine with a properly filled cooling system with the radiator cap off until coolant has completely circulated throughout the engine, or until normal operating temperature is reached.

Add coolant if necessary, and install radiator cap.

On vehicles with coolant recovery system, fill the system with coolant and operate the engine with all coolant caps in place. After coolant has reached normal operating temperature, shut engine off and allow system to cool. Add coolant to recovery bottle as necessary.

**NOTE:** *This procedure may have to be repeated several cycles to maintain full coolant level at operating temperatures.*

### Removing Coolant from Crankcase

If coolant mixes with engine oil, it will clog the oil lines and cause the pistons to seize. Severe damage to the engine will result. If coolant has leaked into the lubricating system, locate the cause for the coolant leak, such as a faulty head gasket or cracked block, and make the necessary repairs. After repairing the leak, use Jeep Crankcase Cleaner, or equivalent, to flush engine.

### Engine Flushing

- (1) Remove thermostat housing and thermostat. Install thermostat housing.
- (2) Attach flushing gun to upper radiator hose at radiator end.
- (3) Attach leadaway hose to water pump inlet.
- (4) Connect water supply hose and air supply line to flushing gun.
- (5) Allow engine to fill with water.
- (6) When engine is filled, apply air in short blasts, allowing system to fill between air blasts. Continue until clean water flows through leadaway hose.
- (7) Remove thermostat housing and install thermostat. Install thermostat housing, using replacement gasket. Tighten screws to 13 foot-pounds (18 N•m) torque.
- (8) Connect radiator hoses.
- (9) Refill cooling system.

### Core Plug Replacement

Remove core plugs with hammer, chisel, and prying tool. Apply a sealer to edges of replacement plug and position plug with lip to outside of block. Install with hammer and suitable tool. Refer to Core Plug Sizes chart.

### Core Plug Sizes

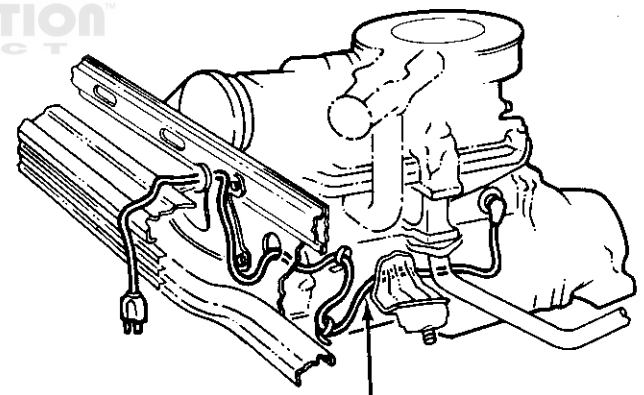
Location	Diameter (inches)
Six-Cylinder Head – Left Side (3) . . . . .	7/8
Eight-Cylinder Heads – Outer Side (2 ea) . . . . .	1
Eight-Cylinder Cylinder Block (3 ea side) . . . . .	1 1/2
Eight-Cylinder Heads (1 ea end) . . . . .	1 1/2
Six-Cylinder Block (3 on left side, 1 at rear) . . . . .	2
Six-Cylinder Head (1 at rear) . . . . .	2

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### ENGINE BLOCK HEATER

#### Installation

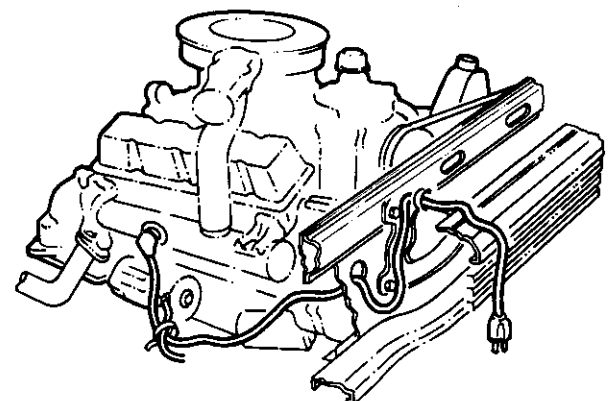
- (1) Drain coolant from engine.
- (2) Remove core plug and install block heater (fig. 1C-18). Tighten six-cylinder T-screw to 20 inch-pounds (2 N•m) torque. Tighten eight-cylinder compression nut to 10 foot-pounds (14 N•m) torque.



ROUTE CORD BETWEEN MOTOR MOUNT BRACKET AND BLOCK

TYPICAL 6-CYL. ENGINE

80053B



TYPICAL 8-CYL. ENGINE

80053C

Fig. 1C-18 Engine Block Heater Installation



## 1C-18 COOLING SYSTEMS

**CAUTION:** Be careful when tightening heater mounting screw. Improper tightening may damage seal or allow heater to loosen, resulting in coolant loss and engine damage.

(3) From front of vehicle, route heater (female) end of power cord through hole in front panel, along wire harness and connect to block heater.

(4) Using nylon straps furnished, tie cord to wire harness and to inside of grille, and allow cord to extend outside of grille.

(5) Install coolant in engine.

### FAN

Fan blade assemblies are balanced within 0.25 in.-oz. and should not be altered in any way. A damaged or bent fan must be replaced. Do not attempt repair. Refer to the Cooling System Components chart for fan applications.

**CAUTION:** Fans are designed to fit certain applications only. DO NOT attempt to increase cooling capacity by installing a fan not intended for a given engine. Fan or water pump damage and noise may result.

### Replacement—All Models

- (1) Disconnect fan shroud from radiator, if equipped.
- (2) Remove fan attaching screws.
- (3) Remove fan, spacer and shroud.
- (4) Install fan, spacer and shroud.
- (5) Install fan attaching screws and tighten.
- (6) Install shroud attaching screws and tighten, if removed.

### WATER PUMP PULLEY

#### Replacement

- (1) Disconnect fan shroud from radiator, if equipped.
- (2) Remove fan attaching screws.
- (3) Remove fan, spacer and shroud.
- (4) Loosen all belts passing around water pump pulley.
- (5) Remove pulley.
- (6) Install pulley.
- (7) Position fan, spacer and shroud.
- (8) Install and tighten belts.
- (9) Install attaching screws and tighten
- (10) Install shroud attaching screws and tighten.

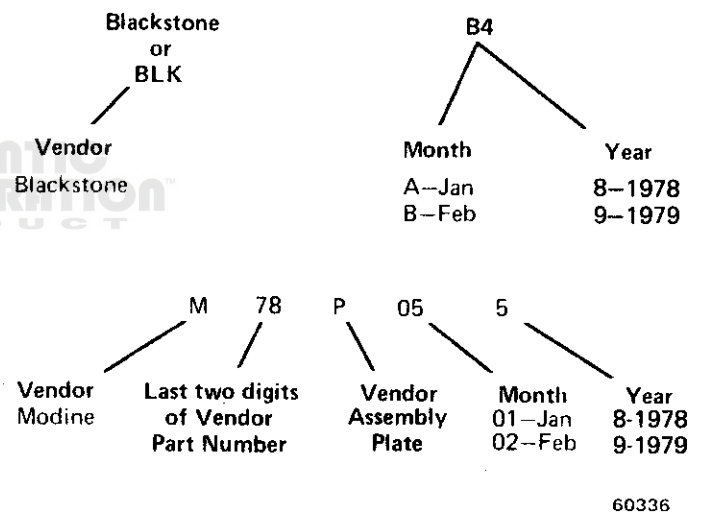
### COOLANT RECOVERY BOTTLE

#### Replacement

- (1) Remove hose from radiator filler neck.
- (2) Remove bottle from radiator support panel.
- (3) Pour coolant into clean container for re-use.
- (4) Remove hose from bottle.
- (5) Install hose in bottle.
- (6) Install bottle to radiator support panel.
- (7) Connect hose to radiator filler neck.
- (8) Install coolant in bottle. Be sure hose is submerged in coolant.

### RADIATOR

Radiators are identified by Jeep part number and the vendor build code number embossed on the upper tank. In some Cherokees, Wagoneers and Trucks, the code is on the radiator right side support.



#### Radiator Identification

**NOTE:** For testing radiator for leaks or pressure loss, see *Cooling System Leakage*.

The radiator should be free from any obstruction to airflow. This includes bugs, bug screens, leaves, mud, emblems, flags, fog lamps, improperly mounted license plates, large non-production bumper guards or collision damage.

**NOTE:** Dirt may be removed by blowing compressed air from the engine side of the radiator through the fins.

Several problems may affect radiator performance:

- Bent or damaged tubes.
- Corrosive deposits restricting coolant flow.
- Tubes blocked due to improper soldering.

Damaged tubes which affect proper operation must be repaired. Leaks can be detected by applying 3 to 5 psi air pressure to the radiator while it is submerged in water. Repair tubes with solder. Clean a clogged radiator by solvent cleaning or by reverse flushing.

### Replacement—All Models

(1) Position drain pan under radiator and open drain cock.

**NOTE:** *DO NOT WASTE reusable coolant. If solution is clean, collect in a clean container for re-use.*

- (2) Open hood and remove radiator cap.
- (3) Disconnect upper radiator hose.
- (4) Disconnect coolant recovery hose, if equipped.
- (5) Remove fan shroud screws, if equipped.
- (6) Remove top radiator attaching screws.
- (7) Remove lower hose.
- (8) Disconnect and plug oil cooler lines, if equipped with automatic transmission.
- (9) Remove bottom radiator attaching screws.
- (10) Remove radiator.
- (11) Install radiator.
- (12) Install attaching screws.
- (13) Position fan shroud and install screws, if removed.
- (14) Install drain cock.
- (15) Remove plugs and connect oil cooler lines, if disconnected.
- (16) Install lower hose, using replacement clamp.
- (17) Install upper hose, using replacement clamp.
- (18) Install coolant.
- (19) Connect coolant recovery hose, if removed.
- (20) Install radiator cap.

### Solvent Cleaning

In some cases, use of a radiator cleaner (Jeep Radiator Kleen, or equivalent) prior to flushing will soften scale and deposits and reinforce the flushing operation.

**CAUTION:** *Be sure to follow directions on the container.*

### Reverse Flushing

**CAUTION:** *The cooling system normally operates at 12 to 15 psi pressure. Exceeding this pressure may damage the radiator, heater core or hoses.*

- (1) Disconnect radiator hoses.
- (2) Attach piece of radiator hose to radiator bottom outlet and insert flushing gun.
- (3) Connect water supply hose and air supply line to flushing gun.
- (4) Allow radiator to fill with water.
- (5) When radiator is filled, apply air in short blasts, allowing radiator to refill between blasts.

Continue this reverse flushing until clean water flows through top radiator opening. If flushing fails to clear radiator passages, the radiator will have to be cleaned more extensively by a radiator repair shop.

### Oil Cooler Repairs

Because of the high pressure in the oil cooler, conven-

tional soldering will not repair leaks. All repairs must be silver soldered or brazed.

### THERMOSTAT REPLACEMENT

#### Replacement

When the thermostat is correctly installed, the pellet, which is encircled by a coil spring, should face the engine. All thermostats are marked on the outer flange to indicate proper installed position.

During installation, observe the recess in the cylinder head (six-cylinder) or intake manifold (eight-cylinder) and fit the thermostat in the groove (fig. 1C-19 and 1C-20). Then install the gasket and thermostat housing. Tightening the housing unevenly or with the thermostat out of its recess will result in a cracked housing. Tighten housing screws to 13 foot-pounds (18 N•m) torque.

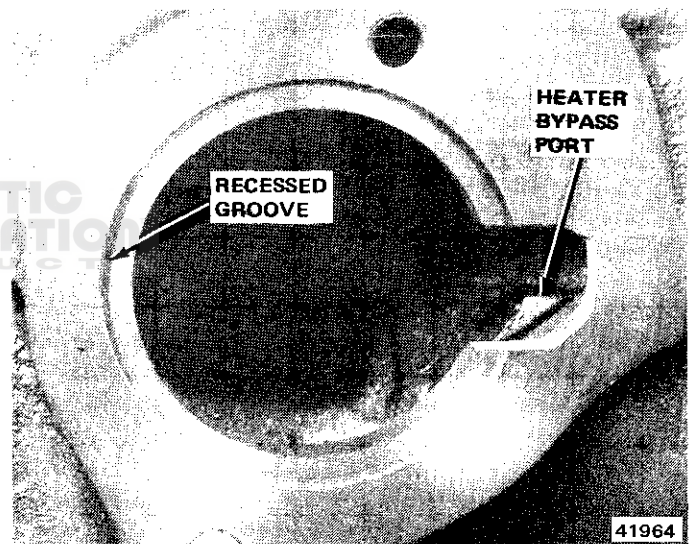


Fig. 1C-19 Thermostat Recess—Six-Cylinder

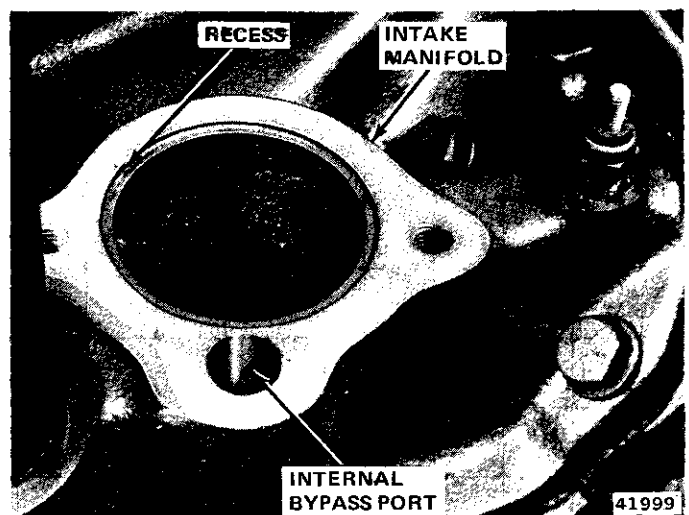


Fig. 1C-20 Thermostat Recess—Eight-Cylinder

## WATER PUMP

The water pump impeller is pressed onto the rear of the pump shaft and bearing assembly. The water pump is serviced only as a complete assembly.

### Removal—Six-Cylinder

The following procedure applies to all vehicles with or without power steering, Air Guard and air conditioning.

- (1) Drain cooling system.
- (2) Disconnect radiator and heater hoses from water pump.
- (3) Remove drive belts.
- (4) Remove fan shroud attaching screws from radiator, if equipped.
- (5) Remove fan and hub assembly and remove fan ring or shroud.

**NOTE:** On some models, fan removal may be easier if the fan shroud is rotated 1/2 turn.

- (6) Remove water pump and gasket.

### Installation—Six-Cylinder

Before installing a replacement pump, clean gasket sealing surfaces and remove deposits and other foreign material from impeller cavity. Inspect block surface for erosion or other faults.

- (1) Install replacement gasket and water pump. Tighten screws to 13 foot-pounds (18 N•m) torque. Rotate shaft by hand to be sure it turns freely.
- (2) Position shroud against front of engine, if removed, and install fan and hub assembly. Tighten screws to 18 foot-pounds (24 N•m) torque.
- (3) Install shroud to radiator.
- (4) Install drive belts and tighten to specified tension, using Belt Tension Gauge J-23600. Refer to Specifications.
- (5) Connect hoses to water pump.
- (6) Fill radiator with coolant.
- (7) Operate engine with heater control valve open and radiator cap off until thermostat opens to remove air from cooling system.
- (8) Check coolant level and add as required.

### Removal—Eight-Cylinder

- (1) Disconnect battery negative cable.
- (2) Drain radiator and disconnect upper radiator hose at radiator.
- (3) Loosen all drive belts.
- (4) If vehicle is equipped with radiator shroud, separate shroud from radiator.
- (5) Install one radiator/shroud screw to retain radiator.
- (6) Remove fan and hub from water pump. Remove fan and shroud, if equipped, from engine compartment.

- (7) If vehicle is equipped with air conditioning, install double nut on air conditioning compressor bracket to water pump stud and remove stud (fig. 1C-21).

**NOTE:** Removal of this stud eliminates removing compressor mounting bracket.

- (8) Remove alternator and mount bracket assembly and place aside. Do not disconnect wires.

- (9) If equipped with power steering, remove two nuts that attach power steering pump to rear half of pump mounting bracket.

- (10) Remove two screws that attach front half of bracket to rear half.

- (11) Remove remaining upper screw from inner air pump support brace, loosen lower bolt and drop brace away from power steering front bracket (fig. 1C-21).

- (12) Remove front half of power steering bracket from water pump mounting stud.

- (13) Disconnect heater hose, bypass hose and lower radiator hose at water pump.

- (14) Remove water pump and gasket from timing case cover.

- (15) Clean all gasket material from gasket surface of timing case cover.

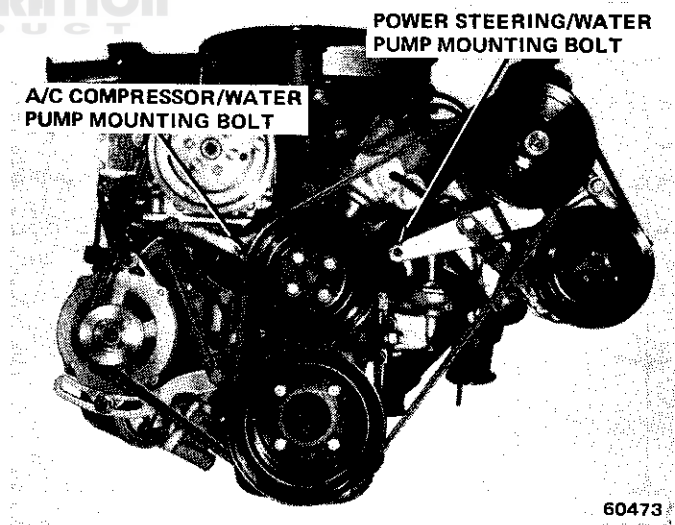


Fig. 1C-21 Water Pump Removal—Eight-Cylinder

### Installation—Eight-Cylinder

**NOTE:** Check timing case cover for erosion damage caused by cavitation.

- (1) Install water pump and replacement gasket to timing case cover.
- (2) Tighten retaining screws to specified torque.
- (3) If removed, install front section of power steering mount bracket, power steering pulley and drive belt.
- (4) Tighten drive belt to specified tension, then tighten pulley retaining nut to 55 to 60 foot-pounds (75 to 81 N•m) torque.

(5) Install air pump drive belt, if removed, and tighten to specified tension.

(6) Install alternator and mount bracket assembly.

(7) Connect heater hose, bypass hose and lower radiator hose to water pump.

**CAUTION:** Check to be sure the wire coil is installed in the lower radiator hose. Failure to install this coil will result in the hose collapsing at high engine rpm.

(8) Position shroud against front of engine and install engine fan and hub assembly. Tighten retaining screws to specified torque.

(9) Position shroud on radiator and install attaching screws.

(10) Install alternator drive belt and tighten to specified tension.

(11) Connect upper radiator hose to radiator.

(12) Connect battery negative cable.

(13) Fill cooling system with a mixture of 50 percent Jeep All-Season Coolant or equivalent and 50 percent water. Operate engine with heater control valve open until thermostat opens. Shut off engine and recheck coolant level.

(14) Reset clock, if equipped.

**SPECIFICATIONS**

**Cooling System Components**

Model	Cooling Package			Engine						Transmission		Radiator		Fan				Shroud
	STD	HD	AC	232	258	304	360 2V	360 4V	401	Man.	Auto	Fins Per Inch	Rows of Tubes	Diam. (inches)	No. of Blades	Spacer (inches)	Tempa-trol	
C5-5 83 CJ-7 93	•				•					•		8	2	16.25	4	.52		
	•				•						•	9	2	16.25	4	.52		
		•			•					•		13	2	15.62	7	.88		•
		•		•	•					•		15	2	15.62	7	.88		•
				•	•							13	2	15.62	7	.88		•
				•	•						•	15	2	15.62	7	.88		•
		•					•			•		10.5	2	19	4	1.5		
Wagoneer 15 Cherokee 16,17,18 Truck 25,45,46	•						•			• <sup>①</sup>		11.5	2	19.5	7	—	•	
	•							•		• <sup>①</sup>		11.5	2	19.5	7	—	•	
	•						•				•	12.5	2	19.5	7	—	•	
	•							•			•	12.5	2	19.5	7	—	•	
	•								•		•	12.5	2	19.5	7	—	•	
							•			• <sup>①</sup>		16	2	19.5	7	—	•	•
		•					•			• <sup>①</sup>		16	2	19.5	7	—	•	•
		•					•				•	16	2	19.5	7	—	•	•
		•					•				•	16	2	19.5	7	—	•	•
		•					•				•	16	2	19.5	7	—	•	•
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								•				16	2	19.5	7	—	•	•
									•			16	2	19.5	7	—	•	•
												9	2	16.25	4	.52		
											10	2	16.25	4	.52			
											13	2	15.62	7	.88		•	
											15	2	15.62	7	.88		•	
											13	2	15.62	7	.88		•	
											15	2	15.62	7	.88		•	

① Not Available on Model 15    ② Not Available on Model 46

NOTE: A 15 PSI Radiator Cap is Used on All Radiators

# 1C-22 COOLING SYSTEMS

## Cooling System Specifications

	Six-Cylinder		Eight-Cylinder	
	USA (ft. lbs.)	Metric (N-m)	USA (ft. lbs.)	Metric (N-m)
Radiator Cap Relief Pressure	15 psi	103 kPa	15 psi	103 kPa
Thermostat	195°F	91°C	195°F	91°C
Rating	192-198°F	89-92°C	192-198°F	89-92°C
Must be open 0.003 inch at	218°F	103°C	218°F	103°C
Fully open				
Water			Centrifugal	
Type			V-Belt	
Drive				
Radiator			Tube & Fin	
Type				
Cooling System Capacities (Includes 1 quart for heater)				
258 CID Engines	10.5 qts. U.S.	8.7 qts. Imp.	10.5 qts. U.S.	8.7 qts. Imp.
304 CID Engines	13.0 qts. U.S.	11.6 qts. Imp.	13.0 qts. U.S.	11.6 qts. Imp.
360 CID Engines	14.0 qts. U.S.	10.8 qts. Imp.	14.0 qts. U.S.	10.8 qts. Imp.
Fan				
Number of Blades			Refer to Cooling System Component Chart	
Diameter			Refer to Cooling System Component Chart	
Drive Belt				
Angle of V	38°	38°	38°	38°
Width — top of groove	0.391-0.453	9.931-11.506	0.391-0.453	9.931-11.506
Type (plain or cogged)	plain	plain	plain	plain

60570



## Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Accessory Drive Pulley Screws (Six-Cylinder)	18	12-25	24	16-34
Air Conditioning Idler Pulley Bracket to Timing Case Cover Nut	7	4-9	10	5-12
Air Pump-to-Bracket Screws	20	15-22	27	20-30
Air Pump Bracket-to-Engine Screws	25	18-28	34	24-38
Air Pump Adjusting Strap to Pump	20	15-22	27	20-30
Alternator Adjusting Bolt	18	15-20	24	20-27
Alternator Mounting Bracket-to-Engine Bolt	28	23-30	38	31-41
Alternator Pivot Bolt or Nut	28	20-35	38	27-48
Alternator Pivot Mounting Bolt to Head	33	30-35	45	41-48
Crankshaft Pulley to Damper Screw	23	18-28	31	24-38
Engine Block Heater Nut (V-8) Compression Type	10	8-13	14	11-18
Engine Block Heater Nut Six-Cylinder T-Bolt Type	20 in-lbs.	17-25 in-lbs.	2	2-3
Fan Blades and Pulley to Hub Screw	18	12-25	24	16-34
Idler Pulley Bearing Shaft to Bracket Nut	33	28-38	45	38-52
Idler Pulley Bracket to Front Cover Nut	7	4-9	10	5-12
Oil Cooler Line Flared Fitting Nuts	25	15-30	34	20-41
Oil Cooler Line Radiator Fitting	15	10-30	20	14-41
Power Steering Pump Adapter Screw	23	18-28	31	24-38
Power Steering Pump Bracket Screw	43	37-47	58	50-64
Power Steering Pump Mounting Screw	28	25-35	38	34-48
Power Steering Pump Pressure Line Nut	30	30-45	41	41-61
Power Steering Pump Pulley Nut	58	40-69	79	54-94
Thermostat Housing	13	10-18	18	14-24
Timing Case Cover to Block (Eight-Cylinder) (through Water Pump)	25	18-33	34	24-45
Water Pump-to-Block Screws (Six-Cylinder)	13	9-18	18	12-24
Water Pump to Engine Block (Eight-Cylinder)	25	18-33	34	24-45
Water Pump-to-Timing Case Cover Screen (Eight-Cylinder)	48 in-lbs.	40-55 in-lbs.	5	5-6

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

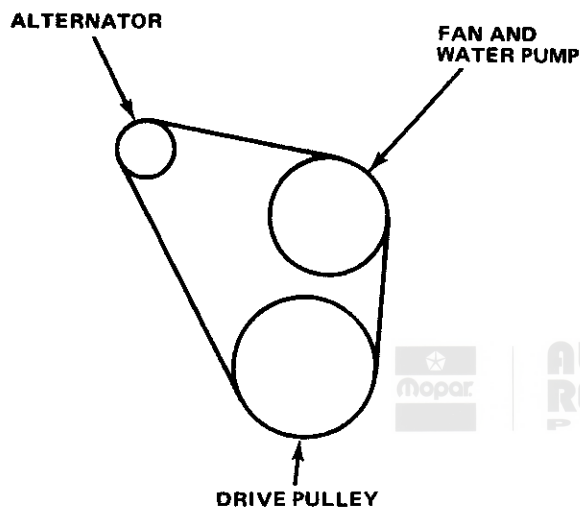
60250

**Engine Drive Belt Tension**

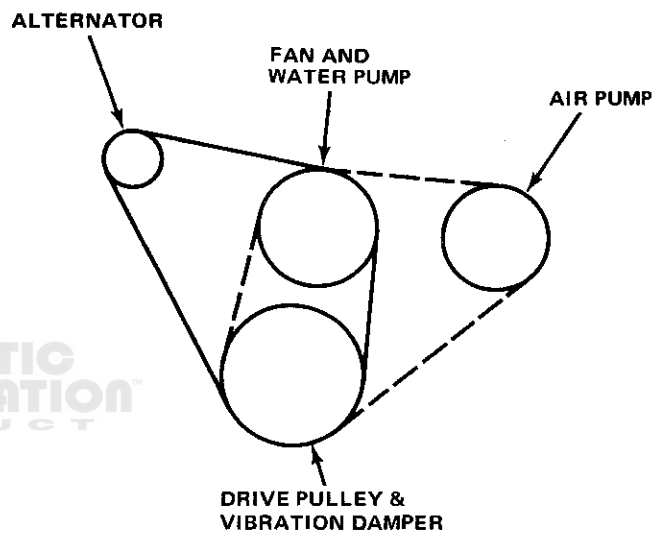
	Initial Pounds New Belt	Reset Pounds Used Belt	Initial Newtons New Belt	Reset Newtons Used Belt
Air Conditioner				
Six-Cylinder . . . . .	125-155	90-115	556-689	400-512
Eight-Cylinder . . . . .	125-155	90-115	556-689	400-512
Air Pump				
All except six-cylinder w/PS. . . . .	125-155	90-115	556-689	400-512
Six-Cylinder w/PS (3/8-inch belt). . . . .	65-75	60-70	289-334	267-311
Fan . . . . .	125-155	90-115	556-689	400-512
Power Steering Pump. . . . .	125-155	90-115	556-689	400-512

60253

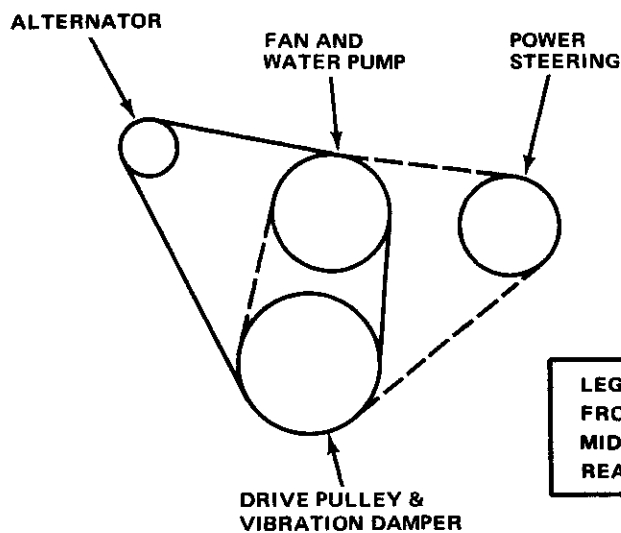
**Engine Drive Belt Arrangement**



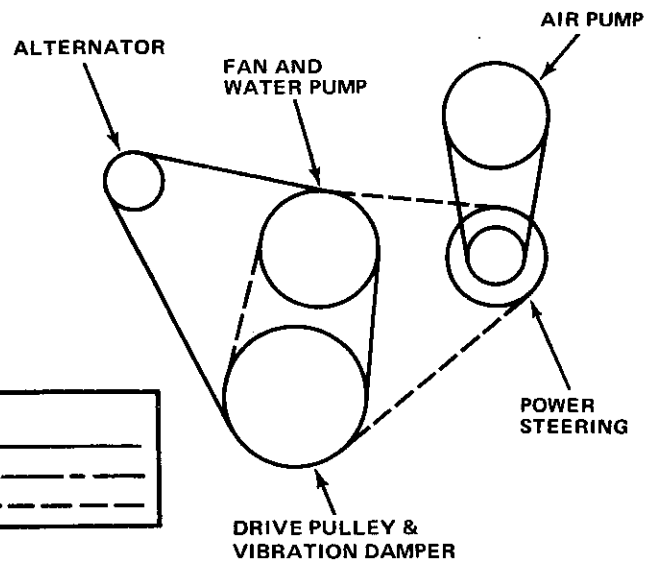
**BASIC BELT ARRANGEMENT SIX-CYLINDER**



**AIR GUARD SIX-CYLINDER**



**POWER STEERING SIX-CYLINDER**



**AIR GUARD AND POWER STEERING SIX-CYLINDER**

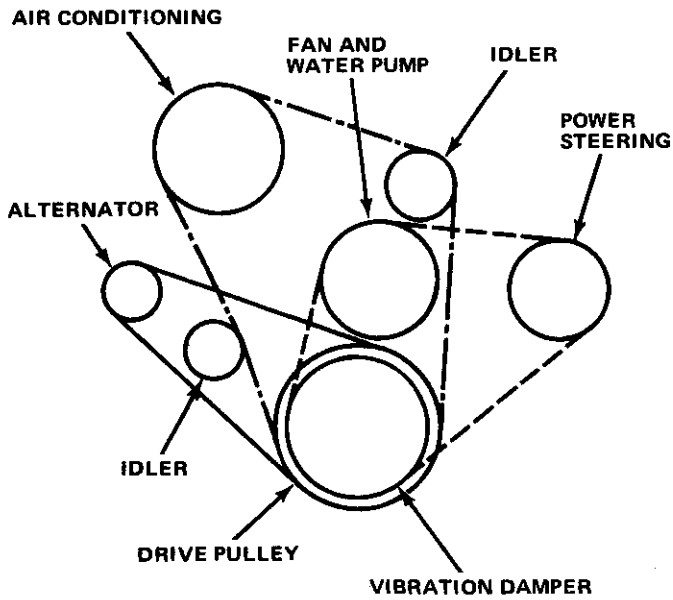
**LEGEND**

FRONT BELT ———

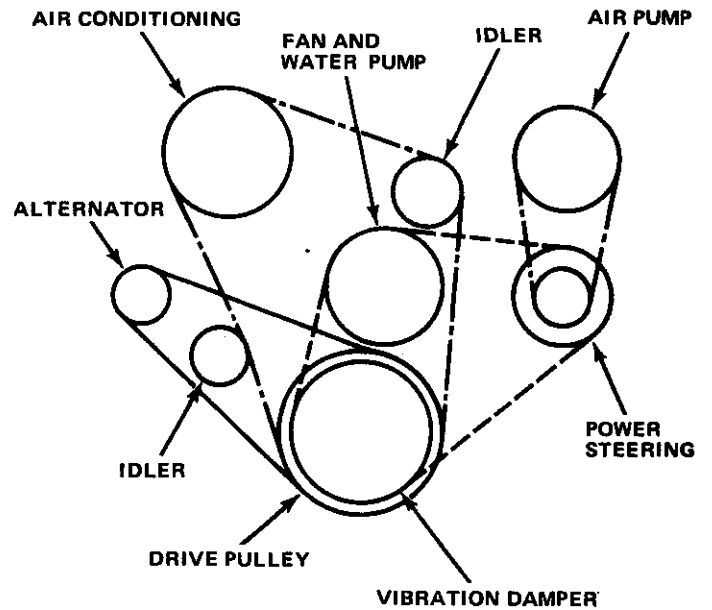
MIDDLE BELT - - - -

REAR BELT - - - - -

# 1C-24 COOLING SYSTEMS



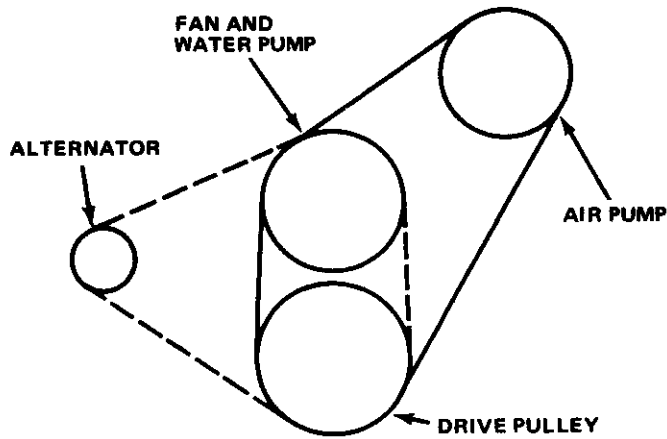
AIR CONDITIONING AND POWER STEERING SIX-CYLINDER



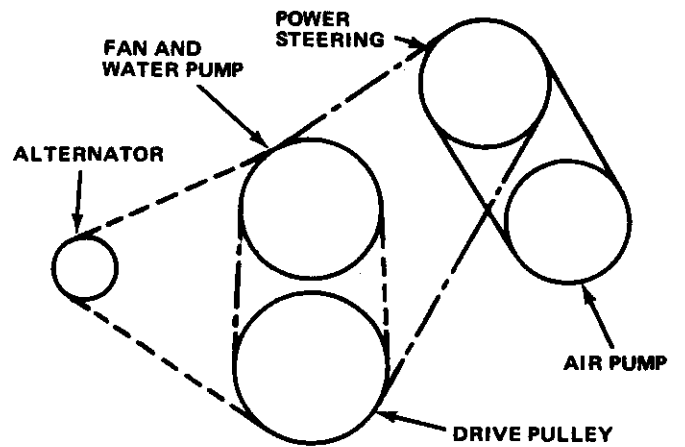
POWER STEERING, AIR GUARD AND AIR CONDITIONING SIX-CYLINDER



**AUTHENTIC RESTORATION**  
PRODUCT

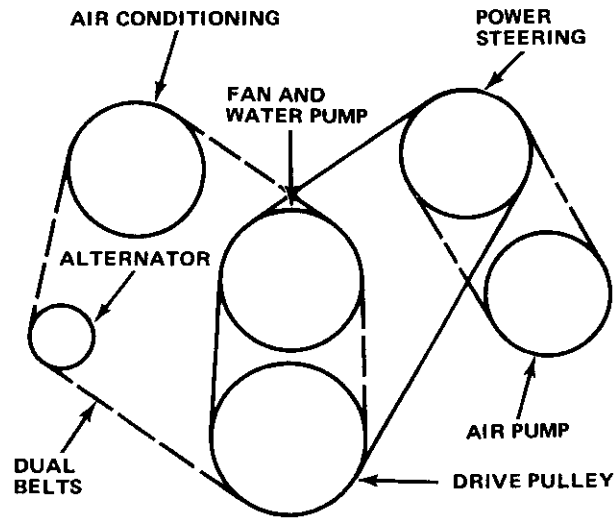


BASIC BELT ARRANGEMENT WITH AIR GUARD EIGHT-CYLINDER



AIR GUARD AND POWER STEERING—EIGHT-CYLINDER

LEGEND	
FRONT BELT	—————
MIDDLE BELT	- - - - -
REAR BELT	- - - - -



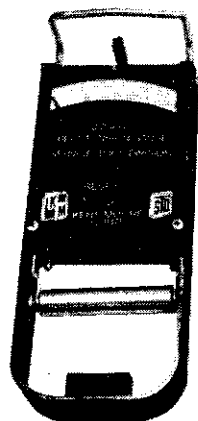
AIR GUARD, AIR CONDITIONING, AND POWER STEERING—EIGHT-CYLINDER

LEGEND	
FRONT BELT	—————
MIDDLE BELT	- - - - -
REAR BELT	· · · · ·

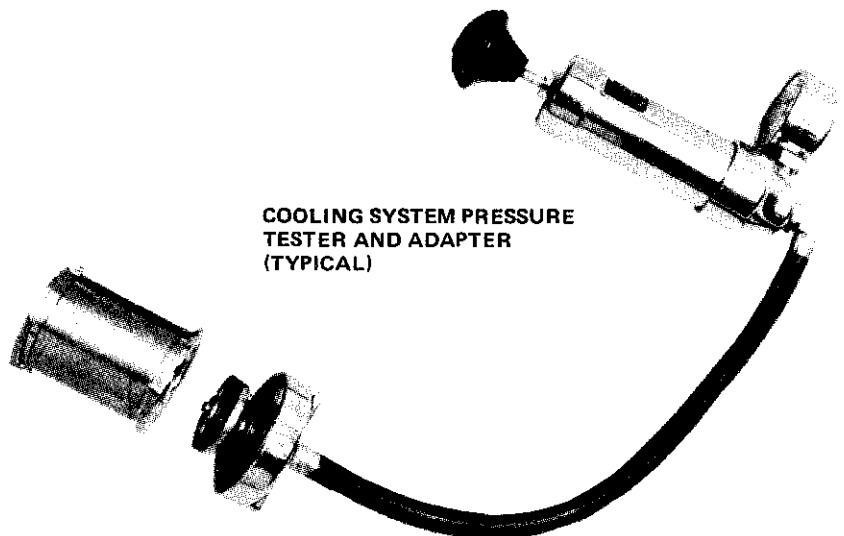


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**Tools**



J-23600  
BELT TENSION GAUGE

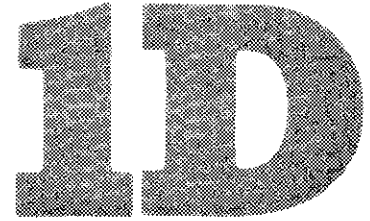


COOLING SYSTEM PRESSURE  
TESTER AND ADAPTER  
(TYPICAL)





# BATTERIES



## SECTION INDEX

	Page		Page
Charging	10-3	Replacement	10-2
General	10-1	Specifications	10-8
Maintenance	10-2	Testing	10-5

### GENERAL

For 1979, all Jeep batteries use plates containing low-antimony lead compound. The benefits are less-frequent electrolyte check, lower self-discharge rate and longer shelf life. It is necessary to check electrolyte only at the beginning of the winter season and every 15,000 miles. A difficult-to-remove cell cap design which discourages casual removal is used on optional batteries. Some 1979 models are equipped with a smaller, lightweight battery with conventional cell caps and a reserve capacity of 75 minutes.

The battery rating designation refers to the reserve capacity. Refer to Reserve Capacity Ratings Chart below. Jeep batteries are available in three ratings: 75, 95 and 110 minutes. A dealer-installed optional battery is rated at 135 minutes. Each rating has the capacity to provide the starting power needed for specific engine applications and accessories. All batteries are 12-volt, lead-acid units, which use a common battery tray, but two different holddowns. When installing an optional battery, use the correct battery holddown. Refer to Specifications for a particular battery model.

**WARNING:** *Explosive gases are present within the battery at all times. Avoid open flames and sparks. Wear eye protection when servicing any battery.*

### Reserve Capacity Rating

Reserve capacity is defined as the number of minutes a fully charged battery at 80°F (26.7°C) can be discharged at a steady 25 amperes and maintain a voltage of 1.75 volts per cell (10.50 volts total battery voltage) or higher. Reserve capacity ratings of Jeep batteries are identified by color codes.

### Reserve Capacity Ratings

Reserve Capacity (Minutes)	Cold Crank (Amps)	Color Code
75	380	Green
95	385	Green
110	410	Red
135*	440	Blue

\*Dealer-installed option only

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### Cold Crank Rating

The cold crank rating specifies the minimum amps a fully charged battery will deliver at 0°F for thirty seconds without falling below 7.2 volts.

### Battery Coding

Each battery is date coded at the time of shipment from the manufacturer. This code is stamped into the edge of the plastic case cover (fig. 1D-1). A second number stamped on the side of the battery case contains manufacturing codes which may be ignored.

The date code is decoded as follows:

- **Month:** A—Jan., B—Feb. (the letter I is not used)
- **Year:** 8—1978, 9—1979

### REPLACEMENT

#### Removal

- (1) Loosen cable clamps.
- (2) Use puller to remove negative (ground) cable from battery terminal. Then remove positive cable.
- (3) Note location of positive and negative terminals so battery can be properly positioned during installation.

## 1D-2 BATTERIES

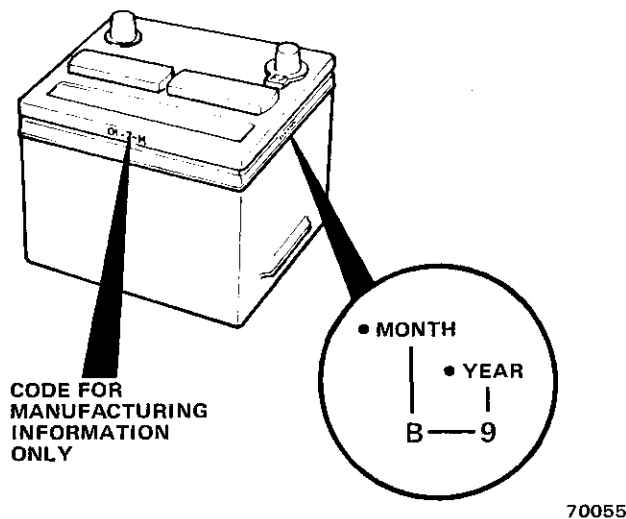


Fig. 1D-1 Date Code Location (Typical)

- (4) Loosen holddowns and remove battery.
- (5) Inspect cables for corrosion and damage. Remove corrosion using wire brush and soda solution. Replace cables that have damaged or deformed terminals.
- (6) Inspect battery tray and holddowns for corrosion. Remove corrosion using wire brush and soda solution. Paint exposed bare metal. Replace damaged components.
- (7) Clean outside of battery case if original battery is to be installed. Flush top cover with soda solution to remove acid film. Be careful to prevent soda solution from entering cells. Remove corrosion from terminals with wire brush. Inspect case for cracks or other damage which would result in leakage of electrolyte.

### Installation

- (1) Refer to Specifications to determine that battery is of correct rating for engine.
- (2) Use hydrometer to test battery. Charge if necessary.
- (3) Position battery in tray. Be sure positive and negative terminals are correctly located. Cables should be able to reach their respective terminals without stretching.

**CAUTION:** Be sure battery tray is clear of loose hardware or debris which could damage battery case.

- (4) Be sure tang on tray is engaged in battery base, then tighten holddown.
- (5) Connect and tighten positive cable first. Then connect and tighten negative cable.

**NOTE:** The tapered positive terminal is 1/16 inch larger in diameter than the negative terminal, and the opening in the positive cable clamp is correspondingly larger to fit.

**CAUTION:** It is imperative that the cables be connected to the battery: positive-to-positive and negative-to-negative. Reverse polarity will damage alternator diodes and radios.

- (6) Apply thin coating of grease to cable terminals.
- (7) Inspect body ground cable for condition and good connection.

### MAINTENANCE

**CAUTION:** Always observe the correct polarity. Reversed battery connections will damage the alternator diodes and radios.

The NEGATIVE battery terminal is grounded to the engine.

It is important that the battery be in a fully charged condition when a new vehicle is delivered. Maintaining a battery at partial charge could shorten its life.

Check electrolyte level in the battery at 15,000 mile intervals and at the beginning of the winter season. Add distilled water to each cell until the liquid level reaches the bottom of the vent well. DO NOT OVERFILL. Use a putty knife or other suitable wide tool to pry filler caps off limited maintenance battery (fig. 1D-2). Do not use a screwdriver. The lightweight 75 minute battery is equipped with conventional filler caps.

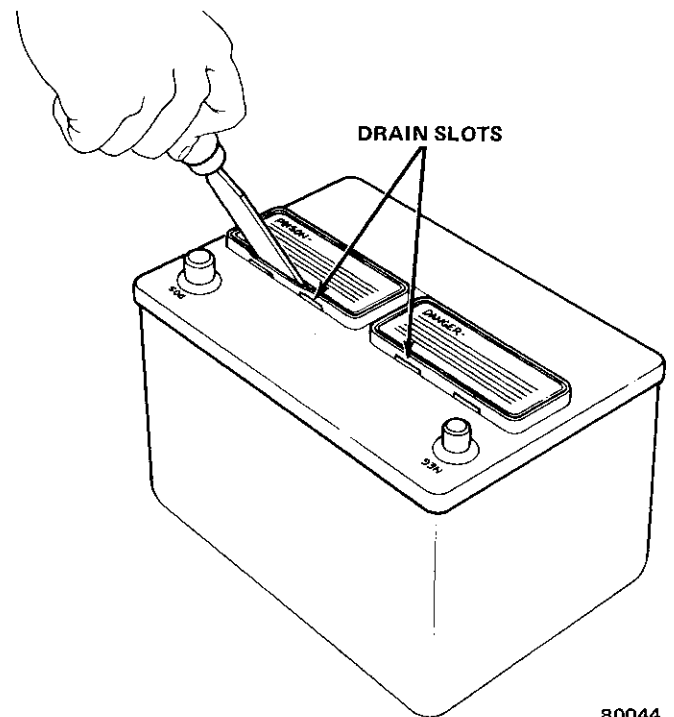


Fig. 1D-2 Removing Filler Cap (Optional Batteries)

Operate the engine immediately after adding water (particularly in cold weather) to assure proper mixing of the water and acid.

Check the external condition of the battery and the cables periodically.

The holddown should be tight enough to prevent the battery from shaking which can cause damage to the battery case.

Take particular care to see that the top of the battery is free of acid film and dirt between the battery terminals. For best results when cleaning the battery, wash with a diluted ammonia or soda solution to neutralize any acid present and then flush with clean water.

**CAUTION:** *Keep filler caps tight so that the neutralizing solution does not enter the cells.*

To ensure good contact, the battery cables must be tight on the battery posts. Check to be sure the terminal clamp has not stretched. This could cause the clamp ends to become butted together without actually being tight on the post. If the battery posts or cable terminals are corroded, disconnect the cables by loosening the terminal clamp bolt and remove the clamp with the aid of a puller. Do not twist, hammer or pry on the cable to free it from the battery post. Clean the terminals and clamps with a soda solution and a wire brush. Connect the cables to the battery posts, and apply a thin coat of grease. Inspect the battery negative cable and body ground cable for good connection and condition.

### Frozen Electrolyte

A 3/4-charged battery is in no danger of damage from freezing. Keep batteries at 3/4 charge or more, especially during winter weather.

Replace the battery if the electrolyte is either slushy or frozen. A battery with this condition, depending on the severity of the freeze, may accept and retain a charge and even perform satisfactorily under a load test. However, after 120 to 150 days in service, a reduction in capacity and service life will become apparent as the individual plates lose their active material.

**CAUTION:** *Do not attempt to charge or use a booster on a battery with frozen electrolyte as it may cause the frozen battery to explode.*

**Freezing Temperature Chart**

Specific Gravity (Corrected to 80° F)	Freezing Temperature
1.270	- 84°F
1.250	- 62°F
1.200	- 16°F
1.150	+ 05°F
1.100	+ 19°F

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### Battery Storage

All wet batteries will discharge slowly when stored. Batteries discharge faster when warm than when cold. For example, at 100°F (37.8°C), a normal self-discharge of 0.0024 specific gravity per day could be expected. At

50°F (10°C), a discharge of 0.0003 specific gravity would be normal. Refer to Self-Discharge Rate chart.

Before storage, clean the battery case with a baking soda solution and wipe the case dry. When storing a battery, charge fully (no change in specific gravity after three readings taken one hour apart) and then store in as cool and dry a place as possible.

Fully charge a stored battery before putting it into service. Refer to Replacement for installation procedures.

### Self-Discharge Rate

Temperature	Approximate Allowable Self-Discharge Per Day For First Ten Days
100°F (37.8°C)	0.0024 Specific Gravity
80°F (26.7°C)	0.0009 Specific Gravity
50°F (10°C)	0.0003 Specific Gravity

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### CHARGING

#### Discharge Chemical Action

A cell is discharged by completing an external circuit such as cranking a starter motor. Sulfuric acid, acting on both positive and negative plates, forms a new chemical compound called lead sulfate. The sulfate is supplied by the acid solution (electrolyte). The acid becomes weaker in concentration as the discharge continues. The amount of acid consumed is in direct proportion to the amount of electricity removed from the battery. When the acid in the electrolyte is partially used up by combining with the plates and can no longer deliver electricity at a useful voltage, the battery is said to be discharged.

The gradual weakening of the electrolyte in proportion to the electricity delivered allows the use of a hydrometer to measure how much unused acid remains with the water in the electrolyte. This information then can be used to determine approximately how much electrical energy is left in each cell.

#### Charge Chemical Action

The lead sulfate in the battery is decomposed by passing a current through the battery in a direction opposite to that of the discharge. The sulfate is expelled from the plates and returns to the electrolyte, gradually restoring it to its original strength. Hydrogen and oxygen gases are given off at the negative and positive plates as the plates approach the fully charged condition. This is caused by an excess of charging current not totally accepted by the plates. A perforated filter and a relief valve in each cap relieve excess gases.

### Dry Charge Battery

**WARNING:** Before activating a dry-charged battery, carefully read the instructions and poison/danger warning on the electrolyte carton.

Do not remove seals until battery is to be activated. Once the seals are removed, the battery must be activated immediately. Discard seals after removal.

#### Activation Procedure

(1) Fill each cell with battery electrolyte to bottom of well, observing handling precautions listed on electrolyte carton.

(2) After cells are filled, tilt battery from side to side to release air bubbles.

(3) Recheck electrolyte level in each cell and add as necessary.

**NOTE:** Uneven filling of cells will affect the battery capacity and service life.

(4) Install caps supplied with battery.

(5) Check battery case for leakage to make sure no damage occurred in handling.

(6) Boost charge for 15 minutes at 30 amps or slow charge until battery is gassing freely.

(7) Install battery in vehicle.

**NOTE:** Since the apparent state of charge of the battery as indicated by a hydrometer is depressed for the first few cycles, load testing is the only valid test at the time of activation. Hydrometer testing may be used after the battery has been cycled in service.

The specific gravity of a newly installed Jeep battery will be approximately 1.225 ( $\pm 0.010$ ). The specific gravity will normally rise to 1.250 to 1.265 after a few days in service.

**NOTE:** Electrolyte is made up of sulfuric acid and pure water. Approximately 35 percent by weight or 24 percent by volume is acid.

**CAUTION:** Never add pure acid to a battery.

### Slow Charge

Slow charging is the preferred method of recharging a battery. The slow charge method may be safely used, regardless of charge condition of the battery, provided the electrolyte is at the proper level in all cells and is not frozen.

**CAUTION:** Do not attempt to charge or use a booster on a battery with frozen electrolyte as it may cause the frozen battery to explode.

The normal charging rate for a battery is one amp per positive plate per cell. The 75 minute battery has 54

plates, and the 95, 110 and 135 minute batteries have 66 plates.

For example, a 54-plate battery has nine plates per cell (54 plates divided by 6). There is always one more negative plate per cell than positive, so each cell has 5 negative and 4 positive plates. The charging rate should be four amps. A 66-plate battery has 11 plates per cell. The charging rate for this battery would be five amps (5 positive and 6 negative plates per cell). A minimum period of 24 hours is required when using this method.

A battery may be fully charged by the slow charge method unless it is not capable of accepting a full charge. **A battery is in a maximum charged condition when all cells are gassing freely and three corrected specific gravity readings, taken at hourly intervals, indicate no increase in specific gravity.**

### Fast Charge

**CAUTION:** Always disconnect the vehicle battery cables before using a fast charger.

A battery may be charged at any rate which does not cause the electrolyte temperature of any cell to exceed 125°F (51.7°C) and which does not cause excessive gassing and loss of the electrolyte.

A fast charger cannot be expected to fully charge a battery within an hour, but will charge the battery sufficiently so that it may be returned to service. The battery will then be fully charged by the vehicle charging system, provided the engine is operated a sufficient length of time.

### Booster Charging

The correct method for starting a vehicle with a discharged battery requires either a portable starting unit or a booster battery. When using either method, it is essential that connections be made correctly.

When using a portable starting unit, the voltage must not exceed 16 volts or damage to the battery, alternator, or starter may result. Because of the accompanying high voltage, a fast charger must not be used for booster starting.

**WARNING:** Battery action generates hydrogen gas which is flammable and explosive. Hydrogen gas is present within a battery at all times even when a battery is in a discharged condition. Keep open flames and sparks (including cigarettes, cigars, pipes) away from the battery. Always wear eye protection when working with a battery.

**WARNING:** If fluid is not visible or ice is evident during cold weather, do not attempt to jump-start as the battery could rupture or explode. The battery must be brought up to 40°F (4.4°C) and water added if necessary before it can be safely jump-started or charged.

(1) Remove vent caps from booster battery and cover cap openings with dampened cloth.

**CAUTION:** *If the vehicle is being jump-started by a battery in another vehicle, the vehicles must not contact each other.*

(2) Connect jumper cable between positive posts of batteries. Positive post has "+" stamped on it. POS is also embossed on battery cover in 1/8-inch letters adjacent to battery terminal.

(3) Connect one end of second jumper cable to negative terminal of booster battery. NEG is embossed on battery cover in 1/8-inch letters adjacent to battery terminal. Make certain clamps are making good contact. **DO NOT CONNECT OTHER END OF JUMPER CABLE TO NEGATIVE TERMINAL OF DISCHARGED BATTERY.** Connect to screw, bracket or nut on engine. Do not connect jumper to carburetor, air cleaner or fuel line. Keep cable clear of belts and pulleys.

(4) When engine starts, remove jumper cables. Disconnect clamp on engine first.

(5) Discard cloth used to cover cap openings because it has been exposed to sulfuric acid.

(6) Install battery caps.

## TESTING

### General

**NOTE:** *A complete battery test includes cleaning the top of the battery case, cleaning terminals and cable clamps and performing hydrometer and heavy load tests.*

The condition of a battery may be determined from the results of two tests—state of charge (hydrometer test) and ability to deliver current (heavy load test). Refer to Battery Diagnosis and Repair Simplification (DARS) Chart.

Perform the hydrometer test first. If specific gravity indicates less than 1.225, the battery must be charged before further testing can be done. A battery which does not accept a charge is defective and no further testing is required.

**NOTE:** *A sulfated battery may require an overnight slow charge to determine if the sulfation is light enough to be broken down by a charge.*

A battery which is over 75 percent charged and does not pass the heavy load test is defective.

In rare cases where a battery goes dead and no apparent cause can be found, the battery should be fully charged and allowed to stand on a shelf for three to seven days to determine if self-discharge is excessive. The Self-Discharge Rate chart shows allowable self-discharge for the first ten days of standing after a battery has been fully charged. A battery is fully charged when all cells are gassing freely and three corrected specific gravity readings, taken at hourly intervals, indicate no increase in specific gravity.

### Hydrometer Test

**NOTE:** *Periodically disassemble the hydrometer and wash components with soap and water. Inspect the float for possible leaks. If the paper inside has turned brown, the float is defective.*

Prior to testing, visually inspect the battery for any damage (broken container, cover, loose post, etc.) that would make the battery unserviceable. To read the hydrometer correctly, position the top surface of the electrolyte in the hydrometer at eye level (fig. 1D-3). Disregard the curvature of the liquid where the surface rises against the float due to surface cohesion. Draw in only enough electrolyte to keep the float off the bottom of the hydrometer barrel with the bulb released. Keep the hydrometer in a vertical position while drawing in liquid and taking the reading. Be careful when inserting the tip of the hydrometer into the cell to avoid damage to separators. Broken separators could result in premature battery failure.

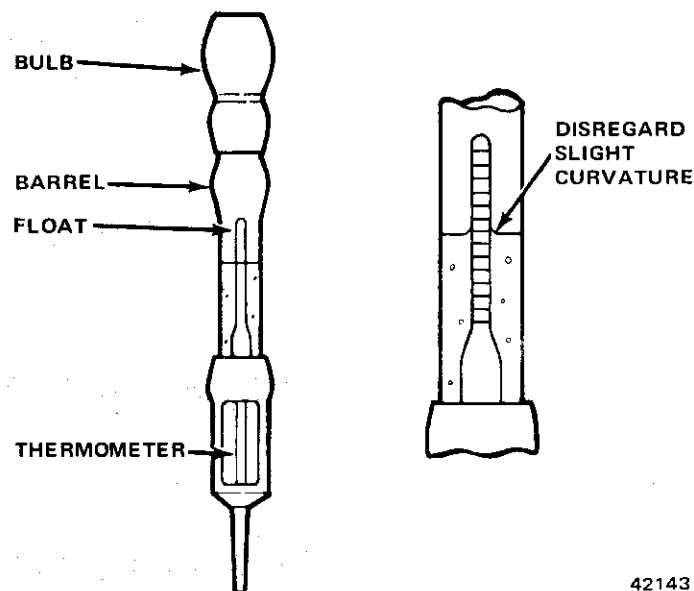


Fig. 1D-3 Hydrometer and Proper Method of Reading

## 1D-6 BATTERIES

Hydrometer floats are generally calibrated to indicate correctly at only one fixed temperature, 80°F. When a reading is taken at any other temperature, a correction factor is required. The correction factor is approximately 0.004 specific gravity, referred to as 4 points of gravity. For each 10°F above 80°F, add 4 points. For each 10°F below 80°F, subtract 4 points. Always correct the readings for temperature variation. Test the specific gravity of the electrolyte in each battery cell.

**Example:** A battery is tested at 10°F and has a specific gravity of 1.240. The actual specific gravity is found as follows:

Number of degrees above or below 80°F equals 70 degrees (80° - 10 degrees).

70° divided by 10° (each 10° difference) equals 7.

7 x 0.004 (temperature correction factor) equals 0.028.

Temperature is below 80° so temperature correction is subtracted.

Temperature corrected specific gravity is 1.212 (1.240 minus 0.028)

A fully charged battery should have a specific gravity of 1.250 to 1.265.

### Specific Gravity

State of Charge	Specific Gravity (Cold and Temperate Climates)
Fully Charged	1.265
75% Charged	1.225
50% Charged	1.190
25% Charged	1.155
Discharged	1.120

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If the specific gravity of all cells is above 1.235, but the variation between cells is more than 50 points (0.050), it is an indication of an unserviceable battery. Remove the battery from the vehicle for further testing.

If the specific gravity of one or more cells is less than 1.235, recharge the battery at approximately 5 amperes until 3 consecutive hourly readings are constant.

If the cell variation is more than 50 points (0.050) at the end of the charge period, replace the battery.

When the specific gravity of all cells is above 1.235 and variation between cells is less than 50 points, the battery may be tested under load.

## Heavy Load Test

**NOTE:** The following instructions refer to Amsero Battery-Alternator-Regulator Tester, Model 21-307.

(1) Before performing heavy load test, battery must be fully charged. Refer to Slow Charge.

(2) Turn carbon pile knob of battery tester to OFF position (fig. 1D-4).

(3) Turn selector knob to AMP position.

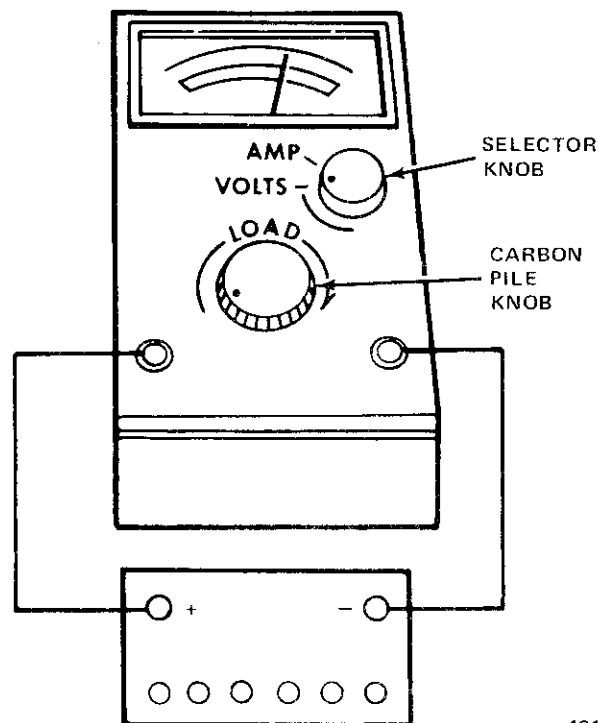
(4) Connect test leads as shown.

(5) Turn carbon pile knob clockwise until ammeter reading is equal to prescribed amperage:

- 135 amperes for 75 minute lightweight battery
- 180 amperes for 95 minute battery
- 190 amperes for 110 minute battery
- 230 amperes for 135 minute battery

(6) Maintain load for 15 seconds. Turn selector switch to VOLTS, and read scale.

If the the voltmeter reading was 9.6 volts or higher with the battery temperature at a minimum of 70°F, the battery has good output capacity. If less than 9.6 volts, replace the battery.



42144

Fig. 1D-4 Heavy Load Test

**BATTERY DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHART**

Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

**PROBLEM: ENGINE WILL NOT CRANK**

**Chart 1**

**STEP SEQUENCE RESULT**

**1**

✓ CHECK FOR:

- LOOSE POST
- LOOSE CONNECTION
- DAMAGED CASE OR COVER
- LOOSE ALTERNATOR DRIVE BELT
- DEFECTIVE CABLE

REPAIR OR REPLACE IF NECESSARY

**2**

**2**

● CHECK ELECTROLYTE LEVEL AND SPECIFIC GRAVITY IN EACH CELL AND RECORD READINGS.

ELECTROLYTE LEVEL TOO LOW FOR SPECIFIC TEST—ADD WATER. CHARGE BATTERY FOR 10 MIN. AT 20 AMPS. MEASURE SPECIFIC GRAVITY.

- OK → **5**
- REPLACE BATTERY → **6**
- **3**

AVERAGE SPECIFIC GRAVITY 1.225 OR MORE CELL READINGS EQUAL WITHIN .050

AVERAGE SPECIFIC GRAVITY 1.225 OR MORE BUT CELL READINGS VARY .050 OR MORE

AVERAGE SPECIFIC GRAVITY BELOW 1.225

**3**

- CONNECT BATTERY CHARGER AND VOLTMETER
- CHARGE BATTERY FOR 3 MINUTES AT 40 AMPS
- AT THE END OF 3 MINUTES READ VOLTMETER WHILE CHARGER IS STILL CHARGING

- OK → **4**
- SLOW CHARGE BATTERY AT 3 TO 4 AMPS FOR 48 TO 72 HOURS → **5**

VOLTAGE IS 15.5 OR LESS

VOLTAGE ABOVE 15.5

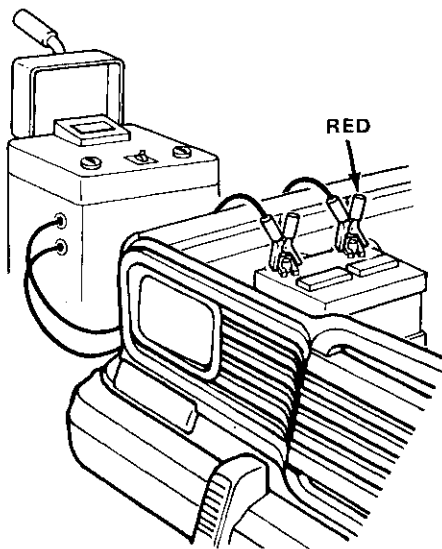


**STEP**

**SEQUENCE**

**RESULT**

**4**



CHARGE BATTERY AS INDICATED IN CHART, AFTER CHARGE IS COMPLETED, RECHECK SPECIFIC GRAVITY.

AVERAGE SPECIFIC GRAVITY	CHARGE RATE (AMPS)	TIME
LESS THAN 1.125	5	12 HOURS
1.125 TO 1.149	20	90 MIN.
1.150 TO 1.174	20	70 MIN.
1.175 TO 1.199	20	50 MIN.
1.200 TO 1.224	20	30 MIN.

**5**

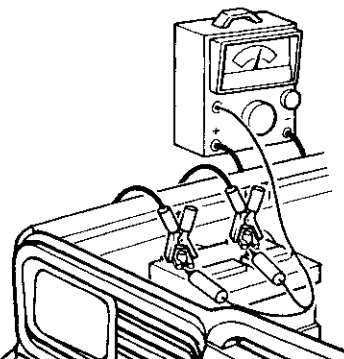
**OK** → AVERAGE SPECIFIC GRAVITY 1.225 OR MORE  
CELL READINGS EQUAL WITHIN .050 → **5**

**OK** → REPLACE BATTERY → **6**

AVERAGE SPECIFIC GRAVITY 1.225 OR MORE  
BUT CELL READINGS VARY .050 OR MORE

**5**

- CLEAN BATTERY POST AND CABLE ENDS
- CONNECT HEAVY LOAD TESTER
- DETERMINE HEAVY LOAD FROM CHART
- ADJUST TESTER TO LOAD
- HOLD LOAD FOR 15 SECONDS
- READ VOLTMETER



HEAVY LOAD OUTPUT TEST

HEAVY LOAD CHART

COLOR CODE	RESERVE CAPACITY	COLD CRANK (AMPS)	HEAVY LOAD
Green	75	380	135
Green	95	385	180
Red	110	410	190
Blue	135	440	230

**6**

● VOLTAGE READING 9.6 OR MORE → **6**

● VOLTAGE READING LESS THAN 9.6 → REPLACE BATTERY → **6**

**6**

**OK** → ENGINE CRANKS → **STOP**

**OK** → ENGINE DOES NOT CRANK → PERFORM STARTER DIAGNOSIS IN STARTER CHAPTER

**STOP**

PERFORM STARTER DIAGNOSIS IN STARTER CHAPTER

## SPECIFICATIONS

### Battery Specifications

Rating	
258 and 304	
Reserve	75 min.
Plates	54
360	
Reserve	95 min.
Plates	66
Optional Battery, Factory Installed	
Reserve	110 min.
Plates	66
Optional Battery, Dealer Installed	
Reserve	135 min.
Plates	66



80380

### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Battery Box Screw	75		8	
Battery Holddown Screw	60-70	50-90	7-8	6-10

All torque values given in inch-pounds and newton-meters with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

## NOTES



**AUTHENTIC  
RESTORATION™**  
PRODUCT

# CHARGING SYSTEM

# 1E

## SECTION INDEX

	Page		Page
Alternator Overhaul	1E-10	Operation	1E-2
Alternator Replacement	1E-9	Specifications	1E-14
Components	1E-1	Testing—Off-Vehicle	1E-7
Drive Belt Adjustment	1E-13	Tools	1E-14
General	1E-1	Troubleshooting	1E-3

### GENERAL

The Delco charging system is used on all engines. It is a negative-ground system consisting of three main components: an alternator, a regulator and a battery. The non-adjustable regulator is a solid-state device and is mounted inside the alternator housing.

Available alternators are rated at 37 and 63 amperes.

### COMPONENTS

#### Alternator

The alternator (fig. 1E-1) is belt-driven by the engine.

Its major components are front and rear housings, stationary windings (stator), rotating field windings (rotor) and rectifying diodes.

The rotor assembly is supported in the drive end housing by a ball bearing and in the slip ring end housing by a roller bearing. These rotor bearings are manufactured with adequate lubricant and do not require periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor and provide long periods of attention-free service. Other than a regularly-scheduled belt tension check, the alternator assembly requires no periodic adjustments or maintenance.

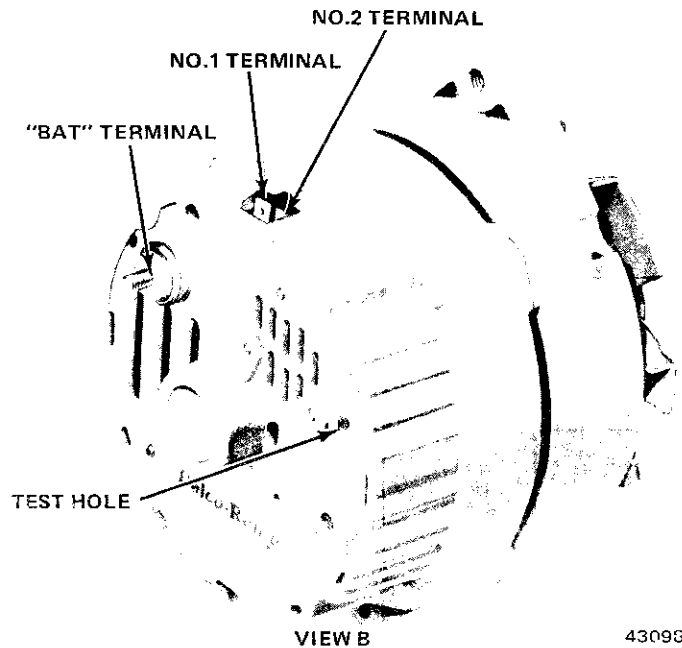
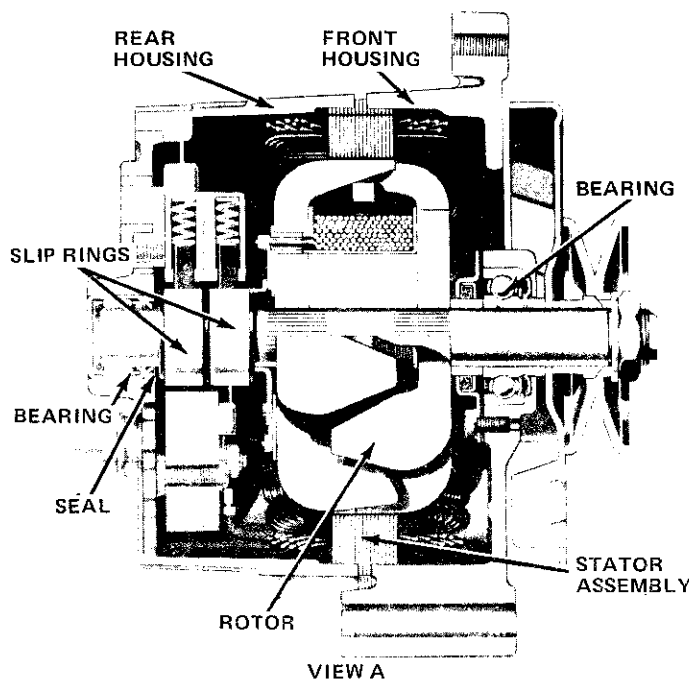


Fig. 1E-1 Delco Alternator—10-SI Series

## 1E-2 CHARGING SYSTEM

The stator windings are assembled on the inside of a laminated core that forms part of the alternator frame. A rectifier bridge connected to the stator windings contains six diodes (three positive and three negative) molded into an assembly which is connected to the stator windings. The rectifier bridge changes the stator AC voltage to DC voltage which appears at the output terminal.

Battery discharge through the alternator is prevented by the blocking action of the diodes, eliminating the need for a conventional cutout relay. Alternator field current is supplied through a diode trio which is also connected to the stator windings.

A capacitor, or condenser, mounted in the end housing protects the rectifier bridge and diode trio from high voltages and suppresses radio noise.

### Voltage Regulator

The voltage regulator utilizes an integrated circuit to regulate current supplied to the alternator field. All regulator components are enclosed in a solid mold, and this unit along with the brush holder assembly is attached to the rear housing. The voltage regulator is not adjustable.

## OPERATION

### General

Charging of the battery is accomplished by supplying current directly from the alternator output terminal (heavy red wire) to the battery, using the starter solenoid as a junction point. The positive battery cable joins the heavy red wire at the solenoid. The alternator is grounded to the engine to complete the return circuit to the negative side of the battery. The amount of charge the battery receives depends upon the state of charge and internal condition of the battery, proper operation of the voltage regulator and the amount of current being consumed by electrical loads such as heater blower motor, lamps and rear window defogger.

### Energizing the System

When the ignition switch is turned to the On position (fig. 1E-2), current from the battery flows through the 10-ohm resistance wire to the alternator No. 1 terminal, through resistor R1, diode D1, and the base-emitter of transistor TR1 to ground, then back to the battery. This turns transistor TR1 On and current flows through the alternator field coil and TR1 back to the battery.

### Voltage Output

When the rotor starts turning, AC voltage is generated in the stator windings. The diode trio converts some of this to DC field current which flows through the field,

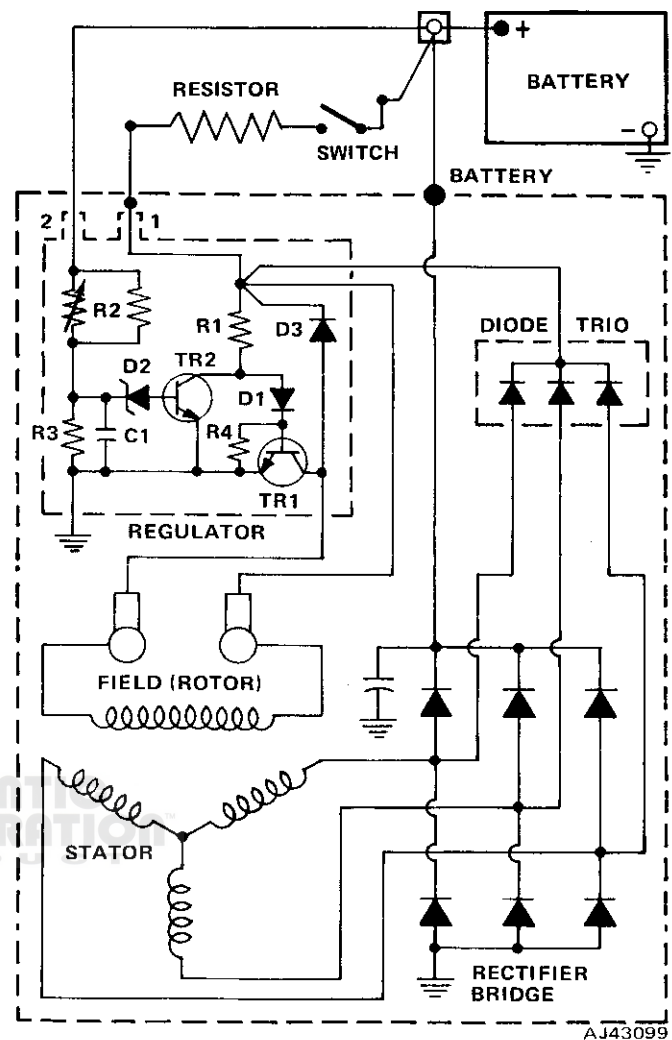


Fig. 1E-2 Charging System Schematic

through TR1, and then through the grounded diodes in the rectifier bridge back to the stator. The six diodes in the rectifier bridge change the stator AC voltage to DC voltage which appears between ground and the alternator BAT terminal. As alternator speed increases, current is provided for charging the battery and operating electrical accessories.

### Regulation

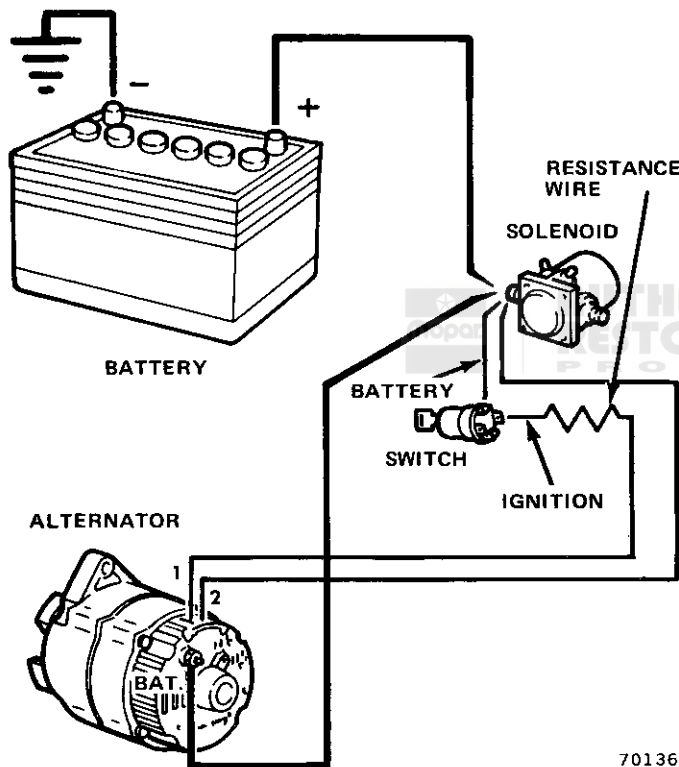
The No. 2 terminal on the alternator is always connected to the battery, but the discharge current is limited to a negligible value by the high resistances of R2 and R3. As the alternator speed and voltage increase, the voltage between R2 and R3 increases and causes zener diode D2 to conduct. Transistor TR2 then turns On and TR1 turns Off. With TR1 Off, the field current and system voltage decrease, and D2 then blocks current flow, causing TR1 to turn back On. The field current and system voltage increase. This cycle repeats many times per second to limit the alternator voltage to a preset value.

Capacitor C1 provides voltage continuity across R3, R4 prevents excessive current through TR1 at high temperatures, and D3 prevents high induced voltages in the field windings when TR1 turns Off. Resistor R2 is a thermistor which causes the regulated voltage to vary with temperature, providing the optimum voltage for charging the battery.

## TROUBLESHOOTING

Close adherence to the following procedures in the order presented will lead to the location and correction of charging system defects in the shortest possible time.

Figure 1E-3 is a basic wiring diagram showing lead connections.



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Fig. 1E-3 Basic Lead Connections

To avoid damage to the electrical equipment, always observe the following precautions:

- Do not polarize the alternator.
- Do not short across or ground any of the terminals in the charging circuit except as specifically instructed.
- NEVER operate the alternator with the output terminal circuit open and No. 1 and No. 2 terminals connected to the alternator.
- Make sure the alternator and battery have the same ground polarity.
- When connecting a charger or a booster battery to the vehicle, connect negative to negative and positive to positive.

**NOTE:** An ammeter is used on Cherokee, Wagoneer and Truck to indicate charging rate. CJ models are equipped with a voltmeter.

Trouble in the charging system will show up as one or more of the following conditions:

- Faulty voltmeter or ammeter operation.
- An undercharged battery, evidenced by slow cranking and low specific gravity readings.
- An overcharged battery, evidenced by excessive water usage.

Before making any electrical checks, perform a visual inspection of all charging system components and wiring.

## Visual Inspection

Check for clean and tight cable connections at the battery posts, engine block, and starter solenoid. Check for corrosion and loose wire connections at the alternator, starter motor solenoid, and the charging system indicator. Inspect all wiring for cracked or broken insulation. Be sure alternator mounting screws are tight and unit is properly grounded. Inspect the fluid level in the battery and add water if necessary. Check for loose alternator drive belt.

## Alternator Noise

Alternator noise may be caused by one of the following conditions:

- Loose mounting screws.
- Loose or misaligned pulley.
- Worn or dirty bearings.
- Out-of-round or rough slip rings.
- Defective brushes.
- Shorted rectifier diode (indicated by high-pitched whine).

Noise from the cooling system can also sound like alternator noise. Disconnect and plug the heater hoses to eliminate the possibility of the alternator bracket acting as a sounding board for heater core noises.

## Faulty Voltmeter or Ammeter Operation

Diagnosis of instrumentation is covered fully in Chapter 1L—Power Plant Instrumentation.

## Overcharged/Undercharged Battery

For battery overcharged-undercharged diagnosis, refer to DARS Charts 1 and 2.

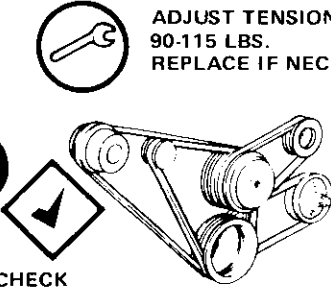
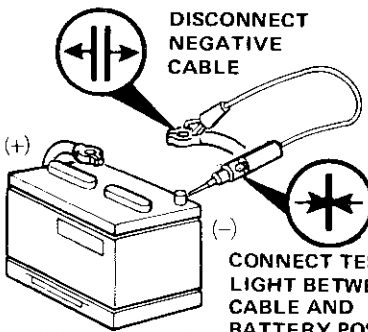
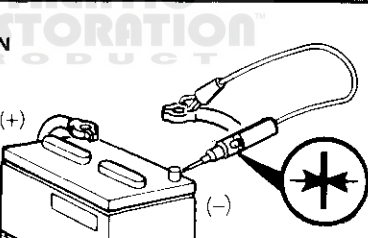
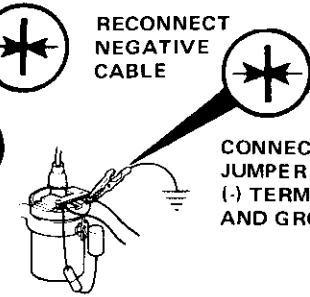
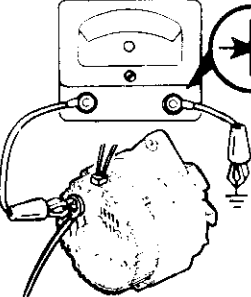
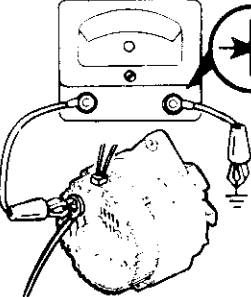
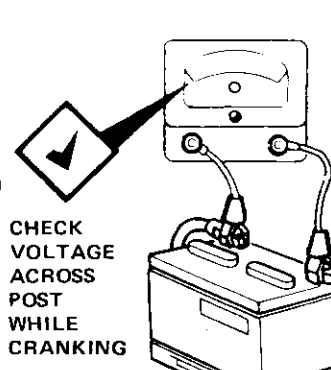
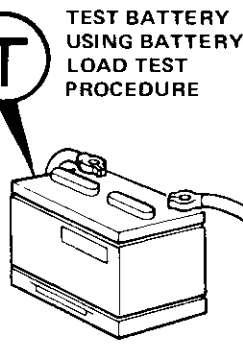
## Alternator Leakage

If the alternator is suspected of discharging the battery because of excessive leakage, perform the following procedure, using a bulb socket with jumper wires attached and a No. 158 bulb.

- (1) Disconnect battery lead to alternator.

CHARGING SYSTEM DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHART

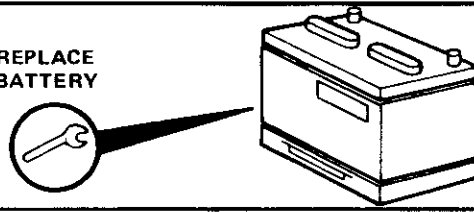
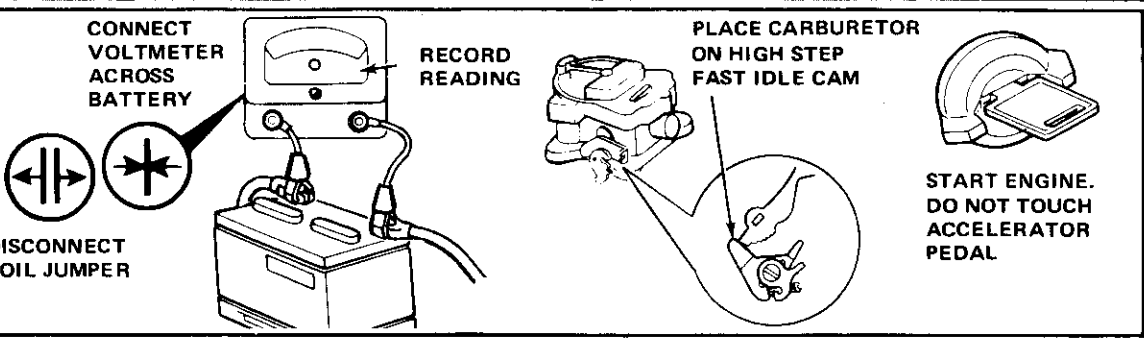
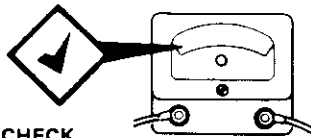
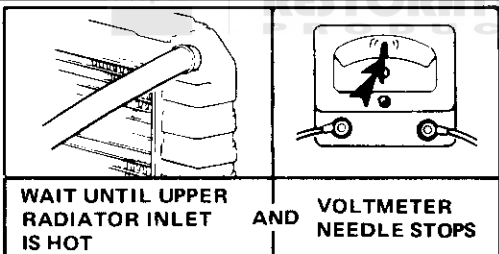
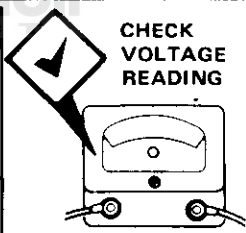
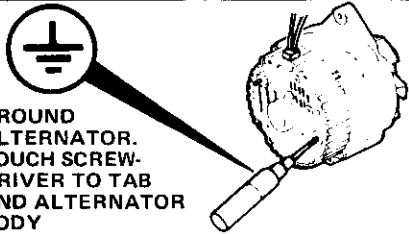
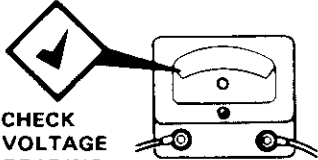
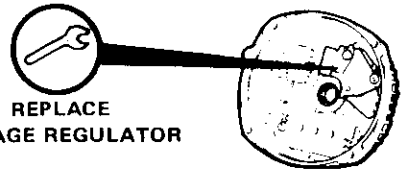
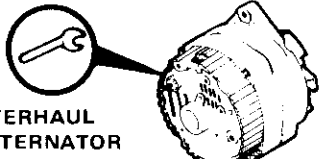
**PROBLEM: BATTERY UNDERCHARGED**

STEP	SEQUENCE	RESULT
<p><b>1</b></p> <p>CHECK ALTERNATOR BELT</p> 	<p>ADJUST TENSION TO 90-115 LBS. REPLACE IF NECESSARY</p> <p>MAKE SURE NO ACCESSORIES ARE ON, IGNITION OFF, DOORS CLOSED, UNDER HOOD LIGHTS DISCONNECTED</p> <p>DISCONNECT NEGATIVE CABLE</p>  <p>CONNECT TEST LIGHT BETWEEN CABLE AND BATTERY POST</p>	<p>TEST LIGHT ON → <b>2</b></p> <p>TEST LIGHT OFF—NO DRAIN ON BATTERY → <b>3</b></p>
<p><b>2</b></p> <p>TRACE AND CORRECT CONTINUOUS DRAIN ON BATTERY</p>	<p>CONNECT TEST LIGHT BETWEEN CABLE AND BATTERY POST</p> 	<p>TEST LIGHT OFF → STOP</p> <p>TEST LIGHT ON → <b>3</b></p>
<p><b>3</b></p> <p>RECONNECT NEGATIVE CABLE</p> 	<p>CONNECT JUMPER (-) TERMINAL AND GROUND</p>  <p>CONNECT VOLTMETER (+) TERMINAL AND GROUND</p>  <p>CRANK ENGINE LONG ENOUGH FOR STABILIZED READING</p>	<p>NEEDLE ABOVE 9.0V → <b>6</b></p> <p>NEEDLE BELOW 9.0V → <b>4</b></p>
<p><b>4</b></p> <p>CHECK VOLTAGE ACROSS POST WHILE CRANKING</p> 	<p>IF READING IS WITHIN .5 VOLT OF VOLTAGE AT ALTERNATOR → <b>T</b></p> <p>IF READING IS NOT WITHIN .5 VOLT OF READING AT ALTERNATOR, CHECK FOR BATTERY-TO-ALTERNATOR CIRCUIT RESISTANCE</p> <p>TEST BATTERY USING BATTERY LOAD TEST PROCEDURE</p> 	<p>BATTERY OK. CHARGE AS SPECIFIED BY TEST → <b>6</b></p> <p>BATTERY NOT OK → <b>5</b></p>

STEP

SEQUENCE

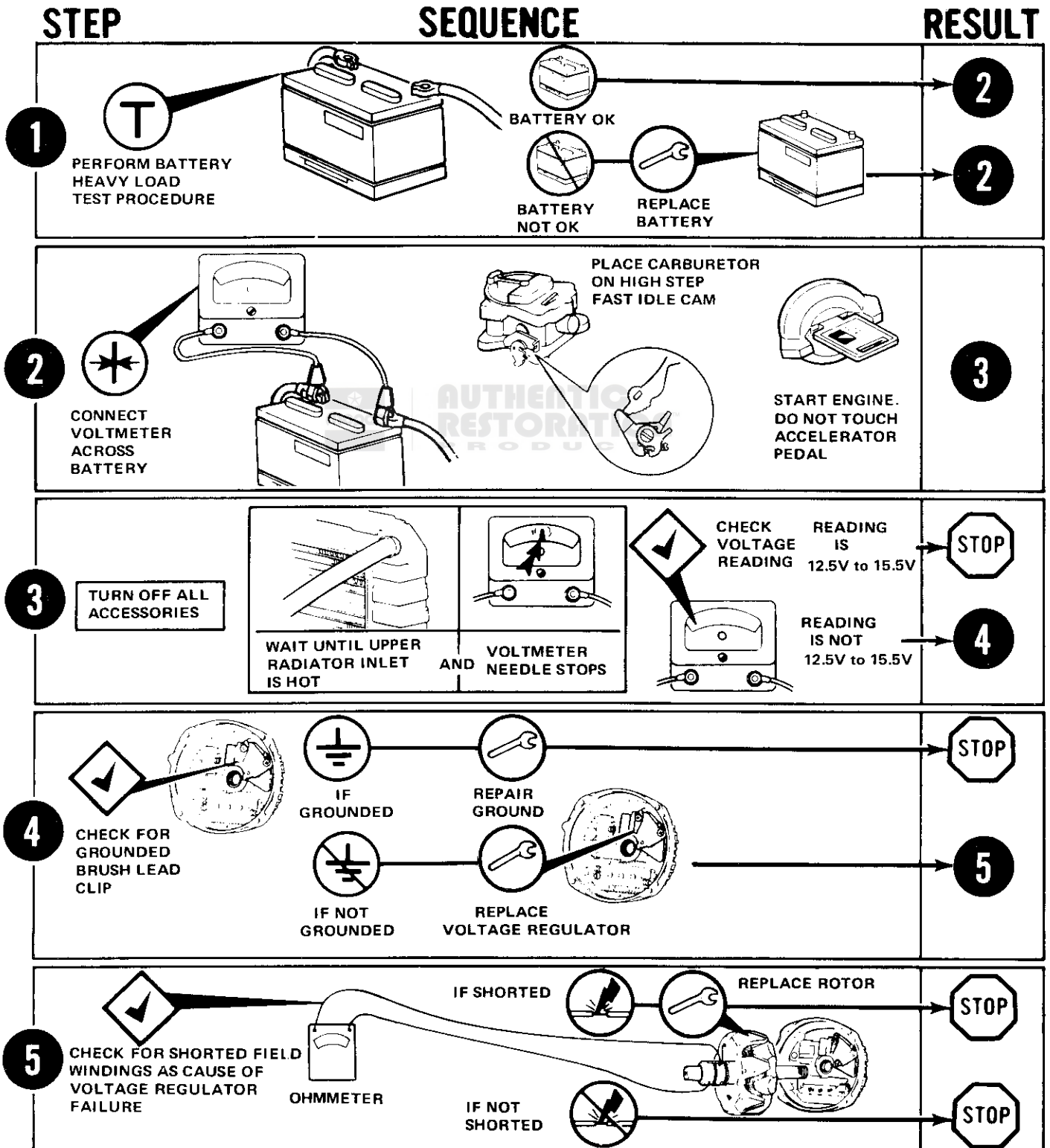
RESULT

<p>5</p>	<p>REPLACE BATTERY</p> 	<p>6</p>								
<p>6</p>	<p>CONNECT VOLTMETER ACROSS BATTERY</p> <p>DISCONNECT COIL JUMPER</p> <p>RECORD READING</p> <p>PLACE CARBURETOR ON HIGH STEP FAST IDLE CAM</p> <p>START ENGINE. DO NOT TOUCH ACCELERATOR PEDAL</p> 	<p>7</p>								
<p>7</p>	<p>TURN ON ACCESSORIES</p> <table border="1" data-bbox="487 829 812 1029"> <tr> <td>HEADLIGHTS-HI</td> <td></td> </tr> <tr> <td>A/C - HI</td> <td></td> </tr> <tr> <td>RADIO</td> <td></td> </tr> <tr> <td>BLOWER-TYPE DEFOGGER</td> <td></td> </tr> </table> <p>CHECK VOLTAGE READING</p> <p>IF VOLTAGE IS LOWER THAN PREVIOUS READING (STEP 6)</p> <p>IF VOLTAGE IS HIGHER THAN PREVIOUS READING (STEP 6)</p> 	HEADLIGHTS-HI		A/C - HI		RADIO		BLOWER-TYPE DEFOGGER		<p>9</p> <p>8</p>
HEADLIGHTS-HI										
A/C - HI										
RADIO										
BLOWER-TYPE DEFOGGER										
<p>8</p>	<p>TURN OFF ACCESSORIES</p> <p>WAIT UNTIL UPPER RADIATOR INLET IS HOT AND VOLTMETER NEEDLE STOPS</p> <p>CHECK VOLTAGE READING</p> <p>IF METER READS UNDER 12.5V</p> <p>IF METER READS OVER 15.5V</p> <p>IF METER READS 12V TO 15.5V SEE NOTE</p>  	<p>9</p> <p>10</p> <p>STOP</p>								
<p>9</p>	<p>GROUND ALTERNATOR. TOUCH SCREW-DRIVER TO TAB AND ALTERNATOR BODY</p> <p>CHECK VOLTAGE READING</p> <p>IF VOLTAGE IS HIGHER THAN PREVIOUS READING (STEP 6)</p> <p>IF VOLTAGE IS LOWER THAN PREVIOUS READING (STEP 6)</p>  	<p>10</p> <p>11</p>								
<p>10</p>	<p>REPLACE VOLTAGE REGULATOR</p> 	<p>STOP</p>								
<p>11</p>	<p>OVERHAUL ALTERNATOR</p> 	<p>STOP</p>								

NOTE: IF NOTHING HAS BEEN FOUND, EXPLAIN TO OWNER THAT EXCESSIVE IDLING, AND SLOW OR SHORT DISTANCE DRIVING WITH ALL ACCESSORIES ON, MAY CAUSE HEAVY DRAIN ON BATTERY - RESULTING IN UNDERCHARGED CONDITION.



# PROBLEM: BATTERY OVERCHARGED (USES TOO MUCH WATER)



(2) Connect No. 158 bulb in series with battery lead and alternator output terminal. Bulb should not light. If bulb lights (even dimly), replace rectifier bridge.

(3) Disconnect connector from No. 1 and 2 terminals of alternator.

(4) Connect No. 158 bulb in series with No. 1 terminal at alternator and the battery positive post. Bulb should not light. If bulb lights (even dimly), test diode trio. If diode trio is not defective, replace voltage regulator.

(5) Connect No. 158 bulb in series with No. 2 terminal at alternator and battery positive post. Bulb should not light. If bulb lights (even dimly), replace voltage regulator.

## TESTING—OFF VEHICLE

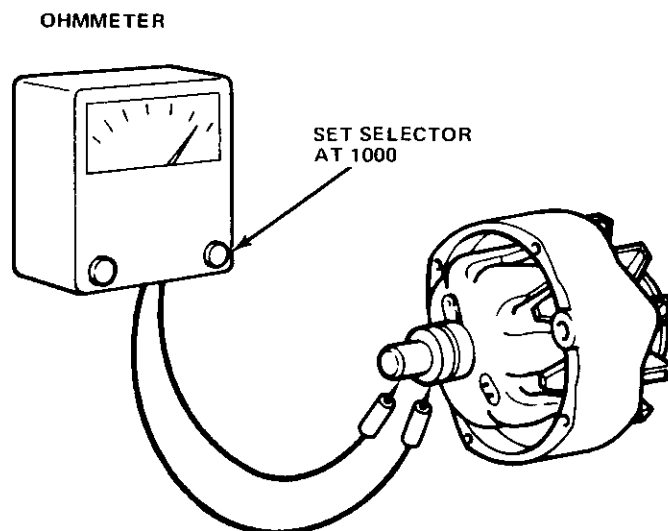
### Rotor Short-to-Ground Test

To perform this test, remove rotor and front housing assembly from stator and rear housing assembly. Refer to Disassembly for procedure. Perform the test with an ohmmeter set to the 1000 scale or with a 110-volt test lamp.

Touch one test lead to rotor shaft and touch other lead to one slip ring (fig. 1E-4). Repeat with other slip ring. In each case, the ohmmeter should indicate infinity (no needle movement) or the test lamp should not light.

#### Test Results

If ohmmeter indicates other than infinity or test lamp lights, a short to ground exists. Check soldered connections at slip rings to be sure they are secure and not grounding against rotor shaft, or that excess solder is not grounding rotor coil. Replace rotor if damaged.



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Fig. 1E-4 Rotor Short-to-Ground Test

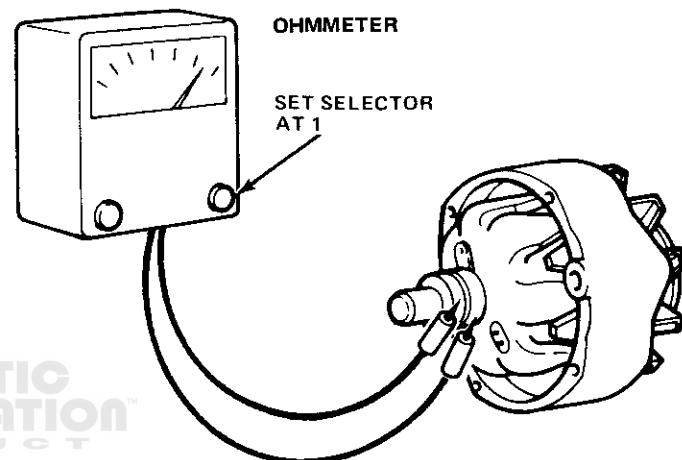
### Rotor Open Test

To perform this test, remove rotor and front housing assembly from stator and rear housing assembly. Refer to Disassembly for procedure. Perform the test with an ohmmeter set to the 1 scale or with a 110-volt test lamp.

Touch one test lead to one slip ring and other test lead to other slip ring (fig. 1E-5). Ohmmeter should read 2.6 to 3.0 ohms or test lamp should light.

#### Test Results

If ohmmeter reading is infinite or test lamp fails to light, the rotor winding is open.



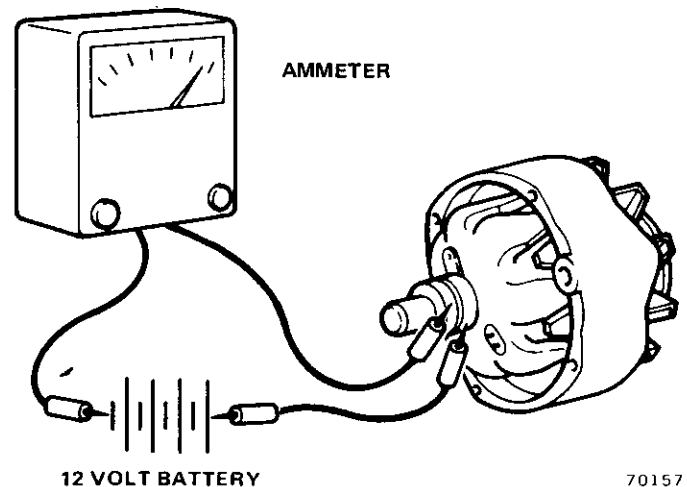
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Fig. 1E-5 Rotor Open Test

### Rotor Internal Short Test

To perform this test, remove rotor and front housing assembly from stator and rear housing assembly. Refer to Disassembly for procedure. This test is performed with a 12-volt battery and an ammeter.

Connect battery and ammeter in series with slip rings (fig. 1E-6). The field current at 12 volts and 80°F should be between 4.0 and 4.6 amps.



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Fig. 1E-6 Rotor Internal Short Test

## 1E-8 CHARGING SYSTEM

### Test Results

Any ammeter reading above 4.6 amps indicates shorted windings.

**NOTE:** The winding resistance and ammeter readings will vary slightly with winding temperature changes. A reading below the specified value indicates excessive resistance. An alternate method is to check the resistance of the field by connecting an ohmmeter to the two slip rings. If the resistance reading is below 2.6 ohms at 80°F, the winding is shorted. If resistance is above 3.0 ohms at 80°F, the winding has excessive resistance.

### Stator Short-to-Ground Test

To perform this test, remove stator and rear housing assembly from rotor and front housing assembly. Remove stator leads from rectifier terminals. Refer to Disassembly for procedures. The test is performed with an ohmmeter set to the 1000 scale or with a 110-volt test lamp.

Touch one test lead to bare metal surface of stator core and other test lead to end of one stator lead (1E-7). Because all three stator leads are soldered together, it is not necessary to test each lead. Ohmmeter should indicate infinity (no needle movement) or test lamp should not light.

### Test Results

If ohmmeter indicates other than infinity or test lamp lights, stator is grounded and must be replaced.

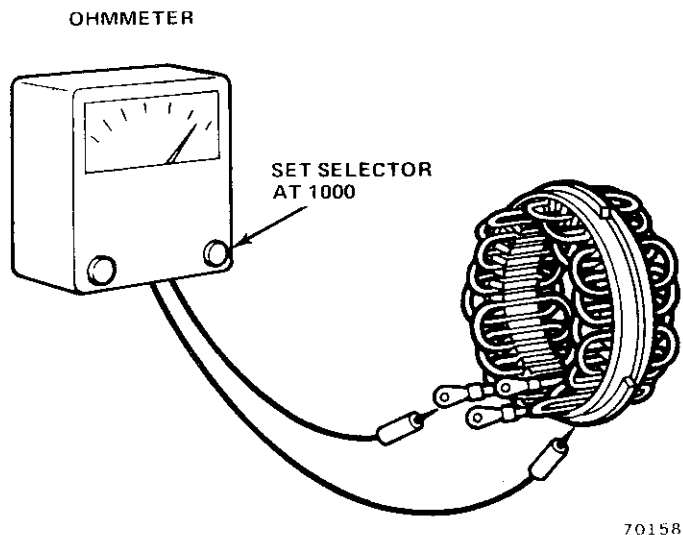


Fig. 1E-7 Stator Short-to-Ground Test

### Stator Continuity Test

To perform this test, remove stator and rear housing assembly from the rotor and front housing assembly. Refer to Disassembly for procedure. An ohmmeter set to the 1 scale is used to perform the tests.

Touch ohmmeter leads to two stator leads and note reading (fig. 1E-8). Test all stator leads in this manner. Equal readings should be obtained for each pair.

### Test Results

An infinity reading (no needle movement) indicates an open winding. Check the neutral junction splice for a poor solder connection. Resolder the connection even though it looks good. Recheck continuity. If an open still exists, replace stator.

A reading of more than 1 ohm indicates a bad solder joint. Check the neutral junction splice.

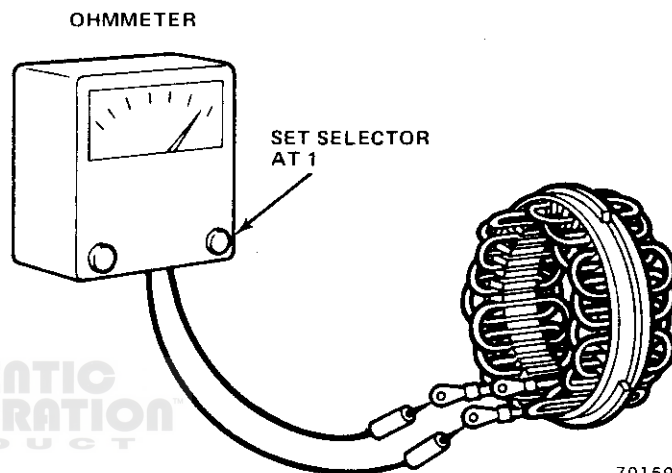


Fig. 1E-8 Stator Continuity Test

### Stator Internal Short Circuit Test

An internal short (for instance, between adjacent windings) is difficult to locate without laboratory test equipment. If all other electrical checks are normal and alternator fails to supply rated output, shorted stator windings are indicated.

### Diode Trio Short Circuit Test

The diode trio is tested in two ways, installed in the rear housing and removed from the rear housing.

**NOTE:** Do not use high voltage, such as 110-volt test lamp, to check the diode trio.

### Test with Diode Trio Installed

(1) Before removing diode trio, connect an ohmmeter, using lowest range scale, from brush lead clip to rear housing (fig. 1E-9).

(2) Reverse lead connections. If both readings are zero, check for grounded brush lead clip caused by omission of insulating washer, omission of insulating sleeve over screw, or damaged insulation (fig. 1E-14).

(3) Remove screw to inspect sleeve. If screw assembly is correct and both ohmmeter readings are same, replace voltage regulator.

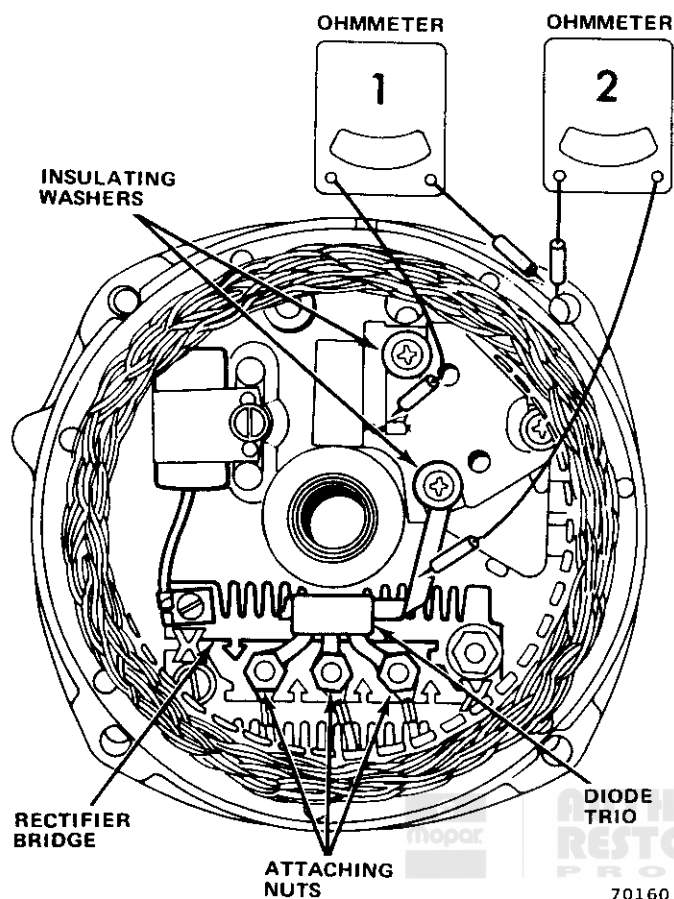


Fig. 1E-9 Rear Housing Assembly

#### Test with Diode Trio Removed

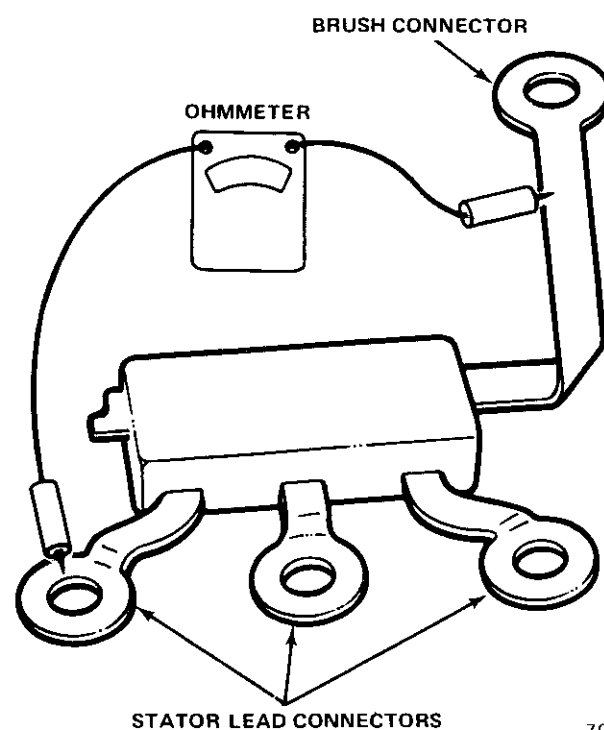
- (1) Remove diode trio from rear housing assembly.
- (2) Connect ohmmeter having 1-1/2 volt cell to single brush connector and one stator lead connector (fig. 1E-10). Observe reading on lowest range scale.
- (3) Reverse leads to same two connectors.
- (4) Replace diode trio if two readings are same. Good diode trio will give one high and one low reading.
- (5) Repeat steps 2, 3, and 4 for each stator lead connector of diode trio.
- (6) Connect ohmmeter to two connectors. If reading is zero, open diode is indicated. Replace diode trio. Repeat test for each combination of stator lead connectors.

#### Rectifier Bridge Test

The rectifier bridge contains six diodes, three positive and three negative. If one diode is defective, the entire rectifier bridge must be replaced.

**NOTE:** Do not use high voltage, such as a 110-volt test lamp, to check this unit.

- (1) Connect ohmmeter to grounded heat sink and one of three terminal tabs (fig. 1E-11). Note reading.
- (2) Reverse ohmmeter lead connections to grounded heat sink and same terminal tab. Note reading.



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Fig. 1E-10 Testing Diode Trio

- (3) Repeat steps (1) and (2) for remaining two terminal tabs.

- (4) In same manner, test between insulated heat sink and each of three terminal tabs.

#### Test Results

Each combination of terminals tested should give one high and one low reading. Replace rectifier bridge if any one pair of readings is the same.

## ALTERNATOR REPLACEMENT

### Removal

**WARNING:** Failure to disconnect battery negative cable may result in injury from battery lead at the alternator.

- (1) Disconnect battery negative cable.
- (2) Disconnect two-terminal plug and battery cable at back of alternator.
- (3) Remove mounting and adjusting screws and washers.
- (4) Remove alternator drive belt from alternator pulley and remove alternator from mounting bracket.
- (5) Remove pulley from alternator.

### Installation

- (1) Install original pulley on replacement alternator.

## 1E-10 CHARGING SYSTEM

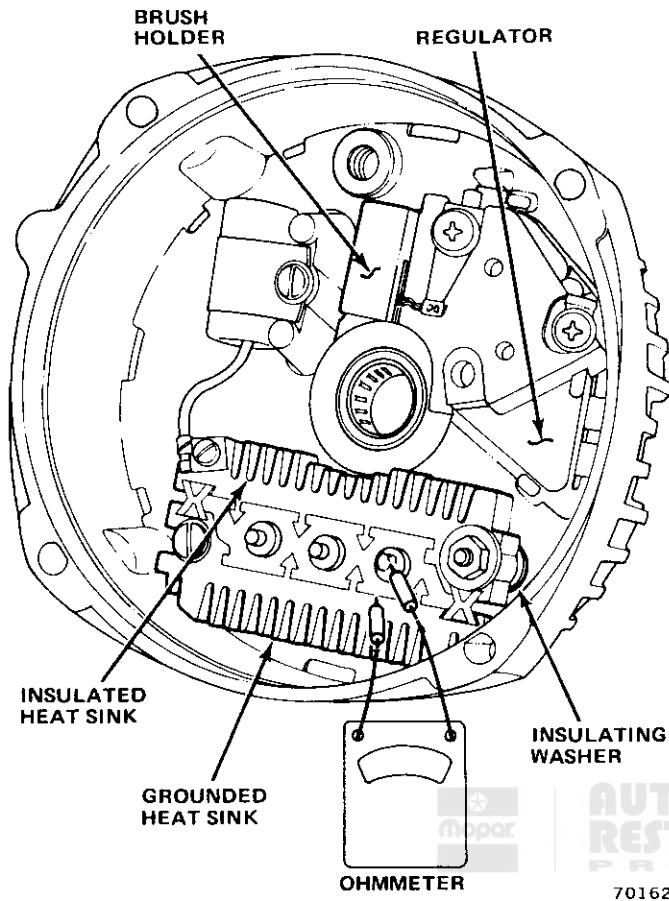


Fig. 1E-11 Testing Rectifier Bridge

- (2) Install alternator to mounting bracket with washers and screws. Tighten screws finger-tight only.
- (3) Install alternator drive belt.
- (4) Tighten belt to specified tension. Refer to Alternator Belt Adjustment for proper belt tensioning procedures.
- (5) Tighten screw at sliding slot bracket to 20 foot-pounds (27 N•m) torque. Tighten remaining screws to 30 foot-pounds (41 N•m) torque.
- (6) Install terminal plug and battery lead to alternator.
- (7) Connect battery negative cable.

## ALTERNATOR OVERHAUL

### Disassembly

**CAUTION:** As rotor and drive end housing assembly is separated from slip ring housing assembly, the brushes will spring out onto the rotor shaft and come in contact with lubricant. Immediately clean brushes which contact shaft to avoid contamination by lubricant, or they will have to be replaced.

(1) Scribe marks on alternator case for assembly reference.

(2) Remove four through-bolts that connect rear housing to front housing (fig. 1E-12).

(3) Separate front housing and rotor assembly from stator assembly by prying apart with screwdriver placed between stator assembly and front housing.

**NOTE:** After disassembly, place a piece of tape over the rear housing bearing to prevent entry of dirt and other foreign material, and also place a piece of tape over the rotor shaft on the slip ring end. Use pressure-sensitive tape and not friction tape, which would leave a gummy deposit on the shaft. If brushes are to be reused, clean with a soft, dry cloth.

(4) Place rotor in vise and tighten vise only enough to permit removal of shaft nut.

**NOTE:** Avoid excessive tightening of the rotor in the vise to prevent rotor distortion.

(5) Alternate pulley nut removal method requires use of Allen wrench to hold rotor from turning while loosening nut with wrench (fig. 1E-13).

(6) Remove shaft nut, washer, pulley, fan, and collar.

(7) Separate drive end housing from rotor shaft.

(8) Remove three stator lead attaching nuts and washers and remove stator leads from rectifier bridge terminals.

(9) Separate stator from rear housing.

(10) Remove diode trio lead clip attaching screw and remove diode trio.

(11) Remove capacitor lead attaching screw.

(12) Disconnect capacitor lead from rectifier bridge.

(13) Remove rectifier bridge attaching screws and battery terminal screw.

(14) Remove rectifier bridge.

(15) Remove two brush holder screws and one diode trio lead strap attaching screw (fig. 1E-14).

(16) Remove brush holder and brushes. Carefully note stack-up of parts for assembly.

(17) Remove voltage regulator.

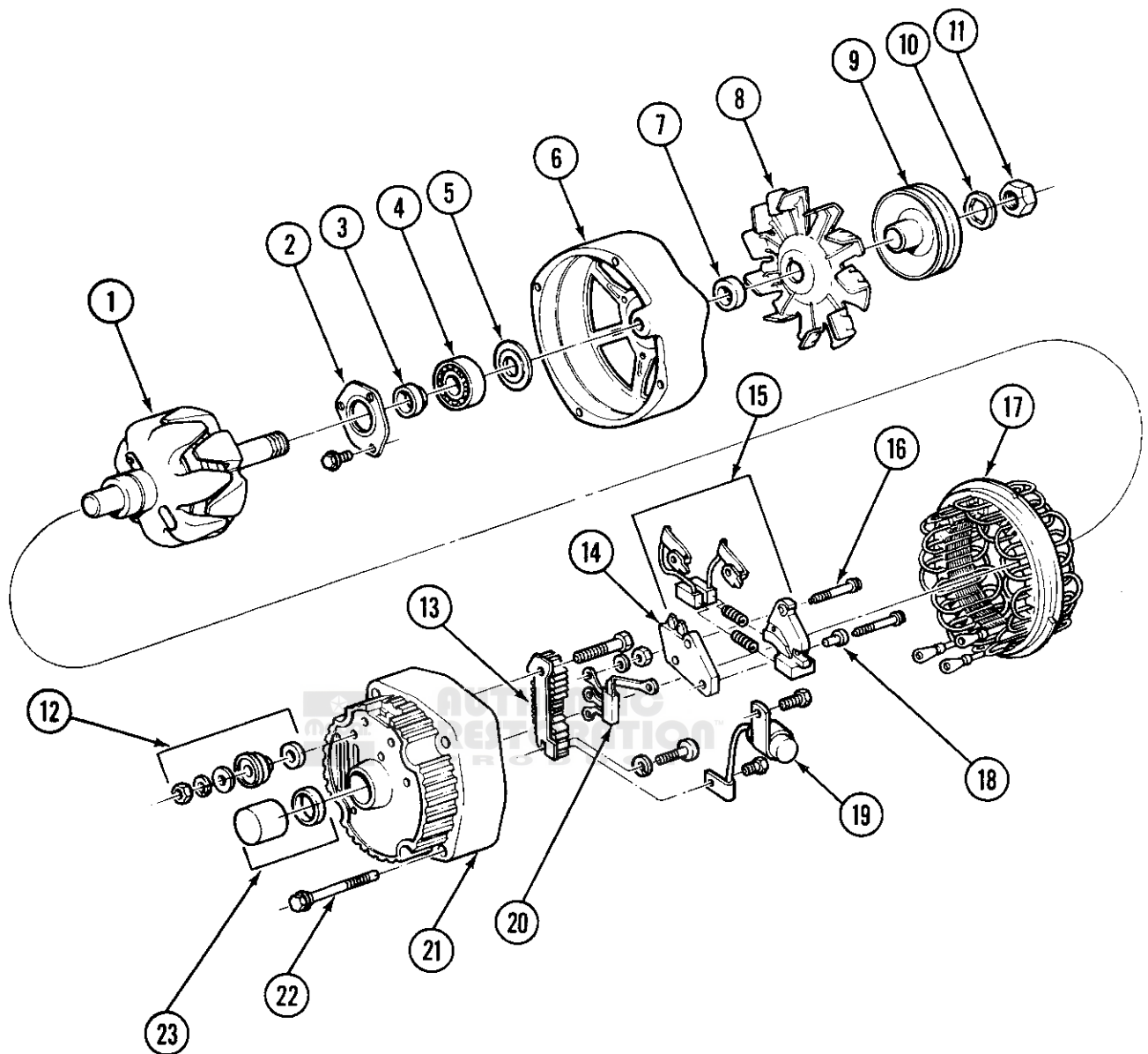
(18) Remove front bearing retaining plate screws.

(19) Press front bearing from front housing with suitable tube or collar.

**NOTE:** If the bearing is in satisfactory condition, it may be reused.

(20) Press out rear bearing using tube or collar that fits inside rear housing. Press from inside of housing toward outside.

**NOTE:** Replace the bearing in the rear housing if its lubricant supply is exhausted. Do not attempt to lubricate and reuse a dry bearing.



1. ROTOR  
 2. FRONT BEARING RETAINER  
 3. COLLAR (INNER)  
 4. BEARING  
 5. WASHER  
 6. FRONT HOUSING  
 7. COLLAR (OUTER)  
 8. FAN

9. PULLEY  
 10. LOCKWASHER  
 11. PULLEY NUT  
 12. TERMINAL ASSEMBLY  
 13. RECTIFIER BRIDGE  
 14. REGULATOR  
 15. BRUSH ASSEMBLY  
 16. SCREW

17. STATOR  
 18. INSULATING WASHER  
 19. CAPACITOR  
 20. DIODE TRIO  
 21. REAR HOUSING  
 22. THROUGH-BOLT  
 23. BEARING AND SEAL ASSEMBLY

Fig. 1E-12 Alternator Components

43105

### Cleaning and Inspection

(1) Clean magnetic poles of rotor by brushing with oleum spirits.

**NOTE:** Do not clean with degreasing solvent.

(2) Inspect slip rings for dirt and roughness. Clean with solvent. If necessary, clean and finish slip rings with commutator paper, or 400 grit polishing cloth. **Do not use metal-oxide paper.** Spin rotor in lathe or other support while holding abrasive against rings.

**NOTE:** When using an abrasive, support the rotor while spinning to clean slip rings evenly. Cleaning slip rings without support may result in flat spots on slip rings, causing brush noise and premature brush wear.

(3) True rough or out-of-round slip rings in lathe to 0.002 inch maximum indicator reading. Remove only enough material to make rings smooth and round. Finish with commutator paper, or 400 grit polishing cloth, and blow away all dust.

(4) Clean stator by brushing with oleum spirits or equivalent.

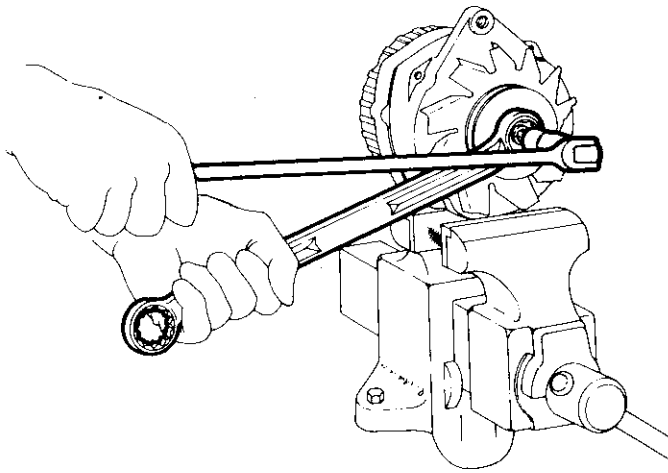


Fig. 1E-13 Removing Pulley Nut

60132

**NOTE:** Do not clean stator in solvent.

(5) Inspect brush springs for evidence of damage or corrosion. Replace springs if there is any doubt about their condition.

(6) Inspect brushes for wear or contamination. If brushes are to be reused, clean with soft, dry cloth until completely free of lubricant.

(7) Inspect condition of brush holder screws for broken or cracked insulation (fig. 1E-14).

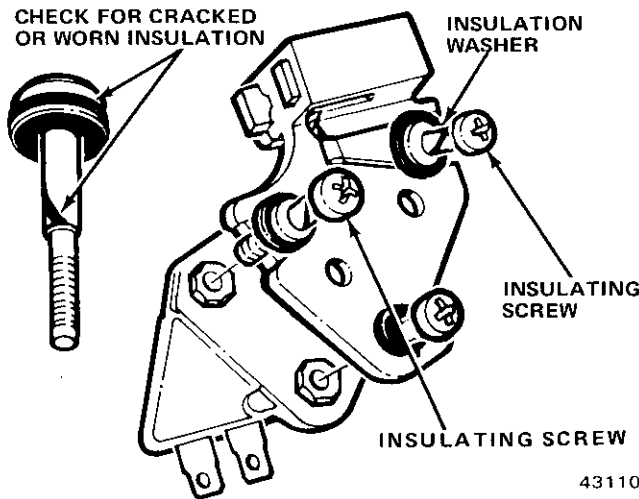


Fig. 1E-14 Brush Holder

43110

**Assembly**

(1) Fill cavity between retainer plate and bearing one-quarter full with Delco-Remy lubricant No. 1948791, or equivalent.

**NOTE:** Overfilling may cause the bearing to overheat.

(2) Assemble bearing and slinger into front housing (fig. 1E-15).

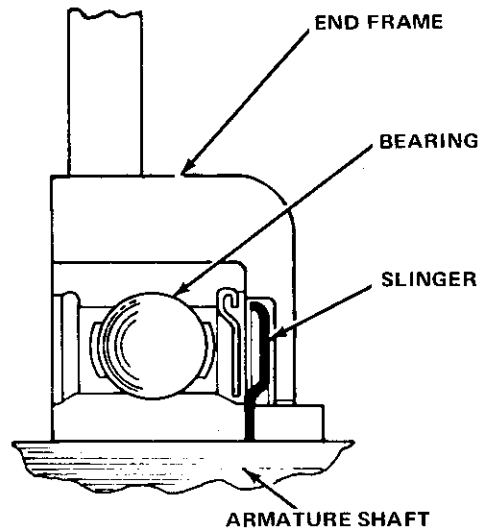


Fig. 1E-15 Front Housing Bearing Assembly

43111

(3) Press bearing in with suitable tube or collar that fits over outer race.

**NOTE:** Install a replacement retainer plate if the felt seal in the retainer plate is hardened.

(4) Install retaining plate and screws.

(5) Position housing, collar, fan, pulley and washer on rotor shaft and install drive pulley nut.

(6) Place rotor in vise. Tighten vise only enough to permit tightening of pulley nut.

(7) Alternate method of tightening pulley nut requires use of Allen wrench to hold rotor from turning while tightening nut with wrench (fig. 1E-16).

(8) If rear bearing was removed, support inside of rear housing with hollow cylinder.

(9) Place flat plate over bearing and press bearing into housing from outside until bearing is flush with housing.

**NOTE:** Use extreme care to avoid misalignment or placing undue stress on bearing.

(10) Install replacement bearing seal. Lightly oil lip to facilitate installation of rotor shaft. Press seal in with lip away from bearing.

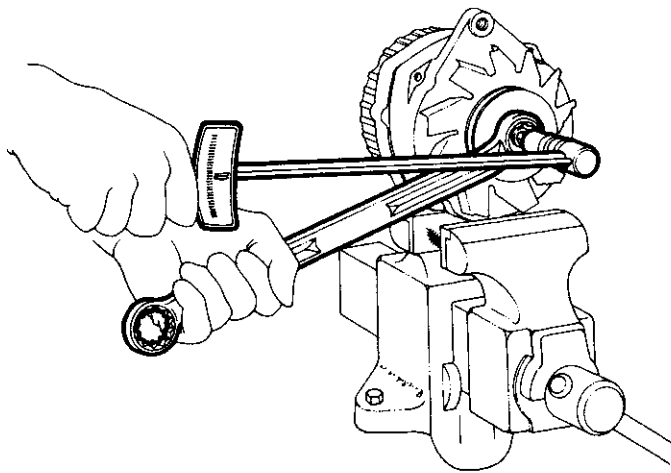
(11) Install springs and brushes into brush holder. Brushes should slide in and out of brush holder without binding.

**NOTE:** Should any of the brush holder assembly parts require replacement, it is necessary to replace the entire brush holder assembly. Individual parts are not serviced.

(12) Insert straight wooden or plastic toothpick (to prevent scratching brushes) into hole at bottom of holder to retain brushes.

(13) Install voltage regulator.

(14) Attach brush holder into rear housing, carefully noting stack-up of parts (fig. 1E-14). Allow toothpick to protrude through hole in rear housing.



60133

Fig. 1E-16 Tightening Pulley Nut

- (15) Install diode trio lead strap attaching screw and washer.
- (16) Securely tighten remaining two brush holder screws.
- (17) Position rectifier bridge to rear housing with insulator between insulated heat sink and rear housing.
- (18) Install rectifier bridge attaching screw and battery terminal screw.
- (19) Connect capacitor lead to rectifier bridge and tighten securely.
- (20) Position diode trio to end housing.
- (21) Install diode trio lead clip screw, making sure insulating washer is over top of diode trio connector.
- (22) Install stator to rear housing.
- (23) Attach stator leads to rectifier bridge terminals. Secure with washers and nuts.
- (24) Before assembling rotor and front housing assembly to stator and rear housing assembly, remove protective tape and make sure that bearing surface of shaft is clean.
- (25) Position front housing and rear housing together, aligning scribe marks.
- (26) Install four through-bolts and securely tighten.
- (27) Remove toothpick from brush holder assembly.

**DRIVE BELT ADJUSTMENT**

If belt has been in service for some time, inspect for general condition before attempting an adjustment. Replace the belt if it is severely cracked or oil-soaked.

- (1) Install Belt Strand Tension Gauge J-23600 on the longest accessible span, midway between pulleys (fig. 1E-17).

**NOTE:** Eight-cylinder engines with air conditioning use dual drive belts. When checking belt tension, install

Tension Gauge to only one belt. Checking both belts together will give inaccurate reading. When using the gauge on a notched belt, position the middle finger of the gauge in the notched cavity of the belt.

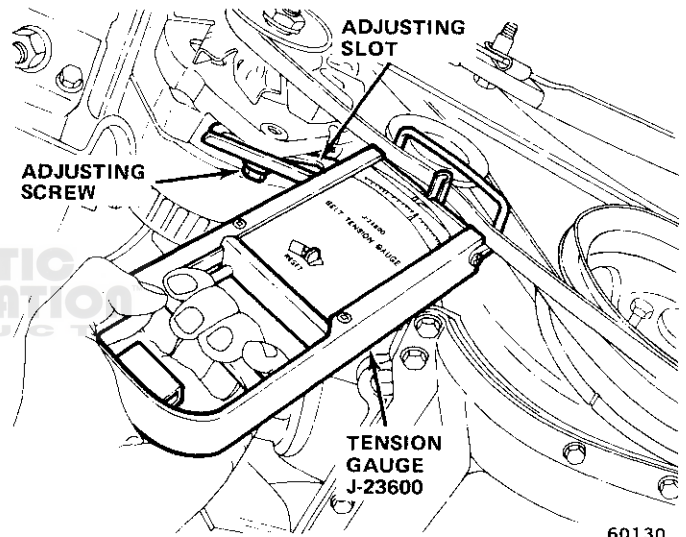
- (2) Loosen alternator pivot screw and adjusting strap screw.

- (3) Adjust alternator by prying against **front housing**, using alternator bracket as pivot point (fig. 1E-18).

**CAUTION:** Do not apply pressure to the rear housing as the aluminum casting will be damaged.

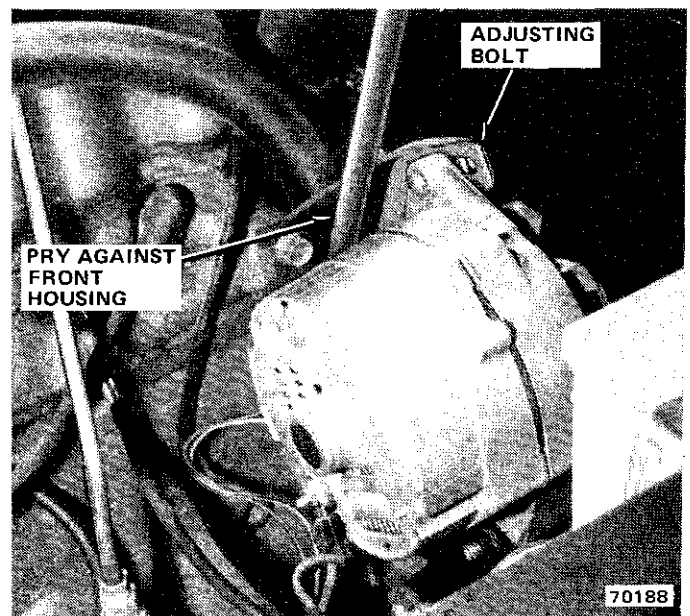
- (4) Rotate alternator on pivot screw until specified belt tension is obtained. Refer to Specifications.

- (5) Tighten adjusting strap screw and pivot screw while maintaining specified tension.



60130

Fig. 1E-17 Checking Belt Tension



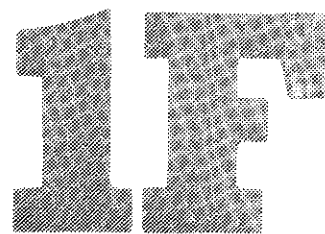
70188

Fig. 1E-18 Adjusting Belt Tension—Typical





# STARTING SYSTEM



## SECTION INDEX

	Page		Page
<b>Components</b>	1F-1	<b>Specifications</b>	1F-14
General	1F-1	<b>Starter Motor Replacement</b>	1F-10
<b>Neutral Safety Switch Replacement</b>	1F-14	<b>Starter Motor Overhaul</b>	1F-11
Off-Vehicle Testing	1F-8	Tools	1F-14
On-Vehicle Testing	1F-2	<b>Troubleshooting</b>	1F-2
Operation	1F-2		

## GENERAL

The starting system used on all Jeep vehicles consists of a positive engagement starter motor, a starter solenoid, a starter switch (integral with the ignition switch), starter circuits protected by fusible links and the vehicle's battery. Vehicles equipped with automatic transmission also have a neutral safety switch. The starter motor uses a moveable pole shoe and appropriate linkage to engage the drive mechanism. Inside the drive assembly, an overrunning clutch protects the starter motor in case of a false start.

## COMPONENTS

### Starter Motor

#### Identification

At the time of manufacture, the starter motor identification code is stamped on the frame adjacent to the Jeep part number. The date is decoded as follows:

- Year (8—1978, 9—1979)
- Month (A—Jan., B—Feb.)
- Week (A—first week in month, B—second week)

#### Field Coils

Four field coils are used. Each is wrapped around an iron pole shoe which acts to concentrate the magnetic field created when current flows through the field coil. Three of the field coils have fixed pole shoes, while the fourth coil has a moveable pole shoe. This fourth coil, mounted at the top of the starter motor, has an additional, smaller coil wrapped inside. This is called the hold-in coil.

### Drive Assembly

A pinion gear, driven by the starter motor armature, is slid into mesh with the engine ring gear when the starter is activated. The sliding motion is accomplished by the action of the moveable pole shoe and its drive yoke (fig. 1F-1). As long as the ignition key is held in the Start position, the drive pinion remains in mesh with the engine ring gear. An overrunning clutch in the drive assembly permits the starter motor to drive the engine ring gear. After the engine starts, it prevents the engine from driving the starter motor before the key is returned to the On position.

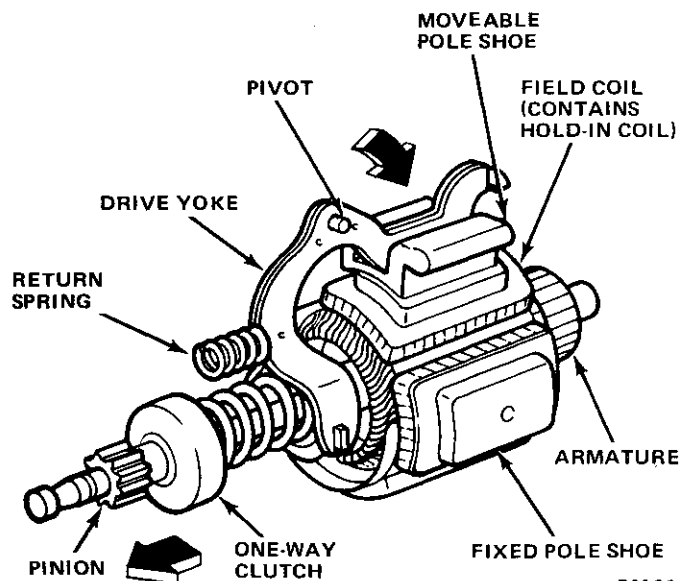


Fig. 1F-1 Moveable Pole Shoe Operation

## 1F-2 STARTING SYSTEM

### Starter Solenoid

The ground circuit for the solenoid pull-in coil is completed through the solenoid mounting bracket.

The starter solenoid is energized when battery voltage is applied to the S-terminal of the solenoid and the pull-in coil is grounded. When the solenoid coil is energized, the contact disc is pulled into the closed position. The disc strikes two contacts in the solenoid, completing the circuit between the battery and the starter motor.

### Neutral Safety Switch

On automatic transmission models, a combination neutral safety—back-up lamp switch is mounted on the steering column. The neutral safety switch permits current to pass only when the transmission selector is in Park or Neutral. Vehicles with manual transmission have a jumper bar across the neutral safety switch connector, providing a direct connection between the ignition switch and the starter motor relay S-terminal.

### Starter System Circuits

The starting system operates on two circuits, a low current circuit and a high current circuit (fig. 1F-2).

The low current circuit is the control circuit. It includes the connections and wires from the ignition switch, through the neutral safety switch to the S-terminal of the starter solenoid.

The high current circuit runs from the battery through the starter solenoid to the starter motor to ground. This circuit uses heavy cables because of the heavy current draw of the starter motor.

### Fusible Links

Current is carried from the battery by cable to the starter solenoid battery terminal. From this terminal, current is distributed to all parts of the vehicle. A 14-gauge fusible link joins the battery terminal to the main body harness. This fusible link protects the complete wiring system of the vehicle.

Fusible links are covered with a special non-flammable insulation. Each link is manufactured with a specific load rating and is intended for a specific circuit. Replacement links are listed in the Parts Catalog.

### OPERATION

The starting circuit begins at the ignition switch (fig. 1F-2). The ignition switch supplies battery voltage to the starter solenoid S-terminal when the ignition key is in the Start position. This voltage energizes the solenoid pull-in coil, completing the circuit between the battery and the starter motor. The starter motor is energized and begins cranking the engine.

### TROUBLESHOOTING

The Starter Motor Service Diagnosis Chart may be used to trace the source of the problem when the starter cranks the engine slowly, will not crank the engine, or has abnormal drive engagement.

If the starter motor cranking speed is normal and the drive pinion engages properly but the engine does not start, a problem is indicated in the fuel system or ignition system.

### ON-VEHICLE TESTING

#### Engine Will Not Crank

(1) Verify battery and cable condition as outlined in Chapter 1D—Batteries to assure correct cranking voltage.

(2) Inspect and tighten battery and starter cable connections at starter solenoid.

(3) Disconnect wire at solenoid S-terminal.

**CAUTION:** Place transmission in Neutral or Park position and apply parking brake prior to conducting solenoid test.

(4) Connect jumper from battery positive post to solenoid S-terminal. If engine cranks, solenoid is not defective. Look for problems in the starter switch circuit.

(5) If engine does not crank, connect another jumper wire from battery negative terminal to solenoid mount bracket. Make certain good connection is made. If solenoid can now be made to operate, solenoid was not properly grounded. Remove rust or corrosion and attach solenoid to panel with cadmium-plated screws.

(6) If engine does not crank, remove jumper wires and connect heavy jumper cable between battery and starter motor terminal of solenoid. If engine cranks, solenoid is defective and must be replaced. If engine does not crank, check starter motor.

#### Starter Motor Solenoid Pull-In Winding Test

This test determines if the solenoid pull-in winding is shorted or open.

(1) Disconnect all wires and cables from solenoid.

(2) Connect ohmmeter leads as shown in figure 1F-3.

(3) If solenoid fails any ohmmeter check, replace solenoid.

**NOTE:** A poor solenoid ground can be determined by connecting one ohmmeter lead to the battery negative terminal and other lead to S-terminal. If resistance is greater than in the S-terminal-to-mount bracket test (fig. 1F-3), the solenoid has a poor ground.

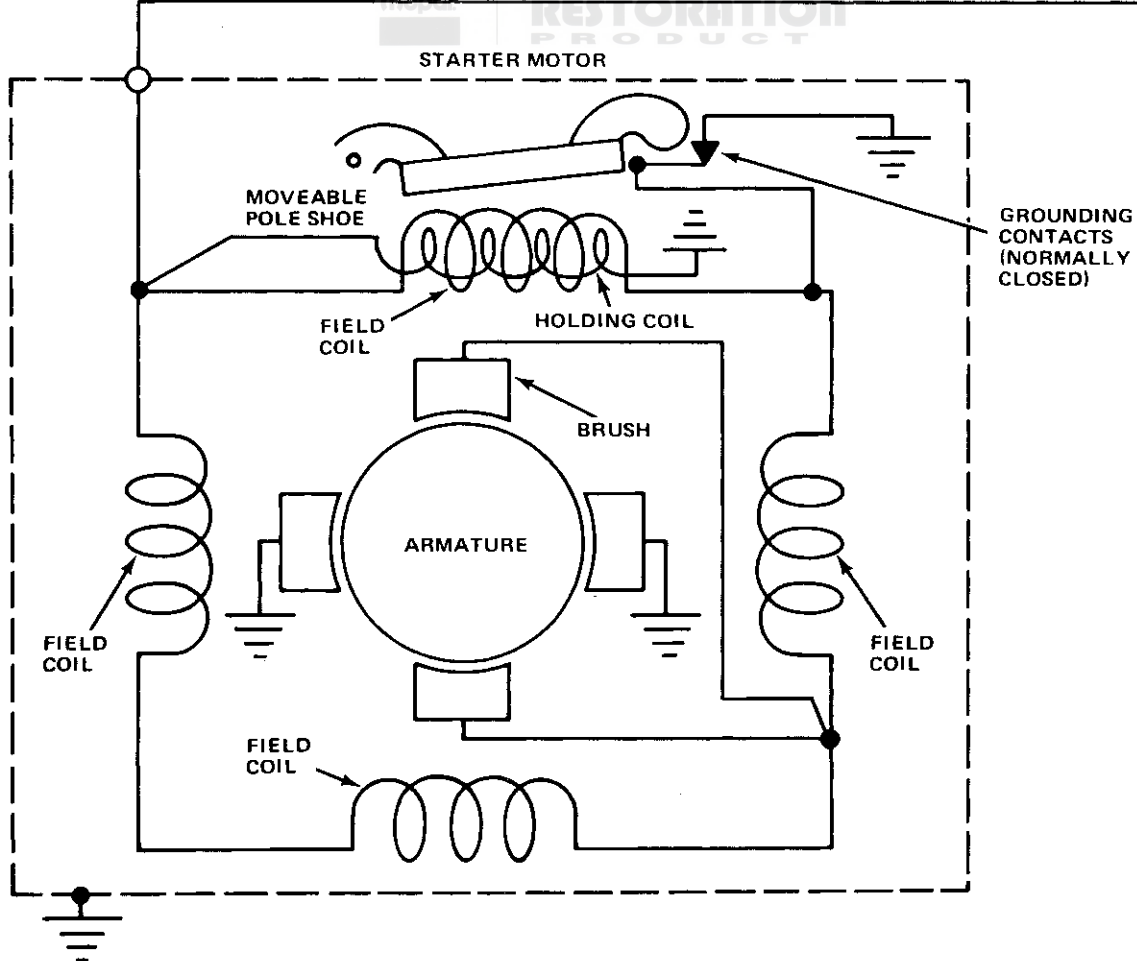
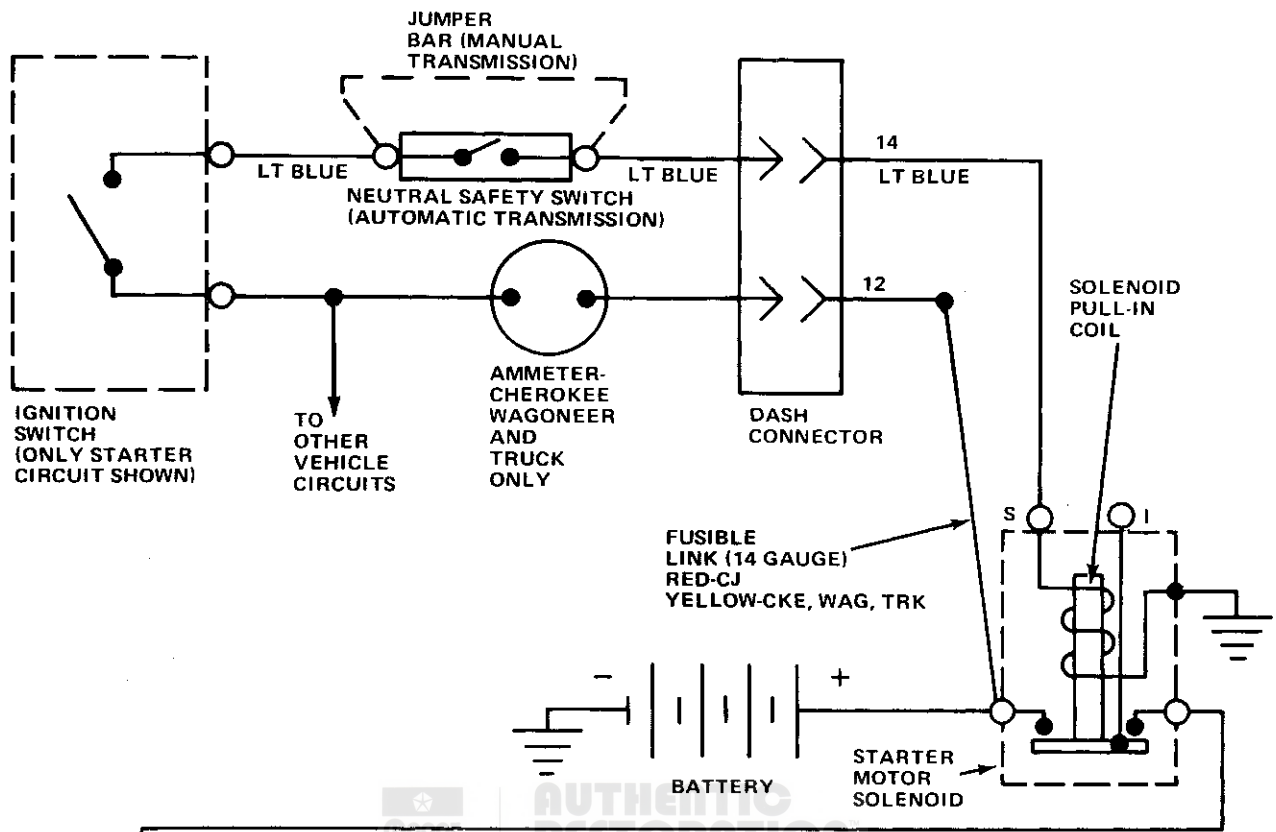


Fig. 1F-2 Starter System Schematic

# 1F-4 STARTING SYSTEM

## Service Diagnosis

Condition	Possible Cause	Correction
STARTER CRANKS ENGINE SLOWLY	<ul style="list-style-type: none"> <li>(1) Battery low or defective.</li> <li>(2) Poor circuit between battery and starter motor.</li> <li>(3) Current draw low.</li> <li>(4) Current draw high.</li> <li>(5) Starter frame deformed.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Charge or replace battery.</li> <li>(2) Clean and tighten, or replace cables.</li> <li>(3) Bench-test starter motor. Look for worn brushes and weak brush springs.</li> <li>(4) Bench-test starter. Check engine for functional drag or coolant in cylinders. Check ring gear clearance to starter motor.</li> <li>(5) Replace frame.</li> </ul>
STARTER WILL NOT CRANK ENGINE	<ul style="list-style-type: none"> <li>(1) Battery low or defective.</li> <li>(2) Faulty solenoid.</li> <li>(3) Damaged drive pinion gear or ring gear.</li> <li>(4) Starter engagement weak.</li> <li>(5) Starter spins slowly and draws high current.</li> <li>(6) Engine seized.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Charge or replace battery.</li> <li>(2) Check solenoid ground. Repair or replace as necessary.</li> <li>(3) Replace damaged gear(s).</li> <li>(4) Bench-test starter.</li> <li>(5) Check drive yoke pull-down and point gap, check for worn end bushings, check ring gear clearance.</li> <li>(6) Repair engine.</li> </ul>
STARTER DRIVE WILL NOT ENGAGE (SOLENOID KNOWN TO BE GOOD)	<ul style="list-style-type: none"> <li>(1) Defective point assembly.</li> <li>(2) Poor point assembly ground.</li> <li>(3) Defective pull-in coil.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Repair or replace point assembly.</li> <li>(2) Repair connection at ground screw.</li> <li>(3) Replace field coil set.</li> </ul>
STARTER DRIVE WILL NOT DISENGAGE	<ul style="list-style-type: none"> <li>(1) Starter motor loose on bellhousing.</li> <li>(2) Worn drive end bushing.</li> <li>(3) Damaged ring gear teeth.</li> <li>(4) Drive yoke return spring broken or missing.</li> <li>(5) Defective starter drive.</li> <li>(6) Ignition Switch adjusted wrong.</li> <li>(7) Foreign metallic object object in dash connector.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Tighten mounting bolts.</li> <li>(2) Replace bushing.</li> <li>(3) Replace ring gear.</li> <li>(4) Replace spring.</li> <li>(5) Replace starter drive.</li> <li>(6) Reposition switch.</li> <li>(7) Remove foreign object.</li> </ul>
STARTER MOTOR DRIVE DISENGAGES PREMATURELY	<ul style="list-style-type: none"> <li>(1) Weak drive assembly thrust spring.</li> <li>(2) Weak hold-in coil.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Replace drive assembly.</li> <li>(2) Replace field coil set.</li> </ul>
LOW CURRENT DRAW	<ul style="list-style-type: none"> <li>(1) Worn brushes.</li> <li>(2) Weak brush springs.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Replace brushes.</li> <li>(2) Replace springs.</li> </ul>

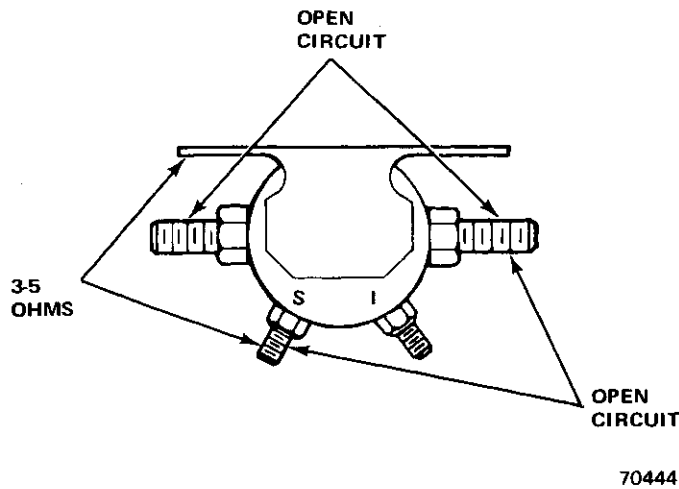


Fig. 1F-3 Ohmmeter Check of Starter Solenoid

### Starter Cable and Ground Cable Tests (Voltage Drop)

The voltage drop tests will determine if there is excessive resistance in the high current circuit. When performing these tests, it is important that the voltmeter be connected to the terminals that the cables are connected to instead of to the cables. For example, when checking between battery and solenoid, the voltmeter probes must touch the battery post and the solenoid threaded stud.

#### Before Performing Tests

- (1) Remove coil secondary wire from distributor and ground coil wire.
- (2) Place transmission in Neutral or Park and apply parking brake.
- (3) Be sure battery is fully charged.

#### Test Procedure

Follow the steps as outlined in the Starter Voltage Drop Test DARS Charts.

#### Current Draw Test

- (1) Prior to performing current draw test, battery must be fully charged as described in Chapter 1D—Batteries.

**NOTE:** The lower the available voltage, the higher the amperage draw.

- (2) Disconnect and ground ignition coil secondary wire.
- (3) Connect remote control starter switch between battery positive terminal and S-terminal of starter solenoid.
- (4) Connect battery-starter tester leads as shown in figure 1F-4. Operate remote control starter switch and read voltage indicated on voltmeter while starter is cranking engine.

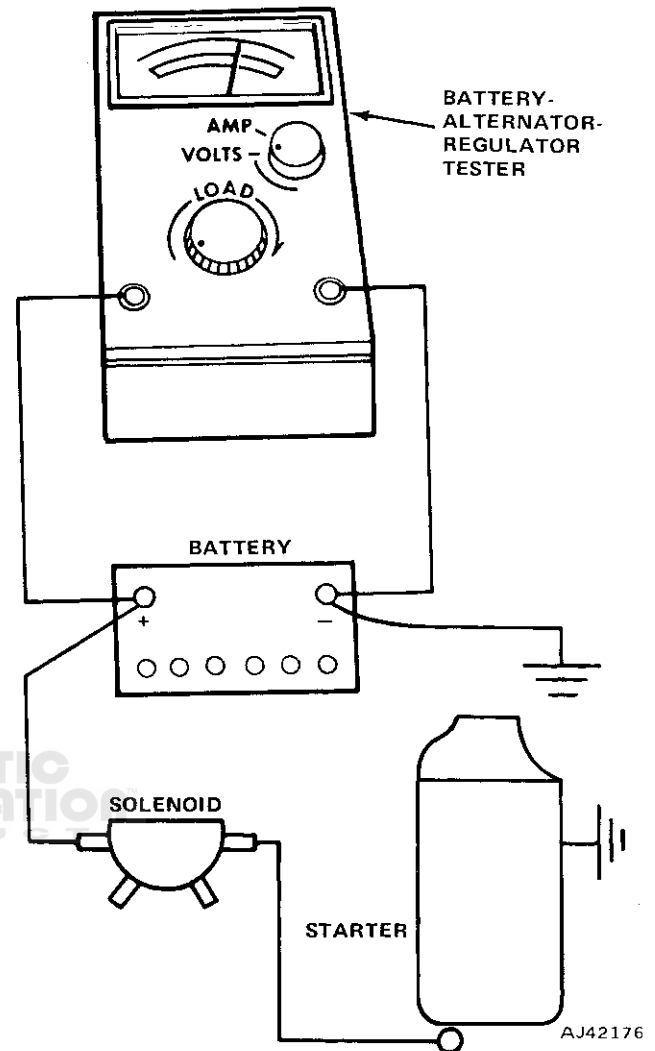


Fig. 1F-4 Starter Motor Current Draw Test

**NOTE:** Do not operate for more than 15 seconds.

- (5) Release remote control starter switch.
- (6) Turn load control knob toward INCREASE (clockwise) until voltmeter reading matches reading obtained when starter was cranking engine.

Read the current draw on the ammeter scale. This is the current being used by the starter under full-load conditions. If the current draw is not within 180 to 220 amperes at room temperature, remove the starter motor from the engine for bench testing.

**NOTE:** Do not consider the initial amperage draw that is required to begin engine cranking. A very hot or very cold engine may draw 400 to 600 amperes for the first few revolutions. Take an amperage draw reading after the starter has obtained its maximum rpm.

#### Neutral Safety Switch Test

- (1) Insert voltmeter leads into switch with all switch leads connected.

**STARTER VOLTAGE DROP TEST DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHARTS**

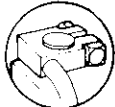
Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

**STARTER VOLTAGE DROP TESTS**

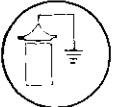
Chart 1

**STEP SEQUENCE RESULT**

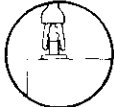
**STARTER DRAW TEST**



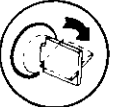
● CLEAN AND CONNECT BATTERY CABLES



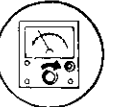
● REMOVE COIL WIRE FROM DISTRIBUTOR AND CONNECT TO GROUND



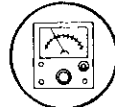
● CONNECT HEAVY LOAD TESTER



● CRANK ENGINE FOR THREE SECONDS

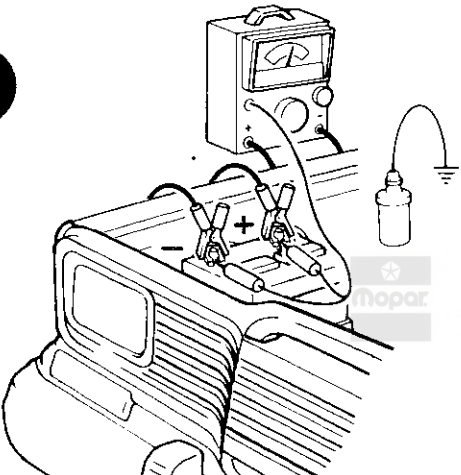


● TURN LOAD CONTROL UNTIL VOLTMETER SHOWS SAME VOLTAGE AS WHEN CRANKING



● READ AMMETER. NOTE READING FOR USE IN LATER STEPS.

1



OK

6 CYL. – 150-180 AMPS  
8 CYL. – 160-210 AMPS

→

OK

6 CYL. – ABOVE 180 AMPS  
8 CYL. – ABOVE 210 AMPS

● BATTERY CABLES AND SOLENOID NOT TESTED

OR

● BATTERY CABLE AND SOLENOID REPAIRS COMPLETED

→

WRENCH

REPAIR STARTER

→

STOP

2

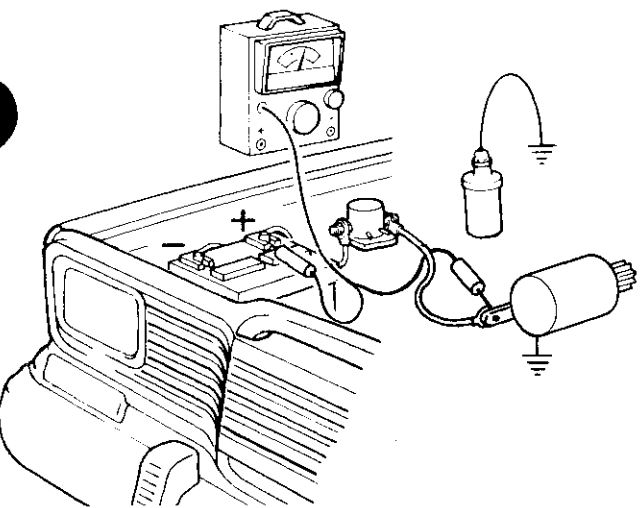
STOP

**VOLTAGE DROP TEST**

- GROUND COIL WIRE
- CONNECT VOLTMETER
- CRANK ENGINE
- READ VOLTMETER
- NOTE AMMETER READING FROM STEP 1

MAXIMUM VOLTAGE DROP BY STARTER DRAW AMPERAGE				
AMPS	150-210	215-295	300-420	425-600
VOLTS	0.5 V	0.7 V	1.0 V	1.5 V

2



OK

VOLTAGE AT OR BELOW MAXIMUM

→

OK

VOLTAGE ABOVE MAXIMUM

→

5

3

**STEP**

**SEQUENCE**

**RESULT**

**3**

**VOLTAGE DROP TEST**

- GROUND COIL WIRE
- CONNECT VOLTMETER
- CRANK ENGINE
- READ VOLTMETER
- NOTE AMMETER READING FROM STEP 1

MAXIMUM VOLTAGE DROP BY STARTER DRAW AMPERAGE				
AMPS	150-210	215-295	300-420	425-500
VOLTS	0.3 V	0.5 V	0.6 V	0.9 V

**OK** — — REPAIR SOLENOID-TO-STARTER CABLE — **5**

VOLTAGE AT OR BELOW MAXIMUM

~~OK~~ — — **4**

VOLTAGE ABOVE MAXIMUM

**4**

**VOLTAGE DROP TEST**

- GROUND COIL WIRE
- CONNECT VOLTMETER
- CRANK ENGINE
- READ VOLTMETER
- NOTE AMMETER READING FROM STEP 1

MAXIMUM VOLTAGE DROP BY STARTER DRAW AMPERAGE				
AMPS	150-210	215-295	300-420	425-600
VOLTS	0.2V	0.3V	0.4V	0.5V

**OK** — — REPAIR SOLENOID — **5**

VOLTAGE AT OR BELOW MAXIMUM

~~OK~~ — — REPAIR BATTERY-TO-SOLENOID CABLE — **5**

VOLTAGE ABOVE MAXIMUM

**5**

**VOLTAGE DROP TEST**

- GROUND COIL WIRE
- CONNECT VOLTMETER
- CRANK ENGINE
- READ VOLTMETER
- NOTE AMMETER READING FROM STEP 1

MAXIMUM VOLTAGE DROP BY STARTER DRAW AMPERAGE				
AMPS	150-210	215-295	300-420	425-600
VOLTS	0.2V	0.3V	0.4V	0.5V

**OK** — VOLTAGE AT OR BELOW MAXIMUM

- REPAIRS TO SOLENOID OR CABLES PERFORMED IN A PREVIOUS STEP — **1**
- REPAIRS TO SOLENOID OR CABLES NOT REQUIRED IN A PREVIOUS STEP — — REPAIR STARTER — **STOP**

~~OK~~ — — REPAIR ENGINE-TO-BATTERY CABLE — **1**

VOLTAGE ABOVE MAXIMUM



## 1F-8 STARTING SYSTEM

**NOTE:** Probe-type tips are required on voltmeter leads. If not available, push cotter pins into switch connector to provide contacts for jaw-type voltmeter leads.

- (2) Turn ignition switch to Start position.
- (3) Voltmeter should indicate less than 0.1 volt.

### OFF-VEHICLE TESTING

#### No-Load Test

The starter motor no-load test will indicate such faults as open or shorted windings, worn bushings (rubbing armature) or bent armature shaft.

**NOTE:** The tester load control knob must be in the *DECREASE* (extreme counterclockwise) position.

- (1) Operate starter with test equipment connected as shown in figure 1F-5. Note voltage reading.

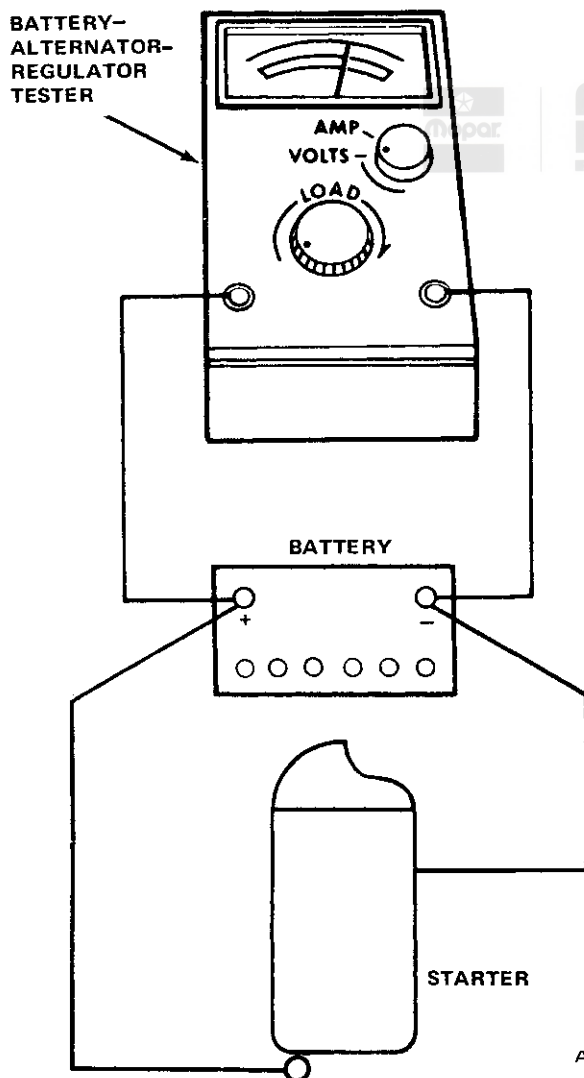


Fig. 1F-5 Starter Motor No-Load Test

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- (2) Determine exact starter rpm using mechanical tachometer (not shown).

**NOTE:** In order to use a mechanical tachometer, remove the seal from the end of the drive end housing and clean the grease from the end of the armature shaft.

- (3) Disconnect starter from battery.
- (4) Turn load control knob toward INCREASE (clockwise) until voltmeter reading matches reading obtained with starter connected to battery.

If the ammeter reading at no-load speed is below specifications, the starter has high electrical resistance and should be repaired or replaced.

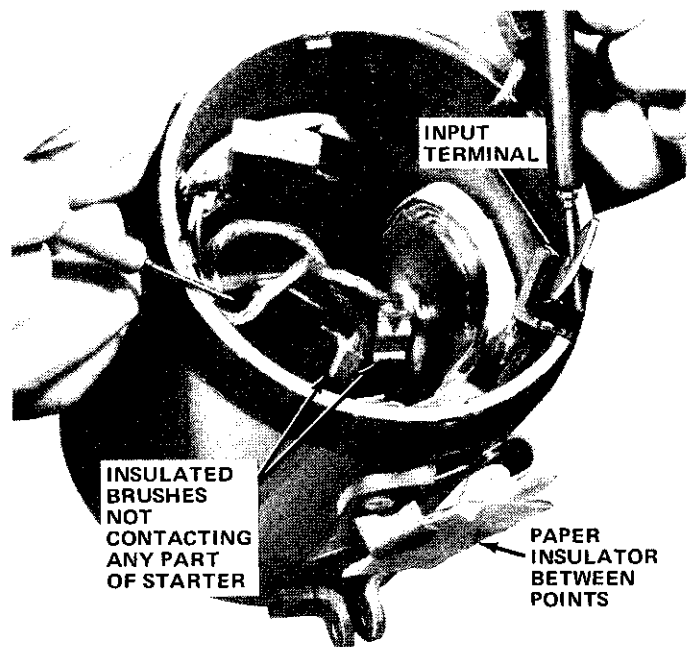
If the ammeter reading is higher than specification and the starter rpm is less than specification, disassemble, clean, inspect and test the starter as outlined in the following paragraphs.

#### Hold-In Coil Resistance Test

This test determines resistance of the windings of the hold-in coil.

- (1) Insert piece of paper between contact points to act as insulator (fig. 1F-6).
- (2) Use ohmmeter to check resistance between terminal and starter frame.

Resistance should be between 2.0 and 3.5 ohms. If resistance is outside specifications, replace field coil assembly.



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Fig. 1F-6 Hold-In Coil Resistance Test

#### Solenoid Point Connection Test

This test determines the quality of the solder joint at the contacts. Use ohmmeter to test resistance through

solder joint (fig. 1F-7). If resistance is above zero ohms, solder joint has excessive resistance. Repair by soldering joint with 600 watt soldering iron.

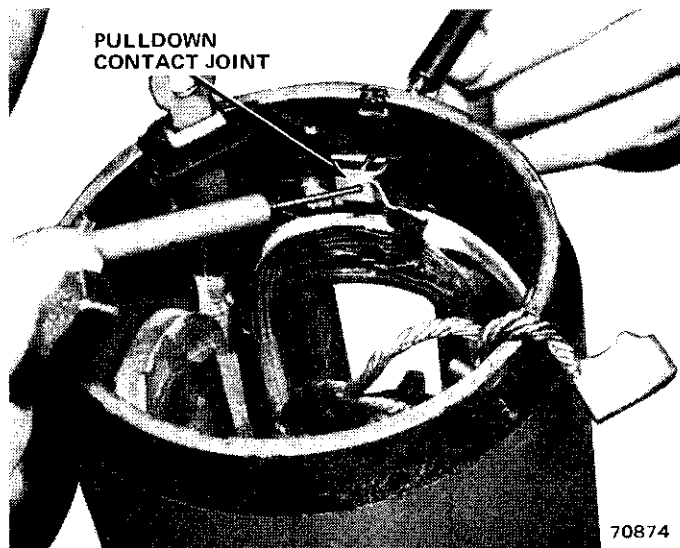


Fig. 1F-7 Solenoid Point Connection Test

### Insulated Brush Connection Test

This test determines the quality of the solder joint between the insulated brush braided wire and the field coils. Use ohmmeter to test resistance through solder joint by touching probes to brush and to copper bus bar (fig. 1F-8). If resistance is above zero ohms, solder joint has excessive resistance. Repair by soldering joint with 600 watt soldering iron.

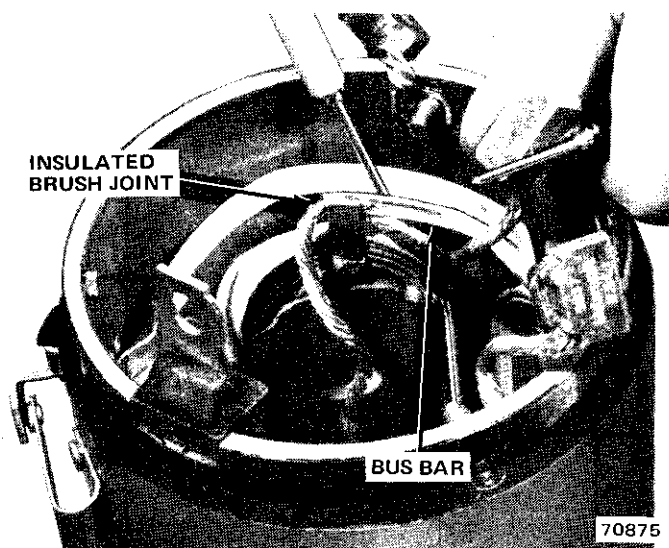


Fig. 1F-8 Insulated Brush Connection Test

### Terminal-to-Brush Continuity Test

This test checks all field coil solder joints.

(1) Insert piece of paper between contact points to act as insulator (fig. 1F-9).

(2) Touch ohmmeter probes to terminal and to insulated brush.

If resistance is above zero ohms, check all solder joints to determine which one has excessive resistance. Repair faulty solder joint(s) by soldering with a 600 watt soldering iron.

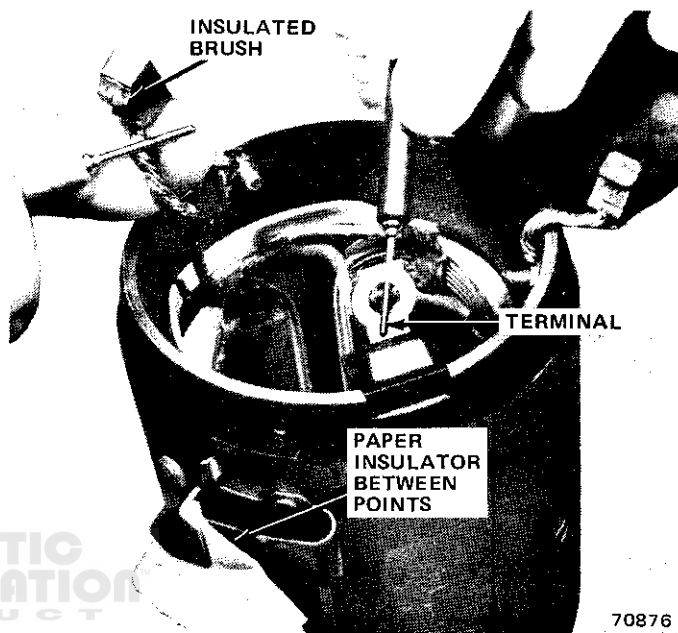


Fig. 1F-9 Terminal-To-Brush Continuity Test

### Terminal Bracket Insulation Test

This test determines if the terminal bracket is properly insulated from the end cap. Use ohmmeter to test continuity between bracket and cap (Fig. 1F-10). If resistance is less than infinity, insulator is faulty. Repair by replacing end cap.

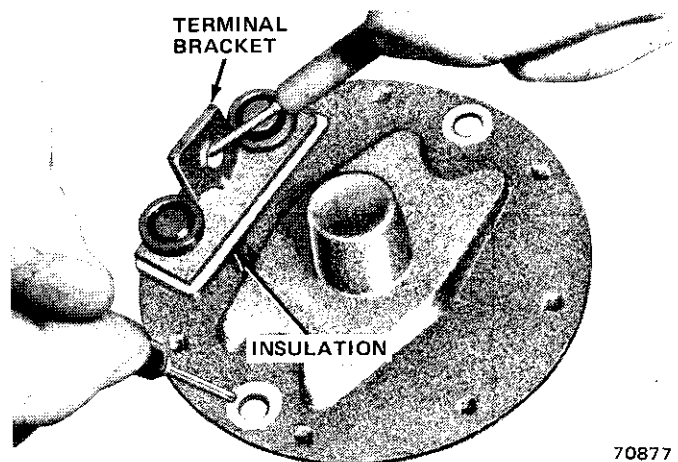


Fig. 1F-10 Terminal Bracket Insulation Test

## 1F-10 STARTING SYSTEM

### Armature Tests

Test the armature for grounds, shorts and balance whenever the starter motor is overhauled. Follow the test equipment manufacturer's procedure or the following.

#### Armature Ground Test

(1) Place armature in growler jaws and turn power switch to TEST position (fig. 1F-11).

(2) Touch one test lead to armature core, touch other lead to each commutator bar one at a time and observe test light. Test light should not glow. If test light glows on any bar, armature is grounded and must be replaced.

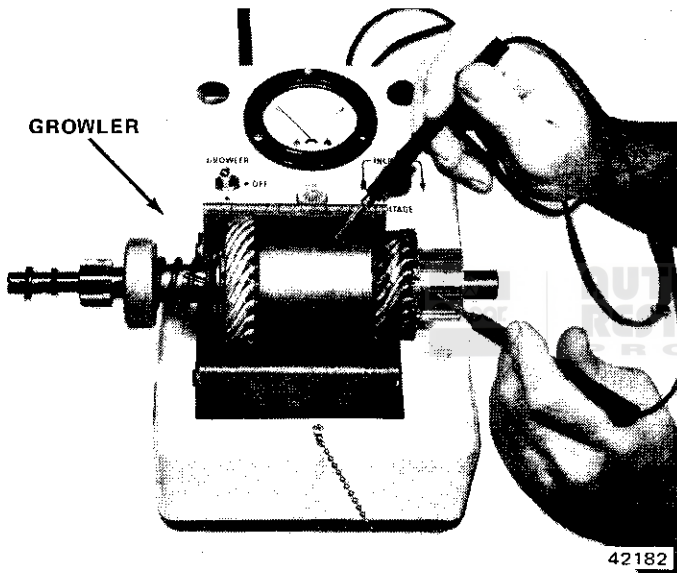


Fig. 1F-11 Armature Ground Test

#### Armature Short Test

**CAUTION:** Never operate the growler in the growler test position without an armature in the jaws.

(1) Place armature in growler jaws and turn power switch to GROWLER position (fig. 1F-12).

(2) Hold steel blade parallel to and touching armature core. Slowly rotate armature one or more revolutions in growler jaws. If steel blade vibrates at any area of core, area is shorted and armature must be replaced.

#### Armature Balance Test

(1) Place armature in growler jaws and turn power switch to GROWLER position (fig. 1F-13).

(2) Place contact fingers of meter test cable across adjacent commutator bars at side of commutator.

(3) Adjust voltage control until needle is at highest reading on scale.

(4) Test each commutator bar with adjacent bar until all bars have been checked. A zero reading indicates an open circuit.

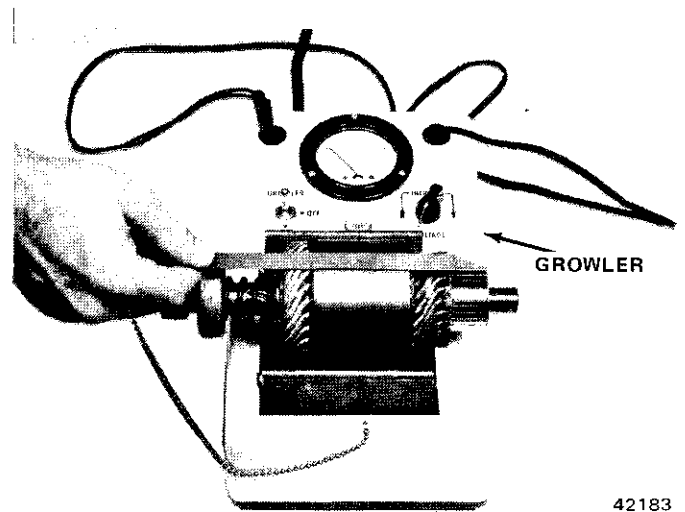


Fig. 1F-12 Armature Short Test

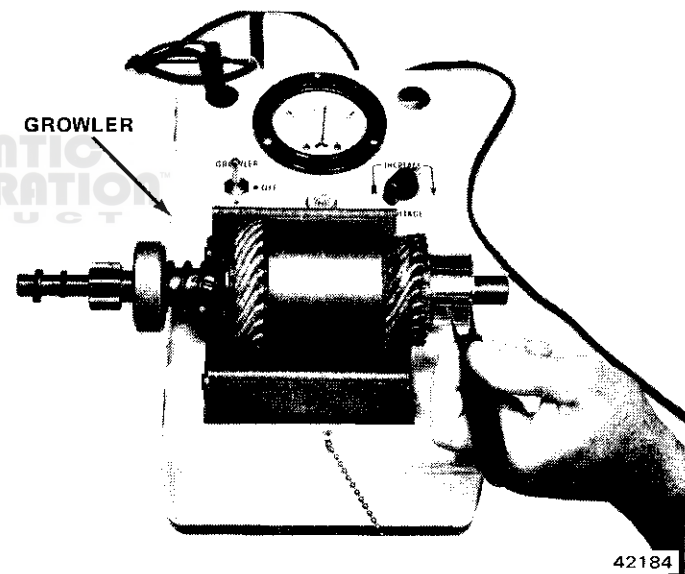


Fig. 1F-13 Armature Balance Test

## STARTER MOTOR REPLACEMENT

### Removal

- (1) Disconnect cable from starter motor terminal.
- (2) Remove attaching screws and remove starter motor from bellhousing.

### Installation

- (1) Position starter motor to bellhousing.

**NOTE:** Make sure mounting surfaces are free of burrs and debris.

- (2) Install mounting screws and tighten to 18 foot-pounds (24 N•m) torque.

(3) Clean terminal on starter motor and terminal end of cable.

(4) Install cable to terminal. Install screw and tighten to 55 inch-pounds (6 N•m) torque.

**NOTE:** Initial torque may exceed this specification if the end plate is new. The terminal screw forms threads in the terminal during installation.

### STARTER MOTOR OVERHAUL

Refer to figure 1F-14 for parts identification.

#### Disassembly

- (1) Remove drive yoke cover and screw.
- (2) Remove through-bolts and remove brush end plate.
- (3) Remove brush springs. Pull brushes from brush holder. Remove brush holder from frame.

(4) Remove drive end housing and drive yoke return spring.

(5) Remove pivot pin and starter drive yoke.

(6) Remove drive assembly and armature.

#### Cleaning and Inspection

(1) Use brush or air to clean starter frame, field coils, armature, drive assembly and drive end housing.

(2) Wash all other parts in solvent and dry parts.

**NOTE:** Do not wash clutch or drive assembly.

(3) Inspect armature windings for broken or burned insulation and poor connections.

(4) Inspect armature for open circuits and grounds as outlined in Armature Tests.

(5) Clean dirty commutator with commutator paper. **Never use emery cloth to clean commutator.**

(6) If armature commutator is worn, out-of-round (0.005 inch or more), or has insulation protruding from between contacts, turn down on lathe.

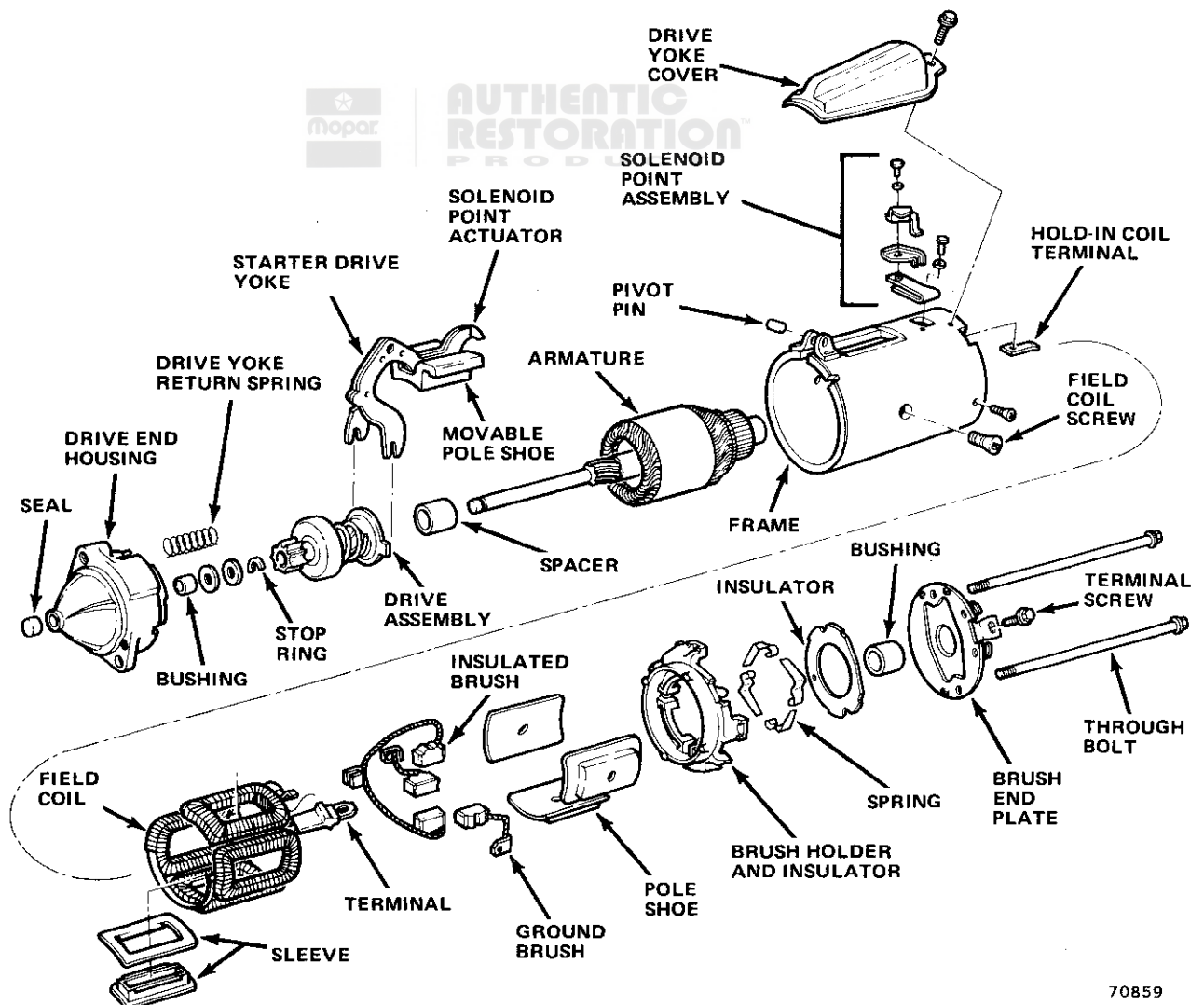


Fig. 1F-14 Parts Identification

## 1F-12 STARTING SYSTEM

(7) Inspect armature shaft and bushings for scoring and excessive wear.

(8) Inspect drive assembly pinion gear for damage. An engine that has repeated starter motor pinion failures should be inspected for:

- Proper ring gear location, shown in figure 1F-15. Inspect for missing or improper parts or misaligned bellhousing.

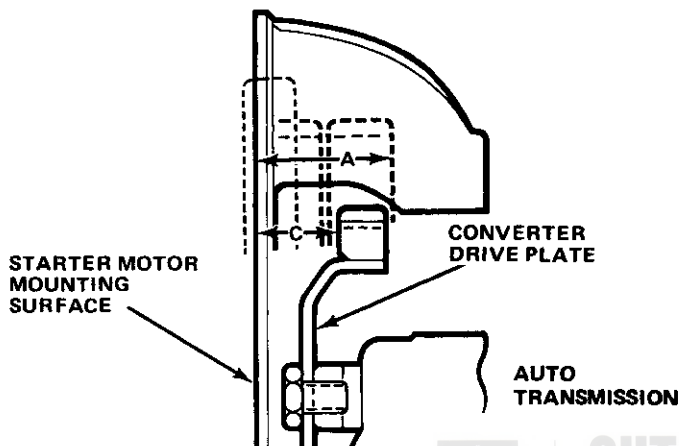
- Wobbling ring gear. Maximum allowable runout is 0.030 inch. Inspect for broken welds or broken flex plate.
- Foreign object such as converter balance weight in bellhousing.

**NOTE:** Inspect the entire circumference of the ring gear for damage when the teeth of the drive assembly pinion gear are damaged. A normal wear pattern will be found in three places on 6-cylinder engine ring gears and four places on 8-cylinder engine ring gears. The normal wear pattern extends approximately two inches along the circumference of the ring gear.

(9) Inspect drive assembly clutch by grasping and rotating pinion gear. Gear should rotate freely in one direction and lock in opposite direction.

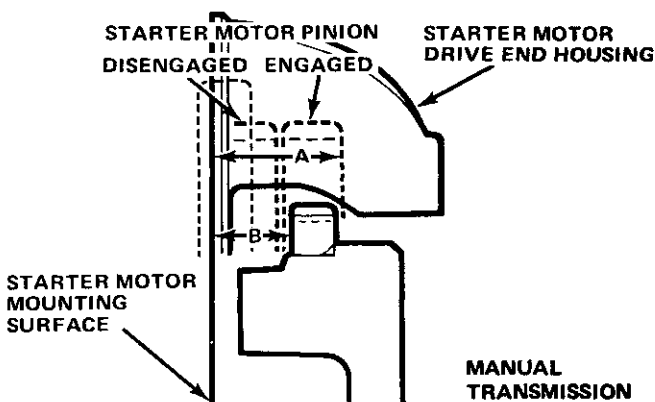
(10) Inspect for broken brush springs. Replace springs that are discolored from heat. Replace brushes if worn to 1/4 inch in length.

(11) Inspect field coils for burned or broken insulation and for broken or loose connections. Check field brush connections and lead insulation.



ENGINE	DRIVE PLATE (INCHES)			
	A		C	
6-CYLINDER	1.2465 TO 1.2060	1 - 1/4 TO 1 - 13/64	0.8305 TO 0.7700	53/64 TO 49/64
8-CYLINDER	1.2465 TO 1.2035	1 - 1/4 TO 1 - 13/64	0.8305 TO 0.7675	53/64 TO 49/64

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ENGINE	FLYWHEEL (INCHES)			
	A		B	
6-CYLINDER	1.2465 TO 1.2060	1 - 1/4 TO 1 - 13/64	0.8365 TO 0.7660	27/32 TO 49/64
8-CYLINDER	1.2465 TO 1.2035	1 - 1/4 TO 1 - 13/64	0.8365 TO 0.7635	27/32 TO 49/64

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Fig. 1F-15 Transmission Ring Gear Location

### Field Coil Replacement

Remove armature and brush holder before starting this procedure.

(1) Remove field coil screws using arbor press and Starter Pole Screw Wrench J-22516. Remove pole shoes.

(2) Cut field coil strap as close as possible to solenoid point contact-to-field coil joint.

**CAUTION:** Do not cut solenoid point contact.

(3) Cut hold-in coil wire at terminal strip.

(4) Straighten tabs of pull-down coil sleeve. Remove sleeve and flange.

(5) Remove field coil assembly from frame.

(6) Clean and tin surfaces of contact tab and field coil strap that are to be soldered.

(7) Install replacement field coil assembly in frame using original pole shoes and screws. Apply drop of Loctite or equivalent to screw threads. Tighten screws using arbor press and Starter Pole Screw Wrench J-22516.

(8) Install pull-down coil sleeve and flange. Have helper hold coil and sleeve assembly against frame while bending retaining tabs.

(9) Wrap hold-in coil wire around terminal strip and solder. Cut off excess wire.

(10) Solder field coil strap to contact strap. Use 600 watt soldering iron and rosin-core solder.

### Solenoid Contact Assembly Replacement

Remove armature and brush holder before starting this procedure.

(1) Cut upper contact as close as possible to contact-to-field coil joint.

**CAUTION:** Do not cut field coil strap.

- (2) Unsolder hold-in coil wire from terminal strip.
- (3) Remove field coil screws using arbor press and tool J-22516. Remove pole shoes.
- (4) Cut rivets inside frame with chisel. Remove contact assembly.
- (5) Position replacement lower (movable) contact on frame (fig. 1F-16). Position hold-in coil terminal strip inside frame. Install *copper* rivet through contact, frame and terminal. Upset rivet.

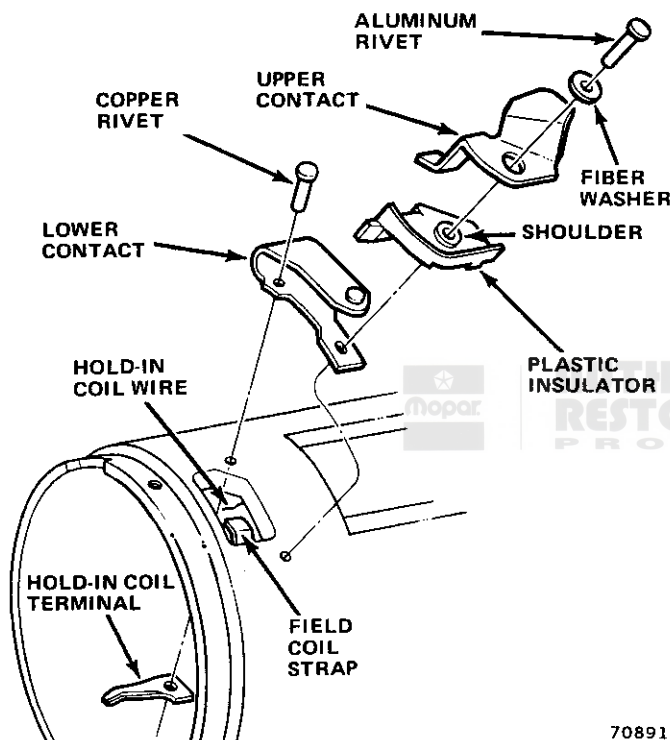


Fig. 1F-16 Solenoid Contact Replacement

**NOTE:** Be sure holes for second rivet are aligned before upsetting copper rivet.

- (6) Install plastic insulator, upper contact and fiber washer to remaining hole in frame. Install *aluminum* rivet and upset.

**NOTE:** Be sure upper contact is positioned on shoulder of plastic insulator before upsetting rivet.

- (7) Install field coil assembly, pole shoes, and screws. Apply a drop of Loctite or equivalent to each screw.

- (8) Solder hold-in coil wire to terminal strip.

- (9) Solder field coil strap to upper contact. Use 600 watt soldering iron and rosin-core solder.

## Bushing Replacement

### Drive End Bushing

- (1) Support drive end housing and remove original bushing and seal.
- (2) Install replacement bushing using armature and pinion as bushing driver. **Do not** install drive end housing seal at this time.

### Commutator End Bushing

- (1) Carefully remove original bushing with chisel.
- (2) Drive replacement bushing into end plate until seated, using suitable socket or bushing driver.

## Drive Assembly Replacement

- (1) Pry stop ring off and remove starter drive from armature shaft.
- (2) Apply grease to armature shaft and end bushings. Service replacement drive assembly is prelubricated.
- (3) Apply thin coating of Lubriplate or equivalent on armature shaft splines.
- (4) When installing drive assembly, check snap ring for tight fit on shaft. Slide drive assembly over shaft and install stop ring and original retainer.

## Assembly

- (1) Insert armature into frame. Install drive yoke and pivot pin. Drive yoke must engage lugs on drive assembly.
- (2) Insert drive yoke return spring into recess in drive housing. Install housing to frame.
- (3) Install brush holder. Be sure depression in holder aligns with rubber boot on terminal.
- (4) Insert brushes into brush holder. Refer to figure 1F-17 for proper wire routing. Install brush springs.

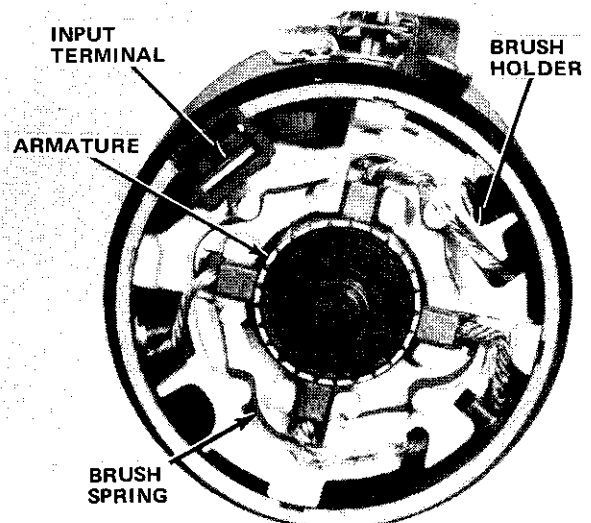


Fig. 1F-17 Brush Wire Routing

## 1F-14 STARTING SYSTEM

- (5) Install end plate. Align hole in terminal with hole in terminal bracket.
- (6) Install through-bolts.
- (7) Depress moveable pole shoe and adjust point clearance by bending upper contact as required. Refer to Specifications.
- (8) Install drive yoke cover and screw.

- (8) Move switch actuating lever against drill.
- (9) Position replacement switch on column, install attaching screws and remove drill.
- (10) Connect wire connector.
- (11) Check switch operation. Engine should start in Park and Neutral positions only. Backup lamp should light when selector lever is in Reverse position only.

### NEUTRAL SAFETY SWITCH REPLACEMENT

- (1) Apply parking brake.
- (2) Check and adjust manual linkage if necessary.
- (3) Disconnect wire connector from neutral switch.
- (4) Remove neutral switch from steering column.
- (5) Place gearshift selector lever in Park position and lock steering column.
- (6) Move switch actuating lever of replacement switch to align with letter "P" stamped on back of switch.
- (7) Insert 3/32-inch drill in hole located below letter "N" stamped on back of switch.

### SPECIFICATIONS

#### Starter Motor Specifications

Usage . . . . .	ALL
Brush Length . . . . .	0.5 in.
Wear Limit. . . . .	0.25 in.
No Load Test (Free Speed)	
Volts . . . . .	12
Amps . . . . .	77
Min. RPM . . . . .	.8900
Max. RPM . . . . .	.9600
Contact Point Clearance . . . . .	.0100-0.020 in. 0.060 preferred

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#### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Starter Motor to Bell Housing . . . . .	18	13-25	24	18-34
Starter Solenoid Terminal Screw . . . . .	55 in-lbs.	40-70 in-lbs.	6	4.5-8

All Torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

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#### Tools



**J-22516  
STARTER POLE  
SCREW WRENCH**

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# IGNITION SYSTEM 1G

## SECTION INDEX

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## DISTRIBUTOR, COIL, AND ELECTRONIC CONTROL UNIT

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Distributor Replacement	1G-15	Testing 1G-14
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### GENERAL

The Solid State Ignition (SSI) system used on all Jeep engines has no breaker points, cam or condenser. Current flow through the coil is controlled by a trigger wheel, a sensor and an electronic control unit. Conventional rotor, advance mechanism and distributor cap are employed.

### COMPONENTS

The SSI system consists of several major components: ignition switch, electronic ignition control unit, ignition coil, primary resistance wire and bypass, distributor, ignition wires and spark plugs.

### Control Unit

The electronic control unit is a solid-state, moisture-resistant module (fig. 1G-1). The component parts are permanently sealed in a potting material to resist vibration and environmental conditions. All connections are weatherproof. The control unit has built-in reverse polarity protection and transient voltage protection.

**NOTE:** *This unit is not repairable and must be serviced as a unit.*

**NOTE:** *When disconnecting SSI system connectors, pull apart with firm, straight pull. Do not attempt to pry apart with screwdriver. When connecting, press together firmly to overcome hydraulic pressure of grease.*

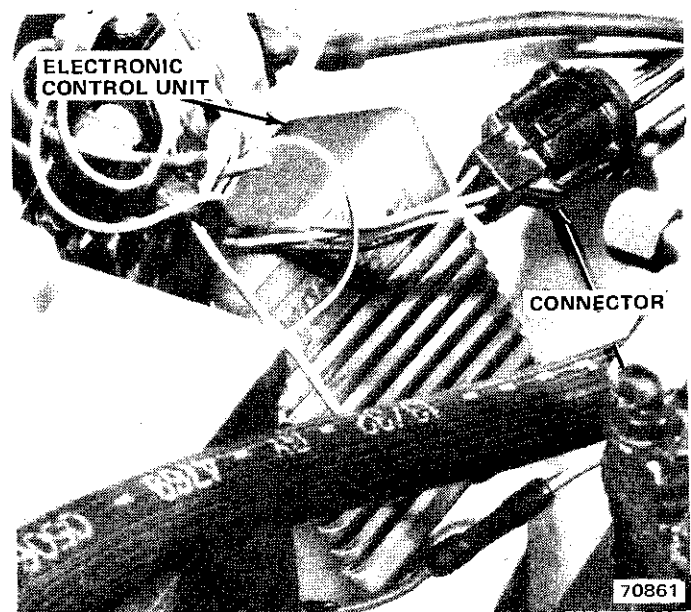


Fig. 1G-1 Electronic Control Unit



## 1G-2 IGNITION SYSTEM

**NOTE:** If connector locking tabs weaken or break off, do not replace associated component. Bind connectors together with harness tie strap or tape to assure good electrical connection.

### Ignition Coil

The ignition coil is oil-filled and hermetically sealed (standard construction). The coil has two windings on a soft iron core. The primary winding consists of comparatively few turns of heavy wire. The secondary winding consists of many turns of fine wire.

The function of the ignition coil in the SSI system is to transform battery voltage in the primary winding to high voltage for the secondary system.

The ignition coil does not require special service other than keeping terminals and connectors clean and tight.

When an ignition coil is suspected of being defective, check it on the vehicle. A coil may break down after it has reached operating temperature. *It is important that the coil be at operating temperature when tests are made.* Perform the tests following the instructions of the test equipment manufacturer.

### Coil Connector

The coil terminals and coil connector are of unique design. Remove the connector from the coil by grasping both sides and pulling connector away from coil (fig. 1G-2).

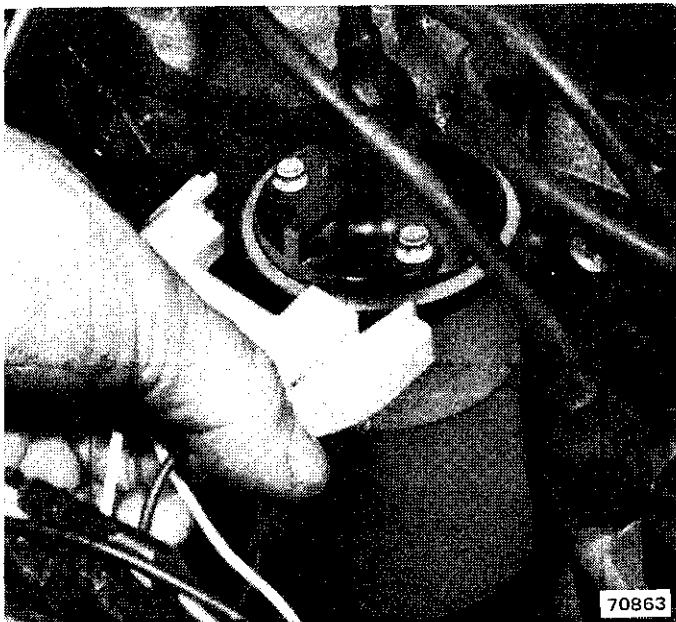


Fig. 1G-2 Removing Coil Connector

When a tachometer is required for engine testing or tune-up, connect tachometer using an alligator clamp as shown in figure 1G-3.

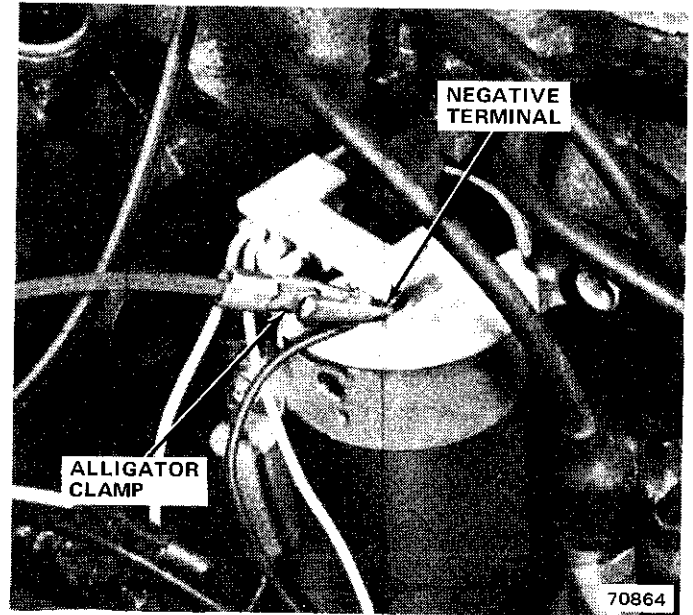


Fig. 1G-3 Tachometer Connection

### Resistance Wire

A wire having 1.35 ohms resistance is provided in the ignition feed to supply less than full battery voltage to the coil during running conditions. During starting, the resistance wire is bypassed and full battery voltage is applied to the coil. Bypass is accomplished by the I-terminal on the starter solenoid. The bypass terminal is energized only while the starting circuit is in operation.

### Distributor

The distributor consists of three groups of components: sensor and trigger wheel, spark advance, and cap and rotor.

### Sensor and Trigger Wheel

When current flows through the ignition coil, a magnetic field is created by the primary windings. When the circuit is open and current flow stops, the magnetic field collapses and induces high voltage in the secondary windings. The circuit ground is switched open and closed electronically by the control unit. The distributor sensor and trigger wheel provide the signal that operates the control unit.

The trigger wheel is mounted to the distributor shaft. There is one tooth on the trigger wheel for each cylinder. The wheel is mounted so that the teeth rotate past the sensor one at a time.

The sensor is a coil of fine wire mounted to a permanent magnet. The sensor develops an electromagnetic field that is sensitive to the presence of metal. The sensor detects the trigger wheel teeth as they pass the sensor. When a trigger wheel tooth disturbs the magnetic field around the sensor, a zero signal level occurs.

This causes the electronic control to switch the coil ground circuit open.

There are no contacting surfaces between the trigger wheel and sensor. Because there is no wear, dwell angle requires no adjustment. Dwell is determined electronically by the control unit. When the coil ground circuit is switched open, an electronic timer in the control unit keeps the circuit open only long enough for the spark to discharge. Then it automatically closes the coil primary ground circuit. The period of time the circuit is closed is referred to as *dwell*. Electronically-timed dwell is not adjustable.

### Spark Advance

Efficient engine operation requires each spark to occur at the correct instant. Varying engine speed or engine load requires the spark to occur earlier or later than required at constant speed or engine load.

Centrifugal advance is controlled by engine speed. Flyweights connected to the distributor shaft are thrown outward by centrifugal force. Higher rpm throws the weights further out. Calibrated-rate springs are used to control this movement. The outward motion of the centrifugal weights causes the rotor and trigger wheel to be rotated on the distributor shaft several degrees in the direction of normal rotation. This is referred to as *centrifugal spark advance*.

When the engine is running under light load, the carburetor throttle plates restrict airflow. This causes a relatively lean mixture to enter the combustion chambers. Ignition must occur earlier, because the lean mixture takes longer to burn. This is accomplished by the vacuum spark advance unit (fig. 1G-4). When carburetor ported vacuum is high, the vacuum unit rotates the sensor several degrees opposite to the direction the distributor is turning. This causes the sensor to detect trigger wheel teeth earlier. This is known as *vacuum spark advance*. Under low vacuum conditions, such as full throttle acceleration, a spring in the vacuum unit pushes the sensor back to a position of no advance.

### Cap and Rotor

The central tower on the distributor cap receives the high voltage from the coil. This voltage flows through a button in the cap into a spring contact on the rotor. The rotor tip aligns with the contact in the cap corresponding to the cylinder to be fired just as the coil output voltage reaches the rotor. In this way, each spark plug receives its voltage in turn.

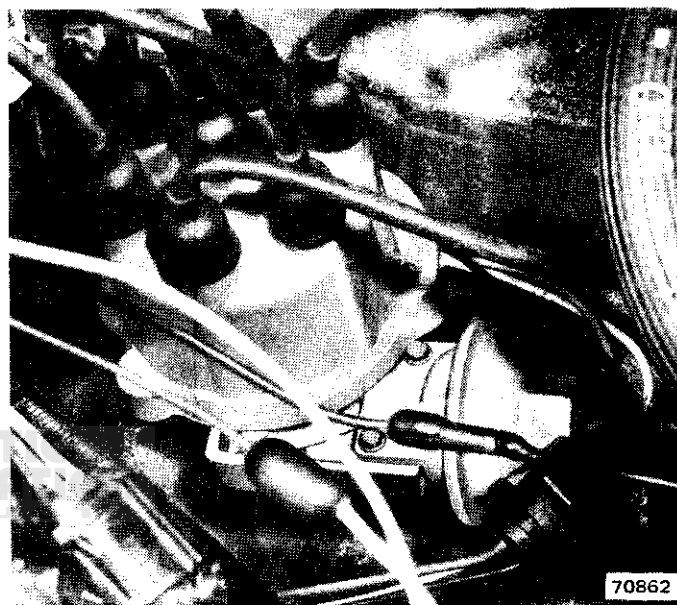


Fig. 1G-4 Distributor Vacuum Unit

### OPERATION

The control unit is activated when the ignition switch is in the Start or Run position (fig. 1G-5). The primary circuit is closed and the coil primary is energized. When the engine begins turning the distributor, the trigger wheel teeth rotate past the sensor. As each tooth aligns with the sensor, a high voltage surge leaves the coil and flows to the distributor cap. The rotor directs the high voltage to the proper spark plug. The timing of the sparks is constantly monitored and changed by the vacuum and centrifugal advance mechanisms.

### TROUBLESHOOTING

For troubleshooting purposes, ignition problems are placed in three categories: full failure, intermittent failure and spark knock.

**Full failure** is always a no-spark situation. The engine will not start. If a full failure occurs when the engine is running, it will refuse to re-start.

## 1G-4 IGNITION SYSTEM

**Intermittent failure** is temporary. The engine may refuse to start on the first try, but will eventually start. If an intermittent failure occurs when the engine is running, it may falter but will continue to run. If it stalls, it will re-start and will continue to run.

**Spark knock** is not a failure mode. The engine will start and will continue to run. If not corrected, spark knock can do extensive damage to internal engine components.

### Full Failure Diagnosis

The first step in diagnosing a failure is to identify which system—primary or secondary—is faulty.

The primary system consists of:

- Battery feed to ignition coil.
- Ignition coil primary winding.
- All wires connected to electronic control unit.
- Distributor

The secondary system consists of:

- Ignition coil secondary winding.
- All heavy wires installed in distributor cap.
- Distributor cap.
- Distributor rotor.
- Spark plugs.

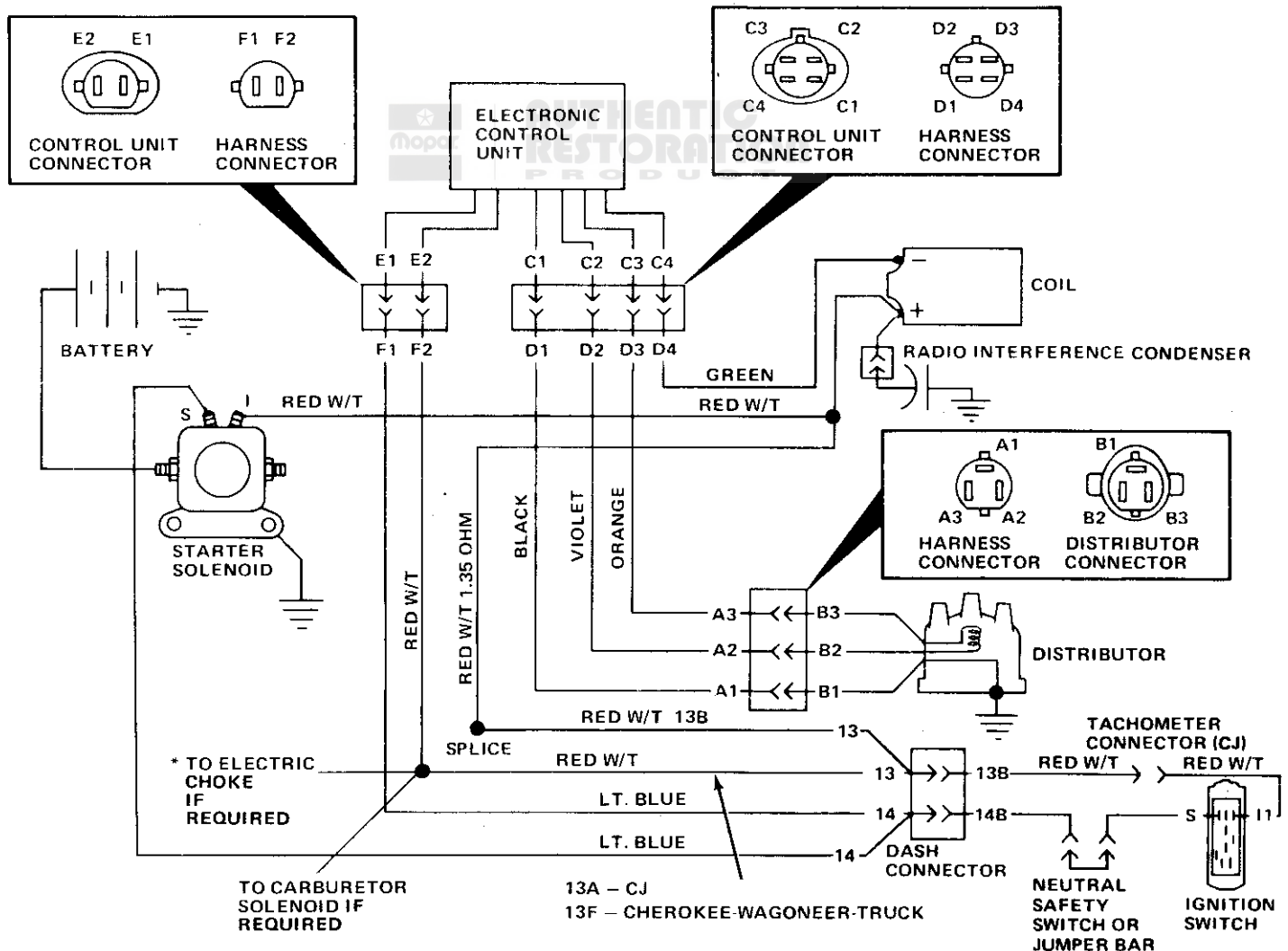


Fig. 1G-5 SSI System Schematic

**Secondary Circuit Check**

**NOTE:** When disconnecting secondary wire from spark plug or distributor cap, twist the rubber boot slightly to break loose. Grasp the boot, not the wire, and pull off with steady, even pressure.

- (1) Disconnect coil wire from center tower of distributor cap. Use insulated pliers to hold wire approximately 1/2 inch from engine block or intake manifold.
- (2) Crank engine and observe wire for spark.
  - (a) If no spark occurs, go to step (5).
  - (b) If spark occurs, go to step (3).
- (3) Connect coil wire to distributor cap. Remove wire from one spark plug.

**CAUTION:** Do not remove wires from plugs in cylinders 3 or 5 of a six-cylinder engine or cylinders 3 or 4 of an eight-cylinder engine when performing this test or sensor may be damaged.

- (4) Use insulated pliers to hold wire 1/2 inch from engine head while cranking engine. Observe spark.
  - (a) If spark occurs, check for fuel problems or incorrect timing.

(b) If no spark occurs, check for defective rotor or distributor cap, or defective spark plug wires.

(5) If no spark occurs at coil, test coil wire resistance. It should not exceed 10,000 ohms. Replace if required and proceed to Diagnosis and Repair Simplification (DARS) chart 1.

**NOTE:** The DARS charts are organized to permit testing each primary circuit separately and in the most logical order. When the problem is located, it is not necessary to perform further tests.

**NOTE:** Perform the DARS charts in order. DO NOT perform any chart before completing all necessary steps in previous charts.

**Intermittent Failure Diagnosis**

Intermittent failures may be caused by loose or corroded terminals, defective components, poor ground connections, or defective wiring. Refer to the Service Diagnosis Chart.

**SERVICE DIAGNOSIS**

Condition	Possible Cause	Correction
ENGINE FAILS TO START (NO SPARK AT PLUGS)	(1) No voltage to ignition system	(1) Check battery, ignition switch and wiring. Repair as required
	(2) Electronic Control Unit ground lead inside distributor open, loose or corroded	(2) Clean, tighten or repair as required
	(3) Primary wiring connectors not fully engaged	(3) Clean and fully engage connectors
	(4) Coil open or shorted	(4) Test coil. Replace if faulty.
	(5) Electronic Control Unit defective	(5) Replace Electronic Control Unit
	(6) Cracked distributor cap	(6) Replace cap
	(7) Defective rotor	(7) Replace rotor
ENGINE BACKFIRES BUT FAILS TO START	(1) Incorrect ignition timing	(1) Check timing. Adjust as required
	(2) Moisture in distributor	(2) Dry cap and rotor
	(3) Distributor cap faulty	(3) Check cap for loose terminals, cracks and dirt. Clean or replace as required
	(4) Ignition wires not in correct firing order	(4) Install in correct order

**SERVICE DIAGNOSIS (Continued)**

Condition	Possible Cause	Correction
ENGINE RUNS ONLY WITH KEY IN START POSITION	(1) Open in resistance wire or excessive resistance	(1) Repair resistance wire
ENGINE CONTINUES TO RUN WITH KEY OFF	(1) Defective starter solenoid (2) Defective ignition switch	(1) Replace solenoid (2) Replace ignition switch
ENGINE DOES NOT OPERATE SMOOTHLY AND/OR ENGINE MISFIRES AT HIGH SPEED	(1) Spark plugs fouled or faulty (2) Ignition cables faulty (3) Spark advance system(s) faulty (4) I-terminal shorted to starter terminal in solenoid (5) Trigger wheel pin missing (6) Distributor leads installed in wrong sockets	(1) Clean and gap plugs. Replace as required (2) Check cables. Replace as required (3) Check operation. Repair as required (4) Replace solenoid (5) Install pin (6) Install leads correctly
EXCESSIVE FUEL CONSUMPTION	(1) Incorrect ignition timing (2) Spark advance system(s) faulty	(1) Check timing. Adjust as required (2) Check operation. Repair as required
ERRATIC TIMING ADVANCE	(1) Faulty vacuum or centrifugal advance assembly	(1) Check operation. Replace if required
TIMING NOT AFFECTED BY VACUUM	(1) Defective vacuum advance unit (2) Sensor pivot corroded	(1) Replace vacuum advance unit (2) Clean pivot
INTERMITTENT OPERATION	(1) Loose or corroded terminals (2) Defective sensor (3) Defective control unit (4) Loose ground connector in distributor (5) Wires to distributor shorted together or to ground	(1) Tighten terminals, remove corrosion, apply electrical grease (2) Perform sensor tests (3) Perform control unit tests (4) Clean and tighten ground connection (5) Check for frayed, pinched or burned wires

SSI SYSTEM DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHART

Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

**IGNITION COIL  
PRIMARY CIRCUIT**  
FUNCTION: PROVIDES BATTERY  
FEED TO COIL AND COIL GROUND

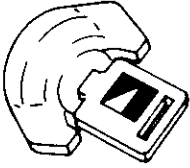
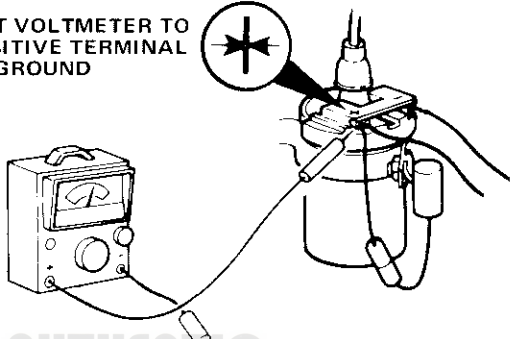
Chart 1

**STEP SEQUENCE RESULT**

REFER TO FIGURE 1G-5 FOR SCHEMATIC

● TURN IGNITION ON

● CONNECT VOLTMETER TO COIL POSITIVE TERMINAL AND TO GROUND

**1** VOLTAGE ACCEPTABLE (6V ± .5V) **OK** → **2**

VOLTAGE NOT ACCEPTABLE (BATTERY VOLTAGE) **OK** → **4**

VOLTAGE NOT ACCEPTABLE (BELOW 6V) **OK** → DISCONNECT CONDENSER LEAD → VOLTAGE ACCEPTABLE (6V ± .5V) **OK** → REPLACE CONDENSER → STOP

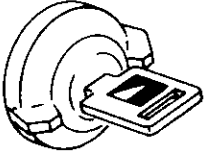
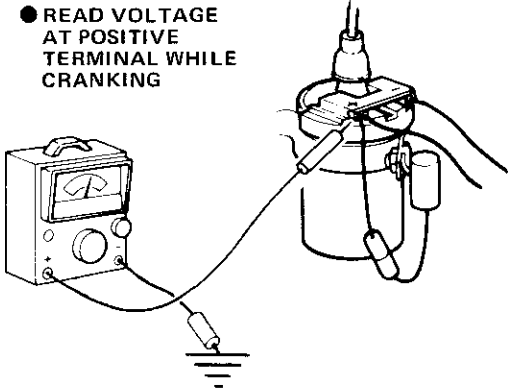
VOLTAGE NOT ACCEPTABLE (BELOW 6V) **OK** → DISCONNECT CONDENSER LEAD → VOLTAGE NOT ACCEPTABLE **OK** → **6**

DISCONNECT CONDENSER LEAD

REPLACE CONDENSER

● TURN IGNITION TO START

● READ VOLTAGE AT POSITIVE TERMINAL WHILE CRANKING

**2** VOLTAGE ACCEPTABLE (BATTERY VOLTAGE) **OK** → STOP

VOLTAGE NOT ACCEPTABLE (LESS THAN BATTERY VOLTAGE) **OK** → **3**

# Chart 1

STEP

SEQUENCE

RESULT

**3**

- ✓ CHECK FOR SHORT OR OPEN IN WIRE ATTACHED TO STARTER I-TERMINAL
- ✓ CHECK SOLENOID AS OUTLINED IN CHAPTER 1F

REPAIR AS REQUIRED

STOP

**4**

DISCONNECT WIRE FROM STARTER SOLENOID I-TERMINAL

● IGNITION REMAINS ON

● OBSERVE VOLTAGE AT COIL POSITIVE TERMINAL

VOLTAGE DROPS TO  $6V \pm .5V$  **OK** → REPLACE STARTER SOLENOID → STOP

VOLTAGE REMAINS AT BATTERY VOLTAGE **OK** → CONNECT JUMPER BETWEEN COIL NEGATIVE TERMINAL AND GROUND

VOLTAGE DROPS TO  $6V \pm .5V$  **OK** → **5**

VOLTAGE DOES NOT DROP **OK** → REPAIR DEFECTIVE RESISTANCE WIRE → **2**

**5**

CHECK:

- CONTINUITY BETWEEN COIL NEGATIVE TERMINAL AND D4
- DI TO GROUND

CONTINUITY OK → REPLACE CONTROL UNIT → STOP

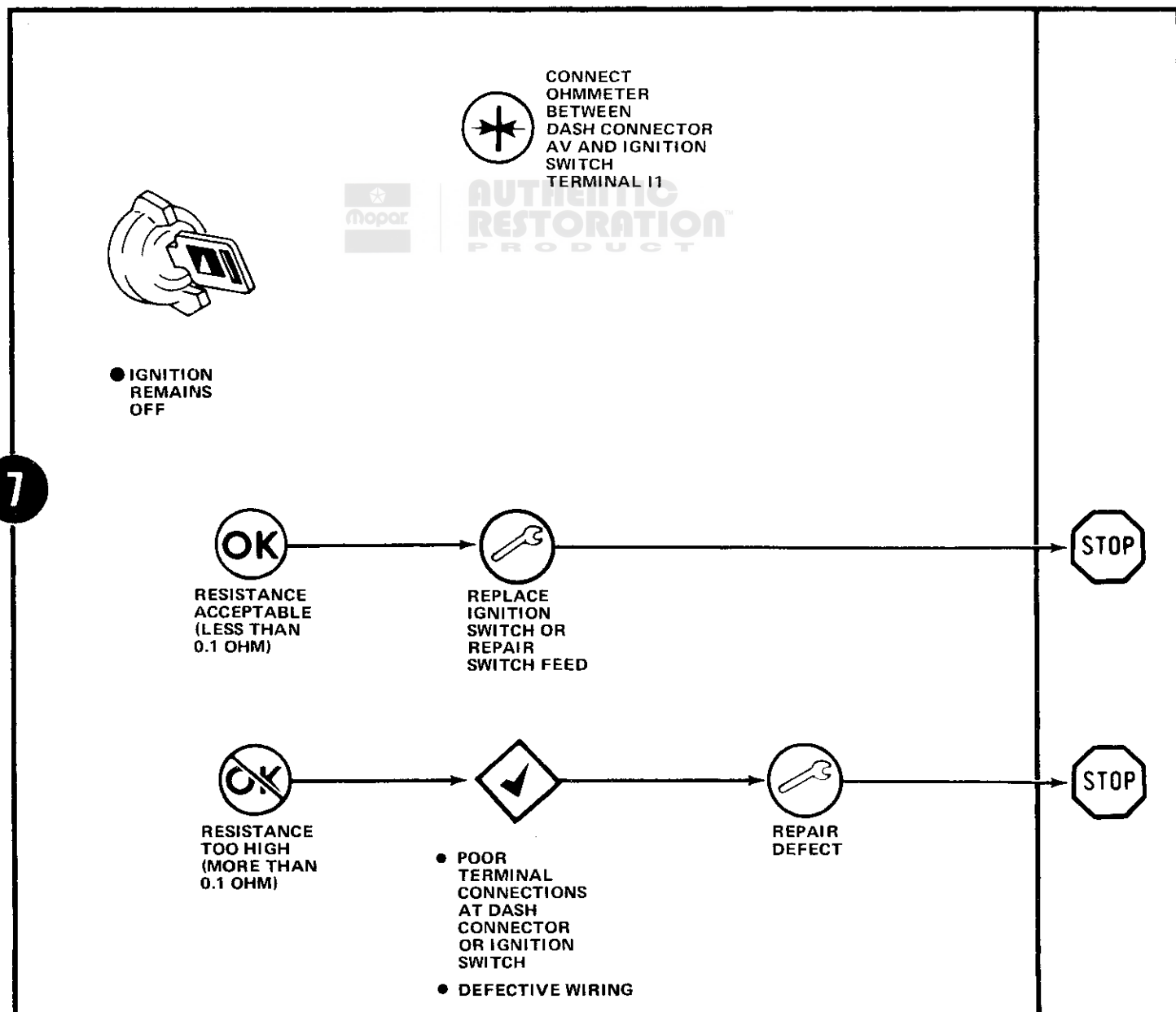
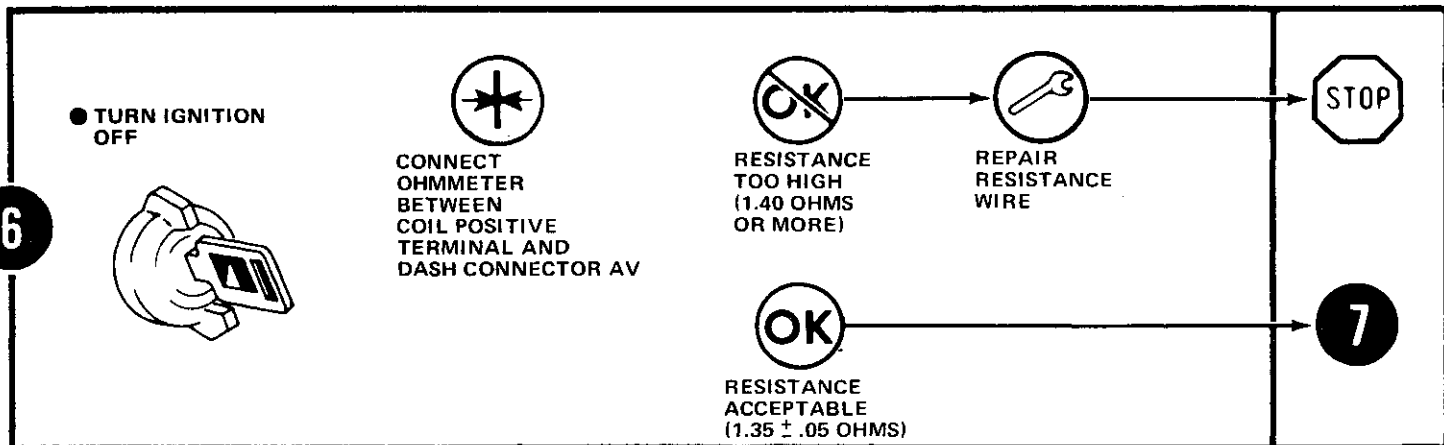
CONTINUITY NOT OK → LOCATE AND REPAIR OPEN → **2**

# Chart 1

STEP

SEQUENCE

RESULT



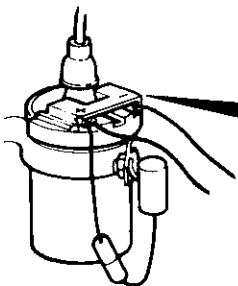
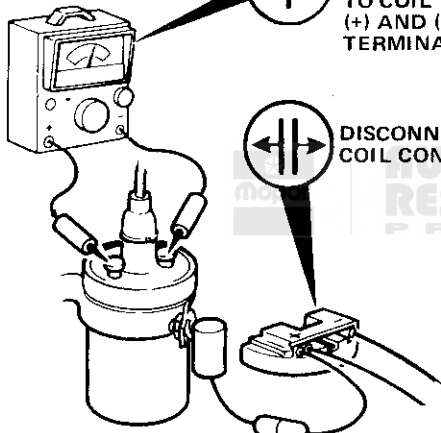
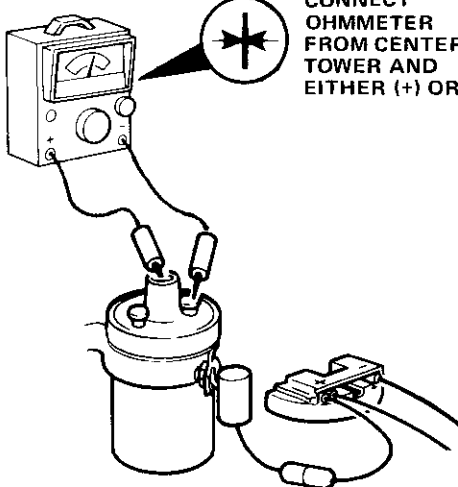


**COIL TEST**

**STEP**

**SEQUENCE**

**RESULT**

<p><b>1</b></p>	 <p>INSPECT COIL FOR OIL LEAKS, OTHER EXTERIOR DAMAGE, CARBON TRACKS</p>	<p>OK → 2</p> <p>OK → REPLACE COIL → STOP</p>	<p><b>2</b></p> <p>STOP</p>
<p><b>2</b></p>	 <p>CONNECT OHMMETER TO COIL (+) AND (-) TERMINALS</p> <p>DISCONNECT COIL CONNECTOR</p>	<p>OK → 3</p> <p>RESISTANCE ACCEPTABLE (1.13 TO 1.23 OHMS AT 75°F) (1.5 OHMS AT 200°F)</p> <p>RESISTANCE NOT WITHIN LIMITS → REPLACE COIL → STOP</p>	<p><b>3</b></p> <p>STOP</p>
<p><b>3</b></p>	 <p>CONNECT OHMMETER FROM CENTER TOWER AND EITHER (+) OR (-)</p>	<p>OK → STOP</p> <p>RESISTANCE NOT WITHIN LIMITS → REPLACE COIL → STOP</p>	<p>STOP</p> <p>STOP</p>

# Chart 3

## SENSOR CHECK AND CONTROL UNIT CHECK

STEP

SEQUENCE

RESULT

**1**

● TURN IGNITION ON

● DISCONNECT COIL WIRE FROM CENTER TOWER OF DISTRIBUTOR AND HOLD 1/2 - INCH FROM ENGINE WITH INSULATED PLIERS

● DISCONNECT 4-WIRE CONNECTOR AT CONTROL UNIT

SPARK AT COIL WIRE (NORMAL) → **2**

NO SPARK → **5**

**2**

CONNECT OHMMETER TO D2 AND D3

OK → **6**

OHMMETER INDICATES 400-800 OHMS (NORMAL)

~~OK~~ → **3**

OHMMETER DOES NOT INDICATE 400 - 800 OHMS

**3**

● DISCONNECT AND RECONNECT 3 - WIRE CONNECTOR AT DISTRIBUTOR

OK → **6**

OHMMETER NOW INDICATES 400 - 800 OHMS

~~OK~~ → **4**

OHMMETER REMAINS OUTSIDE 400 - 800 OHMS

DISCONNECT 3 - WIRE CONNECTOR AT DISTRIBUTOR

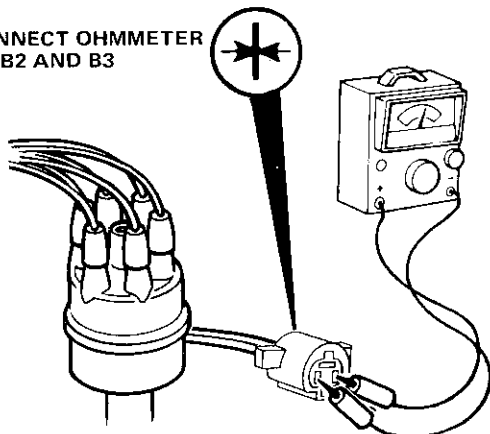
STEP

SEQUENCE

RESULT

**4**

CONNECT OHMMETER TO B2 AND B3



OHMMETER INDICATES 400 - 800 OHMS

OHMMETER DOES NOT INDICATE 400 - 800 OHMS

REPAIR OR REPLACE HARNESS BETWEEN 3 - WIRE AND 4 - WIRE CONNECTOR

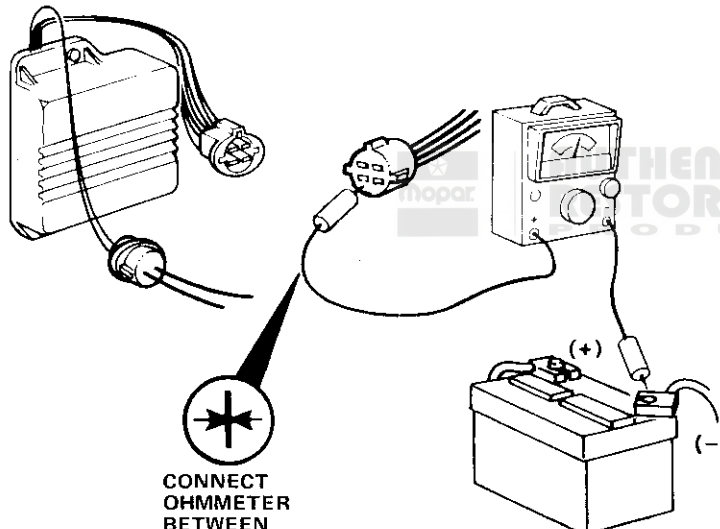
REPLACE SENSOR

STOP

STOP

**5**

CONNECT OHMMETER BETWEEN D1 AND BATTERY NEGATIVE TERMINAL



OHMMETER INDICATES ZERO (NOT ABOVE 0.002 OHM)

OHMMETER INDICATES ABOVE 0.002 OHM.

LOCATE AND REPAIR SOURCE OF BAD GROUND

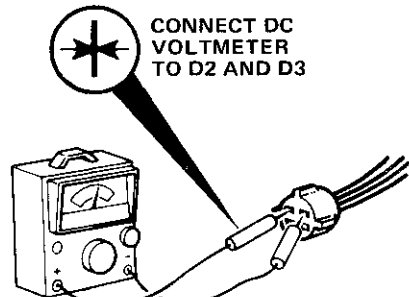
- GROUND CABLE RESISTANCE
- DISTRIBUTOR-TO-BLOCK RESISTANCE
- GROUND SCREW IN DISTRIBUTOR TO D1

2

STOP

**6**

CONNECT DC VOLTMETER TO D2 AND D3



CRANK ENGINE

VOLTMETER FLUCTUATES, INDICATING PROPER SENSOR AND TRIGGER WHEEL OPERATION

VOLTMETER DOES NOT FLUCTUATE

LOCATE AND REPAIR FAULT

- DEFECTIVE TRIGGER WHEEL
- DISTRIBUTOR NOT TURNING

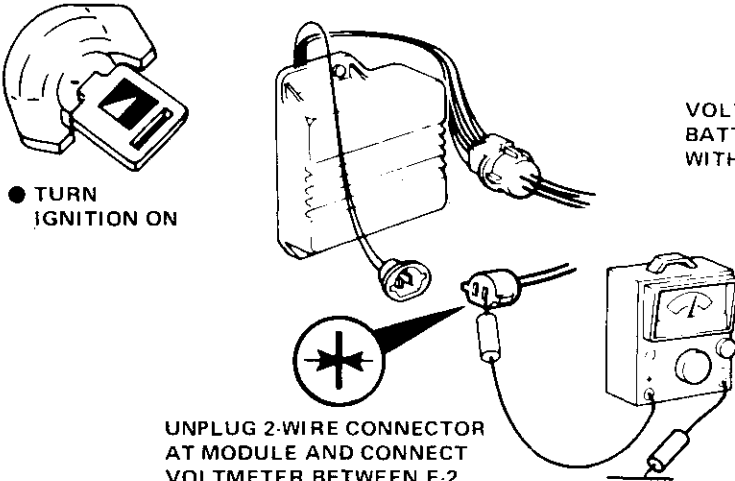
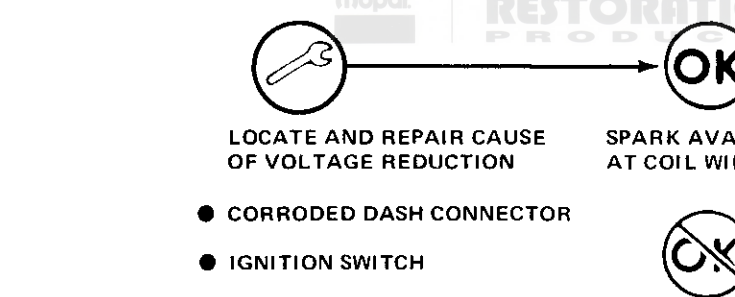
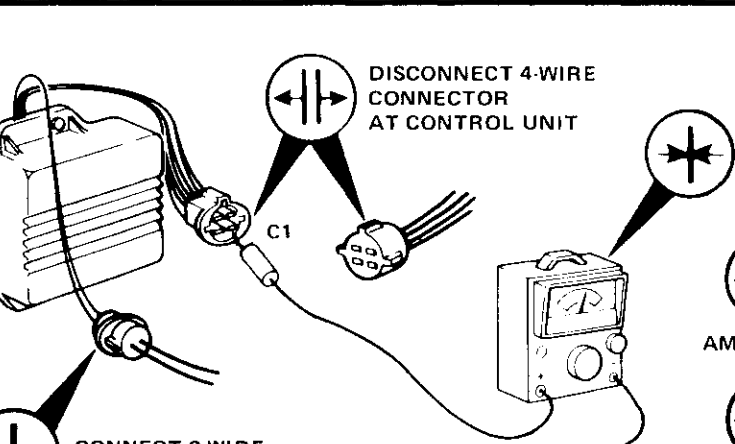
STOP

STOP

Chart 4

**IGNITION FEED TO ELECTRONIC CONTROL UNIT**

NOTE: DO NOT PERFORM CHART 4 WITHOUT PERFORMING CHART 3

STEP	SEQUENCE	RESULT
1	 <p>● TURN IGNITION ON</p> <p>UNPLUG 2-WIRE CONNECTOR AT MODULE AND CONNECT VOLTMETER BETWEEN F-2 AND GROUND</p> <p>OK → REPLACE CONTROL UNIT</p> <p>VOLTMETER INDICATES BATTERY VOLTAGE WITHIN 0.2V.</p> <p>✗ →</p> <p>VOLTMETER DOES NOT INDICATE BATTERY VOLTAGE WITHIN 0.2V</p>	<p>3</p> <p>2</p>
2	 <p>LOCATE AND REPAIR CAUSE OF VOLTAGE REDUCTION</p> <ul style="list-style-type: none"> <li>● CORRODED DASH CONNECTOR</li> <li>● IGNITION SWITCH</li> </ul> <p>OK →</p> <p>SPARK AVAILABLE AT COIL WIRE</p> <p>✗ → REPLACE CONTROL UNIT</p> <p>SPARK NOT AVAILABLE AT COIL WIRE</p>	<p>STOP</p> <p>STOP</p>
3	 <p>DISCONNECT 4-WIRE CONNECTOR AT CONTROL UNIT</p> <p>CONNECT AMMETER BETWEEN C1 AND GROUND</p> <p>OK →</p> <p>AMMETER READS 1 AMP ± 0.1</p> <p>✗ → REPLACE MODULE</p> <p>AMMETER READS HIGHER OR LOWER</p> <p>CONNECT 2-WIRE CONNECTOR AT CONTROL UNIT</p>	<p>STOP</p> <p>STOP</p>

### Engine Spark Knock (Ping) Diagnosis

Spark knock can be attributed to a number of factors. The most common are climatic factors such as temperature, air density and humidity.

- **High Underhood Temperature**

Underhood temperature is increased by the use of air conditioning (especially during long periods of idling), overloading (trailer pulling, operating in too high a gear), and the installation of accessories that restrict airflow.

- **Air Density**

Air density increases as barometric pressure rises or as temperature drops. A denser than normal mixture of air and fuel drawn into the cylinder has the same effect as raising the the compression ratio. This increases the possibility of spark knock.

- **Humidity**

Low humidity increases the tendency to spark knock. High humidity decreases spark knock.

- **Fuel Octane Rating**

Fuels of equivalent research octane rating may vary in their knocking characteristics in a given engine. It may be necessary to reduce initial timing (not more than 2 degrees from specifications) or select an alternate source of fuel.

- **Ignition Timing**

Ignition timing should be checked to be sure it is set within specifications.

**NOTE:** *The white paint mark on the timing degree scale represents the specified spark setting at idle speed, not TDC (Top Dead Center).*

- **Combustion Chamber Deposits**

An excessive build-up of deposits in the combustion chamber may be caused by not using recommended fuels and lubricants, prolonged engine idling or continuous low speed operation. These deposits may be reduced by the occasional use of Carburetor and Combustion Area Cleaner or its equivalent, or by operating the vehicle at turnpike speeds.

- **Distributor Advance Mechanism**

The centrifugal and vacuum advance units should be checked to be sure they are operating freely.

- **Exhaust Manifold Heat Valve**

If the heat valve sticks in the heat ON position, the intake manifold is heated excessively.

### TESTING

#### Electrical Tests

Refer to Troubleshooting for test procedures.

### Distributor Advance Tests

#### Centrifugal Advance

- (1) Disconnect vacuum line from vacuum advance unit and plug.

- (2) Connect timing light and tachometer.

- (3) Start engine and observe timing mark while engine is idling.

- (4) Slowly increase engine speed to 2000 rpm. Timing should advance smoothly as engine speed increases. Refer to Chapter 1A—General Service and Diagnosis for advance curve information.

#### Vacuum Advance

**NOTE:** *Engine must be warmed up to operating temperature.*

- (1) Connect vacuum line to vacuum advance unit.

- (2) Observe timing mark while engine is idling.

- (3) Slowly increase engine speed to 2000 rpm. With vacuum applied, timing should advance more than with centrifugal advance alone. At 2000 rpm, vacuum advance should cause total advance to be higher than centrifugal advance alone. Refer to Chapter 1A—General Service and Diagnosis for advance curve information.

### Coil Tests

The coil can be tested on any conventional coil tester or with an ohmmeter. A coil tester is preferable as it will detect faults that an ohmmeter will not.

#### Primary Resistance Test

- (1) Remove connector from negative and positive terminals of coil.

- (2) Set ohmmeter to low scale and calibrate to zero.

- (3) Connect ohmmeter to negative and positive terminals. Resistance should read 1.13 to 1.23 ohms at 75°F. At temperatures above 200°F, 1.50 ohms is acceptable.

#### Secondary Resistance Test

- (1) Remove ignition wire from center terminal of coil.

**NOTE:** *Ignition must be off.*

- (2) Set ohmmeter to 1000 scale and calibrate to zero.

- (3) Connect ohmmeter to brass contact in center terminal and to either primary terminal. Resistance should read 7700 to 9300 ohms at 75°F. A maximum of 12,000 ohms is acceptable if coil temperature is 200°F or more.

#### Current Flow Test

- (1) Remove connector from coil.

- (2) Depress plastic barb and withdraw positive wire from connector. Barb is visible from coil side of connector.

- (3) Repeat for negative wire.
- (4) Connect ammeter between positive terminal and disconnected positive wire.
- (5) Connect jumper wire from coil negative terminal to known good ground.
- (6) Turn ignition to On position.
- (7) Amperage should read approximately 7 amps, and should not exceed 7.6 amps.
- (8) If current flow is more than 7.6 amps, replace coil.
- (9) Leave ammeter connected to coil positive terminal. Remove jumper wire from negative terminal. Connect coil green wire to negative terminal. Current flow should be approximately 4 amps. If current flow is less than 3.5 amps, check for poor connections in 4-wire and 3-wire connectors or poor ground at ground screw inside distributor. If current flow is greater than 5 amps, the control unit is defective.
- (10) Start engine. Normal current flow with engine running is 2.0 to 2.4 amps. If current flow is outside specifications, the control unit is defective.

### Coil Output Test

- (1) Connect oscilloscope to engine.
- (2) Start engine and observe secondary spark voltage.
- (3) Remove one spark plug wire from distributor cap. Observe voltage on oscilloscope corresponding to disconnected plug wire. This voltage, referred to as open circuit voltage, should be 24,000 volts (24 KV) minimum.

**CAUTION:** Do not remove wires from plugs in cylinders 3 or 5 of a six-cylinder engine or cylinders 3 or 4 of an eight-cylinder engine when performing this test, or sensor may be damaged.

**CAUTION:** Do not operate engine with spark plug disconnected for more than 30 seconds or catalytic converter may be damaged.

## DISTRIBUTOR REPLACEMENT

### Removal

- (1) Unfasten distributor cap retaining screws. Remove distributor cap with high tension cables and position aside.
- (2) Disconnect vacuum hose from distributor vacuum advance unit.
- (3) Disconnect distributor primary wiring connector.

(4) Scribe mark on distributor housing in line with tip of rotor. Scribe mark on distributor housing near clamp and scribe matching mark on engine. Note position of rotor and distributor housing in relation to surrounding engine parts as reference points for installing distributor.

- (5) Remove distributor holddown screw and clamp.
- (6) Withdraw distributor carefully from engine.

### Installation

- (1) Clean distributor mounting area of engine block.
- (2) Install replacement distributor mounting gasket in counterbore of engine.
- (3) Position distributor in engine. If engine was not rotated while distributor was removed, perform the following:
  - (a) Align rotor tip with mark scribed on distributor housing during removal. Turn rotor approximately 1/8-turn counterclockwise past scribed mark.
  - (b) Slide distributor down into engine. Align scribe mark on distributor with matching scribe mark on engine.

**NOTE:** It may be necessary to move rotor and shaft slightly to start gear into mesh with camshaft gear and to engage oil pump drive tang, but rotor should align with scribed mark when distributor is down in place.

- (c) Install distributor holddown clamp, screw and lockwasher, but do not tighten screw.
- (4) If engine was rotated while distributor was removed, it will be necessary to establish timing as follows:
  - (a) Remove No. 1 spark plug. Hold finger over spark plug hole and rotate engine until compression pressure is felt. Slowly continue to rotate engine until timing mark on crankshaft pulley lines up with top dead center (0) mark on timing quadrant. Always rotate engine in direction of normal rotation. Do not turn engine backward to align timing marks.
  - (b) Turn distributor shaft until rotor tip points in the direction of the No. 1 terminal in the distributor cap. Turn rotor 1/8-turn counterclockwise past the position of the No. 1 terminal.
  - (c) Slide distributor down into engine and position distributor vacuum advance housing in approximately the same location (in relation to surrounding engine parts) as when removed. Align scribe mark on distributor with matching scribe mark on engine.

**NOTE:** It may be necessary to rotate the oil pump shaft with a long flat-blade screwdriver to engage oil pump drive tang, but rotor should align with the position of No. 1 terminal when distributor is down in place.

## 1G-16 IGNITION SYSTEM

(d) Install distributor holddown clamp, screw and lockwasher, but do not tighten screw.

(5) Install distributor cap (with ignition cables) on distributor housing, making sure rubber sensor lead grommet in distributor housing aligns with depression in distributor cap and that cap fits on rim of distributor housing. Two different diameter screws are used to retain distributor cap.

**NOTE:** If distributor cap is incorrectly positioned on distributor housing, cap or rotor may be damaged when engine is cranked.

(6) Apply Jeep Silicone Dielectric Compound or equivalent to connector blades and cavities. Connect distributor primary wiring connector. Press firmly to overcome hydraulic pressure of grease.

**NOTE:** If connector locking tabs weaken or break off, bind connectors together with harness tie strap or tape to assure good electrical connection.

(7) Connect timing light to No. 1 spark plug.

**CAUTION:** Do not puncture high tension cables or boots to make contact. Use proper adapters.

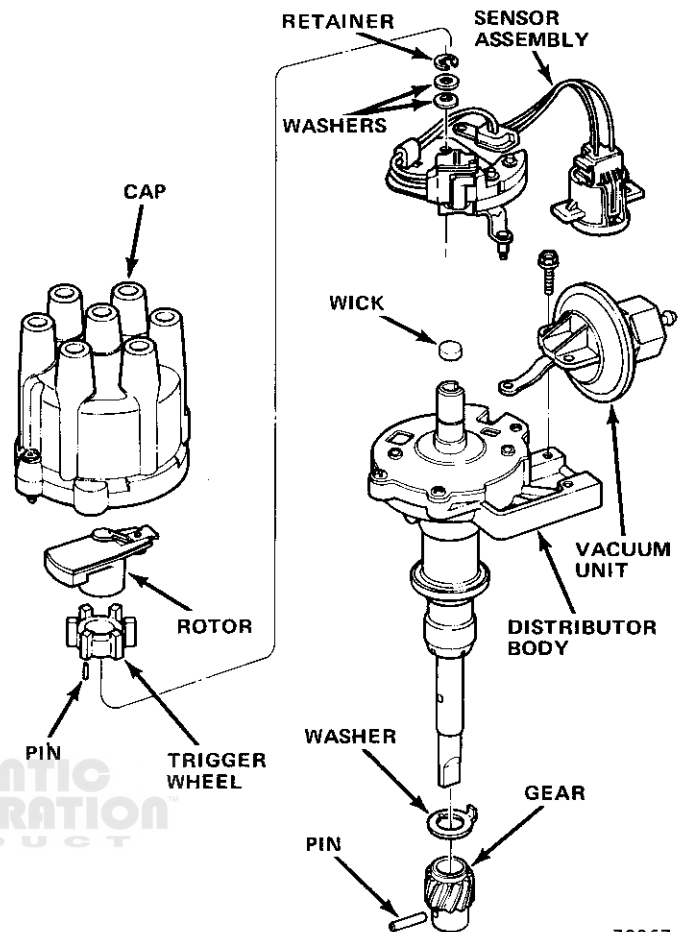
**NOTE:** The timing case cover has a hole provided for using a magnetic timing probe. Ignition timing may be checked by inserting the probe through the hole until it touches the vibration damper. The probe is calibrated to compensate for probe hole location which is  $9.5^{\circ}$  ATDC. Movement of the damper properly spaces the magnetic probe and timing is indicated on a meter.

(8) Operate engine at 500 rpm and observe timing mark with timing light. Rotate distributor housing as needed to align timing mark on vibration damper with mark on timing quadrant. Refer to Chapter 1A—General Service and Diagnosis for timing specifications. When timing is correct, tighten distributor hold-down screw and check timing to be sure it did not change.

(9) Disconnect timing light and connect vacuum hose to distributor vacuum advance unit.

### DISTRIBUTOR COMPONENT REPLACEMENT

When replacing sensor, trigger wheel or vacuum unit, it is not necessary to remove the distributor from the engine. It is necessary to check ignition timing if sensor or vacuum unit is replaced. Refer to figure 1G-6 for parts identification.



70867

Fig. 1G-6 SSI Distributor Components—Six-Cylinder Shown

### Trigger Wheel and/or Sensor

#### Removal

(1) Place distributor in suitable holding device, if removed from engine.

(2) Remove cap.

(3) Remove rotor.

(4) Remove trigger wheel using small gear puller, J-28509 or equivalent. Use flat washer to prevent gear puller from contacting inner shaft. Alternately, use two screwdrivers to carefully lever trigger wheel from shaft. Remove pin.

(5) Six-Cylinder—remove sensor retainer and washers from pivot pin on base plate.

(6) Eight-Cylinder—remove sensor snap ring from central shaft. Remove retainer from vacuum unit-to-sensor drive pin and move vacuum unit lever aside.

(7) Remove ground screw from harness tab.

(8) Lift sensor assembly from distributor housing.

(9) If vacuum unit is to be replaced, remove screws and lift vacuum unit out of distributor housing. Do not remove vacuum unit unless replacement is required.

### Installation

(1) If vacuum unit was removed, install unit and attaching screws to distributor housing.

**NOTE:** *If replacement vacuum unit is installed, refer to Vacuum Unit for calibration procedure.*

(2) Position sensor assembly into distributor housing.

(3) Be sure pin on sensor fits into hole in vacuum unit link on six-cylinder. Install vacuum unit lever and retainer to sensor pin on eight-cylinder.

(4) Install washers and retainer onto pivot pin to secure sensor assembly to base plate on six-cylinder. Install snap-ring on eight-cylinder.

(5) Position wiring harness in slot in distributor-housing. Install ground screw through tab and tighten.

(6) Install trigger wheel to shaft with long portion of teeth upward using hand pressure. When trigger wheel and slot in shaft are properly aligned, use suitable drift and small hammer to tap pin into locating groove in trigger wheel and shaft. If distributor is out of engine, support shaft while installing trigger wheel pin.

(7) Install rotor. Install distributor cap.

### Vacuum Unit

#### Removal

(1) Remove vacuum line from vacuum unit.

(2) Six-cylinder—remove attaching screws and remove vacuum unit from distributor body. It is necessary to tip unit to disengage link from sensor pin protruding through distributor body. It may be necessary to loosen base plate screws for necessary clearance.

(3) Eight-cylinder—remove distributor cap. Remove retainer from sensor pin. Remove attaching screws and lift vacuum unit from distributor body.

#### Installation

(1) If replacement vacuum unit is to be installed, calibrate as follows:

(a) Insert Allen wrench into vacuum hose tube of original vacuum unit. Count number of clockwise turns necessary to bottom adjusting screw.

(b) Turn adjusting screw of replacement vacuum unit clockwise to bottom. Turn counterclockwise same number of turns counted in step (a).

(2) Six-cylinder—install vacuum unit to distributor body. Be sure that vacuum advance link is engaged on pin of sensor. Install retaining screws. Tighten base plate screws, if loosened.

(3) Eight-cylinder—install vacuum unit to distributor body. Install retaining screws. Position vacuum unit lever onto sensor pin and install retainer. Install distributor cap.

(4) Check timing and adjust if required.

(5) Install vacuum line to vacuum unit.

### Rotor

Inspect the rotor during precision tune-ups as outlined in Chapter 1A—General Service and Diagnosis. A new feature of the SSI system is the silicone grease applied to the rotor blade during manufacture. Radio interference is greatly reduced by the presence of a small quantity of silicone grease on the rotor blade. After a few thousand miles, this grease becomes charred by the high voltage carried by the rotor (fig. 1G-7). This is normal. Do not scrape the residue from the rotor blade.

When installing a replacement rotor, apply a thin coat (0.03 to 0.12 inch) of Jeep Silicone Dielectric Compound, or equivalent, to tip of the rotor blade.

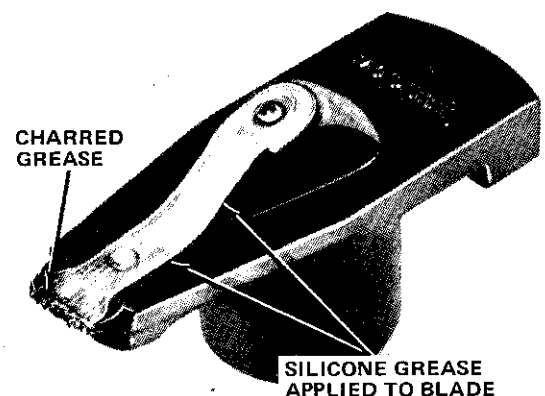


Fig. 1G-7 Rotor Grease Application



**SPECIFICATIONS**

**Distributor and Coil Specifications**

Distributor Sensor Resistance	400 to 800 ohms
Coil	
Primary Resistance	1.13 to 1.23 ohms
Secondary Resistance	7700 to 9300 ohms
Minimum Output at 1000 rpm	24 KV
Spark Plugs	
Required Voltage at 1000 rpm	5 to 16 KV
Maximum Variation Between Cylinders	3 to 5 KV
	70868

**Torque Specifications**

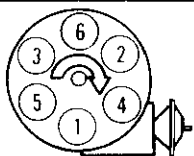
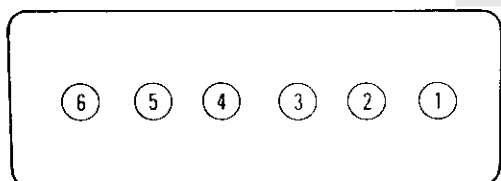
Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft.lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Distributor Clamp Screw	13	10-18	18	13-24

All Torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

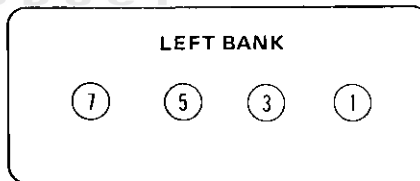
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**Distributor Wiring Sequence and Firing Order**

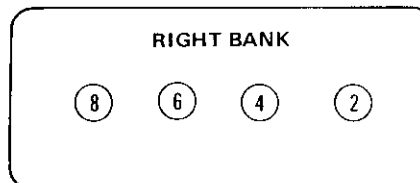


CLOCKWISE ROTATION  
1-5-3-6-2-4

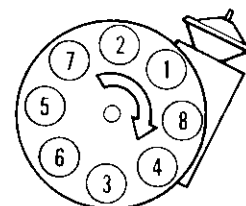
SIX-CYLINDER ENGINES



CLOCKWISE ROTATION  
1-8-4-3-6-5-7-2



EIGHT CYLINDER ENGINES



FRONT

42189

**SPARK CONTROL SYSTEMS**

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General	1G-18	
Non-Linear Vacuum Regulator Valve	1G-20	

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Spark Coolant Temperature Override (CTO) Systems	1G-19

**GENERAL**

Manifold vacuum and carburetor ported vacuum are both used to provide signals for the ignition spark advance mechanism. On some engines, a Coolant Temperature Override (CTO) switch chooses the proper vacuum

source, depending upon coolant temperature. On other engines, a Non-Linear Vacuum Regulator (NLVR) valve combines regulated vacuum at idle speed and carburetor ported vacuum proportional to the amount of throttle opening. Refer to the Emission Components charts in Chapter 1A for model application.

## SPARK COOLANT TEMPERATURE OVERRIDE (CTO) SYSTEMS

### General

On all Jeep vehicles with spark CTO, the vacuum spark advance operates on carburetor ported vacuum after warming up. Warm-up driveability is improved by operating the distributor vacuum spark advance by manifold vacuum while the engine is cold. This is accomplished by the CTO system (fig. 1G-8). The CTO switch is threaded into the left rear of the block on six-cylinder engines, and into the thermostat housing on eight-cylinder engines. A thermal sensor on the CTO switch is in contact with engine coolant (fig. 1G-9). Depending on coolant temperature, the CTO switch permits either manifold vacuum or carburetor ported vacuum to pass through to the distributor vacuum unit.

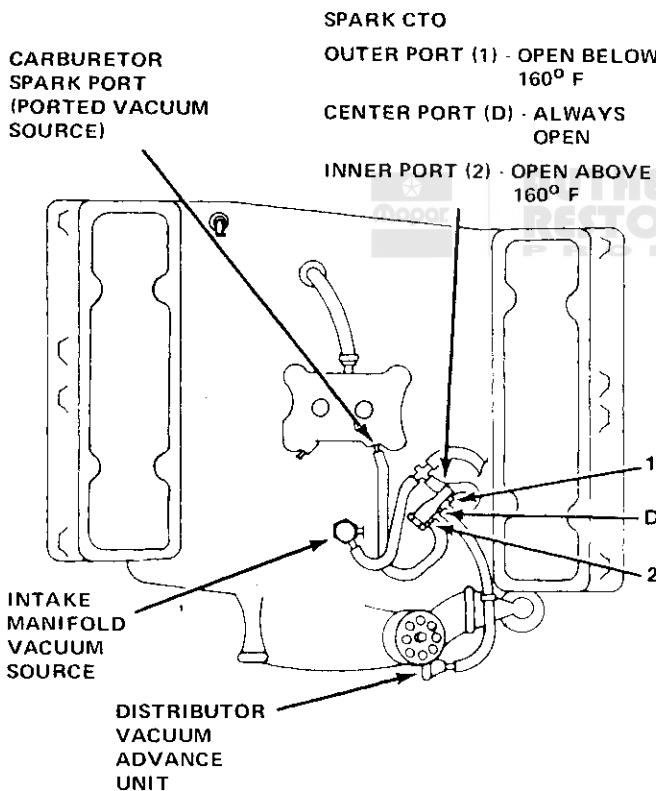
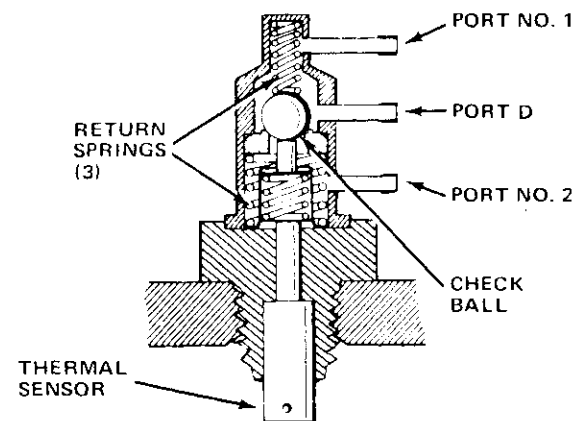


Fig. 1G-8 Spark CTO System—Typical

### Operation

When coolant temperature is below 160°F, the check ball is held against the bottom seat by spring pressure. Manifold vacuum is admitted through port 1 and is applied to port D. A hose connects port D with the distributor spark advance diaphragm. In this operating mode, full vacuum advance is obtained.



42024

Fig. 1G-9 Spark CTO Switch

When engine coolant reaches 160°F, the check ball is moved upward, blocking manifold vacuum at port 1. Carburetor ported vacuum is admitted through port 2 and is applied to port D. The distributor spark advance diaphragm is now operated by ported vacuum. This may be regarded as the normal operating mode.

### Test

Connect a vacuum gauge to the center port (D) of the CTO switch. Below 160°F manifold vacuum should be indicated. Above 160°F carburetor ported vacuum should be indicated. Defective switches must be replaced.

**NOTE:** Ported vacuum is not available with throttle closed. Ported vacuum is available when throttle is opened to achieve engine speed of 1000 rpm.

### Spark Coolant Temperature Override Dual Range (Dual Range CTO)

This is a dual function valve which replaces the function of the standard CTO switch until an upper temperature limit is reached, at which time the valve switches ported vacuum back to manifold vacuum. It is adapted to the engine in the same place as the single range CTO.

When the coolant temperature is below the lower switching temperature (149°F), manifold vacuum is routed through Port 3 into Port 2 allowing manifold vacuum to be applied through a hose connection to the distributor advance unit (Fig. 1G-10). This results in full vacuum advance which improves driveability during the warmup period by providing full distributor vacuum advance until the coolant temperature has reached the switching temperature (149°F). At this time, Port 3 closes and Ports 1 and 2 are opened. Manifold vacuum is blocked and carburetor ported vacuum is applied to the distributor advance unit. This continues until the coolant temperature reaches 220°F at which time the switch closes Port 1 and reconnects Ports 2 and 3 which reapplies manifold vacuum to the distributor advance

unit. With manifold vacuum applied to the distributor at the upper temperature limits, engine idle speed is increased thereby improving engine cooling efficiencies and reducing idle boiling tendencies.

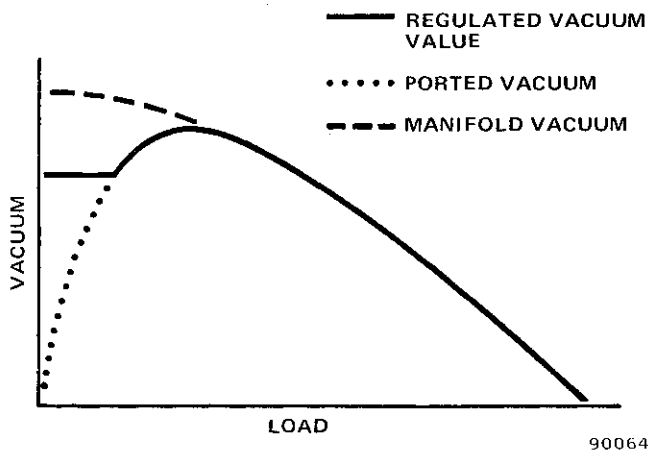


Fig. 1G-10 Dual Range Spark CTO

**Test**

- (1) Connect a vacuum gauge to Port 2 (Dist.) of the dual range CTO switch. Below 149°F manifold vacuum should be indicated.
- (2) Above 149°F carburetor ported vacuum should be indicated.
- (3) At 220°F Port 1 closes and reconnects Ports 2 and 3 which reapplies manifold vacuum to Port 2 (Dist.).

**Spark Coolant Temperature Override—Heavy Duty Cooling**

This is a single function valve which is utilized in conjunction with heavy-duty cooling to prevent overheating at high ambient temperatures. It is adapted to the engine in the same place as either the spark coolant override switch or the dual range spark coolant temperature override switch.

When the coolant temperature is below the switching temperature (220°F), ported vacuum is routed through Port 1 into Port D allowing ported vacuum to be applied through a hose connection to the distributor advance unit. When the coolant temperature reaches 220°F, Port 1 closes and Port 2 is connected to Port D thereby routing manifold vacuum to the distributor advance. With manifold vacuum applied to the distributor, engine idle speed is increased thereby improving engine cooling efficiencies and reducing idle boiling tendencies.

**Test**

- (1) Connect a vacuum gauge to Port D (Dist.) of the heavy-duty cooling CTO switch. Below 220°F, carburetor ported vacuum should be indicated.
- (2) Above 220°F, Port 1 (Carb.) closes and Port 2 (Manifold) is connected to Port D (Dist.). Manifold vacuum should now be indicated.

**Spark CTO Replacement**

**Removal—Six-Cylinder**

- (1) Drain coolant from radiator.
- (2) Code vacuum lines and disconnect from spark CTO switch.
- (3) Place drain pan under engine below CTO switch.
- (4) Using 7/8-inch open end wrench, remove switch from block.

**WARNING:** Be careful of scalding hot coolant leaking from block when removing the switch.

**Installation—Six-Cylinder**

- (1) Install switch.
- (2) Connect vacuum lines to switch.
- (3) Install coolant.

**NOTE:** Remove temperature gauge sending unit from head to aid in bleeding air while filling the cooling system.

**Removal—Eight-Cylinder Engine**

- (1) Drain coolant from radiator.
- (2) Remove air cleaner assembly.
- (3) Code vacuum lines and disconnect from CTO switch.
- (4) Using 7/8-inch open end wrench, remove switch from thermostat housing or intake manifold.

**Installation—Eight-Cylinder Engine**

- (1) Install spark CTO switch in thermostat housing.
- (2) Connect vacuum lines to switch.
- (3) Install air cleaner assembly.
- (4) Install coolant.
- (5) Purge cooling system of air.

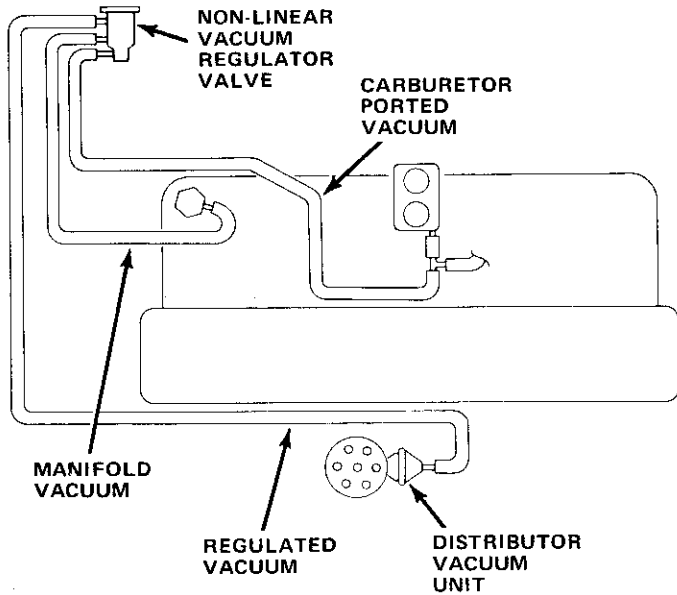
**NON-LINEAR VACUUM REGULATOR (NLRV) VALVE**

**General**

On all Jeep vehicles with NLVR, vacuum spark advance is operated by regulated vacuum (fig. 1G-10). Regulation is determined by engine load.

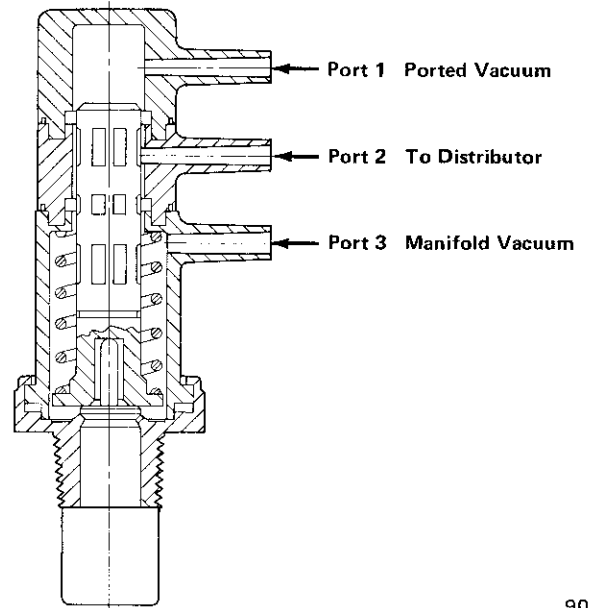
**Operation**

The NLRV valve has two input ports (manifold vacuum and carburetor ported vacuum) and one outlet port (distributor vacuum unit). Under no-load or low-load conditions, the NLRV valve provides regulated vacuum (fig. 1G-11). Under these conditions, manifold vacuum is high and ported vacuum is either non-existent or very low. The NLRV valve provides a signal somewhere between the two vacuum levels, as determined by the calibration of the valve. As engine load increases and the signal increases above the regulated value, the regulator valve switches to ported vacuum.



90063

Fig. 1G-11 Regulated Vacuum System—Typical



90189

Fig. 1G-12 Non-Linear Vacuum Regulator Valve Operation



AUTHENTIC RESTORATION PRODUCTIONS

**Test—Non-Linear Vacuum Regulator Valve**

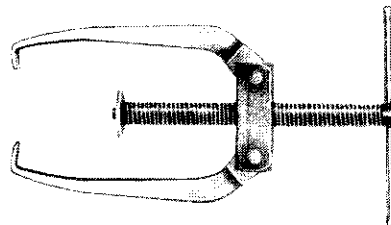
Connect a vacuum gauge to the distributor port (Dist.) of the non-linear vacuum regulator valve. With the engine at idle speed, a vacuum reading of 7 in. Hg. should be indicated. As the throttle is opened and engine speed increases, ported vacuum from the carburetor should be indicated on the vacuum gauge.

**Replacement—Non-Linear Vacuum Regulator Valve**

- (1) Disconnect vacuum lines and remove non-linear vacuum regulator valve.
- (2) Connect vacuum lines to replacement valve.

**NOTE:** Be sure vacuum lines are connected to correct ports of non-linear valve.

**Tools**

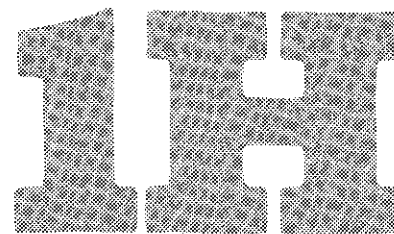


J-28509 TRIGGER WHEEL PULLER

J-28509 Gear Puller



# CRUISE COMMAND



## SECTION INDEX

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Adjustments	1H-11	Operation	1H-2
Bellows Chain Replacement	1H-13	Regulator Replacement	1H-13
Bellows Replacement	1H-13	Relay Replacement	1H-13
Components	1H-1	Testing	1H-5
Control Switch Replacement	1H-13	Troubleshooting	1H-5
General	1H-1		

### GENERAL

Cruise Command automatic speed control senses vehicle speed through the speedometer cable and uses engine intake manifold vacuum to regulate the accelerator to automatically maintain any preset cruising speed between 30 mph and the legal maximum speed limit.

A slight increase or decrease of speed (as much as 3.5 mph) is normal when vehicles are driven up or down grades not exceeding 7% (most interstate highways). A change of speed greater than 3.5 mph may be experienced when driving in unusually hilly terrain or at high altitudes.

The Cruise Command control is an integral part of the directional switch lever and consists of two separate switches, the OFF-ON-RES (resume) slide switch and the pushbutton switch.

To engage the speed control, move the slide switch to the ON position and accelerate to the desired speed. Press the pushbutton on the end of the directional switch lever and release. The speed control system will now maintain the selected speed. The system will automatically disengage when the brake pedal is lightly depressed.

After accelerating to 30 mph, the speed control can be re-engaged to the previously selected speed by moving the slide switch to the RES position and releasing the switch. When the RES function is used, the rate of acceleration is regulated by engine intake manifold vacuum. The rate of acceleration cannot be adjusted. On large displacement eight-cylinder engines, the acceleration rate will be firm.

**WARNING:** *Cruise Command should not be used when driving on slippery roads.*

**NOTE:** *When the ignition or slide switch is moved to the OFF position, the preset speed of the RES function is canceled and must be reset when the system is reactivated.*

The Cruise Command can be set at a higher speed than initially selected by accelerating to the desired speed and then depressing and releasing the pushbutton. Depressing and holding the pushbutton while cruising at a preset speed will also cause a slow increase in speed. A lower controlled speed can be achieved by lightly pressing the brake pedal momentarily, allowing the vehicle to slow to the desired speed and then pressing and releasing the pushbutton.

### COMPONENTS

The Cruise Command system consists of five basic components: the regulator, the relay, the bellows, the control switch and the release circuit.

#### Regulator

The regulator senses speed through the speedometer cable connecting the regulator to the transmission. The flyweight-type governor reacts to the cable speed and engages the low speed switch at approximately 30 mph. When the low speed switch is closed, the driver may engage the Cruise Command system.

The regulator is serviced as an assembly.

#### Relay

The relay is energized when the ignition switch is turned to On position. It prevents a battery drain when the ignition switch is turned Off.

## 1H-2 CRUISE COMMAND

### Bellows

The bellows, a vacuum servo, receives the modulated vacuum and controls the vehicle speed by actuating the throttle through a beaded chain.

### Control Switch

The control switch is an integral part of the turn signal lever. When actuated, it energizes either the solenoid valve, the coupling coil or both.

### Release Circuit

When the brake pedal is depressed slightly, the stop-lamp current de-energizes the solenoid valve, disengaging the speed control.

## OPERATION

### General

The regulator consists of three functional groups: the governor assembly, the solenoid and valve assembly, and the coupling coil and centering spring assembly.

### Governor Assembly

The governor assembly consists of two flyweights on a shaft, an actuator assembly, and a spring (fig. 1H-1). The shaft passes through the actuator assembly but is not keyed to it. The actuator is free to slide on the shaft. The spring applies pressure which holds the actuator against the flyweights. When the shaft is spun by the speedometer cable, the flyweights are thrown outward by centrifugal force. This forces the actuator to slide away from the flyweights against the resistance of the spring. At a road speed of approximately 30 mph, the actuator has moved far enough to close the low speed switch. A spring-loaded slider on the actuator engages a drive pin on the coupling coil.

### Solenoid and Valve Assembly

The valve controls vacuum entering the regulator by sealing the manifold vacuum port until the solenoid coil is energized (fig. 1H-2). When current is supplied to the coil, the valve stem is pulled upward, opening the manifold vacuum port. When the coil is de-energized, the valve is pushed shut by the spring.

A glass-encapsulated reed switch is mounted on the outside of the solenoid coil. The magnetic field surrounding the energized coil activates the reed switch and permits current to pass. As long as current is supplied to the reed switch, the coil remains energized, holding the valve open.

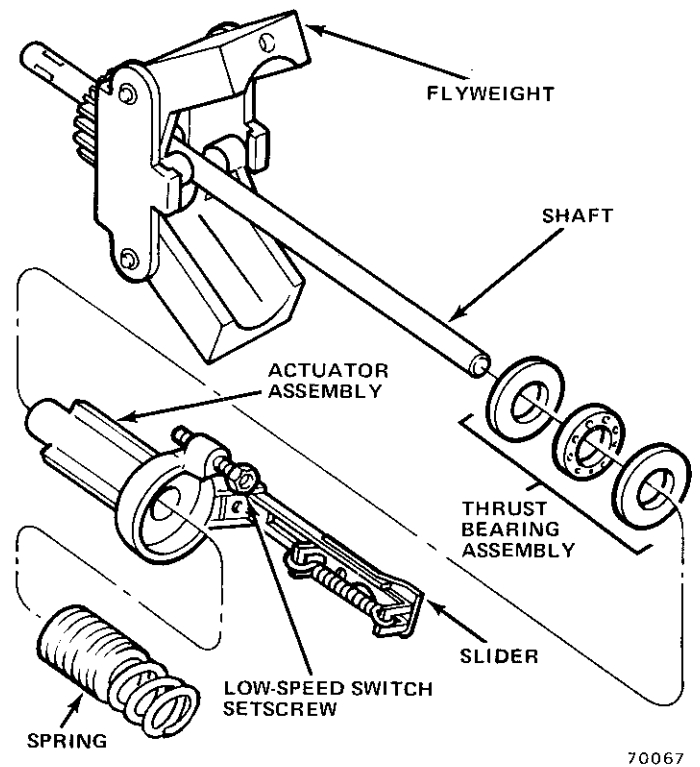


Fig. 1H-1 Governor Assembly

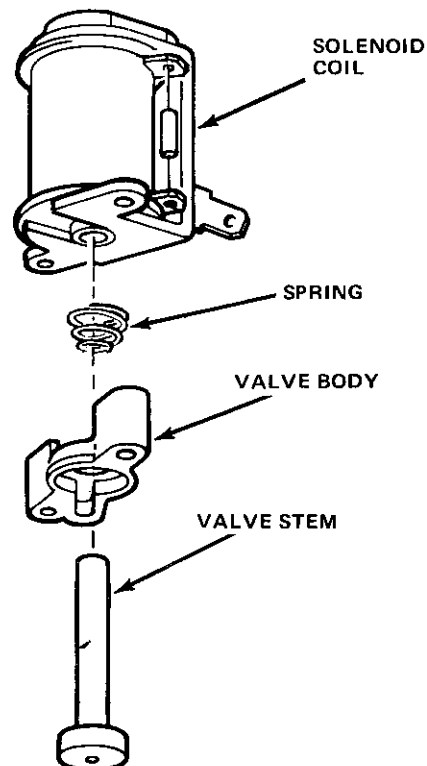
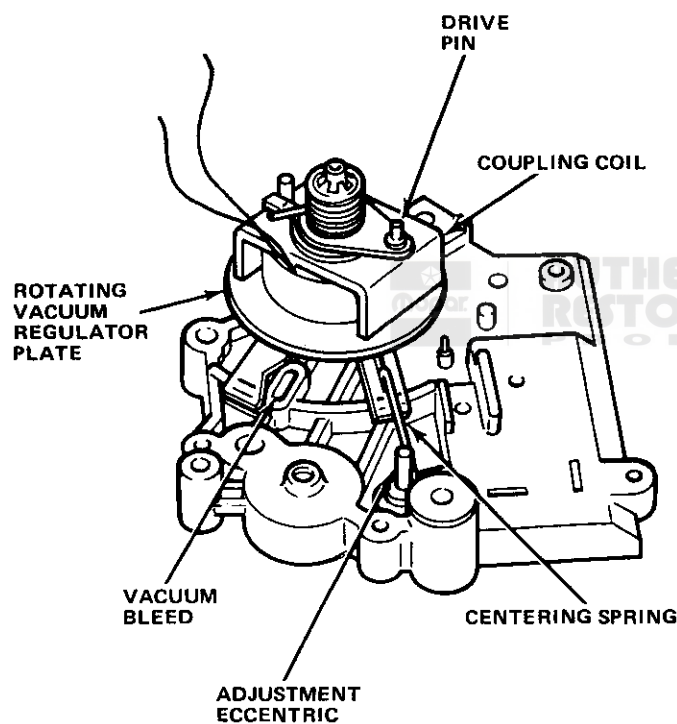


Fig. 1H-2 Solenoid and Valve Assembly

### Coupling Coil and Centering Spring Assembly

The coupling coil is the mechanism that gives the Cruise Command its memory during the resume phase (fig. 1H-3). When not under the influence of the magnetic coupling coil, the rotating vacuum regulator plate is held in a centered position by the centering spring (fig. 1H-4).

The coupling coil is rotated on its axis by motion of the governor actuator assembly. When the coil is not energized, the coupling coil can be rotated without affecting the position of the rotating vacuum regulator plate. When energized, the coupling coil captures the regulator plate and forces it to rotate in unit with the coupling coil. Slight rotational movement of the vacuum regulator plate uncovers or blocks the vacuum bleed port.



70069

Fig. 1H-3 Coupling Coil and Centering Spring Assembly

The centering spring determines the position of the rotating vacuum regulator plate over the bleed port during the set speed phase (fig. 1H-4). Its adjustment is accomplished by an eccentric. Adjustments of more than 1/8 turn of the eccentric should not be attempted.

### Slide Switch ON

With the engine running and the ignition switch On, the Cruise Command relay is energized and current is supplied to the slide switch (fig 1H-5). When road speed reaches approximately 30 mph, the governor flyweights have moved outward enough to close the low speed switch.

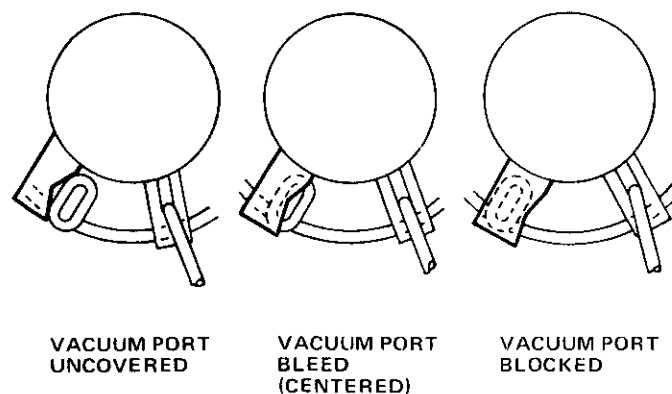


Fig. 1H-4 Vacuum Regulator Plate Positions

When the slide switch is moved to the ON position, current is supplied through the pushbutton to the coupling coil which is energized. The coupling coil grounds through the regulator case. Note that the solenoid valve is in the relaxed position and seals the vacuum source because no current has yet been supplied to energize the solenoid valve coil. The system is now ready to be set provided road speed is above 30 mph, closing the low speed switch.

### Pushbutton Depressed—Setting Speed

When the desired speed is reached, the pushbutton is depressed momentarily (fig 1H-6). Current to the coupling coil is interrupted, de-energizing the coil and releasing the coupling coil from the vacuum regulator plate. Spring pressure in the actuator assembly rotates the freed coupling coil until it is in the position which corresponds to the selected road speed. The vacuum regulator plate is moved by the centering spring to its neutral (calibrated bleed) position. Simultaneously, current is supplied to the solenoid valve coil which pulls the vacuum valve off its seat. The vacuum source begins to evacuate air from the mixing chamber of the regulator valve and the bellows.

The vacuum solenoid valve circuit is grounded through the stoplamp bulbs.

### Pushbutton Released—Maintaining Speed

This mode begins when the vacuum solenoid valve reaches the energized position (fig 1H-7). At that time, current supplied through the reed switch flows through the solenoid coil, through the low-speed switch to ground at the stoplamp bulbs. This current acts to hold the solenoid in the energized position. When the pushbutton is released, the hold-in current maintains the vacuum solenoid valve in the open position. The vacuum solenoid valve hold-in circuit grounds through the stoplamp bulbs. Current is simultaneously supplied to the



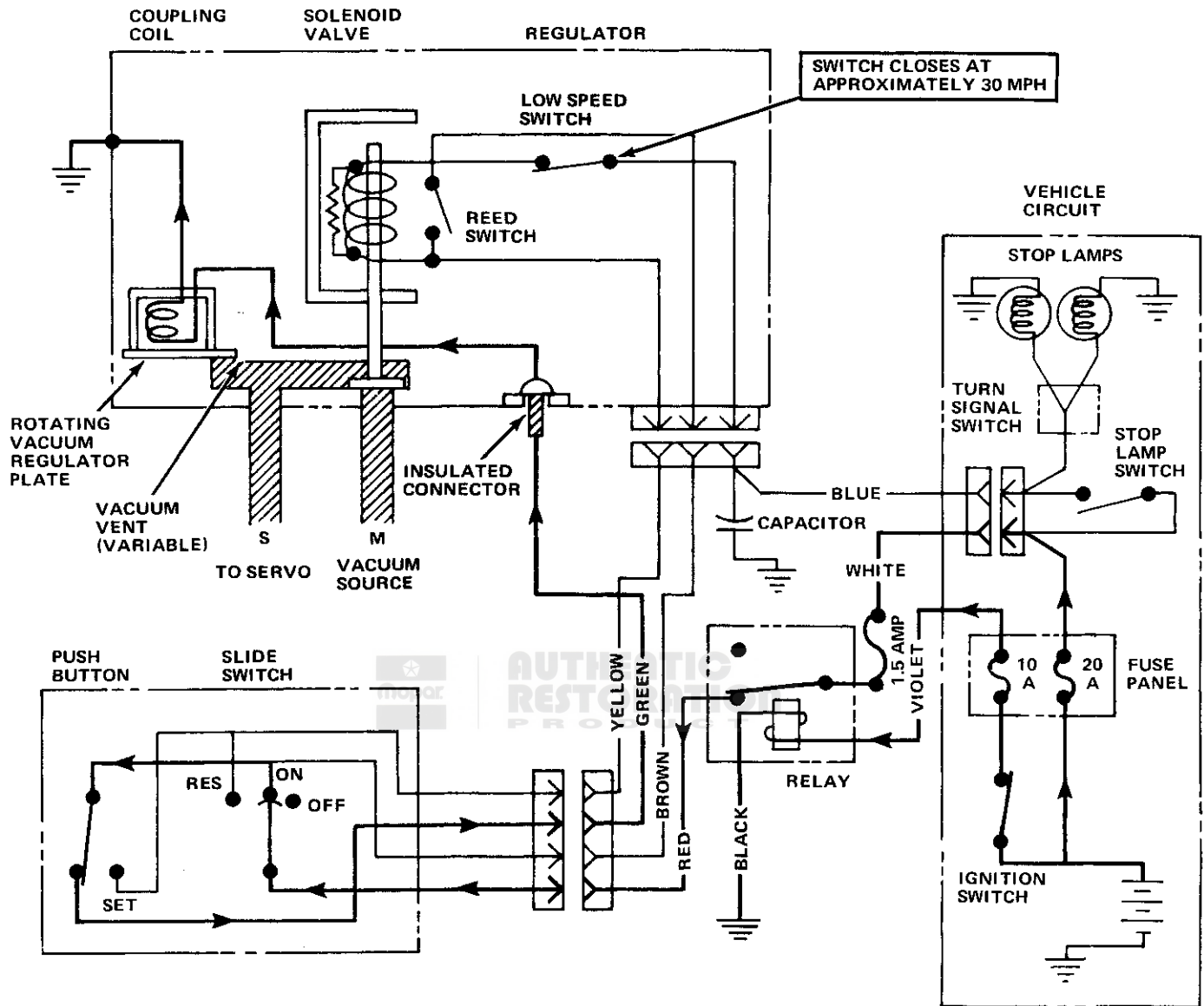


Fig. 1H-5 Current Flow—Slide Switch On

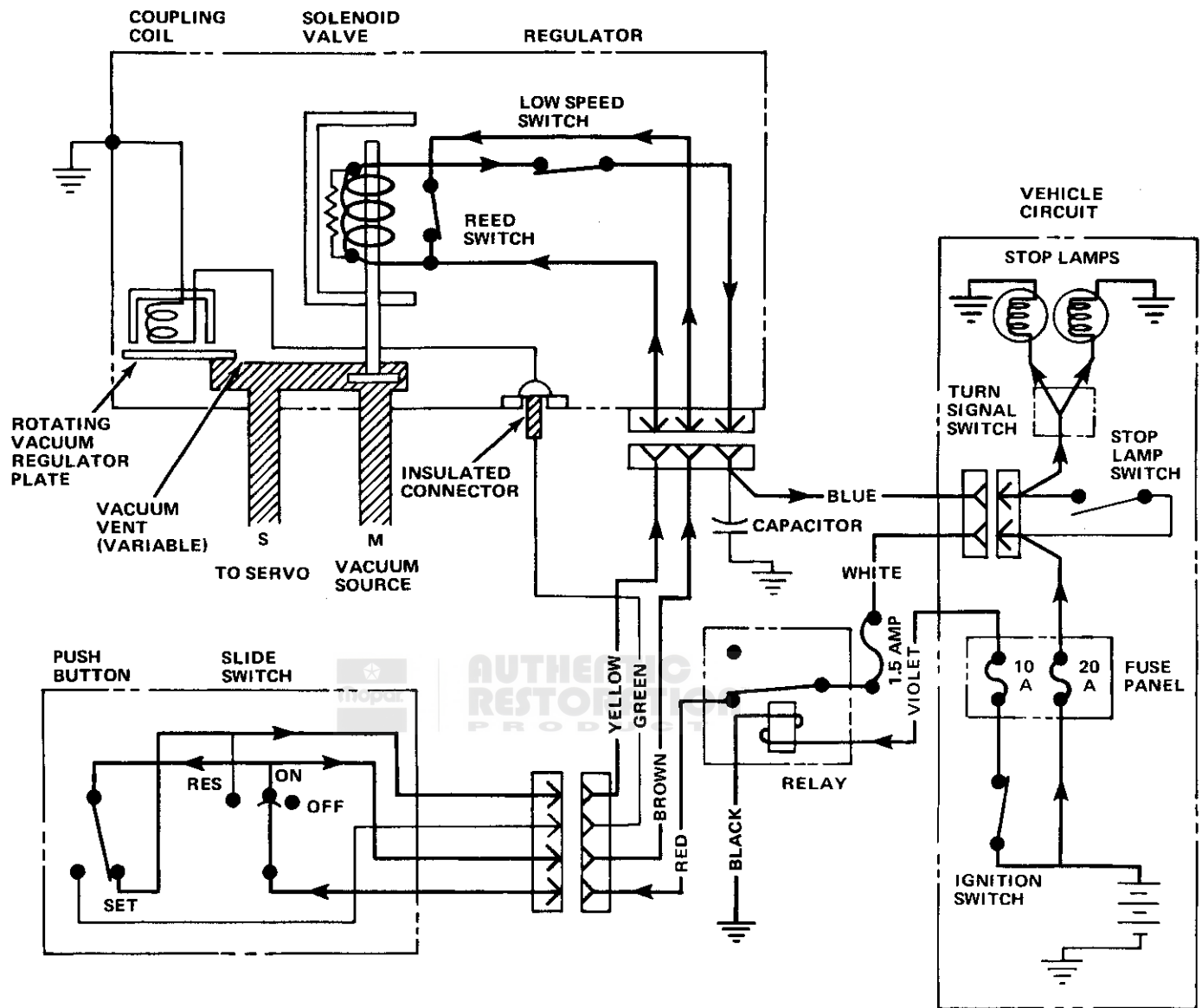
80064

coupling coil, which captures the vacuum regulator plate. The coupling coil and regulator plate are magnetically locked together and may be regarded as a single unit. The coupling coil circuit grounds through the regulator case.

Varying road speed causes the governor flyweights to turn the coupling coil. Lower speeds cause the weights to collapse, blocking vacuum bleed. This directs all the vacuum to the bellows, causing the throttle to open further. Higher speeds cause the weights to move outward, uncovering the vacuum bleed port. Decreased vacuum at the bellows causes the throttle to close.

### Brake Release

In the speed setting phase and the speed maintaining phase, the vacuum solenoid coil circuit is grounded through the stoplamp bulbs. When the brakes are applied, counter voltage travels from the stoplamp switch through the circuit until it reaches the solenoid coil (fig. 1H-8). There it counteracts hold-in voltage and the coil immediately de-energizes. This allows the valve to seat against the manifold vacuum seat and relieves vacuum to the bellows. The throttle closes, and the engine is no longer under the control of the Cruise Command system. The coupling coil is not affected, because it does not ground through the stoplamp bulbs. The coupling coil and vacuum regulator plate remain held together.



80065

Fig. 1H-6 Current Flow—Pushbutton Depressed—Setting Speed

### Resume Switch Operation

Road speed must be above 30 mph, so the low-speed switch is closed. When the resume slide switch is operated, current is supplied to the vacuum solenoid coil (fig. 1H-9). The valve is opened, and vacuum is applied to the bellows. Since the coupling coil circuit was not disturbed during brake release, it continues to control vacuum bleed.

When the resume switch is returned to the ON position, the hold-in circuit keeps the vacuum solenoid valve open.

A mechanical interlock in the control switch prevents operating the resume circuit and pushbutton set-speed circuit at the same time.

### TROUBLESHOOTING

For troubleshooting of the Cruise Command system, refer to Service Diagnosis and Testing.

Refer to Volume Three for details on speedometer cable and gear replacement.

### TESTING

The following tests should be performed as part of the diagnosis to determine the cause of the malfunction and the correction required.

#### Control Switch Continuity Test

Check control switch operation using an ohmmeter or test lamp. Connect tester to wires indicated in the Control Switch Continuity Chart.

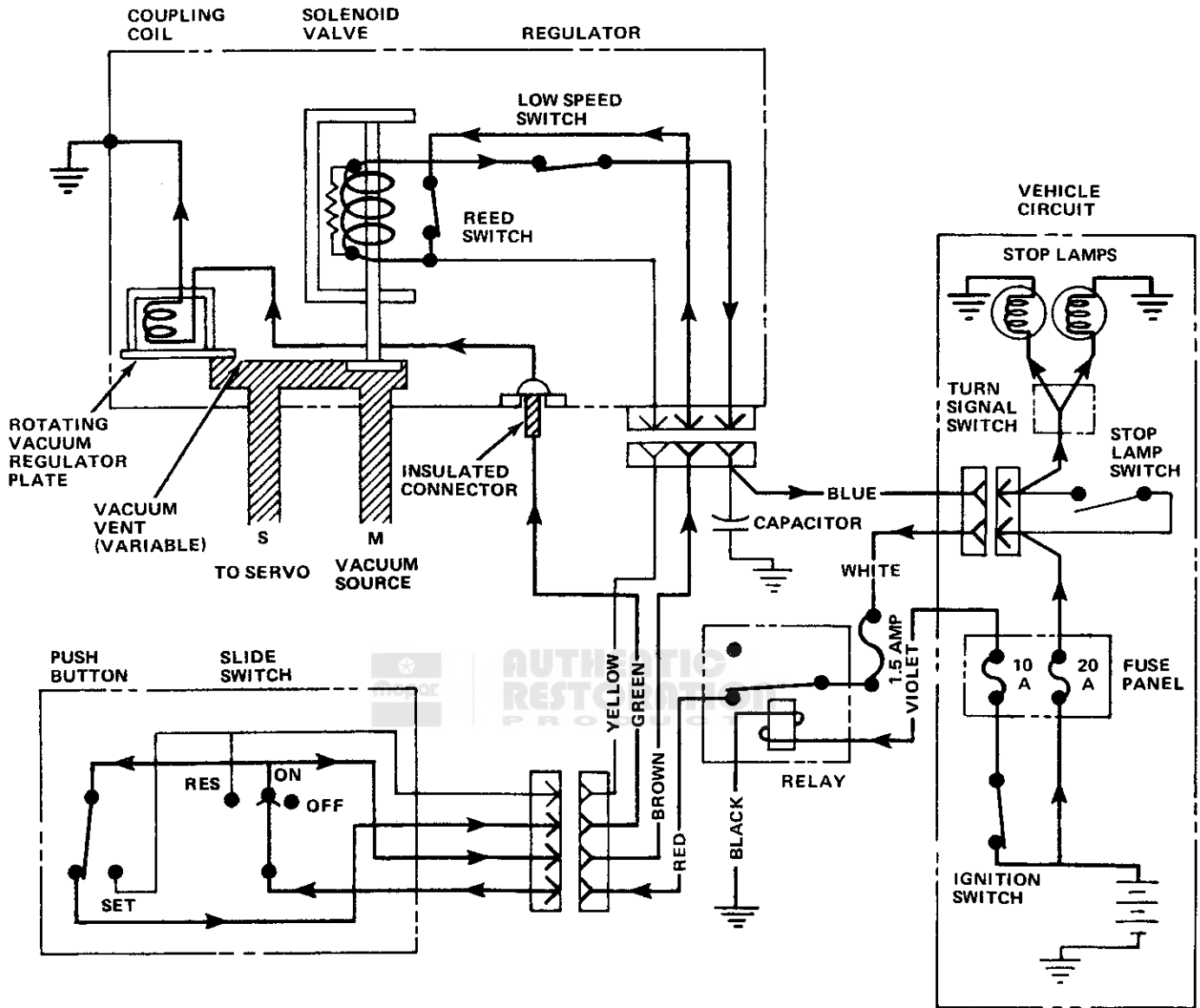


Fig. 1H-7 Current Flow—Pushbutton Released—Maintaining Speed

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**Control Switch Continuity Chart**

Switch Wire Continuity	Slide Switch			Pushbutton Depressed Slide Switch On
	Off	On	Resume	
Red/Brown	Open	Closed	Closed	Closed
Red/Green	Open	Closed	Closed	Open
Red/Yellow	Open	Open	Closed	Closed

NOTE: Pushbutton cannot be depressed with slide switch in resume position

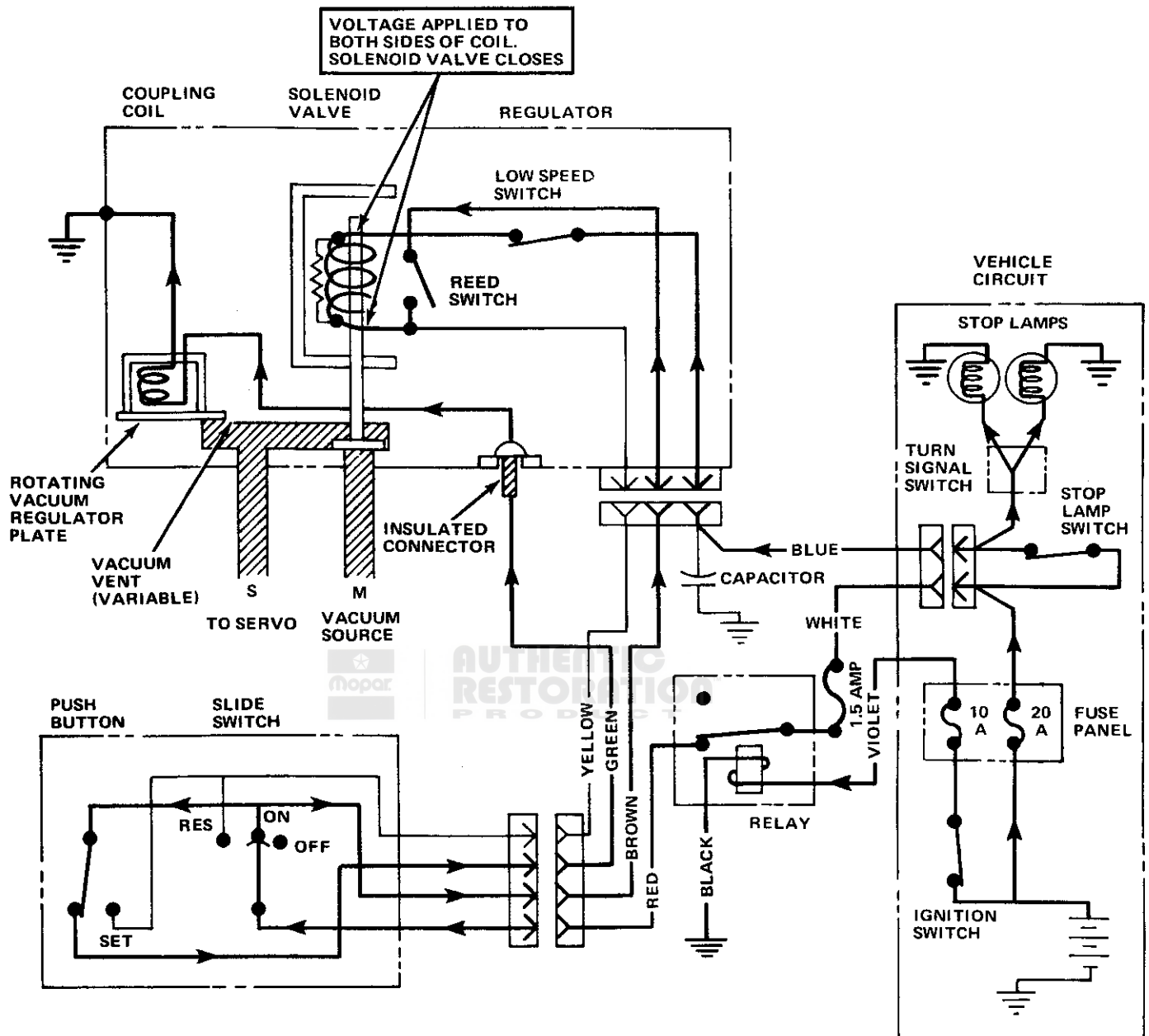
70072

**Circuitry Tests**

The following checks should be performed as part of the diagnosis to determine the cause and correction of Cruise Command trouble. Refer to figure 1H-10 for wiring details.

**NOTE:** It is not always necessary to remove the regulator in case of inoperative Cruise Command.

- (1) Disconnect push-on connectors (single and triple) at regulator.
- (2) Turn ignition switch to Accessory position.
- (3) Move slide switch to ON position.



80067

Fig. 1H-8 Current Flow—Brake Release

(4) Using test lamp, ground one test lamp lead and touch other lead to brown wire and then dark green wire at connectors. Test lamp should light. If test lamp does not light on either wire, check fuse, relay, control switch and connection at power source.

(5) Push SET SPEED button in and hold. Ground one test lamp lead and touch other lead to each wire connector. Test lamp should light on brown and yellow wires and should not light on dark green or blue wire.

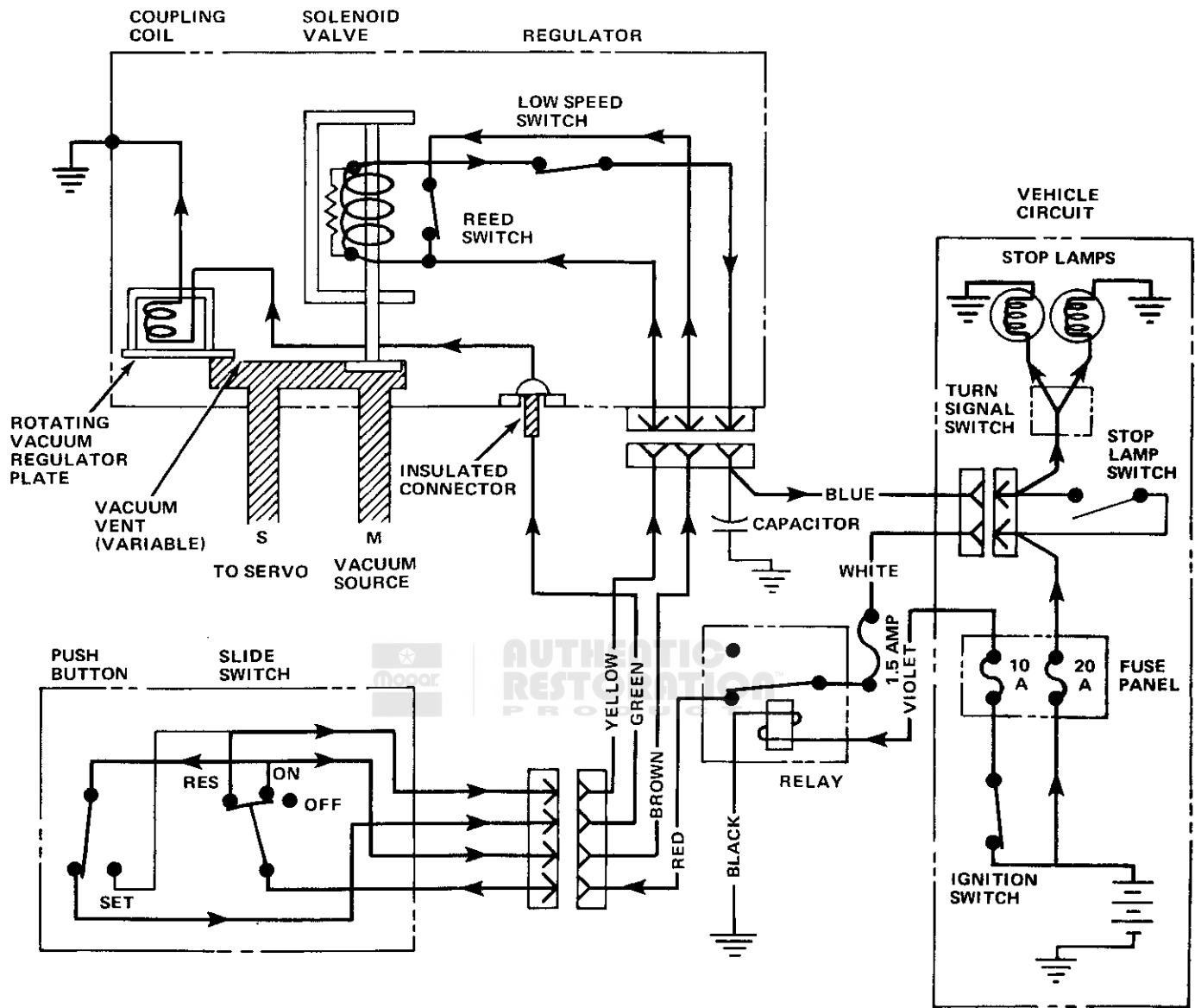
(6) Release SET SPEED button.

(7) Move slide switch to RES position and hold. Ground one test lamp lead and touch other lead to each

wire in connector. Test bulb should light on all wires except blue wire (blue connects to brake lamp side of brake lamp switch).

**NOTE:** To make an independent check of engagement switch before removal from the vehicle, disconnect switch from wiring harness at the multiple connector in passenger compartment, and make the following checks (omit steps (8) through (15) if steps (1) through (7) check out).

(8) Attach jumper wire from 12-volt power source to red lead of control switch.



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Fig. 1H-9 Current Flow—Resume Slide Switch Operation

- (9) Move slide switch to OFF position.
- (10) Using test lamp, ground one test lamp lead and touch other lead, in turn, to brown wire, dark green wire, and yellow wire. Test lamp should not light on any of these wires.
- (11) Move slide switch to ON position.
- (12) Touch test lamp lead to brown wire and then dark green wire. Test lamp should light on these wires. Touch lead to yellow wire. Lamp should not light.
- (13) Push SET SPEED in and hold. Test lamp should light on brown wire and on yellow wire. Test lamp should not light on light green wire.

- (14) Release SET SPEED pushbutton.
- (15) Move slide switch to RES position and hold. Touch test lamp lead, in turn, to brown wire, yellow wire, and then to light green wire. Test lamp should light on all three wires.

**NOTE:** If steps (1) through (7) do not check out and steps (8) through (15) do check out, replace Cruise Command wire harness. If steps (8) through (15) do not check out, replace control switch.

**Service Diagnosis**

Condition	Possible Cause	Correction
<b>BLOWING STOPLAMP FUSES</b>	(1) 250 mfd capacitor shorted.	(1) Replace capacitor.
<b>BLOWING FUSES</b>	(1) Short or ground in Cruise Command wiring circuit.	(1) Perform electrical checks.
<b>CRUISE COMMAND DOES NOT ENGAGE</b>	(1) Cruise Command harness fuse burned out.	(1) Check for cause. Replace fuse (1.5 amp only).
	(2) Faulty brake lamp switch.	(2) Replace brake lamp switch.
	(3) No current to brown wire.	(3) Check for loose connection or repair wiring harness.
	(4) Vacuum leak.	(4) Repair leak.
	(5) Bad ground at regulator.	(5) Check regulator for ground (use ohmmeter—check from regulator to mounting bracket).
	(6) Bad relay ground.	(6) Check ground wire for loose connection (use ohmmeter — check from relay case to known good ground).
	(7) Faulty connections.	(7) Check connections, repair as necessary.
	(8) Brake lamp fuse burned out.	(8) Check for cause and repair, replace fuse.
	(9) Brake lamp bulb(s) burned out.	(9) Replace bulb(s).
	(10) Control switch inoperative.	(10) See Circuitry Tests—steps (8) through (15).
	(11) Faulty regulator.	(11) Replace regulator.
	(12) Solenoid valve deformed.	(12) Replace regulator.
	(13) Relay inoperative.	(13) Replace relay, check ground, look for open in white wire.
<b>CRUISE COMMAND DISENGAGES WHEN TURN SIGNAL SWITCH IS OPERATED</b>	(1) 250 mfd capacitor open.	(1) Replace capacitor or repair ground.
	(2) Stop/turn lamp burned out on side opposite direction of turn.	(2) Replace bulb.

# 1H-10 CRUISE COMMAND

## Service Diagnosis (Continued)

Condition	Possible Cause	Correction
CRUISE COMMAND DOES NOT DISENGAGE WHEN BRAKE IS APPLIED	<ul style="list-style-type: none"> <li>(1) Defective brake lamp switch (open).</li> <li>(2) Collapsed hose from servo to regulator.</li> <li>(3) 250 mfd. capacitor shorted.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Replace brake lamp switch.</li> <li>(2) Replace hose.</li> <li>(3) Replace capacitor.</li> </ul>
RE-ENGAGES WHEN BRAKE IS RELEASED	<ul style="list-style-type: none"> <li>(1) Faulty control switch.</li> <li>(2) Check wiring for proper location.</li> <li>(3) Solenoid valve deformed.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Replace control switch.</li> <li>(2) Correct wiring location at regulator or 4-wire connector.</li> <li>(3) Replace regulator.</li> </ul>
CARBURETOR DOES NOT RETURN TO NORMAL IDLE OR PULSATING ACCELERATOR PEDAL	<ul style="list-style-type: none"> <li>(1) Improper throttle chain linkage adjustment.</li> <li>(2) Speedometer cable or drive cable.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Adjust throttle chain linkage.</li> <li>(2) Lubricate cable, including tips.</li> </ul>
SPEEDOMETER INOPERATIVE AND CRUISE COMMAND OPERATES	<ul style="list-style-type: none"> <li>(1) Speedometer cable not driving speedometer.</li> <li>(2) Faulty regulator.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Check for broken cable or loose connections.</li> <li>(2) Replace regulator as necessary.</li> </ul>
NEITHER SPEEDOMETER NOR CRUISE COMMAND OPERATES	<ul style="list-style-type: none"> <li>(1) Transmission cable not driving regulator.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Check for broken cable or loose connections.</li> </ul>
CRUISE COMMAND ENGAGES ABOVE OR BELOW DESIRED SPEED	<ul style="list-style-type: none"> <li>(1) Regulator out of adjustment.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Refer to centering spring adjustment.</li> </ul>
SYSTEM DISENGAGES ON LEVEL ROAD WITHOUT APPLYING BRAKE	<ul style="list-style-type: none"> <li>(1) Loose wiring connections or poor ground.</li> <li>(2) Loose hoses.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Tighten connection and check ground.</li> <li>(2) Check hose connections.</li> </ul>

Condition	Possible Cause	Correction
SYSTEM DISENGAGES ON LEVEL ROAD WITHOUT APPLYING BRAKE	(3) Servo linkage chain broken or throttle clevis slipped. (4) Oversensitive stop lamp switch.	(3) Repair chain or install clevis. (4) Replace switch or check for binding in brake linkage.
ERRATIC OPERATION OF CRUISE COMMAND	(1) Check vacuum servo or vacuum hose. (2) Check regulator.	(1) Replace servo or vacuum hose. (2) Replace regulator as necessary.
CRUISE COMMAND CONTINUES TO ACCELERATE AFTER ENGAGEMENT	(1) Open circuit in green wire attached to number 4 terminal at regulator.	(1) Repair open circuit in green wire. Check for improper connection at brake switch (crossed wires).
CAR LOSES EXCESSIVE SPEED ON HILLS	(1) Excessive slack in servo chain. (2) Lack of engine manifold vacuum.	(1) Refer to Adjustments. (2) Move vacuum source to center of intake manifold.

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### Release Circuit Test

The release circuit is part of the stoplamp circuit. To check the stoplamp circuit, observe the stoplamps. Stoplamps should light when brake pedal is depressed one-quarter inch or more.

**NOTE:** *If the Cruise Command is to disengage when brakes are applied, the stoplamp circuit must not be shorted to ground. Correct any stoplamp problem before proceeding. Check for burned out bulbs, improper ground connections, open or grounded circuits in the brake release switch or wire harness.*

- (1) Check all harness connections for proper fit.
- (2) Disconnect three-wire connector at regulator.
- (3) Connect one side of test lamp to ground and other to blue wire. Test lamp should not light. If test lamp lights, Cruise Command wire is connected to wrong side of stoplamp switch.
- (4) Press brake pedal 1/4 inch. Test lamp should light. If test lamp does not light, check power source fuse, stoplamp switch, and wire harness to regulator to locate problem.

### Automatic Speed Control Relay Test

The automatic speed control relay is located close to the fuse panel under the instrument panel.

**NOTE:** *Check all connections prior to testing.*

- (1) Turn ignition switch and slide switch to ON position.
- (2) Using test lamp, ground one lead and touch other lead to each individual connector at relay. Test lamp should light at every wire except ground wire. If test lamp does not light on red but lights on white and violet connectors, replace relay. If test lamp does not light on white and violet wires, check power source, fuse and wire harness.

### ADJUSTMENTS

#### Bellows Chain Linkage Adjustment

**NOTE:** *Before adjusting the bellows chain, the carburetor throttle must be at idle position, ignition off and choke valve fully open.*



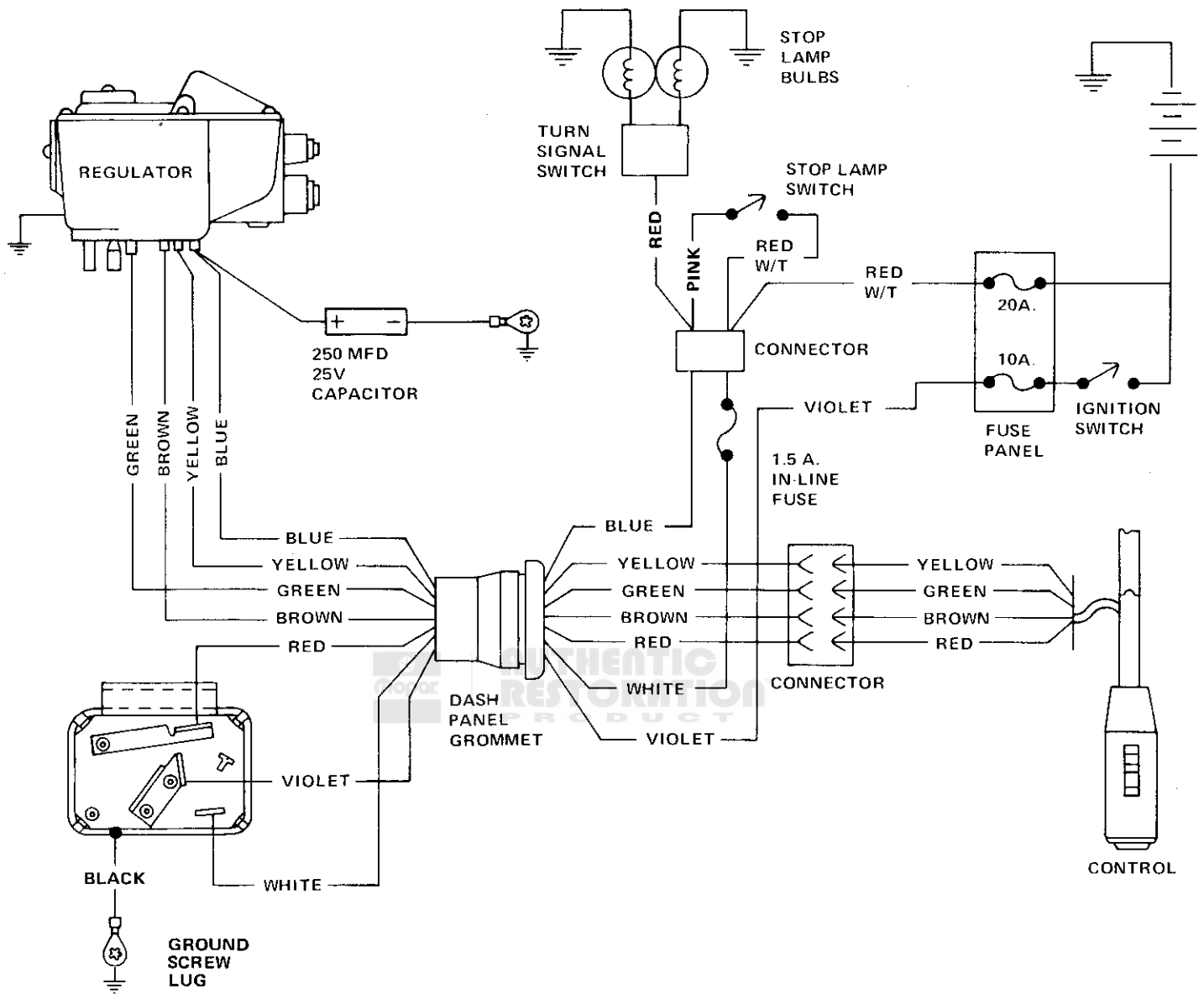


Fig. 1H-10 Cruise Command Schematic

Check to be sure the bellows bracket screws are tight. Adjust the chain at the bellows hook, one bead at a time, until a free pin fit is obtained at the accelerator lever. When properly adjusted, there should be a slight deflection in the chain without moving either the throttle lever or bellows.

After the chain has been properly adjusted, bend the bellows hook tabs together. The chain must be free in the hook after bending the tabs.

Do not use any type of lubrication on the chain guide and pulley assembly.

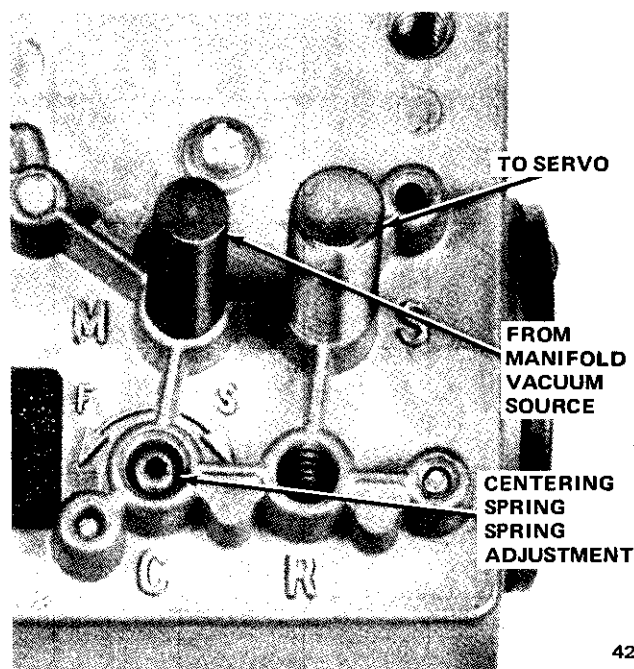
**Centering Spring Adjustment**

**NOTE:** The centering spring adjustment is extremely sensitive and must never be turned more than one-eighth turn in either direction.

Adjustment is made by turning the centering spring adjustment screw.

If speed control engages at two or more mph higher than selected speed, turn centering spring adjusting screw "C" toward "S" 1/32 inch or less. If engagement speed is any amount below selected speed, turn centering spring adjusting screw toward "F" 1/32 inch or less (fig. 1H-11).

**NOTE:** The centering spring is adjusted ideally when the speed remains steady or increases very slightly when engaged. The centering spring adjustment has no affect on maintaining speed unless the centering spring is completely out of adjustment.



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Fig. 1H-11 Centering Spring Adjustment

## REGULATOR REPLACEMENT

- (1) Disconnect driven hex cable from regulator.
- (2) Disconnect knurled drive cable from regulator.
- (3) Disconnect hoses and electrical connectors.
- (4) Remove regulator and relay.
- (5) Install regulator, relay and ground connector.
- (6) Attach hoses and electrical connectors.
- (7) Connect knurled drive cable.
- (8) Connect driven hex cable.

## RELAY REPLACEMENT

- (1) Disconnect wires at relay.
- (2) Remove relay.
- (3) Install relay.
- (4) Connect wires to relay.

## BELLOWS REPLACEMENT

- (1) Disconnect vacuum hose from bellows.
- (2) Count number of beads outside bellows tabs. Disconnect chain from bellows.
- (3) Remove bellows.
- (4) Install replacement bellows.
- (5) Connect chain, allowing number of beads outside tabs as counted in step 2. Crimp tabs.
- (6) Connect vacuum hose.

## BELLOWS CHAIN REPLACEMENT

- (1) Count number of chain beads outside bellows tabs.
- (2) Open tabs on bellows.
- (3) Disconnect chain from throttle lever. Remove chain and compare length to replacement chain.

- (4) Install chain to bellows, allowing number of beads outside tabs as counted in step 1. Crimp tabs.
- (5) Install chain to throttle lever.

## CONTROL SWITCH REPLACEMENT

The Cruise Command control switch is part of the turn signal lever. The switch is not repairable. The switch and harness are serviced only as a unit.

### Removal

- (1) Remove the following:
  - Horn button insert
  - Steering wheel
  - Anti-theft cover
  - Locking plate and horn contact
- (2) Remove turn signal lever (allow handle to hang loose outside steering column).
- (3) Remove four-way flasher knob.
- (4) Remove holddown screws and turn signal switch.
- (5) Remove trim piece from under steering column.
- (6) Disconnect four-wire connector.
- (7) *Tilt Column*—Remove harness from plastic connector. Tape two of four wires back along harness (to allow a smaller diameter) and tape string to harness.
- (8) *Standard Column*—Tie or tape string to plastic connector.
- (9) Remove lever and harness assembly from column.

### Installation

- (1) Check replacement Cruise Command control switch by connecting to wire harness before installing in steering column. Refer to Control Switch Continuity Test.

**NOTE:** When installing the harness, be sure to feed the harness through the turn signal lever opening as the handle will not fit through the opening.

- (2) Tape two of four leads back along harness. Tape harness to string that was attached to original harness before removal.
- (3) Pull replacement harness down through steering column. On tilt column, harness must pass through hole on left side of steering shaft.

**NOTE:** It may be necessary to loosen steering column mounting screws for easier routing of harness.

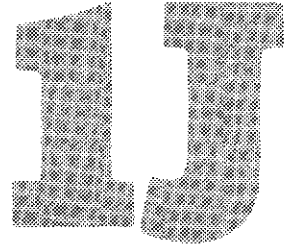
- (4) Install turn signal switch and four-way flasher knob.
- (5) Install Cruise Command lever.
- (6) Install horn contact, locking plate and locking anti-theft cover.
- (7) Install steering wheel and horn button insert.
- (8) Install trim on steering column.

## NOTES



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PRODUCT**

# FUEL SYSTEMS



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Carburetor Model 2100—2 Venturi	1J-20	Thermostatically Controlled Air Cleaner (TAC) System	1J-43
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## GENERAL INFORMATION

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Fuel Filter	1J-2	Fuel Tank	1J-2
Fuel Gauge	1J-7	Specifications	1J-9
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### AIR CLEANER

The replaceable element (paper-type) is used as standard equipment (fig. 1J-1). A polyurethane wrap is available for the paper element for heavy-duty use (fig. 1J-2).

The air cleaner is necessary to protect the fuel system as well as the working parts of the engine from the abrasive and clogging effects of dust, dirt and sediment normally present in the combustion air supply.

The lower portion of the air cleaner is designed to reduce the noise emitted by air rushing through the carburetor to the intake system. The air cleaner also acts as a flame arrester in the event of a backfire through the carburetor.

Replace the air cleaner element at the intervals listed in the Maintenance Schedule. More frequent replacement is advisable when the vehicle is operated in dusty areas or on unpaved roads.

The air cleaner inlet neck contains the air valve for the Thermostatically Controlled Air Cleaner (TAC) System. The operation and diagnosis of this system are covered under Thermostatically Controlled Air Cleaner at the end of this chapter.

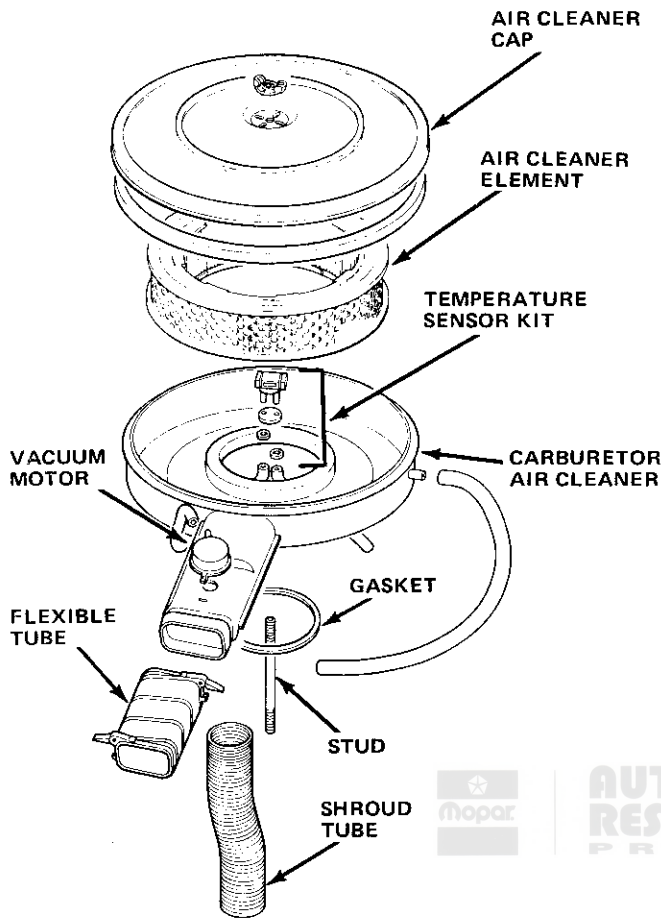
### Service

To clean the paper cartridge, shake out accumulated dirt—DO NOT WASH. Use compressed air to carefully blow through the element from the inside toward the outside, opposite the direction of normal airflow.

Replace the air cleaner paper cartridge more frequently than specified in the Maintenance Schedule if there is any apparent damage or evidence of plugging. At the same time, inspect the polyurethane element and replace it if torn or otherwise damaged.

To clean the optional polyurethane element, carefully remove it from the paper cartridge and wash it in water and detergent. Wrap the element in a clean, dry cloth and squeeze to remove all possible water. Do not wring the element as it may tear.

After cleaning, oil the polyurethane element liberally with engine oil (SAE 10W-30) and squeeze to evenly distribute the oil through the element and to remove excess oil. The element should be slightly dampened with oil. Install the polyurethane element on the paper cartridge with the edges of the polyurethane element over the plastic end plates of the paper cartridge.



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Fig. 1J-1 Carburetor Air Cleaner—Typical

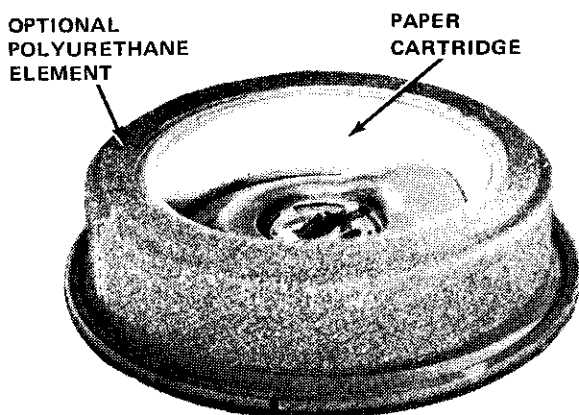


Fig. 1J-2 Optional Polyurethane Air Cleaner Element

## FUEL FILTERS

All carburetors are protected against the entry of dirt and other foreign matter through the fuel inlet by a replaceable 15-micron, pleated paper filter located in the carburetor fuel inlet line and secured by two short rubber hoses and clamps. Replace the filter at the intervals outlined in the Maintenance Schedule.

All vehicles have a fuel return system which requires an extra nipple on the fuel filter to route vapor back to the fuel tank. Refer to Fuel Return System.

All vehicles use a woven Saran sleeve-type filter which is attached to the end of the fuel outlet tube inside the fuel tank. This filter is rated at 65 microns and repels water. Under normal conditions it requires no maintenance or service.

## FUEL TANK

The fuel tank on CJ models is attached to a skid plate which is bolted to the chassis. On Cherokee and Wagoneer models, the tank is secured to the chassis by a single strap at the center, a bracket at the rear, and a bracket at the front. The Truck models have two straps which run front to rear. A fuel tank skid plate is optional on Cherokee, Wagoneer and Truck models. The various fuel tank and venting arrangements are illustrated in figures 1J-3, 1J-4 and 1J-5.

The fuel tank is an external expansion type and is vented by vapor lines. On CJ models, vapors are routed to a charcoal canister. Refer to Fuel Vapor Control System. On Cherokee, Wagoneer and Truck models, vapors are routed through a rollover check valve and vent to atmosphere. Refer to Fuel Vapor Control System.

## Fuel Tank Replacement

### Removal—CJ Models

- (1) Position jack under tank and remove screws.
- (2) Disconnect fuel outlet and return lines, fuel inlet hose and inlet vent hose.
- (3) Lower tank part way and disconnect vent lines.
- (4) Disconnect fuel gauge sending unit wire, lower tank and remove.

### Installation—CJ Models

- (1) Position tank on jack and raise part way.
- (2) Install fuel line, return line, fuel gauge sending unit wire and vent lines.
- (3) Raise tank to installed position, install screws and tighten.
- (4) Install fuel inlet hose and inlet vent hose.

### Removal—Cherokee and Wagoneer Models

- (1) Remove parking brake cable guide clips.
- (2) Remove skid plate, if equipped.
- (3) Disconnect one brake cable at connector.
- (4) Disconnect four lines at left rear of tank.
- (5) Place jack under tank and remove attaching parts.
- (6) Lower tank and disconnect fuel gauge sending unit wire, fuel outlet line and return line.

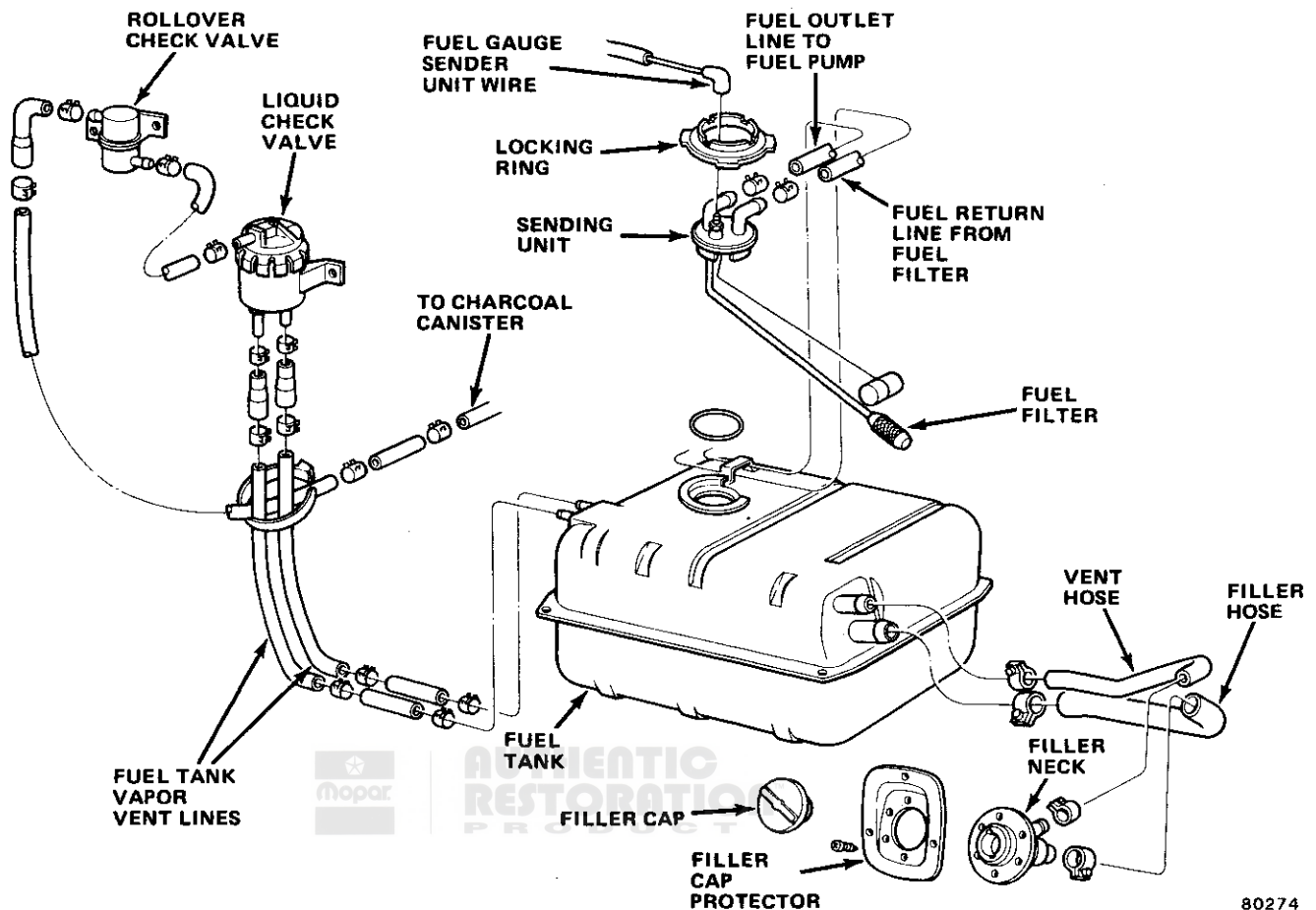


Fig. 1J-3 Fuel Tank and Vent Lines—CJ-5 and CJ-7 Models

**Installation—Cherokee and Wagoneer Models**

- (1) Place tank on jack. Connect fuel gauge sending unit wire, fuel outlet line and return line.
- (2) Raise tank into place. Install attaching parts.
- (3) Connect four lines at rear of tank
- (4) Install skid plate, if removed.
- (5) Connect parking brake cable.

**Removal—Truck Models**

- (1) Remove skid plate, if equipped.
- (2) Disconnect fuel inlet hose, inlet vent hose and vapor vent hoses at forward left corner.
- (3) Place jack under tank.
- (4) Loosen straps and lower tank.
- (5) Disconnect fuel gauge sending unit wire, fuel outlet line and fuel return line.
- (6) Remove tank.

**Installation—Truck Models**

- (1) Install replacement clamps on vent lines and fuel outlet and return lines.
- (2) Position tank on jack.

- (3) Connect outlet and return lines and sending unit wire.

- (4) Raise tank and install straps.
- (5) Connect four hoses at left front corner of tank.
- (6) Install skid plate, if removed.

**Fuel Tank Sending Unit**

This assembly utilizes a float pivoted to a variable resistance element.

On CJ and Truck models, fuel pickup and fuel return system nipples and the sending wire connection are mounted on the sending unit mounting cover which is secured to the fuel tank with a locking ring. On Cherokee and Wagoneer models, the fuel pickup and return nipples are mounted on a separate cover.

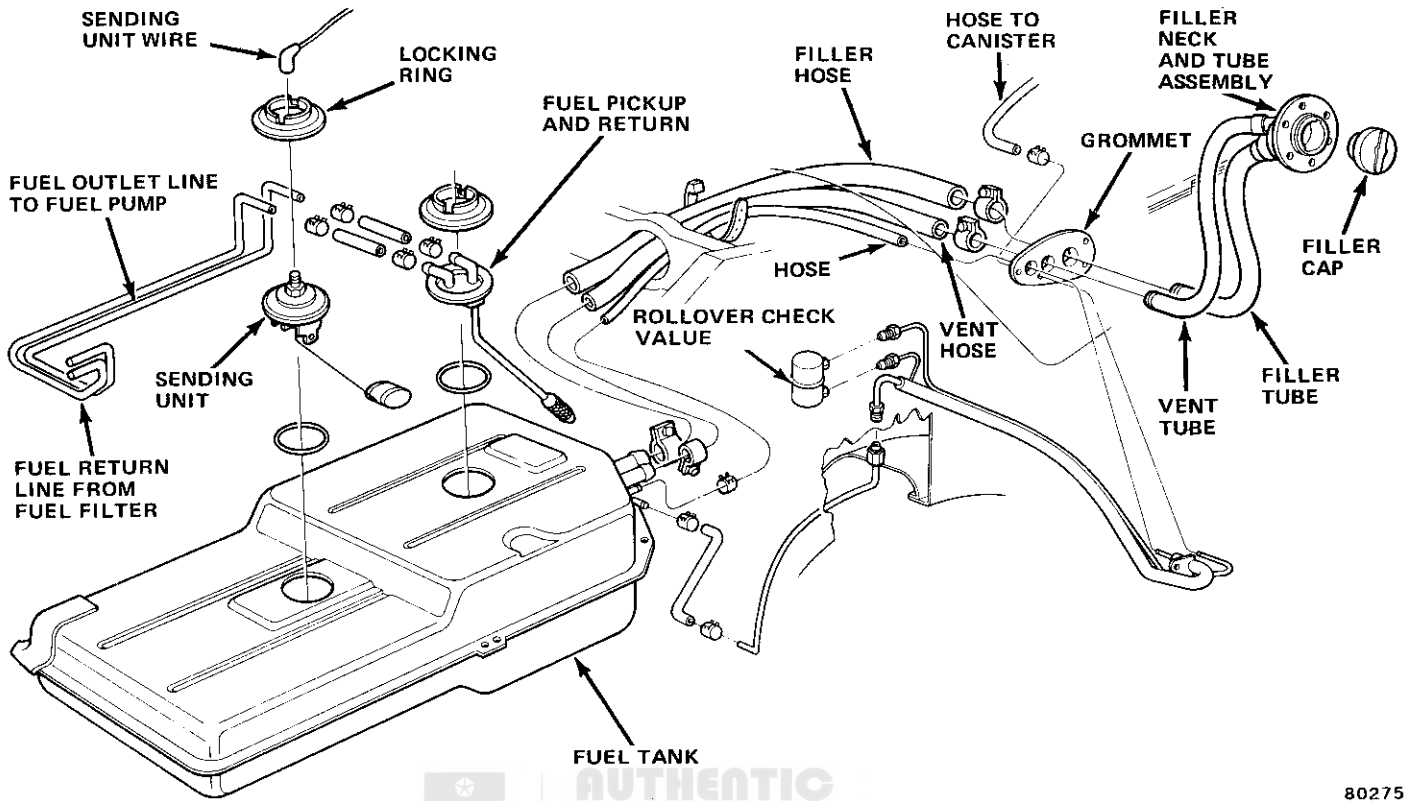
To replace the fuel sending unit, remove the fuel tank.

**Fuel Tank Filler Neck**

The fuel filler neck on all models has been designed to provide for vapor control during fill-up and improved fill rate.

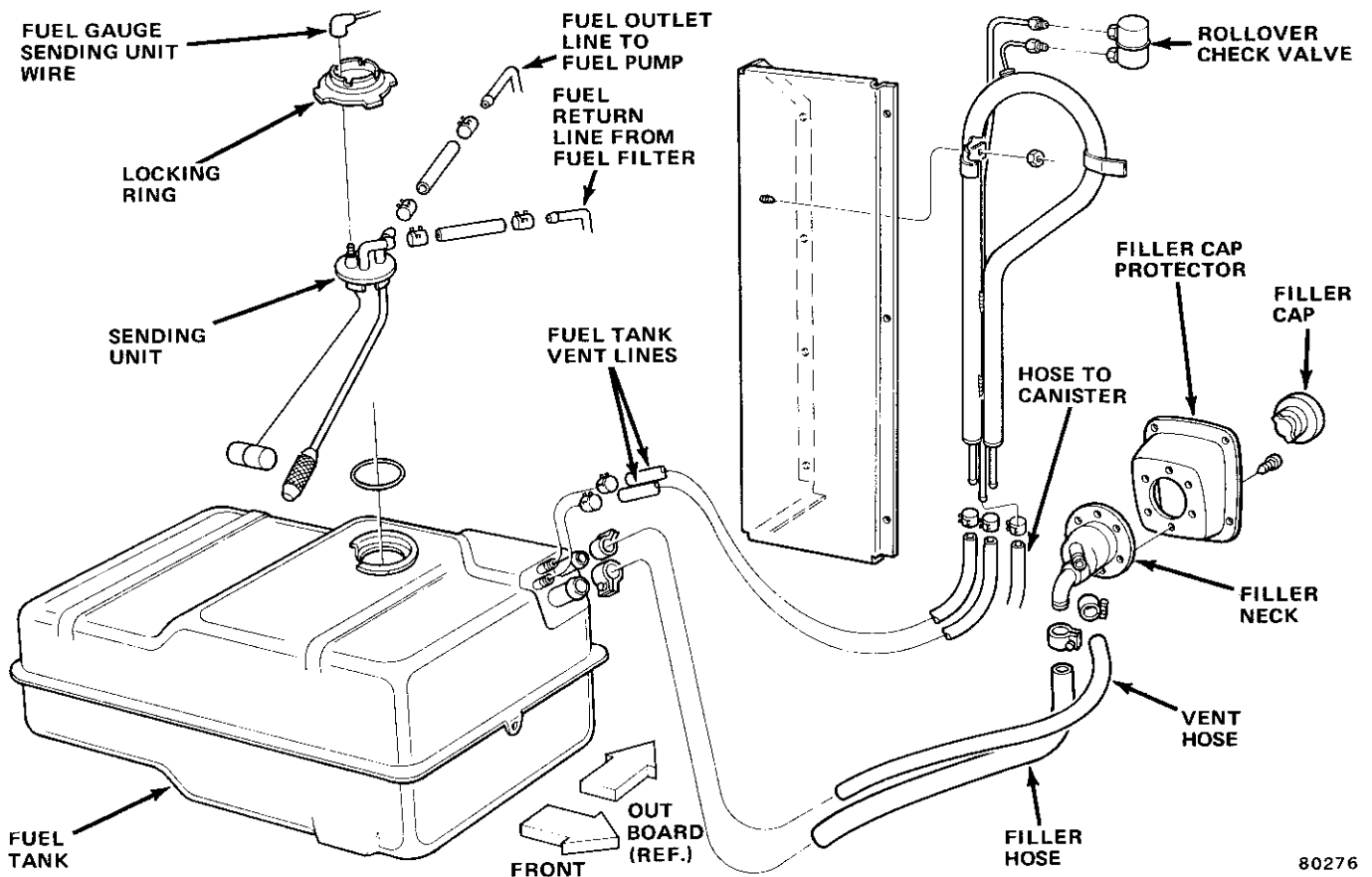
The filler neck of all models incorporates a restrictor to prevent entry of nozzles used on leaded fuel gasoline

**1J-4 FUEL SYSTEMS**



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**Fig. 1J-4 Fuel Tank and Vent Lines—Cherokee and Wagoneer Models**



80276

**Fig. 1J-5 Fuel Tank and Vent Lines—Truck Models**

station pumps. The restrictor reduces the size of the filler neck to a small opening which is covered by a trap door. The small diameter unleaded fuel pump nozzle can pass through the restrictor opening and push open the restrictor trap door, allowing the fuel tank to be refilled. In this way, the catalytic converter is protected from contamination by leaded fuel.

The filler neck opening is located on the right rear body panel on CJ-5 and CJ-7 models. On Cherokee and Wagoneer models, the filler neck opening is located on the left rear quarter panel. On Truck models, it is located on the left side of the pickup box.

The filler neck is connected to the fuel tank inlet by a hose secured with clamps.

All fuel tanks are equipped with a vent hose which extends from a fitting at the top of the tank to the filler neck. This vent relieves the air displaced as the tank is filled.

### Fuel Tank Filler Cap

The filler cap incorporates a two-way relief valve which is closed to atmosphere under normal operating conditions. The relief valve is calibrated to open only when a pressure of 0.75 to 1.5 psi (5 to 10 kPa) or a vacuum of 1.1 to 1.8 inches of Hg (4 to 6 kPa) occurs within the tank. When the pressure or vacuum is relieved, the valve returns to the normally closed position.

### FUEL VAPOR CONTROL SYSTEM

The fuel vapor control system prevents raw fuel vapors from escaping into the atmosphere. Fuel vapors from the fuel tank and carburetor bowl are collected in a charcoal-filled canister and are metered into the intake manifold for combustion. On all vehicles, a rollover valve in the vent system prevents fuel from flowing out of the vent lines if the vehicle is accidentally rolled over. The various components, shown in figure 1J-6, are described below.

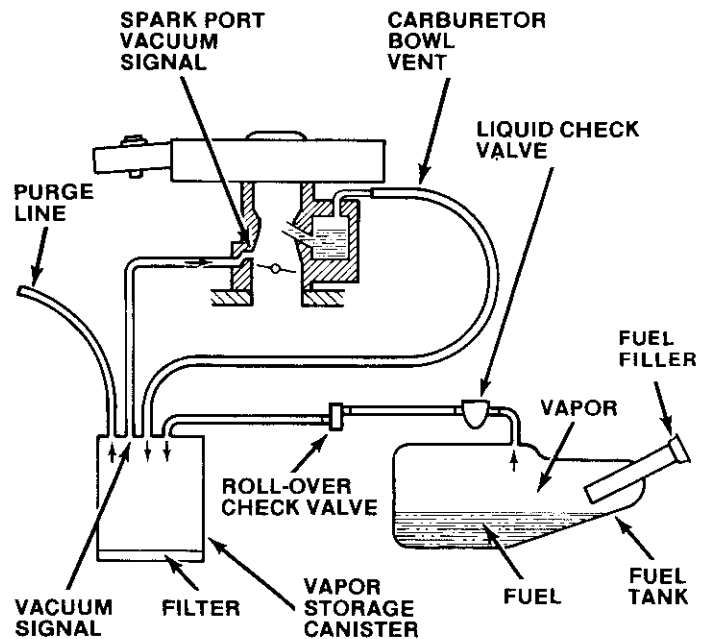
### Components

#### Charcoal Canister

This component is used on all models. The charcoal canister is filled with granules of activated charcoal. Vapors entering the canister are adsorbed onto the surface of the granules.

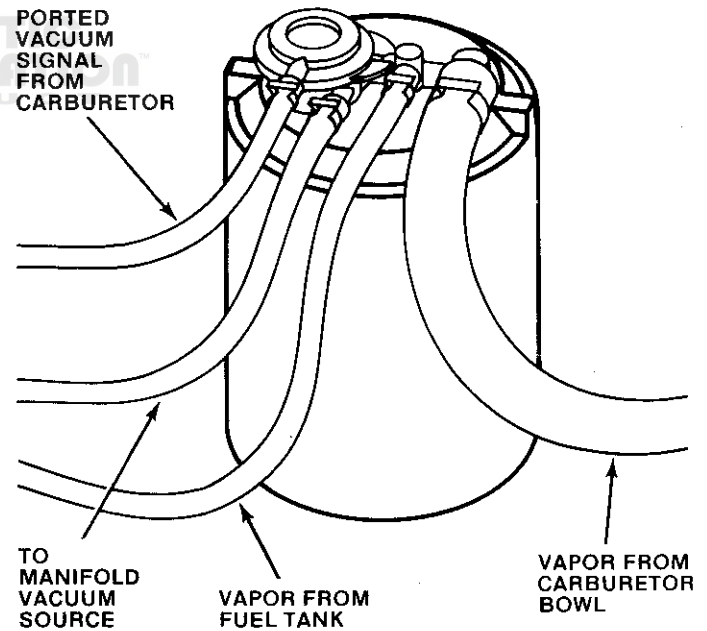
The canister has a staged dual purge feature (fig. 1J-7). Two inlets are provided, one for tank vapor and one for carburetor bowl vapor. The outlet is connected to intake manifold vacuum. The fourth nipple is connected to the carburetor spark port (ported vacuum).

When the engine is running, manifold vacuum draws fresh air through the inlet filter in the bottom of the canister and purges stored vapors. When ported vacuum reaches 12 inches Hg (41 kPa), the secondary purge



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Fig. 1J-6 Fuel Vapor Control System—Typical



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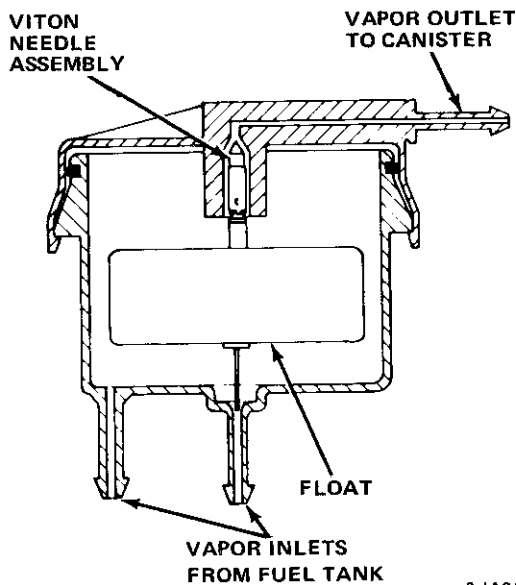
Fig. 1J-7 Charcoal Canister and Hoses

circuit is opened, and the canister is purged at a much higher rate.

#### Liquid Check Valve

This component is used on CJ models. The liquid check valve permits free passage of vapors, but prevents liquid fuel from reaching the charcoal canister. If liquid enters the check valve, the float rises, forcing the needle into its seat (fig. 1J-8).



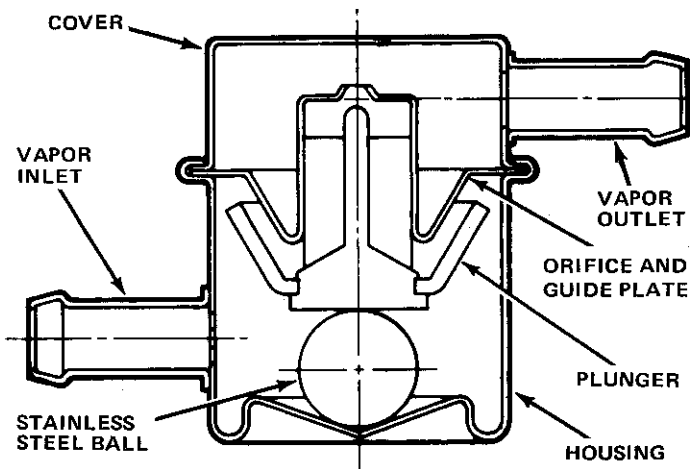


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Fig. 1J-8 Liquid Check Valve—Typical

**Rollover Check Valve**

This component is used on all Jeep vehicles. The rollover check valve prevents fuel flow from the fuel tank through the fuel line in the event of vehicle rollover. The check valve consists of a plunger and a stainless steel ball (fig. 1J-9). When inverted, the stainless steel ball pushes the plunger against its seat. A properly functioning rollover valve will hold 3 psi (21 kPa) of air pressure on the inlet side when inverted.



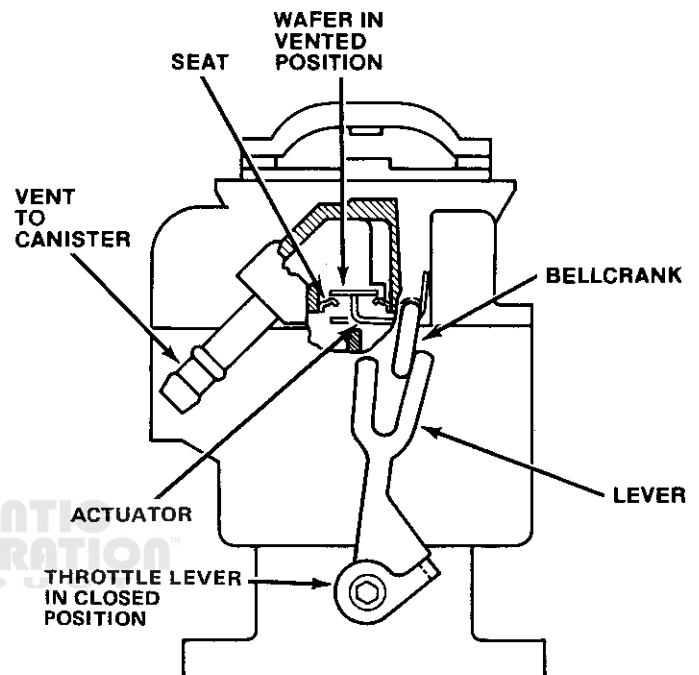
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Fig. 1J-9 Rollover Check Valve

**Carburetor Mechanical Bowl Vent**

This component is used on all models. The carburetor external bowl vent provides an outlet for fuel vapors when the engine is not running (fig. 1J-10). If the vent were not provided, raw fuel vapors would enter the

atmosphere. Some would also enter the intake manifold, making hot restarts difficult. When the engine is running, the fuel bowl must be vented to the inside of the air cleaner for proper fuel flow. This is accomplished by automatically closing the bowl vent by a mechanical link to the throttle. Refer to Float Circuit in each carburetor subsection for specific operating principles.



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Fig. 1J-10 Bowl Vapor Vent—Typical

**FUEL RETURN SYSTEM**

All models use a fuel return system to reduce the possibility of high temperature fuel vapor problems. The fuel return system consists of a special fuel filter and a return line to the fuel tank (fig. 1J-11).

The special fuel filter has an outlet nipple connected to the fuel return line. The fuel return line is routed to the fuel tank, where it attaches to a nipple on the fuel tank sending unit. During normal operation, a small portion of fuel is returned to the tank. During periods of high underhood temperatures, vaporized fuel is returned to the tank and not passed through the carburetor.

The return line nipple on the fuel filter should be positioned upward to ensure proper fuel system operation.

Some engine/carburetor combinations are equipped with a check valve in the fuel return system at the fuel filter. The valve eliminates any possibility of fuel feeding back to the carburetor through the fuel return line.

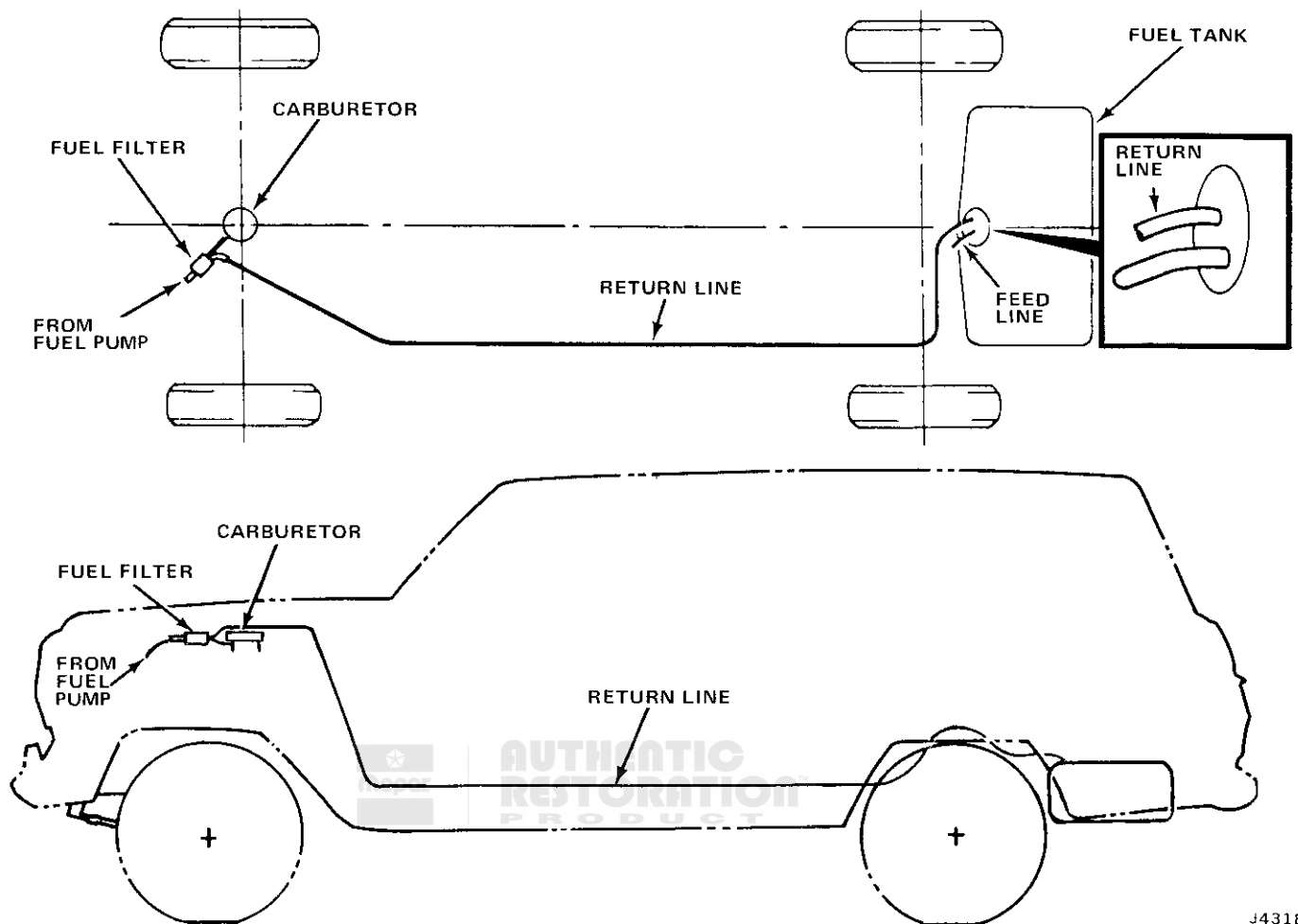


Fig. 1J-11 Fuel Vapor Return System—Typical

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The check valve uses a stainless steel, spring-assisted check ball to close the orifice (fig. 1J-12). It is mounted in the fuel return line at the fuel filter and is secured by a clamp. Pressure of from 0.1 to 0.6 psi (.68 to 4.13 kPa) at the fuel filter side opens the check valve and permits normal operation of the fuel return system.

The check valve is marked with an arrow in the direction of flow. If it is reversed, the fuel return system will not operate.

### FUEL GAUGE

Refer to Chapter 1L—Power Plant Instrumentation for Operation, Diagnosis and Replacement. Service of the sending unit is covered under Fuel Tank in this chapter.

### FUEL PUMP

A single-action, stamped fuel pump is used for all engine applications.

The fuel pump consists of an actuating lever, a diaphragm and spring, an inlet valve and an outlet valve (fig. 1J-13). An eccentric on the engine camshaft oper-

ates the fuel pump lever which is linked to the pump diaphragm. The lever pulls the diaphragm to its extended position, drawing fuel through the inlet valve. Spring pressure pushes the diaphragm toward its relaxed position, forcing fuel out through the outlet valve.

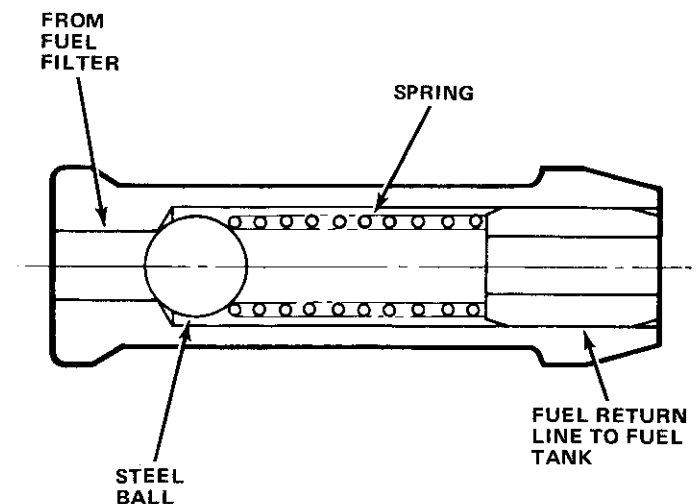


Fig. 1J-12 In-Line Check Valve

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## 1J-8 FUEL SYSTEMS

When the carburetor float needle valve closes, fuel pump output is limited to the amount that bleeds back to the fuel tank through the fuel return line. The fuel accumulated in the fuel pump chamber prevents the diaphragm from relaxing. The actuating lever continues to rock up and down, but is prevented from operating the diaphragm, which is held in its extended position by fuel pressure. Fuel flow from the pump remains halted until excess pressure bleeds through the return line or the carburetor needle opens. This process continues as long as the engine is running.

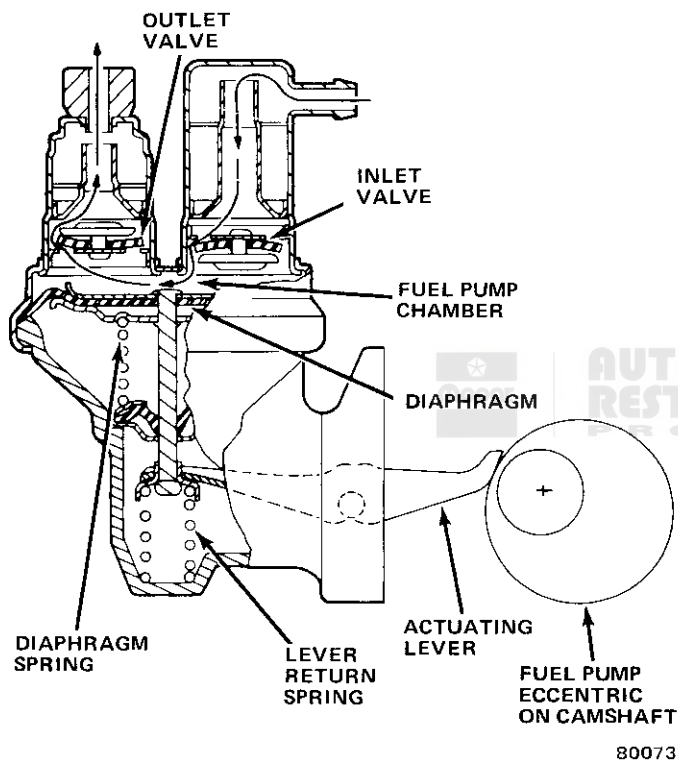


Fig. 1J-13 Fuel Pump

Fuel pumps cannot be overhauled. Replace a fuel pump that fails the following tests.

**NOTE:** Make sure the in-line fuel filter is not clogged before performing tests.

### Pressure Test

- (1) Remove air cleaner assembly.
- (2) Disconnect fuel inlet line or fuel filter at carburetor.
- (3) Disconnect fuel return line at fuel filter and plug nipple on filter.

**NOTE:** Use care to prevent combustion due to fuel spillage.

- (4) Connect pressure gauge, restrictor and flexible hose between fuel filter and carburetor (fig. 1J-14).

- (5) Position flexible hose and restrictor so fuel can be discharged into suitable graduated container.

- (6) Operate engine at curb idle rpm and vent system into container by momentarily opening hose restrictor.

- (7) Close hose restrictor, allow pressure to stabilize, and note gauge reading. Gauge should indicate 4 to 5 psi (28 to 34 kPa) for six-cylinder engines, and 5 to 6.5 psi (34 to 45 kPa) for eight-cylinder engines.

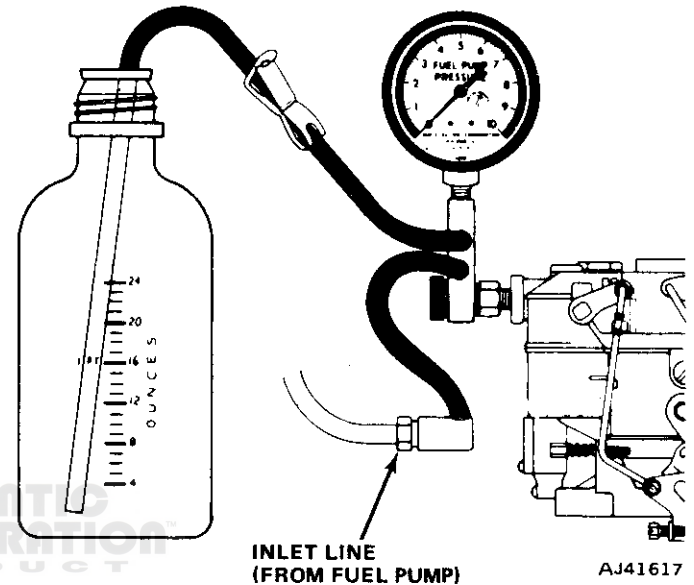


Fig. 1J-14 Fuel Pump Pressure Test

If the pump pressure is not within specification and the fuel lines and filter are in satisfactory condition, the pump is defective and should be replaced. If the pump pressure is within specifications, perform the capacity and vacuum tests.

### Capacity (Volume) Test

If fuel pump pressure is within specification, test the capacity (volume) as follows:

- (1) Operate engine at curb idle rpm.
- (2) Open hose restrictor and allow fuel to discharge into graduated container for 30 seconds, then close restrictor.

At least one pint (.47 liters) of fuel should have been discharged. If pump volume is less than one pint, (.47 liters) repeat test using an auxiliary fuel supply and a replacement fuel filter. If the pump volume meets specification while using the auxiliary fuel supply, check for a restriction in the fuel supply from the tank and for proper tank venting.

### Vacuum Tests

Two vacuum tests may be performed on the fuel pump. In the direct connection test, the vacuum test gauge is connected directly to the fuel pump inlet. This tests the pump's ability to create a vacuum. In the in-

direct connection test, a vacuum gauge is connected by a T-fitting into the pump inlet line. This test checks for obstruction in the fuel line or the in-tank fuel filter.

**Direct Connection Test**

- (1) Disconnect fuel inlet line at fuel pump.
- (2) Connect vacuum gauge to fuel pump inlet.
- (3) Operate engine at curb idle rpm and note vacuum gauge reading. Gauge should indicate a vacuum of ten inches of mercury (10 Hg) (34 kPa). If the pump vacuum reading is not within specification, the pump is defective and should be replaced.

**NOTE:** Vacuum gauge will not register a reading until fuel in carburetor float bowl has been used and pump begins to operate at full capacity.

**Indirect Connection Test**

- (1) Disconnect fuel inlet line at fuel pump.
- (2) Install T-fitting between disconnected line and fuel pump. Attach vacuum gauge to T-fitting.
- (3) Operate engine at 1500 rpm for 30 seconds. Vacuum should not exceed 2 inches of mercury (7 kPa).
- (4) If vacuum exceeds 2 inches of mercury (7 kPa) check fuel line for blockage. A partially clogged in-tank fuel filter may also be the cause.

**NOTE:** Vacuum gauge will not register a reading until fuel in carburetor float bowl has been used and pump begins to operate at full capacity.

**Fuel Pump Replacement**

**Removal**

- (1) Disconnect fuel lines from fuel pump.
- (2) Remove retaining screws.
- (3) Remove pump and gasket.

**Installation**

- (1) Install pump and replacement gasket.

**NOTE:** Be sure actuating lever is positioned properly on camshaft eccentric.

- (2) Install retaining screws.
- (3) Connect fuel lines to fuel pump.

**FUEL ECONOMY TESTS**

When checking fuel economy, connect the testing device between the fuel filter and the carburetor because of the fuel return system. Do not block off the fuel return line as this may affect miles-per-gallon reading.

**SPECIFICATIONS**

**Fuel Pump Specifications**

	Volume (30 seconds)	Pressure (PSI)	Vacuum (Hg)	
			Direct	Indirect
Six-Cylinder	1 pint (.47 liters)	4 to 5 (28 to 34 KPa)	10 (34 KPa)	3 (7 KPa)
Eight-Cylinder	1 pint (.47 liters)	5 to 6.5 (34 to 45 KPa)	10 (34 KPa)	3 (7 KPa)

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**Fuel Tank Capacity**

Model	Gallons
CJ	14.8 (56.0 liters)
Cherokee Wagoneer	21.5 (81.4 liters)
Truck	18.2 (68.9 liters)

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# CARBURETOR MODEL BBD-2 VENTURI

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**GENERAL**

The Carter Model BBD two-venturi carburetor incorporates three lightweight aluminum assemblies, the air horn, main body and throttle body (fig. 1J-15).

The air horn contains the choke valve assembly, mechanical linkage for accelerator pump and metering rods, and bowl vent.

The main body contains fuel bowl, accelerator pump, vacuum piston and metering rod assembly, venturi assembly and solenoid, if equipped.

## 1J-10 FUEL SYSTEMS

The throttle body contains throttle valves and levers, choke housing, choke vacuum diaphragm and idle mixture screws.

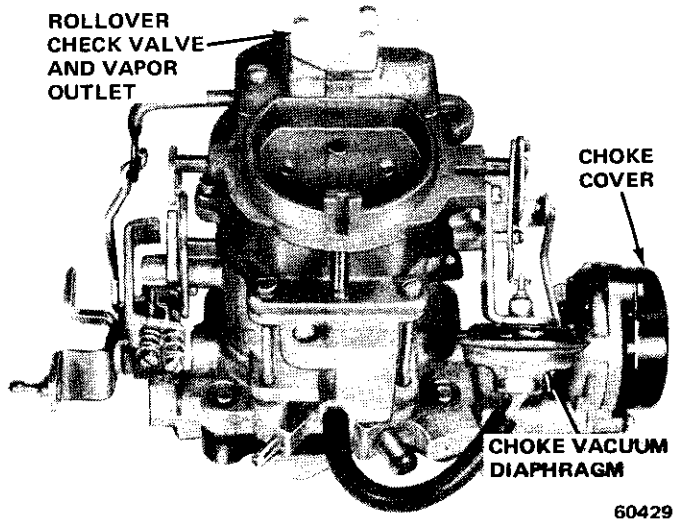


Fig. 1J-15 Model BBD Carburetor Assembly

### Identification

The carburetor is identified by a code number and build date which is stamped on the identification tag. Each carburetor build month is coded alphabetically beginning with the letter A in January and ending with the letter M in December (the letter I is not used). The tag is attached to the carburetor and must remain with the carburetor to assure proper identification (fig. 1J-16).

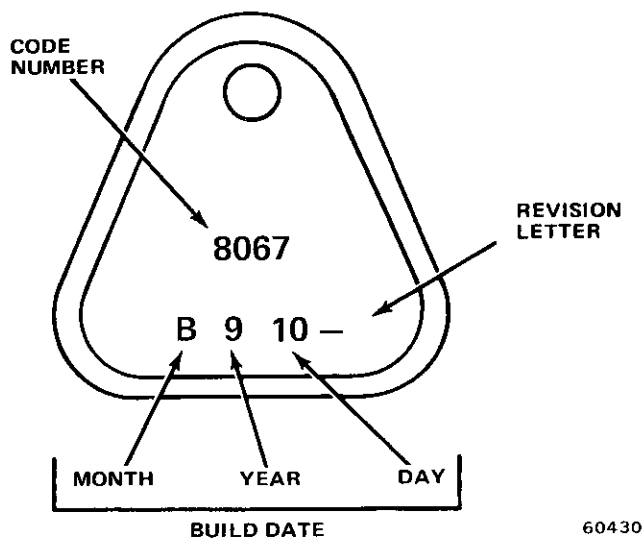


Fig. 1J-16 Identification Tag

### CARBURETOR CIRCUITS

Five conventional circuits are used: Float (Fuel Inlet) Circuit, Idle (Low Speed Circuit), Main (High Speed) Circuit, Pump Circuit and Choke Circuit.

### Float (Fuel Inlet) Circuit

The float circuit maintains the specified fuel level in the bowl to provide sufficient fuel to metering circuits for all engine operating conditions (fig. 1J-17).

Fuel flows into the bowl through a needle and seat assembly controlled directly by dual floats hinged to the float fulcrum pin.

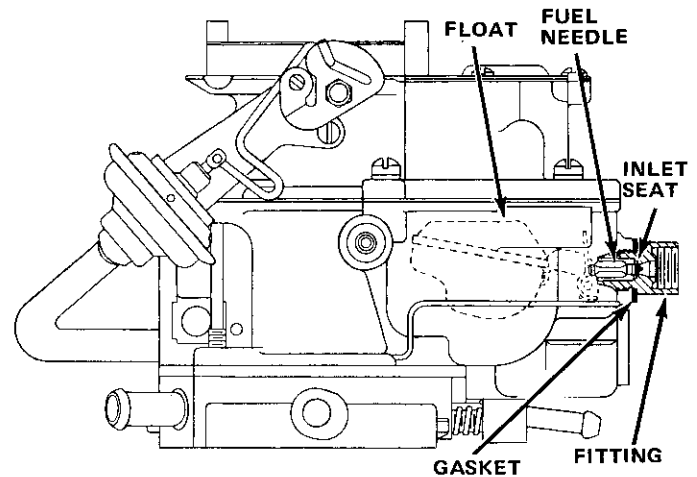


Fig. 1J-17 Float Circuit

When the fuel in the bowl fills to the proper level, the float lever pushes the needle toward its seat and restricts incoming fuel, admitting only enough to replace that being used.

### Idle (Low Speed) Circuit

Fuel for idle and early part-throttle operation is metered through the idle circuit.

Fuel flows through main metering jets into the main wells and continues through the idle fuel pickup tube where fuel mixes with air entering through idle air bleeds located in the venturi cluster screws (fig. 1J-18).

At curb idle, this fuel-air mixture flows down the idle channel and is further mixed with air entering the idle channel through the transfer slot which is above the position of the throttle valve at curb idle. The mixture then passes the idle mixture adjustment screw which controls the volume of mixture discharged below the throttle valve.

During low speed operation, the throttle valve moves to expose the transfer slot as well as the idle port. This increased airflow creates a low pressure in the venturi and the main metering system begins to discharge fuel.

### Main (High Speed) Metering Circuit

At part throttle and cruising speed, increased airflow through the venturi creates a low pressure area in the venturi. Since air above the fuel level in the bowl is at

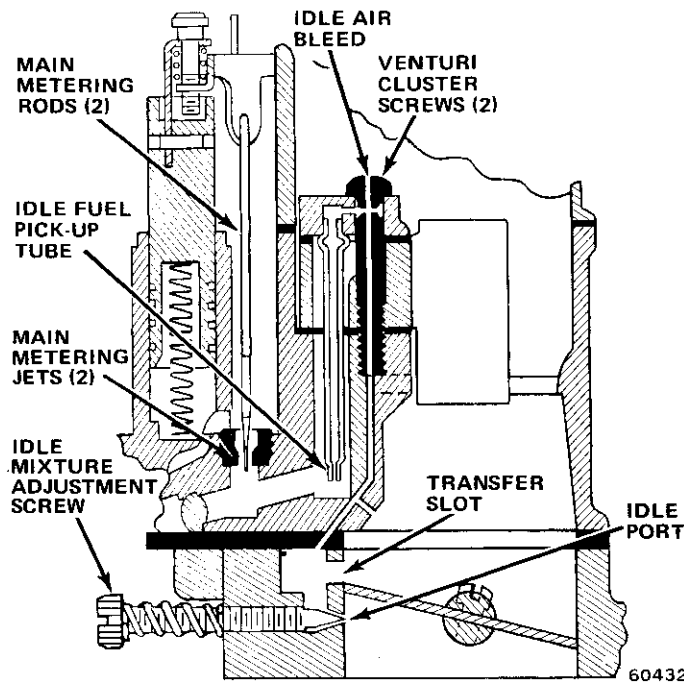


Fig. 1J-18 Idle Circuit

normal pressure, fuel flows to the lower pressure area created by the venturi and magnified by the booster venturi.

The fuel flow moves through the main jets to the main well. Air enters through the main well air bleeds. The resulting mixture of fuel and air is lighter than raw fuel, responds more quickly to changes in venturi vacuum, and is more readily vaporized when discharged into the venturi (fig. 1J-19).

**Power Enrichment Circuit**

During heavy road load or high speed operation, the fuel-air ratio must be enriched to provide increased engine power.

Power enrichment is accomplished by means of two calibrated metering rods yoked to a single manifold vacuum actuated piston (fig. 1J-19). The metering rod piston rides on a calibrated spring which attempts to keep the piston at the top of its cylinder. This allows only the smallest diameter of the tapered metering rods to extend into the main metering jets and permits maximum fuel flow through the jets to the main well cavities.

At idle, part throttle or cruise conditions when manifold vacuum is high, the piston is drawn down into the vacuum cylinder against calibrated spring tension and the larger diameters of the metering rods extend into the main metering jets, restricting the fuel flow to the main well cavities. An additional control is provided by the rod lifter on the accelerator pump rod. This provides a direct relationship between metering rod position and throttle valve opening.

**Pump Circuit**

When the throttle is opened suddenly, airflow response through the carburetor is almost immediate.

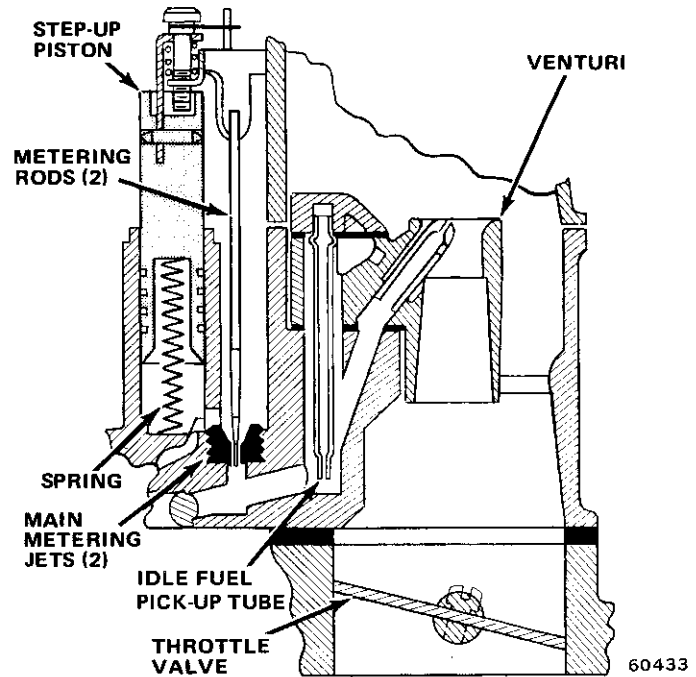


Fig. 1J-19 Main Metering Circuit

There is a brief time lag before fuel inertia can be overcome. This lag causes the desired fuel-air ratio to be leaned out.

A piston-type accelerating pump system mechanically supplies the fuel necessary to overcome this deficiency (fig. 1J-20).

Fuel is drawn into the pump cylinder from the fuel bowl through a port and check ball in the bottom of the pump well below the pump piston. When the engine is turned off, fuel vapors in the pump cylinder vent through the area between the pump rod and pump piston.

As the throttle lever is moved, the pump link, operating through a system of levers and assisted by the pump drive spring, pushes the pump piston down. Fuel is forced through a passage, past the pump discharge check ball, and out the pump discharge jets in the venturi cluster.

**Choke Circuit**

The choke valve, located in the air horn assembly, provides a high vacuum both above and below the throttle valves when closed. During cranking, vacuum above the throttle valve causes fuel to flow from the main metering and idle circuits and provides the richer fuel-air ratio needed for cold engine starting (fig. 1J-21).

The choke shaft is connected by linkage to a thermostatic coil within the choke cover, which winds up when cold and unwinds when heated. When the engine is cold, the tension of the thermostatic coil holds the choke valve closed. When the engine starts, manifold vacuum is applied to the diaphragm assembly to open the choke valve slightly. This is called the initial choke valve clearance.

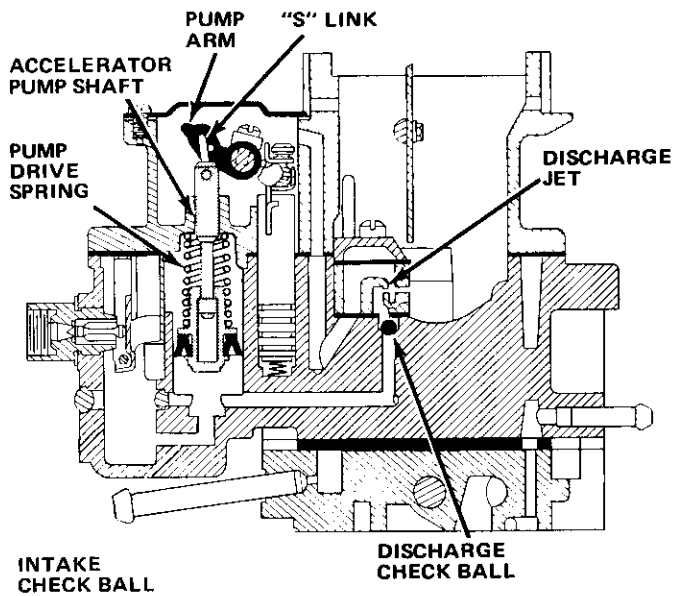


Fig. 1J-20 Pump Circuit

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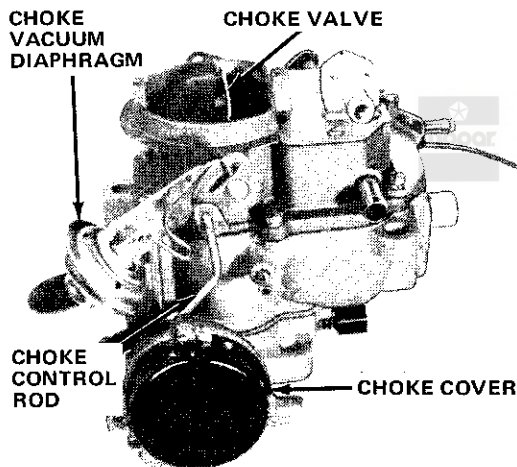


Fig. 1J-21 Choke Components

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As the thermostatic coil is warmed by air rising through the heat tube from the exhaust manifold, the coil expands and exerts pressure to further open the choke valve, keeping it fully open at operating temperature.

If the engine is accelerated during the warm-up period, the corresponding drop in the manifold vacuum allows the thermostatic coil to momentarily close the choke valve to provide a richer mixture.

A faster idle speed is provided to prevent stalling during warm-up. The fast idle cam, actuated by the choke shaft through connecting linkage, rotates into position against the fast idle screw. The cam is progressively stepped to provide correct idle setting in proportion to the choke valve opening. When the choke valve reaches its fully open position, the cam rotates free of the fast idle screw, allowing the throttle lever to return to curb idle position when released.

If the engine floods during starting, the choke valve may be opened to vent excess fuel by depressing the accelerator pedal to the floor and cranking the engine. With the accelerator linkage in this position, a tang on the throttle lever contacts the fast idle cam, causing the choke rod to move upward to open the choke valve a predetermined distance.

## CARBURETOR REPLACEMENT

### Removal

- (1) Remove air cleaner.
- (2) Code all lines attached to carburetor for aid during installation.
- (3) Remove accelerator cable from accelerator lever and disconnect vacuum hoses, return spring, choke clean air tube, PCV hose, fuel line, choke heat tube and solenoid wire, if equipped.
- (4) Remove carburetor retaining nuts. Remove carburetor. Remove carburetor gasket from spacer.

### Installation

(1) Clean gasket mounting surface of spacer. Install replacement gasket on spacer. Position carburetor on spacer and gasket and install nuts. To prevent leakage, distortion or damage to carburetor body flange, alternately tighten nuts in crisscross pattern.

(2) Connect fuel line, throttle cable, choke heat tube, PCV hose, return spring, choke clean air tube, all vacuum hoses and solenoid wire, if equipped.

(3) Adjust engine idle speed, idle fuel mixture and solenoid. Refer to Chapter 1A—General Service and Diagnosis.

(4) Install air cleaner.

## CARBURETOR OVERHAUL

The following procedures apply to complete overhaul with the carburetor removed from the engine.

A complete disassembly is not necessary when performing adjustments. In most cases, service adjustments of individual systems may be completed without removing the carburetor from the engine. Refer to Service Adjustment Procedures.

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection and replacement of all gaskets and worn or damaged parts. It also includes idle adjustment, mixture adjustment and fast idle adjustment after the carburetor is installed. Refer to figure 1J-22 for parts identification.

**NOTE:** When using an overhaul kit, use all parts included in the kit.

**NOTE:** Flooding, stumble on acceleration, and other performance problems are in many instances caused by the presence of dirt, water, or other foreign matter in the carburetor. To aid in diagnosing the problem, carefully remove the carburetor from the engine without removing the fuel from the bowl. Examine the bowl contents for contamination as the carburetor is disassembled.

1. DIAPHRAGM CONNECTOR LINK
2. SCREW
3. CHOKE VACUUM DIAPHRAGM
4. HOSE
5. VALVE
6. METERING ROD
7. S-LINK
8. PUMP ARM
9. GASKET
10. ROLLOVER CHECK VALVE
11. SCREW
12. LOCK
13. ROD LIFTER
14. BRACKET
15. NUT
16. SOLENOID
17. SCREW
18. AIR HORN RETAINING SCREW (SHORT)
19. AIR HORN RETAINING SCREW (LONG)
20. PUMP LEVER
21. VENTURI CLUSTER SCREW
22. IDLE FUEL PICK-UP TUBE
23. GASKET
24. VENTURI CLUSTER
25. GASKET
26. CHECK BALL (SMALL)
27. FLOAT
28. FULCRUM PIN
29. BAFFLE
30. CLIP
31. CHOKE LINK
32. SCREW
33. FAST IDLE CAM
34. GASKET
35. THERMOSTATIC CHOKE SHAFT
36. SPRING
37. SCREW
38. PUMP LINK
39. CLIP
40. GASKET
41. LIMITER CAP
42. SCREW
43. THROTTLE BODY
44. CHOKE HOUSING
45. BAFFLE
46. GASKET
47. RETAINER
48. CHOKE COIL
49. LEVER
50. CHOKE ROD
51. CLIP
52. NEEDLE AND SEAT ASSEMBLY
53. MAIN BODY
54. MAIN METERING JET
55. CHECK BALL (LARGE)
56. ACCELERATOR PUMP PLUNGER
57. FULCRUM PIN RETAINER
58. GASKET
59. SPRING
60. AIR HORN
61. LEVER

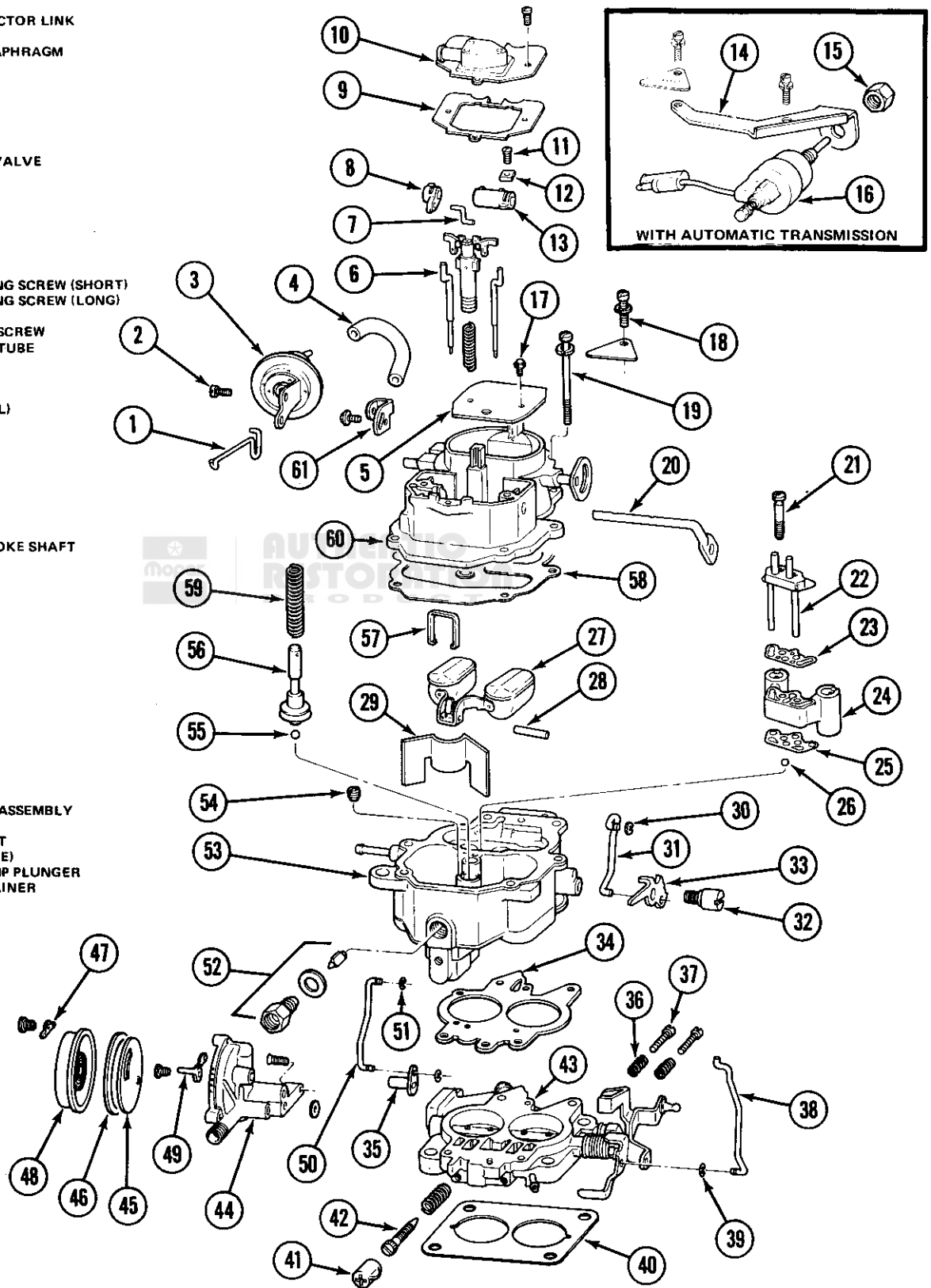


Fig. 1J-22 Parts Identification—Carter Model BBD



## 1J-14 FUEL SYSTEMS

### Disassembly

(1) Place carburetor on repair stand to protect throttle valves from damage and to provide stable work base.

(2) Remove retaining clip from accelerator pump arm link and remove link (fig. 1J-23).

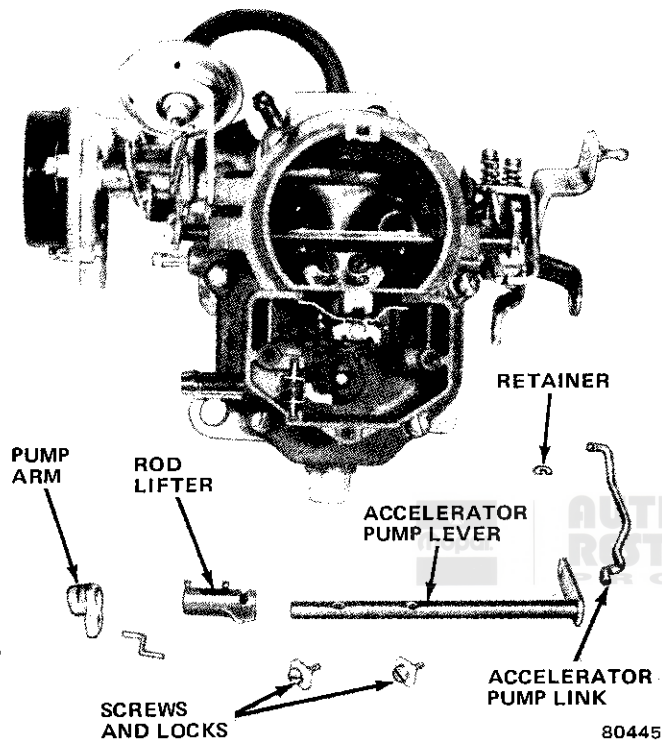


Fig. 1J-23 Accelerator Pump and Lever

(3) Remove cover and gasket from top of air horn.

(4) Remove screws and locks from accelerator pump arm and vacuum piston rod lifter. Slide pump lever out of air horn. Remove pump arm and rod lifter. Lift vacuum piston and metering rod assembly straight up and out of air horn. Remove vacuum piston spring (fig. 1J-24).

(5) Disconnect clips and remove link from choke housing lever and choke lever.

(6) Remove screw and lever from choke shaft.

(7) Remove vacuum hose from carburetor main body and choke vacuum diaphragm. Remove choke diaphragm, linkage and bracket assembly. Place diaphragm aside to be cleaned separately.

(8) Remove fast idle cam retaining screw. Remove fast idle cam, linkage and clip.

(9) Remove choke housing cover, retainers and screws. Remove gasket and baffle.

(10) Remove choke housing from throttle body.

(11) Remove air horn retaining screws and lift air horn straight up away from main body. Remove solenoid, if equipped. Discard gasket (fig. 1J-25).

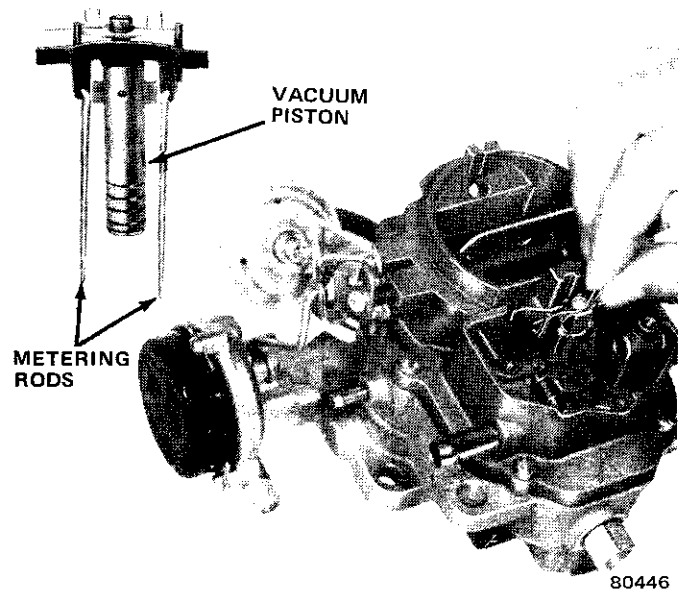


Fig. 1J-24 Removing Piston and Metering Rods

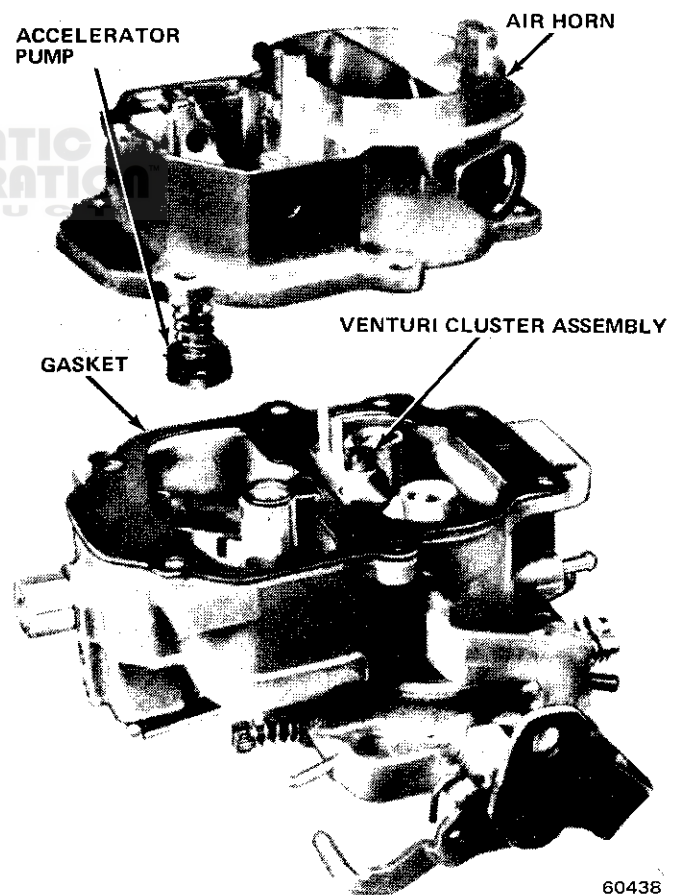
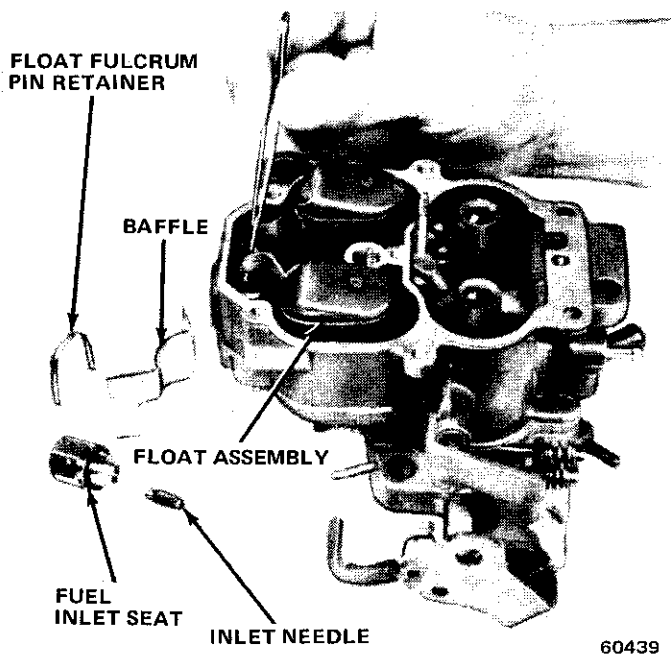


Fig. 1J-25 Removing Air Horn

(12) Invert air horn and compress accelerator pump drive spring. Remove S-link from pump shaft. Remove pump assembly.

(13) Remove fuel inlet needle valve, seat and gasket from main body.

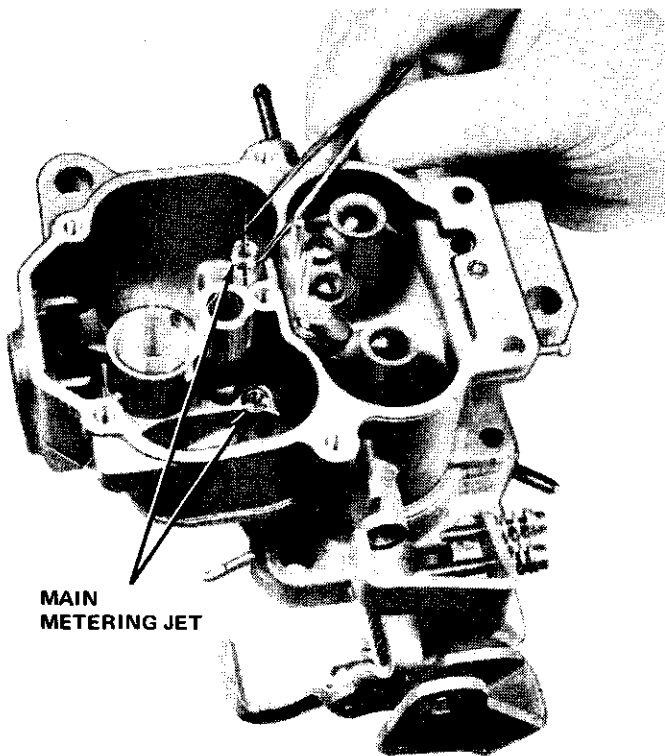
(14) Remove float fulcrum pin retainer and baffle. Remove floats and fulcrum pin (fig. 1J-26).



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Fig. 1J-26 Float Assembly

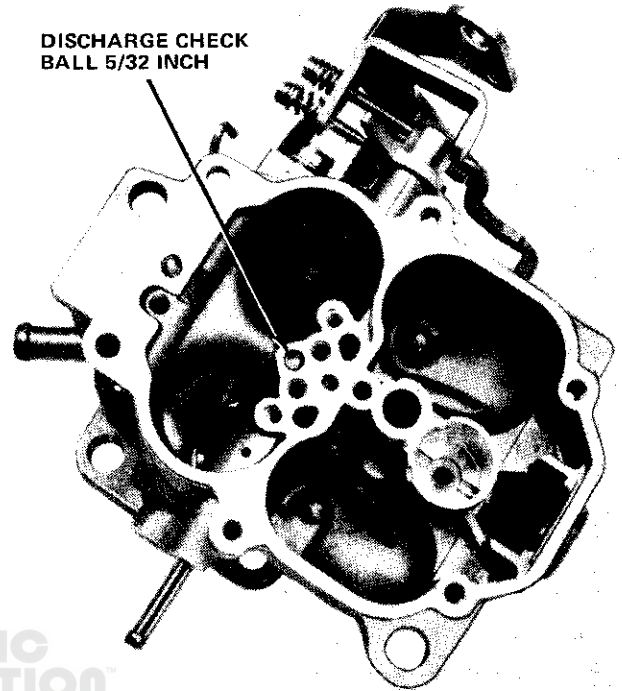
- (15) Remove main metering jets (fig. 1J-27).
- (16) Remove venturi cluster screws. Remove venturi cluster and gaskets from main body. Discard gaskets. Do not remove idle orifice tubes or main vent tubes from cluster.



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Fig. 1J-27 Main Metering Jets

- (17) Invert carburetor main body and drop out accelerator pump discharge (fig. 1J-28).



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Fig. 1J-28 Check Ball Location

- (18) Turn idle limiter caps to stop. Remove plastic limiter caps from idle air mixture screws by carefully turning No. 10 sheet metal screw into center of cap. Alternately, cut through limiters with soldering gun and pry off. Count number of turns required to seat each screw and make note for use during assembly. Remove idle screws and springs from throttle body.

- (19) Remove screws attaching throttle body to main body and separate bodies. Discard gasket.

### Cleaning and Inspection

Dirt, gum, water, or carbon contamination in the carburetor or on exterior moving parts is often responsible for unsatisfactory performance. Efficient carburetion depends upon careful cleaning and inspection.

The cleaning and inspection procedures here do not cover those parts included in the carburetor overhaul repair kit. Install all gaskets and parts included in the repair kit when the carburetor is assembled. Discard original gaskets and parts.

Wash all parts, except vacuum diaphragm, in clean commercial carburetor cleaning solvent. If a commercial solvent is not available, use mineral spirits, lacquer thinner or denatured alcohol.

If commercial solvent is used, rinse the cleaned parts in hot water to remove all traces of solvent, then blow dry with compressed air. Wipe the parts that cannot be

immersed in solvent with a clean, soft, dry cloth. Be sure all dirt, gum, carbon and other foreign matter are removed from all parts.

Force compressed air through all passages of the carburetor.

**CAUTION:** Do not use a wire brush to clean any part. Do not use a drill or wire to clean out openings or passages. This may enlarge the passages and change the calibration of the carburetor.

Check the choke shaft for excessive looseness or binding. Inspect the choke valve for nicked edges and for ease of operation. Check the throttle shaft for excessive looseness or binding in its bore. Check throttle valve for burrs or nicks which might prevent proper closing. Inspect the main body, throttle body, air horn, venturi assemblies, choke housing and choke cover for cracks.

Replace the float if the arm needle contact surface is grooved. If the float is serviceable, polish the needle contact surface of the arm with crocus cloth or steel wool. Replace float shaft if worn. Replace all damaged screws and nuts and all distorted or broken springs. Inspect all gasket mating surfaces for nicks or burrs. Replace any parts that have damaged gasket surfaces.

### Assembly

**NOTE:** Be sure all holes in the replacement gaskets have been properly punched and that no foreign material has adhered to the gaskets.

(1) Install idle mixture screws and springs in body. Do not use screwdriver. Turn screws lightly against their seats with fingers then back off number of turns counted at disassembly. Do not install plastic limiter caps at this time.

(2) Invert main body, place throttle body on main body, and align. Install screws and tighten securely.

(3) Install accelerator pump discharge check ball [5/32-inch (3.96 mm) diameter] in discharge passage.

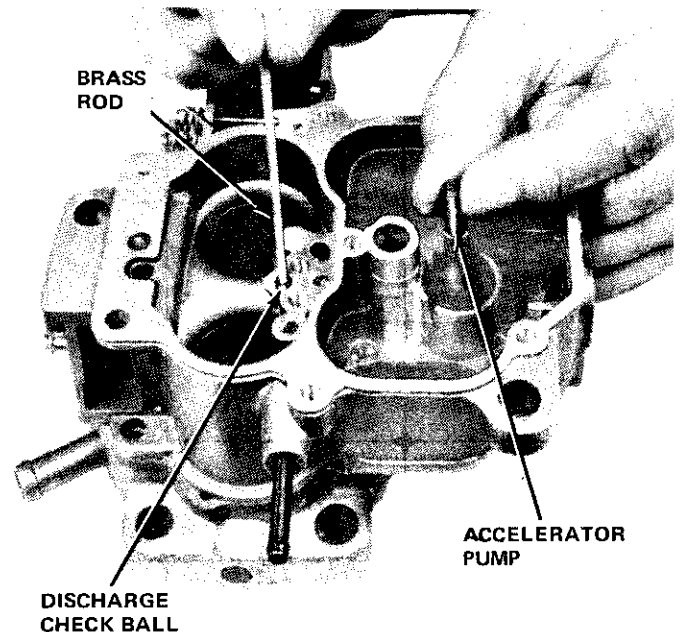
(4) Check operation of accelerator pump system. Pour clean gasoline into carburetor bowl 1/2 inch (12.7 mm) deep. Insert pump piston into pump cylinder, work piston up and down gently to expel air from pump passage. With suitable clean brass rod, hold discharge check valve firmly against its seat. Raise piston and press down. No fuel should be emitted from either intake or discharge passages (fig. 1J-29).

(5) Clean passages and ball seat if leakage is evident. If leakage persists, replace main body.

(6) Install replacement gaskets on venturi cluster, install cluster screws and tighten securely.

(7) Install main metering jets.

(8) Install floats with fulcrum pin and pin retainer in main body. Install needle, seat and gasket and tighten securely. Adjust float level. Refer to Service Adjustment Procedures. Install baffle plate.



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Fig. 1J-29 Accelerator Pump Check

(9) Place accelerator pump drive spring on pump plunger shaft and insert shaft into air horn. Compress spring and insert S-link.

(10) Place vacuum piston spring in vacuum piston bore. Position replacement gasket on main body and install air horn. Install solenoid, if equipped. Tighten retaining screws alternately one turn at a time to compress gasket evenly.

(11) Check vacuum piston gap. Refer to Service Adjustment Procedures and fig. 1J-30. Carefully install step-up piston and metering rod assembly into its bore in air horn. Be sure metering rods are in main metering jets. Be sure metering rod springs are installed properly (fig. 1J-30).

(12) Place two lifting tangs of plastic rod lifter under piston yoke. Slide shaft of accelerator pump lever through rod lifter and pump arm. Install locks and adjusting screws, but do not tighten.

(13) Install fast idle cam and linkage. Tighten retaining screw securely.

(14) Connect accelerator pump linkage to pump lever and throttle lever. Install retaining clip.

(15) Adjust vacuum piston and accelerator pump. Refer to Service Adjustment Procedures.

(16) Install dust cover, using replacement gasket.

(17) Install diaphragm assembly and secure with attaching screws. Do not connect vacuum hose to diaphragm fitting until initial choke valve clearance has been set. Refer to Service Adjustment Procedures.

(18) Engage diaphragm link with slot in choke lever. Install choke lever and screw to choke shaft.

(19) Install choke housing to throttle body.

(20) Install baffle, gasket and cover on housing. Turn cover 1/4 turn rich (clockwise) and tighten one screw.

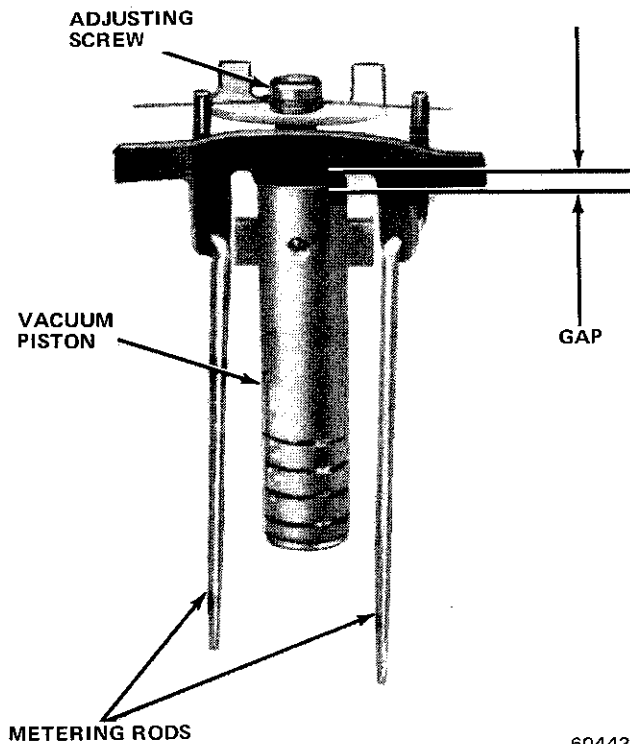


Fig. 1J-30 Vacuum Piston and Metering Rod Assembly

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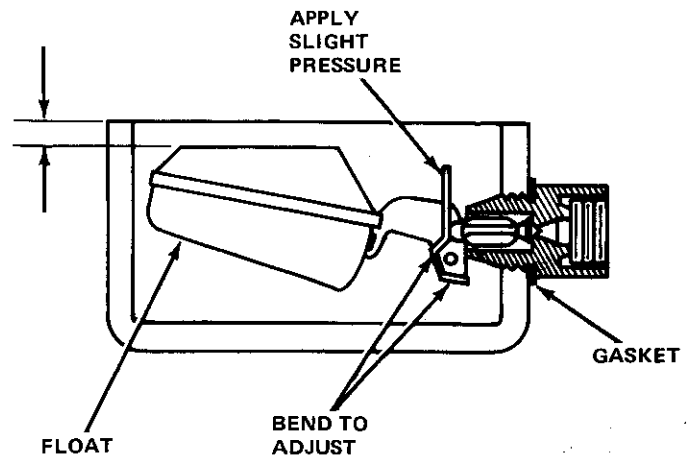


Fig. 1J-31 Float Level Adjustment

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### Vacuum Piston Gap Adjustment

The vacuum piston gap is a critical adjustment (fig. 1J-32). Turning the adjusting screw clockwise makes the fuel mixture richer. Turning the adjusting screw counterclockwise makes the fuel mixture leaner. Turn adjusting screw to set gap. Refer to Specifications.

### Vacuum Piston Adjustment

- (1) Adjust gap in vacuum piston to specifications as described above.
- (2) Back off curb idle adjustment until throttle valves are completely closed. Count number of turns so screw can be returned to original position. Turn idle screw until it just contacts stop, then turn in one full turn.
- (3) Fully depress vacuum piston while holding moderate pressure on rod lifter tab. While in this position, tighten rod lifter lock screw (fig. 1J-32).
- (4) Release piston and rod lifter.
- (5) Adjust accelerator pump as outlined below.
- (6) Return curb idle screw to its original position.
- (7) Install dust cover.

- (21) Install link and retainer between choke lever and choke housing lever.
- (22) Install link and retainer to fast idle cam and choke lever.
- (23) Adjust initial choke valve clearance. Refer to Service Adjustment Procedures.
- (24) Adjust fast idle cam clearance. Refer to Service Adjustment Procedures.
- (25) Adjust choke unloader clearance. Refer to Service Adjustment Procedures.
- (26) Loosen choke cover screw and set cover index to specification. Tighten all cover screws.

## SERVICE ADJUSTMENT PROCEDURES

### Float Level Adjustment

- (1) Remove air horn.
- (2) Hold float gently against needle to raise float (fig. 1J-31).
- (3) Place straightedge across float bowl to measure float level. Refer to Specifications.
- (4) If adjustment is necessary, release floats and bend float lever.

**CAUTION:** Never bend float lever while it is resting against needle. Pressure may damage synthetic tip and cause a false setting.

- (5) Install air horn.

### Accelerator Pump Adjustment

- (1) Remove dust cover.
- (2) Back off curb idle speed adjusting screw to completely close throttle valve. Open choke valve so fast idle cam allows throttle valves to seat in bores.
- (3) Turn curb idle adjusting screw in until it just contacts stop. Then continue two complete turns.
- (4) Measure distance between surface of air horn and top of accelerator pump shaft (fig. 1J-33). Refer to Specifications for correct dimension.
- (5) Loosen pump arm adjusting lock screw and rotate sleeve to adjust pump travel to proper measurement. Tighten lock screw.
- (6) Install cover and screws.

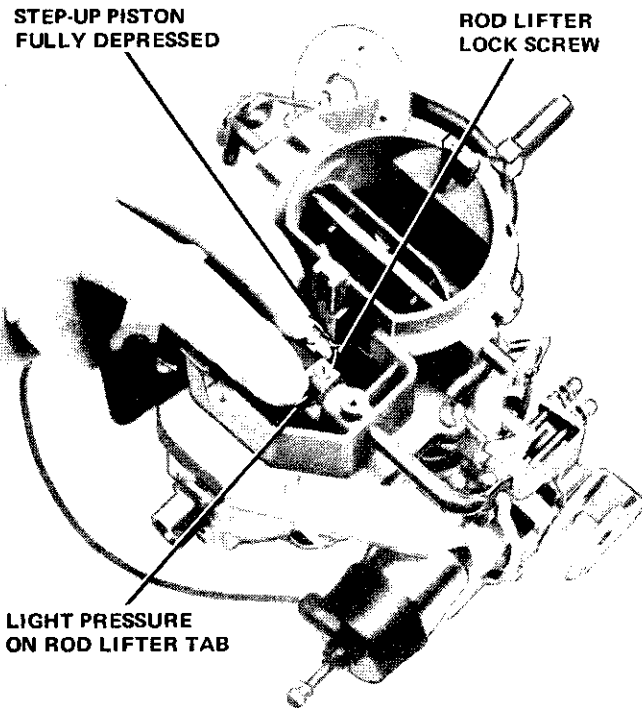


Fig. 1J-32 Vacuum Piston Adjustment

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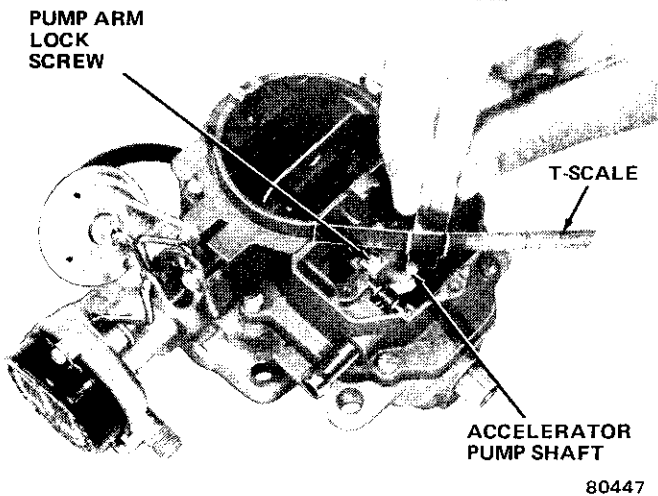


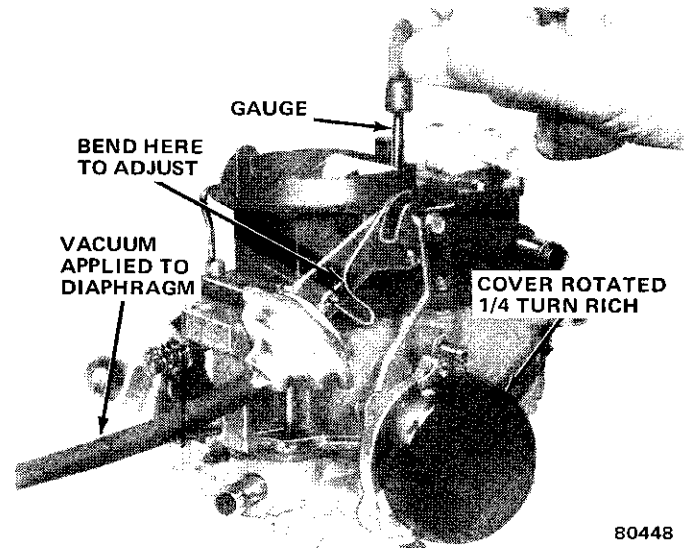
Fig. 1J-33 Accelerator Pump Adjustment

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### Initial Choke Valve Clearance Adjustment

- (1) Loosen choke cover and turn 1/4 turn rich. Tighten one retaining screw.
- (2) Open throttle valve slightly to place fast idle screw on high step of cam.
- (3) Use tool J-23738 or any vacuum source which holds at least 19 inches of mercury (Hg) (64 kPa) to pull in diaphragm against stop.
- (4) Measure clearance between choke plate and air horn wall. Refer to Specifications.

- (5) Adjust clearance by bending diaphragm connector link (fig. 1J-34).

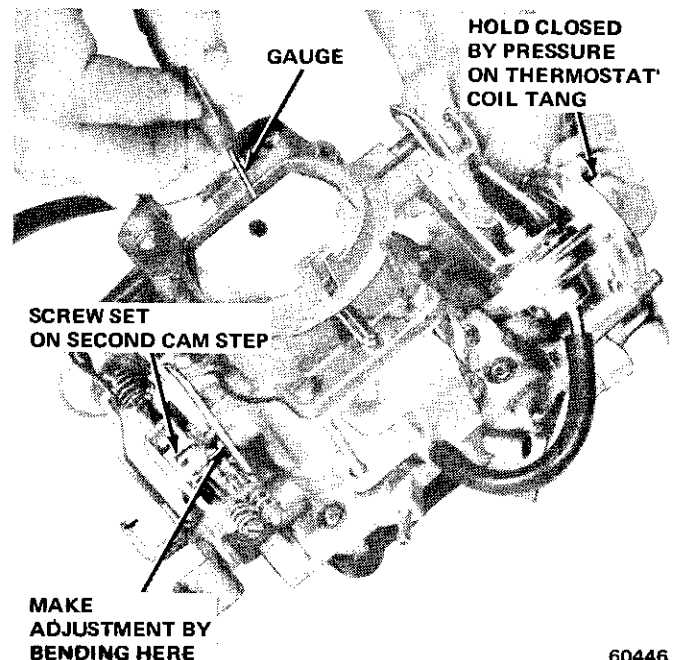


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Fig. 1J-34 Initial Choke Valve Clearance

### Fast Idle Cam Position Adjustment

- (1) Loosen choke housing cover and turn 1/4 turn rich. Tighten one retaining screw.
- (2) Open throttle slightly and place fast idle screw on second step of cam.
- (3) Measure distance between choke plate and air horn wall (fig. 1J-35). Refer to Specifications for correct dimension.
- (4) Adjust by bending fast idle cam link down to increase measurement or up to decrease measurement.
- (5) Loosen choke housing cover screw. Set index to specifications. Tighten all housing retaining screws.



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Fig. 1J-35 Fast Idle Cam Adjustment

### Choke Unloader Adjustment

- (1) Hold throttle wide open (fig. 1J-36).
- (2) Apply light pressure to choke plate and hold in closed position.
- (3) Measure distance between choke plate and air horn wall. Refer to Specifications.
- (4) Adjust by bending unloader tang. Do not bend tang so that it binds or interferes with any other part.

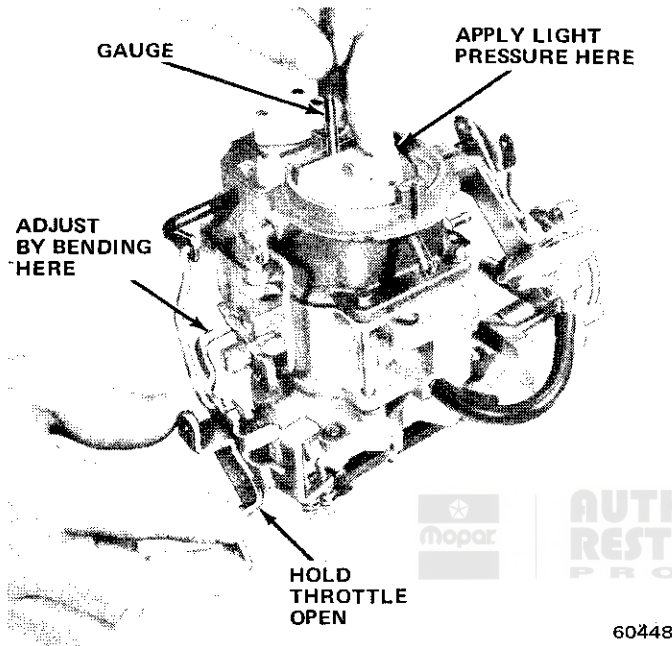


Fig. 1J-36 Choke Unloader Adjustment

### Automatic Choke Adjustment (On or Off Vehicle)

The automatic choke setting is made by loosening coil housing retaining screws and rotating housing in the desired direction as indicated by the arrow on the face of the housing. Refer to Specifications for the correct setting. The specified setting will be satisfactory for most

driving conditions. If stumble or stalls occur on acceleration during engine warm-up, the choke may be set richer or leaner to meet individual engine requirements.

**NOTE:** *The automatic choke acts like a timer. The richer the setting the longer spring tension acts against the linkage and holds the choke valve in a closed position. Warmed incoming air warms the spring. Spring tension is reduced and fast idle cam weight moves the choke linkage against spring tension.*

### Idle Speed and Mixture Adjustment

Refer to procedures outlined in Chapter 1A—General Service and Diagnosis.

### Fast Idle Speed Adjustment

Set the fast idle speed with the engine at operating temperature and with EGR and TCS solenoid disconnected. Position fast idle adjusting screw in contact with the second step and against the shoulder of the fast idle cam. Refer to Specifications for the correct setting. Adjust by turning the fast idle adjustment screw.

### CHOKE MECHANISM SERVICE

The choke mechanism may be serviced without removing the carburetor from the engine. If the choke binds, sticks or does not operate smoothly, perform the following:

- (1) Remove choke housing cover.
- (2) Remove choke lever screw and remove choke lever.
- (3) Disconnect choke control rod and remove thermostatic choke shaft from housing.
- (4) Polish shaft and shaft bore in housing.
- (5) Install shaft to housing. Install choke control rod.
- (6) Install choke lever to shaft.
- (7) Install housing cover and set to specification.

### SPECIFICATIONS

#### Model BBD Carburetor Calibrations (Inches)

	8185	8186	8187	8188	8195	8229
Throttle Bore Size	1.44	1.44	1.44	1.44	1.44	1.44
Main Venturi Size	1.19	1.19	1.19	1.19	1.19	1.19
Fuel Inlet Diameter	0.101	0.101	0.101	0.101	0.101	0.101
Low Speed Jet (Tube)	0.0295	0.0295	0.0295	0.0295	0.0295	0.0295
Economizer	0.059	0.059	0.059	0.059	0.059	0.055
Idle Air Bleed	0.059	0.063	0.063	0.059	0.063	0.063
Main Jet Size	0.089	0.089	0.089	0.089	0.089	0.089
Accelerator Pump Jet	0.033	0.033	0.033	0.033	0.033	0.033
Main Metering Jet Number	120-389	120-389	120-389	120-389	120-389	120-389
Choke Heat Bypass	0.042	0.042	0.042	0.042	0.042	0.042
Choke Heat Inlet Restriction	0.078	0.078	0.078	0.078	0.078	0.078
Choke Vacuum Restriction	0.059	0.059	0.059	0.059	0.059	0.059

**Carburetor Service Specifications**

List Number	Application	Float Level		Vacuum Piston Gap		Initial Choke Valve Clearance		Fast Idle Cam Setting		Automatic Choke Cover Setting (Notches Rich)		Accelerator Pump Dimensions		Choke Unloader	Fast Idle <sup>1</sup> Speed		Choke Bimetal ID
		Set To	OK Range	Set To	OK Range	Set To	OK Range	Set To	OK Range	Set To	OK Range	Set To	OK Range		Set To	OK Range	
8185	258 Automatic 49 State	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.140	0.125 to 0.155	0.110	0.095 to 0.125	1NR	1/2 to 1-1/2	0.470	0.450 to 0.490	0.280	1600	1500 to 1700	T
8186	258 Manual 49 State	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.150	0.135 to 0.165	0.110	0.095 to 0.125	1NR	1/2 to 1-1/2	0.520	0.500 to 0.540	0.280	1500	1400 to 1600	T
8187	258 Automatic California	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.140	0.125 to 0.155	0.110	0.095 to 0.125	1NR	1/2 to 1-1/2	0.470	0.450 to 0.490	0.280	1600	1500 to 1700	T
8188	258 Manual California	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.150	0.135 to 0.165	0.110	0.095 to 0.125	1NR	1/2 to 1-1/2	0.520	0.500 to 0.540	0.280	1500	1400 to 1600	T
8195	258 Manual Automatic 49 State	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.140	0.125 to 0.155	0.110	0.095 to 0.125	1NR	1/2 to 1-1/2	0.470	0.450 to 0.490	0.280	1500M 1600A	1400/1600 1500/1700	T
8229	258 Manual Hilly Terrain	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.128	0.113 to 0.143	0.095	0.080 to 0.110	1NR	1/2 to 1-1/2	0.520	0.500 to 0.540	0.280	1500	1400 to 1600	T

<sup>1</sup>Hot with EGR disconnected.

# CARBURETOR MODEL 2100-2 VENTURI

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## GENERAL

The Motorcraft Model 2100 carburetor is a two-venturi carburetor which incorporates two lightweight aluminum assemblies, the air horn and the main body.

The air horn assembly serves as the main body cover and also contains the choke assembly and fuel bowl vents.

The throttle shaft assembly and all units of the fuel metering systems are contained in the main body assembly. The automatic choke assembly and the solenoid are attached to the main body (fig. 1J-37).

## Identification

The carburetor is identified by a code number and build date which is stamped on the identification tag. Each carburetor build month is coded alphabetically beginning with the letter A in January and ending with the letter M in December (the letter I is not used). The tag is attached to the carburetor and must remain with the carburetor to assure proper identification (fig. 1J-38).

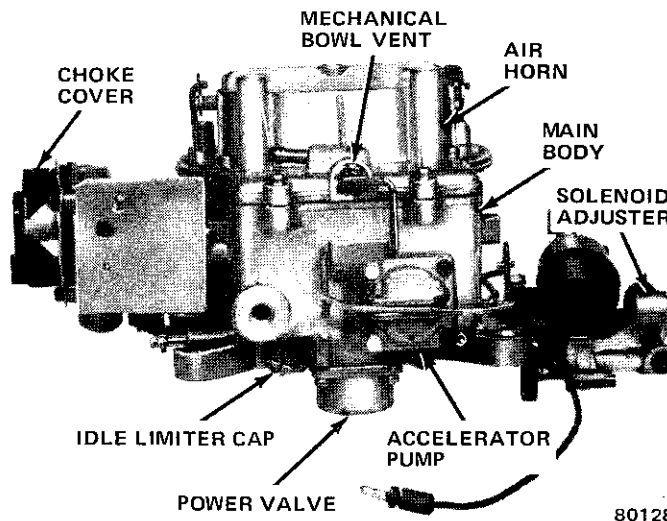
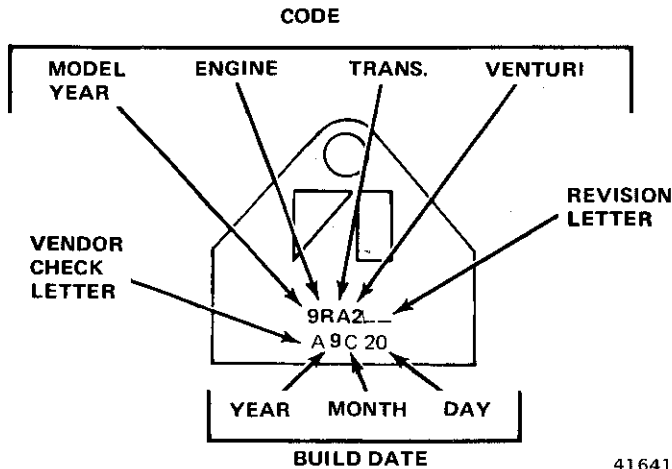


Fig. 1J-37 Model 2100 Carburetor Assembly

## CARBURETOR CIRCUITS

The Model 2100 carburetor utilizes five conventional metering circuits: Float (Fuel Inlet) Circuit, Idle (Low



41641

Fig. 1J-38 Identification Tag

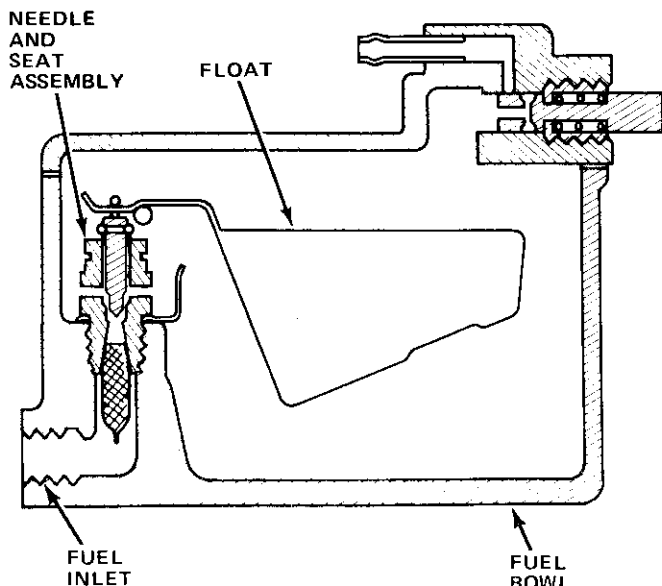
Speed) Circuit, Main (High Speed) Circuit, Pump Circuit and Choke Circuit.

**Float (Fuel Inlet) Circuit**

Fuel under pressure enters the fuel bowl through the fuel inlet fitting in the main body.

The Viton-tipped fuel inlet needle is controlled by the float and lever assembly which is hinged on the float shaft. A wire retainer is hooked over grooves on opposite ends of the float shaft and into a groove behind the fuel inlet needle seat. The retainer holds the float shaft firmly in the fuel bowl guides and also centers the float assembly in the fuel bowl.

An integral retaining clip is hooked over the end of the float lever and attached to the fuel inlet needle. This assures reaction of the fuel inlet needle during downward movement of the float (fig. 1J-39).



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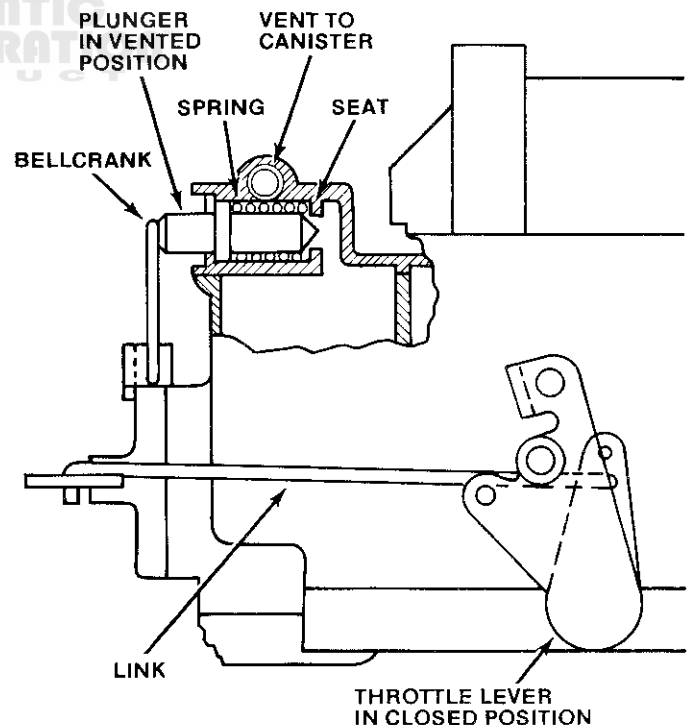
Fig. 1J-39 Float Circuit

The float circuit maintains a specified fuel level in the bowl, enabling the basic fuel metering circuits to deliver the proper mixture to the engine. The amount of fuel entering the bowl is regulated by the distance the fuel inlet needle is raised off its seat. The float drops as the fuel level drops and raises the fuel inlet needle off its seat. This permits additional fuel to enter the bowl past the fuel inlet needle. When the fuel reaches a preset level, the fuel inlet needle is lowered to admit only enough fuel to replace that being used.

**Bowl Vent**

Two bowl vents are required. The internal vent is used to balance air pressure in the fuel bowl when the engine is running. The external vent provides a method of controlling fuel vapors in the bowl when the engine is not running.

The external fuel bowl vent permits vapors to move from the carburetor to the fuel vapor storage canister. A bellcrank attached to the accelerator pump housing actuates the bowl vent (fig. 1J-40). At idle, or solenoid Off position, if equipped, the vent opens, permitting vapors to pass. At any throttle position above idle, the vent is mechanically closed.



80269

Fig. 1J-40 External Bowl Vent

**Idle (Low Speed) Circuit**

Fuel for idle and low speed operation flows from the fuel bowl through the main jets into the main wells.



From the main wells, the fuel is metered as it passes through calibrated restrictions at the lower end of the idle tubes. After flowing through the idle tubes, the fuel enters diagonal passages above the tubes. The fuel is metered again as it flows downward through restrictions at the lower end of the diagonal passages and then enters the idle passages in the main body (fig. 1J-41).

Air enters the idle system through air bleeds which are located in the main body directly below the booster venturi. The air bleeds serve as anti-siphon vents during off-idle, high speed operation and when the engine is stopped.

The fuel-air mixture moves down the idle passages past the idle transfer slots which serve as additional air bleeds during curb idle operation. The fuel-air mixture then moves past the idle mixture adjusting screw tips which control the amount of discharge. From the adjusting screw ports, the fuel-air mixture moves through short horizontal passages and is discharged below the throttle valves.

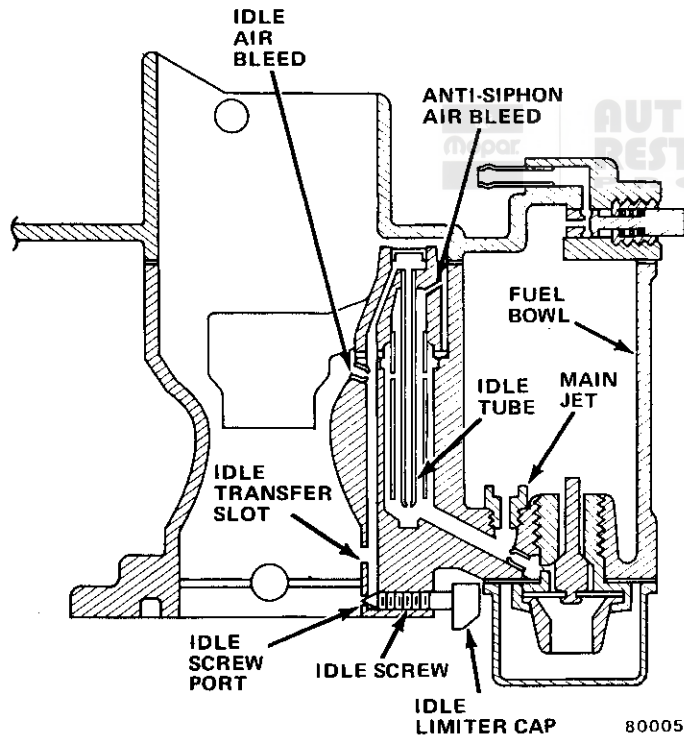


Fig. 1J-41 Idle Circuit

At speeds slightly above idle, the idle transfer slots begin discharging the fuel-air mixture as the throttle valves expose them to manifold vacuum. As the throttle valves continue opening and engine speed increases, the airflow through the carburetor increases proportionately. This increased airflow creates a vacuum in the venturi and the main metering system begins discharging a fuel-air mixture. The discharge from the idle circuit tapers off as the main metering circuit begins discharging.

### Main Metering (High Speed) Circuit

As engine speed increases, the air velocity through the booster venturi creates a low pressure area. Fuel flow through the main metering circuit is caused by atmospheric pressure in the fuel bowl and low pressure at the main discharge ports. Fuel flows from the fuel bowl, through the main jets and into the main wells. The fuel then moves up the main well tubes where it is mixed with air. The air, supplied through the main air bleeds, mixes with the fuel through small holes in the sides of the main well tubes. The main air bleeds meter an increasing amount of air, whenever venturi vacuum increases, to maintain the proper fuel-air ratio. The mixture of fuel and air, being lighter than raw fuel, responds quickly to changes in venturi vacuum. It also atomizes more readily than raw fuel.

The fuel-air mixture moves from the main well tubes to the discharge ports and is discharged into the booster venturi (fig. 1J-42).

Anti-siphon air bleeds, located near the top of the main well tubes, prevent siphoning of fuel from the main well when decelerating.

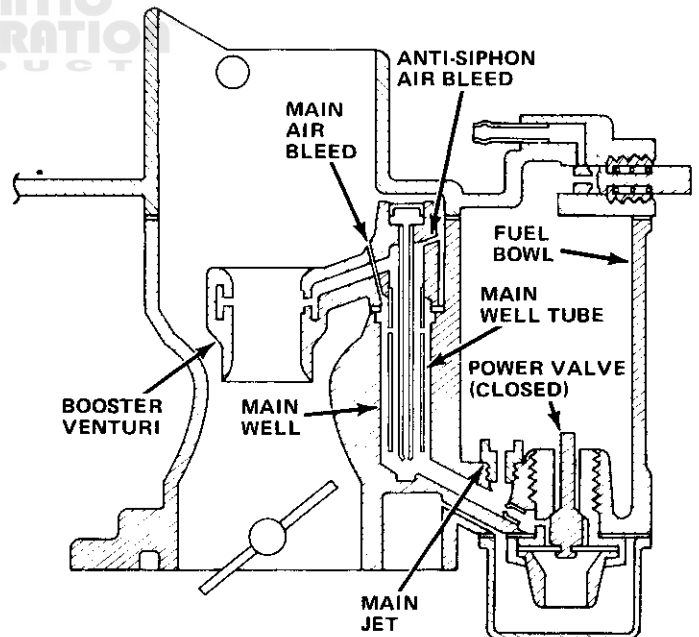


Fig. 1J-42 Main Metering Circuit

### Power Enrichment Circuit

During heavy load conditions or high speed operation, the fuel-air ratio must be increased for higher engine output. The power enrichment circuit supplies extra fuel during this period and is controlled by intake manifold vacuum (fig. 1J-43).

Manifold vacuum is applied to the power valve diaphragm from an opening in the base of the main body, through a passage in the main body and power valve chamber to the power valve diaphragm. During idle and normal driving conditions, manifold vacuum is high enough to overcome the power valve spring tension and holds the valve closed. When higher engine output is required, the increased load on the engine results in decreased manifold vacuum. The power valve spring opens the first stage of the power valve when manifold vacuum drops below a predetermined value and a small amount of fuel flows through the valve.

When manifold vacuum drops to a lower value, the power valve spring opens the second stage of the power valve and allows a greater amount of fuel to flow through the valve.

The fuel which flows through the power valve is added to the fuel in the main metering circuit to enrich the mixture. As engine load requirements decrease, manifold vacuum increases and overcomes the tension of the power valve spring, closing the power valve.

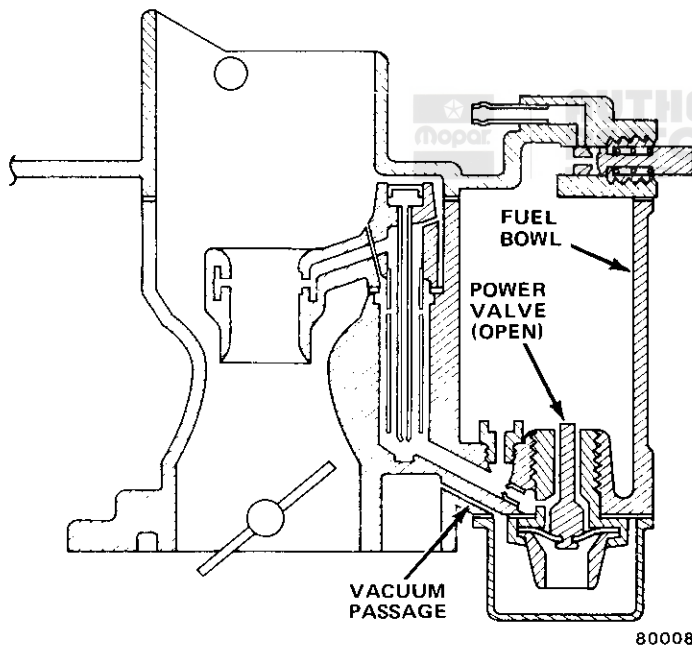


Fig. 1J-43 Power Enrichment Circuit

### Pump Circuit

When the throttle valves are opened quickly, the air-flow through the carburetor responds almost immediately. Since fuel is heavier than air, there is a brief lag in time before the fuel flow can gain sufficient speed to maintain the proper fuel-air ratio. During this lag, the pump circuit supplies the required fuel until the proper fuel-air ratio can be maintained by the other metering circuits (fig. 1J-44).

The pump is charged when the throttle valves are closed. The diaphragm return spring exerts force against the diaphragm and pushes it against the cover.

Fuel is drawn through the inlet, past the Elastomer valve, and into the pump chamber. A discharge check ball and weight prevents air from being drawn into the pump chamber.

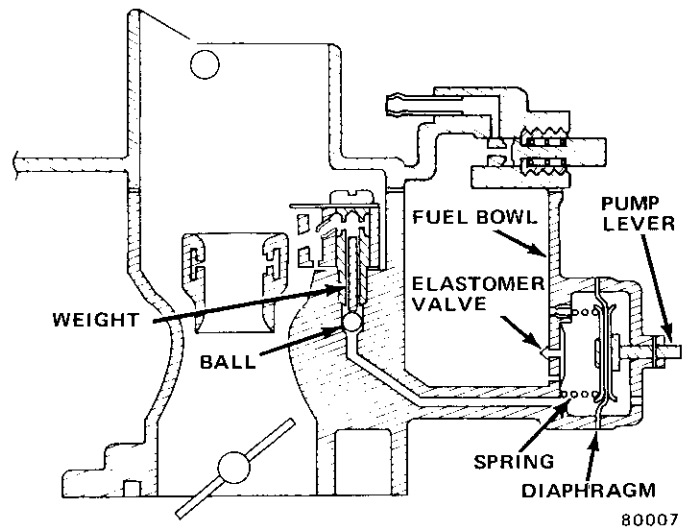


Fig. 1J-44 Pump Circuit

When the throttle valves are opened, the diaphragm rod is pushed inward forcing fuel from the pump chamber into the discharge passages. The Elastomer valve seals the inlet hole during pump discharge preventing fuel from returning to the fuel bowl. Fuel under pressure unseats the discharge check ball and weight and is forced through the pump discharge screw. The fuel is then sprayed into the main venturi through discharge ports.

An air bleed is provided in the pump chamber to prevent vapor accumulation and pressure buildup.

### Choke Circuit

The choke valve, located in the air horn assembly, provides a high vacuum above as well as below the throttle valves when closed. During cranking, vacuum above the throttle valves causes fuel to flow from the main metering and idle circuits. This provides the richer fuel-air mixture required for cold engine starting.

The choke shaft is connected by linkage to a thermostatic coil which winds up when cold and unwinds when warm.

The position of the choke valve is controlled by the action of a vacuum modulator exerting force against the tension of the thermostatic coil (fig. 1J-45).

When the engine is cold, tension of the thermostatic coil holds the choke valve closed. When the engine is started, manifold vacuum is channeled through an opening at the base of the carburetor through a passage of the bottom side of the modulator diaphragm assembly, moving the diaphragm downward against the set screw.

At the same time, the modulator arm contacts a tang on the choke shaft. The downward movement of the diaphragm assembly compresses the piston spring and exerts a pulling force on the modulator arm, causing the choke valve to open slightly. This opening is known as initial choke valve clearance.

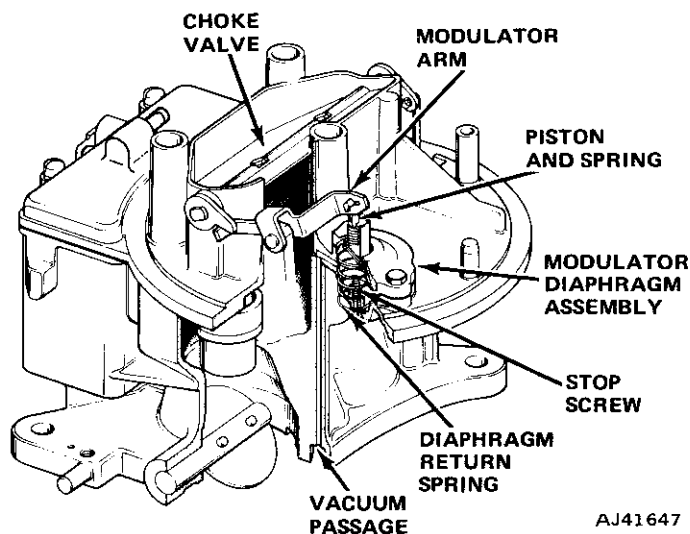


Fig. 1J-45 Choke Circuit

As the engine begins to warm up, heated air from the exhaust crossover is routed through a heat tube to the choke housing. A thermostatic bypass valve, which is integral with the choke heat tube, helps prevent premature choke valve opening during the early part of the warmup period. The valve regulates the temperature of the hot airflow to the choke housing by allowing outside unheated air to enter the heat tube. A thermostatic disc is incorporated in the valve which is calibrated to close the valve at 75°F and open it at 55°F.

The heated air entering the choke housing causes the thermostatic coil to begin unwinding and decreases the closing force exerted against the choke valve. The coil gradually loses its tension and allows the choke valve to open.

When the engine reaches operating temperature, the thermostatic coil continues unwinding and exerts pressure against the choke linkage, forcing the choke valve fully open. A continual flow of warm air passes through the choke housing and is exhausted into the intake manifold. The thermostatic coil remains heated and the choke valve remains fully open until the engine is stopped and allowed to cool.

Air flowing through the choke housing must be filtered to minimize contamination of the choke coil and associated parts. The air is supplied by a tube originating inside the air cleaner.

A fast idle is required to prevent engine stalling during the warmup period. The fast idle cam, actuated by the choke rod, contacts the fast idle speed adjustment

screw and increases engine speed in proportion to the choke valve opening. When the choke valve reaches the fully open position, the fast idle cam rotates free of the fast idle speed adjusting screw, allowing the throttle lever to return to curb idle.

If the engine is accelerated during the warmup period, the resulting drop in manifold vacuum allows the thermostatic coil to momentarily close the choke valve. This provides a richer mixture to prevent engine stalling.

If the engine becomes flooded during the starting period, the choke valve may be opened manually to purge excess fuel from the intake manifold. This is accomplished by depressing the accelerator pedal to the floor and cranking the engine. With the the accelerator linkage in this position, a tang on the fast idle lever contacts the fast idle cam, causing the choke valve to open a predetermined amount. This is referred to as choke unloader clearance.

## CARBURETOR REPLACEMENT

### Removal

- (1) Remove air cleaner.
- (2) Remove accelerator cable from accelerator lever. Disconnect vacuum hoses, pullback spring, choke clean air tube, solenoid wire if equipped, PCV hose, in-line fuel filter and choke heat tube at carburetor.
- (3) Remove carburetor retaining nuts. Remove carburetor and gasket from intake manifold.

### Installation

(1) Clean gasket mounting surfaces of spacer and carburetor. Position gasket on intake manifold. Position carburetor on spacer and gasket and install nuts. To prevent leakage, distortion or damage to carburetor body flange, alternately tighten nuts in crisscross pattern.

(2) Connect in-line fuel filter, throttle cable, choke heat tube, PCV hose, pullback spring, solenoid wire if equipped, choke clean air tube and vacuum hoses.

(3) Adjust engine idle speed and idle fuel mixture. Refer to Chapter 1A—General Service and Diagnosis for procedures.

## CARBURETOR OVERHAUL

The following procedure applies to complete overhaul with the carburetor removed from the engine.

A complete disassembly is not necessary when performing adjustments. In most cases, service adjustments of individual systems may be completed without removing the carburetor from the engine. Refer to Service Adjustment Procedures.

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection, and replacement of all gaskets and worn or damaged parts. Refer to figure 1J-46 for parts identification.

1. MODULATOR COVER
2. MODULATOR RETAINING SCREW (3)
3. PIVOT PIN
4. MODULATOR ARM
5. CHOKE VALVE RETAINING SCREW (2)
6. CHOKE VALVE
7. CHOKE SHAFT
8. AIR HORN
9. AIR HORN RETAINING SCREW (4)
10. AIR HORN GASKET
11. FLOAT AND LEVER ASSEMBLY
12. FLOAT SHAFT RETAINER
13. FLOAT SHAFT
14. NEEDLE RETAINING CLIP
15. CURB IDLE ADJUSTING SCREW
16. CURB IDLE ADJUSTING SCREW SPRING
17. THROTTLE SHAFT AND LEVER ASSEMBLY
18. DASHPOT
19. DASHPOT LOCKNUT
20. DASHPOT BRACKET
21. DASHPOT BRACKET RETAINING SCREW
22. ADJUSTING SCREW
23. CARRIAGE
24. ELECTRIC SOLENOID
25. MOUNTING BRACKET
26. THROTTLE VALVE RETAINING SCREW (4)
27. THROTTLE VALVE (2)
28. NEEDLE AND SEAT ASSEMBLY
29. NEEDLE SEAT GASKET
30. MAIN JET (2)
31. MAIN BODY
32. ELASTOMER VALVE
33. PUMP RETURN SPRING
34. PUMP DIAPHRAGM
35. PUMP LEVER PIN
36. PUMP COVER
37. PUMP ROD
38. PUMP ROD RETAINER
39. PUMP LEVER
40. BOWL VENT BELLCRANK
41. FUEL INLET FITTING
42. POWER VALVE GASKET
43. POWER VALVE
44. POWER VALVE COVER GASKET
45. POWER VALVE COVER
46. POWER VALVE COVER RETAINING SCREW (4)
47. IDLE LIMITER CAP (2)
48. IDLE MIXTURE SCREW (2)
49. IDLE MIXTURE SCREW SPRING (2)
50. RETAINER
51. FAST IDLE LEVER RETAINING NUT
52. FAST IDLE LEVER PIN
53. RETAINER
54. LEVER AND SHAFT
55. FAST IDLE CAM ROD
56. CHOKE SHIELD
57. CHOKE SHIELD RETAINING SCREW (2)
58. PISTON PASSAGE PLUG
59. HEAT PASSAGE PLUG
60. CHOKE COVER RETAINING CLAMP
61. CHOKE COVER RETAINING SCREW (3)
62. CHOKE COVER
63. CHOKE COVER GASKET
64. THERMOSTAT LEVER RETAINING SCREW
65. THERMOSTAT LEVER
66. CHOKE HOUSING RETAINING SCREW (3)
67. CHOKE HOUSING
68. CHOKE SHAFT BUSHING
69. FAST IDLE SPEED ADJUSTING SCREW
70. FAST IDLE LEVER
71. FAST IDLE CAM
72. CHOKE HOUSING GASKET
73. PUMP DISCHARGE CHECK BALL
74. PUMP DISCHARGE WEIGHT
75. BOOSTER VENTURI GASKET
76. BOOSTER VENTURI ASSEMBLY
77. AIR DISTRIBUTION PLATE
78. PUMP DISCHARGE SCREW
79. RETAINER
80. CHOKE ROD
81. CHOKE LEVER RETAINING SCREW
82. CHOKE PLATE LEVER
83. CHOKE ROD SEAL
84. STOP SCREW
85. MODULATOR RETURN SPRING
86. MODULATOR DIAPHRAGM ASSEMBLY

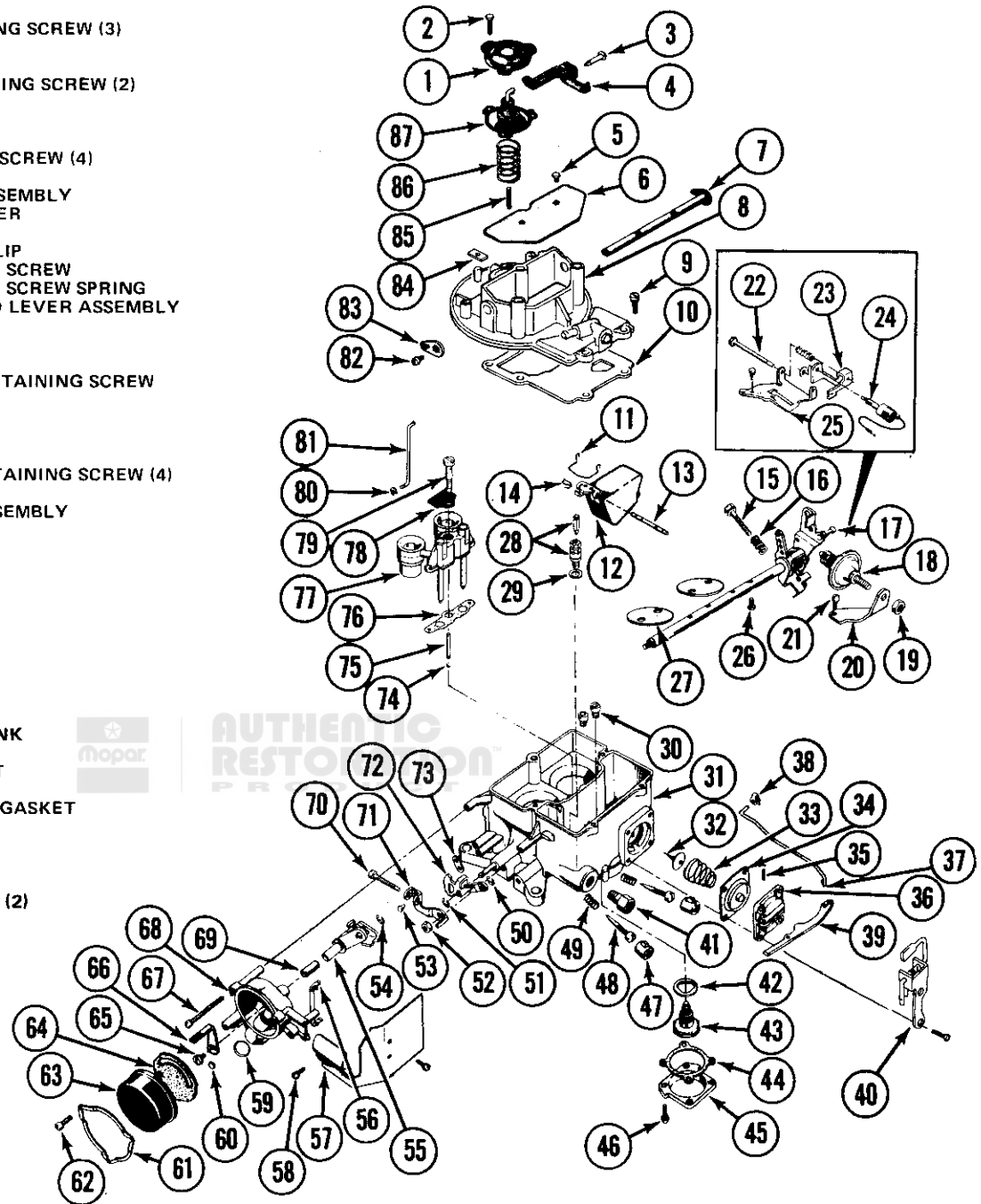


Fig. 1J-46 Parts Identification—Motorcraft Model 2100

## 1J-26 FUEL SYSTEMS

**NOTE:** When using an overhaul kit, use all parts included in kit.

**NOTE:** Flooding, stumble on acceleration, and other performance problems are in many instances caused by the presence of dirt, water, or other foreign matter in the carburetor. To aid in diagnosing the cause of the problem, carefully remove the carburetor from the engine without removing the fuel from the bowl. Examine the contents of the bowl for contamination as the carburetor is disassembled.

### Disassembly

- (1) Remove air cleaner anchor screw.
- (2) Remove automatic choke rod retainer from thermostatic choke shaft lever.
- (3) Remove air horn attaching screws, lockwashers and carburetor identification tag. Remove air horn and air horn gasket.
- (4) Remove choke rod by loosening screw that secures choke shaft lever to choke shaft. Remove rod and plastic dust seal from air horn.
- (5) Remove choke modulator assembly (fig. 1J-47).

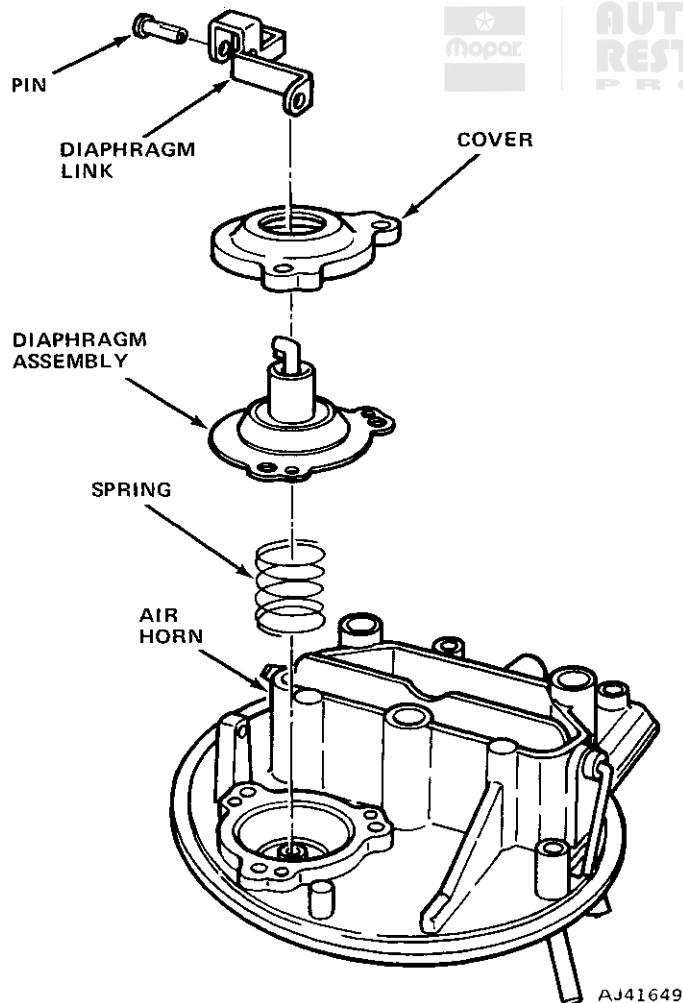


Fig. 1J-47 Choke Modulator Assembly

- (6) Remove fast idle cam retainer (fig. 1J-48).
- (7) Remove choke shield.
- (8) Remove thermostatic choke spring housing retaining screws and clamp, housing and gasket.

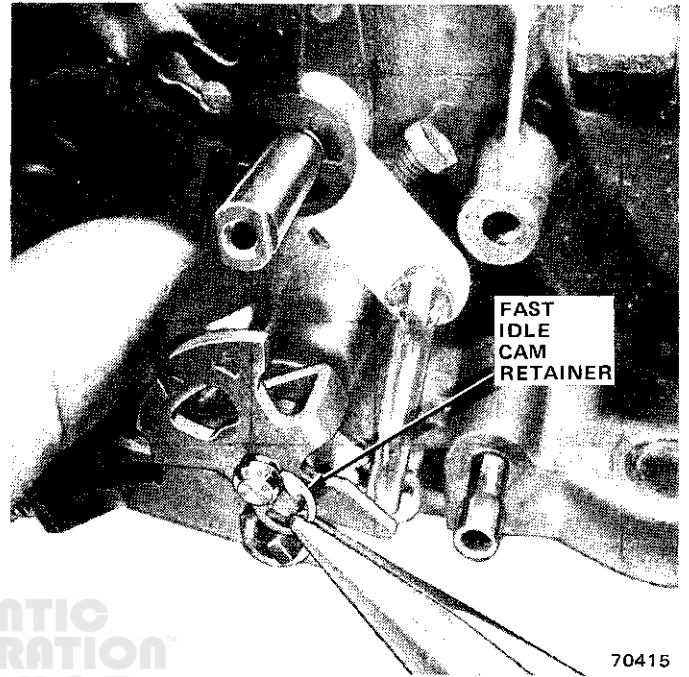


Fig. 1J-48 Fast Idle Cam Retainer

- (9) Remove fast idle cam rod from fast idle cam lever.
- (10) Remove choke housing assembly retaining screws, housing assembly and gasket.
- (11) Remove fast idle cam.
- (12) Remove thermostat lever retaining screw and washer. Remove thermostatic choke shaft and fast idle cam lever from the choke housing.
- (13) Pry float shaft retainer from fuel inlet seat (fig. 1J-49). Remove float, float shaft retainer and fuel inlet needle assembly. Remove retainer and float shaft from float lever.

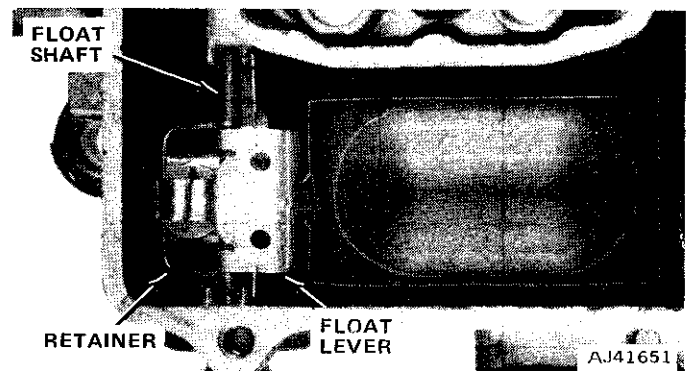


Fig. 1J-49 Float Assembly

(14) Remove fuel inlet needle seat and gasket. Remove main jets with Main Metering Jet Wrench J-10174-01 (fig. 1J-50).

(15) Remove accelerator pump discharge screw, air distribution plate, booster venturi and gasket (fig. 1J-51). Do not attempt to remove tubes from venturi assembly. Invert main body and catch accelerator pump discharge weight and ball.

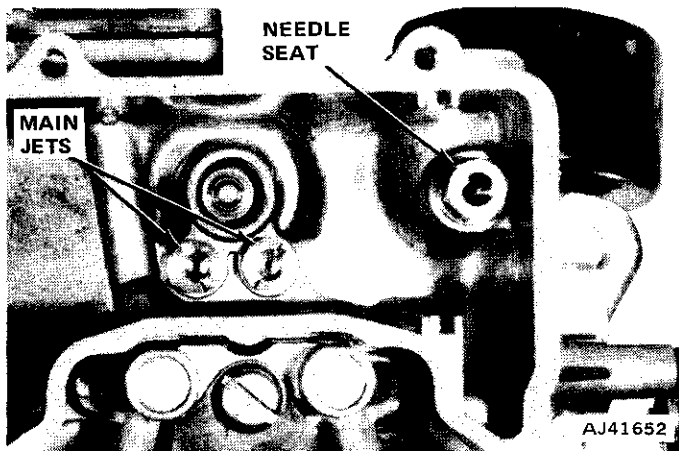


Fig. 1J-50 Interior View of Fuel Bowl

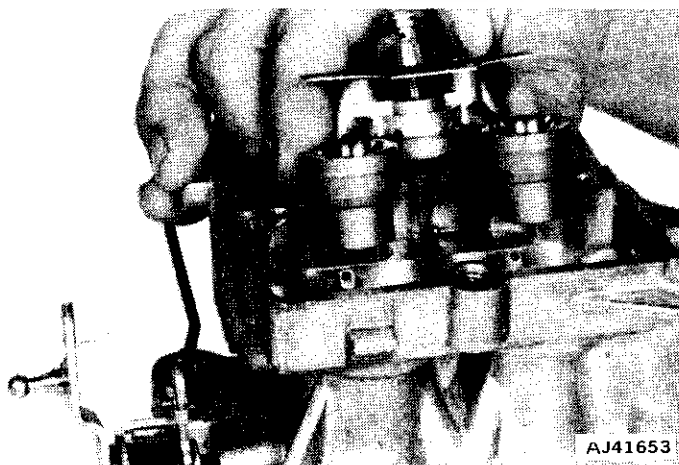


Fig. 1J-51 Booster Venturi Assembly

(16) Disconnect accelerator pump operating rod from overtravel lever. Remove rod and retainer.

(17) Remove accelerator pump cover attaching screws. Remove bowl vent bellcrank and bracket assembly, accelerator pump cover, diaphragm assembly and spring (fig. 1J-52).

(18) Remove Elastomer valve by grasping firmly and pulling out.

**NOTE:** If the Elastomer valve tip breaks off during removal, be sure to remove the tip from the fuel bowl. Elastomer valve must be replaced whenever it has been removed from the carburetor.

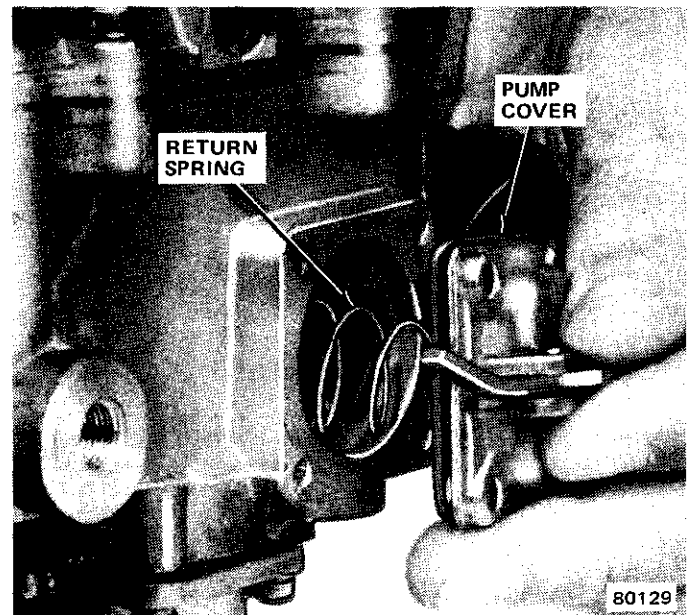


Fig. 1J-52 Accelerator Pump Assembly

(19) Invert main body and remove power valve cover, gasket and screws. Remove power valve (fig. 1J-53). Remove and discard power valve gasket.

(20) Remove limiter caps from idle mixture adjusting screws. Use soldering gun to cut through limiter caps. Remove idle mixture adjusting screws and springs.

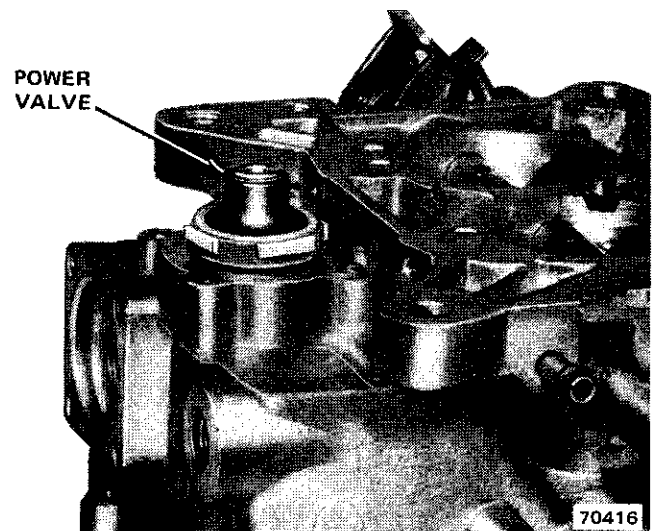


Fig. 1J-53 Power Valve

(21) Remove solenoid, if equipped.

### Cleaning and Inspection

Dirt, gum, water or carbon contamination in the carburetor or the exterior moving parts of the carburetor are often responsible for unsatisfactory performance. Efficient carburetion depends upon careful cleaning and inspection.

The cleaning and inspection procedures here do not cover those parts included in the carburetor overhaul repair kit. Install all gaskets and parts included in the repair kit when the carburetor is assembled. Discard the original gaskets and parts.

Wash all the carburetor parts except accelerator pump diaphragm, power valve, modulator diaphragm, and the dashpot assembly in clean commercial carburetor cleaning solvent. If a commercial solvent is not available, use lacquer thinner or denatured alcohol. If a commercial cleaner is used, rinse the parts in hot water to remove all traces of the cleaning solvent, then dry them with compressed air. Wipe all parts that cannot be immersed in solvent with a clean, soft, dry cloth. Be sure all dirt, gum, carbon and other foreign matter are removed from all parts.

Force compressed air through all passages of the carburetor.

**CAUTION:** *Do not use a wire brush to clean any parts. Do not use a drill or wire to clean out any openings or passages in the carburetor. A drill or wire may enlarge the hole or passage, changing the calibration of the carburetor.*

Check the choke shaft for wear and excessive looseness or binding. Inspect the thermostatic choke shaft and polish with fine crocus cloth or steel wool. Inspect the choke valve for nicked edges and for ease of operation and free it if necessary. Be sure all carbon and foreign material has been removed from the automatic choke housing. Check the throttle shaft for excessive looseness or binding in its bore. Check the throttle valves for burrs which prevent proper closure. Inspect the main body, air horn, booster venturi assemblies, choke housing and choke cover, power valve cover and accelerator pump cover for cracks. Replace the float if the arm needle contact surface is grooved. If the float is serviceable, polish the needle contact surface of the arm with crocus cloth or steel wool. Replace float shaft if worn. Replace all screws and nuts that have stripped threads. Replace all distorted or broken springs. Inspect all gasket mating surfaces for nicks and burrs. Repair or replace any parts that have a damaged gasket surface.

## Assembly

**NOTE:** *Be sure all holes in the replacement gaskets have been properly punched and that no foreign material has adhered to the gaskets. Inspect vacuum diaphragms for tears or cuts.*

- (1) Install fast idle speed adjusting screw and spring on fast idle lever.
- (2) Install solenoid, if removed.
- (3) Place fast idle lever assembly on throttle shaft and install retaining washer and nut.

(4) Lubricate tip of replacement Elastomer valve and insert tip into accelerator pump cavity center hole.

(a) Using needlenose pliers, reach into fuel bowl and grasp valve tip.

(b) Pull valve in until it seats in pump cavity wall. Cut off tip forward of retaining shoulder.

(c) Remove tip from bowl.

(5) Install accelerator pump diaphragm return spring in depression in chamber. Insert diaphragm assembly in cover, place cover and diaphragm assembly into position on main body and install two right-side cover screws.

(6) Position bowl vent bellerank and bracket assembly over accelerator pump cover left-side holes. Be sure vent lever is positioned behind pump lever. Install retaining screws.

(7) Insert accelerator pump operating rod into in-board hole of accelerator pump actuating lever.

(8) Position accelerator pump operating rod retainer over hole 3 in overtravel lever.

(9) Invert main body and install power valve and replacement gasket. Tighten valve securely.

(10) Install power valve cover and replacement gasket.

**NOTE:** *Install the power valve cover with limiter stops on the cover in position to provide a positive stop for the tabs on the idle adjusting limiters.*

(11) Install idle mixture adjusting screws and springs. Turn screws in gently with fingers until they just touch seat, then back off two turns for preliminary idle fuel mixture adjustment.

**NOTE:** *Do not install idle mixture limiters at this time.*

(12) Install main jets.

(13) Install fuel inlet seat and replacement gasket. Install fuel inlet needle assembly in fuel inlet seat. Fuel inlet needles and seats are matched assemblies. Be sure correct needle and seat are assembled together.

(14) Slide float shaft into float lever. Position float shaft retainer on float shaft.

(15) Install float damper spring with short wire under float lever (fig. 1J-54).

(16) Insert float assembly into fuel bowl and hook float lever tab under fuel inlet needle assembly. Insert float shaft into its guides at sides of fuel bowl.

(17) Press float shaft retainer into groove on fuel inlet needle seat and check float setting. Refer to Service Adjustment Procedures.

(18) Drop accelerator pump discharge ball into passage in main body.

(19) Position replacement booster venturi gasket and booster venturi in main body.

(20) Drop accelerator pump discharge weight into booster on top of discharge ball.

(21) Install air distribution plate and accelerator pump discharge screw and tighten screw.

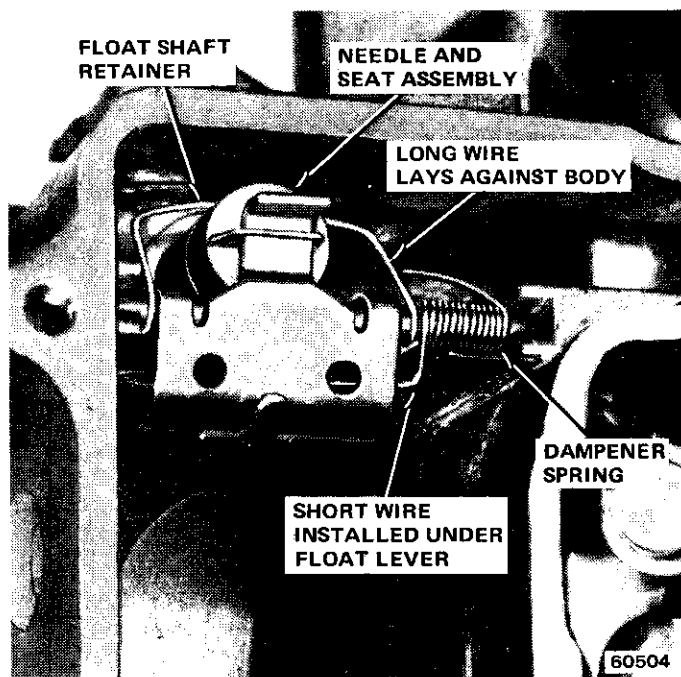


Fig. 1J-54 Damper Spring Installation

(22) Position fast idle cam lever on thermostatic choke shaft. Install retainer.

**NOTE:** The bottom of the fast idle cam lever adjusting screw must rest against the tang on the choke shaft.

(23) Insert choke shaft into the rear of choke housing. Position choke shaft so that choke hole in shaft is to left side of choke housing.

(24) Install fast idle cam rod on fast idle cam lever.

(25) Install fast idle cam and retainer to hub on main body.

(26) Place choke housing vacuum pickup port-to-main body gasket on choke housing flange.

(27) Wipe choke shaft bushing clean (small piece of plastic material), and install in choke shaft bore in choke housing.

(28) Position choke housing on main body and install choke housing attaching screws.

(29) Install retainer to fast idle cam rod at fast idle cam.

(30) Install thermostat lever.

(31) Install choke cover, gasket, retainer and screws. Turn choke housing 1/4 turn rich and tighten one retaining screw.

(32) Install choke shield.

(33) Insert choke rod into choke valve lever. Lower end of rod must protrude through air horn.

(34) Install choke valve lever to choke shaft and tighten screw.

(35) Install plastic dust shield to choke rod.

(36) Position main body gasket on main body.

(37) Position air horn on main body and gasket so that choke valve rod fits through opening in main body. Be sure plastic shield is free to slide.

(38) Insert end of choke valve rod into choke valve lever.

(39) Install air horn attaching screws and carburetor identification tag. Tighten attaching screws.

(40) Attach choke valve rod and retainer to thermostatic choke shaft lever.

(41) Install air cleaner anchor screw.

(42) Install modulator diaphragm return spring in recess of air horn. Position modulator cover over diaphragm assembly and engage piston rod with keyed slot of modulator arm. Place diaphragm and cover over return spring and install cover retaining screws.

(43) Adjust initial choke valve clearance. Refer to Service Adjustment Procedures.

(44) Adjust fast idle cam linkage. Refer to Service Adjustment Procedures.

(45) Adjust choke unloader clearance. Refer to Service adjustment Procedures.

(46) Loosen choke cover screw and set cover index. Refer to Specifications. Tighten all cover screws.

## SERVICE ADJUSTMENT PROCEDURES

### Float Level Adjustment—Dry

(1) Remove air horn assembly and gasket. Raise float by pressing down on float tab until fuel inlet needle is lightly seated.

(2) Use T-scale to measure distance from fuel bowl machined surface to flat surface of either corner of float at free end. Refer to Specifications for correct setting.

(3) Bend float tab to adjust. Hold fuel inlet needle off its seat while adjusting to prevent damage to Viton-tipped needle (fig. 1J-55).

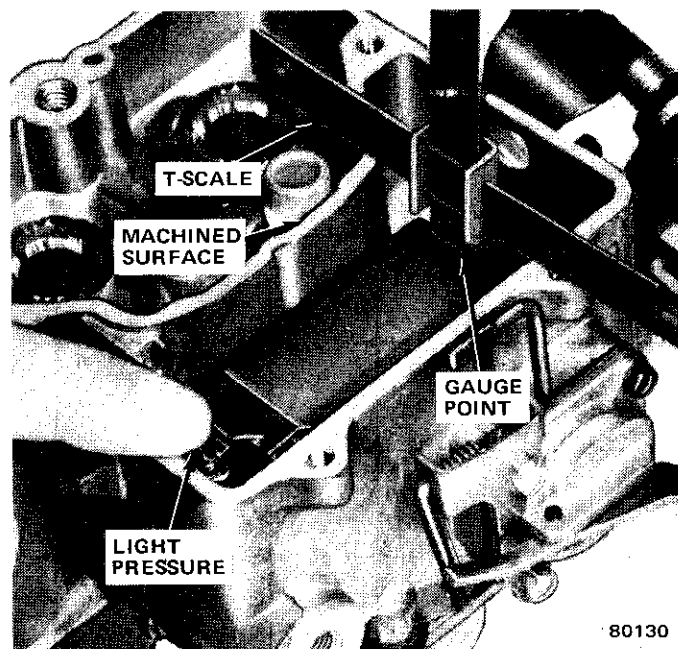


Fig. 1J-55 Dry Float Adjustment



### Float Level Adjustment—Wet

**WARNING:** Exercise extreme caution when performing this procedure. Fuel vapor is present when carburetor air horn is removed. Extinguish cigarettes and other smoking materials.

(1) Position vehicle on flat, level surface and warm engine to normal operating temperature. Turn engine off. Remove carburetor air cleaner assembly and anchor screw.

(2) Remove air horn attaching screws and carburetor identification tag. Temporarily place air horn and gasket in position on carburetor main body and start engine. Let engine idle one minute, then turn engine off and move air horn aside. Remove air horn gasket to provide access to float assembly.

(3) Use T-scale to measure vertical distance from top machined surface of carburetor main body to level of fuel in fuel bowl (fig. 1J-86). Make measurement at least 1/4 inch away from any vertical surface to assure accurate reading, because surface of fuel is concave (higher at edges than in center). Be careful to measure fuel level at point of contact between scale and fuel. Refer to Specifications for correct fuel level (wet) setting.

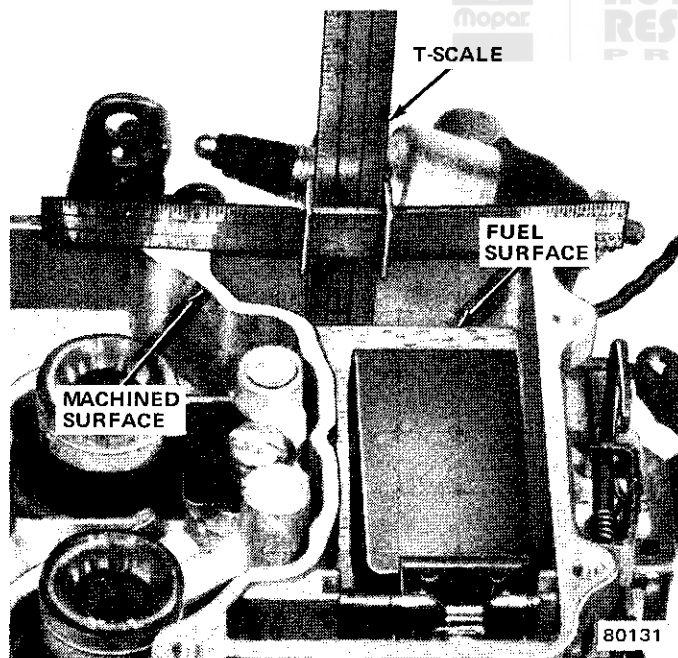


Fig. 1J-56 Wet Float Level Adjustment

(4) To adjust fuel level, bend float tab (contacting fuel inlet valve) upward in relation to original position to raise fuel level, and downward to lower it. Each time adjustment is made to float tab to alter fuel level, place gasket and air horn on carburetor, start engine and permit to idle one minute to stabilize fuel level. Turn engine off and check fuel level after each adjustment until specified level is obtained.

(5) Install replacement air horn gasket, air horn assembly, carburetor identification tag and attaching screws. Be sure plastic dust seal on choke operating rod is positioned correctly and does not cause rod to bind. Tighten screws. Install air cleaner anchor screw and tighten.

(6) Check idle fuel mixture and idle speed adjustments. Adjust carburetor as required. Refer to Chapter 1A—General Service and Diagnosis.

(7) Install air cleaner.

### Initial Choke Valve Clearance Adjustment

(1) Loosen choke cover retaining screws and rotate choke cover 1/4-turn counterclockwise (rich). Tighten one screw.

(2) Disconnect choke heat inlet tube. Align fast idle speed adjusting screw with second step (index) of fast idle cam.

(3) Start engine without moving accelerator linkage. Turn fast idle cam lever adjusting screw out (counterclockwise) three (3) full turns. Measure clearance between lower edge of choke valve and air horn wall. Refer to Specifications for correct setting.

(4) Adjust by turning set screw on bottom of modulator. Turn screw in to increase clearance or turn out to decrease clearance (fig. 1J-57).

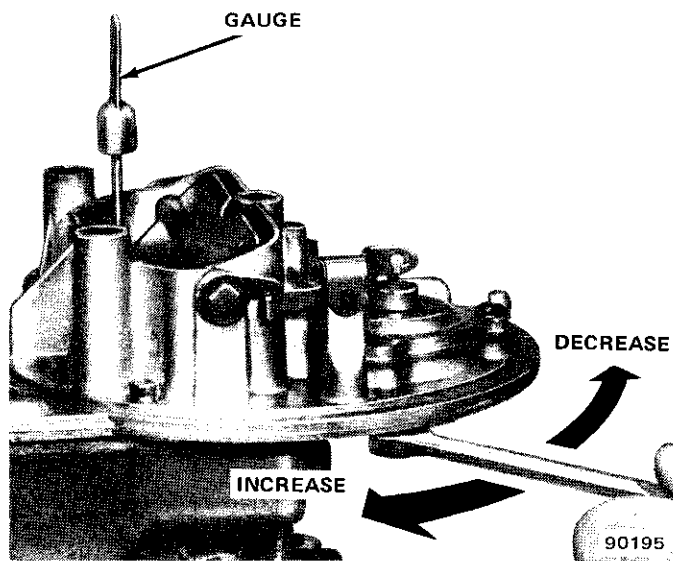


Fig. 1J-57 Initial Choke Valve Clearance Adjustment

(5) After completing adjustment, turn engine off and connect choke heat tube. Do not reset choke cover until fast idle cam linkage adjustment has been performed.

### Fast Idle Cam Linkage Adjustment

(1) Push down on fast idle cam lever until fast idle speed adjusting screw is in contact with second step (index) and against shoulder of high step (fig. 1J-58).

(2) Measure clearance between lower edge of choke valve and air horn wall. Refer to Specifications for correct setting.

(3) Adjust by turning fast idle cam lever screw.

(4) Loosen choke cover retaining screws and adjust choke as outlined under Automatic Choke Adjustment.

(5) Install choke shield clamp and retaining screws.

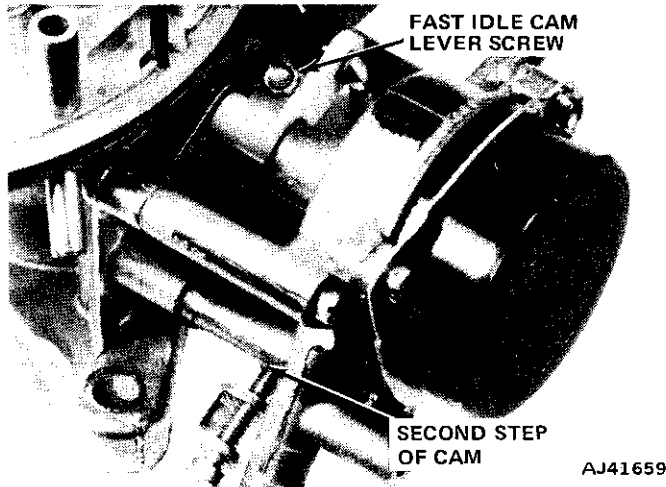


Fig. 1J-58 Fast Idle Cam Linkage Adjustment

### Choke Unloader Adjustment

(1) Hold throttle fully open and apply pressure on choke valve toward closed position.

(2) Measure clearance between lower edge of choke valve and air horn wall. Refer to Specifications for correct setting.

**CAUTION:** Do not bend the unloader tang downward from a horizontal plane.

(3) Adjust by bending unloader tang which contacts fast idle cam (fig. 1J-59). Bend toward cam to increase clearance and away from cam to decrease clearance.

(4) After making adjustment, open throttle until unloader tang is directly below fast idle cam pivot. There must be exactly 0.070-inch (1.8 mm) clearance between unloader tang and edge of fast idle cam (fig. 1J-60).

(5) Operate throttle and check unloader tang to make sure it does not bind, contact or stick on any part of carburetor casting or linkage. After carburetor installation, check for full throttle opening when throttle is operated from inside vehicle. If full throttle opening is not obtainable, it may be necessary to remove excess padding under floor mat or reposition throttle cable bracket located on engine.

### Automatic Choke Adjustment

Loosen choke cover retaining screws and rotate cover in the desired direction as indicated by the arrow on the face of the cover. Refer to Specifications for the correct

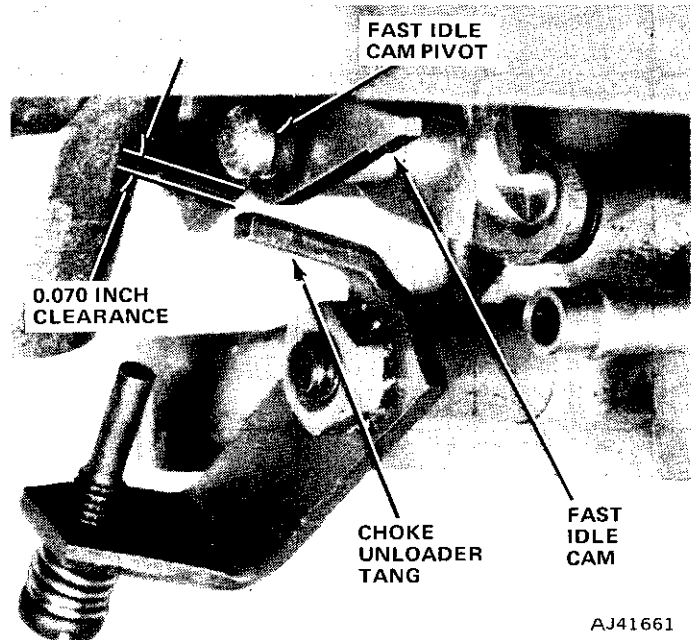


Fig. 1J-59 Unloader Adjustment

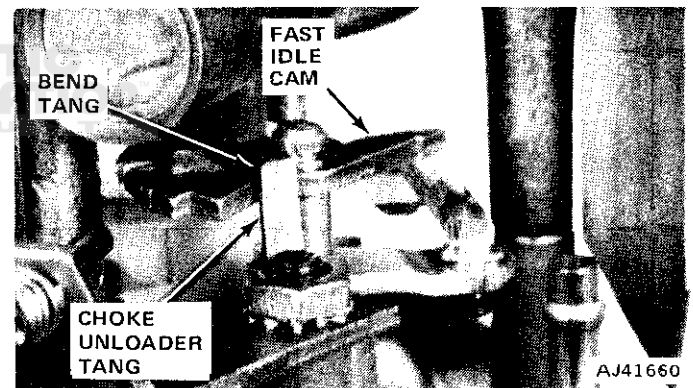


Fig. 1J-60 Unloader to Fast Idle Cam Clearance

setting. The specified setting will be satisfactory for most driving conditions.

**NOTE:** The automatic choke acts like a timer. The richer the setting the longer the spring tension acts against the linkage and holds the choke in a closed position. Warmed incoming air warms the spring. Spring tension is reduced and fast idle cam weight moves the choke linkage against spring tension.

### Accelerating Pump Stroke Adjustment

The specified accelerator pump stroke has been selected to help keep the exhaust emission level of the engine within Federal limits. The unused adjustment holes permit adjusting the stroke for specific engine and climate applications. The primary throttle shaft lever (overtravel lever) has four holes and the accelerator pump link has two holes (fig. 1J-61).

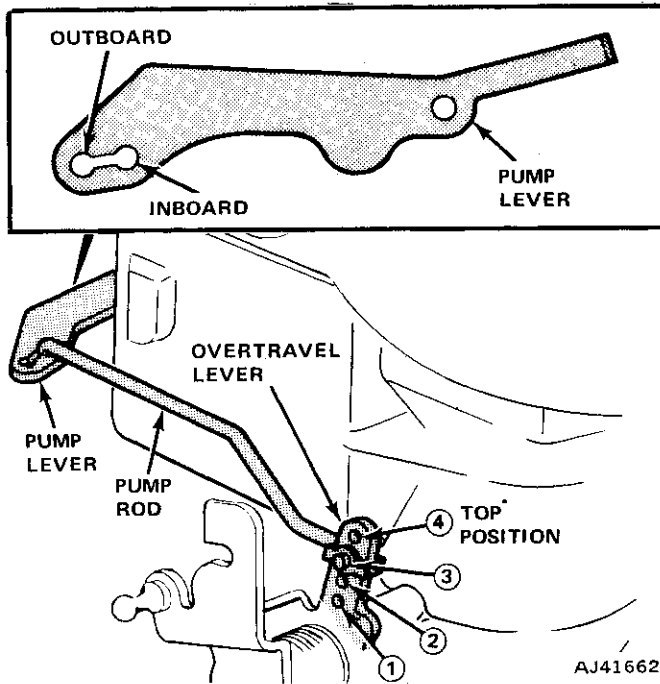


Fig. 1J-61 Accelerator Pump Stroke Adjustment

For normal operating conditions, the accelerator pump operating rod should be in the third hole (away from the lever pivot) of the overtravel lever and the inboard hole (closest to the pump plunger) in the accelerating pump link. In extremely hot climate regions, the pump stroke may be shortened to provide smoother acceleration by placing the pump rod in the second hole of the overtravel lever. In extremely cold climate regions, the pump stroke may be increased to provide smoother acceleration by placing the pump rod in the fourth hole of the overtravel lever.

(1) Remove operating rod from retaining clip.

(2) Position clip over specified hole in overtravel lever. Insert operating rod through clip and overtravel lever. Snap release clip over rod.

### Idle Speed and Mixture Adjustment

Refer to procedures outlined in Chapter 1A—General Service and Diagnosis.

### Fast Idle Speed Adjustment

Set the fast idle speed with the engine at operating temperature and with EGR and TCS solenoid disconnected. Position fast idle screw in contact with second step and against the shoulder of the high step of the fast idle cam. Refer to Specifications for the correct setting. Adjust by turning the fast idle screw.

### Bowl Vent

This is not a precise adjustment. It is made to ensure that the mechanical bowl vent is open at idle and closed at greater throttle openings. It may be performed on or off vehicle.

(1) If on vehicle, turn ignition off. Be sure throttle is completely off fast idle cam.

(2) Manually depress stem of bowl vent valve and insert gauge between valve stem and flat on end of bellcrank. Refer to Specifications for clearance.

(3) If clearance is not correct, bend bellcrank as required. Do not bend lever on accelerator pump.

### CHOKE MECHANISM SERVICE

The choke mechanism may be serviced without removing the carburetor from the engine. If the choke binds, sticks, or does not operate smoothly, perform the following.

(1) Remove choke cover.

(2) Remove choke lever and screw.

(3) Remove choke housing. Slide off thermostatic choke shaft. Remove thin plastic bearing material.

(4) Polish shaft with crocus cloth. Wipe bearing material clean and insert into housing.

(5) Wipe fast idle cam clean.

(6) Install choke housing to thermostatic choke shaft and install housing screws.

(7) Install choke lever and screw.

(8) Install housing cover and set to specification.

### SPECIFICATIONS

#### Model 2100 Carburetor Calibrations (Inches)

	9DM2	8DM2C	9DA2J	9DM2H
Throttle Bore Size	1.562	1.562	1.562	1.562
Main Venturi Size	1.080	1.080	1.080	1.080
Fuel Inlet Diameter	0.101	0.101	0.101	0.101
Low Speed Jet (Tube)	0.031	0.028	0.032	0.033
Economizer	0.052	0.046	0.046	0.046
Idle Air Bleed	0.106	0.106	0.101	0.101
Main Jet Number	44	49	44	43
High Speed Bleed	0.052	0.052	0.052	0.052
Power Valve Timing (inches of Hg)				
—First Stage	9.0	10.0	9.0	7.5
—Second Stage	5.0	5.5	5.0	2.0
Accelerator Pump Jet	0.032	0.028	0.024	0.032
Vacuum Spark Port				
—Height	0.050	0.050	0.050	0.050
—Width	0.085	0.085	0.085	0.085
Spark Port Location Above Closed Throttle	0.025	0.025	0.042	0.042
Choke Heat Bypass	0.114	0.114	0.114	0.114
Choke Heat Inlet Restriction	0.076	0.076	0.076	0.076
Choke Vacuum Restriction	0.082	0.082	0.089	0.089

**Model 2100 Carburetor Specifications**

List Number	Application	Float Level (Wet)		Float Level (Dry)	Initial Choke Valve Clearance		Fast Idle Cam Setting		Automatic Choke Cover Setting (Notches Rich)		Choke Unloader	Fast Idle Speed		Bowl Vent Clearance	Choke Bimetal ID
		Set To	OK Range		Set To	OK Range	Set To	OK Range	Set To	OK Range		Set To	OK Range		
9DM2	304 Manual 49 State	0.93	0.868 to 0.992	Measure from machined surface to a point on float 1/8-inch from tip. Needle Seated. Set to 0.555 OK Range 0.493 to 0.617	0.125	0.102 to 0.148	0.120	0.105 to 0.135	2	1-1/2 to 2-1/2	0.300 min.	1500	1400 to 1600	0.120	EKL
9DM2C	304 Manual California	0.93	0.868 to 0.992		0.132	0.109 to 0.155	0.120	0.105 to 0.135	1	1/2 to 1-1/2	0.250 min.	1500	1400 to 1600	0.120	EKL
9DA2J	304 Automatic 49 State	0.93	0.868 to 0.992		0.128	0.105 to 0.151	0.113	0.098 to 0.128	1	1/2 to 1-1/2	0.300 min.	1600	1500 to 1700	0.120	EKL
9DM2H	304 Manual Hilly Terrain	0.93	0.868 to 0.992		0.140	0.163 to 0.117	0.125	0.110 to 0.140	Index	1/2R to 1/2L	0.360 min.	1500	1400 to 1600	0.120	EKL

Hot with EGR Valve Disconnected.

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# CARBURETOR MODEL 2150-2 VENTURI

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## GENERAL

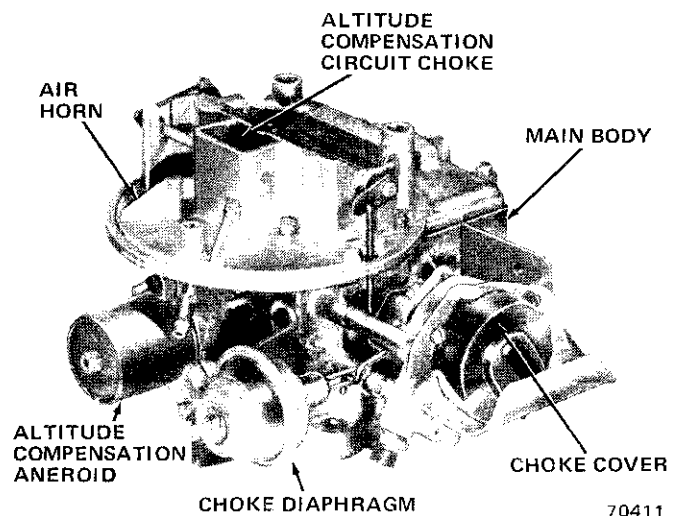
The Motorcraft Model 2150 carburetor with altitude compensation is installed on eight-cylinder engines in vehicles sold for use at elevations of 4000 (1 219 m) feet or more.

This carburetor features a compensation circuit which mixes a metered amount of additional air into the fuel/air mixture to prevent an over-rich condition at higher altitudes. An automatic device (aneroid) senses atmospheric pressure and overrides the compensation feature at lower altitudes (fig. 1J-62).

**NOTE:** At extremely low barometric pressure levels, the aneroid may open the bleed valve at sea level. This is normal and does not indicate a faulty component.

The Model 2150 carburetor uses a choke diaphragm to provide initial choke valve clearance. The vacuum modulator used in the Model 2100 is not used on the Model 2150.

The Model 2150 Carburetor operates and is serviced the same as the Model 2100 except for the altitude compensation device and the choke circuit. This section cov-



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Fig. 1J-62 Model 2150 Carburetor Assembly

ers only operational differences. Service procedures and adjustment procedures are provided only for the compensation device and choke diaphragm. All other information is covered in the preceding section, Model 2100 Carburetor—2V.

## CARBURETOR CIRCUITS

### Altitude Compensation Circuit

The altitude compensation circuit supplies the extra air necessary to lean out the fuel/air mixture at high altitudes. The compensation circuit parallels the main carburetor intake circuit (fig. 1J-63). At the top, a small choke valve controls the airflow when the main choke is closed. Air flows down through a passage in the main body into a plenum chamber located adjacent to the two main venturi bores. A spring-loaded valve regulates the amount of air passed from the plenum into the compensator body. Air flows from the compensator body through two air passages bored into the main venturis.

The opening and closing of the valve in the compensator body is controlled by an aneroid which is sensitive to atmospheric pressure. At the lower atmospheric pressure of high altitudes, the aneroid pushes on the end of the compensator valve stem, opening the valve. At lower altitudes, the aneroid relaxes, automatically closing the valve.

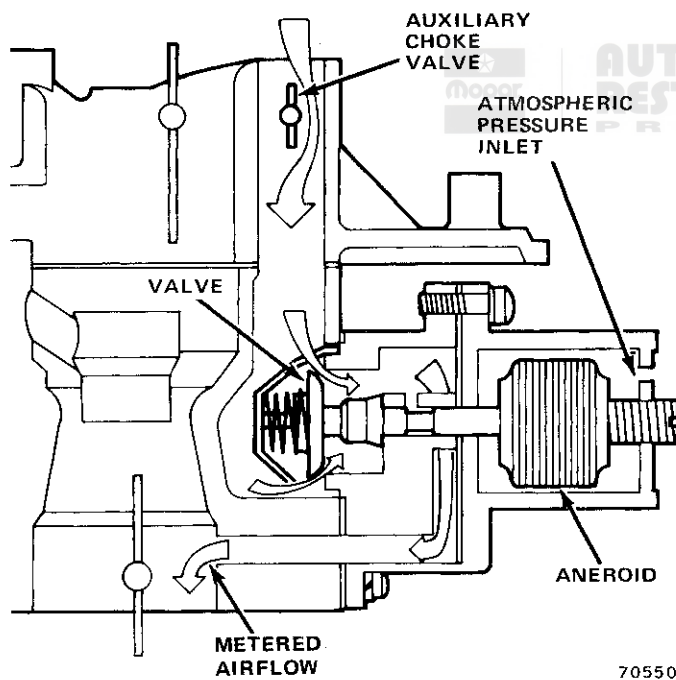


Fig. 1J-63 Altitude Compensation Circuit

The aneroid is factory calibrated and is not adjustable. Do not tamper with the hex-head plug on the aneroid.

### Choke Circuit

The compensation circuit is provided with a separate choke valve linked directly to the main choke valve (fig. 1J-64). It is not adjustable.

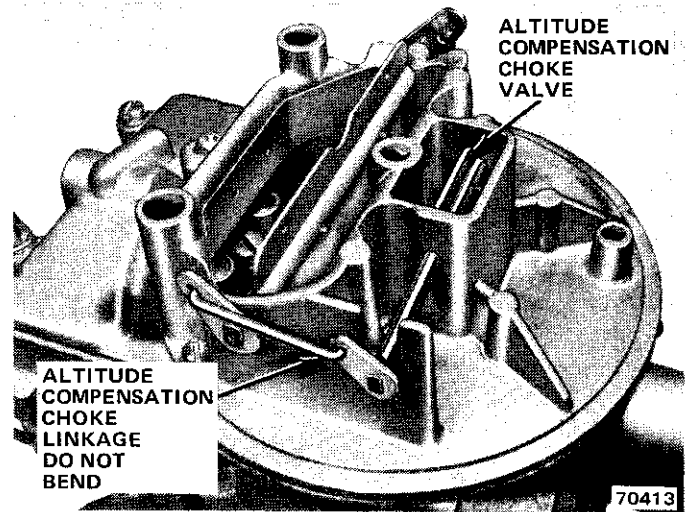


Fig. 1J-64 Compensation Circuit Choke Valve

A thermostatic coil is used to operate the choke valve for cold engine start-up. The bimetal coil winds up when cold and unwinds when warm. Exhaust-heated air is provided to warm the coil as the engine warms up. An electric coil supplies additional heat to open the choke valve more quickly. The electric choke consists of a ceramic heater in the choke coil housing. Current to operate the heater is supplied through an oil pressure sensing switch. When the engine is operating, oil pressure closes the switch to operate the choke. If the engine should stall, current to the heater coil is interrupted until the engine is restarted.

When the engine starts, manifold vacuum is applied to the choke vacuum diaphragm to open the choke valve slightly. This is called the initial choke valve clearance.

If the engine is accelerated during the warm-up period, the corresponding drop in manifold vacuum allows the thermostatic coil to momentarily close the choke valve to provide a richer mixture.

## CARBURETOR OVERHAUL

In addition to Model 2100 overhaul procedures, perform the following:

### Disassembly

- (1) Remove attaching screws and remove compensation assembly and gasket from carburetor body.
- (2) Remove aneroid-to-chamber screws. Remove gasket and aneroid from chamber.

### Cleaning and Inspection

**CAUTION:** Do not immerse any part of the altitude compensation assembly in cleaning solvent. Wipe all parts with clean, lint-free cloths.

With the aneroid removed from the chamber, spring tension should push the air valve fully shut. Check the position of the spring in the retainer to be sure it is properly seated (fig. 1J-65). Inspect the rubber seal on the valve stem. Check the aneroid assembly to be sure that the atmospheric pressure inlet hole is free of debris.

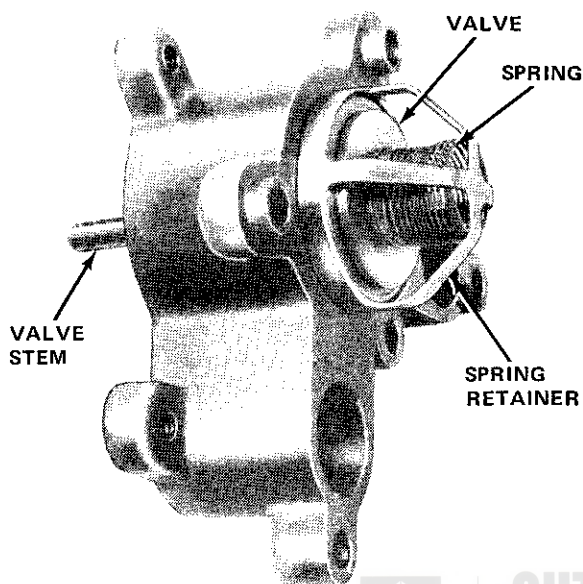


Fig. 1J-65 Inspecting Compensator

**Assembly**

- (1) Install aneroid to chamber using replacement gasket. Install screws.
- (2) Install assembly to carburetor body using replacement gasket. Install screws.

**SERVICE ADJUSTMENT PROCEDURES**

In addition to the Model 2100 adjustment procedures, perform the following.

**Altitude Compensation Assembly Adjustment**

There are no adjustments to this assembly. **Do not** attempt to turn the fitting on the aneroid. It is set and sealed at the factory.

**Initial Choke Valve Clearance Adjustment**

- (1) Loosen choke cover retaining screws.
- (2) Open throttle and rotate choke cover until choke valve is held closed. Tighten one retaining screw.
- (3) Close throttle with fast idle speed screw on top step of cam.
- (4) Apply vacuum to hold choke diaphragm against setscrew. Do not press on links.

**NOTE:** If vacuum is applied to the choke diaphragm with a hand pump, a vacuum leak may be noticed. This is normal.

(5) Measure clearance between lower edge of choke valve and air horn (fig. 1J-66).

(6) Adjust clearance by turning screw located at rear of diaphragm housing.

(7) Adjust fast idle cam linkage.

(8) Loosen choke cover screw and rotate cover to relieve tension on choke bimetallic coil. Set choke cover to specifications and tighten choke cover retaining screws.

**NOTE:** Do not reset the choke cover until fast idle cam linkage adjustment has been performed.

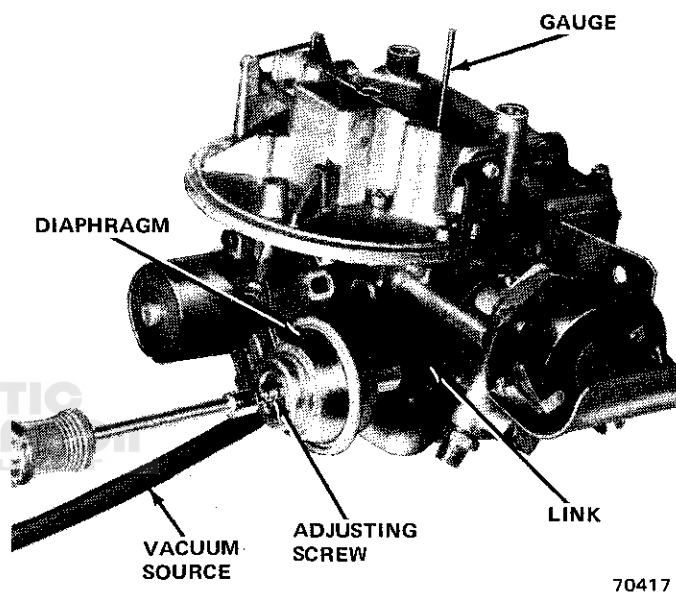


Fig. 1J-66 Initial Choke Valve Clearance Adjustment

**SPECIFICATIONS**

**Model 2150 Carburetor Calibrations (Inches)**

	9RHM2	9RHA2
Throttle Bore Size	1.562	1.562
Main Venturi Size	1.21	1.21
Fuel Inlet Diameter	0.101	0.101
Low Speed Jet (Tube)	0.033	0.036
Economizer	0.052	0.061
Idle Air Bleed	0.086	0.086
Main Jet Number	55	55
High Speed Bleed	0.055	0.055
Power Valve Timing (inches of Hg)		
- First Stage	9.0	9.0
- Second Stage	5.0	5.0
Accelerator Pump Jet	0.024	0.024
Vacuum Spark Port		
- Height	0.050	0.050
- Width	0.085	0.085
Choke Heat Bypass	0.114	0.114
Choke Heat Inlet Restriction	0.076	0.076
Choke Vacuum Restriction	0.089	0.089

Model 2150 Carburetor Specifications

List Number	Application	Float Level		Float Drop	Initial Choke Valve Clearance		Fast Idle Cam Setting		Automatic Choke Cover Setting (Notches Rich)		Choke Unloader	Fast Idle <sup>1</sup> Speed		Bowl Vent Clearance	Choke Bimetal ID
		Set To	OK Range		Set To	OK Range	Set To	OK Range	Set To	OK Range		Set To	OK Range		
9RHM2	360 Manual 49 State	0.93	0.868 to 0.992	Measure from machined surface to a point on float 1/8-inch from tip Needle Seated	0.104	0.091 to 0.127	0.086	0.071 to 0.101	2	1-1/2 to 2-1/2	0.348 min.	1500	1400 to 1600	0.120	EKL
9RHA2	360 Automatic 50 State	0.93	0.868 to 0.992		Set to 0.555 OK Range 0.403 to 0.617	0.113	0.090 to 0.136	0.093	0.078 to 0.108	2	1-1/2 to 2-1/2	0.350 min.	1600	1500 to 1700	0.120

<sup>1</sup> Hot with EGR Disconnected

# VACUUM THROTTLE MODULATING (VTM) SYSTEM

This system reduces the emission of hydrocarbons (HC) during rapid throttle closure at high speeds. It is not used on CJ models, but is used on some 49-State Cherokee, Wagoneer and Truck models with eight-cylinder engine.

The system consists of a deceleration valve located at the right front side of the intake manifold and a throttle modulating diaphragm located at the carburetor base. The deceleration valve is connected by one hose to a manifold vacuum source and by another hose to the throttle modulating diaphragm (fig. 1J-67).

During high speed deceleration, when manifold vacuum reaches approximately 21 to 22 inches (71 to 74 kPa) the deceleration valve triggers a vacuum signal to the throttle modulating diaphragm and causes a plunger to move out and open the throttle slightly. The increased throttle opening allows more air to enter the combustion chambers and lean out the overrich mixture, reducing the emission of the hydrocarbons.

The deceleration valve calibration is preset at time of manufacture and normally does not require adjustment. To check and adjust the throttle modulating diaphragm, proceed as follows:

(1) Set curb idle speed to specification, then turn engine off.

(2) Position throttle lever against curb idle adjusting screw.

(3) Measure clearance between throttle modulating diaphragm plunger and throttle lever. It should be 1/16 inch (0.062 inch) (1.57 mm).

(4) Adjust by loosening jamnut and turning diaphragm assembly.

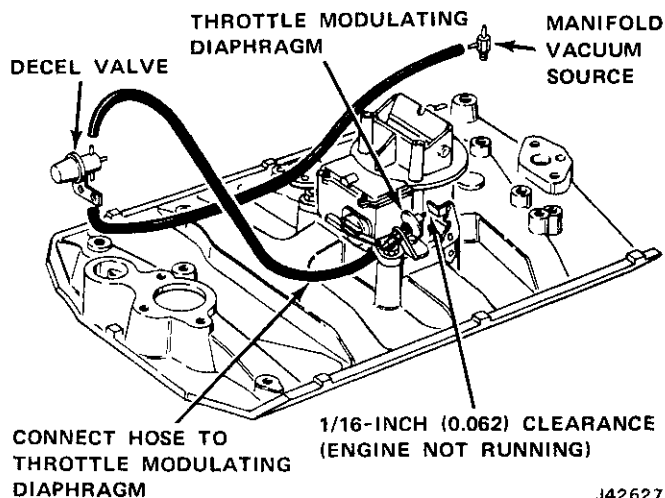


Fig. 1J-67 Vacuum Throttle Modulating System—Typical

# EXHAUST GAS RECIRCULATION (EGR) SYSTEM

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## GENERAL

The EGR system used on all Jeep vehicles reduces the formation of oxides of nitrogen (NOx) by introducing a metered amount of exhaust gas into the combustion chambers. Exhaust gas is inert (will not burn), so combustion temperature is reduced. Less NOx is produced at lower combustion temperature.

EGR does not take place until engine operating temperature has reached a preset level and engine load is sufficient to permit proper EGR operation.

Jeep vehicles use three different types of EGR systems (fig. 1J-68, 1J-69 and 1J-70). The EGR system without back pressure sensor; EGR system with integral back pressure sensor; EGR system with external, non-integral back pressure sensor.

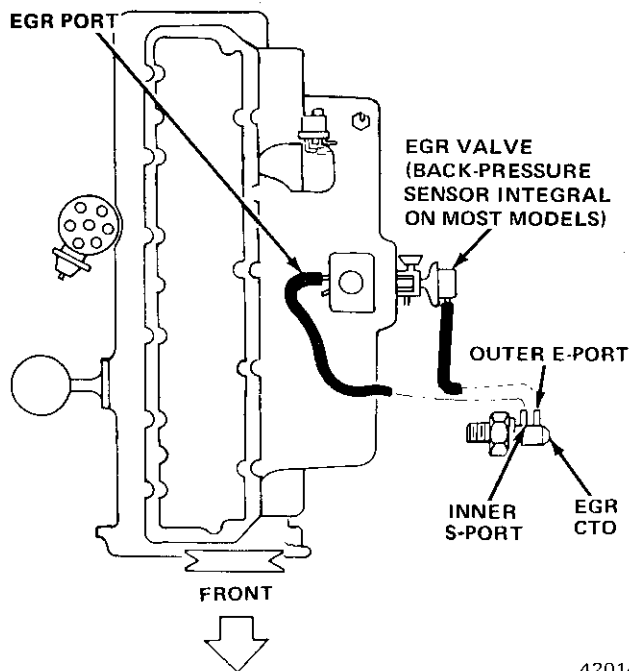


Fig. 1J-68 EGR System—Six-Cylinder—Typical

The EGR CTO switch prevents EGR action until engine temperature reaches a preset level, and the back-pressure sensor, if equipped, permits EGR action only at increased engine loads, improving driveability.

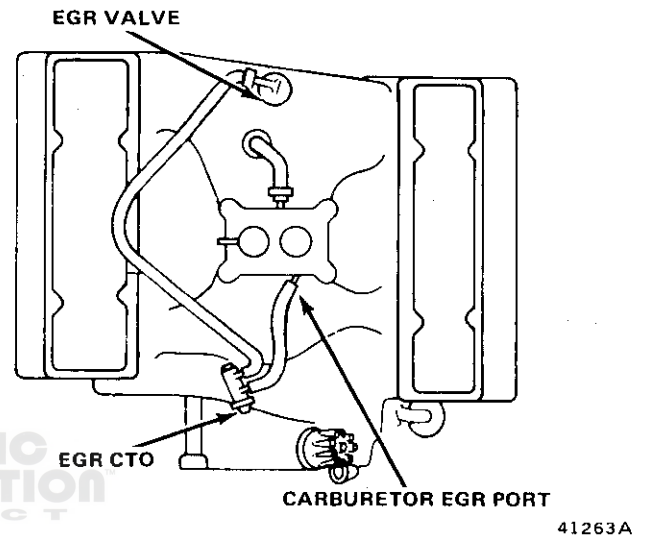


Fig. 1J-69 EGR System—Eight-Cylinder—Typical

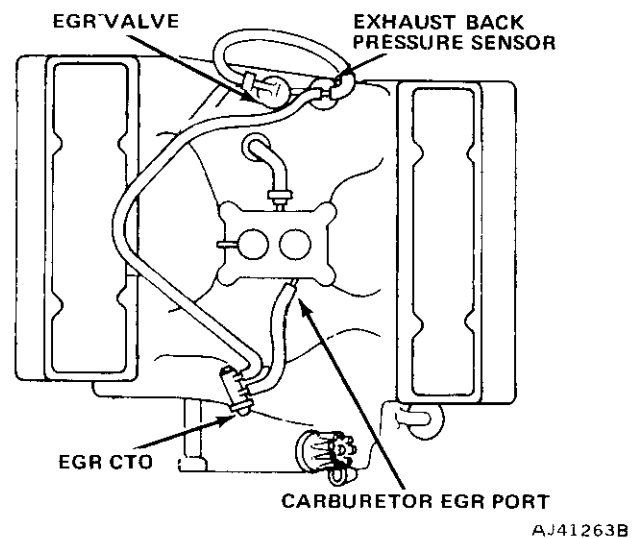


Fig. 1J-70 EGR System—Eight-Cylinder—with External, Non-Integral Back-Pressure Sensor

Depending on model applications the following components may be used either separately or together. The Thermal Vacuum Switch is located in the air cleaner and is controlled by air cleaner air temperature. The TVS controls the vacuum passage between the EGR-CTO switch and the EGR valve. At temperatures below the



calibrated valve, the TVS limits the passage of vacuum to the EGR valve prohibiting EGR valve operation and improving cold driveability. The EGR Dump Valve is in series with the EGR vacuum signal source and the EGR valve, at the calibrated vacuum level, the vacuum signal to the EGR valve is interrupted thereby "Dumping" the EGR. This valve is used to eliminate EGR function at relatively low vacuum signal levels.

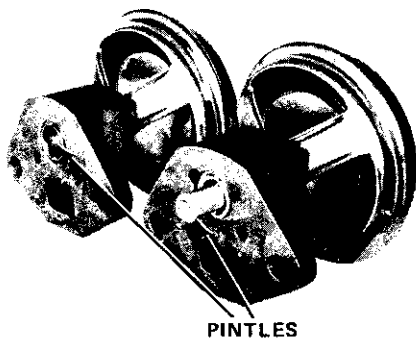
**EGR VALVE**

The EGR valve mounts on the side of the intake manifold on six-cylinder engines and on a machined surface at the rear of the intake manifold on eight-cylinder engines. When the separate back-pressure sensor is used, the EGR valve mounts on the spacer which is an integral part of the back-pressure sensor. Exhaust gas is drawn from an area near the heat riser in six-cylinder engines and from the exhaust crossover passage in eight-cylinder engines.

**EGR Valve without Back-Pressure Sensor**

EGR valves are calibrated by the use of differently shaped pintles (fig. 1J-71). The valve is normally held closed by a spring located above the diaphragm (fig. 1J-72). The valve opens when sufficient vacuum is applied through hoses connecting the CTO switch and the back-pressure sensor (if used) to the EGR vacuum port at the carburetor.

When vacuum overcomes the diaphragm spring pressure, a pintle within the valve is lifted off its seat and exhaust gas, which reaches the EGR valve through special passages, is metered into the intake manifold.



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Fig. 1J-71 EGR Valve Pintles

**EGR Valve with Integral Back-Pressure Sensor**

Calibration is accomplished by the selective use of different diaphragm spring loads and flow control orifices. The unit combines the functions of the EGR valve and back-pressure transducer into a single component. A restrictor plate is not required.

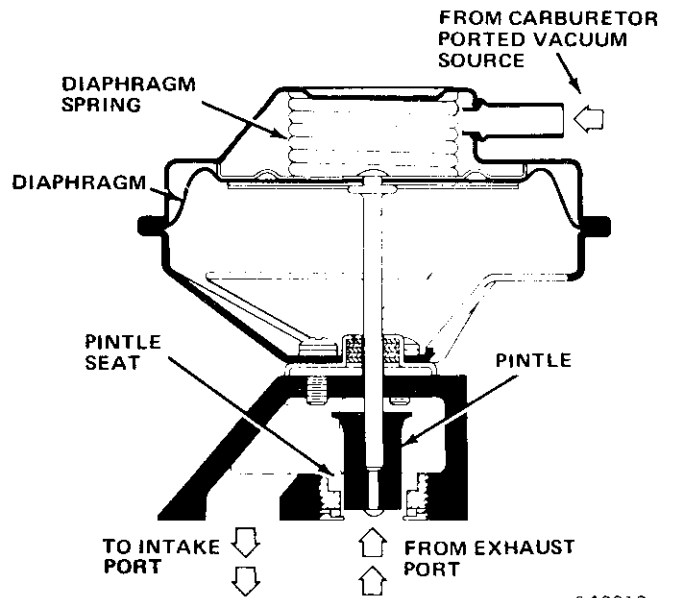


Fig. 1J-72 EGR Valve without Back-Pressure Sensor

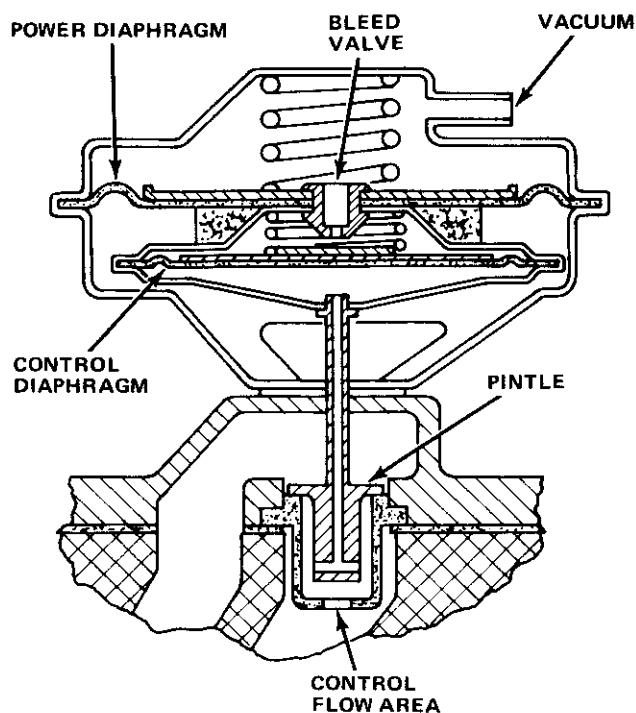
The flow (recirculation) of exhaust gas is controlled by a movable pintle (fig. 1J-73). In the relaxed position, spring pressure holds the pintle against its seat, confining exhaust gases to the exhaust manifold. Carburetor vacuum is available at the power diaphragm to pull the pintle from its seat, but this cannot happen while the vacuum bleed valve in the power diaphragm is open.

Exhaust gas exerts pressure (back-pressure) inside the exhaust manifold whenever the engine is running. This pressure is conducted through the hollow pintle stem into the control diaphragm chamber. If this pressure is great enough to overcome control spring pressure, the control diaphragm is moved against the bleed valve. Full vacuum is now applied to the power diaphragm, the pintle moves off its seat, and EGR now begins. If back-pressure drops sufficiently, the control diaphragm moves away from the bleed valve, the power diaphragm again relaxes and EGR stops.

System pressure remains constant, within the range of the unit. Recirculation is a function of the exhaust manifold back-pressure level. EGR is dependent on back-pressure and is a fixed percentage of the incoming charge.

**EGR Valve Test**

On vehicles with back-pressure sensor (integral and non-integral), the condition of the exhaust system may affect EGR operation. Excessive back pressure from exhaust system restrictions may create driveability problems. Refer to Chapter 1K for Restricted Exhaust System Diagnosis. Leaks in the exhaust system may decrease back pressure enough to prevent proper EGR operation. This will increase exhaust emissions. Visually inspect exhaust system if leaks are suspected.



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Fig. 1J-73 EGR Valve with Integral Back-Pressure Sensor

#### Valve Opening Test

With engine at operating temperature and curb idle, rapidly open and close throttle. Throttle should be opened sufficiently for engine to reach 1500 rpm. A definite movement should be noticed in the EGR diaphragm.

If the diaphragm does not move, the probable causes are: faulty vacuum signal to EGR, defective EGR diaphragm or defective back-pressure sensor diaphragm, if equipped. Check vacuum lines for leaks.

#### Valve Closing Test

With the engine at operating temperature and curb idle, manually depress the EGR valve diaphragm. This should cause an immediate drop in engine speed, indicating that the EGR valve had been properly cutting off the flow of exhaust gas at idle.

If there is no change in engine rpm and the engine is idling properly, exhaust gases do not reach the combustion chamber. The probable cause is a plugged passage between the EGR valve and the intake manifold.

If the engine idles poorly and rpm is not greatly affected by compressing the EGR diaphragm, the EGR valve is not closing off the flow of exhaust gases. There is a fault in the hoses, hose routings or the valve itself.

#### EGR Valve Replacement

##### Removal

(1) On eight-cylinder engines, remove air cleaner assembly.

- (2) Disconnect vacuum hoses.
- (3) Remove two retaining screws from manifold.
- (4) Remove EGR valve, gasket, spacer and attached exhaust back-pressure sensor assembly (if used), restrictor plate and its gaskets (if used).
- (5) Clean EGR pintle if required. Refer to EGR Valve Maintenance.
- (6) Discard gaskets and clean all mating surfaces.

##### Installation

- (1) Install restrictor plate (if used) between two gaskets and install spacer (if used), EGR gasket and EGR valve.
- (2) Install retaining screws and tighten.
- (3) Connect vacuum lines and install air cleaner assembly, if removed.

**NOTE:** The non-integral exhaust back-pressure assembly, if used, should extend toward the left side on eight-cylinder engines. The stainless steel restrictor plate is calibrated for the engine and exhaust system found on that vehicle. Always replace the same restrictor plate originally installed.

#### EGR Valve Maintenance—Cherokee-Wagoneer-Truck

Remove all lead or carbon deposits from the stainless steel metering pintle of the valve using a wire brush. After cleaning, depress the diaphragm, cap the vacuum inlet and repeatedly open the EGR valve manually by pressing down on the diaphragm and releasing. Pintle should remain retracted. If it does not, diaphragm has a leak and valve must be replaced.

On six-cylinder engines, lead or carbon deposits will build most rapidly in the exhaust gas discharge passage (upper hole). If the deposits cannot be removed with a spiral-type wire brush, a 9/16-inch (14 mm) drill may be used. Coat the tip of the drill with heavy grease and use pliers (Vise-Grip) to rotate the bit in the discharge passage.

#### EGR CTO SWITCH

The EGR CTO switch is located at the left side of the cylinder block on six-cylinder engines and at the coolant passage of the intake manifold adjacent to the oil filler tube on eight-cylinder engines. The inner port (S) connects by hose to the EGR port at the carburetor, the outer port (E) connects to the EGR valve. When the vehicle is equipped with a non-integral back-pressure sensor, the E-port connects to the back-pressure sensor.

When coolant temperature is below the rating of the CTO switch there is no vacuum signal to the EGR system. The EGR CTO switch opens at 115°F (46°C) and has a black body or a black paint dab. All other Jeep models have an 160°F (71°C) CTO switch with a yellow body or yellow paint dab.

**EGR CTO Test**

**NOTE:** Engine coolant temperature must be below 100°F.

(1) Check vacuum lines for leaks and correct routings (fig. 1J-68, 1J-69 and 1J-70).

(2) Disconnect vacuum line at back-pressure sensor if equipped, or at the EGR valve. Connect line to vacuum gauge.

(3) Operate engine at 1500 rpm. No vacuum should be indicated on gauge. If vacuum is indicated, replace EGR CTO switch.

(4) Idle engine until coolant temperature exceeds 115°F (46°C) (black color code) or 160°F (71°C) (yellow color code).

**NOTE:** The temperature gauge needle is about halfway between the cold mark and the beginning of the band at 115°F (46°C) and about at the beginning of the band at 160°F (71°C).

(5) Accelerate engine to 1500 rpm. Carburetor ported vacuum should be indicated on vacuum gauge. If not, replace EGR CTO switch.

**EGR CTO Switch Replacement**

**Removal—Six-Cylinder**

**WARNING:** Serious burns can result if hot coolant is not drained before removing switch from block.

- (1) Drain coolant from radiator.
- (2) Disconnect vacuum lines.
- (3) Using 7/8-inch open-end wrench, remove switch from block.

**Installation—Six-Cylinder**

- (1) Install EGR CTO switch in block.
- (2) Connect vacuum lines.
- (3) Install coolant and purge air from cooling system.

**Removal—Eight-Cylinder Engine**

**WARNING:** Serious burns can result if hot coolant is not drained before removing switch from intake manifold.

- (1) Drain coolant from radiator.
- (2) Remove air cleaner assembly.
- (3) Remove coil bracket attaching screw and tip coil away from EGR CTO switch.
- (4) Disconnect vacuum hoses from CTO switch.
- (5) Using 7/8-inch open-end wrench, remove switch from intake manifold.

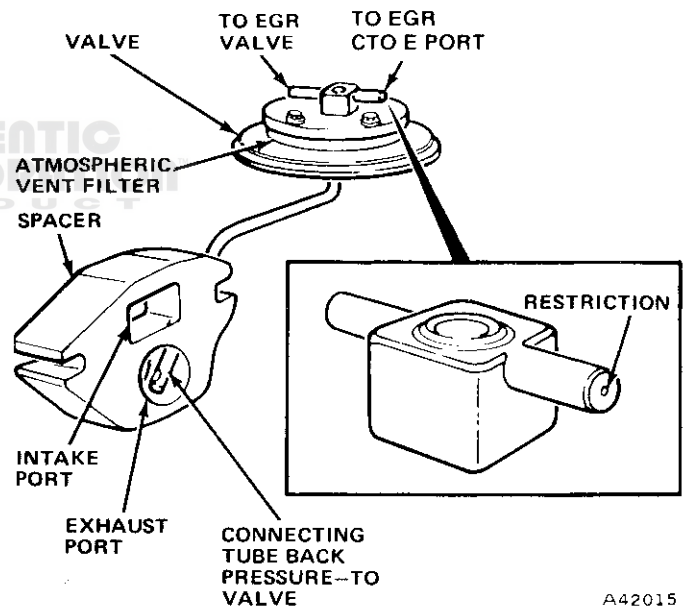
**Installation—Eight-Cylinder Engine**

- (1) Install EGR CTO switch in intake manifold.
- (2) Install coil and bracket with attaching screw.
- (3) Connect vacuum hose to switch.
- (4) Install air cleaner assembly.
- (5) Install coolant and purge cooling system of air.

**EXHAUST BACK-PRESSURE SENSOR—NON-INTEGRAL**

This device monitors exhaust back-pressure and permits EGR operation only when engine operating conditions are favorable for EGR action with a given engine/exhaust combination. Back-pressure sensors are variously calibrated, are not serviceable, and must be replaced when necessary with the same part number.

The exhaust back-pressure sensor consists of a diaphragm valve and a spacer connected by a metal tube which projects into an exhaust port in the spacer body (fig. 1J-74). The EGR valve mounts directly on the spacer.



**Fig. 1J-74 Non-Integral Exhaust Back-Pressure Sensor**

The metal tube connecting the diaphragm valve to the spacer picks up exhaust back-pressure from the exhaust port into which it projects. When the back-pressure reaches the calibrated level of the sensor, the diaphragm valve spring pressure is overcome, permitting a vacuum signal to the EGR valve when the coolant temperature override (CTO) switch is open. Refer to EGR CTO Switch in this chapter.

This system permits EGR operation only when the engine has warmed up sufficiently and when exhaust pressure is relatively high, as in acceleration and at some cruising speeds. When back-pressure has not reached calibrated levels, or if the CTO switch has not opened, the carburetor vacuum signal vents to the atmosphere from a vent at the diaphragm valve.

**Removal**

- (1) Remove vacuum lines from exhaust back-pressure sensor valve and EGR valve.
- (2) Remove two attaching nuts from EGR valve.
- (3) Remove EGR valve and exhaust back-pressure sensor assembly.
- (4) Clean intake manifold and back-pressure sensor ports and all mating surfaces.

**Installation**

- (1) Install replacement gasket on intake manifold and position exhaust back-pressure sensor on top of gasket.

**NOTE:** Exhaust back-pressure sensor assembly should extend toward the left side on eight-cylinder engines.

- (2) Install replacement gasket on exhaust back-pressure sensor spacer and install EGR valve.
- (3) Install support bracket to valve portion of sensor and tighten screws.
- (4) Install two attaching nuts and tighten to 13 foot-pounds (18 N•m) torque.
- (5) Attach vacuum lines to exhaust back-pressure sensor valve and EGR valve.

**NOTE:** Vacuum line from CTO switch must be connected to nipple with 0.030-inch (0.762 mm) restriction.

**Non-Integral Exhaust Back-Pressure Sensor Test**

- (1) Inspect all EGR vacuum lines for leaks and correct routing.
- (2) Install tee in vacuum line between EGR valve and exhaust back-pressure sensor.
- (3) Attach vacuum gauge to tee.
- (4) Start engine and allow to idle. No vacuum should be indicated.

**NOTE:** If vacuum is indicated at idle speed, verify correct line connections. Be sure manifold vacuum is not being used as source. If carburetor is providing ported

vacuum, inspect for partially-open throttle plate, which could apply premature ported vacuum to back-pressure sensor.

- (5) Accelerate engine to 2000 rpm and observe vacuum gauge for the following:
  - If coolant temperature is below 115°F (46°C), no vacuum should be indicated.
  - If coolant temperature is above 115°F (46°C) (black CTO switch) or 160°F (71°C) (yellow CTO switch), ported vacuum should be indicated.
  - If no vacuum was indicated during test, be sure vacuum is being applied to inlet side of back-pressure sensor. Then remove back-pressure sensor and inspect spacer port and tube for restrictions. Restrictions caused by carbon or lead deposits can be removed with spiral wire brush. Otherwise, replace back-pressure sensor.

**RESTRICTOR PLATES**

**NOTE:** Restrictor plates are used only on vehicles equipped with the non-integral back-pressure sensor.

The restrictor plate (fig. 1J-75) is located between the exhaust back-pressure sensor spacer and the intake manifold, mounted between gaskets. The stainless steel restrictor plate is calibrated for a particular engine/exhaust system and should never be altered or replaced with a restrictor plate of different calibration.

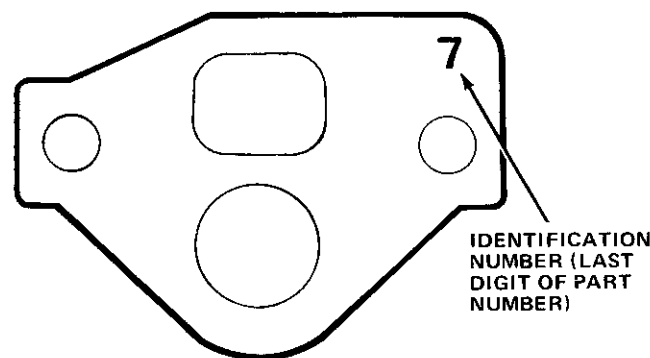


Fig. 1J-75 Restrictor Plate

# POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

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**GENERAL**

The PCV system prevents crankcase vapors from entering the atmosphere. Filtered air is directed into the

crankcase and vapors are drawn out, channeled into the intake manifold and burned in the combustion chambers.

In addition to controlling crankcase vapors, the PCV system also constantly ventilates the crankcase. The free movement of air helps prevent the formation of sludge.

**COMPONENTS**

The PCV system consists of an air inlet filter, a flow-control (PCV) valve and associated hoses (fig. 1J-76 and 1J-77).

The air inlet filter is located inside the air cleaner housing on six-cylinder engines. It is contained in the oil filler cap on eight-cylinder engines.

**Positive Crankcase Ventilation (PCV) Valve**

Two PCV valves with different flow rates are used. Flow rate is measured in cubic feet per minute (cfm). The yellow valve is used on all six-cylinder engines and the black valve is used on all eight-cylinder engines.

Replace the PCV valve at the intervals specified in the Maintenance Schedule. Inspect all hoses in the PCV system at this time for leaks or restrictions and clean or replace as required. PCV valve replacement may be required more often under adverse operating conditions.

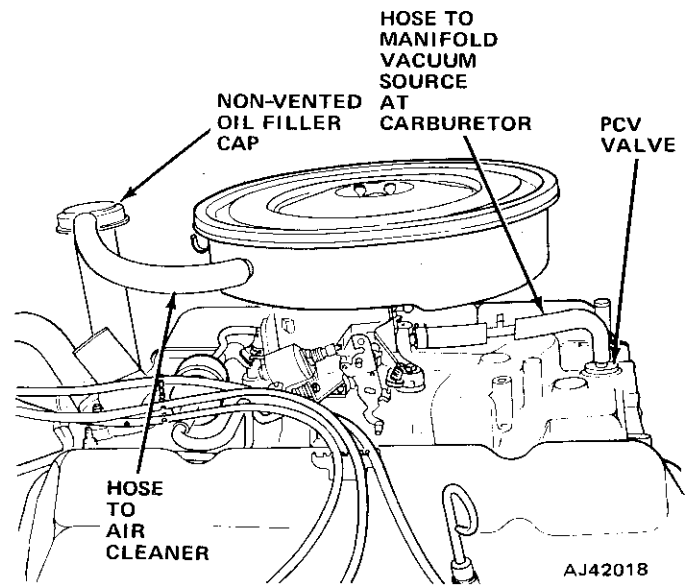


Fig. 1J-77 PCV System—Eight-Cylinder Engine

through the PCV valve into the intake manifold. The vapors mix with fuel/air mixture and are burned in the combustion chambers. The PCV valve is calibrated to control airflow to a rate acceptable to the intake system.

If crankcase vapor pressures (blowby) exceed the flow capacity of the PCV valve, airflow in the system reverses. Crankcase vapors are drawn through the air cleaner element and carburetor and burned along with the fuel-air mixture.

**PCV VALVE TEST**

Test the valve at idle speed for correct flow rate (cfm) providing the engine manifold vacuum is at least 14 inches Hg (4 kPa). When checking vacuum, connect the gauge to a fitting which is as centrally located as possible on the intake manifold.

(1) Remove valve from grommet in cylinder head cover (six-cylinder) or manifold vacuum source hose (eight-cylinder). Connect plastic hose of PCV Valve Tester J-23111 to valve (fig. 1J-78).

**NOTE:** The PCV valve must be held in a horizontal position and tapped lightly during the test. Hold the tester in a vertical position.

(2) Start engine and allow it to idle. Observe flow rate (cfm). Refer to PCV Valve Flow Chart. At low vacuum readings, it may be necessary to load engine while checking flow rate.

(3) Replace valve which flows above or below specification. Be sure to use correct PCV valve for replacement.

**PCV AIR INLET FILTER MAINTENANCE**

Perform air inlet filter maintenance at the intervals specified in the Maintenance Schedule in Chapter B.

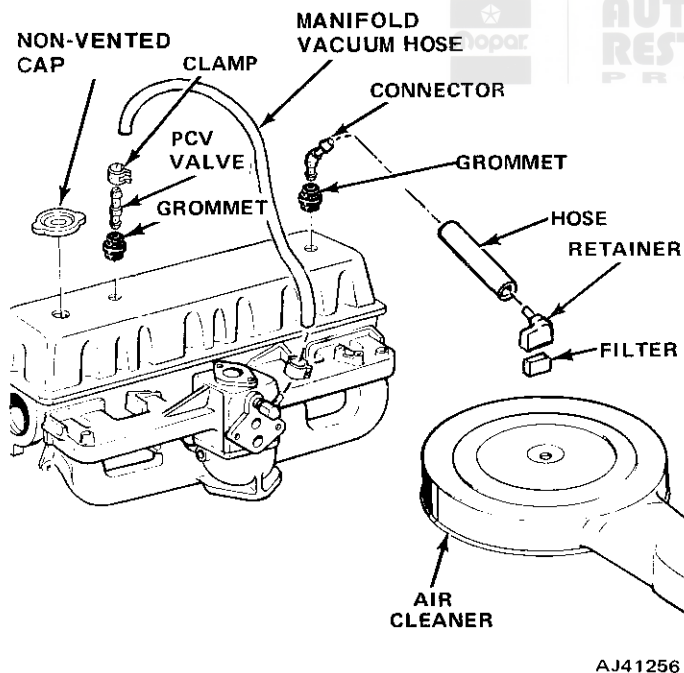


Fig. 1J-76 PCV System—Six-Cylinder Engine

**OPERATION**

Air flow through the PCV system is controlled primarily by manifold vacuum. There are two basic operating modes. When manifold vacuum is relatively high, as at idle or at cruising speed, fresh air is drawn through the air intake filter into the crankcase. After circulating through the crankcase, the vapor-filled air is drawn

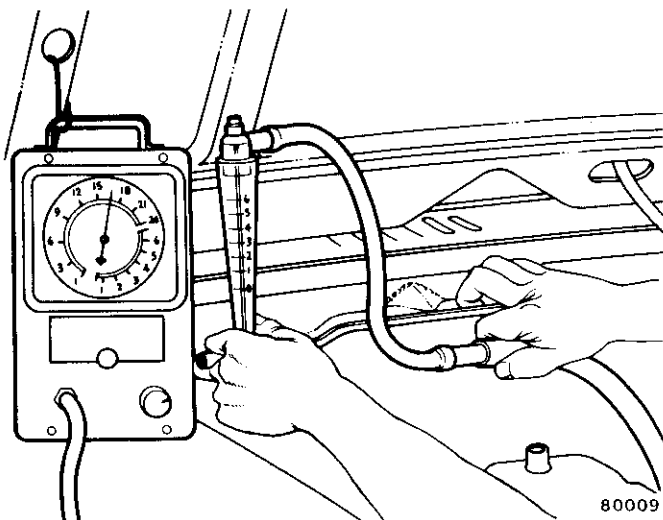


Fig. 1J-78 PCV Valve Test

**PCV Valve Flow**

Engine Manifold Vacuum (in. Hg.)	Air Flow CFM (liters/second)	
	Yellow Six-Cylinder	Black Eight-Cylinder
16		1.34-1.63 (.003-.004)
13	1.30-1.90 (.003-.005)	
7		2.70-3.79 (.007-.010)
5	1.21-2.26 (.003-.006)	
3		3.30-4.39 (.009-.012)
2	1.28-2.56 (.003-.007)	

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**Six-Cylinder**

A polyurethane foam PCV air inlet filter is located in a filter retainer in the air cleaner.

- (1) Rotate retainer to remove from air cleaner (fig. 1J-79).
- (2) Clean filter in kerosene.
- (3) Lightly oil filter with clean engine oil.
- (4) Install filter and retainer to air cleaner.

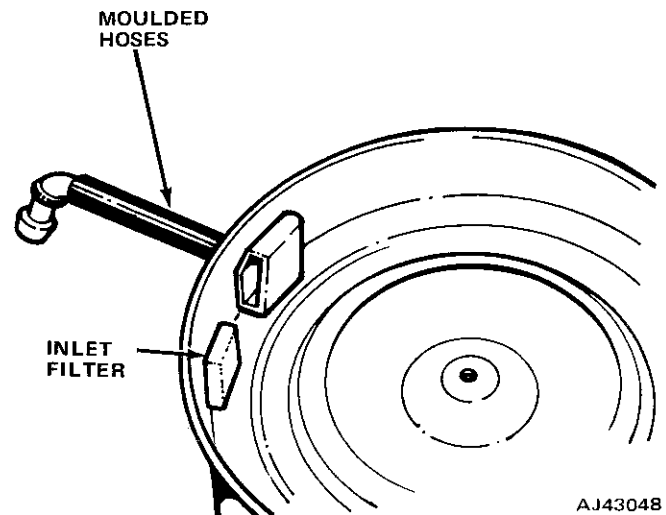


Fig. 1J-79 PCV Air Inlet Filter—Six-Cylinder

**Eight-Cylinder**

A polyurethane foam PCV air inlet filter is located in the sealed oil filler cap.

- (1) Remove oil filler cap from engine.
- (2) Apply light air pressure in reverse direction of normal flow (through filler tube opening of cap).
- (3) Install oil filler cap and connect hose from air cleaner to oil filler cap.

**NOTE:** Replace the filler cap if filter is deteriorated.

# THERMOSTATICALLY CONTROLLED AIR CLEANER (TAC) SYSTEM

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**GENERAL**

The Thermostatically Controlled Air Cleaner (TAC) System provides pre-warmed air to the carburetor air cleaner during engine warm-up, while under-hood air

temperature is low. Warm intake air permits the carburetor to be calibrated leaner, reducing hydrocarbon emissions. It also improves engine warm-up and minimizes carburetor icing.

For 1979, all Jeep vehicles are equipped with a vacuum-operated TAC system.

This system consists of a heat shroud at the exhaust manifold, a hot air hose, a special air cleaner assembly equipped with a thermal sensor, and a vacuum motor and air valve assembly (fig. 1J-80). The air cleaner snorkel is attached by flexible hose to the ambient air inlet at the front of the engine compartment.

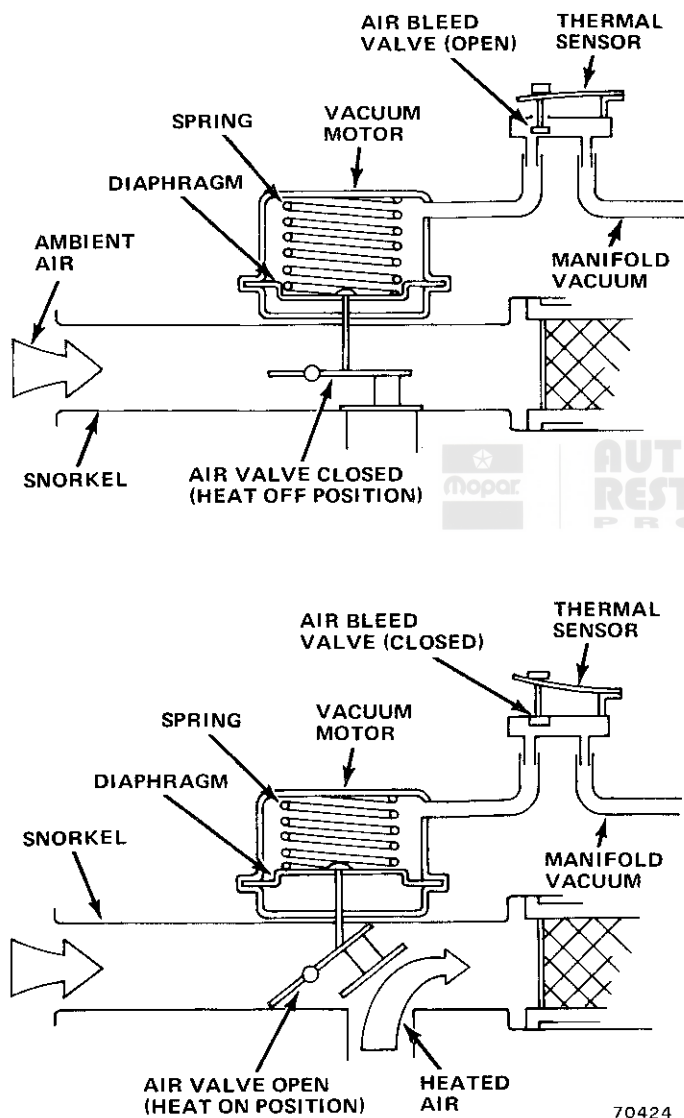


Fig. 1J-80 TAC System—Typical

## OPERATION

The position of the heat valve is controlled by manifold vacuum acting against a spring. Manifold vacuum is controlled by a temperature-sensitive switch in the air cleaner housing.

During engine warm-up, the temperature-sensitive switch applies vacuum to the TAC vacuum motor. The valve is held in the heat On position. Exhaust manifold-heated air flows to the air cleaner. As the temperature of the incoming air approaches 90°F (32°C), the temperature switch vents vacuum to atmosphere, allowing spring pressure to push the valve to the heat Off position. Air flows from outside the vehicle, through the ambient air duct, to the air cleaner.

During hard acceleration, manifold vacuum drops. This causes the TAC valve to move to the heat Off position, regardless of temperature, providing maximum airflow.

## TESTING

- (1) Remove air cleaner assembly from engine and allow to cool to room temperature.
- (2) After cooling, sight through air cleaner snorkel to observe position of air valve. It should be fully open to outside air (heat Off position).
- (3) Install air cleaner assembly to engine and connect hot air tube and manifold vacuum hose.
- (4) Start engine and observe position of air valve. It should be fully closed to outside air (heat On position).
- (5) Move the throttle lever rapidly to approximately 1/2 to 3/4 opening and release. Air valve should open and then close again.
- (6) Allow engine to warm to operating temperature and observe position of air valve. It should be fully open to outside air (heat Off position).

If air valve does not move to heat On position at temperature below 83°F (28°C) with vacuum applied, check for a mechanical bind in the snorkel, disconnected vacuum motor linkage or vacuum leaks in hoses or connections at the vacuum motor, thermal sensor and intake manifold.

If air valve mechanism is operating freely and no vacuum leaks are detected, connect a hose from an intake manifold vacuum source directly to vacuum motor.

If air valve now moves to heat On position, replace thermal sensor.

If air valve remains in heat Off position, replace air cleaner body and vacuum motor assembly.

## THERMAL SENSOR

### Replacement

- (1) Remove air cleaner and disconnect vacuum hoses from sensor.
- (2) Break vacuum nipples off sensor. Remove sensor and gasket from air cleaner.
- (3) Install replacement sensor and gasket. Press retainers over vacuum nipples.
- (4) Connect vacuum hoses and install air cleaner.

# CARBURETOR BOWL COOLING SYSTEM

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## GENERAL

After engine shut down the carburetor bowl cooling system automatically cools the carburetor bowl when the underhood temperature is above a pre-determined temperature. The length of cooling time is also controlled by a preset timer (relay). The system reduces fuel percolation during high heat soak periods.

Components are:

- Cooling fan—draws in cool ambient air for bowl cooling.
- Duct—directs cooling air to the base of the carburetor.
- Timer (Relay)—directs current to the cooling fan (through the sensor) for a pre-determined amount of time.
- Sensor—acts as an on/off switch for cooling fan current (this is a heat sensitive device placed in an area of underhood heat).
- Deflector—attached to carburetor bowl and directs air flow at bowl.
- Vent—attached to fan and protects fan assembly from foreign matter.

## OPERATION

When the ignition switch is cycled (engine started, and then the ignition switch turned to the Off position), the timer directs current to the fan through the sensor. If the underhood temperature is above the sensor switching temperature, the circuit is closed and the cooling fan operates. If during carburetor cooling operation the underhood temperature falls below the sensor temperature calibration, the sensor opens the circuit and the fan stops. The timer turns off the fan after a preset time interval regardless of underhood temperature.

In the event of an engine re-start during fan cooling operation, the fan turns off and the timer resets.

## COOLING FAN REPLACEMENT

### Removal

- (1) Open hood.
- (2) Remove hose from fan.
- (3) Remove motor and grille.

### Installation

- (1) Install motor and grille.
- (2) Install hose to fan.
- (3) Close hood.

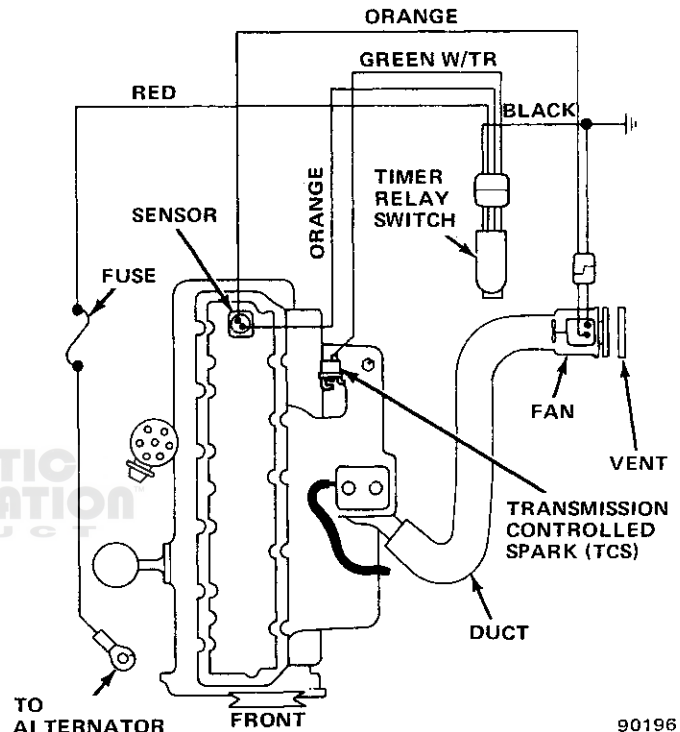


Fig. 1J-81 Carburetor Bowl Cooling System

## TIMER REPLACEMENT

### Removal

- (1) Open hood.
- (2) Disconnect negative battery cable.
- (3) Remove leads at starter solenoid and ignition coil feed.
- (4) Cut straps and remove timer assembly.

### Installation

- (1) Connect leads to ignition coil feed and starter solenoid.
- (2) Secure timer assembly with tiedown straps.
- (3) Connect negative battery cable.
- (4) Close hood.

## HOSE REPLACEMENT

### Removal

- (1) Open hood.
- (2) Remove air cleaner.
- (3) Remove hose from carburetor and fan.



**Installation**

- (1) Install hose to carburetor and fan.
- (2) Install air cleaner.
- (3) Close hood.

**SENSOR REPLACEMENT**

**Removal**

- (1) Open hood.
- (2) Unplug sensor.
- (3) Cut strap retaining sensor.

**Installation**

- (1) Install sensor and secure with strap.
- (2) Plug in sensor to timer lead.
- (3) Close hood.

**DEFLECTOR REPLACEMENT**

**Removal**

- (1) Open hood.
- (2) Remove air cleaner.

- (3) Remove duct from deflector.
- (4) Remove deflector.

**Installation**

- (1) Install deflector.
- (2) Install duct to reflector.
- (3) Install air cleaner.
- (4) Close hood.

**VENT REPLACEMENT**

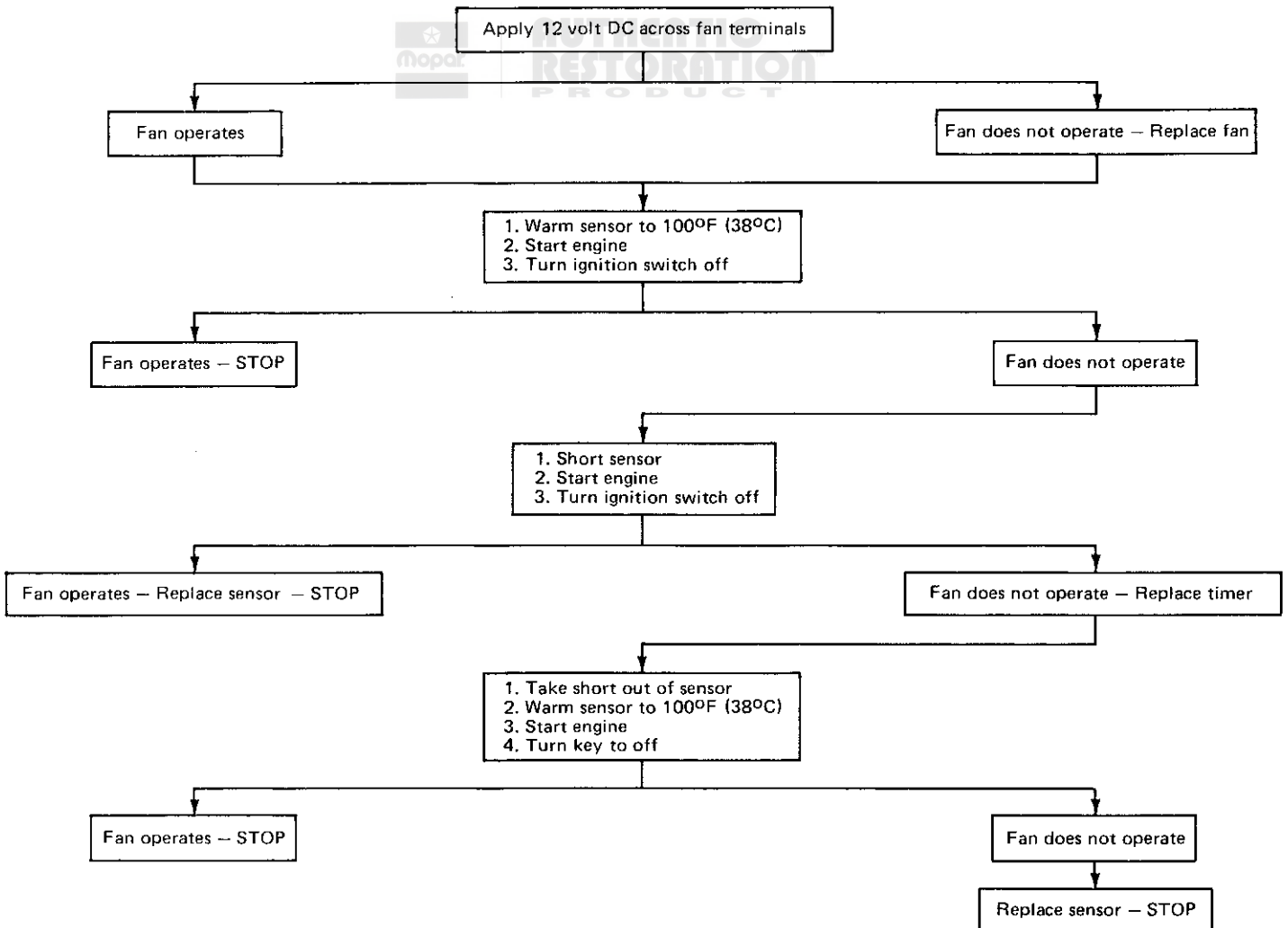
**Removal**

- (1) Open hood.
- (2) Remove duct from fan.
- (3) Unplug fan and remove screws.
- (4) Remove vent and fan.

**Installation**

- (1) Install vent and fan.
- (2) Connect fan leads.
- (3) Connect duct to fan.
- (4) Close hood.

**Carburetor Bowl Cooling System Diagnosis**



Tools



J-10174-01  
MAIN JET REMOVER  
AND INSTALLER



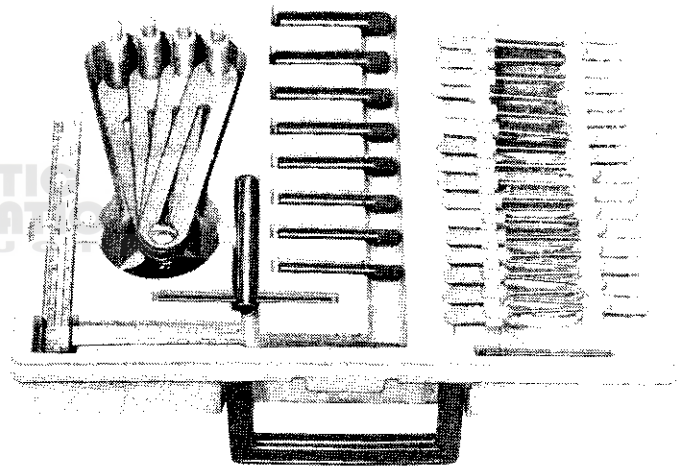
J-10175  
POWER VALVE  
SOCKET



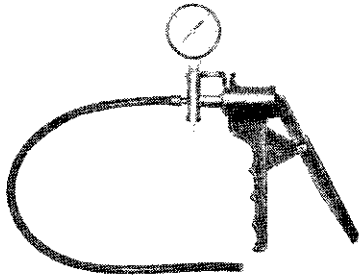
J-10185  
NEEDLE SEAT  
REMOVER



J-1137  
BENDING TOOL



J-9789-02  
UNIVERSAL CARBURETOR  
GAUGE KIT



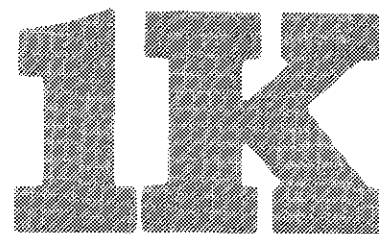
J-23738  
HAND OPERATED  
VACUUM PUMP

## NOTES



**AUTHENTIC  
RESTORATION™**  
PRODUCT

# EXHAUST SYSTEMS



## SECTION INDEX

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Catalytic Converter System	1K-13	Tools	1K-15

## EXHAUST MANIFOLDS, MUFFLERS AND PIPES

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General	1K-1	Restricted Exhaust System Diagnosis	1K-1
Heat Valve	1K-7	Specifications	1K-9
Muffler	1K-8		

### GENERAL

The basic exhaust system on all vehicles consists of exhaust manifold(s), front exhaust pipe, catalytic converter, muffler and tailpipe.

All six-cylinder CJ models use a catalytic converter (fig. 1K-1). Six-cylinder CJ models for California use a monolithic catalytic converter and a pellet-type catalytic converter (fig. 1K-1). All eight-cylinder CJ models use a single pellet-type catalytic converter (fig. 1K-2).

Cherokee, Wagoneer and Truck models use a single pellet-type catalytic converter (fig. 1K-3 through 1K-6).

The exhaust system must be properly aligned to prevent stress, leakage, and grounding. If the system grounds on any body panel, it may amplify objectionable noises originating from the engine or the body. When inspecting an exhaust system, check for cracked or loose joints, stripped screw threads, and corrosion damage. Check for worn or broken hangers. Replace all parts that are badly corroded or damaged. Do not attempt to repair.

### RESTRICTED EXHAUST SYSTEM DIAGNOSIS

A restricted or blocked exhaust system usually results in loss of power or popping through the carburetor. Verify that the condition is not caused by ignition or

timing problems, then perform a visual inspection of the exhaust system. If the restriction cannot be located by visual inspection, perform the following procedure.

- (1) Attach a vacuum gauge to intake manifold.
- (2) Connect tachometer.
- (3) Start engine and observe vacuum gauge. Gauge should indicate 16 to 21 inches of vacuum.
- (4) Increase engine speed to 2,000 rpm and observe vacuum gauge. Vacuum will drop when speed is increased rapidly, but should settle at 16 to 21 inches and remain steady. If vacuum drops below 16 inches, exhaust system is restricted or blocked. Stop engine and proceed to step (5).
- (5) Disconnect exhaust pipe at manifold.
- (6) Start engine and increase speed to 2,000 rpm. Observe vacuum gauge.
  - (a) If vacuum settles at 16 to 21 inches, restriction or blockage is in exhaust pipe, catalytic converter or muffler.
  - (b) If vacuum drops below 16 inches with exhaust pipe disconnected, exhaust manifold is restricted.
- (7) Connect exhaust pipe, remove muffler and check vacuum gauge.
  - (a) If vacuum drops below 16 inches, restriction or blockage is in catalytic converter.
  - (b) If vacuum is normal, muffler is restricted.

## 1K-2 EXHAUST SYSTEMS

**NOTE:** If converter has failed, always check muffler to be sure converter debris has not entered muffler.

(8) Stop engine.

(9) Disconnect tachometer and vacuum gauge.

(10) On six-cylinder engines, remove exhaust manifold. On eight-cylinder engines, remove both exhaust manifolds.

(11) Inspect ports of exhaust manifold for casting flash by dropping length of chain into each port.

**NOTE:** Do not use a wire or a light to check ports. The restricted opening may be large enough for them to pass through but small enough to cause excessive back pressure at high engine rpm.

(12) Remove casting flash. If flash is at lower end of port, it can usually be chipped out. If flash cannot be removed, replace manifold.

(13) Install exhaust manifold(s).

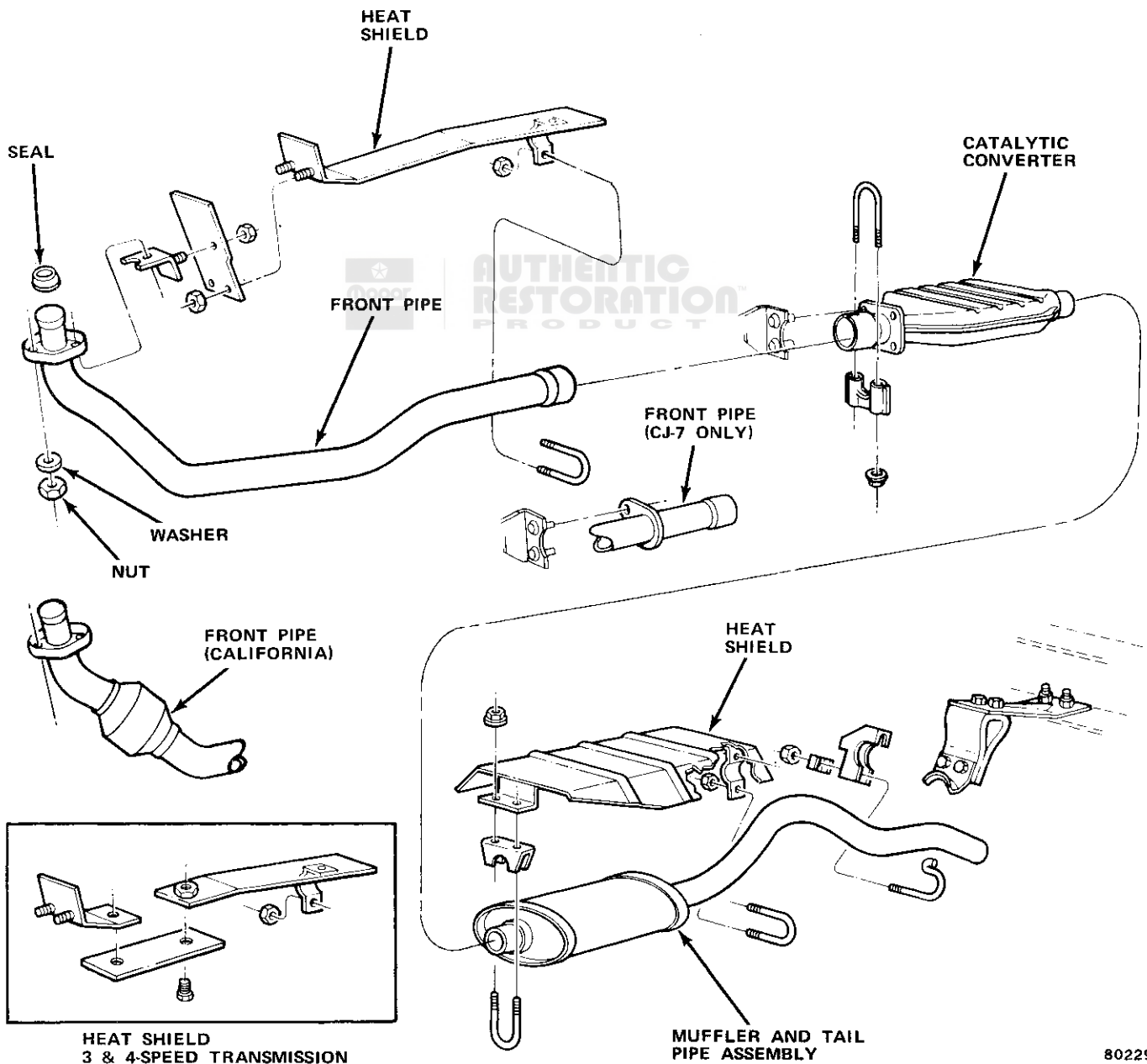


Fig. 1K-1 Exhaust System—Six-Cylinder CJ Models

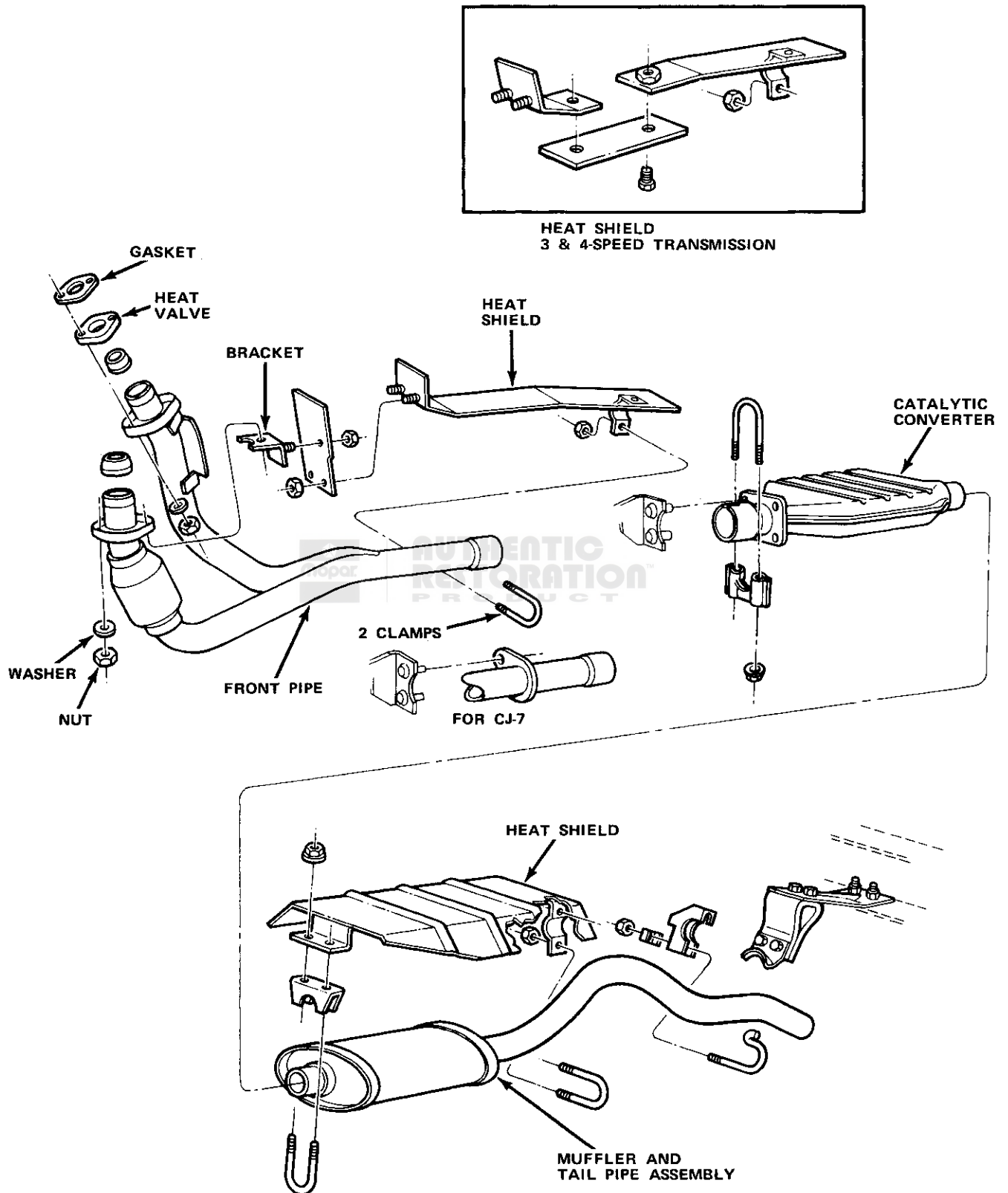


Fig. 1K-2 Exhaust System—Eight-Cylinder CJ Models

# 1K-4 EXHAUST SYSTEMS

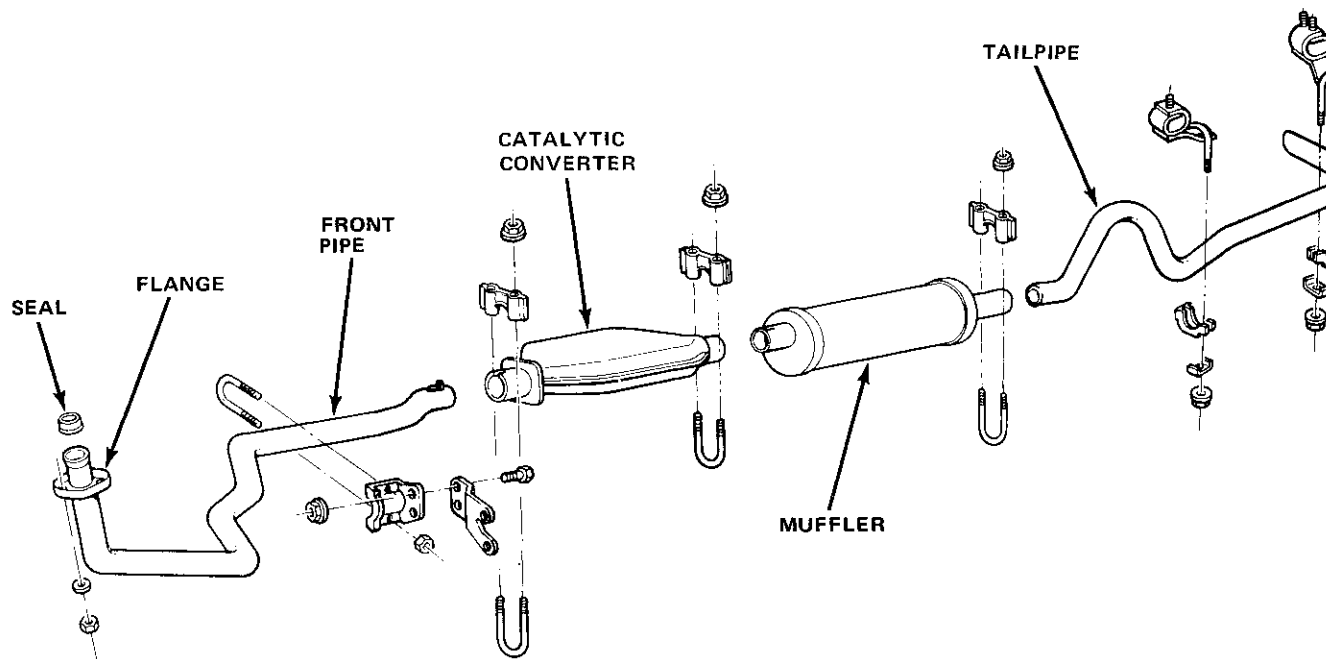


Fig. 1K-3 Exhaust System—Six-Cylinder Cherokee



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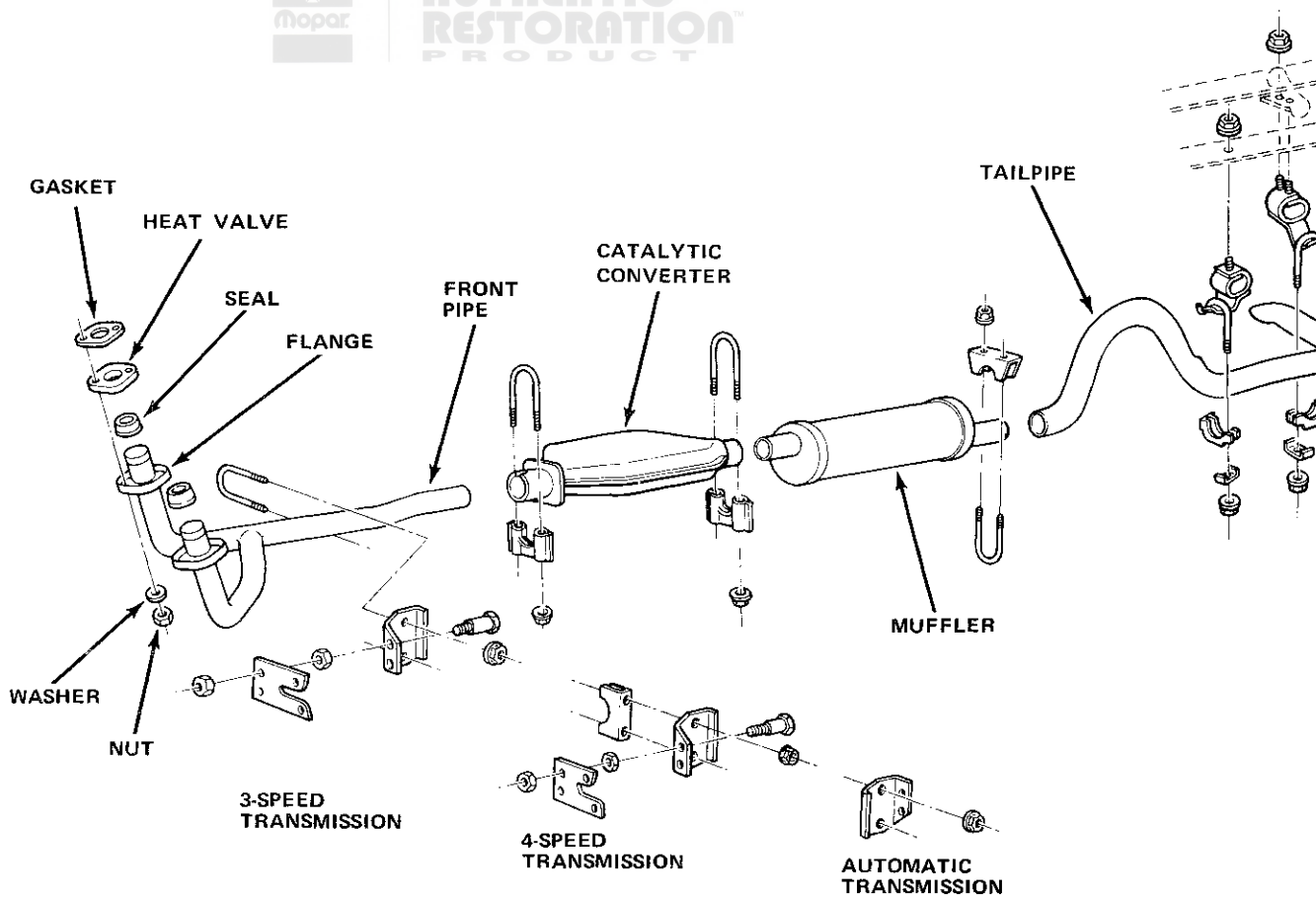
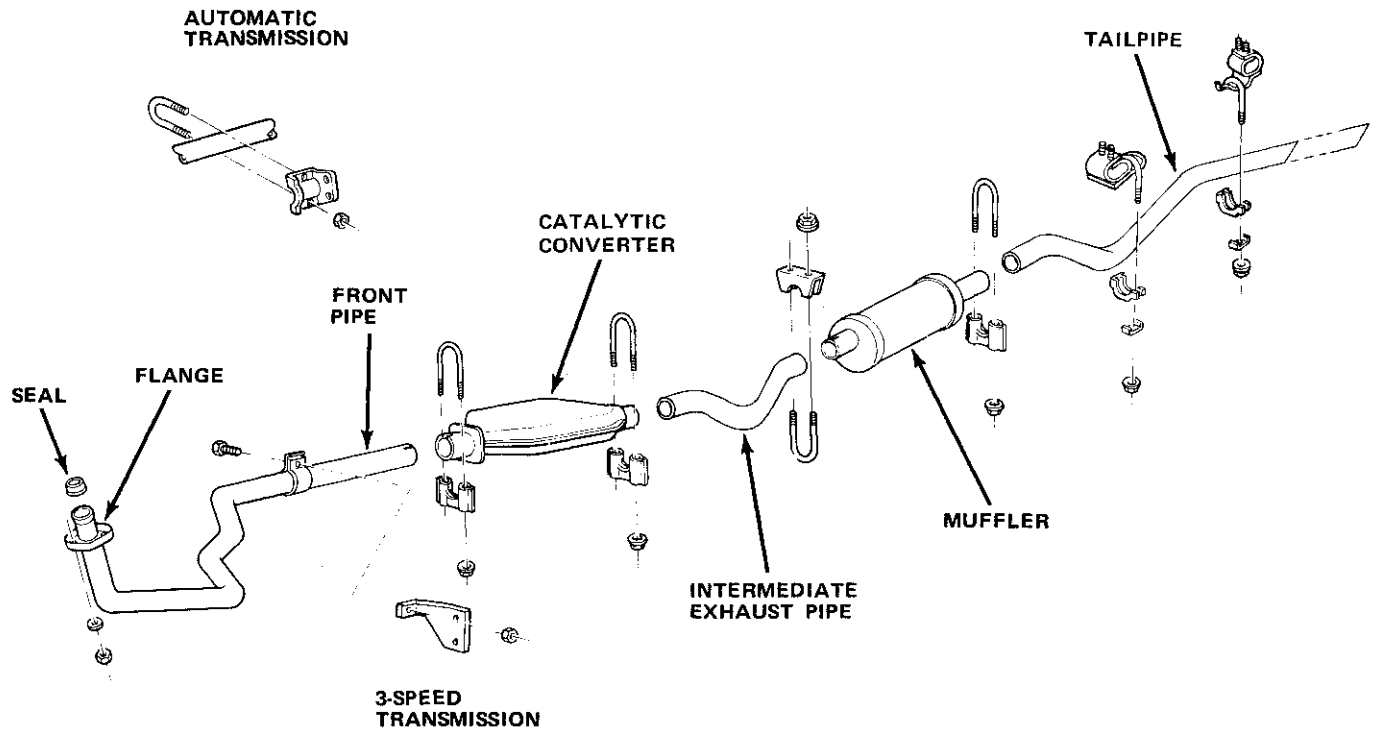


Fig. 1K-4 Exhaust System—Eight-Cylinder Cherokee and Wagoneer



3-SPEED TRANSMISSION

Fig. 1K-5 Exhaust System—Six-Cylinder Truck

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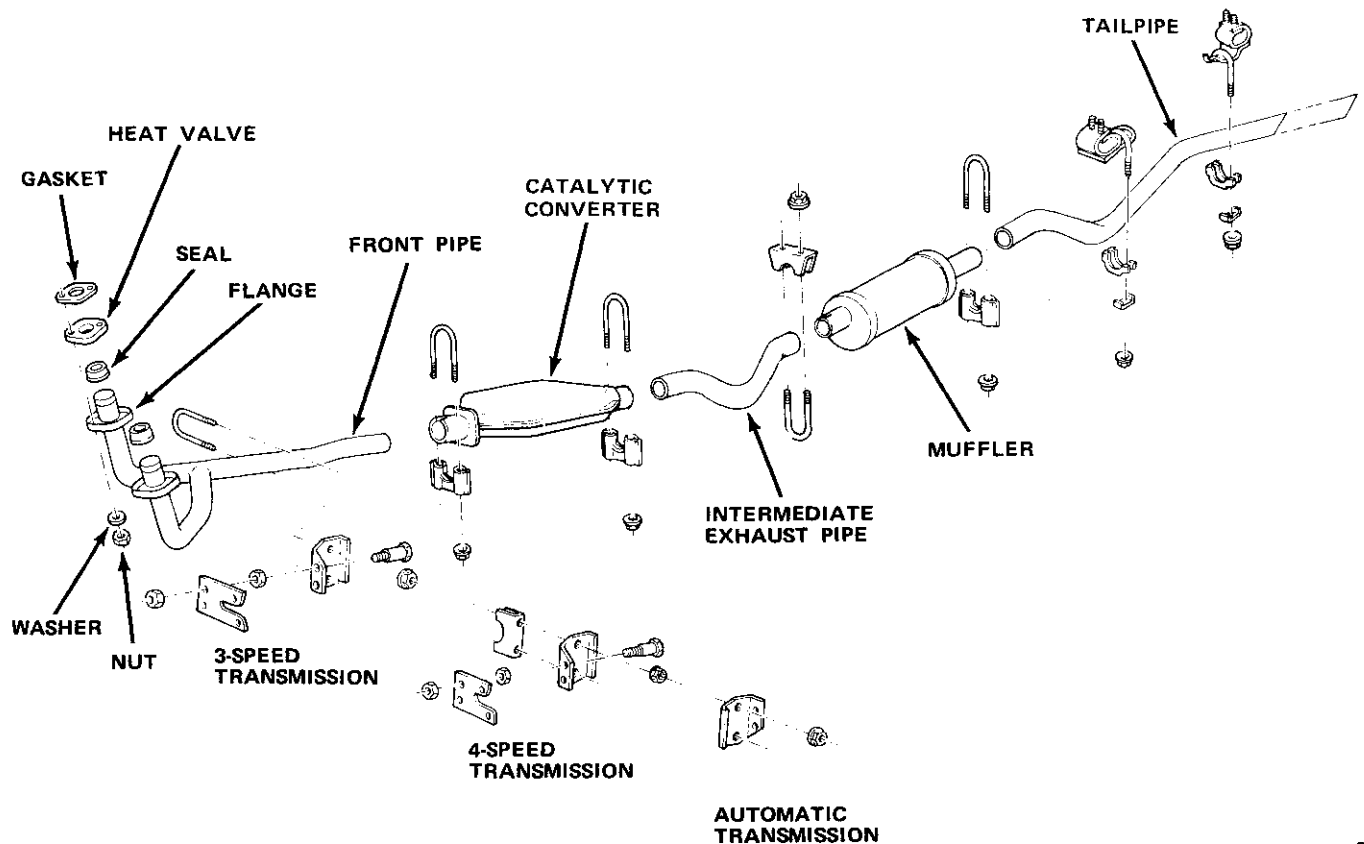


Fig. 1K-6 Exhaust System—Eight-Cylinder Truck

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## EXHAUST MANIFOLD

### Replacement—Six-Cylinder Engine

#### Removal

The intake and exhaust manifolds are attached as a unit to the cylinder head on the left side of the engine. A gasket is used between the intake manifold and the cylinder head. None is used between the exhaust manifold and cylinder head. An asbestos gasket is used at the mating surfaces of the intake manifold to exhaust manifold and also between the exhaust manifold and exhaust pipe (fig. 1K-7).

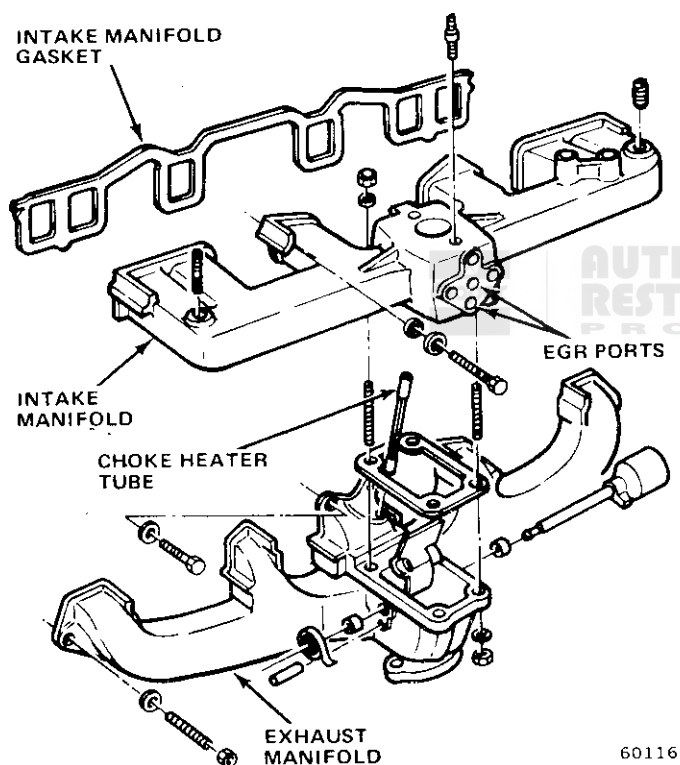


Fig. 1K-7 Manifold Assembly

**NOTE:** It is necessary to remove intake and exhaust manifold assembly from the engine before separating the manifolds.

- (1) Remove air cleaner.
- (2) Disconnect choke heater tube from choke coil housing. Disconnect clean air tube from carburetor.
- (3) Disconnect accelerator cable from carburetor.
- (4) Remove carburetor from intake manifold and set aside with vacuum lines attached. It is necessary to disconnect only fuel line and canister line.
- (5) Disconnect hose at EGR valve.
- (6) Disconnect accelerator cable from accelerator bellcrank.

(7) Disconnect PCV vacuum hose from intake manifold.

(8) Remove spark CTO vacuum tubes and disconnect TCS solenoid vacuum valve wiring, if equipped.

(9) Disconnect Air Guard hoses at air pump and air injection manifold check valve. Disconnect diverter vacuum hose from manifold and remove diverter valve with hoses.

(10) Remove air pump/power steering mounting bracket, if equipped.

(11) Remove air pump.

(12) Detach power steering pump and set aside, if equipped. Do not remove hoses.

(13) Remove air conditioning drive belt idler assembly from cylinder head, if equipped.

(14) Disconnect exhaust pipe from manifold flange.

(15) Remove manifold attaching screws, nuts and clamps. Remove intake and exhaust manifold as an assembly. Discard gasket.

(16) Remove accelerator control bracket.

(17) Separate manifolds.

(18) Remove distributor CTO tube clamp and install on replacement manifold.

(19) Remove air injection manifold and screws and install on replacement manifold.

#### Installation

(1) Install replacement gasket between manifolds. Install accelerator control bracket. Tighten nuts finger tight.

**CAUTION:** Manifolds must be held together loosely enough to slide when manifolds are attached to cylinder head.

(2) Install choke clean air tube into bottom of exhaust manifold and install tube clip.

(3) Position replacement intake manifold gasket on cylinder head and install manifold assembly. Tighten manifold attaching bolts and nuts in sequence (fig. 1K-8) to 23 foot-pounds (31 N•m) torque.

(4) Install flange gasket and connect exhaust pipe to manifold flange. Use replacement nuts.

(5) Install carburetor to intake manifold. Connect fuel line and hose from vapor canister.

(6) Install air conditioning idler assembly, if removed.

(7) Install air pump, if removed.

(8) Install air pump/power steering pump mounting bracket, if removed.

(9) Install diverter valve. Connect hoses to air pump and check valve. Connect vacuum hose to manifold.

(10) Install drive belts and tighten to specification. Refer to Chapter 1C—Cooling Systems.

(11) Install spark CTO vacuum tubes. Connect TCS wiring, if removed.

(12) Connect vacuum line at EGR valve.

- (13) Install throttle return spring and carburetor control shaft.
- (14) Connect accelerator cable and PCV hose.
- (15) Install choke heater tube and clean air tube to carburetor.
- (16) Start engine and check for vacuum or exhaust leaks.
- (17) Install air cleaner.

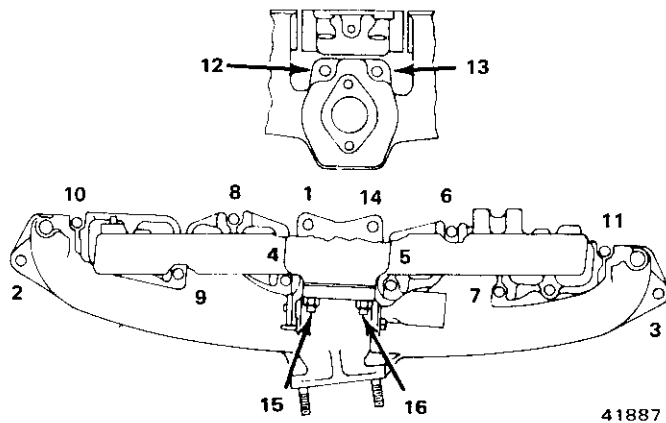


Fig. 1K-8 Six-Cylinder Manifold Torque Sequence

### Replacement—Eight-Cylinder Engine

#### Removal

- (1) Disconnect ignition wires.
- (2) Disconnect air delivery hose at injection manifold.
- (3) Remove air injection manifold, attaching screws and washers.
- (4) Disconnect exhaust pipe at exhaust manifold.
- (5) Remove exhaust manifold retaining screws.
- (6) Separate exhaust manifold from cylinder head.

#### Installation

- (1) Clean mating surfaces of exhaust manifold and cylinder head. **Do not nick or scratch.**
- (2) Install exhaust manifold and retaining screws.
- (3) Install air injection manifold and retaining screws. Tighten screws to 38 foot-pounds (52 N•m) torque. Tighten screws to 25 foot-pounds (34 N•m) torque.
- (4) Connect exhaust pipe using replacement seal if required. Tighten nuts to 20 foot-pounds (27 N•m) torque.
- (5) Connect air delivery hose to air injection manifold.
- (6) Connect ignition wires.

## HEAT VALVE

### Six-Cylinder Engine

A thermostatically controlled heat valve in the exhaust manifold directs exhaust heat to the floor of the intake manifold for rapid fuel vaporization during engine warmup. The valve is in the heat On position, directing exhaust heat to the intake manifold, when the counterweight is in the extreme counterclockwise position when viewed from the counterweight end (fig. 1K-9). As the engine reaches operating temperature, the thermostatic spring heats up and loses tension, allowing the counterweight to move the valve to the heat Off position (fig. 1K-10).

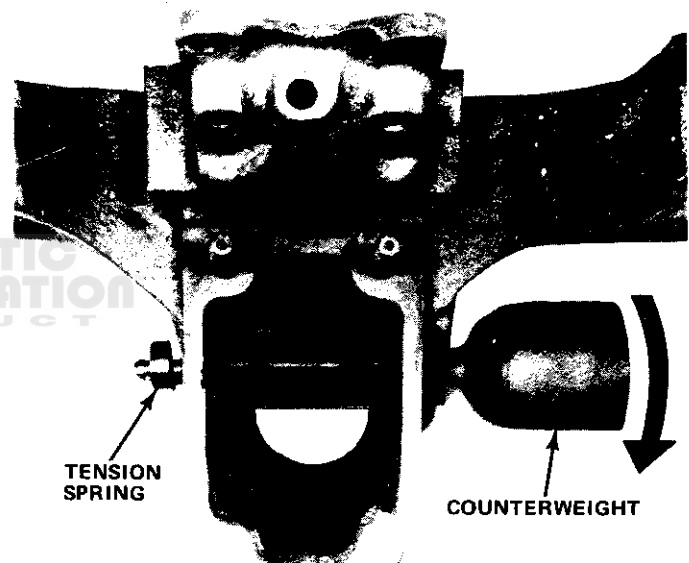


Fig. 1K-9 Heat Valve in Heat On Position—Six-Cylinder

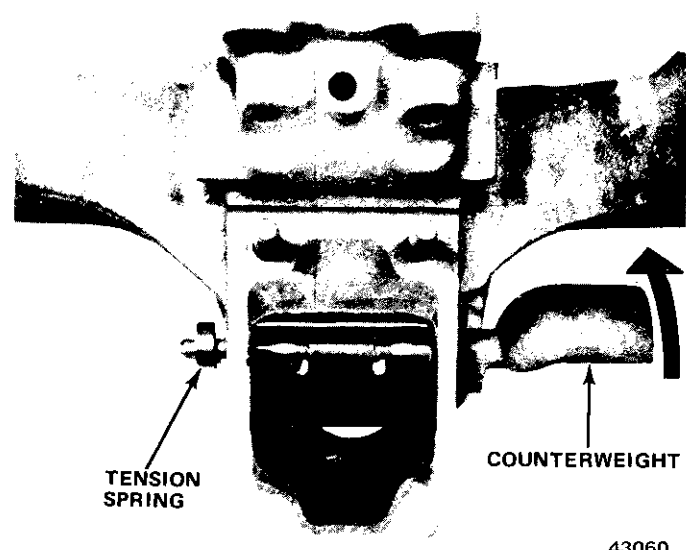


Fig. 1K-10 Heat Valve in Heat Off Position—Six-Cylinder

## 1K-8 EXHAUST SYSTEMS

The manifold heat valve must (48 000 km) operate freely. Check and lubricate every 30,000 miles with Jeep Heat Valve Lubricant, or equivalent.

### Replacement

- (1) Remove and separate intake and exhaust manifolds.
- (2) Remove manifold heat valve assembly by cutting heat valve shaft on both sides of valve.
- (3) Lift valve from manifold and drive out remaining shaft sections and bushings.
- (4) Install replacement bushings using heat valve shaft as guide pin.
- (5) Ream out replacement bushings with 5/16-inch drill bit to remove all burrs.
- (6) Position heat valve as shown in figure 1K-10 and install shaft and counterweight assembly.
- (7) Rotate counterweight until spring stop contacts bottom of manifold boss.
- (8) Align hole in valve with screw threads in shaft and install, but do not tighten retaining screw.
- (9) Close heat valve and install tension spring with hook end up and pointing away from manifold. Hook spring under support pin.
- (10) Operate heat valve several times to allow shaft to center.
- (11) Hold shaft and move valve as far as possible from counterweight. Tighten retaining screw.
- (12) Check operation of valve.
- (13) Install intake and exhaust manifolds.

### Eight-Cylinder Engine

A thermostatically controlled heat valve mounted between the right exhaust manifold and exhaust pipe directs exhaust heat to the intake manifold for rapid fuel vaporization during engine warmup. When the counterweight is in the horizontal position, the valve is in the heat On position, directing exhaust heat through the intake manifold crossover passage (fig. 1K-11). The exhaust heat crosses through the intake manifold and discharges into the left exhaust manifold until the engine reaches operating temperature. At this time, the thermostatic spring loses its tension and the counterweight moves downward, moving the valve to the heat Off position and allowing the exhaust heat to discharge through the right exhaust pipe.

Check the manifold heat valve for free movement and lubricate every 30,000 miles (48 000 km) with Jeep Heat Valve Lubricant, or equivalent.

### Replacement

- (1) Disconnect and lower exhaust pipes.
- (2) Replace manifold heat valve and gasket.
- (3) Replace exhaust pipe gasket.
- (4) Position exhaust pipes and connect to exhaust manifolds.

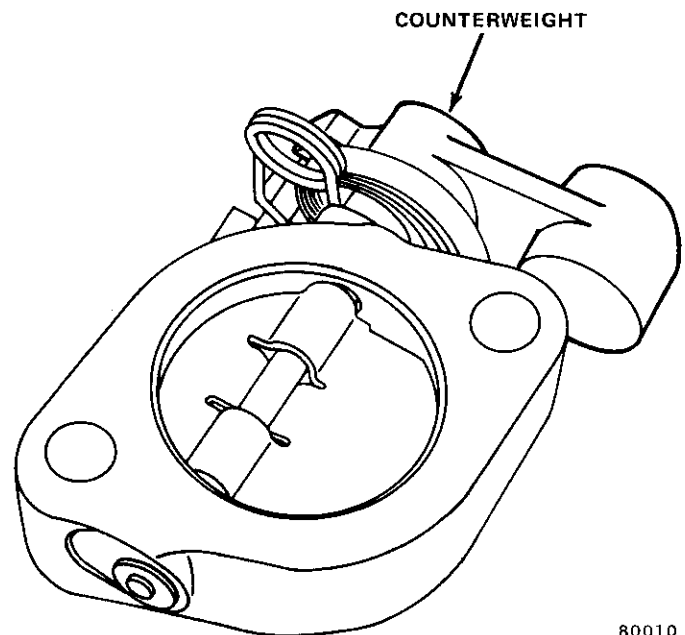


Fig. 1K-11 Exhaust Manifold Heat Valve In Heat On Position—Eight-Cylinder

### MUFFLER

#### Replacement

#### Removal

- (1) Remove front and rear muffler clamps.
- (2) Support rear of vehicle by side rails and allow axle to hang free.
- (3) Remove tailpipe hanger clamp.
- (4) Insert tool between tailpipe and muffler several places to loosen pipe from muffler.
- (5) Disconnect hanger from rear of muffler, if equipped.
- (6) Heat rear pipe-to-muffler joint with oxyacetylene torch until cherry red.
- (7) Place block of wood against front of muffler and drive muffler rearward to disengage.
- (8) Drive muffler off tailpipe.

#### Installation

- (1) Drive muffler onto tailpipe. Be sure locator on tailpipe aligns with slot of muffler.
- (2) Drive rear pipe into muffler. Be sure pipe has sufficient clearance with floorpan.
- (3) Drive entire assembly forward to mate with front pipe or converter.
- (4) Install clamps and hangers.
- (5) Start engine and check for leaks and contact with body panels.

**PIPES**

**Exhaust Pipe Replacement**

**Removal**

- (1) Disconnect pipe at manifold.
- (2) Disconnect twin pin mounting bracket and/or clamp.
- (3) Heat front pipe-to-converter joint with oxyacetylene torch until cherry red. Twist front pipe back and forth to disengage.

**Installation**

- (1) Install rear of pipe into converter.
- (2) Clean mating surface at manifold(s). Install pipe to manifold(s) but do not tighten. Use replacement seal if required.

- (3) Align pipe. Tighten clamp or twin pin mount bracket at rear. Tighten flange to manifold(s).

**Tailpipe Replacement**

**Removal**

To install a tailpipe, support the vehicle by frame rails.

To remove any pipe attached to the muffler, cut the pipe close to the muffler. Collapse the part remaining in the muffler and remove.

**Installation**

To install a tailpipe, disconnect the twin pin mounting bracket and lower the front of the muffler. Install the pipe. Secure the twin pin mounting bracket and tighten.

**SPECIFICATIONS**

**Torque Specifications**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Exhaust and Intake Manifold Screws and Nuts —				
Six-Cylinder . . . . .	23	18-28	31	24-38
Exhaust Manifold Screws — Eight-Cylinder				
Center (2) . . . . .	25	20-30	34	27-41
Outer (4) . . . . .	15	12-18	20	20-34
Exhaust Pipe-to-Manifold Nuts . . . . .	20	27	15-25	20-34

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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**AIR GUARD SYSTEM**

	<b>Page</b>		<b>Page</b>
<b>Air Injection Manifolds</b>	1K-12	<b>General</b>	1K-9
<b>Air Pump</b>	1K-9	<b>Specifications</b>	1K-13
<b>Divorter Valve</b>	1K-11		

**GENERAL**

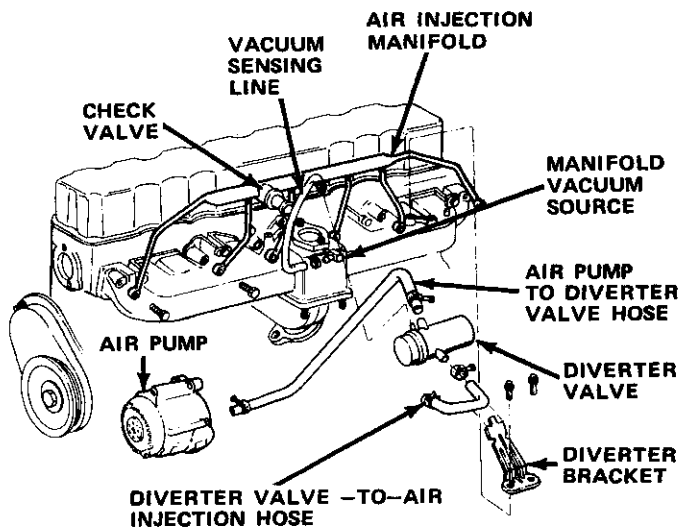
This system incorporates a belt-driven air pump, diverter (bypass) valve, air injection manifold(s) and connecting hoses (fig. 1K-12 and 1K-13).

Air is discharged from the air pump to the diverter valve which directs it to the air distribution manifold(s) or dumps it through a bypass port, depending on engine

operating conditions. Air pressure in this system is maintained at approximately 5 psi by a relief valve incorporated in the diverter valve.

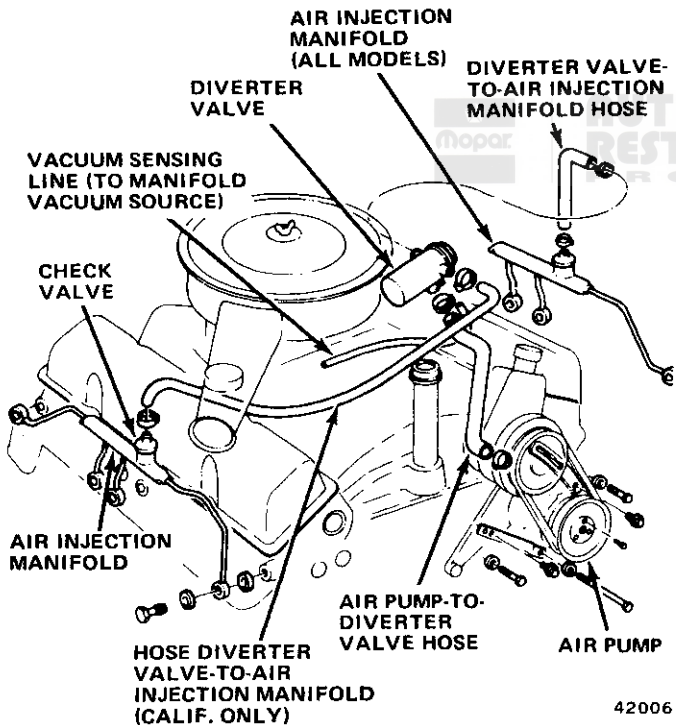
Air is routed through the air injection manifold into the engine exhaust port area. The air mixes with hot exhaust products and causes a further burning of the mixture, reducing hydrocarbon and carbon monoxide emissions to the atmosphere.

## 1K-10 EXHAUST SYSTEMS



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Fig. 1K-12 Air Guard System—Six-Cylinder Engine



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Fig. 1K-13 Air Guard System—Eight-Cylinder Engine

### AIR PUMP

#### Components

The same air pump is used for six-cylinder and eight-cylinder engines. The major components of the air pump are enclosed in a die-cast aluminum housing. A filter fan assembly, rotor shaft and drive hub are visible on the pump exterior (fig. 1K-14).

The pump is designed for long life and is serviceable only by replacement. Do not remove the rear housing

cover for any reason. The internal components of the pump are not serviceable.

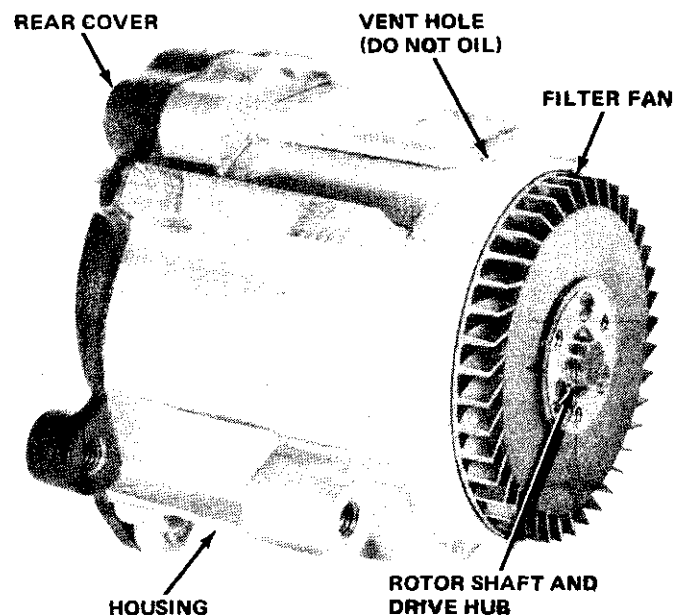
The aluminum housing has cavities for air intake, compression and exhaust and a bore for mounting the front bearing. The housing also includes cast metering areas that reduce the noise of intake and compression. Mounting bosses are located on the housing exterior.

**NOTE:** The relief valve assembly is incorporated in the diverter valve. If defective, replace the diverter valve assembly.

The front bearing supports the rotor shaft. The bearing is secured in position by plastic injected around grooves in the housing and bearing outer race.

The rear cover supports the vane pivot pin, rear bearing inner race and exhaust tube. Dowel pins pressed into the housing correctly position the end cover which is fastened by four screws.

The rotor positions and drives the two vanes. A stamped steel liner supports the carbon shoes and shoe springs which seal the vanes and rotor. The two plastic vanes are molded to hubs which support bearings that rotate on the pivot pin. The pulley drive hub is pressed on the rotor shaft, and threaded holes in the hub provide for attachment of a pulley.



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Fig. 1K-14 Air Pump

#### Operation

The pump vanes are located 180° apart and rotate around the pivot pin which is located on the centerline of the pump housing. The rotor which drives the vanes rotates off the centerline of the pump housing. This creates changes in the distance between the outside of

the rotor and the inner wall of the pump housings during rotor rotation. As the leading vane moves past the intake opening, it is moving from a small area to a large area. This creates a partial vacuum which draws air into the pump. As the vanes and rotor continue to rotate, the trailing vane passes the intake and traps the air between the vanes. The vanes and rotor move the air into a smaller area. This begins to compress the air. Compression continues until the leading vane passes the exhaust opening. There the compressed air passes out of the pump and on to the rest of the Air Guard System.

### Air Pump Noise Diagnosis

The air pump is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. Allow for normal break-in wear of the pump prior to replacement for excessive noise.

A **chirping or squeaking noise** probably originates from vane rub in the housing bore and is noticeable at low speed intermittently. Vane chirping is often eliminated at increased pump speeds or with additional wear-in time. A chirping noise may also be caused by the drive belt slipping on a seized pump.

Bearing noise, a **rolling sound noticeable at all speeds**, is easily distinguished from vane chirping. It does not necessarily indicate bearing failure. If bearing noise reaches an objectionable level at certain speeds, the pump may have to be replaced.

Failure of a rear bearing is identified by a **continuous knocking noise** and replacement of the pump is required.

### Service Precautions

The following is a list of service precautions to prevent damage to the air pump.

- Do not attempt to prevent pulley from rotating by inserting tools into the centrifugal filter fan.
- Do not operate engine with pump belt removed or disconnected except for noise diagnosis.
- Do not attempt to lubricate.
- Do not clean centrifugal filter.
- Do not disassemble pump or remove rear cover.
- Do not exceed 20 foot-pounds (27 N•m) torque on mounting bolts.
- Do not pry on aluminum housing to adjust belt tension.
- Do not clamp pump in vise.
- Do not permit liquids to enter pump when steam- or pressure-cleaning engine.

### Service Procedures

#### Removal—Six-Cylinder Engine

- (1) Disconnect air pump output hose at back of air pump.

- (2) Remove adjustment bolt and remove drive belt.
- (3) Remove front mounting bracket.
- (4) Remove adjustment bracket from cylinder head.
- (5) Slide pump from pivot stud.

#### Installation—Six-Cylinder Engine

- (1) Slide pump onto pivot stud.
- (2) Install front mounting bracket.
- (3) Install adjustment bracket and install adjustment screw.
- (4) Install drive belt and adjust to specified tension. Tighten pivot stud nut.
- (5) Connect air pump output hose to back of pump.

**NOTE:** Adjust the belt tension by hand only.

#### Removal—Eight-Cylinder Engine

- (1) Disconnect air pump output hose at pump.
- (2) Loosen mount bracket-to-pump attaching screw and bolt. Remove drive belt.
- (3) Remove pivot screw and brace screws.
- (4) Remove pump.

#### Installation—Eight-Cylinder Engine

- (1) Position pump at mounting location and install pivot and brace attaching screws. Do not tighten.
- (2) Install drive belt and adjust to specified tension.
- (3) Tighten mounting screws and adjusting strap screw to 20 foot-pounds (27 N•m) torque.

**NOTE:** Adjust the belt tension by hand only.

## DIVERTER (BYPASS) VALVE

### General

A diverter valve is used in all Air Guard applications. The valves for six-cylinder and eight-cylinder engines differ only in the number of outlets. The six-cylinder diverter valve has one outlet and the eight-cylinder diverter valve has two for California certification and one outlet for 49-state models (on left side). A high flow diverter is used on some applications where greater air flow is required for emission control.

The valve momentarily diverts air pump output from reaching the exhaust manifolds during rapid deceleration. It also acts as a pressure release when air pump output is excessive. An internal silencer is incorporated in the diverter housing to muffle the airflow.

### Operation

In a rapid deceleration condition, high intake manifold vacuum is applied to the diaphragm in the diverter. When the vacuum signal is 20 inches of mercury or more, the spring tension of the diaphragm is overcome.

## 1K-12 EXHAUST SYSTEMS

This moves the metering valve down against its upper seat and away from its lower seat, diverting air pump output pressure to atmosphere (fig. 1K-15). Air pump output is diverted only momentarily because of a bleed hole in the diaphragm. This hole allows vacuum to quickly equalize on both sides of the diaphragm and the diaphragm spring returns the metering valve to its normal position.

If the air pump develops excessive output pressure, this excessive pressure overcomes the diaphragm spring tension, pushing the metering valve down. Pump output pressure is diverted to atmosphere. When pump output pressure returns to normal, the metering valve moves up from the upper seat and against the lower seat, returning to its normal open position. Pump output pressure is directed to the exhaust manifold(s).

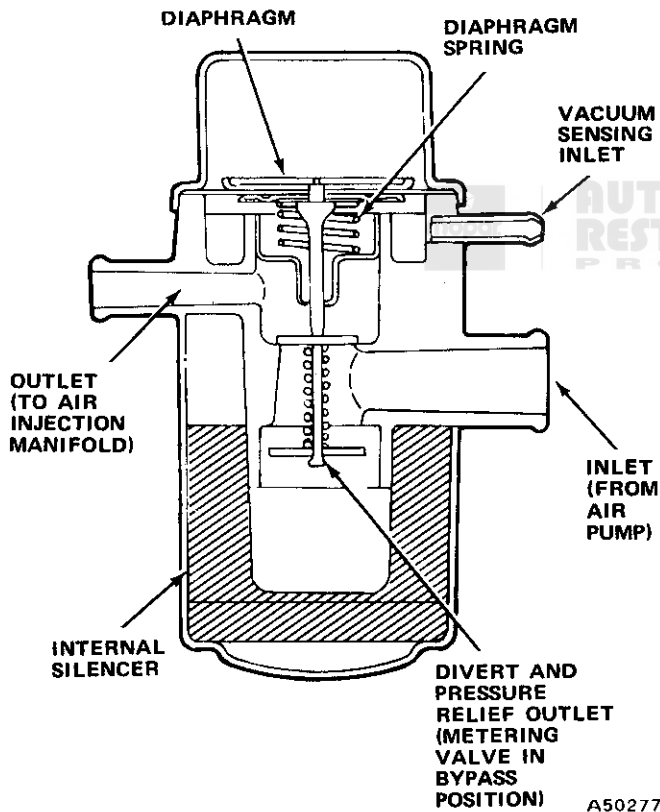


Fig. 1K-15 Diverter Valve—Typical

### Diverter Test

- (1) Start engine and run at idle.
- (2) Check diverter vents. Little or no air should flow from vents.
- (3) Accelerate engine to 2000 to 3000 rpm and rapidly close throttle. A strong flow of air should pass from the diverter vents for approximately 5 seconds. The high flow diverter used on some engines should vent for ap-

proximately 3 seconds. If air does not flow or if backfire occurs, make certain vacuum sensing line has vacuum and is not leaking.

**NOTE:** The diverter valve diverts air pump output when a vacuum of 20 inches Hg or more is applied at vacuum sensing line. Diverter also operates when pump output exceeds 5 psi (8 psi on some models).

- (4) Slowly accelerate engine. Between 2500 and 3500 rpm air should begin to flow from diverter vents.

### Diverter Replacement

The diverter valve is not serviceable and must be replaced if defective. The valve is attached to a bracket or suspended by the hoses between the air pump and air injection manifolds. Removal involves disconnecting the hoses, the vacuum sensing line and bracket clamp, if used. Installation entails connecting the hoses, vacuum line and bracket clamp, if used.

### AIR INJECTION MANIFOLDS

The air injection manifold is constructed of cold-rolled steel with a zinc plating and distributes air from the pump to each of the injection screws.

A check valve, incorporating a stainless steel spring plunger and an asbestos seat, is integral with the air injection manifold. Its function is to prevent the reverse flow of exhaust gases to the pump during pump or belt failure or diverter valve bypass operation. Reverse flow would damage the air pump and connecting hoses.

The distribution tubes of the air injection manifold are connected directly to the exhaust manifold. The hollow attaching screws conduct airflow into the manifold.

### Check Valve Test

To check the air injection manifold check valve for proper operation, disconnect the air supply hose at the injection manifold. With the engine running above idle speed, listen and feel for exhaust leakage at the check valve. A slight leak is normal.

### Removal—Six-Cylinder Engine

- (1) Disconnect air delivery hose at check valve.
- (2) Remove injection screws from each cylinder exhaust port.

**NOTE:** Some resistance to removal may be encountered due to carbon build-up on the screws.

- (3) Remove air injection manifold.

**Installation—Six-Cylinder Engine**

- (1) Assemble air injection manifold and screws to exhaust manifold. Tighten screws to 20 foot-pounds (27 N•m) torque.
- (2) Connect air delivery hose.

**Removal—Eight-Cylinder Engine**

- (1) Disconnect air delivery hose at check valve.
- (2) Remove injection screws.

**NOTE:** Some resistance to removal may be encountered due to carbon build-up on the screws.

- (3) Remove air injection manifold.
- (4) Remove sealing gaskets from air injection manifold.

**Installation—Eight-Cylinder Engine**

- (1) Install air injection manifold using replacement sealing gasket on either side of each opening.
- (2) Install injection screws to exhaust manifold. Tighten screws to 38 foot-pounds (52 N•m) torque.
- (3) Connect air delivery hose to check valve.

**SPECIFICATIONS**

**Torque Specifications**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N•m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Air Pump Mounting Screws . . . . .	20	27	15-22	20-30
Air Injection Screws —				
Six-Cylinder . . . . .	20	27	15-20	20-27
Eight-Cylinder . . . . .	38	52	30-45	41-61

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

70296

# CATALYTIC CONVERTER SYSTEM

	Page
Catalyst Replacement	1K-14
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Operation	1K-14

**GENERAL**

A pellet-type catalytic converter is used on all models. Leaded fuel poisons the catalytic converter, although use of a few gallons of leaded fuel in an emergency does not seriously impair the converter.

All CJ models are designed to use unleaded fuel and are equipped with a fuel filler neck restrictor, which admits only the smaller nozzle of the unleaded fuel pump.

**Converter Types**

The **monolithic converter** contains a mixture of platinum and palladium catalyzing agents is coated on an extruded material resembling a honeycomb. The front pipe and the monolithic converter are constructed as a unit. The catalyst is not serviceable.

The **pellet-type converter** contains beads of alumina coated with platinum and palladium catalyzing agents. Thousands of pellets are contained in a stainless steel



## 1K-14 EXHAUST SYSTEMS

canister. A plug is provided in the converter to permit replacement of the pellets should they become poisoned.

### OPERATION

Both monolithic and pellet-type converters operate on the same chemical principles. All exhaust gases flow through the catalytic converter. A chemical change oxidizes carbon monoxide and hydrocarbons into water and carbon dioxide. The catalysts which produce this chemical change are platinum and palladium present as a fine coating on the substrate.

The temperature inside the converter during the chemical reaction is somewhat higher than the temperature of the exhaust gases as they leave the engine. Insulation in the pellet-type converter keeps the outside skin of the converter at about the same temperature as the muffler. Due to its larger mass, the converter stays hot much longer than the muffler.

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 is not the fault of the converter—the engine has a carburetor, air pump or ignition problem permitting unburned fuel to enter the converter. If a converter is heat-damaged, the carburetor, air pump, or ignition problem should be corrected at the same time the converter is replaced, and all other components of the exhaust system should also be checked for heat damage.

### CATALYST REPLACEMENT

#### Monolithic Converter

The entire unit must be replaced if defective.

The monolithic converter is removed by disconnecting at the exhaust manifold and removing at the pellet type converter. Clean mating surface of manifold. Use replacement seal if required.

#### Pellet-Type Converter

The threaded plug used in previous years has been replaced with a pressed-in plug for 1979. A replacement kit consists of bridge, plug, washer and screw (fig. 1K-16).

- (1) Raise vehicle.
- (2) Place hose of Vacuum Pump Tool J-25077 on exhaust pipe and tighten clamp (fig. 1K-17).
- (3) Connect shop air (80 psi minimum) to fitting on vacuum pump.
- (4) Remove plug from bottom of converter.
  - (a) Drive small chisel between plug and converter housing. Do not damage housing.
  - (b) Continue driving chisel into plug to deform.
  - (c) Repeat steps (a) and (b) several places

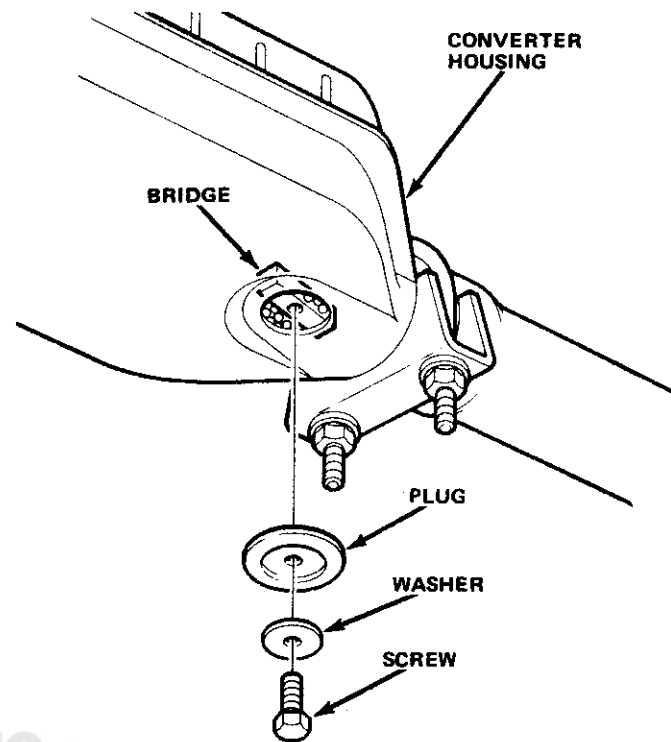


Fig. 1K-16 Fill Plug Replacement Parts

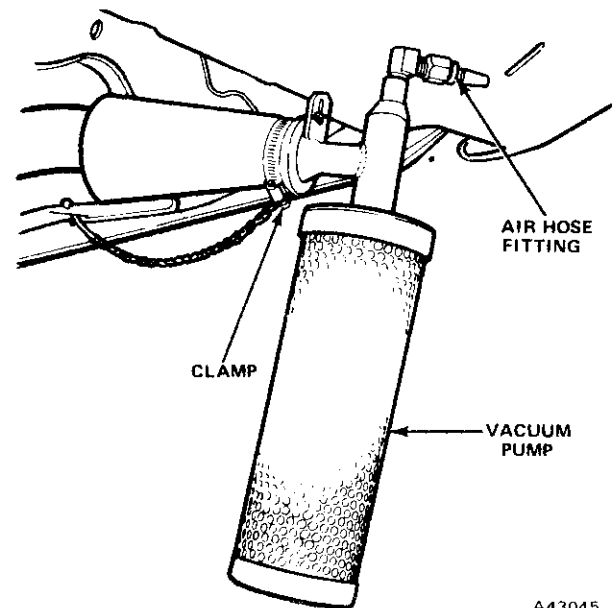


Fig. 1K-17 Vacuum Pump

around edge of plug until deformed sufficiently to be removed with pliers. Do not pry plug from housing.

(5) Position Vibrator Tool J-25077 on converter and lock in place (fig. 1K-18).

(6) Remove shop air hose from vacuum pump.

(7) Connect shop air hose to fitting on vibrator. Catalyst pellets will fall into can for approximately 10 minutes.

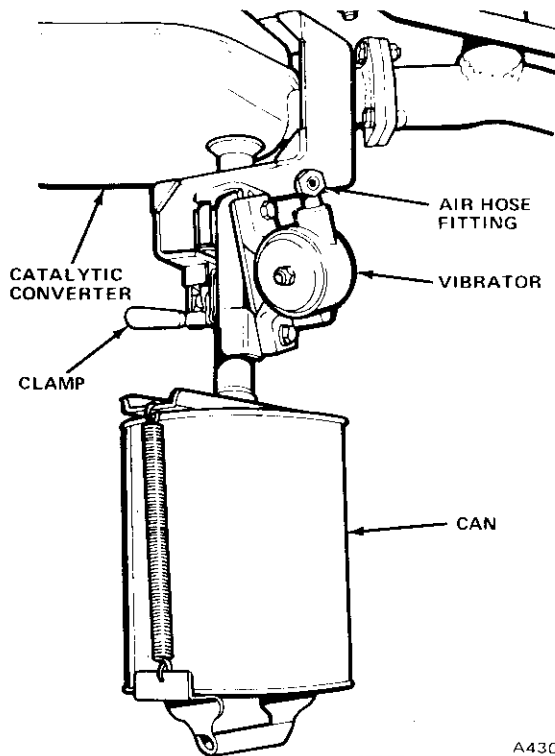


Fig. 1K-18 Vibrator Tool

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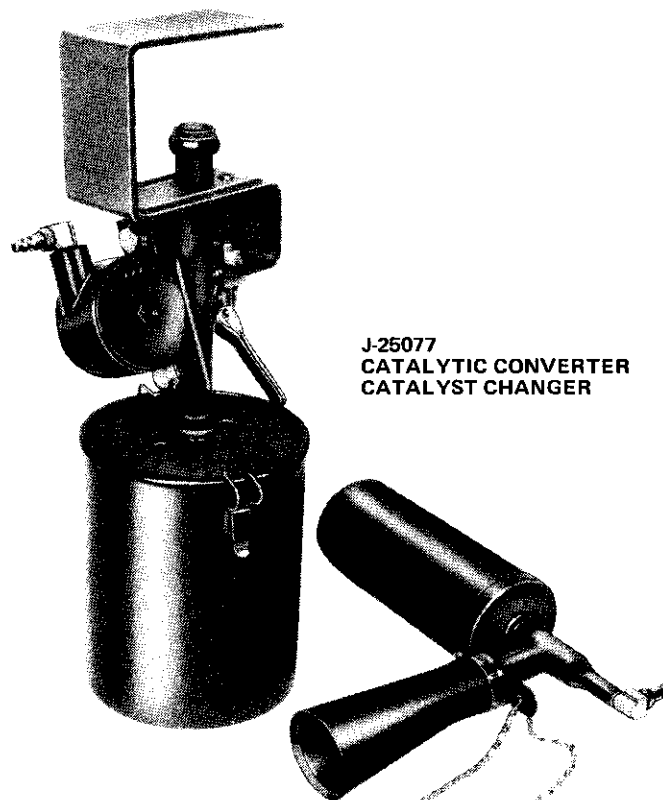
AUTHENTIC RESTORATION PRODUCT

- (8) When converter is empty, disconnect shop air hose, remove can, and discard pellets.
- (9) Install refill can on vibrator.
- (10) Connect shop air hose to vacuum pump and vibrator. Pellets will be drawn up and packed into place.

**NOTE:** If any pellets come out of the tailpipe, the converter is defective and must be replaced.

- (11) When converter is full, remove shop air hose from vibrator and remove vibrator from converter.
- (12) Install plug on bottom of converter.
  - (a) Install screw into bridge and position bridge into plug opening.
  - (b) Use screw as handle to position bridge inside housing.
  - (c) Remove screw from bridge. Do not disturb position of bridge.
  - (d) Insert screw through washer and plug.
  - (e) Carefully thread screw into bridge and tighten.
- (13) Disconnect shop air from vacuum pump and remove vacuum pump.
- (14) Lower vehicle.

**Tools**



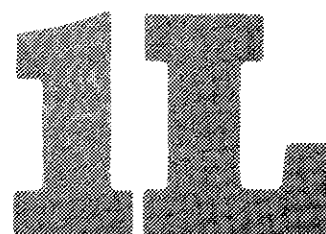
J-25077  
CATALYTIC CONVERTER  
CATALYST CHANGER

## NOTES



**AUTHENTIC  
RESTORATION™  
PRODUCT**

# POWER PLANT INSTRUMENTATION



## SECTION INDEX

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Circuits and Schematics	1L-41	Specifications—CJ	1L-40
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## GENERAL INFORMATION

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Constant Voltage Regulator (CVR) Replacement	1L-7	Operation	1L-1
Gauge Replacement	1L-5	Printed Circuit Replacement	1L-7
Instrument Cluster Replacement	1L-4		

### GENERAL

This chapter is divided into three sub-sections. The first sub-section, General Information, contains verbal descriptions of all instrumentation, operating principles, test procedures and replacement procedures. The second sub-section, Diagnosis and Repair Simplification (DARS) Charts, contains pictorial guides for diagnosing instrumentation malfunctions. The third sub-section, Circuits and Schematics, contains specifications, cluster illustrations, cluster schematics and separate schematics for each gauge circuit.

Power plant instrumentation includes all instrument panel gauges used to monitor engine-related systems included in this volume. Refer to Chapter 3C—Instrument Panels and Components for speedometer, odometer, clock, illumination lamps, turn signal indicators and high beam indicator. Instrumentation covered in this chapter includes: ammeter, constant voltage regulator (CVR), fuel gauge, oil pressure gauge, tachometer, temperature gauge and voltmeter (fig. 1L-1 and 1L-2). These gauges are all electrically operated.

### OPERATION

#### Ammeter

The ammeter is standard on Cherokee, Wagoneer and Truck. It is not available on CJ models.

The ammeter is an instrument used to indicate current flow into or out of the battery. Whenever electrical loads in the vehicle are greater than the alternator can supply, current flows from the battery, and the ammeter indicates discharge (-). Whenever alternator output is greater than the electrical loads of the vehicle, the excess current is available to charge the battery, and the ammeter indicates charge (+). If the battery is fully charged, the voltage regulator reduces alternator output to meet only immediate vehicle electrical loads. When this happens, the ammeter indicates zero.

The ammeter is connected between the battery and the alternator in order to indicate current flow into and out of the battery.

#### Constant Voltage Regulator (CVR)

Several gauges in each vehicle are designed to operate on low voltage. The CVR provides approximately 5 volts for this purpose. Battery voltage is supplied to the CVR. The CVR contains a small heating coil and thermostatic points. With battery voltage applied to the CVR, the points vibrate at a rate which supplies an average of 5 volts to the gauges. The CVR is built into the fuel gauge on CJ models and into the temperature gauge on Cherokee, Wagoneer and Truck models. A circuit is provided to carry CVR voltage to other gauges, as required.

## 1L-2 POWER PLANT INSTRUMENTATION

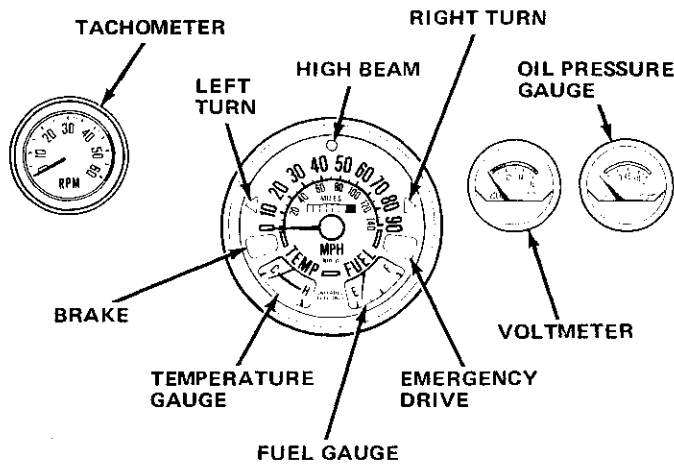


Fig. 1L-1 CJ Instrumentation

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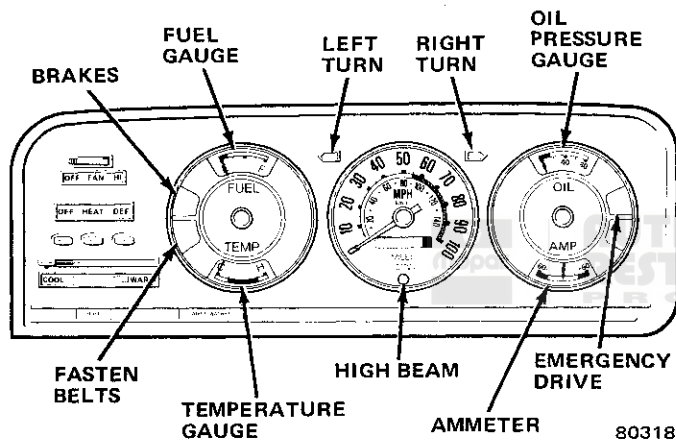


Fig. 1L-2 Cherokee-Wagoneer-Truck Instrumentation

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### Fuel Gauge

Fuel gauges on all models operate on regulated voltage provided by the constant voltage regulator (CVR). The fuel gauge system consists of the gauge, a variable-resistance sending unit in the fuel tank, appropriate wiring and the CVR.

The gauge needle is attached to a bimetal coil which responds to temperature changes. A heating coil wrapped around the bimetal provides heat to operate the bimetal. Current flows from the CVR through the heating coil, and is grounded through the sending unit in the fuel tank. The sending unit offers high resistance at low fuel level and very low resistance at high fuel level.

### Oil Pressure Gauge

The oil pressure gauge is standard on all Jeep vehicles.

### CJ Models

The oil pressure gauge system consists of a magnetic-type gauge, a variable-resistance sending unit and appropriate wiring. Battery voltage is applied to two coils in the gauge. One coil is connected directly to ground.

The other coil is connected to the sending unit. Variable resistance in the sending unit is controlled by the oil pressure applied to it. Magnetic fields are created around both coils in the gauge. The needle is attracted to the coil having the greater current flow.

### Cherokee-Wagoneer-Truck Models

The oil pressure gauge system consists of a CVR-powered gauge, a variable-resistance sending unit, appropriate wiring and the CVR. The gauge needle is attached to a bimetal strip which responds to temperature changes. A heating coil wrapped around the bimetal provides heat to operate the bimetal. Current flows from the CVR, through the heating coil and is grounded through the sending unit on the engine.

### Tachometer

The tachometer is an optional instrument on CJ only.

The tachometer is wired in series with the ignition coil primary between ignition switch and coil positive terminal. Current flowing through the coil is turned on and off by the ignition system each time a spark plug fires. The tachometer senses these interruptions in current flow, and converts pulses per second into revolutions per minute. The information is displayed by a needle on a dial.

### Temperature Gauge

The temperature gauge is standard equipment on all vehicles.

All temperature gauges operate on regulated voltage provided by the constant voltage regulator (CVR). The temperature gauge system consists of the gauge, a variable-resistance sending unit, appropriate wiring and the CVR.

The gauge needle is attached to a bimetal coil which responds to temperature changes. A heating coil wrapped around the bimetal provides heat to operate the bimetal. Current flows through the heating coil from the CVR, and is grounded through the sending unit in the engine. The sending unit offers high resistance at low engine temperature and very low resistance at high engine temperature.

### Voltmeter

The voltmeter is standard equipment on CJ models only. It is not available on other models. The voltmeter indicates regulated voltage. This provides an indication of the charging system's ability to keep the battery charged. Continuous readings in either high or low red bands indicates improper regulation, broken or slipping alternator drive belt, shorted alternator diode(s) or defective battery. Low readings in the green band are normal at idle or after prolonged engine cranking. Continuous readings in the low green band indicate faulty operation.

## INSTRUMENTATION DIAGNOSIS

### General

Improper operation of electrical gauges is usually traced to faulty continuity of wiring (including printed circuits), improperly calibrated components or high resistance caused by loose or corroded connections.

A common diagnostic procedure is to bypass a suspected component, wire, or connection with a jumper wire. If the system functions properly with the jumper installed, the problem usually is within the bypassed item.

### Test Equipment

Several gauge tests require Universal Gauge Tester J-24538. This instrument provides variable resistance over a wide range of ohm readings. If the tester is not available, a suitable substitute can be made with an accurate ohmmeter and a spare fuel tank sending unit.

- (1) Attach one lead of ohmmeter to sending unit terminal.
- (2) Attach other ohmmeter lead to sending unit ground wire.
- (3) Refer to Sending Unit Resistance Requirements chart for resistance values that apply to gauge being tested. Chart is included in specifications. Move float arm and mark appropriate resistance values on sending unit case.
- (4) Disconnect ohmmeter. Fasten jumper wire to sending unit terminal. Tester is now calibrated and ready to use.

### Printed Circuit Test

The following procedure is used to pinpoint suspected breaks or shorts in the conducting foil.

- (1) Remove instrument cluster from vehicle and remove all bulbs and gauges. Refer to Instrument Cluster Replacement for procedures.
- (2) Connect test lamp or ohmmeter lead to correct pin terminal for circuit to be tested. Trace each circuit from pin to bulb or gauge in that circuit.

**NOTE:** Use ohmmeter or Test Lamp J-21008. When using an ohmmeter, use low scale (0 to 10 ohms) and adjust meter to zero reading.

- (3) Check for continuity at each uncoated position in circuit. Test lamp should light or ohmmeter should read zero ohms at each position.
- (4) Trace circuit leading away from bulb or gauge to terminal pin or ground screw.
- (5) Check for continuity in circuit at each uncoated position. Test lamp should light or ohmmeter should read zero ohms.
- (6) Connect test lamp or ohmmeter lead to ground pin terminal and other lead to cluster metal case. Test lamp should light or ohmmeter should read zero ohms.

(7) Replace printed circuit if lamp fails to light or ohmmeter indicates resistance on any test.

(8) Check for shorting between circuits. With lead connected to correct pin for circuit to be tested, move other lead to all other pin terminals in cluster. Lamp should not light or ohmmeter should indicate infinite resistance between circuits.

### Ammeter Diagnosis

The accuracy of the ammeter may be determined by comparing readings against an ammeter of known accuracy.

- (1) Turn ignition Off.
- (2) Disconnect main harness wire from terminal of starter solenoid.
- (3) Connect known good ammeter between solenoid terminal and disconnected wire.
- (4) Turn ignition switch to On position. Do not start engine. Turn headlamps on. Turn heater blower to high speed.
- (5) Compare reading of known good ammeter with reading of ammeter in vehicle.
- (6) Start engine and run at high idle. Turn headlamps and heater blower off. Compare reading of known good ammeter with reading of ammeter in vehicle.
- (7) Replace ammeter if readings of vehicle ammeter and test ammeter vary more than tolerance listed in Specifications.

### Fuel Gauge Diagnosis

Movement of the fuel in the tank may be caused by driving on long hills, driving on bumpy surfaces or by rapidly accelerating or braking. Erratic up and down motion of the fuel level indicator float may temporarily cause the fuel gauge to indicate incorrectly. Be sure to consider these conditions before suspecting an actual abnormal condition in the indicating system.

Abnormal conditions are all variations of four basic malfunctions:

- Needle does not move.
- Needle moves but indicates a fuel level that does not correspond with actual fuel level.
- Needle moves to top of scale and remains there.
- Needle pulsates.

Refer to DARS chart 1 for a systematic method of finding the causes of these conditions. Charts 2 and 3 provide additional procedures needed only as directed in chart 1.

### Oil Pressure Gauge Diagnosis

The oil pressure gauge may malfunction in several ways:

- Needle does not move.
- Needle moves but indicates an oil pressure that does not correspond with actual oil pressure.
- Needle moves to top of scale and remains there.

## 1L-4 POWER PLANT INSTRUMENTATION

- Needle pulsates.

Refer to DARS chart 4 or 5 for a systematic method of finding the causes of these problems.

### Calibration Test

If an oil pressure gauge is suspected of indicating pressure that does not correspond with actual oil pressure, perform a calibration test before performing electrical diagnosis procedures in DARS chart 4 or 5.

(1) Remove sending unit from engine. Install T-fitting in sending unit hole in engine. Install sending unit to T-fitting.

(2) Connect direct-reading oil gauge to T-fitting.

(3) Start engine. Compare reading of vehicle gauge with test gauge. Make observation at idle and at higher engine speeds. If readings of both gauges are same (within 10%), vehicle gauge is acceptable. If gauge is outside specifications, perform gauge test as outlined in DARS chart 4 or 5.

(4) After performing test, remove T-fitting, install sending unit and check for leaks.

### Tachometer Diagnosis

Test the accuracy of a tachometer by comparing with a test tachometer of known accuracy. A special terminal is provided on the coil connector for test tachometer connection. Refer to Chapter 1G—Ignition. Tachometers are not adjustable. Replace if defective.

### Temperature Gauge Diagnosis

Before performing temperature gauge diagnosis, be sure the cooling system is performing properly. Overheating may be caused by low coolant level, restrictions, loose or broken drive belt, defective water pump or incorrect ignition timing. Undercooling may be caused by a stuck thermostat. Be sure to consider these conditions before suspecting an actual abnormal condition in the indicating system. Abnormal conditions are all variations of four basic malfunctions:

- Needle does not move.
- Needle moves but indicates a temperature that does not correspond with actual coolant temperature.
- Needle moves to top of scale and remains there.
- Needle pulsates.

Refer to DARS chart 6 for a systematic method of finding the causes of these conditions. Charts 2 and 3 provide additional procedures needed only as directed in chart 6.

### Voltmeter

(1) Connect voltmeter of known accuracy across battery terminals.

(2) Turn ignition switch On.

(3) Compare indication of test voltmeter with indication of vehicle voltmeter. Replace voltmeter if readings vary more than tolerance listed in Specifications.

## INSTRUMENT CLUSTER REPLACEMENT

### CJ Models

#### Removal

- (1) Disconnect battery negative cable.
- (2) Separate speedometer cable from speedometer head.
- (3) Remove four attaching nuts and pull cluster from mounting studs.
- (4) Note positions of all lamps. Note wire colors for use during installation.
- (5) Remove gauge wires and lamps.

#### Installation

- (1) Install gauge wires and cluster lamps to cluster.
- (2) Position cluster on mounting studs and install attaching nuts.
- (3) Connect speedometer cable.
- (4) Connect battery negative cable.
- (5) Reset clock, if equipped.

### Cherokee-Wagoneer-Truck Models

#### Removal

- (1) Disconnect battery negative cable.
- (2) Remove cluster retaining screws.
- (3) Disconnect speedometer cable at cluster.
- (4) Disconnect cluster pin terminal plug by pulling straight off.
- (5) Disconnect four-terminal connector.
- (6) Mark ammeter wires for identification during installation. Disconnect ammeter wires.
- (7) Disconnect fan wiring connector.
- (8) Disconnect vacuum hoses from heater control.

**NOTE:** Tag each hose according to its numbered location to ensure proper connection when installing cluster.

- (9) Remove heater control panel lamps.
- (10) Disconnect temperature control wire from lever.
- (11) Remove cluster assembly.

#### Installation

- (1) Connect harness connectors and identification lamps to heater control.
- (2) Connect temperature control wire to operating lever.

- (3) Connect vacuum hoses.
- (4) Connect cluster wire connectors.
- (5) Identify and install ammeter wires to original locations. If wires are reversed, ammeter will indicate discharge instead of charge.
- (6) Connect speedometer cable.
- (7) Position cluster on instrument panel and install screws.
- (8) Connect battery negative cable.
- (9) Reset clock, if equipped.

## GAUGE REPLACEMENT

### Ammeter

- (1) Remove cluster.
- (2) Remove printed circuit board and gauge assembly.
- (3) Remove mask from oil gauge and ammeter.

**CAUTION:** *Be careful to not scratch paint on mask.*

- (4) Remove attaching nuts and remove ammeter.
- (5) Install ammeter and tighten nuts.
- (6) Install mask and screws.
- (7) Install circuit board and gauge assembly to bezel.
- (8) Install cluster.

### Fuel Gauge

#### CJ Models

- (1) Remove cluster.
- (2) Carefully uncrimp lip of outer bezel. Remove outer bezel, glass and glass retaining bezel.
- (3) Remove attaching screws from speedometer housing. Remove speedometer and face plate assembly.
- (4) Remove attaching nuts and remove insulator and fuel gauge.

**NOTE:** *It may be necessary to carefully pry light guard aside.*

- (5) Install gauge, insulator and attaching nuts. Toothed lockwasher goes on A-terminal. Be sure gauge is properly centered in face plate opening, then tighten nuts.
- (6) Check all light guards for position. Install speedometer and face plate assembly. Install attaching screws and washers.
- (7) Check glass for fingerprints and debris.
- (8) Install glass, glass retaining bezel and outer bezel. Crimp outer bezel lip four places.
- (9) Install cluster.

#### Cherokee-Wagoneer-Truck Models

- (1) Remove cluster.
- (2) Remove printed circuit board and gauge assembly.
- (3) Remove mask from fuel gauge and temperature gauge.

**CAUTION:** *Be careful to not scratch paint on mask.*

- (4) Remove attaching nuts and remove fuel gauge.
- (5) Install fuel gauge and tighten nuts.
- (6) Install mask and screws.
- (7) Install circuit board and gauge assembly to bezel.
- (8) Install cluster.

### Oil Pressure Gauge

#### CJ Models

- (1) Remove illumination lamp and disconnect wire connectors.
- (2) Remove retaining nuts and bracket behind instrument panel.
- (3) Remove gauge from instrument panel.
- (4) Position gauge in instrument panel opening.
- (5) Install bracket and nuts.
- (6) Connect wires and install lamp.

#### Cherokee-Wagoneer-Truck Models

- (1) Remove cluster.
- (2) Remove printed circuit board and gauge assembly.
- (3) Remove mask from oil pressure gauge and ammeter.

**CAUTION:** *Be careful to not scratch paint on mask.*

- (4) Remove attaching nuts and remove oil pressure gauge.
- (5) Install oil pressure gauge and tighten nuts.
- (6) Install mask and screws.
- (7) Install circuit board and gauge assembly to bezel.
- (8) Install cluster.

### Tachometer

- (1) Disconnect wires:
  - (a) Black ground wire
  - (b) Orange illumination wire from fuse block
  - (c) Red and red w/t wires from main harness
- (2) Remove screw and retaining cup.
- (3) Remove tachometer from instrument panel.



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**NOTE:** *It is possible to drive vehicle with tachometer removed. Connect harness wires to each other where tachometer was originally connected.*

- (4) Install tachometer, cup and screw.
- (5) Connect wires.

### Temperature Gauge

#### CJ Models

- (1) Remove cluster.
- (2) Carefully uncrimp lip of outer bezel. Remove outer bezel, glass and glass retaining bezel.
- (3) Remove attaching screws from speedometer housing. Remove speedometer and face plate assembly.
- (4) Remove attaching nuts and remove insulator and temperature gauge.

**NOTE:** *It may be necessary to carefully pry light guard aside.*

(5) Install gauge, insulator and attaching nuts. Toothed lockwasher goes on S-terminal. Be sure gauge is properly centered in face plate opening, then tighten nuts.

(6) Check all light guards for position. Install speedometer and face plate assembly. Install attaching screws and washers.

(7) Check glass for fingerprints and debris.

(8) Install glass, glass retaining bezel and outer bezel. Crimp outer bezel four places.

(9) Install cluster.

#### Cherokee-Wagoneer-Truck Models

- (1) Remove cluster.
- (2) Remove printed circuit board and gauge assembly.
- (3) Remove mask from fuel gauge and temperature gauge.

**CAUTION:** *Be careful to not scratch paint on mask.*

(4) Remove attaching nuts and remove temperature gauge.

(5) Install temperature gauge and tighten nuts.

(6) Install mask and screws.

(7) Install circuit board and gauge assembly to bezel.

(8) Install cluster.

### Voltmeter

(1) Disconnect illumination lamp and wire connectors. Note wire locations for installation.

(2) Remove retaining nuts and bracket behind instrument panel.

- (3) Remove gauge from instrument panel.
- (4) Position gauge in instrument panel opening.
- (5) Install bracket and nuts.
- (6) Connect wires in original locations and install lamp.

### PRINTED CIRCUIT REPLACEMENT

Only Cherokee, Wagoneer and Truck models use a circuit board. CJ models use direct wiring for all gauges and cluster lamps.

#### Removal

- (1) Remove instrument cluster.
- (2) Remove radio noise suppressor (connector strip when not equipped with radio).
- (3) Remove all lamps from cluster. Twist counterclockwise to remove.
- (4) Remove circuit board and gauge assembly.
- (5) Remove retaining nuts from ammeter and oil pressure gauges.
- (6) Lift ammeter, oil pressure gauge and plate out of cluster as assembly.
- (7) Remove retaining nuts from fuel and temperature gauges. Remove large ground screw from circuit board above speedometer.
- (8) Remove speedometer, fuel gauge, and temperature gauge as assembly.

#### Installation

(1) Install circuit board to speedometer and gauge assembly. Check position of blue illumination lamp diffusers. Install ground screw and gauge retaining nuts.

(2) Install ammeter and oil pressure gauge assembly to circuit board. Check position of blue diffuser. Install retaining nuts. Stamped nuts are used on oil gauge. Plain nuts and lockwashers are used on ammeter.

(3) Check gauge lenses for fingerprints and debris.

(4) Install circuit board and gauge assembly to bezel.

(5) Install lamps.

(6) Install radio noise suppressor or connector strip.

(7) Install cluster.

### CONSTANT VOLTAGE REGULATOR (CVR) REPLACEMENT

#### CJ Models

The CVR is contained in the fuel gauge case. If CVR is defective, replace fuel gauge.

#### Cherokee-Wagoneer-Truck Models

The CVR is contained in the temperature gauge case. If CVR is defective, replace temperature gauge.

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**DIAGNOSIS AND REPAIR  
SIMPLIFICATION (DARS)  
CHARTS**

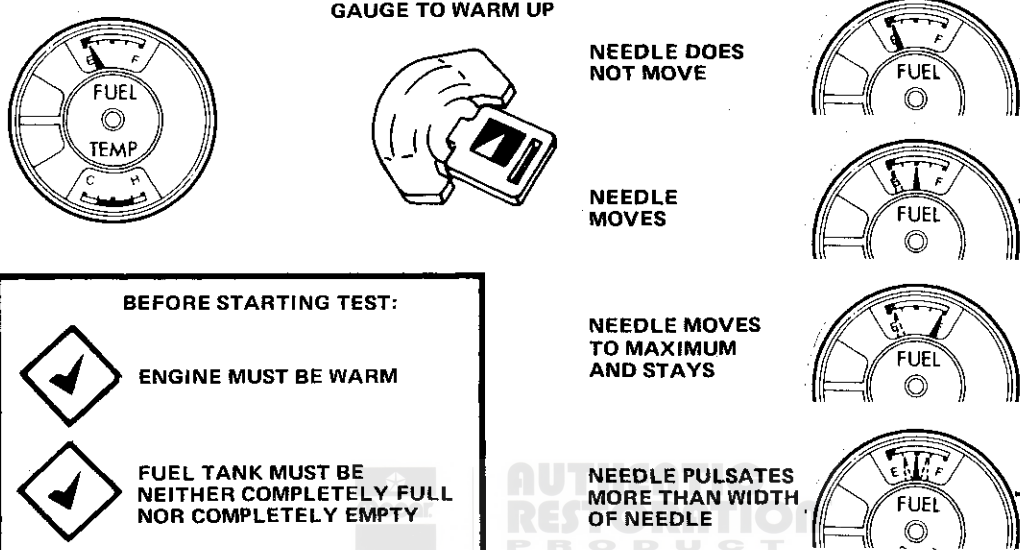
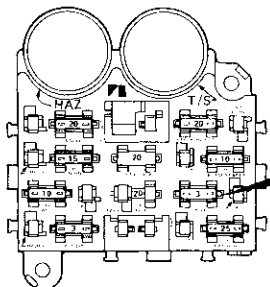
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Fuel Gauge and Temperature Gauge Both Malfunction	1L-19	Oil Pressure Gauge—Cherokee-Wagoneer-Truck Models	1L-26
Fuse Blown	1L-17	Temperature Gauge	1L-32

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Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

Chart 1

**PROBLEM: FUEL GAUGE NOT FUNCTIONING PROPERLY**

STEP	SEQUENCE	RESULT
<p><b>1</b></p> <ul style="list-style-type: none"> <li>NOTE POSITION OF FUEL GAUGE NEEDLE</li> <li>TURN IGNITION ON AND WAIT 2 MINUTES FOR GAUGE TO WARM UP</li> <li>OBSERVE NEEDLE</li> </ul> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p><b>BEFORE STARTING TEST:</b></p> <ul style="list-style-type: none"> <li>ENGINE MUST BE WARM</li> <li>FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY</li> </ul> </div>	 <p>NEEDLE DOES NOT MOVE</p> <p>NEEDLE MOVES</p> <p>NEEDLE MOVES TO MAXIMUM AND STAYS</p> <p>NEEDLE PULSATES MORE THAN WIDTH OF NEEDLE</p> <p>REPLACE CVR</p>	<p><b>2</b></p> <p><b>20</b></p> <p><b>10</b></p> <p><b>STOP</b></p>
<p><b>2</b></p>	 <p>CHECK 3-AMP FUSE AT FUSE PANEL</p> <p>FUSE BLOWN</p> <p>FUSE NOT BLOWN</p>	<p>GO TO CHART 2 STEP 1</p> <p><b>3</b></p>
<p><b>3</b></p>	<p>OBSERVE TEMPERATURE GAUGE</p> <p>TEMPERATURE GAUGE NEEDLE DOES NOT MOVE</p> <p>TEMPERATURE GAUGE NEEDLE INDICATES PROPERLY</p> <p>CJ MODELS</p> <p>CHEROKEE WAGONEER TRUCK MODELS</p>	<p>GO TO CHART 3 STEP 1</p> <p><b>4</b></p> <p><b>7</b></p>

# Chart 1

**STEP**

**SEQUENCE**

**RESULT**

**4**

- REMOVE CLUSTER
- LEAVE INSTRUMENT LEADS ATTACHED

CONNECT JUMPER BETWEEN CLUSTER CASE AND INSTRUMENT PANEL

CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION

CHECK FOR PRESENCE OF VOLTAGE AT GAUGE INPUT

OK  
VOLTAGE NOT PRESENT

LOCATE AND REPAIR FAULT IN JUMPER STRAP

OK  
VOLTAGE PRESENT

STOP

**5**

**5**

GROUND SENDER TERMINAL OF GAUGE

NEEDLE MOVES

NEEDLE DOES NOT MOVE

REPLACE GAUGE

**6**

STOP

**6**

LOCATE AND REPAIR OPEN CIRCUIT IN SENDER WIRE

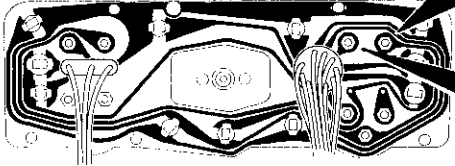
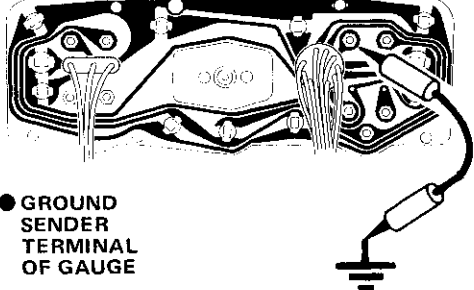
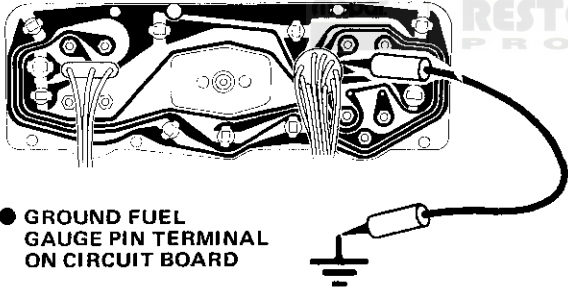
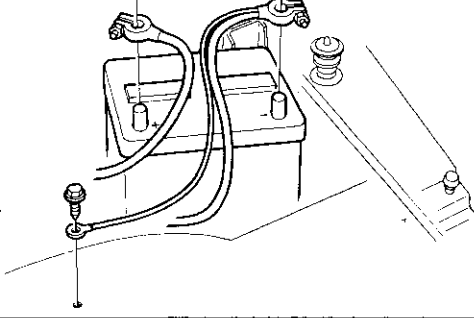
STOP

# Chart 1

## RESULT

## STEP

## SEQUENCE

<p><b>7</b></p>	<ul style="list-style-type: none"> <li>● REMOVE CLUSTER</li> <li>● DO NOT DISCONNECT INSTRUMENT CLUSTER WIRING CONNECTOR</li> </ul> 	<p>CHECK FOR PRESENCE OF VOLTAGE AT GAUGE INPUT</p> <p>CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION</p>	<p> VOLTAGE NOT PRESENT</p> <p> REPLACE CIRCUIT BOARD</p> <p> VOLTAGE PRESENT</p>	<p> STOP</p> <p><b>8</b></p>
<p><b>8</b></p>	<ul style="list-style-type: none"> <li>● GROUND SENDER TERMINAL OF GAUGE</li> </ul> 	<p> FUEL NEEDLE MOVES</p> <p> FUEL NEEDLE DOES NOT MOVE</p>	<p> REPLACE GAUGE</p>	<p><b>9</b></p> <p> STOP</p>
<p><b>9</b></p>	<ul style="list-style-type: none"> <li>● GROUND FUEL GAUGE PIN TERMINAL ON CIRCUIT BOARD</li> </ul> 	<p> FUEL NEEDLE MOVES</p> <p> FUEL NEEDLE DOES NOT MOVE</p>	<p> REPAIR OPEN CIRCUIT IN SENDER WIRE</p> <p> REPLACE CIRCUIT BOARD</p>	<p> STOP</p> <p> STOP</p>
<p><b>10</b></p>	<p> CHECK GROUND STRAP</p> <ul style="list-style-type: none"> <li>● BROKEN</li> <li>● MISSING</li> <li>● CORRODED</li> <li>● SCREWS LOOSE, MISSING</li> </ul> 		<p> GROUND NOT OK</p> <p> GROUND OK</p>	<p><b>11</b></p> <p><b>12</b></p>
<p><b>11</b></p>	<p> REPAIR GROUND</p>	<p>NEEDLE DROPS FROM MAXIMUM</p> <p>NEEDLE REMAINS AT MAXIMUM</p>	<p> FUEL NEEDLE DROPS FROM MAXIMUM</p> <p> FUEL NEEDLE REMAINS AT MAXIMUM</p>	<p> STOP</p> <p><b>12</b></p>

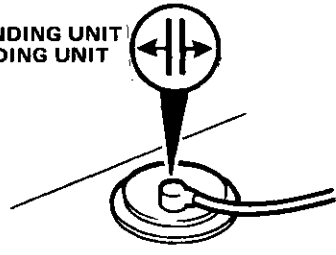
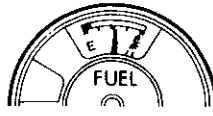
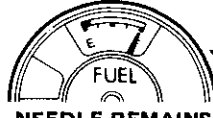
# Chart 1

## STEP

## SEQUENCE

## RESULT

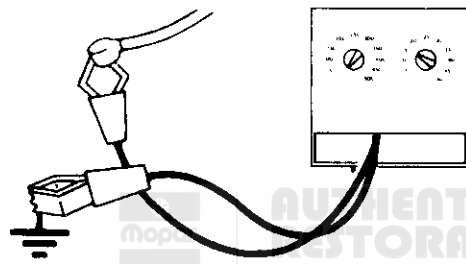
**12** DISCONNECT SENDING UNIT WIRE FROM SENDING UNIT

**13**

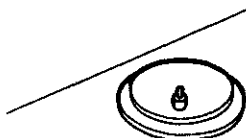
**17**

**13**



CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE

- TURN IGNITION ON
- ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE REQUIREMENTS CHART. OBSERVE FUEL GAUGE INDICATION AT EACH OHM SETTING.



**OK**

**14**

GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING

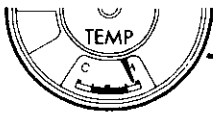
**OK**

**15**

GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING

**14** ● OBSERVE TEMPERATURE GAUGE

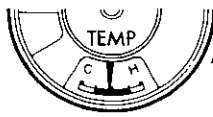
TEMPERATURE GAUGE NEEDLE IS AT MAXIMUM



**REPAIR CLUSTER GROUND OR REPLACE CVR**

**STOP**

TEMPERATURE GAUGE NEEDLE INDICATES NORMALLY



**REPLACE FUEL GAUGE**

**STOP**

Chart 1  
RESULT

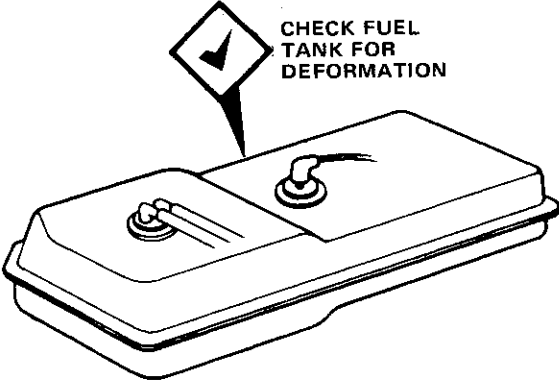
STEP

SEQUENCE

RESULT

**15**


CHECK FUEL TANK FOR DEFORMATION



OK  
FUEL TANK NOT DEFORMED

**16**

~~OK~~  
FUEL TANK DEFORMED

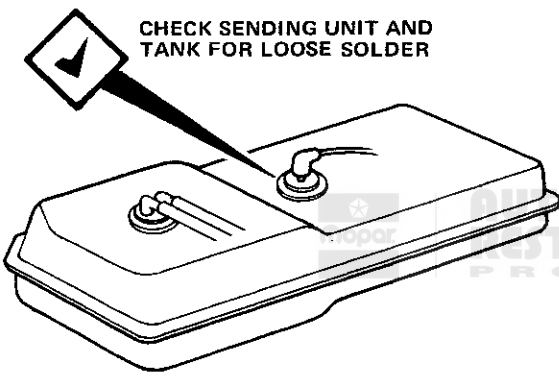
  
REPAIR OR REPLACE FUEL TANK

**16**


**STOP**

**16**

CHECK SENDING UNIT AND TANK FOR LOOSE SOLDER




OK  
NO LOOSE SOLDER

  
REPLACE SENDING UNIT

**STOP**

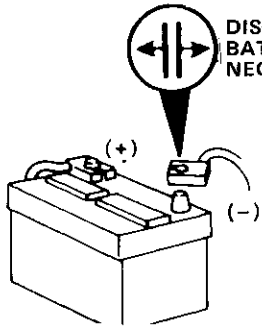
~~OK~~  
LOOSE SOLDER PRESENT

  
REMOVE LOOSE SOLDER

**STOP**

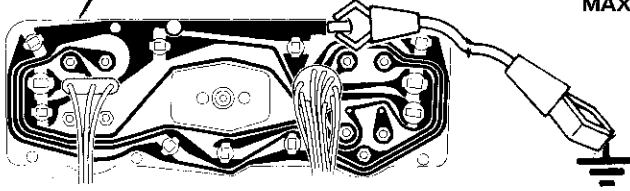
**17**

DISCONNECT BATTERY NEGATIVE CABLE

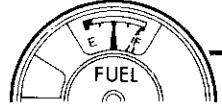


CONNECT BATTERY NEGATIVE CABLE

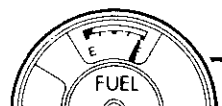
REMOVE INSTRUMENT CLUSTER. DO NOT DISCONNECT WIRE HARNESS



CONNECT JUMPER WIRE BETWEEN CLUSTER GROUND AND BODY


  
NEEDLE DROPS FROM MAXIMUM

**18**

  
NEEDLE REMAINS AT MAXIMUM

**19**

**18**

 REPAIR INSTRUMENT GROUND PANEL

**STOP**

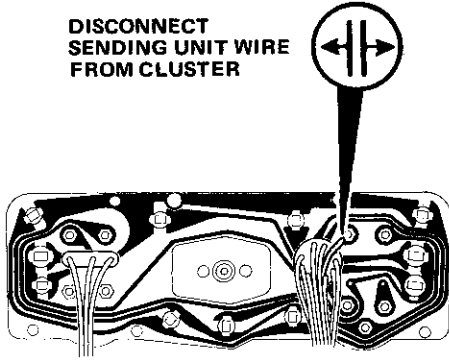
# Chart 1 RESULT

## STEP

## SEQUENCE

**19**

DISCONNECT SENDING UNIT WIRE FROM CLUSTER



NEEDLE DROPS FROM MAXIMUM

REPAIR OR REPLACE SENDING UNIT WIRE

NEEDLE REMAINS AT MAXIMUM



REPLACE GAUGE (CJ)

REPLACE CIRCUIT BOARD (CHEROKEE, WAGONEER, TRUCK)

STOP

STOP

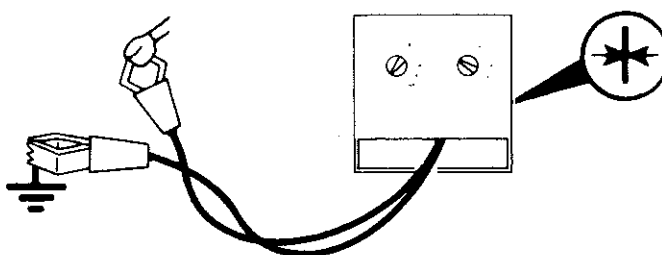
STOP

**20**

TURN IGNITION ON

ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE REQUIREMENTS CHART. OBSERVE FUEL GAUGE INDICATION AT EACH OHM SETTING.



CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE

GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING

GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING

REPLACE SENDING UNIT

21  
CJ

22  
CHEROKEE WAGONEER TRUCK

STOP



STEP

SEQUENCE

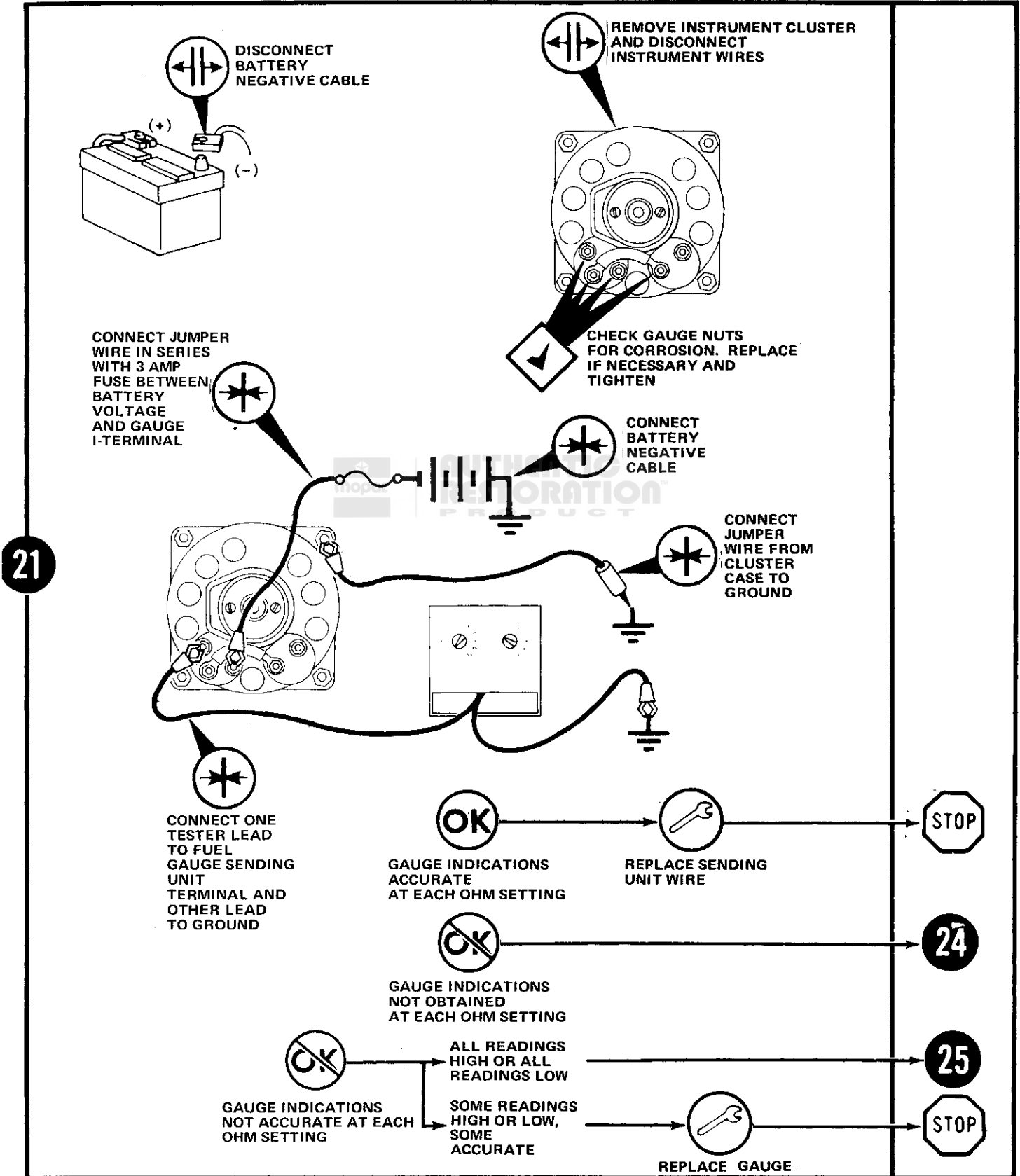


Chart 1  
RESULT

STEP

SEQUENCE

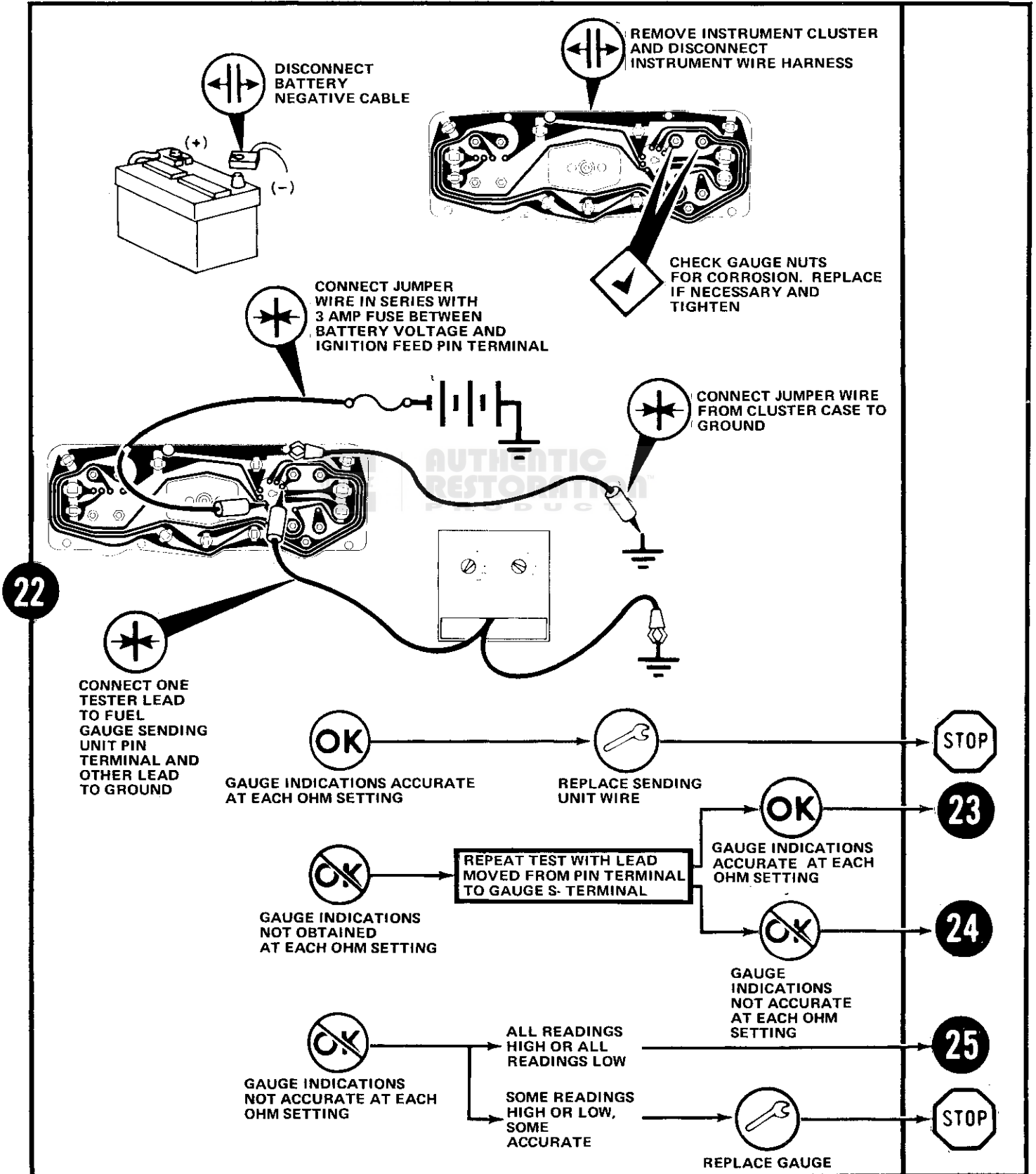



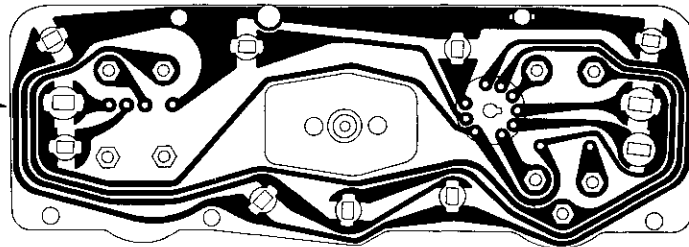
Chart 1  
RESULT

STEP

SEQUENCE

23

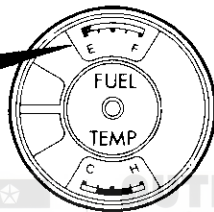
 REPLACE  
CIRCUIT  
BOARD





24

 REPLACE  
GAUGE





25



CONNECT OHMMETER LEADS TO GAUGE  
INPUT TERMINAL AND GAUGE SENDER TERMINAL

- COMPARE OHMMETER  
READING WITH VALUES LISTED  
IN GAUGE RESISTANCE VALUES CHART



GAUGE  
RESISTANCE  
CORRECT



REPLACE  
CVR



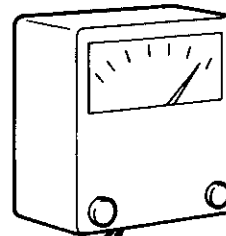
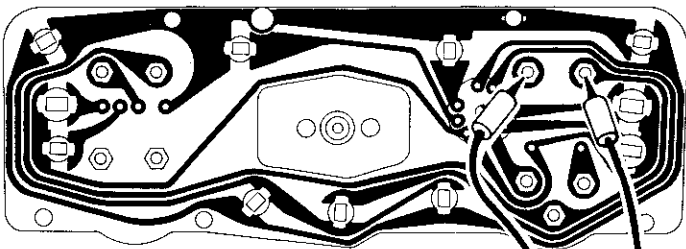


GAUGE  
RESISTANCE  
INCORRECT



REPLACE  
GAUGE





OHMMETER

# PROBLEM: GAUGE FUSE BLOWN

## Chart 2

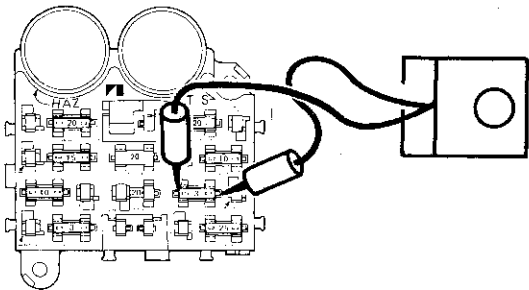


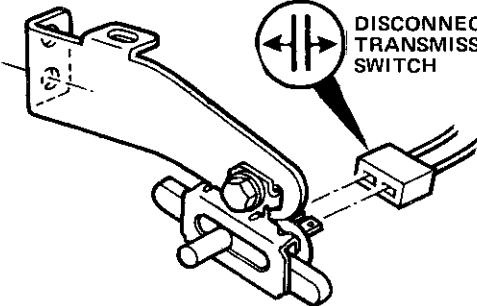

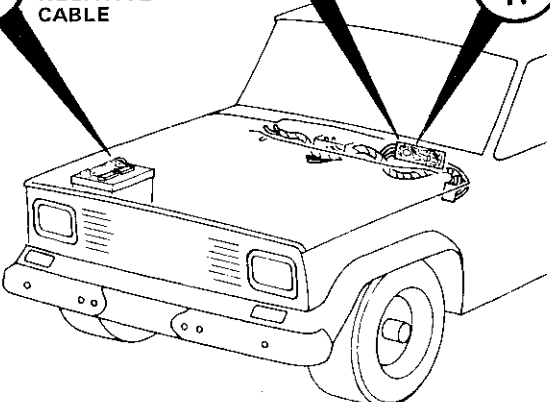

STEP	SEQUENCE	RESULT
1	 <p>CONNECT SHORT CHECKER J-8681</p>	<p>OK → 2 SHORT NOT INDICATED</p> <p><del>OK</del> → 3 SHORT INDICATED</p>
2	 <p>CHECK FOR INTERMITTENT SHORT</p> <ul style="list-style-type: none"> <li>● RED IGNITION FEED TO GAUGES</li> <li>● TRANSMISSION KICKDOWN CIRCUIT</li> </ul>	<p> → STOP REPAIR AS NECESSARY</p>
3	 <p>DISCONNECT AUTOMATIC TRANSMISSION KICKDOWN SWITCH</p>	<p><del>OK</del> → 4 SHORT INDICATED</p> <p>OK →  → STOP SHORT NOT INDICATED    REPLACE KICKDOWN SWITCH</p>
4	 <p>DISCONNECT BATTERY NEGATIVE CABLE</p> <p>REMOVE INSTRUMENT CLUSTER</p> <p>DISCONNECT INSTRUMENT WIRE HARNESS CONNECTOR FROM PRINTED CIRCUIT (CHEROKEE, WAGONEER, TRUCK) OR FROM GAUGES (CJ)</p>	<p> CHECK FOR SHORT AT GAUGE FUSE</p> <p><del>OK</del> → 5 SHORT INDICATED</p> <p>CONNECT BATTERY NEGATIVE CABLE</p> <p>OK → 6 SHORT NOT INDICATED</p> <p>OK → 7 SHORT NOT INDICATED</p> <p>CHEROKEE WAGONEER TRUCK</p> <p>CJ</p>

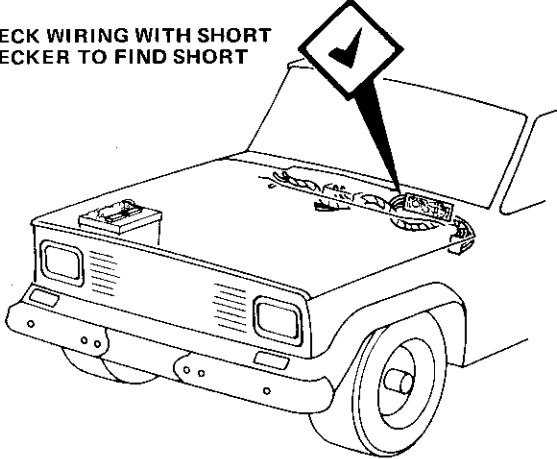
Chart 2  
RESULT

STEP

SEQUENCE

**5**

CHECK WIRING WITH SHORT CHECKER TO FIND SHORT

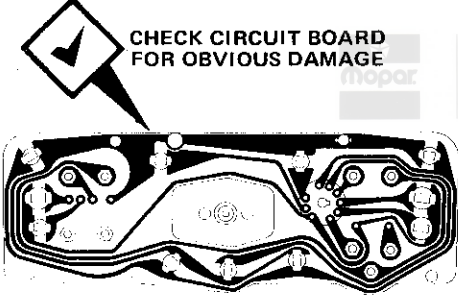


REPLACE SHORTED WIRE HARNESS

STOP

**6**

CHECK CIRCUIT BOARD FOR OBVIOUS DAMAGE



OK  
CIRCUIT BOARD NOT DAMAGED

REPLACE CVR

STOP

~~OK~~  
CIRCUIT BOARD DAMAGED

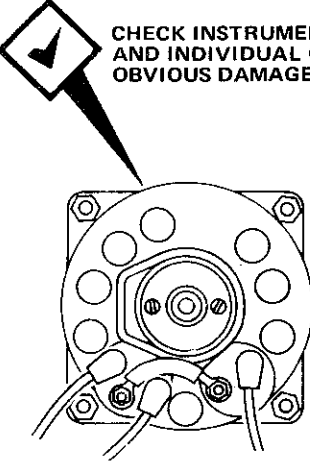
DETERMINE CAUSE OF DAMAGE: CVR OR GAUGE FAULTY

REPLACE CIRCUIT BOARD AND FAULTY COMPONENT

STOP

**7**

CHECK INSTRUMENT CLUSTER AND INDIVIDUAL GAUGES FOR OBVIOUS DAMAGE



OK  
DAMAGE NOT EVIDENT

REPLACE CVR

STOP

~~OK~~  
DAMAGE EVIDENT

REPLACE DAMAGED COMPONENT

STOP

Chart 3

**PROBLEM: NEITHER TEMPERATURE GAUGE NOR FUEL GAUGE OPERATES (ALSO OIL GAUGE ON CHEROKEE, WAGONEER AND TRUCK)**

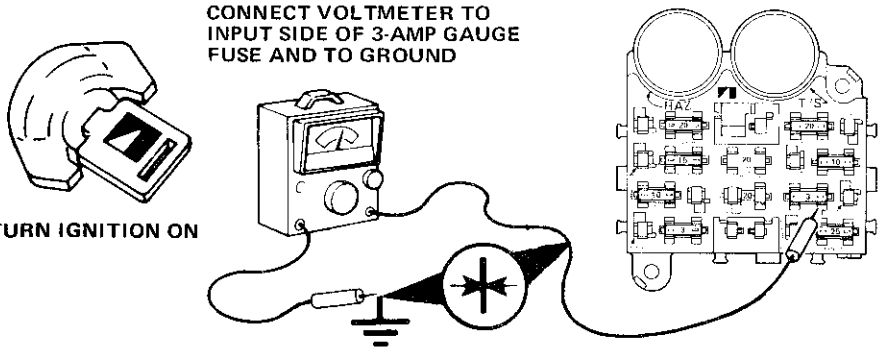
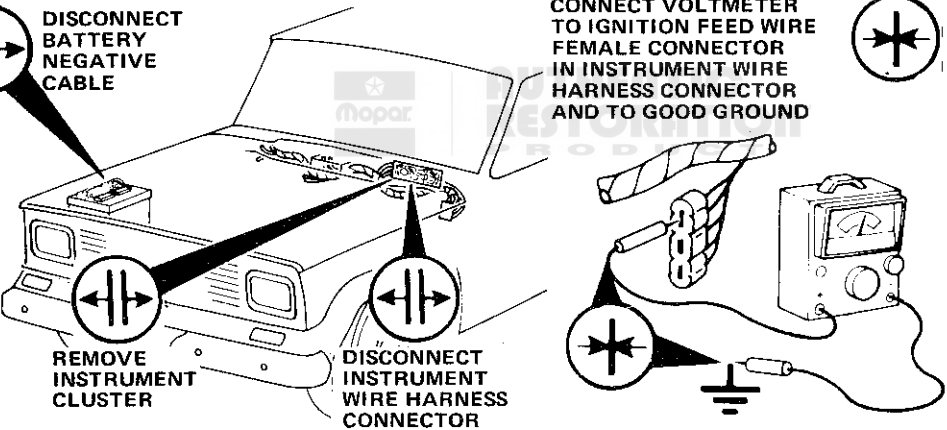
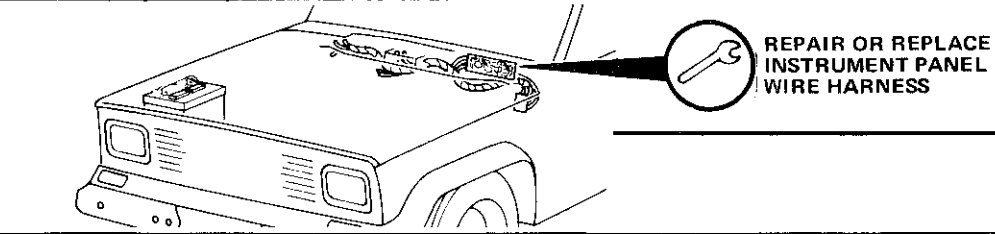
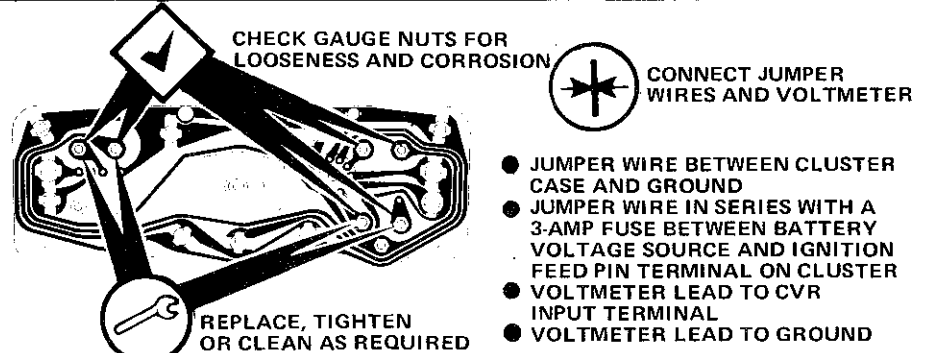
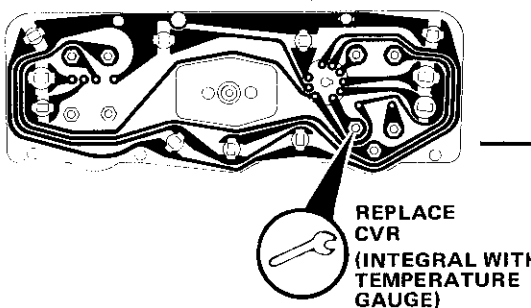

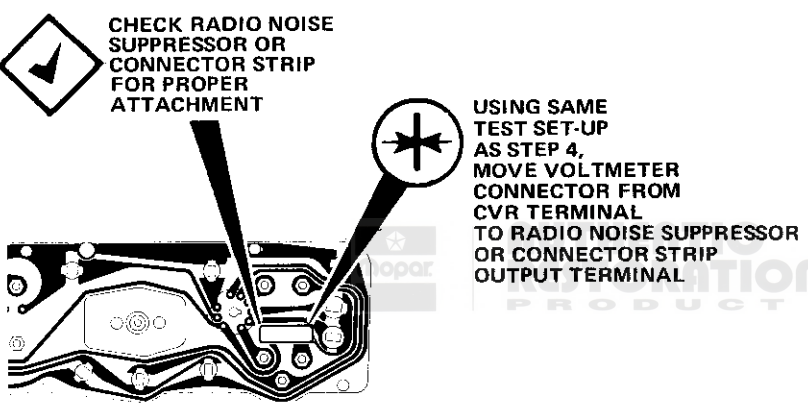


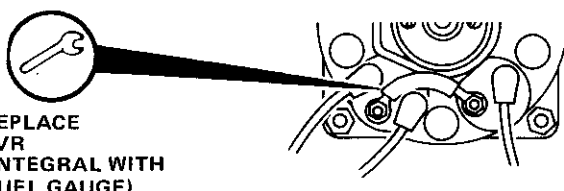





STEP	SEQUENCE	RESULT
1	<p>CONNECT VOLTMETER TO INPUT SIDE OF 3-AMP GAUGE FUSE AND TO GROUND</p>  <p>TURN IGNITION ON</p>	<p>WRITE DOWN VOLTMETER INDICATION → 2</p>
2	<p>DISCONNECT BATTERY NEGATIVE CABLE</p> <p>REMOVE INSTRUMENT CLUSTER</p> <p>DISCONNECT INSTRUMENT WIRE HARNESS CONNECTOR</p> <p>CONNECT VOLTMETER TO IGNITION FEED WIRE FEMALE CONNECTOR IN INSTRUMENT WIRE HARNESS CONNECTOR AND TO GOOD GROUND</p> <p>CONNECT BATTERY NEGATIVE CABLE</p> 	<ul style="list-style-type: none"> <li>● VOLTMETER INDICATION DIFFERENT FROM STEP 1 → 3</li> <li>● VOLTMETER INDICATION SAME AS STEP 1 → 4</li> <li>● CHEROKEE WAGONEER TRUCK CJ → 7</li> </ul>
3	<p>REPAIR OR REPLACE INSTRUMENT PANEL WIRE HARNESS</p> 	<p>STOP</p>
4	<p>CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION</p> <p>REPLACE, TIGHTEN OR CLEAN AS REQUIRED</p> <p>CONNECT JUMPER WIRES AND VOLTMETER</p> <ul style="list-style-type: none"> <li>● JUMPER WIRE BETWEEN CLUSTER CASE AND GROUND</li> <li>● JUMPER WIRE IN SERIES WITH A 3-AMP FUSE BETWEEN BATTERY VOLTAGE SOURCE AND IGNITION FEED PIN TERMINAL ON CLUSTER</li> <li>● VOLTMETER LEAD TO CVR INPUT TERMINAL</li> <li>● VOLTMETER LEAD TO GROUND</li> </ul> 	<ul style="list-style-type: none"> <li>● VOLTMETER INDICATION SAME AS STEP 1 → 5</li> <li>● VOLTMETER INDICATION DIFFERENT FROM STEP 1 → 6</li> </ul>

Chart 3  
RESULT

STEP

SEQUENCE

<p>5</p>	 <p>REPLACE CVR (INTEGRAL WITH TEMPERATURE GAUGE)</p>	
<p>6</p>	 <p>CHECK RADIO NOISE SUPPRESSOR OR CONNECTOR STRIP FOR PROPER ATTACHMENT</p> <p>USING SAME TEST SET-UP AS STEP 4, MOVE VOLTMETER CONNECTOR FROM CVR TERMINAL TO RADIO NOISE SUPPRESSOR OR CONNECTOR STRIP OUTPUT TERMINAL</p>	<p>VOLTMETER INDICATION SAME AS STEP 1 → </p> <p>VOLTMETER INDICATION DIFFERENT FROM STEP 1 → </p>
<p>7</p>	 <p>REPLACE CVR (INTEGRAL WITH FUEL GAUGE)</p>	
<p>8</p>	 <p>REPLACE CIRCUIT BOARD</p>	
<p>9</p>	 <p>REPLACE RADIO NOISE SUPPRESSOR OR CONNECTOR STRIP</p>	

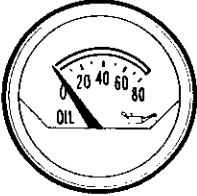
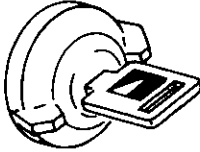
# PROBLEM: OIL PRESSURE GAUGE NOT FUNCTIONING PROPERLY (C)

## Chart 4

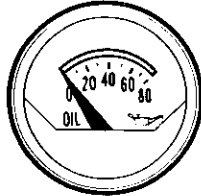
**STEP** **SEQUENCE** **RESULT**

**1**

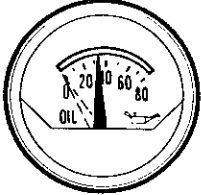
- NOTE POSITION OIL GAUGE NEEDLE
- START ENGINE
- OBSERVE NEEDLE

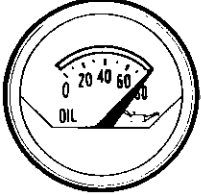
NEEDLE DOES NOT MOVE



NEEDLE MOVES



NEEDLE MOVES TO MAXIMUM AND STAYS



**BEFORE STARTING TEST:**

- OIL PAN MUST BE FILLED TO SPECIFICATION
- FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY

NOTE: Indicated Readings are Observed from Driver's Seat

2


11

6


**2**

- OBSERVE FUEL GAUGE

FUEL GAUGE NEEDLE DOES NOT MOVE



FUEL GAUGE NEEDLE INDICATES PROPERLY

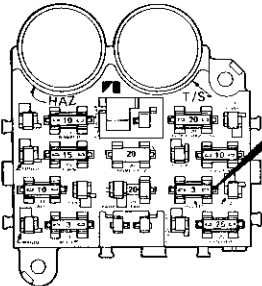


3


4

**3**

CHECK 3-AMP FUSE AT FUSE PANEL




FUSE BLOWN




GO TO CHART 2 STEP 1

FUSE NOT BLOWN



LOCATE AND REPAIR FAULT IN IGNITION FEED TO INSTRUMENTS



STOP



# Chart 4 RESULT

## STEP

## SEQUENCE

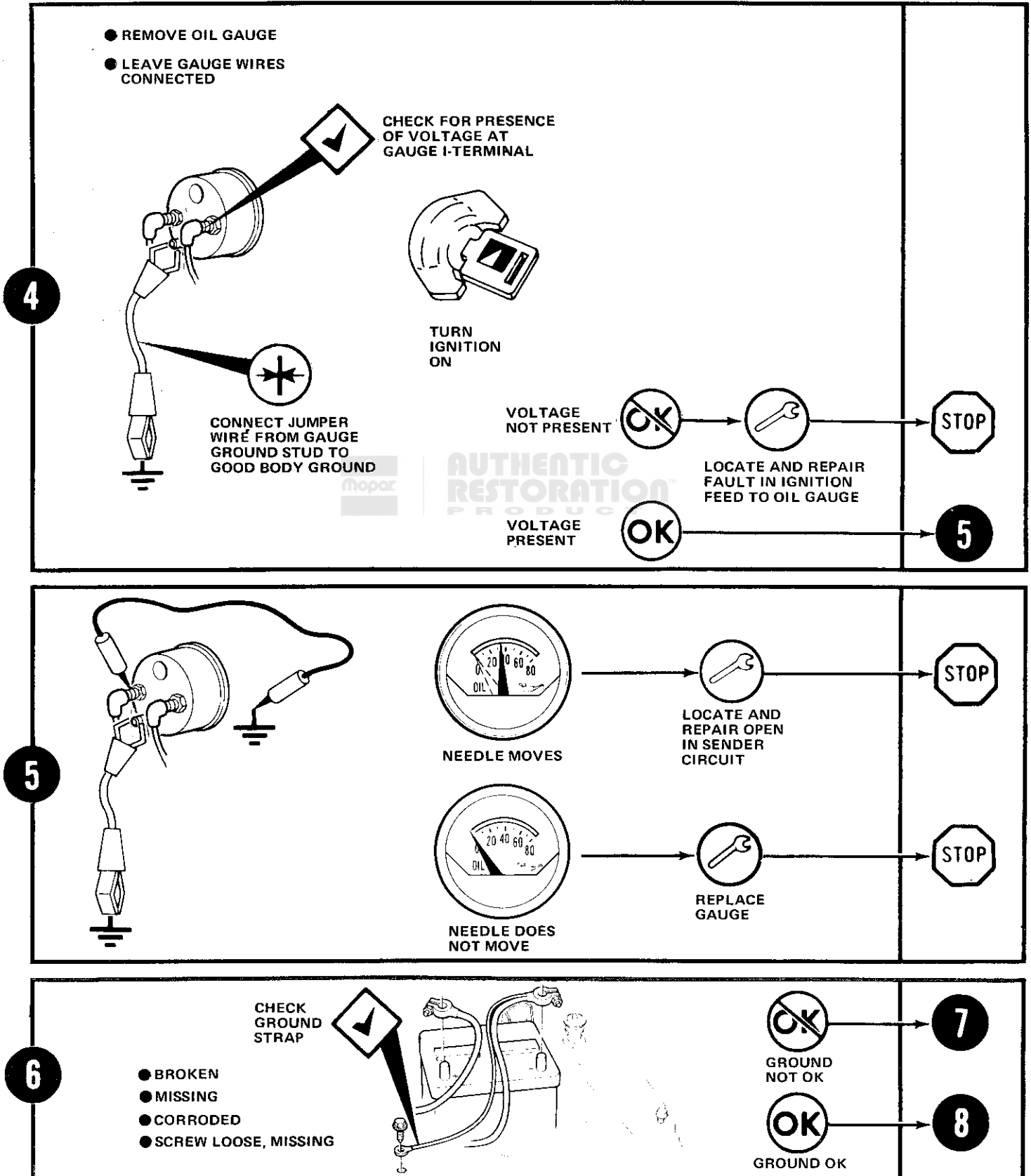
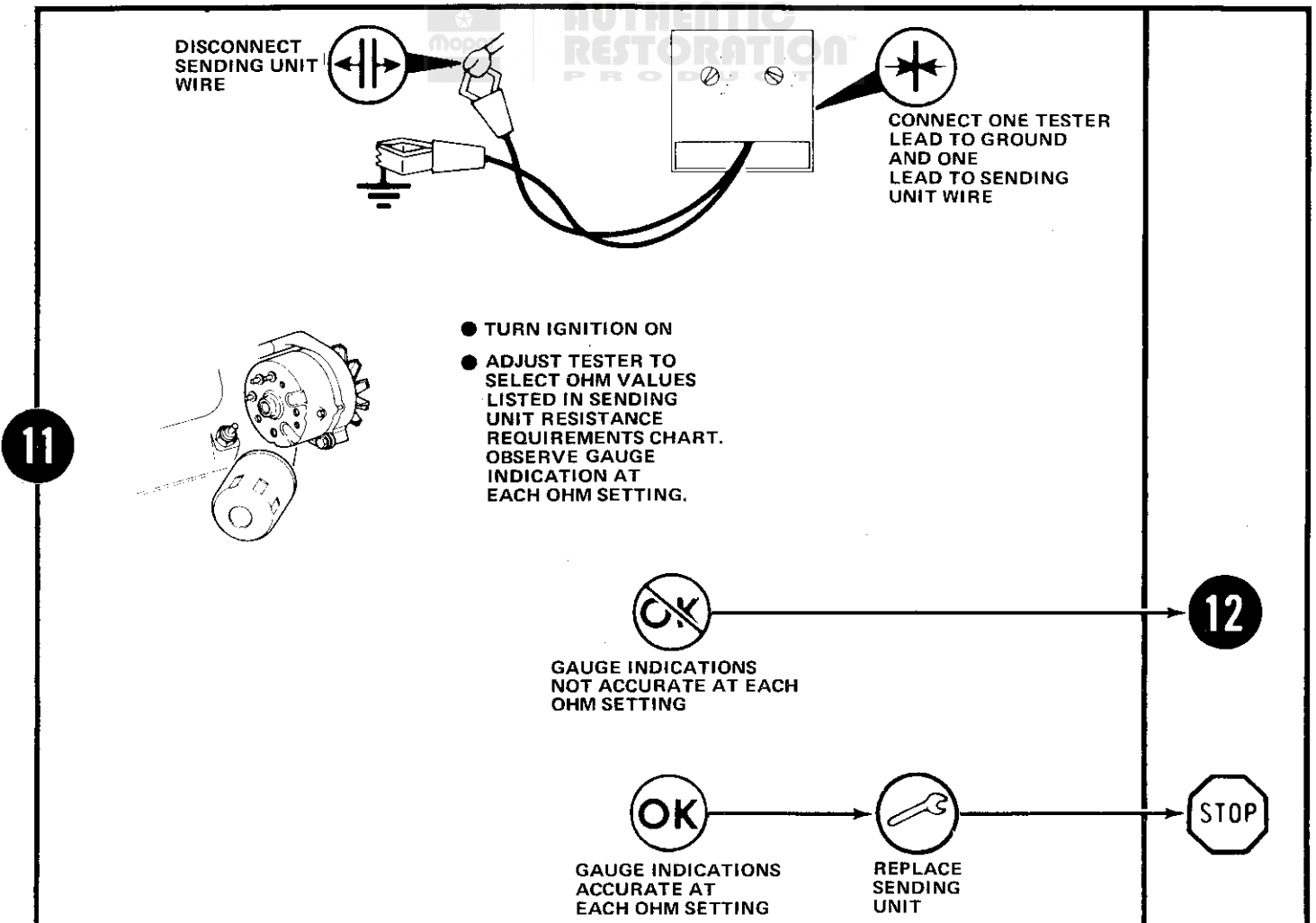
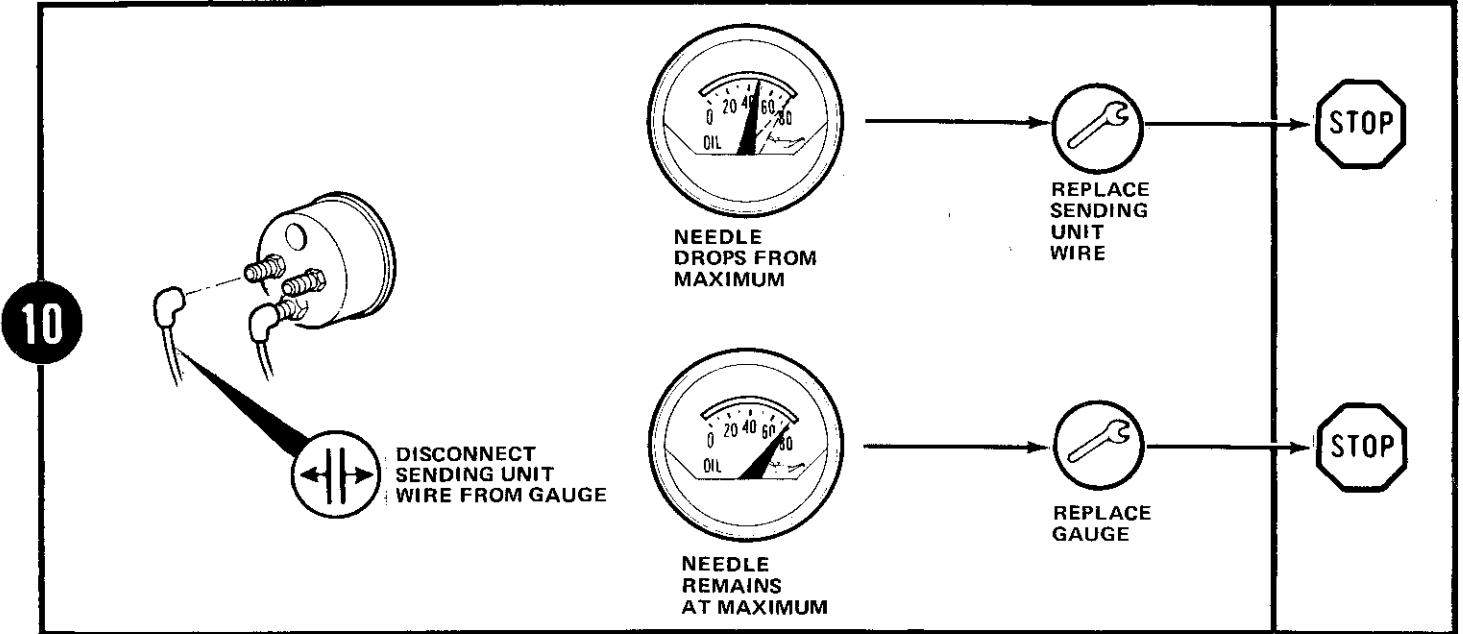




Chart 4  
RESULT

STEP

SEQUENCE



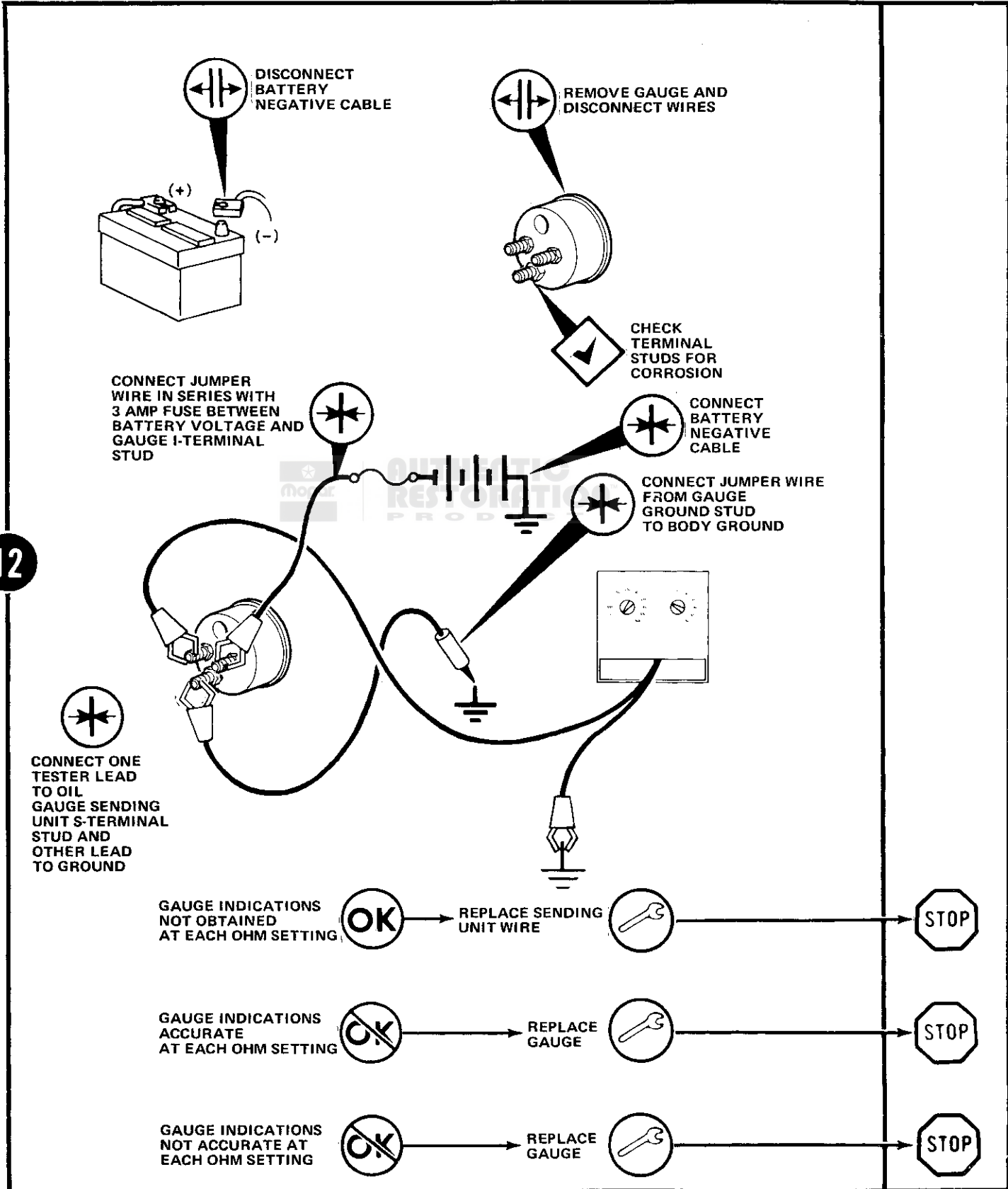
# Chart 4

STEP

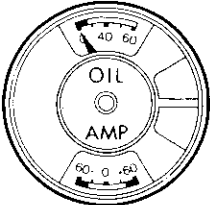

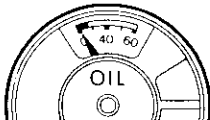
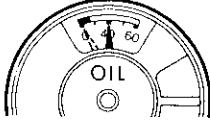
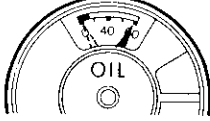
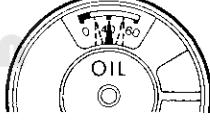

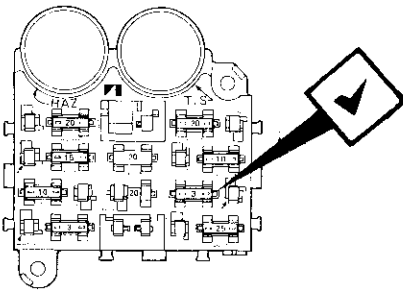
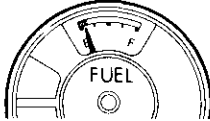
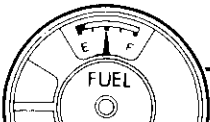
SEQUENCE

RESULT

12



# PROBLEM: OIL PRESSURE GAUGE NOT FUNCTIONING PROPERLY (CHEROKEE, WAGONEER AND TRUCK ONLY)

STEP	SEQUENCE	RESULT
<p><b>1</b></p> <ul style="list-style-type: none"> <li>NOTE POSITION OF OIL GAUGE NEEDLE</li> <li>START ENGINE AND WAIT 2 MINUTES FOR GAUGE TO WARM UP</li> <li>OBSERVE NEEDLE</li> </ul> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>BEFORE STARTING TEST:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> OIL PAN MUST BE FILLED TO SPECIFICATION</li> <li><input checked="" type="checkbox"/> FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY</li> </ul> </div>	  <p>NEEDLE DOES NOT MOVE</p> <p>NEEDLE MOVES</p> <p>NEEDLE MOVES TO MAXIMUM AND STAYS</p> <p>NEEDLE PULSATES MORE THAN WIDTH OF NEEDLE</p>      <p>REPLACE CVR</p>	<p><b>2</b></p> <p><b>15</b></p> <p><b>7</b></p> <p><b>STOP</b></p>
<p><b>2</b></p>	<p>CHECK 3-AMP FUSE AT FUSE PANEL</p>  <p>FUSE BLOWN</p> <p>FUSE NOT BLOWN</p>	<p>GO TO CHART 2 STEP 1</p> <p><b>3</b></p>
<p><b>3</b></p>	<p>OBSERVE FUEL GAUGE</p> <p>FUEL GAUGE NEEDLE DOES NOT MOVE</p> <p>FUEL GAUGE NEEDLE INDICATES PROPERLY</p>  	<p>GO TO CHART 3 STEP 1</p> <p><b>4</b></p>

# Chart 5

## STEP

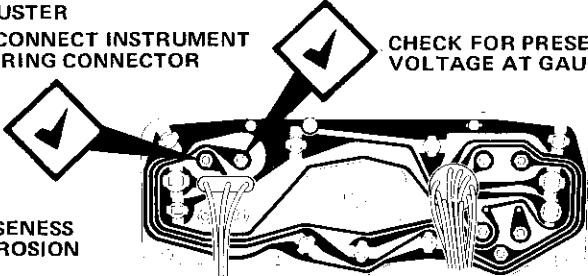
## SEQUENCE

## RESULT

**4**

- REMOVE CLUSTER
- DO NOT DISCONNECT INSTRUMENT CLUSTER WIRING CONNECTOR
- CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION

CHECK FOR PRESENCE OF VOLTAGE AT GAUGE INPUT

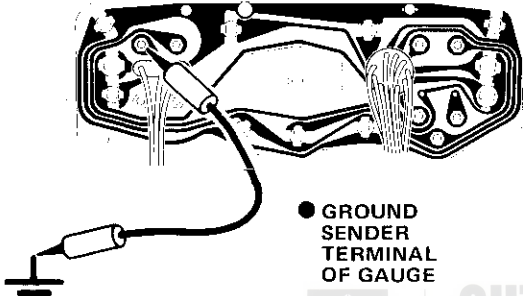


VOLTAGE NOT PRESENT → REPLACE CIRCUIT BOARD → STOP

VOLTAGE PRESENT → 5

**5**

- GROUND SENDER TERMINAL OF GAUGE

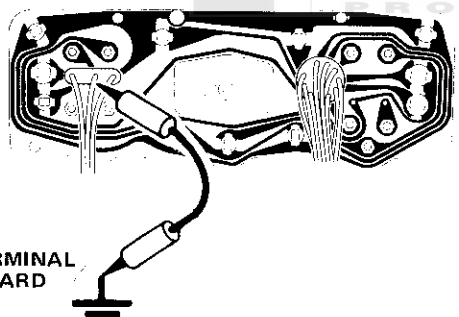


NEEDLE MOVES → 6

NEEDLE DOES NOT MOVE → REPLACE GAUGE → STOP

**6**

- GROUND GAUGE PIN TERMINAL ON CIRCUIT BOARD



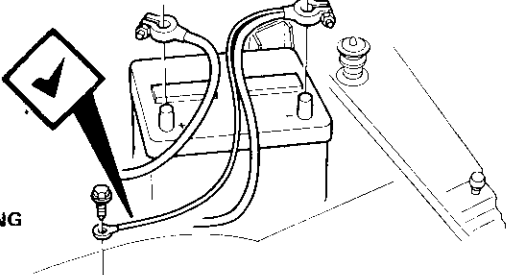
REPAIR OPEN CIRCUIT IN SENDER WIRE → STOP

REPLACE CIRCUIT BOARD → STOP

**7**

CHECK GROUND STRAP

- BROKEN
- MISSING
- CORRODED
- SCREWS LOOSE, MISSING



GROUND NOT OK → 8

GROUND OK → 9

**8**

REPAIR GROUND

NEEDLE DROPS FROM MAXIMUM → STOP

NEEDLE REMAINS AT MAXIMUM → 9

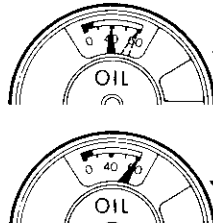
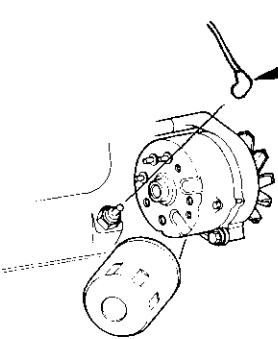
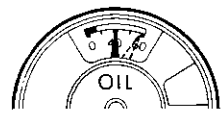
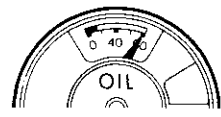
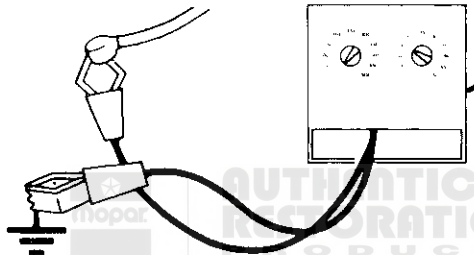


Chart 5  
RESULT

STEP	SEQUENCE	RESULT
9	 <p>DISCONNECT SENDING UNIT WIRE FROM SENDING UNIT</p>  <p>NEEDLE DROPS FROM MAXIMUM</p>  <p>NEEDLE REMAINS AT MAXIMUM</p>	<p>10</p> <p>12</p>
10	 <p>CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE</p> <ul style="list-style-type: none"> <li>● TURN IGNITION ON</li> <li>● ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE REQUIREMENTS CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING.</li> </ul> <p><del>OK</del> → GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → 11</p> <p>OK → GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → REPLACE SENDING UNIT → STOP</p>	<p>11</p> <p>STOP</p>
11	<ul style="list-style-type: none"> <li>● OBSERVE FUEL GAUGE</li> </ul> <p>FUEL GAUGE NEEDLE IS AT MAXIMUM → REPAIR CLUSTER GROUND OR REPLACE CVR → STOP</p> <p>FUEL GAUGE NEEDLE INDICATES NORMALLY → REPLACE OIL GAUGE → STOP</p>	<p>STOP</p> <p>STOP</p>

# Chart 5

STEP

SEQUENCE

RESULT

**12**

DISCONNECT BATTERY NEGATIVE CABLE

REMOVE INSTRUMENT CLUSTER. DO NOT DISCONNECT WIRE HARNESS

CONNECT JUMPER WIRE BETWEEN CLUSTER GROUND AND BODY

CONNECT BATTERY NEGATIVE CABLE

NEEDLE DROPS FROM MAXIMUM

NEEDLE REMAINS AT MAXIMUM

**13**

**14**

**13**

REPAIR INSTRUMENT PANEL GROUND

STOP

**14**

DISCONNECT SENDING UNIT WIRE FROM CLUSTER

NEEDLE DROPS FROM MAXIMUM

REPAIR OR REPLACE SENDING UNIT WIRE

NEEDLE REMAINS AT MAXIMUM

REPLACE CIRCUIT BOARD

STOP

STOP

**15**

DISCONNECT SENDING UNIT WIRE

CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE

TURN IGNITION ON

ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE REQUIREMENTS CHART. OBSERVE FUEL GAUGE INDICATION AT EACH OHM SETTING.

GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING

GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING

REPLACE SENDING UNIT

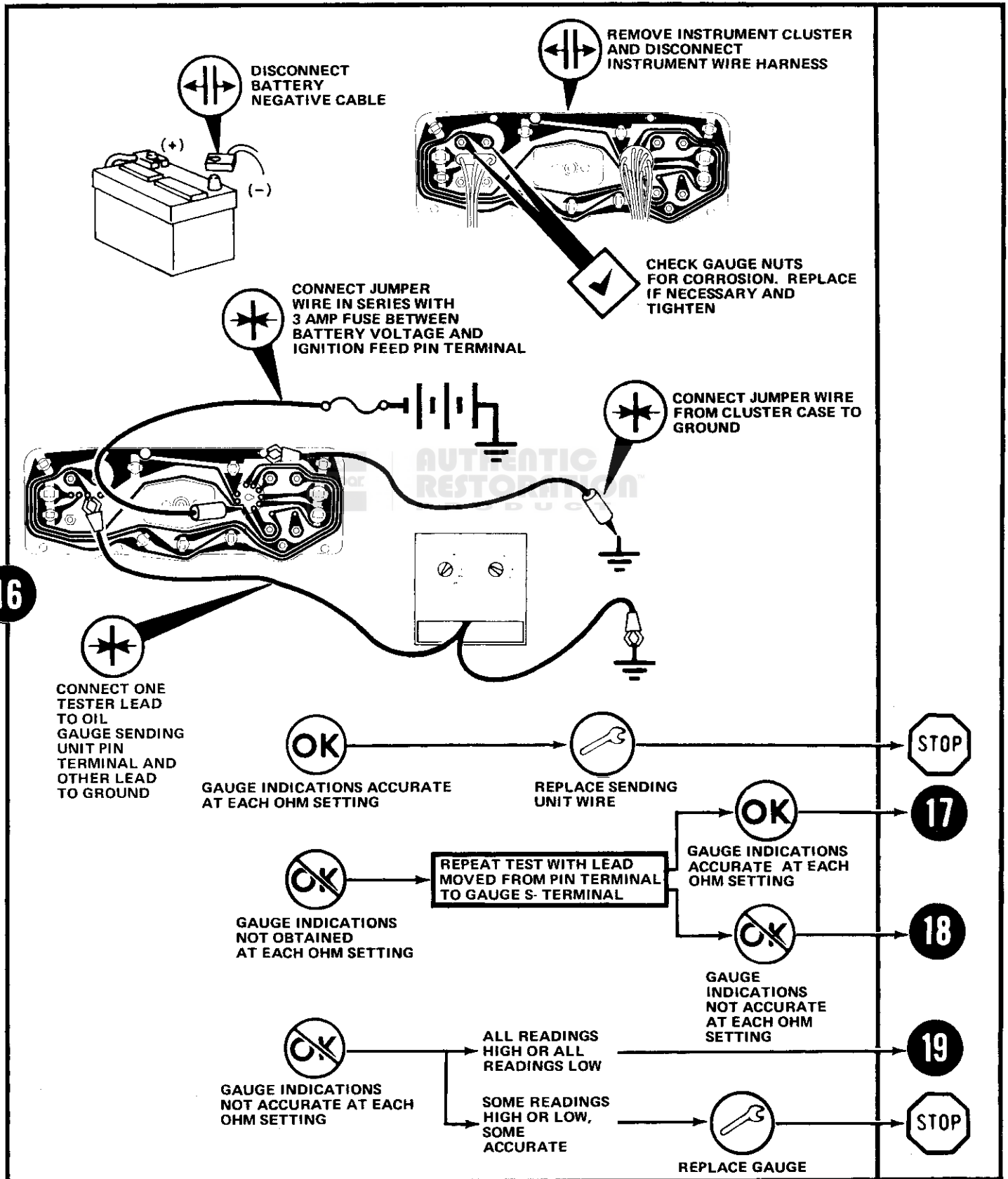
STOP

**16**



STEP

SEQUENCE

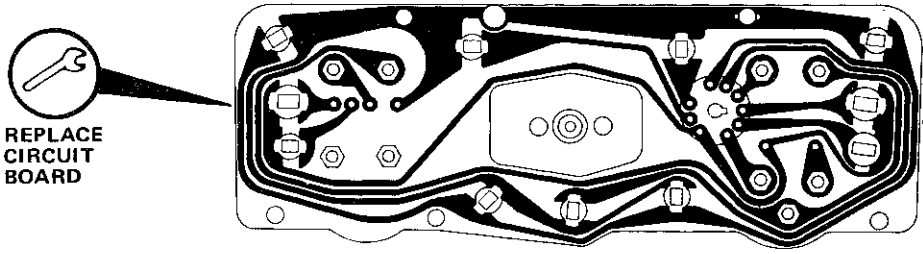

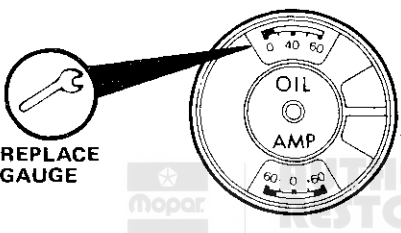

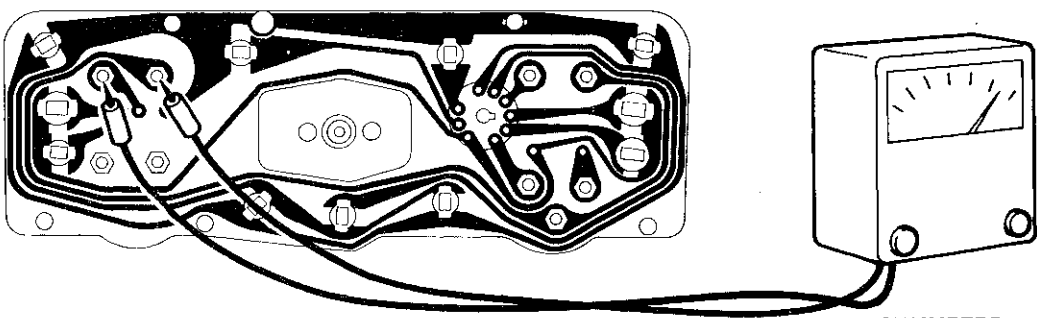









# Chart 5

## RESULT

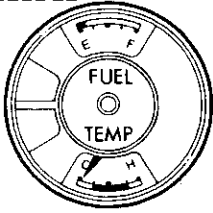
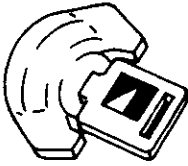
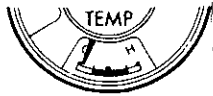
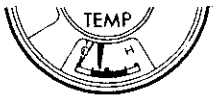
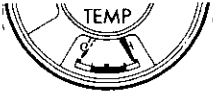
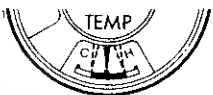
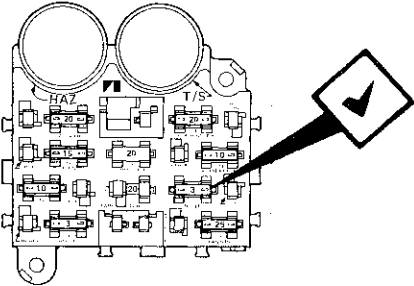
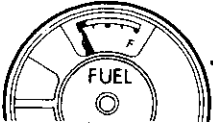
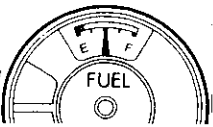
**STEP**

**SEQUENCE**

<p><b>17</b></p>	 <p>REPLACE CIRCUIT BOARD</p>	
<p><b>18</b></p>	 <p>REPLACE GAUGE</p>	
<p><b>19</b></p>	 <p>OHHMMETER</p> <ul style="list-style-type: none"> <li>  <p>CONNECT OHMMETER LEADS TO GAUGE INPUT TERMINAL AND GAUGE SENDER TERMINAL</p> </li> <li> <p>● COMPARE OHMMETER READING WITH VALUES LISTED IN GAUGE RESISTANCE VALUES CHART</p> </li> </ul> <div style="display: flex; justify-content: space-between;"> <div style="text-align: center;">  <p>GAUGE RESISTANCE CORRECT</p> </div> <div style="text-align: center;">  <p>REPLACE CVR</p> </div> </div> <div style="display: flex; justify-content: space-between;"> <div style="text-align: center;">  <p>GAUGE RESISTANCE INCORRECT</p> </div> <div style="text-align: center;">  <p>REPLACE GAUGE</p> </div> </div>	  

# PROBLEM: TEMPERATURE GAUGE NOT FUNCTIONING PROPERLY

## Chart 6

STEP	SEQUENCE	RESULT
1	<p>● NOTE POSITION OF TEMPERATURE GAUGE NEEDLE</p>  <p>● TURN IGNITION ON AND WAIT 2 MINUTES FOR GAUGE TO WARM UP</p>  <p>● OBSERVE NEEDLE</p> <p>NEEDLE DOES NOT MOVE</p>  <p>NEEDLE MOVES</p>  <p>NEEDLE MOVES TO MAXIMUM AND STAYS</p>  <p>NEEDLE PULSATES MORE THAN WIDTH OF NEEDLE</p>  <p>BEFORE STARTING TEST:</p> <ul style="list-style-type: none"> <li>ENGINE MUST BE WARM</li> <li>FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY</li> </ul> <p>REPLACE CVR</p>	<p>2</p> <p>17</p> <p>9</p> <p>STOP</p>
2	<p>CHECK 3-AMP FUSE AT FUSE PANEL</p>  <p>FUSE BLOWN</p> <p>FUSE NOT BLOWN</p>	<p>GO TO CHART 2 STEP 1</p> <p>3</p>
3	<p>● OBSERVE FUEL GAUGE</p> <p>FUEL GAUGE NEEDLE DOES NOT MOVE</p>  <p>FUEL GAUGE NEEDLE INDICATES PROPERLY</p>  <p>CJ MODELS</p> <p>CHEROKEE WAGONEER TRUCK MODELS</p>	<p>GO TO CHART 3 STEP 1</p> <p>4</p> <p>6</p>

# Chart 6 RESULT

## STEP

## SEQUENCE

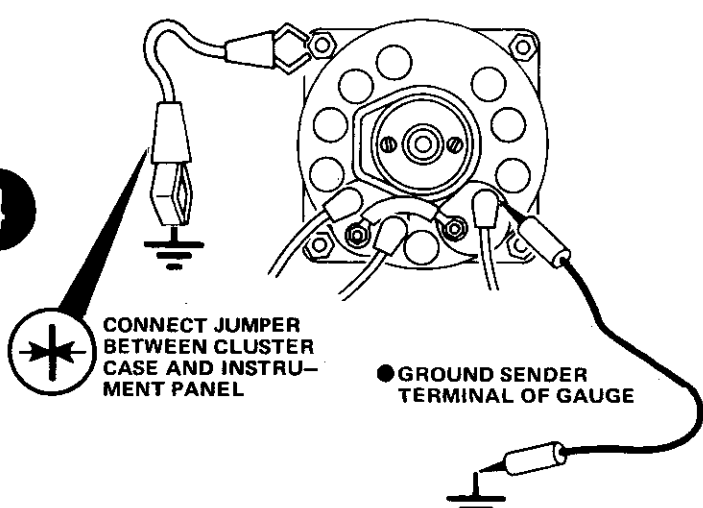
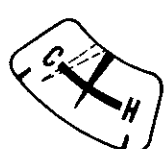
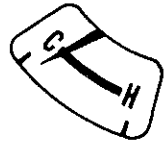



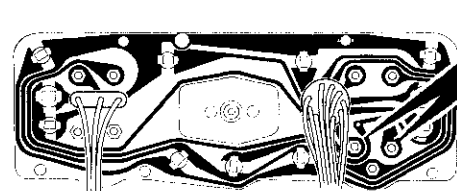
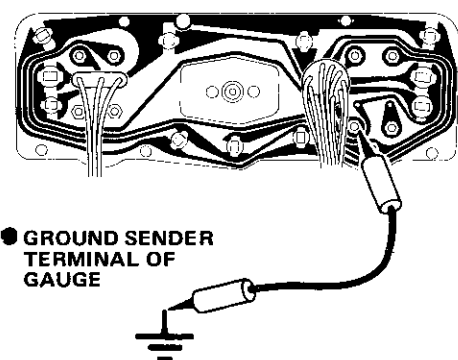
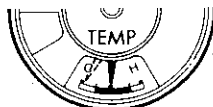
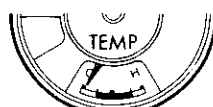

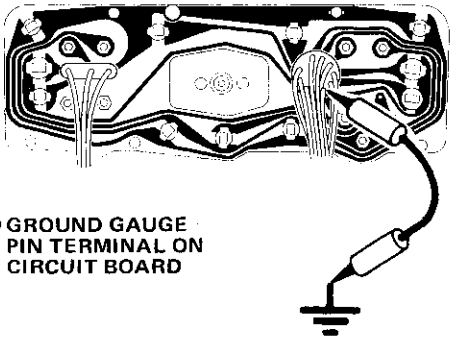
<p><b>4</b></p> <ul style="list-style-type: none"> <li>● REMOVE CLUSTER</li> <li>● LEAVE INSTRUMENT LEADS ATTACHED</li> </ul>  <p>CONNECT JUMPER BETWEEN CLUSTER CASE AND INSTRUMENT PANEL</p> <p>GROUND SENDER TERMINAL OF GAUGE</p>	 <p>NEEDLE MOVES</p>  <p>NEEDLE DOES NOT MOVE</p>  <p>REPLACE GAUGE</p>	<p><b>5</b></p> <p>STOP</p>
<p><b>5</b></p>  <p>LOCATE AND REPAIR OPEN CIRCUIT IN SENDER WIRE</p>		<p>STOP</p>
<p><b>6</b></p> <ul style="list-style-type: none"> <li>● REMOVE CLUSTER</li> <li>● DO NOT DISCONNECT INSTRUMENT CLUSTER WIRING CONNECTOR</li> </ul>	 <p>CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION</p>	<p><b>7</b></p>
<p><b>7</b></p>  <p>GROUND SENDER TERMINAL OF GAUGE</p>	 <p>NEEDLE MOVES</p>  <p>NEEDLE DOES NOT MOVE</p>  <p>REPLACE GAUGE</p>	<p><b>8</b></p> <p>STOP</p>

Chart 6  
RESULT

STEP

SEQUENCE

**8**



● GROUND GAUGE PIN TERMINAL ON CIRCUIT BOARD

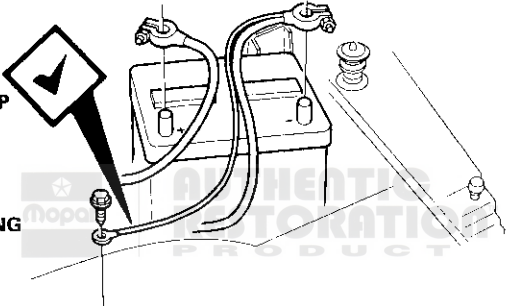
NEEDLE MOVES → REPAIR OPEN CIRCUIT IN SENDER WIRE → STOP

NEEDLE DOES NOT MOVE → REPLACE CIRCUIT BOARD → STOP

**9**

CHECK GROUND STRAP

- BROKEN
- MISSING
- CORRODED
- SCREWS LOOSE, MISSING



GROUND NOT OK → **10**

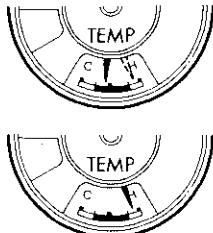
GROUND OK → **11**

**10**

REPAIR GROUND

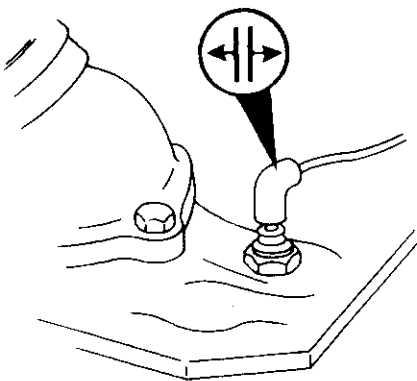
NEEDLE DROPS FROM MAXIMUM → STOP

NEEDLE REMAINS AT MAXIMUM → **11**



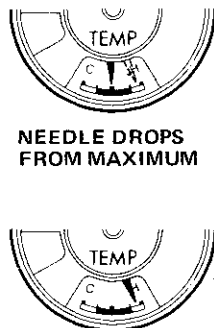
**11**

DISCONNECT SENDING UNIT WIRE FROM SENDING UNIT



NEEDLE DROPS FROM MAXIMUM → **12**

NEEDLE REMAINS AT MAXIMUM → **14**

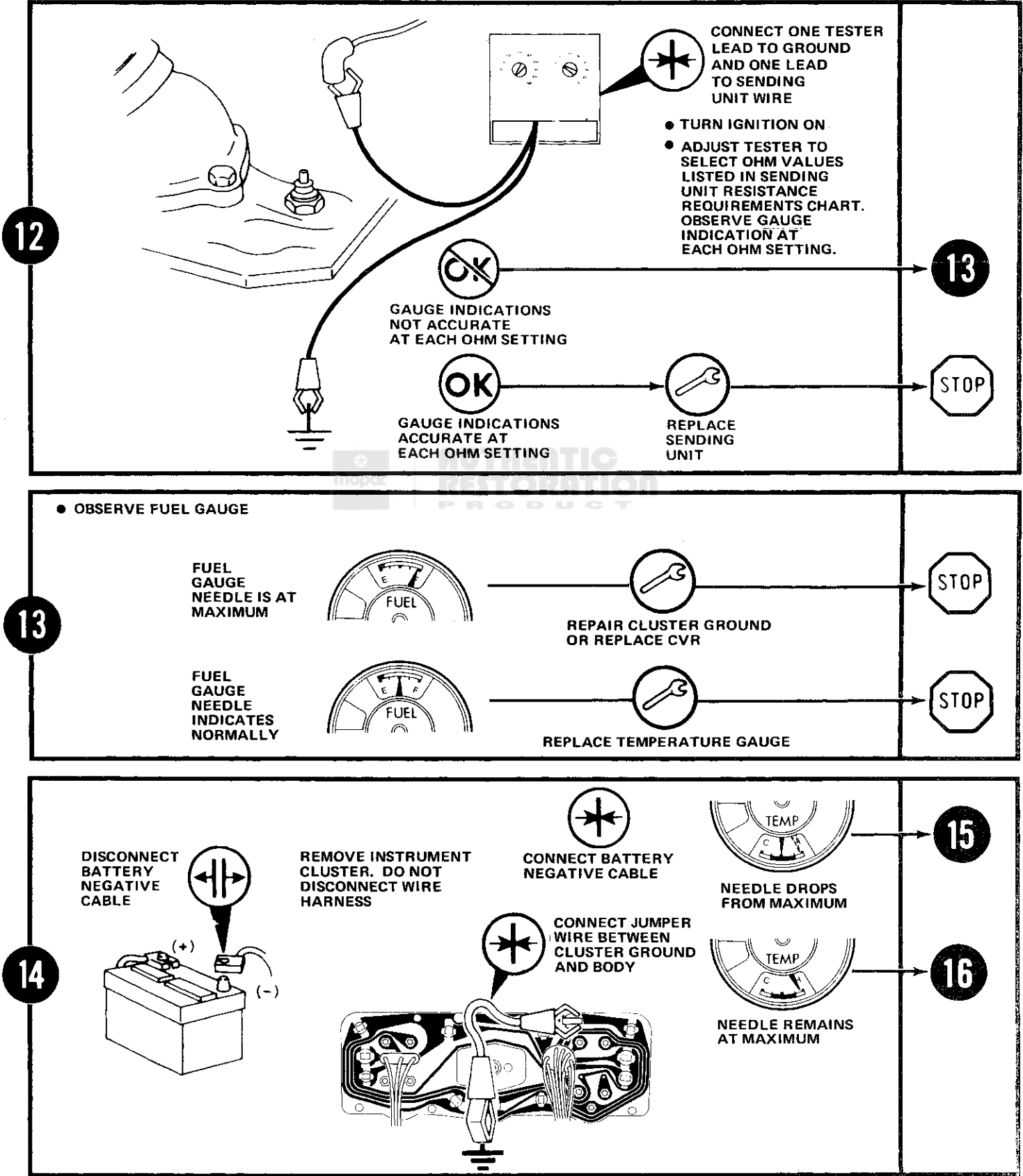


# Chart 6

## RESULT

**STEP**

**SEQUENCE**



12

13

14

13

STOP

STOP

STOP

15

16

Chart 6  
RESULT

STEP

SEQUENCE

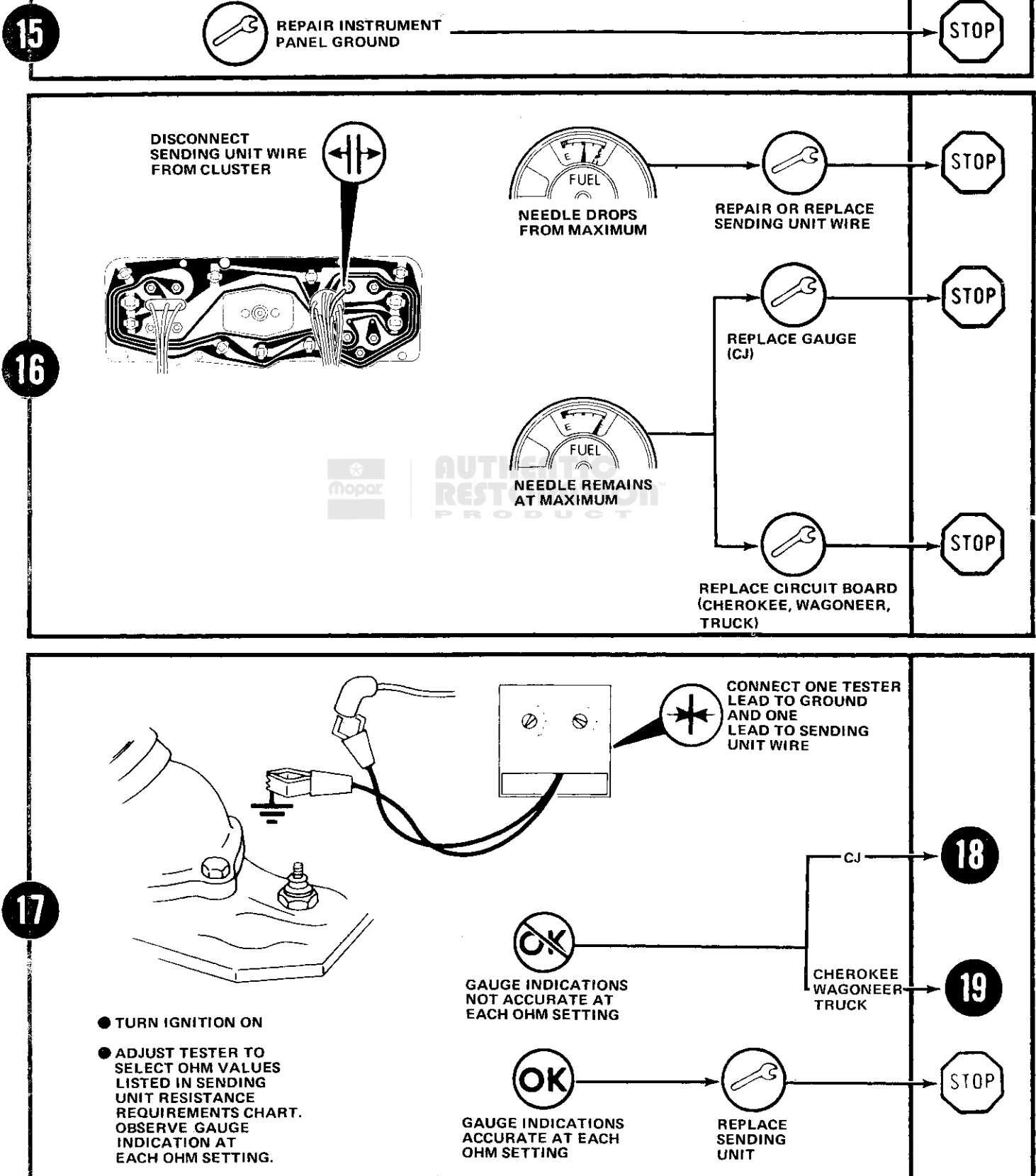
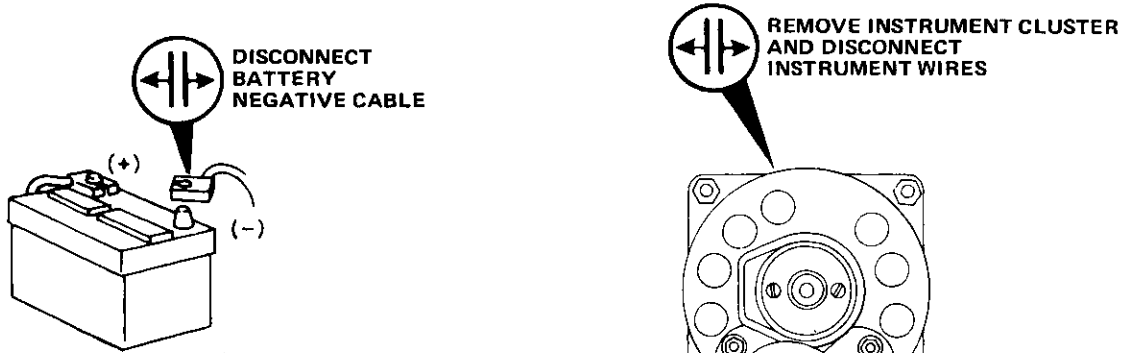


Chart 6  
RESULT

STEP

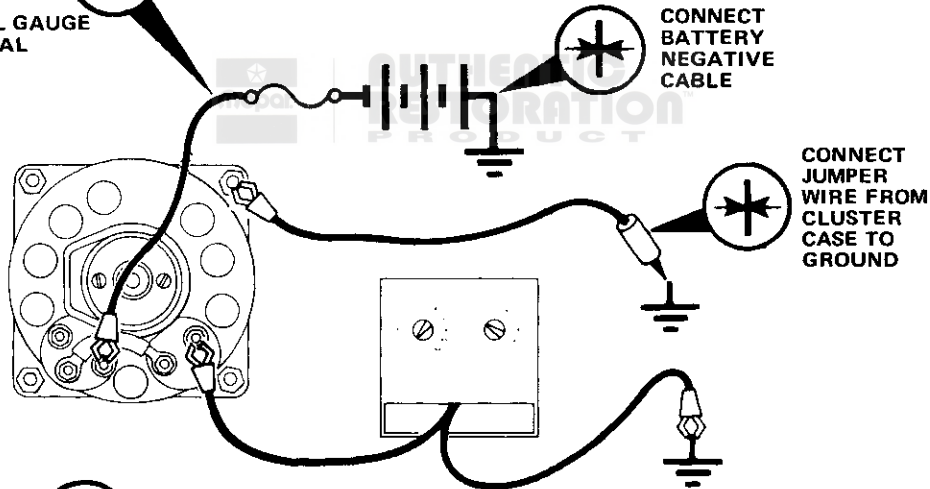
SEQUENCE

18



CONNECT JUMPER WIRE IN SERIES WITH 3 AMP FUSE BETWEEN BATTERY VOLTAGE AND FUEL GAUGE 1-TERMINAL

CHECK GAUGE NUTS FOR CORROSION. REPLACE IF NECESSARY AND TIGHTEN

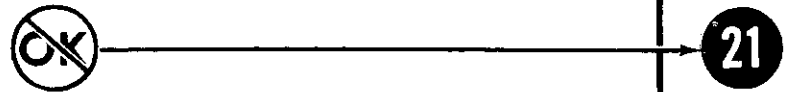


CONNECT ONE TESTER LEAD TO TEMPERATURE GAUGE SENDING UNIT TERMINAL AND OTHER LEAD TO GROUND



GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING

REPLACE SENDING UNIT WIRE



GAUGE INDICATIONS NOT OBTAINED AT EACH OHM SETTING



ALL READINGS HIGH OR ALL READINGS LOW

GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING

SOME READINGS HIGH OR LOW, SOME ACCURATE

REPLACE GAUGE







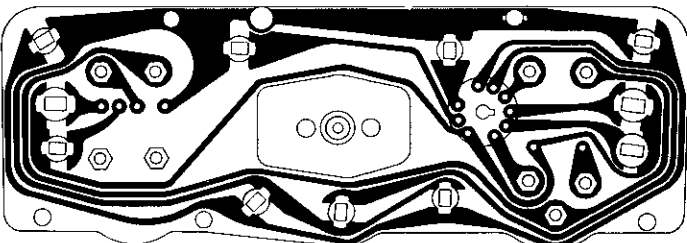
# Chart 6 RESULT

STEP

SEQUENCE

20

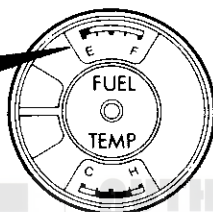
REPLACE  
CIRCUIT  
BOARD



STOP

21

REPLACE  
GAUGE



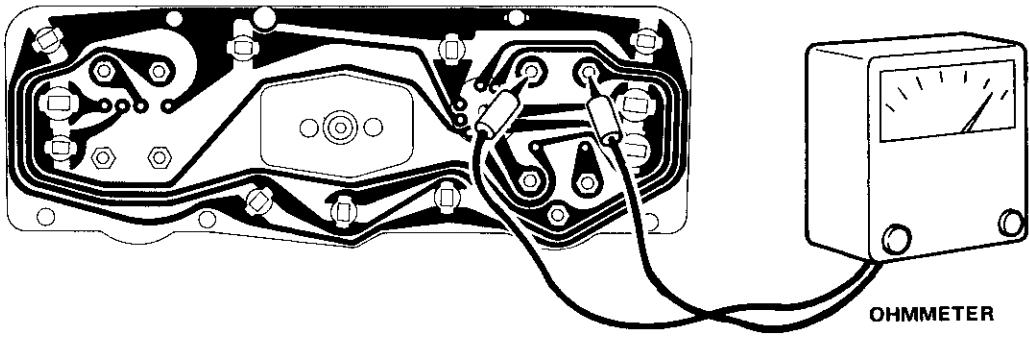
STOP

22



CONNECT OHMMETER LEADS TO GAUGE  
INPUT TERMINAL AND GAUGE SENDER TERMINAL

● COMPARE OHMMETER  
READING WITH VALUES LISTED  
IN GAUGE RESISTANCE VALUES CHART



OHMMETER

OK

GAUGE  
RESISTANCE  
CORRECT

REPLACE  
CVR

STOP

~~OK~~

GAUGE  
RESISTANCE  
INCORRECT

REPLACE  
GAUGE

STOP

# CIRCUITS AND SCHEMATICS

	Page		Page
Cherokee	1L-44	Specifications—Cherokee	1L-43
CJ	1L-41	Specifications—CJ	1L-40
Truck	1L-44	Specifications—Truck	1L-43
Wagoneer	1L-44	Specifications—Wagoneer	1L-43

## SPECIFICATIONS—CJ MODELS

**Fuel Gauge Sending Unit Resistance (Ohms)**

E	1/2	F
73	23	10

**Temperature Gauge Sending Unit Resistance (Ohms)**

C	BEGINNING OF BAND	END OF BAND	H
73	36	13	9

80670

80674



**Fuel Gauge Resistance (Internal)**

CONTINUITY	OHMS
S to Ground	68 to 72
S to I	19 to 21
S to A	19 to 21
I to A	ZERO
I to Ground	49 to 51
A to Ground	49 to 51

80671

**Tachometer Calibrations (RPM)**

ACTUAL	INDICATED
500	380 to 620
1500	1380 to 1620
4500	4330 to 4620

80675

**Oil Pressure Gauge Sending Unit Resistance (Ohms)**

PSI	0	20	40	60	80
OHMS	234-246	149-157	100.5-105.5	65-69	32.5-34.5

80672

**Voltmeter Calibrations (Volts)**

ACTUAL	INDICATED
12.4	11.7 to 12.3
14.4	13.8 to 14.2

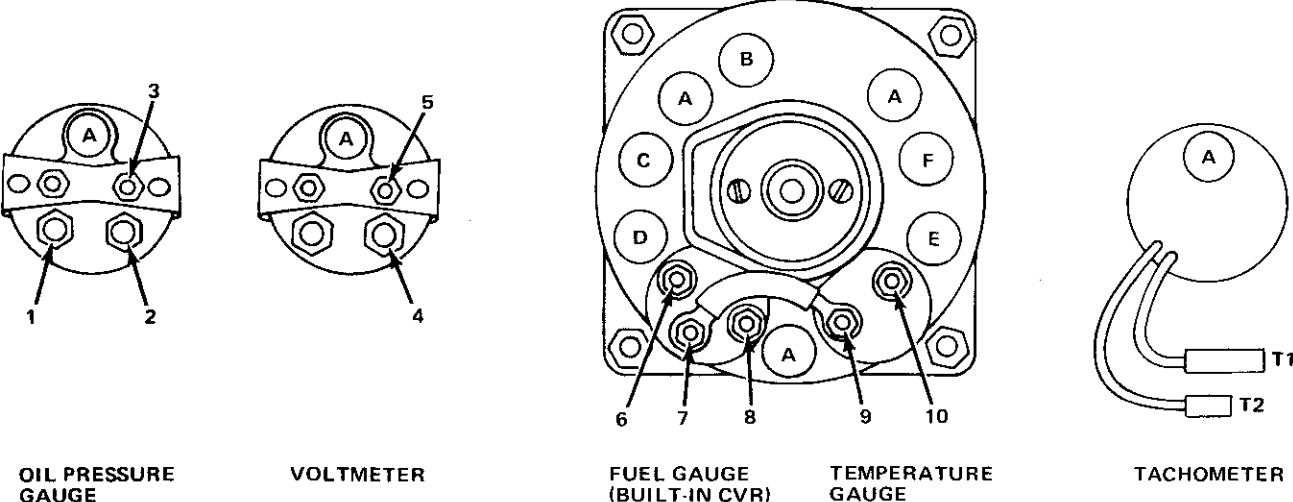
NOTE: Indicated Readings are Observed from Drivers Seat

80676

**Temperature Gauge Resistance (Internal)**

S to A	19 to 21 ohms
--------	---------------

80673



TERMINAL STUDS

- 1. OIL GAUGE S-TERMINAL
- 2. OIL GAUGE I-TERMINAL
- 3. OIL GAUGE GROUND
- 4. VOLTMETER +-TERMINAL
- 5. VOLTMETER GROUND
- 6. FUEL GAUGE S-TERMINAL
- 7. FUEL GAUGE A-TERMINAL
- 8. FUEL GAUGE I-TERMINAL
- 9. TEMPERATURE GAUGE S-TERMINAL
- 10. TEMPERATURE GAUGE A-TERMINAL

LAMPS

- A ILLUMINATION
- B HIGH BEAM
- C RIGHT TURN
- D EMERGENCY DRIVE
- E BRAKE
- F LEFT TURN

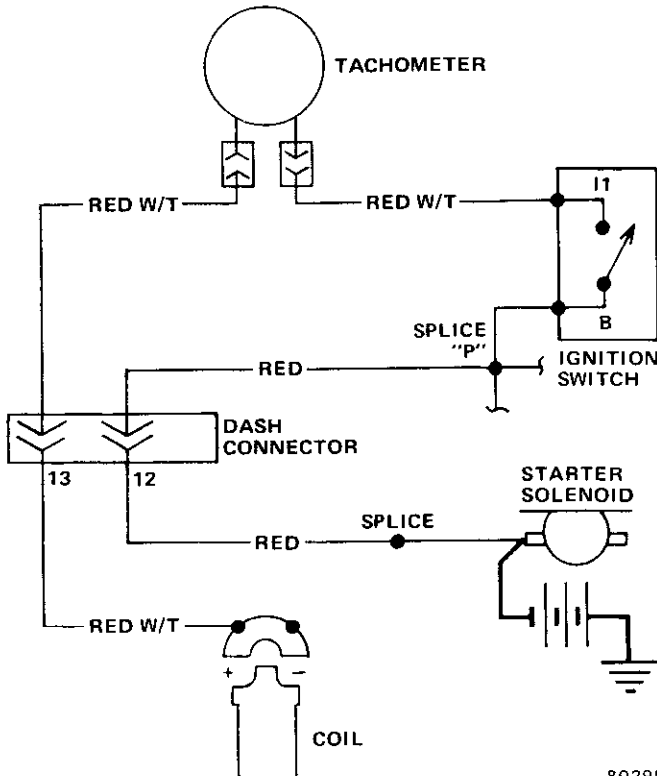
OTHER

- T1 TACHOMETER LEAD
- T2 TACHOMETER LEAD



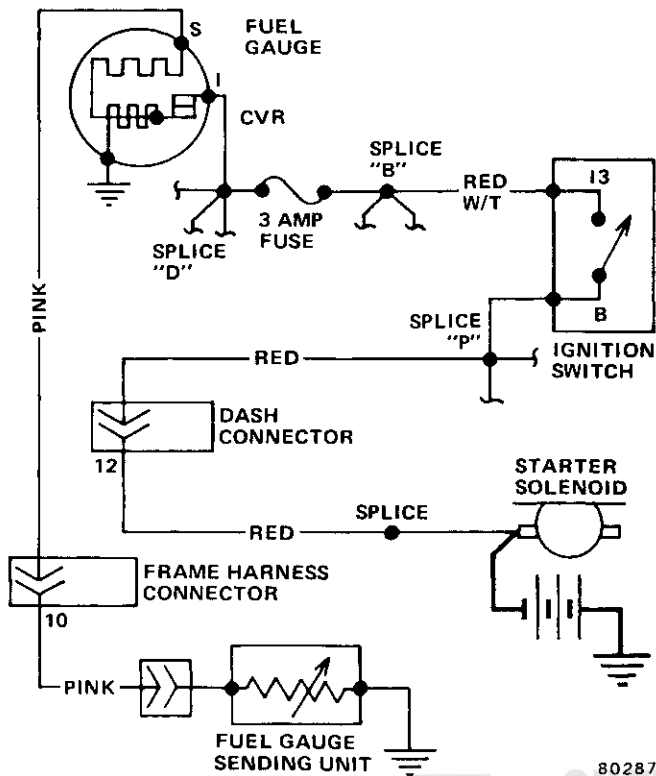
80125

Instrument Cluster—CJ



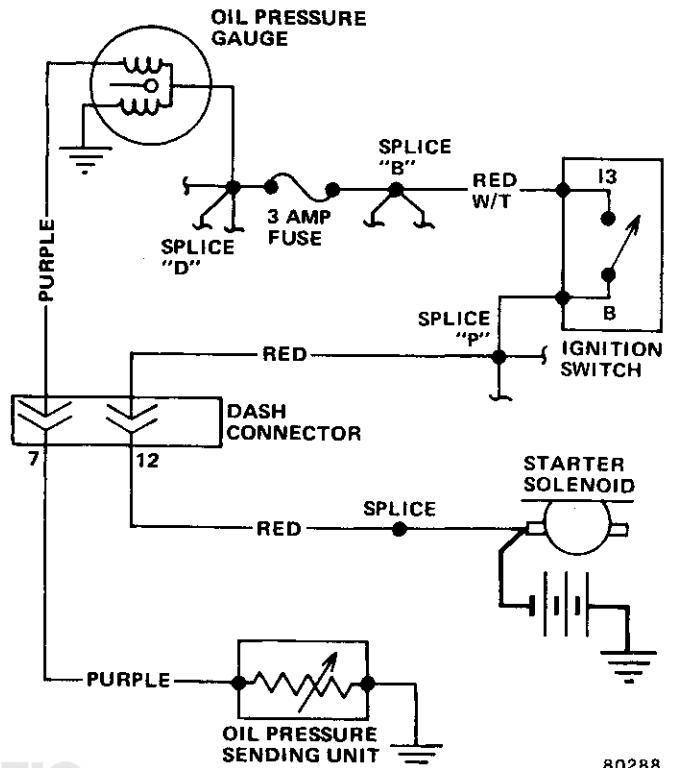
80295

Tachometer Circuit—CJ



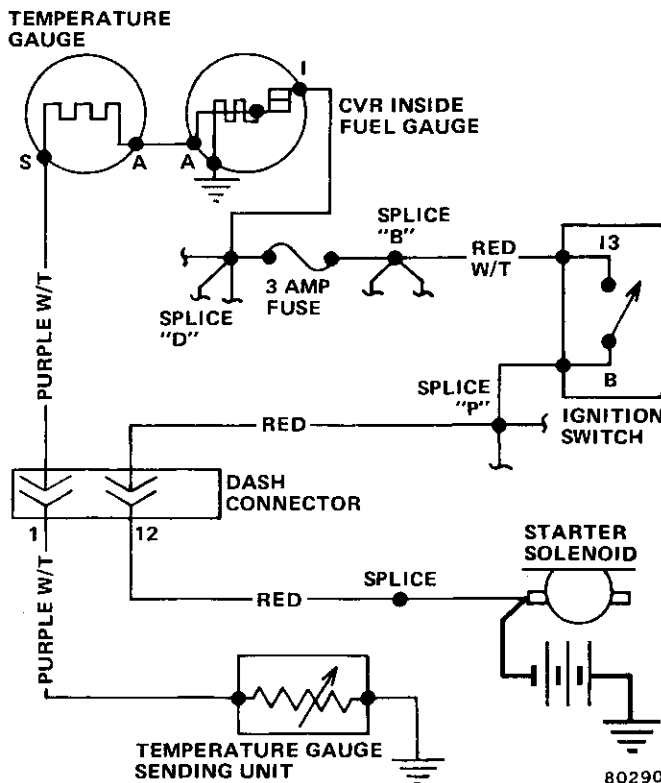
Fuel Gauge Circuit—CJ

80287



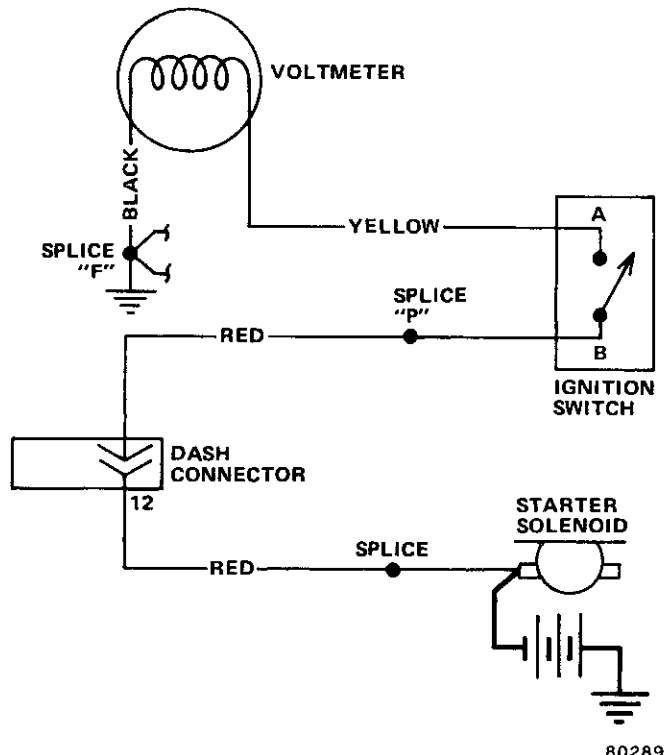
Oil Pressure Gauge Circuit—CJ

80288



Temperature Gauge Circuit—CJ

80290



Voltmeter Circuit—CJ

80289

RESTORATION  
PRODUCT

**SPECIFICATIONS—CHEROKEE-WAGONEER-TRUCK MODELS**

**Ammeter Calibrations**

ACTUAL	INDICATED
-60	-48 to -72
0	0 ± Needle Width
+60	+48 to +72

80677

**Fuel Gauge Sending Unit Resistance (Ohms)**

E	1/2	F
73	23	10

80670

**Fuel Gauge Resistance (Internal)**

S to A	19 to 21 ohms
--------	---------------

80673

**Oil Pressure Gauge Sending Unit Resistance (Ohms)**

PSI	0	10	60	80
OHMS	69-77	35-38	13-15	9.5-10.5

80678

**Temperature Gauge Sending Unit Resistance (Ohms)**

C	BEGINNING OF BAND	END OF BAND	H
73	36	13	9

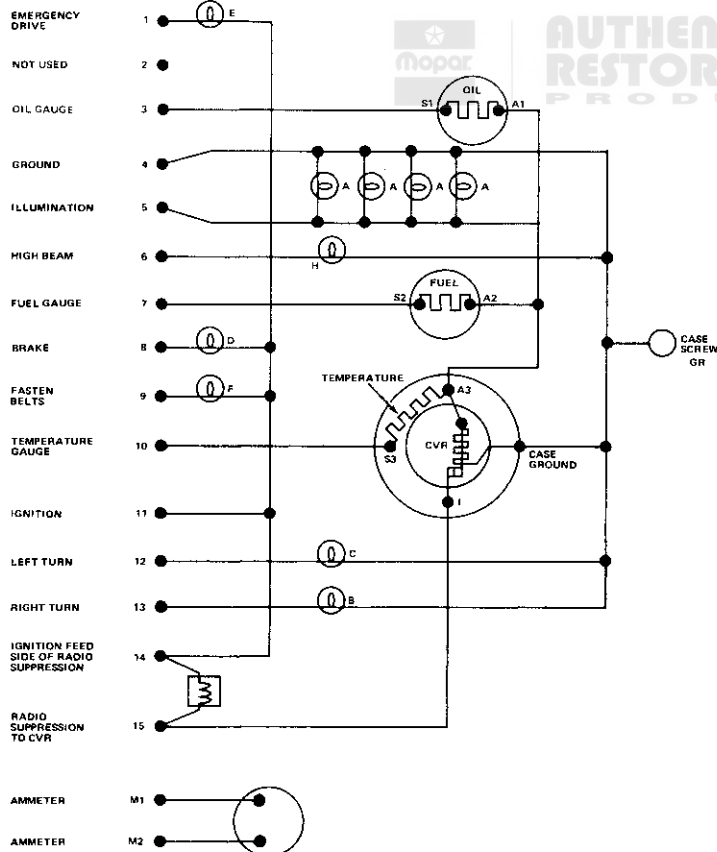
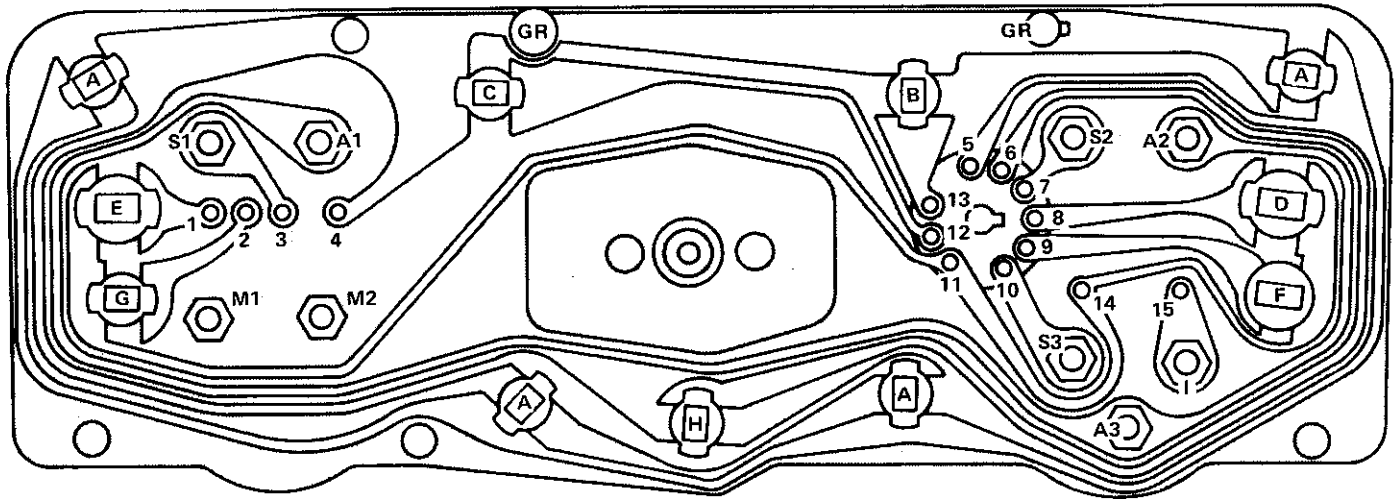
80674

**Temperature Gauge Resistance (Internal)**

CONTINUITY	OHMS
S to Ground	68 to 72
S to I	19 to 21
S to A	19 to 21
I to A	ZERO
I to Ground	49 to 51
A to Ground	49 to 51

80671

# 1L-44 POWER PLANT INSTRUMENTATION



## PIN TERMINALS

1. EMERGENCY DRIVE
2. NOT USED
3. OIL GAUGE
4. GROUND
5. ILLUMINATION
6. HIGH BEAM
7. FUEL GAUGE
8. BRAKE
9. FASTEN BELTS
10. TEMPERATURE GAUGE
11. IGNITION
12. LEFT TURN
13. RIGHT TURN
14. IGNITION FEED SIDE OF RADIO SUPPRESSION
15. RADIO SUPPRESSION TO CVR

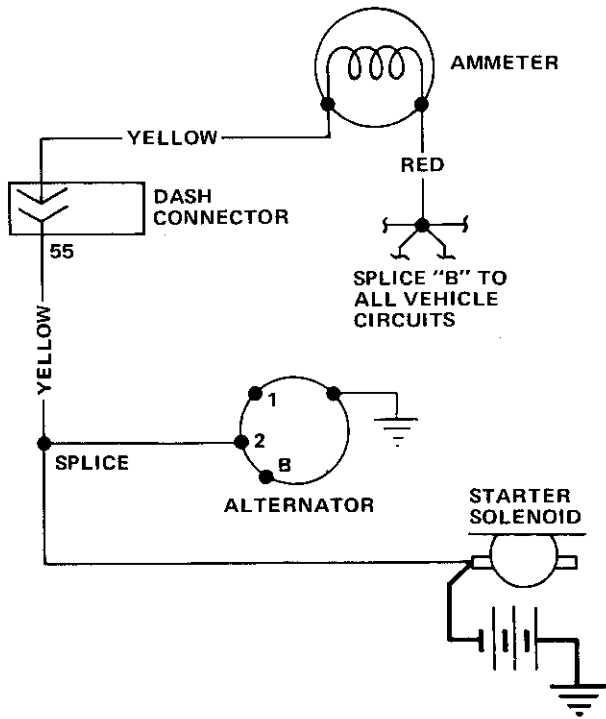
## LAMPS

- A ILLUMINATION
- B RIGHT TURN INDICATOR
- C LEFT TURN INDICATOR
- D BRAKE INDICATOR
- E EMERGENCY DRIVE INDICATOR
- F FASTEN BELT INDICATOR
- G NOT USED
- H HIGH BEAM INDICATOR

## OTHER

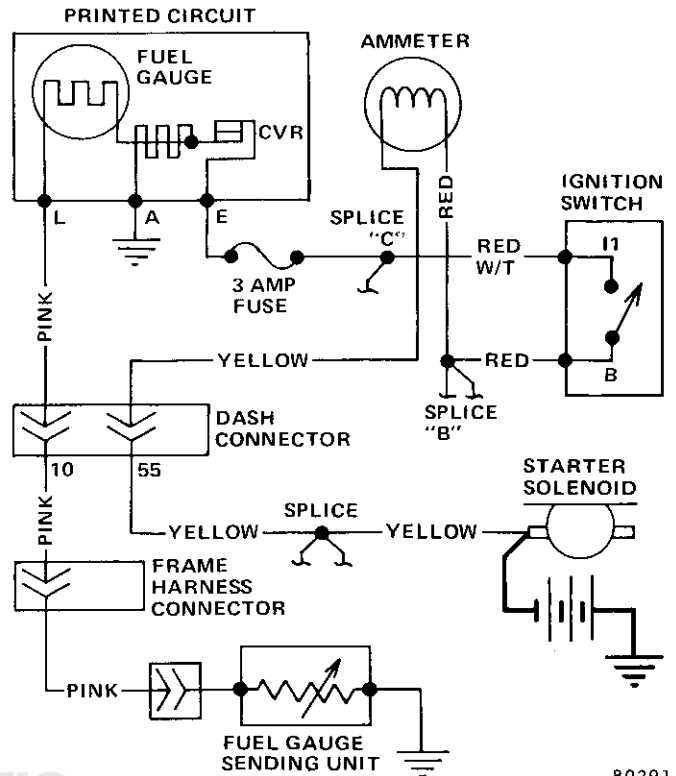
- A1 OIL GAUGE A TERMINAL
- S1 OIL GAUGE S TERMINAL
- A2 FUEL GAUGE A TERMINAL
- S2 FUEL GAUGE S TERMINAL
- A3 TEMPERATURE GAUGE A TERMINAL
- S3 TEMPERATURE GAUGE S TERMINAL
- I CVR I TERMINAL (CVR INSIDE TEMPERATURE GAUGE)
- M1 AMMETER STUD
- M2 AMMETER STUD
- GR GROUND SCREW

80127



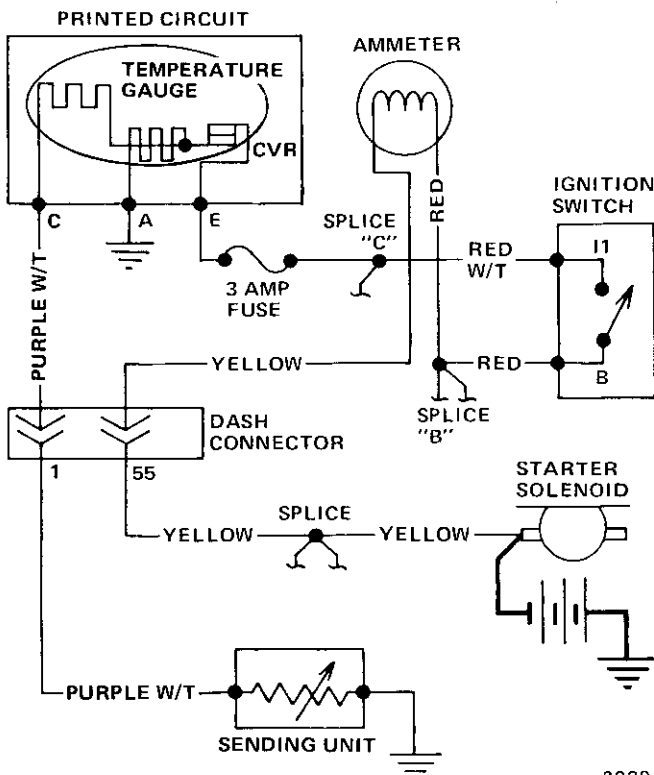
80293

**Ammeter Circuit—  
Cherokee-Wagoneer-Truck Models**



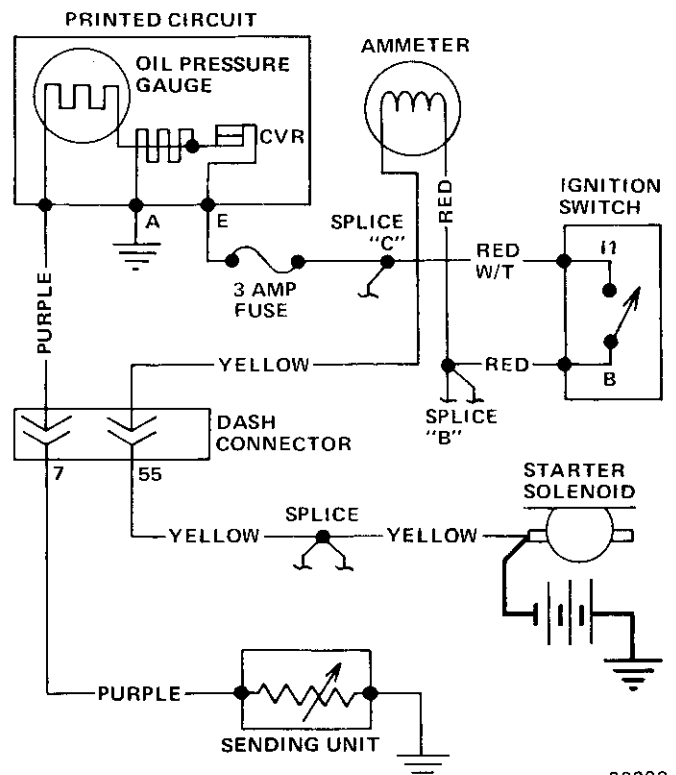
80291

**Fuel Gauge Circuit—  
Cherokee-Wagoneer-Truck Models**



80294

**Temperature Gauge Circuit—  
Cherokee-Wagoneer-Truck Models**



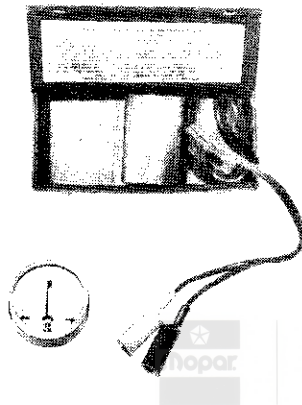
80292

**Oil Pressure Gauge Circuit—  
Cherokee-Wagoneer-Truck Models**

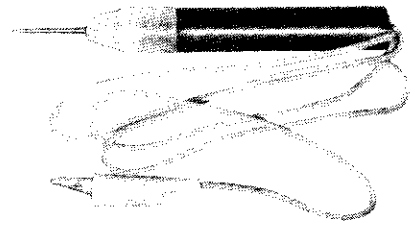


## 1L-46 POWER PLANT INSTRUMENTATION

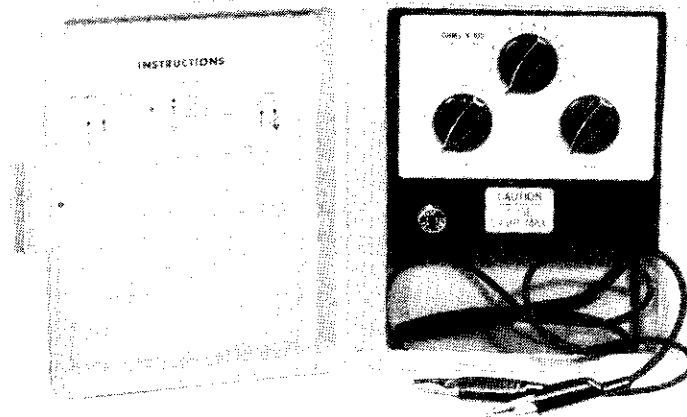
### Tools



J-8681  
SHORT CHECKER



J-21008  
CONTINUITY LIGHT



J-24538  
FUEL AND TEMPERATURE  
GAUGE TESTER

AUTHENTIC  
RESTORATION  
PRODUCT



Navigation Tools: Click on the "Chapter" below, or use the Bookmarks to the left.



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# SECTION 2

## CHASSIS

# CHAPTER INDEX

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Section 3 - Body

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Automatic Transmission	2C
Transfer Case	2D
Propeller Shaft	2E
Axles	2F
Brakes	2G
Wheels and Tires	2H
Steering Columns	2J
Manual Steering Gear	2K
Power Steering Gear And Pump	2L
Steering Linkage	2M
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# CLUTCH

# 2A

## SECTION INDEX

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General Information	2A-1	Clutch Service	2A-8

## GENERAL INFORMATION

	Page		Page
Clutch Adjustments	2A-6	Clutch Pedal Free Play Adjustment	2A-6
Clutch Component Service	2A-8	General	2A-1
Clutch Linkage	2A-6	Service Diagnosis	2A-1

### GENERAL

The clutch assembly used in Jeep vehicles consists of a single dry-disc driven plate and a spring and lever-type clutch cover (fig. 2A-1).

Two clutch cover styles are used. A 10.5 inch (26.7 cm) diameter direct spring pressure cover is used in CJ models with six- or eight-cylinder engines. An 11.0 inch (27.9 cm) diameter semi-centrifugal cover is used on Cherokee and Truck models with eight-cylinder engine. Cherokee and Truck models with six-cylinder engine use an 11.0 inch (27.9 cm) direct spring pressure cover.

The two clutch covers are similar in appearance and construction consisting of a pressure plate, release levers, lever pivots, apply springs, and outer cover.

Both covers apply spring pressure directly against the pressure plate to maintain engagement. However, the semi-centrifugal cover also utilizes six rollers, located between the pressure plate and cover, to exert additional apply force at higher engine speeds. At these speeds, centrifugal force moves the rollers outward wedging them between the cover and pressure plate to increase apply force.

The driven plate consists of a steel hub with integral cushion springs and clutch friction material which is riveted to the hub (fig. 2A-1). The function of the cushion springs is to absorb excessive torque loads and provide smoother clutch engagement.

The clutch release mechanism consists of a throwout bearing located on the transmission front bearing cap and a forked lever mounted on a ball and pivot installed in the clutch housing. A spring, attached to the lever and anchored to the ball pivot, is used to maintain lever-to-pivot ball contact.

Two throwout bearing designs are used (fig. 2A-2). The bearing used in CJ models is connected to the throwout lever by retaining springs riveted to the support and sleeve portion of the bearing. The bearing used on Cherokee and Truck models has a groove machined in the support and sleeve to accept the throwout lever. A wave washer is used to retain the lever on the bearing.

### SERVICE DIAGNOSIS

#### General

Clutch problems can generally be assigned to one of the following categories defined as:

- Clutch chatter
- Clutch slippage or inadequate clutch pedal free play
- Clutch drag or inadequate clutch release
- Clutch pedal pulsation
- Clutch-related vibration
- Clutch area noises

Each category is described in common complaint language and followed by simplified diagnosis and repair procedures.

**NOTE:** Before performing any of the following diagnosis and repair procedures, adjust pedal free play and be sure the clutch pedal returns to the pedal stop completely.

#### Clutch Chatter

Clutch chatter can be described as a shaking or shuddering sensation felt throughout the vehicle. Chatter

## 2A-2 CLUTCH

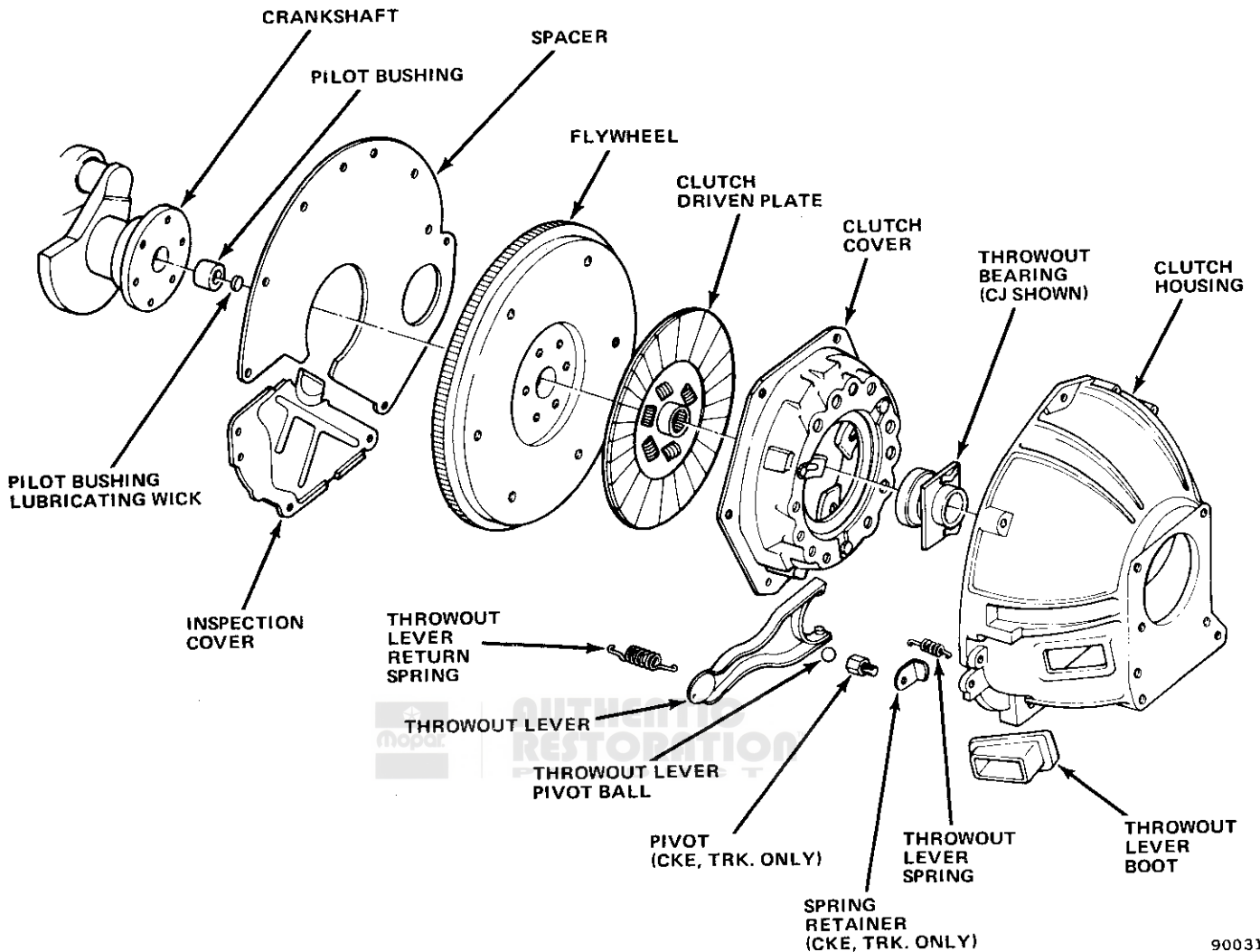


Fig. 2A-1 Clutch Assembly

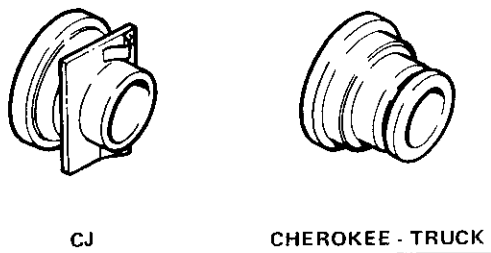


Fig. 2A-2 Throwout Bearing Application

usually develops when the clutch cover pressure plate makes initial contact with the driven plate and ceases when the clutch is fully engaged (clutch pedal released). Check clutch operation as follows:

**WARNING:** The following test requires clutch engagement to the point of vehicle movement. Do not allow anyone to stand at the front or rear of the vehicle during this test.

(1) Start engine, press clutch pedal to floor and shift transmission into first gear.

(2) Increase engine speed to 1200/1500 rpm and slowly release clutch pedal. When pressure plate makes initial contact with driven plate, note clutch operation. Press clutch pedal to floor and release accelerator pedal.

(3) Shift transmission into reverse and repeat procedure outlined in step (2).

(4) If clutch chatter does not develop in either gear range, increase engine speed to 1700/2200 rpm and repeat steps (2) and (3).

(5) If clutch chatter does not develop after performing tests outlined in steps (1) through (4), problem may be improper operation by owner. If clutch chatter does develop, proceed to next step.

(6) Raise vehicle on hoist.

(7) Check for loose or broken front or rear engine support cushions. Tighten or replace as necessary. Check for loose clutch housing-to-engine or housing adapter-to-transmission attaching bolts. Tighten as necessary. Refer to torque specifications in this section.

Check for binding, worn, bent or broken clutch linkage components. Lubricate or replace as necessary.

(8) If components inspected are in good condition, proceed to next step. If one or more problems were discovered and corrected, lower vehicle and repeat step (1). If chatter is still evident, proceed to next step.

(9) Remove transmission and clutch components as outlined in this chapter.

**NOTE:** *Whenever the clutch components are removed, also remove the pilot bushing lubricating wick, soak the wick in engine oil and reinstall the wick before assembly.*

(10) Check for oil or grease contamination of driven plate. If contaminated, correct cause of contamination and replace driven plate.

(11) Check clutch cover for broken or collapsed apply springs and inspect surface of pressure plate for deep scoring, cracks, heat checking, or warping (check surface with straightedge). Replace clutch cover if it exhibits any of these conditions. Do not replace clutch cover if cover is in good condition.

(a) Clean oil and dirt from cover with mineral spirits and allow to air dry.

(b) Sand pressure plate surface lightly with fine emery cloth.

(c) Lubricate release lever pivots and check release lever height. Adjust height if necessary.

**CAUTION:** *Apply lubricant to pivots sparingly. Excessive lubrication could result in grease contamination of the pressure plate and driven plate surfaces.*

(12) Inspect crankshaft pilot bushing. Replace bushing if worn, deeply scored, or discolored.

**NOTE:** *Soak replacement bushing in engine oil before installation.*

(13) Inspect condition of splines on transmission clutch shaft and in driven plate hub. If splines are worn, galled, chipped or broken, replace clutch shaft or driven plate. Remove corrosion, rust, or burrs from splines using oilstone or fine-tooth file. Install driven plate on clutch shaft. Plate must move freely on shaft.

(14) If all clutch components are in good condition, proceed to next step. If one or more components were determined to be faulty, repair as necessary and proceed to next step.

(15) Check clutch housing alignment as outlined in this chapter. Correct alignment if necessary and proceed to next step.

(16) Apply thin film of chassis lubricant to transmission clutch shaft splines. Do not apply lubricant to shaft pilot hub.

(17) Install pilot bushing lubricating wick and install clutch components and transmission. Refer to Clutch Installation.

**NOTE:** *Do not replace the throwout bearing unless it is defective or damaged. Refer to Clutch Area Noises.*

### Clutch Slippage Or Inadequate Clutch Linkage Free Play

Clutch slippage can be described as a condition in which the engine overspeeds but does not generate any increase in torque supplied to the wheels. Clutch slippage occurs when the driven plate is not gripped firmly between the flywheel and clutch cover pressure plate and rotates or slips between them at high torque. Clutch slippage can occur during initial acceleration or during subsequent shifts. Check clutch operation as follows:

(1) Block wheels and apply parking brake.

(2) Operate engine until it reaches normal operating temperature.

(3) Shift transmission into third gear and increase engine speed to 2000 rpm.

**WARNING:** *Do not permit anyone to stand in front of the vehicle during this test.*

(4) Slowly release clutch pedal until clutch is fully engaged.

**CAUTION:** *Do not allow the clutch to be engaged for more than 5 seconds at a time as the clutch components could be damaged.*

(5) If engine stalls within 5 seconds, clutch is not defective. If engine continues to run, proceed to next step.

(6) Raise vehicle on hoist. Check clutch linkage for binding, worn, broken, or bent components. Lubricate or replace as necessary. If all components inspected are in good operating condition, proceed to next step.

(7) If one or more problems were discovered and corrected during inspection in previous step, repeat steps (1) through (4). If clutch slippage is corrected, stop repair. If slippage persists, proceed to next step.

(8) Remove transmission and clutch components. Refer to Clutch Removal.

**NOTE:** *Whenever the transmission is removed, also remove the pilot bushing lubricating wick, soak the wick in engine oil, and reinstall the wick before assembly.*

(9) Inspect driven plate. If 1/16 inch (1.58 mm) or less friction material remains above rivet heads, or plate is severely glazed or contaminated with oil or grease, replace driven plate.

**NOTE:** *If the driven plate is contaminated, determine the cause and make correction before proceeding.*

(10) Inspect clutch cover. If cover is heat-checked, has broken or collapsed springs, or exhibits signs of overheating (e.g., has blue coloration), replace cover. If cover does not exhibit any of these conditions, do not replace it.

## 2A-4 CLUTCH

(a) Clean oil and dirt from cover using mineral spirits and allow cover to air dry.

(b) Sand pressure plate surface lightly using fine emery cloth.

(c) Lubricate cover release lever pivots and check and adjust release lever height as necessary.

**CAUTION:** *Apply lubricant to the pivots sparingly. Excessive lubrication could result in grease contamination of the driven plate and pressure plate surfaces.*

(11) Check throwout bearing mounting surface of transmission front bearing cap for galling, deep scores, or roughness. Install throwout bearing on bearing cap and check for smooth fore/aft movement. Replace bearing or bearing cap as necessary if bind occurs. Fill throwout bearing groove with chassis grease and apply thin coat of grease to bearing mounting surface of front bearing cap.

**CAUTION:** *The throwout bearing used with the T-150 transmission has retaining springs which position the bearing on the throwout lever. Check these springs for distortion, loss of tension, or for being bent or broken. Replace the bearing if these springs are damaged. Also, when installing the bearing, be sure the retaining projections on the throwout lever are properly engaged in the retaining holes in the bearing sleeve.*

**NOTE:** *Do not replace the throwout bearing unless it is actually defective or damaged. Refer to Clutch Area Noises.*

(12) Apply thin film of chassis grease to transmission clutch shaft splines. Do not apply grease to shaft pilot hub.

(13) Install pilot bushing and lubricating wick.

(14) Install clutch components and transmission. Refer to Clutch Installation.

(15) Lower vehicle.

### Clutch Drag Or Inadequate Release

Clutch drag can be described as a condition in which the clutch driven plate, and consequently the transmission clutch shaft, does not come to a complete stop after the clutch pedal is depressed (clutch disengaged). Clutch drag can cause gear clash when shifting into reverse or hard or difficult shifting. Check clutch operation as follows.

**NOTE:** *Occasionally, the clutch driven plate and clutch shaft will require approximately 5 seconds to lose momentum and come to a complete stop after initial clutch disengagement. This is normal and should not be mistaken for clutch drag.*

(1) Start engine, depress clutch pedal fully, and shift transmission into first gear.

(2) Shift transmission into neutral but **do not** release clutch pedal.

(3) Wait 5 to 10 seconds and shift transmission into reverse. If shift is smooth with no gear clash, clutch operation is normal. If shifting into reverse produces gear clash, proceed to next step.

(4) Raise vehicle on hoist. Check clutch linkage for binding, worn, broken or bent components. Lubricate or replace as necessary. If components are in good operating condition, proceed to next step. If one or more problems were discovered and repaired, lower vehicle and repeat steps (1) through (3). If clutch now operates correctly, stop repair. If clutch drag persists, proceed to next step.

(5) Remove transmission and clutch components. Refer to Clutch Removal.

**NOTE:** *Whenever the transmission is removed, also remove the pilot bushing lubricating wick, soak the wick in engine oil, and reinstall the wick before assembly.*

(6) Observe wear pattern on driven plate. If wear pattern is uneven (e.g., two areas heavily worn on one side, two only partially worn on opposite side), or has opposing wear patterns on front and reverse side, the driven plate is warped and should be replaced.

(7) Inspect clutch cover assembly. If clutch cover assembly has worn, bent, or broken release levers or lever pivots, is heavily scored, or warped, replace clutch cover assembly. If cover assembly does not exhibit any of these conditions, do not replace it.

(a) Clean oil and dirt from clutch cover with solvent and allow cover to air dry.

(b) Sand pressure plate surface lightly using fine emery cloth.

(c) Lubricate cover release lever pivots with chassis grease.

**NOTE:** *Apply lubricant to pivots sparingly. Excessive lubricant could result in grease contamination of pressure plate and driven plate surfaces.*

(8) Check and adjust clutch cover release lever height as necessary.

**NOTE:** *If the release lever height cannot be adjusted, the release lever(s) are bent. Replace the clutch cover.*

(9) Inspect crankshaft pilot bushing for heavy scoring, angular wear pattern, or discoloration. Replace as necessary. Be sure to soak bushing in engine oil before installation.

**NOTE:** *If the pilot bushing displays an angular-type wear pattern, check and correct clutch housing alignment before proceeding. Refer to Clutch Housing Alignment.*

(10) Inspect condition of splines on transmission clutch shaft and in driven plate hub. If severely worn, galled, or corroded, replace clutch shaft or driven plate.

Corrosion, rust, or burrs can be removed from splines using an oilstone or fine-tooth file. Install driven plate on clutch shaft. Driven plate must move freely on shaft.

(11) If components inspected in previous steps are in good condition, proceed to next step. If one or more problems were discovered during inspection procedure, repair as necessary and proceed to next step.

(12) Check clutch housing alignment. Refer to Clutch Housing Alignment. Correct alignment if necessary and proceed to next step.

(13) Apply thin film of chassis grease to transmission clutch shaft splines. Do not apply grease to shaft pilot hub.

(14) Install pilot bushing lubricating wick.

(15) Install transmission and clutch components. Refer to Clutch Installation.

(16) Lower vehicle.

**NOTE:** Do not replace the throwout bearing unless actually defective. Refer to Clutch Area Noises.

### Clutch Pedal Pulsation

Clutch pedal pulsation can be described as a rapid up-and-down or pumping-type movement of the pedal that is not accompanied by any noise. In most cases, pedal movement is slight and cannot be observed but can be felt by the driver. However, on occasion, pedal movement will be great enough to be visually observed and cause a noticeable vibration.

Clutch pedal pulsation occurs when the throwout bearing makes initial contact with the clutch cover release levers (clutch partially disengaged), or at any time the bearing is in contact with the release levers. Pulsation is usually caused by incorrect clutch release lever height or clutch housing misalignment. Check clutch operation as follows.

(1) Start engine, slowly depress clutch pedal until throwout bearing makes initial contact with clutch release levers, and check for pulsation.

**NOTE:** Some minor pulsation is normal.

(2) Continue to depress clutch pedal while checking for pulsation until pedal is fully depressed.

(3) If pulsation is not evident or is minor, stop repair. If pulsation is very rapid and can be felt throughout vehicle, refer to Clutch-Related Vibrations. If vehicle displays pulsation symptoms, proceed to next step.

(4) Remove transmission and clutch components. Refer to Clutch Removal.

(5) Remove pilot bushing lubricating wick and soak wick in engine oil.

(6) Inspect clutch cover release levers. If levers are bent or excessively worn, replace clutch cover and proceed to step (8). If release levers are in good condition, clean oil and dirt from clutch cover assembly using mineral spirits, allow assembly to air dry and proceed to next step.

(7) Sand clutch cover pressure plate surface lightly using fine emery cloth.

(8) Lubricate clutch cover release lever pivots lightly with chassis grease.

**NOTE:** Apply lubricant to the pivots sparingly. Excessive lubrication could result in grease contamination of the driven plate and pressure plate surface.

(9) Check and adjust clutch cover release lever height if necessary.

**NOTE:** If release lever height cannot be adjusted, the levers are bent and the cover must to be replaced.

(10) Check clutch housing alignment. Refer to Clutch Housing Alignment. Correct alignment if necessary and proceed to next step.

(11) Apply thin film of chassis grease to transmission clutch shaft splines but do not apply grease to shaft pilot hub.

(12) Install pilot bushing lubricating wick.

(13) Install clutch components and transmission. Refer to Clutch Installation.

### Clutch Related Vibrations

Clutch related vibrations differ from pedal pulsations in frequency and magnitude. They usually occur at relatively high engine speeds (over 1500 rpm), are not affected by clutch pedal position, and can be felt throughout the vehicle.

Although clutch related vibrations are usually caused by clutch component imbalance, this condition occurs very infrequently because the clutch cover and driven plate are balanced as a unit during assembly. At this time, the cover and plate are installed on the crankshaft/flywheel assembly and given a final fine-tune balance before installation in the vehicle.

Replacement of clutch components to correct vibrations should be performed only after exhausting all other possibilities. Check clutch operation as follows.

(1) Raise vehicle on hoist and check engine front support cushion interlocks for grounding. Repair as necessary. Check other engine components (e.g., exhaust manifold, valve cover, etc.) for grounding on body or frame. If one of these components is grounded, repair and check for vibration. If vibration ceases, stop repair. If vibration continues, lower vehicle and proceed to next step.

(2) Disconnect accessory drive belts one at a time, start engine, and check for vibration. If vibration stops after removal of a drive belt, cause of vibration is related to accessory driven by belt or by belt itself. Repair as necessary. If vibration persists after checking all belts and accessories, proceed to next step.

(3) Raise vehicle on hoist and remove transmission and clutch housing. Refer to Clutch Removal.

(4) Support engine firmly.



(5) Check for loose flywheel mounting bolts. Tighten bolts to 105 foot-pounds (142 N•m) torque if necessary and operate engine. If vibration ceases, stop repair. If vibration is still evident, proceed to next step.

(6) Check flywheel face runout while holding crankshaft end play to zero. If runout is 0.005 inch (0.12 mm) or less, proceed to next step. If runout exceeds 0.005 inch (0.12 mm), replace flywheel and operate engine. If vibration ceases, stop repair. If vibration is still evident, proceed to next step.

(7) Check for damaged crankshaft vibration dampener. If dampener is in good condition, proceed to next step. If dampener is damaged, replace dampener and operate engine. If vibration ceases, stop repair. If vibration is still evident, proceed to next step.

(8) Check clutch cover imbalance as follows:

(a) Remove clutch cover and driven plate from flywheel.

(b) Start and operate engine at speed where vibration occurred.

(c) If vibration ceases, replace clutch cover and recheck operation. If now OK, install clutch housing and transmission. Refer to Clutch Installation.

(9) Lower vehicle.

### Clutch Noises

#### Throwout Bearing Noise

Throwout bearing noises can be described as whirring, grating, or grinding noises that occur when the clutch pedal is depressed (clutch disengaged).

These noises usually continue until the clutch pedal is fully released (clutch engaged) and the bearing is no longer in contact with the clutch cover release levers.

Throwout bearing noise is corrected by replacing the bearing as outlined in this chapter.

**NOTE:** *The throwout bearing should not be replaced as a matter of course when servicing the clutch cover or driven plate. Replace the bearing only if defective.*

#### Transmission Clutch Shaft or Countershaft Bearing Noise

Transmission clutch shaft or countershaft bearing noises can be described as whirring, grating, or grinding noises which cease when the clutch pedal is depressed (clutch disengaged) or when the transmission is shifted into gear. These noises are most noticeable when the clutch pedal is fully released and the transmission is in neutral. Correction of these noises will require transmission removal and replacement of the problem bearing(s).

#### Crankshaft Pilot Bushing Noise

Pilot bushing noises can be described as squealing, howling, or elephant-type trumpeting noises which are most noticeable when the engine is cold. These noises occur during the first few inches of clutch pedal travel as the pedal is being released (partial clutch engagement) with the transmission in gear. It can also occur in very cold weather when the pedal is fully depressed (clutch disengaged) and the engine is started with the transmission in neutral. To correct pilot bushing noise, replace bushing as outlined in this section.

### CLUTCH ADJUSTMENTS

There are two clutch adjustments required: clutch pedal free play and clutch cover release lever height.

Clutch pedal free-play should be checked and adjusted at the intervals specified in the Mechanical Maintenance Schedule, Chapter B, or whenever diagnosis indicates adjustment is needed. Refer to Clutch Pedal Free Play Adjustment in this section.

Clutch cover release lever height should be checked and adjusted whenever the cover is removed or replaced during service operations, or whenever diagnosis indicates adjustment is needed. Refer to the Clutch Service section in this chapter.

#### CLUTCH PEDAL FREE PLAY ADJUSTMENT

(1) Lift clutch pedal upward and against pedal stop (fig. 2A-3 and fig. 2A-4).

(2) Raise vehicle.

(3) On Cherokee and Truck models, adjust clutch push rod lower ball pivot assembly in-or-out on push rod (fig. 2A-4) until bellcrank inner lever is parallel to front face of clutch housing. Lever should be slightly forward from vertical.

(4) Loosen release rod adjuster jamnut.

(5) Turn release rod adjuster in or out to obtain specified clutch pedal free play.

(6) Tighten release rod jamnut.

(7) Lower vehicle.

#### CLUTCH LINKAGE

The suspended-type clutch pedal is connected to the throwout lever through the clutch push rod, bellcrank outer and inner levers, and release rod (fig. 2A-3 and fig. 2A-4). The throwout bearing is mounted on the transmission front bearing cap and acts directly against the clutch cover release levers to engage and disengage the clutch. The bearing is actuated by a throwout lever mounted in the clutch housing. The lever pivots on a steel ball mounted inside the clutch housing.

The bellcrank pivots on ball studs mounted in the inner and outer support brackets (fig. 2A-3 and fig. 2A-4). Idler bushings, installed in each end of the bellcrank provide bearing surfaces for the ball studs.

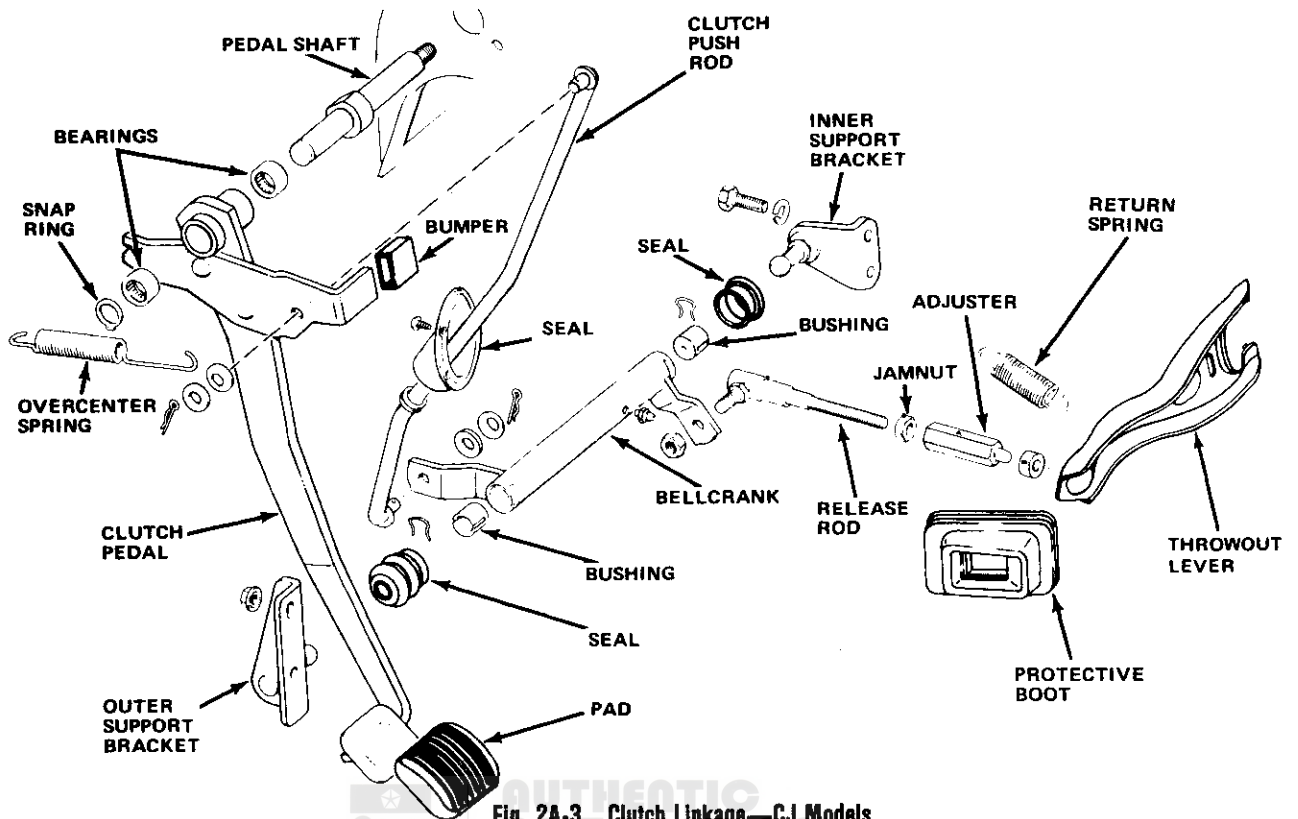


Fig. 2A-3 Clutch Linkage—CJ Models

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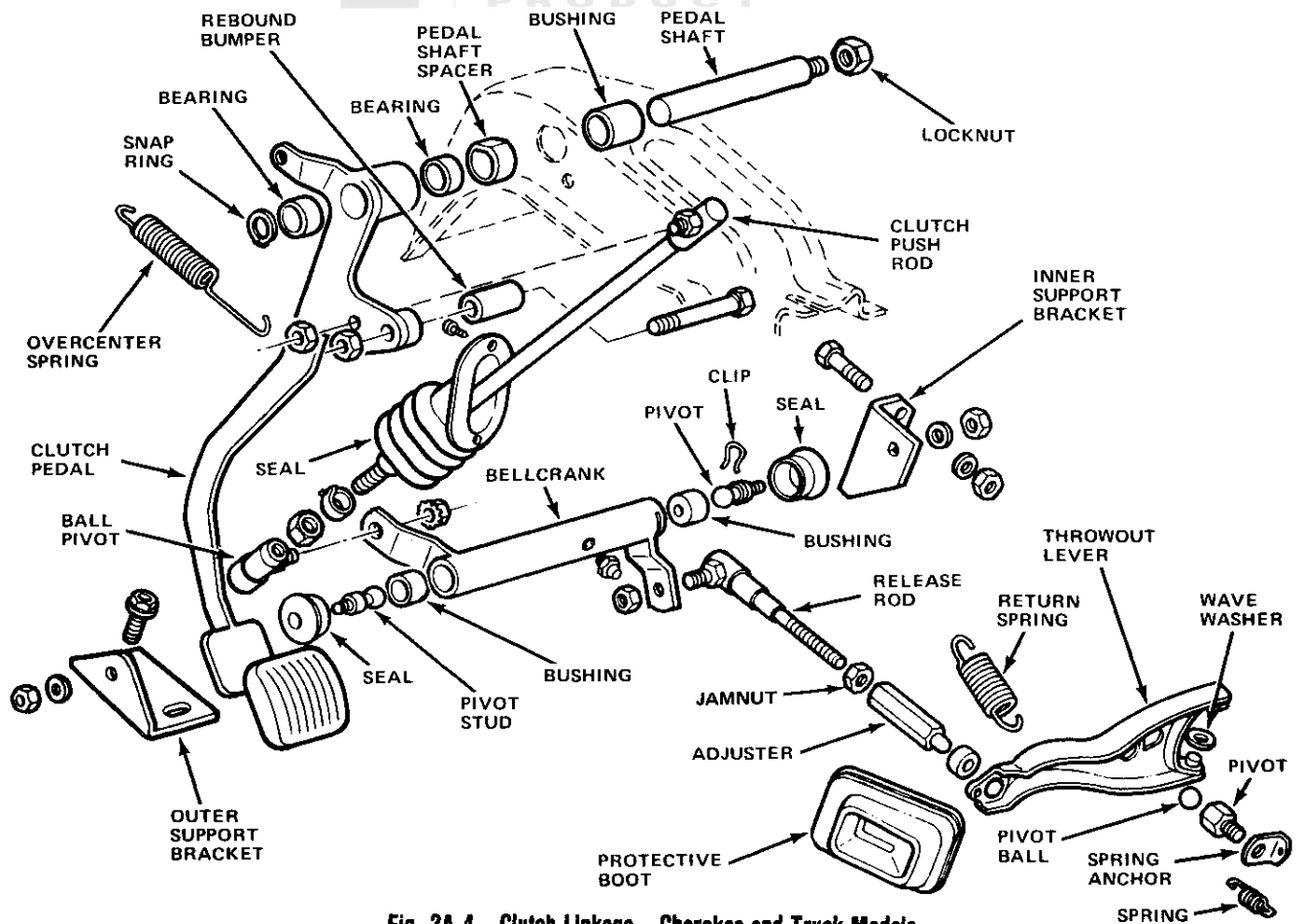


Fig. 2A-4 Clutch Linkage—Cherokee and Truck Models

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**Clutch Linkage Lubrication**

The clutch linkage ball studs are the only linkage components that require periodic lubrication. The studs should be lubricated at the intervals specified in the Mechanical Maintenance Schedule, Chapter B.

**Lubrication Procedure**

The bellcrank has a lubrication fitting to facilitate ball stud lubrication. Whenever lubrication is necessary, proceed as follows:

- (1) Raise vehicle.

- (2) Fill lube gun with lithium-base chassis grease.
- (3) Connect lube gun nozzle to bellcrank fitting and lubricate ball studs.
- (4) Remove lube gun and lower vehicle.

**CLUTCH COMPONENT SERVICE**

The clutch cover, driven plate, and throwout bearing are each serviced as an assembly only. Do not attempt to disassemble any of these components to effect repair. If any component has become damaged or severely worn replace the component as an assembly only.

**CLUTCH SERVICE**

	Page		Page
Clutch Cover Release Lever Adjustment	2A-11	Clutch Pedal and Overcenter Spring Replacement—Cherokee-Truck	2A-13
Clutch Housing Alignment	2A-10	Clutch Removal	2A-8
Clutch Inspection and Service	2A-9	Specifications	2A-14
Clutch Installation	2A-8	Tools	2A-15
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**CLUTCH REMOVAL**

- (1) Remove transmission as outlined in Chapter 2B.
- (2) Remove starter motor.
- (3) Remove throwout bearing.
- (4) Remove clutch housing.
- (5) Mark position of clutch cover on flywheel for assembly alignment reference.
- (6) Loosen clutch cover attaching bolts one or two turns at a time and in rotation to relieve spring tension on cover.

**CAUTION:** *The clutch cover bolts must be loosened evenly and in rotation to avoid cover distortion. The cover is a steel stamping and could be warped if improperly removed resulting in clutch chatter when installed.*

- (7) Remove clutch cover bolts and remove cover and driven plate from flywheel.

**NOTE:** *Observe which side of the driven plate faces the flywheel before removing the plate. Paint or chalk alignment marks on the plate for assembly reference.*

- (8) Remove pilot bushing lubricating wick and soak wick in engine oil.
- (9) Inspect and service clutch components as outlined under Clutch Component Inspection.

**CLUTCH INSTALLATION**

- (1) Check and correct clutch cover release lever height if necessary. Lubricate release lever pivots sparingly. Do not overlubricate pivots.
- (2) Install pilot bushing lubricating wick in crankshaft bore.

- (3) Insert Clutch Alignment Tool J-22056 (Cherokee-Truck), or Alignment Tool J-25353 (CJ), or spare clutch shaft in driven plate hub and mount assembled plate and tool on flywheel. Be sure tool is fully seated in pilot bushing.

**CAUTION:** *Be sure the correct side of the driven plate faces the flywheel. Refer to the reference marks placed on the driven plate during clutch removal.*

- (4) Position clutch cover on flywheel and over driven plate and alignment tool. Align cover and flywheel according to reference marks made during clutch removal and install cover attaching bolts finger tight only.

- (5) Tighten cover attaching bolts alternately and evenly to 40 foot-pounds (54 N•m) torque. Be sure to maintain cover-to-plate alignment while tightening bolts.

**CAUTION:** *The cover attaching bolts must be tightened alternately and evenly to avoid distorting the cover.*

- (6) Install clutch housing and tighten housing attaching bolts to specified torque. Refer to Specifications.
- (7) Install starter motor.
- (8) Install throwout bearing (fig. 2A-2). On Cherokee and Truck models, be sure wave washer is installed on throwout lever. On CJ models, be sure bearing tension springs are engaged in throwout lever.
- (9) Install transmission as outlined in Chapter 2B.

## CLUTCH INSPECTION AND SERVICE

### Driven Plate

Inspect the friction material for excessive wear, or charred, cracked, broken or loose friction material. Check the driven plate steel hub and cushion springs for distortion, cracks, or breakage. Replace the driven plate if it exhibits any of these conditions.

**NOTE:** Do not replace the driven plate if the cushion springs only appear loose. This is a normal condition when the plate is removed from the vehicle and the springs are not under load.

### Clutch Cover

Inspect the cover for cracks, distortion, broken or collapsed apply springs and for broken, bent, loose, or excessively worn release levers. Inspect the pressure plate surface for deep scores, cracks, heat checking or discoloration, and for evidence of warping (use a straightedge to check pressure plate surface flatness). Replace the cover as an assembly if it exhibits any of these conditions.

**NOTE:** The centrifugal rollers in the clutch cover may rattle when the cover is removed and not under load. Do not replace the cover if this occurs, it is a normal condition.

### Throwout Bearing

Two throwout bearings are used on Jeep vehicles. On Cherokee-Truck models, a spring-type wave washer is used to retain the throwout lever on the bearing. On CJ models, the bearing is retained on the lever by tension springs.

**CAUTION:** The throwout bearings used on Jeep vehicles are permanently lubricated during manufacture. Do not wash or immerse the bearings in solvent as the bearing lubricant could be dissolved. Clean the bearing by wiping it with shop towels.

Inspect the bearing for excessive wear and deep scoring on the release lever contact surface, looseness on the sleeve, or discoloration which indicates overheating. Check the sleeve bore for excessive wear or burrs which could cause it to bind on the front bearing cap. Rotate the bearing on the sleeve. The bearing must rotate freely and not bind. When rotating the bearing, also listen for grinding or grating sounds which indicate that the internal rollers are worn or damaged. On CJ models, check the bearing tension springs for distortion or breakage. Replace the bearing if it exhibits any of these conditions.

### Transmission Front Bearing Cap

Inspect the bearing cap for deep scoring or excessive wear. Replace the bearing cap if worn or scored and inspect the throwout bearing sleeve for burrs, wear or other damage which could cause a bind condition. Replace the bearing cap or throwout bearing if either exhibits these conditions.

### Crankshaft Pilot Bushing

Inspect the bushing for excessive wear, deep scoring, cracks, or looseness. Replace the bushing if worn or damaged.

#### Bushing Replacement

- (1) Obtain replacement bushing and soak bushing in engine oil.
- (2) Remove bushing lubricating wick.
- (3) Fill crankshaft bore and pilot bushing with chassis grease.
- (4) Insert clutch aligning tool into bushing and tap end of tool with lead hammer. Hydraulic pressure generated by compressed grease will force bushing out of crankshaft bore.
- (5) Remove all grease from crankshaft bore and clean bore thoroughly.
- (6) Install replacement pilot bushing on clutch alignment tool.
- (7) Install bushing in crankshaft bore using clutch alignment tool as bushing driver. Keep bushing straight during installation and be sure it is fully seated.
- (8) Install bushing lubricating wick.

### Flywheel

Inspect the flywheel surfaces for cracks, deep scoring, excessive wear, heat checking, discoloration, and excessive face runout or distortion. Check face runout using a dial indicator. Runout must not exceed 0.005 inch (0.12 mm) with the crankshaft end play held to zero. Use a straight edge to check surface flatness. Inspect the ring gear teeth for cracks, breakage, or excessive wear. If the ring gear teeth are severely milled (worn), also check the starter motor drive teeth for similar wear or damage. Check the flywheel attaching bolt torque and tighten the bolts to 105 foot-pounds (142 N•m) torque if necessary. Replace the flywheel if it exhibits any of the conditions just described.

### Transmission Clutch Shaft

Install the driven plate on the clutch shaft. The driven plate must move freely on the shaft splines. If the splines have burrs, remove them using a file or oilstone. If the driven plate does not move freely on the splines, incomplete clutch release will occur resulting in hard shifting. Replace the clutch shaft if worn or damaged. Refer to Chapter 2B for procedure.

## CLUTCH HOUSING ALIGNMENT

Clutch housing misalignment is caused by excessive face or bore runout of the clutch housing or housing-to-transmission adapter. Misalignment will cause improper clutch release, driven plate failure, front transmission bearing failure, premature crankshaft pilot bushing wear, and clutch noise and vibration. In severe cases, misalignment will also cause gear jump-out on deceleration. If these malfunctions occur, the rear face and bore of the clutch housing or housing-to-transmission adapter must be checked for excessive runout.

### Alignment Check—Without Transmission Adapter

**NOTE:** Use the following procedure when the vehicle is not equipped with a clutch housing-to-transmission adapter.

- (1) Remove transmission as outlined in Chapter 2B.
- (2) Remove clutch housing, clutch cover, and driven plate.
- (3) Remove one flywheel attaching bolt.
- (4) Obtain 1/2-20 X 9-inch bolt and 1/2-20 nut for use as dial indicator support.
- (5) Thread nut onto bolt until 10 or 12 bolt threads are exposed.
- (6) Thread bolt into crankshaft attaching bolt hole and tighten nut to secure bolt.
- (7) Install clutch housing on engine and tighten housing attaching bolts to specified torque. Refer to Specifications.
- (8) Mount dial indicator on 9-inch bolt. Indicator stylus must contact rear face of clutch housing approximately 1/8 inch from edge of bore (fig. 2A-5).

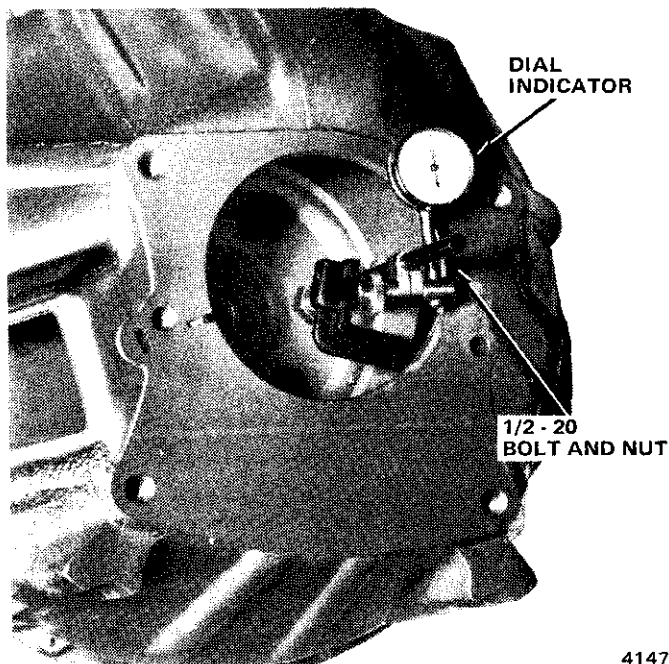


Fig. 2A-5 Mounting Dial Indicator

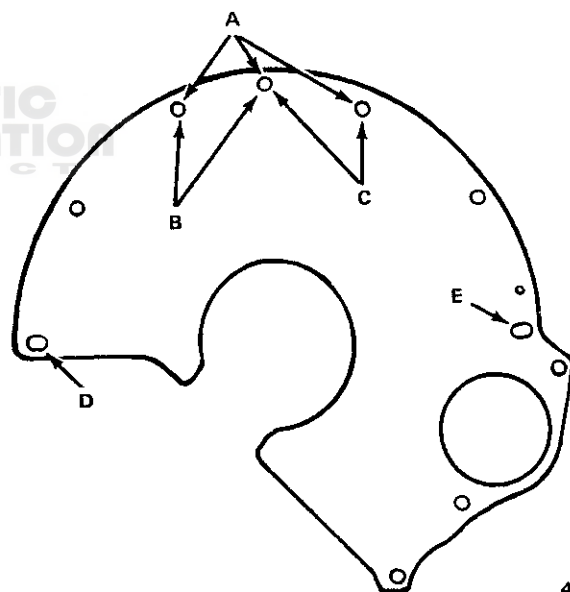
(9) Rotate crankshaft and check face runout of housing. Face runout must not exceed 0.010 inch (0.25 mm) total indicator reading at any point throughout 360 degrees rotation.

**NOTE:** Crankshaft end play must be held to zero to obtain an accurate face runout reading. Move and hold the crankshaft forward or rearward using a pry bar to remove end play.

(10) If face runout is over specified limits, correct runout as follows:

(a) Move dial indicator aside and loosen clutch housing attaching bolts.

(b) Insert shims between housing and engine-to-housing spacer as required to correct runout (fig. 2A-6). Install shims at points A to align top of housing with bottom of housing. Install shims at points B, D, C, or E to correct runout at either side of clutch housing. Shims installed at points D and E will also align housing from bottom to top.



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Fig. 2A-6 Shim Placement (Six-Cylinder Engine Shown)

(c) Tighten housing attaching bolts to specified torque.

(d) Reposition dial indicator stylus on housing face and recheck face runout.

(e) Total face runout of clutch housing must not exceed 0.010 inch (0.25 mm). Relocate shims as necessary to correct runout.

(11) Check clutch housing bore alignment by positioning dial indicator stylus on inside diameter of housing bore.

(12) Hold crankshaft end play to zero, rotate crankshaft and note dial indicator reading at four equally spaced points. Bore runout must not exceed 0.010 inch (0.25 mm) total indicator reading at any point.

**NOTE:** Any change in face alignment will also change bore alignment. In some cases, it is possible to correct bore alignment simply by correcting face alignment. Where it is impossible to correct bore alignment to a maximum of 0.010 inch (0.25 mm) runout (after changing face alignment), replace the clutch housing.

### Alignment Check—With Transmission Adapter

Use the following procedure to check clutch housing-to-transmission adapter alignment.

- (1) Remove transmission as outlined in Chapter 2B.
- (2) Remove clutch housing and adapter as assembly. Do not remove adapter from housing.
- (3) Remove clutch cover and driven plate.
- (4) Remove one flywheel attaching bolt.
- (5) Obtain 1/2-20 by 15-inch bolt and 1/2-20 nut for use as dial indicator support.
- (6) Thread nut onto bolt until 10 to 12 threads are exposed.
- (7) Thread bolt into flywheel attaching bolt hole and tighten nut to secure bolt.
- (8) Install clutch housing and adapter assembly and tighten housing bolts to specified torque.
- (9) Mount dial indicator on bolt. Position indicator so stylus contacts transmission mating face of adapter about 1/8 inch from edge of adapter bore.
- (10) Zero dial indicator, rotate crankshaft 360 degrees, and observe adapter face runout. Runout must not exceed 0.010 inch (0.25 mm) total indicator reading at any point through 360 degrees of rotation.

**CAUTION:** Crankshaft end play must be held to zero to obtain an accurate face runout reading. Move and hold the crankshaft forward or rearward using a pry bar to eliminate end play.

- (11) Check bore runout of adapter. Position dial indicator so stylus contacts adapter bore at approximate center of bore.

- (12) Zero dial indicator, rotate crankshaft 360 degrees, and observe runout of adapter bore. Runout must not exceed 0.010 inch (0.25 mm) at any point through 360 degrees of rotation.

**NOTE:** Crankshaft end play must be held to zero to obtain an accurate runout reading. Move and hold the crankshaft forward or rearward using a pry bar to eliminate end play.

- (13) If adapter runout is above specified limits, correct adapter misalignment as outlined in following steps.

- (14) If adapter bore runout is within limits but out of tolerance at face, shim clutch housing as required to obtain runout of 0.010 inch (0.25 mm) or less. Shim housing as outlined under Alignment Check—Without Transmission Adapter.

- (15) If adapter face runout is within limits but out of tolerance at bore, proceed as follows:

- (a) Loosen adapter-to-clutch housing bolts one or two turns.

- (b) Move adapter up, down, or side-to-side as required to obtain runout of 0.010 inch (0.25 mm) or less. Tap adapter with hammer to reposition it.

- (c) When runout is corrected, tighten adapter bolts to 35 foot-pounds (47 N•m) torque.

- (d) Recheck runout and adjust adapter position again if necessary.

- (16) If adapter face or bore runout cannot be brought within tolerance, replace adapter and clutch housing.

- (17) If adapter and housing are replaced, install dial indicator and check runout of replacement parts.

- (18) After checking and correcting adapter alignment, remove dial indicator and remove clutch housing with adapter attached. Do not remove adapter or disturb adapter position if runout was corrected.

**CAUTION:** If the clutch housing was shimmed, mark the location of the shims for assembly reference before removing the housing.

- (19) Remove 1/2-20 bolt and nut from flywheel and install flywheel bolt removed previously. Tighten bolt to 105 foot-pounds (142 N•m) torque.

- (20) Install driven plate and clutch cover. Tighten clutch cover bolts to 40 foot-pounds (54 N•m) torque.

- (21) Install clutch housing and adapter assembly and clutch housing alignment shims as necessary.

- (22) Tighten clutch housing bolts to specified torque. Refer to Specifications.

- (23) Install transmission as outlined in Chapter 2B.

### CLUTCH COVER RELEASE LEVER ADJUSTMENT

**NOTE:** Always check and correct the release lever height adjustment, if necessary, before installing an original or replacement clutch cover.

- (1) Install Gauge Plate Tool J-1048, on flywheel in position normally occupied by driven plate (fig. 2A-7).

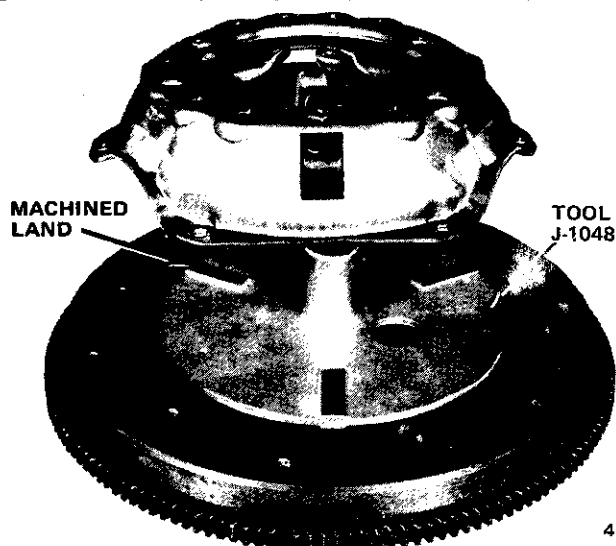


Fig. 2A-7 Mounting Gauge Plate J-1048

(3) Install clutch cover on flywheel. Tighten cover attaching bolts in rotation, one or two turns at a time to avoid distorting cover.

(4) Compress each release lever several times to seat levers in operating position (fig. 2A-8). Use hammer handle to compress levers.

(2) Position clutch cover over gauge plate. Cover release levers must be directly over machined lands of gauge plate and gauge plate hub must be centered between ends of release levers.

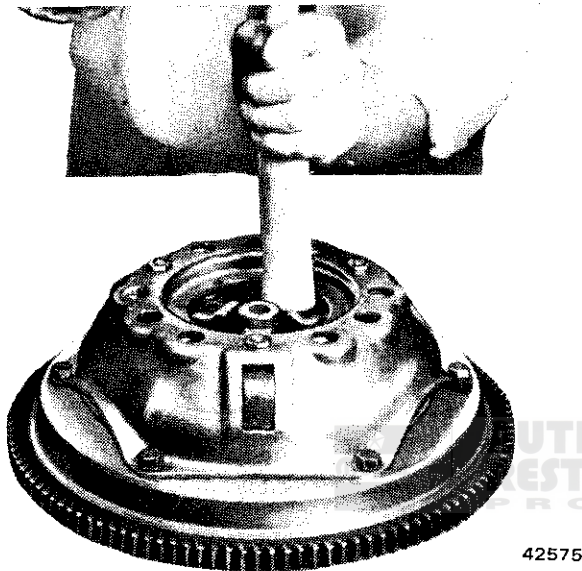


Fig. 2A-8 Compressing and Seating Release Levers

(5) Measure height of each lever relative to gauge hub using Clutch Lever Height Gauge Tool J-23330. Gauge tool has four different dimensional settings which can be used for measuring above and below hub. (fig. 2A-9).

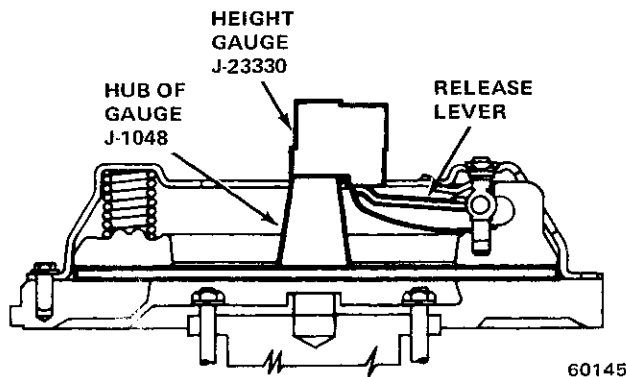


Fig. 2A-9 Measuring Release Lever Height

(6) Adjust release levers by turning lever height adjusting nuts until lever is at desired height.

(7) After each lever has been adjusted, work lever down and up several times and recheck adjustment. If adjustment is correct, stake nut with punch to secure it.

## CLUTCH PEDAL AND OVERCENTER SPRING REPLACEMENT—CJ MODELS

### Removal

- (1) Disconnect clutch pedal push rod at bellcrank.
- (2) Disconnect battery negative cable.
- (3) Remove bolt attaching engine compartment wiring harness connector to dash panel connector.
- (4) Disconnect engine compartment wiring harness out from dash panel connector.
- (5) Remove headlight switch attaching nut and remove switch from instrument panel.
- (6) Disconnect wires at headlamp indicator and remove indicator from instrument panel.
- (7) Remove steering column bezel.
- (8) Disconnect clutch pedal push rod at clutch pedal.
- (9) Remove fuse panel attaching screws and remove fuse panel.
- (10) Remove steering column toe plate attaching screws and remove toe plates.
- (11) On vehicles with nonpower brakes:
  - (a) Disconnect master cylinder push rod at brake pedal.
  - (b) Remove nuts and bolts attaching master cylinder to dash panel and move cylinder away from dash panel. Do not disconnect brakelines at master cylinder.
  - (c) Secure master cylinder to grille support rod with wire.
- (12) On all vehicles, remove nuts and bolts attaching pedal support bracket to dash panel.

**NOTE:** To ease removal of the support bracket attaching bolts, install locking-type pliers on either the bolt heads or nuts to prevent them from turning during removal.

- (13) On vehicles with power brakes:
  - (a) Disconnect power unit push rod at brake pedal.
  - (b) Remove nuts and bolts attaching power unit bracket to dash panel and move power unit and master cylinder away from dash panel. Do not disconnect brakelines at master cylinder.
  - (c) Secure power unit to grille support rod with wire.
- (14) Remove bolts attaching steering column mounting bracket to pedal support bracket.
- (15) Disconnect any wires that may interfere with pedal support bracket removal. Tag wires for assembly reference.
- (16) Disconnect wires from brakelight switch.
- (17) Remove pedal support bracket and pedals as assembly and place bracket on workbench.
- (18) Remove snap ring at clutch pedal end of pedal shaft.

(19) Slide clutch pedal toward end of pedal shaft just far enough for clutch pedal stop to rotate past brake pedal.

(20) Rotate brake pedal to relieve tension on over-center spring and remove spring and clutch pedal.

### Installation

(1) Mount clutch pedal on pedal shaft if removed.

(2) Connect overcenter spring to clutch pedal and pedal support bracket.

(3) Rotate clutch pedal on pedal shaft until pedal stop bracket clears brake pedal.

(4) Install clutch pedal completely on pedal shaft. Use plastic mallet to tap pedal onto shaft.

(5) Install snap ring on clutch pedal end of pedal shaft.

(6) Position pedal support bracket assembly in vehicle.

(7) Connect brakelight wires to brakelight switch.

(8) Align pedal support bracket with dash panel and install support bracket lower attaching bolts to hold bracket in position. Install bolts from inside vehicle.

(9) Align steering column mounting bracket with pedal support bracket and install column mounting bracket bolts finger tight only.

(10) On vehicles with power brakes:

(a) Remove wire securing power unit to grille support rod.

(b) Position power unit bracket over pedal support bracket bolts and install nuts on bolts to hold power unit in place.

(c) Install pedal support bracket upper attaching bolt and nut from engine compartment side of dash panel. Tighten bolt and nut finger tight only.

(d) Remove pedal support bracket lower attaching bolts installed previously and reinstall bolts from engine compartment side of dash panel. Tighten bolts finger tight only.

(11) On vehicles with nonpower brakes:

(a) Install pedal support bracket attaching bolts and nuts. Tighten bolts finger tight only.

(b) Position master cylinder on dash panel and install cylinder attaching bolts and nuts. Tighten bolts to 35 foot-pounds (47 N•m) torque.

(12) Connect brake pedal push rod to brake pedal. Use replacement cotter pin only to retain pedal.

(13) Tighten pedal support bracket attaching bolts securely.

(14) Install steering column toe plates. Tighten toe plate screws to 12 foot-pounds (16 N•m) torque.

(15) Tighten bolts attaching steering column mounting bracket to support bracket to 20 foot-pounds (27 N•m) torque.

(16) Install steering column bezel.

(17) Install fuse panel on dash panel.

(18) Install headlamp indicator in instrument panel and connect wires to indicator.

(19) Position headlamp switch in instrument panel and install switch attaching nut.

(20) Connect all wiring that was disconnected during pedal support bracket removal.

(21) Connect engine compartment wiring harness to dash panel connector and install connector attaching bolt.

(22) Connect battery negative cable.

(23) Connect clutch pedal push rod to bellcrank. Be sure release rod has not become disengaged from throw-out lever.

(24) Check and adjust clutch pedal free play if necessary.

## CLUTCH PEDAL AND OVERCENTER SPRING REPLACEMENT—CHEROKEE-TRUCK

### Overcenter Spring

#### Overcenter Spring Removal

(1) On vehicles with air conditioning, remove left side duct extension.

(2) Disconnect clutch push rod at clutch pedal.

(3) Remove clutch pedal stop.

(4) Press clutch pedal halfway down to spread over-center spring coils slightly and insert thin shims between overcenter spring coils.

(5) Raise clutch pedal until pedal stops against lower edge of instrument panel.

(6) Disconnect and remove overcenter spring from pedal and support bracket.

#### Installation

(1) Insert thin shims between overcenter spring coils.

(2) Install overcenter spring on support bracket and clutch pedal.

(3) Remove shims from overcenter spring coils.

(4) Connect clutch push rod to clutch pedal.

(5) Install clutch pedal stop.

(6) Check clutch release rod position. Be sure rod has not become disengaged from throwout lever.

(7) Check and adjust clutch pedal free play if necessary.

### Clutch Pedal

#### Removal

(1) Disconnect battery negative cable.

(2) Remove bolt attaching engine compartment wiring harness to dash panel connector.

(3) Pull engine compartment wiring harness out of dash panel connector.

(4) On vehicles with air conditioning, remove left side duct extension.



## 2A-14 CLUTCH

- (5) Disconnect clutch push rod at clutch pedal.
- (6) Remove clutch pedal stop.
- (7) Remove overcenter spring. Refer to Clutch Pedal Overcenter Spring Replacement —Cherokee-Truck.
- (8) Remove fuse panel attaching screws and remove fuse panel.
- (9) Remove snap ring from clutch pedal end of pedal shaft using snap ring pliers with 90 degree tips.
- (10) Remove clutch pedal from pedal shaft.

### Installation

- (1) Install clutch pedal on pedal shaft.

- (2) Install retaining snap ring on clutch pedal end of pedal shaft. Be sure ring is fully seated.
- (3) Install fuse panel.
- (4) Install overcenter spring. Refer to Clutch Pedal Overcenter Spring Replacement—Cherokee and Truck.
- (5) Install clutch pedal stop.
- (6) Connect clutch push rod to clutch pedal.
- (7) On vehicles with air conditioning, install left side duct extension.
- (8) Connect engine compartment wiring harness to dash panel connector and install connector attaching screw.
- (9) Install battery negative cable.
- (10) Check and adjust clutch pedal free play if necessary.

## SPECIFICATIONS

### Clutch Specifications

Model	Engine (CID)	Clutch Diameter	Release Lever Height (Above Gauge Hub)	Pedal Free Play
CJ-5/CJ-7	232,258, 304	10-1/2 in. (26.7 cm)	3/32 to 7/64 in. (2.3 to 2.7 mm)	1 to 1-1/4 in. (25.4 to 31.7 mm)
Cherokee, Wagoneer, Truck,	258, 360	11 (27.9 cm)	3/16 (4.7 mm)	3/8 to 5/8 (9.5 to 15.8 mm)

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### Clutch Housing Alignment Specifications

Clutch Housing Bore to Crankshaft Centerline	0.010 max. (0.25 mm)
Clutch Housing Transmission Mounting Face to Crankshaft Centerline	0.010 max. (0.25 mm)
Clutch Housing to Transmission Adapter Bore to Crankshaft Centerline	0.010 max. (0.25 mm)
Clutch Housing to Transmission Adapter Face to Crankshaft Centerline	0.010 max. (0.25 mm)
Flywheel Runout at Face	0.005 max. (0.12 mm)

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## Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	Metric (N·m)		USA (ft·lbs.)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Clutch Bellcrank Bracket to Frame Rail Bolt (Cke., Trk.)	19	16-22	14	12-16
Clutch Bellcrank Pivot	47	41-54	35	30-40
Clutch Cover Bolt	54	47-61	40	35-45
Clutch Housing to Engine Block Bolt				
Six-Cylinder Engines				
Top	47	41-54	35	30-40
Bottom	61	54-68	45	40-50
Eight-Cylinder Engines				
Top	41	34-47	30	25-35
Bottom	41	34-47	30	25-35
Clutch Housing to Engine Dowel Bolt Nut	61	54-68	45	40-50
Clutch Housing Spacer to Block Bolt (Eight-Cylinder Engines)	20	16-23	15	12-17
Clutch Pedal Rebound Bumper, Bolt, Nut, and Lockwasher Assembly to Pedal	54	47-61	40	35-45
Clutch Pedal Shaft Locknut	45	41-49	33	30-36
Starter Motor to Clutch Housing Bolt	24	16-34	18	12-25
Transmission Case to Clutch Housing Bolt	74	68-81	55	50-60

All Torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified. Refer to the Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

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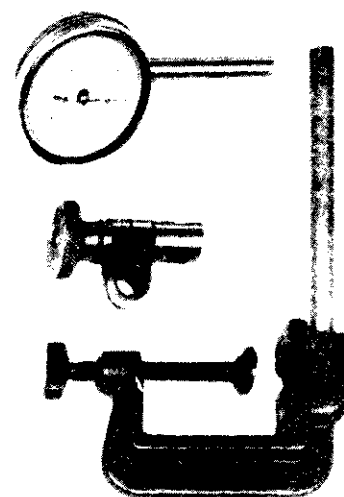
Tools



J-1048  
CLUTCH  
GAUGE  
PLATE



J-22056 OR J-25353  
ALIGNING  
TOOL



J-8001  
DIAL  
INDICATOR  
SET

J-23330  
CLUTCH LEVER  
HEIGHT GAUGE

## NOTES



**AUTHENTIC  
RESTORATION  
PRODUCT**

# MANUAL TRANSMISSION

# 2B

## SECTION INDEX

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Model T-150 3-Speed	2B-4	Tools	2B-29
Model T-15A 3-Speed	2B-12		

## GENERAL INFORMATION

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General	2B-1	Transmission Installation	2B-4
Identification	2B-1	Transmission Lubricants	2B-1
Service Diagnosis	2B-2	Transmission Removal	2B-3

### GENERAL

Three manual transmission models are used in Jeep vehicles; they are Models T-150, T-15A, and T-18A.

Models T-150 and T-15A are 3-speed, constant mesh units providing synchromesh engagement in all forward gear ranges. Model T-18A is a 4-speed, constant mesh unit providing synchromesh engagement in second, third, and fourth gear ranges only. First gear is not synchronized in this transmission.

Model T-150 is used in CJ models with six- or eight-cylinder engines. Model T-15A is used in Cherokee and Truck models with six- or eight-cylinder engines and model T-18A is used in all models with six or eight-cylinder engines.

The three transmission models are all floor shift units. Column shift units are not available in any Jeep model.

The entire shift mechanism on all transmission models is located within the shift control housing which also serves as the transmission top cover. The shift mechanism does not require adjustment and can be serviced independently of the transmission.

### BACKUP LAMP SWITCH

A spring and plunger-type backup lamp switch is used on all models. The switch is located in the shift control housing and is actuated by the first-reverse shift rail on Models T-150 and T-15A and by the reverse shift rail on Model T-18A. The switch does not require adjustment and is serviced as an assembly only.

### TCS SWITCH

A nonadjustable, spring and plunger-type switch is used on models equipped with TCS (transmission controlled spark). The switch is located in the shift control housing and is actuated by the second-third shift rail on Models T-150 and T-15A and by the third-fourth rail on Model T-18A. The switch is activated in direct drive gear range only.

### IDENTIFICATION

An identification tag displaying the Jeep part number is attached to the shift control housing. The information on this tag is necessary to obtain correct replacement parts should replacement become necessary. Be sure the tag is securely attached in the original location after completing all service operations.

### TRANSMISSION LUBRICANT

The recommended lubricant for all transmission models is SAE 90 Gear Lubricant. This lubricant grade should be used during all service and maintenance operations.

**NOTE:** Do not use gear lubricants containing lead, chlorine, or sulphur compounds.

When refilling or adding lubricant to the transmission, fill the transmission until the lubricant level is at the lower edge of the fill plug hole only. Lubricant capacities for the three transmission models are:

- T-150—2-3/4 Pints (1.30 liters).
- T-15A—2-3/4 Pints (1.30 liters).
- T-18A—6-1/2 Pints (3.07 liters).

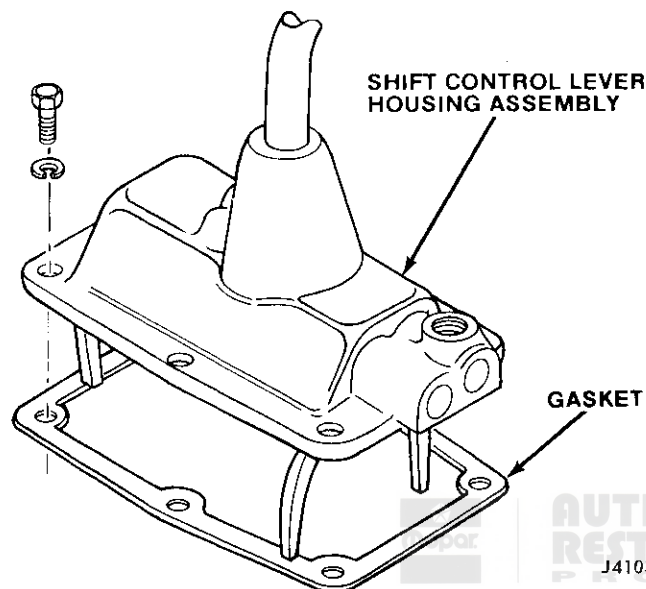
## 2B-2 MANUAL TRANSMISSION

### Service Diagnosis

Condition	Possible Cause	Correction
LOCKS IN TWO GEARS	(1) Worn shift mechanism components.	(1) Replace shift control housing components.
HARD SHIFTING	(1) Improper clutch adjustment. (2) Synchronizer wear or damage. (3) Incorrect lubricant.	(1) Adjust clutch pedal free play. (2) Replace synchronizer(s). (3) Replace lubricant.
JUMPS OUT OF GEAR	(1) Synchronizer wear or damage. (2) Incorrect lubricant. (3) Gear teeth worn or tapered. (4) Insufficient shift mechanism inter-lock spring tension. (5) Misaligned or loose clutch housing or clutch housing to transmission adapter. (6) Excessive transmission end play. (7) Worn or loose engine mounts. (8) Damaged clutch shaft roller bearings. (9) Damaged or worn crankshaft pilot bushing.	(1) Replace synchronizer(s). (2) Replace lubricant. (3) Replace gears as necessary. (4) Replace shift components. (5) Align and/or tighten. (6) Replace snap rings and thrust washer. (7) Tighten or replace mounts. (8) Replace bearings. (9) Replace bushing.
NOISE IN LOW GEAR	(1) Gear teeth worn or broken. (2) Shift fork bent. (3) Lack of lubrication.	(1) Replace gears. (2) Replace fork. (3) Add lubricant as required.
LUBRICANT LEAKS INTO CLUTCH HOUSING	(1) Gasket leaking at front bearing cap or cap oil seal leaking. Oil slinger broken or missing.	(1) Inspect oil seal, gasket, and oil slinger. Replace as required.
LUBRICANT LEAKS INTO TRANSFER CASE CAUSING UNDERFILL IN TRANSMISSION AND OVERFILL IN TRANSFER CASE	(1) Mainshaft drive gear seal leaking.	(1) Replace seal.

**TRANSMISSION REMOVAL**

- (1) Remove shift lever knob, trim ring, and boot.
- (2) Remove floor covering and transmission access cover from floorpan.
- (3) On Cherokee and Truck models with T15A transmission, remove shift control lever housing assembly (fig. 2B-1).



**Fig. 2B-1 Shift Control Lever Housing Assembly—3-Speed Transmission**

- (4) On all models with T-18A transmission or CJ models with T-150 transmission, unthread shift lever cap and remove cap, cap gasket, spring seat, spring and shift lever as assembly and remove shift lever locating pins (fig. 2B-2).

- (5) On models with T18A transmission, remove transfer case shift lever.

- (6) Raise vehicle.

- (7) Mark front and rear propeller shafts and axle yokes for assembly alignment reference before removal.

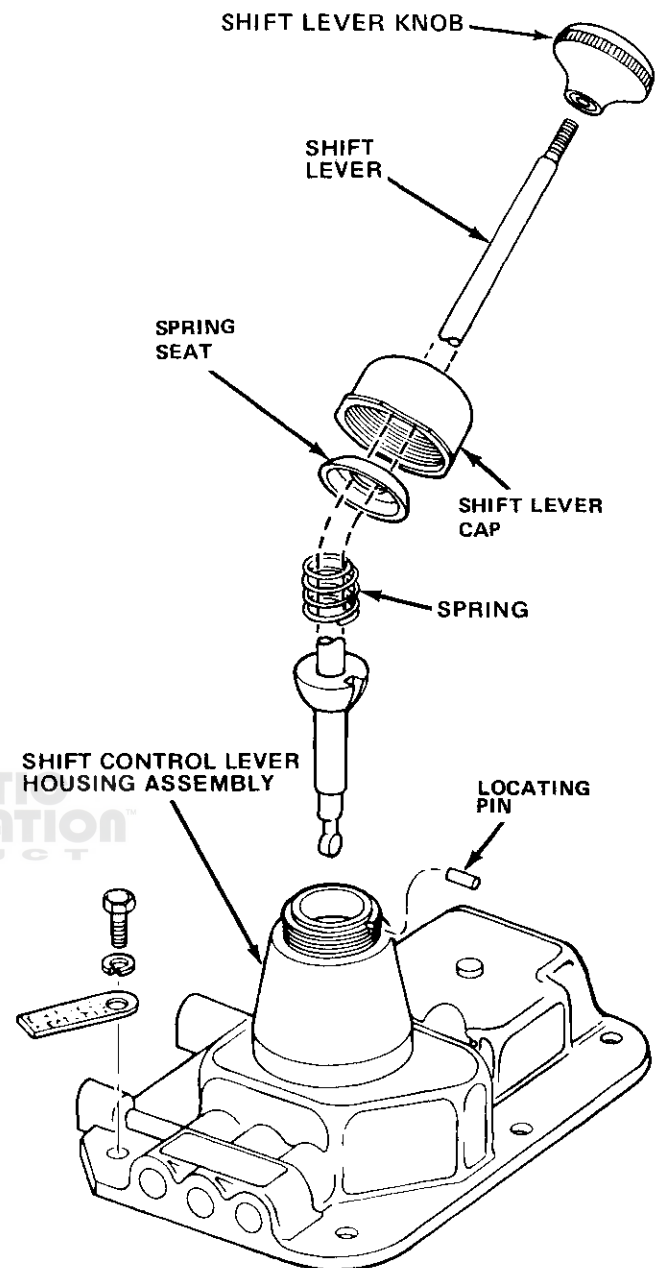
- (8) Disconnect front propeller shaft at transfer case and axle and remove shaft.

- (9) Disconnect rear propeller shaft at transfer case.

- (10) Disconnect speedometer cable, backup lamp switch wires, TCS switch wires, if equipped, and parking brake cable if cable is attached to crossmember.

- (11) On models with eight-cylinder engine, remove nuts securing exhaust pipes to manifolds and lower catalytic converter, if equipped, and exhaust pipes.

- (12) Place support stand under clutch housing to support engine.



**Fig. 2B-2 Shift Control Lever Housing Assembly—4-Speed Transmission**

- (13) Disconnect rear crossmember at frame side sills.

- (14) Remove bolts attaching transmission to clutch housing or transmission adapter.

- (15) Lower transmission slightly, and move transmission, transfer case, and crossmember rearward until transmission clutch shaft clears clutch housing or transmission adapter.

- (16) Remove transmission-transfer case assembly from vehicle.

- (17) Remove lubricating wick from pilot bushing and soak wick in engine oil.

**TRANSMISSION INSTALLATION**

(1) Install lubricating wick in pilot bushing.

(2) If removed, install wave washer on throwout lever, position throwout bearing in lever, and center bearing over clutch cover release levers.

**CAUTION:** *Protect the transmission clutch shaft splines and maintain throwout bearing alignment when installing the transmission.*

(3) Slide transmission-transfer case assembly into position. Maneuver assembly as necessary to align clutch shaft and driven plate splines.

(4) Install bolts attaching transmission to clutch housing or transmission adapter.

(5) Attach rear crossmember to frame side sills.

(6) On eight-cylinder models, connect exhaust pipes to manifolds.

(7) Connect speedometer cable, backup lamp switch wires, and TCS switch, if equipped.

(8) Install front propeller shaft. Be sure to align index marks made during removal.

(9) Connect rear propeller shaft to transfer case. Be sure to align index marks made during removal.

(10) Lower vehicle.

(11) On models with T-18A transmission, install transfer case shift lever.

(12) On models with T-18A or CJ models with T-150 transmission, install shift lever locating pins in housing and install shift lever, spring, spring seat, gasket, if equipped, and shift lever cap in housing. Tighten lever cap securely.

(13) On Cherokee and Truck models with T-15A transmission, place transmission gears in Neutral and install shift control housing. Be sure shift forks are fully seated in synchronizer sleeves.

(14) On Cherokee and Truck models with T-15A transmission, align shift control housing, housing gasket and transmission case bolt holes and install housing attaching bolts and lockwashers. Tighten bolts to 12 foot-pounds (16 N•m) torque.

(15) Install transmission access cover and floor covering on floorpan.

(16) Install boot, trim rings and shift knob on shift lever.

(17) Check transmission for proper shifting.

(18) Check and correct lubricant level if necessary.

## MODEL T-150 3-SPEED TRANSMISSION

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Shift Control Housing	2B-11
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**DISASSEMBLY**

(1) Remove bolts attaching transfer case to transmission.

(2) Separate transfer case and transmission.

(3) Remove shift control housing.

(4) Move second-third synchronizer sleeve forward and first-reverse sleeve rearward to lock mainshaft.

(5) Remove transfer case drive gear locknut, flat washer, and drive gear (fig. 2B-3).

(6) Move both synchronizer sleeves back to Neutral position.

(7) Remove fill plug.

(8) Remove countershaft roll pin using 3/16 (4.7 mm) diameter pin punch. Roll pin is accessible through fill plug hole (fig. 2B-4).

(9) Remove countershaft and access plug using Arbor Tool J-25232 (fig. 2B-5). Remove countershaft from rear of case. Allow countershaft gear to remain at bottom of case after countershaft removal.

(10) Punch alignment marks in front bearing cap and transmission case for assembly reference.

(11) Remove front bearing cap and gasket.

(12) Remove large lockring from front bearing.

(13) Remove clutch shaft and front bearing as assembly using tool J-6654-01 (fig. 2B-6).

(14) Remove second-third synchronizer blocking ring from clutch shaft or synchronizer hub.

(15) Remove rear bearing and adapter using brass drift and hammer (fig. 2B-7).

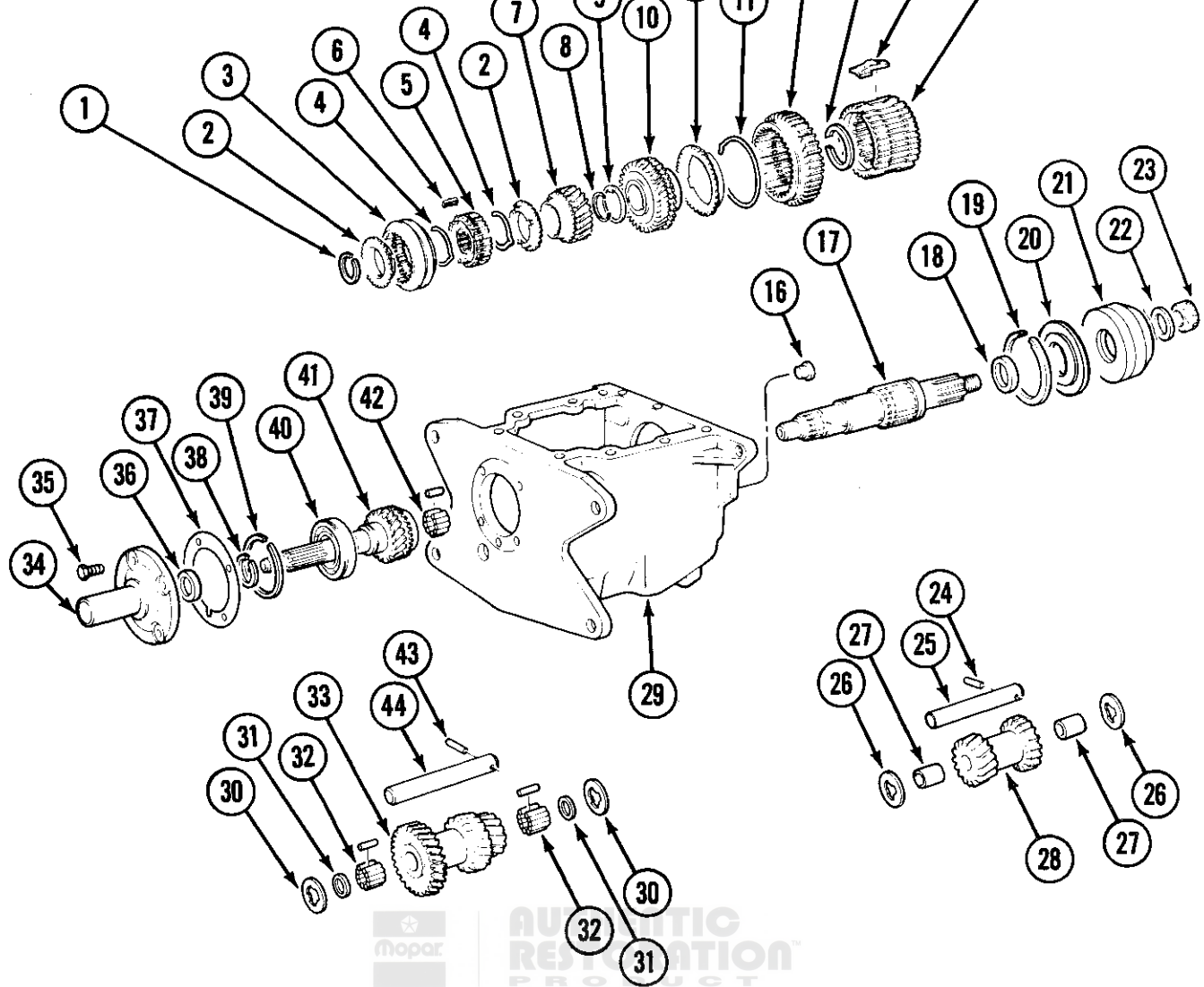
(16) Remove main shaft and geartrain assembly. Tilt spline end of shaft downward and lift forward end of shaft upward and out of case.

(17) Remove countershaft gear and arbor tool as assembly.

(18) Remove countershaft gear thrust washers, countershaft roll pin, and any main shaft pilot roller bearings which may have fallen into case during clutch shaft removal.

(19) Remove reverse idler gear shaft. Insert brass drift through clutch shaft bore in front of case and tap shaft until end of shaft with roll pin clears counterbore in rear of case (fig. 2B-8) and remove shaft.

(20) Remove reverse idler gear and thrust washers.



- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>1. MAINSHAFT RETAINING SNAP RING</li> <li>2. SYNCHRONIZER BLOCKING RINGS (3)</li> <li>3. SECOND-THIRD SYNCHRONIZER SLEEVE</li> <li>4. SECOND-THIRD SYNCHRONIZER INSERT SPRING (2)</li> <li>5. SECOND-THIRD HUB</li> <li>6. SECOND-THIRD SYNCHRONIZER INSERT (3)</li> <li>7. SECOND GEAR</li> <li>8. FIRST GEAR RETAINING SNAP RING</li> <li>9. FIRST GEAR TABBED THRUST WASHER</li> <li>10. FIRST GEAR</li> <li>11. FIRST-REVERSE SYNCHRONIZER INSERT SPRING</li> <li>12. FIRST-REVERSE SLEEVE AND GEAR</li> <li>13. FIRST-REVERSE HUB RETAINING SNAP RING</li> <li>14. FIRST-REVERSE SYNCHRONIZER INSERT (3)</li> <li>15. FIRST-REVERSE HUB</li> <li>16. COUNTERSHAFT ACCESS PLUG</li> <li>17. MAINSHAFT</li> <li>18. MAINSHAFT SPACER</li> <li>19. REAR BEARING ADAPTER LOCK RING</li> <li>20. OIL SLINGER/SPACER</li> <li>21. REAR BEARING AND ADAPTER ASSEMBLY</li> <li>22. WASHER</li> </ul> | <ul style="list-style-type: none"> <li>23. LOCKNUT</li> <li>24. ROLL PIN</li> <li>25. REVERSE IDLER GEAR SHAFT</li> <li>26. THRUST WASHER</li> <li>27. BUSHING (PART OF IDLER GEAR)</li> <li>28. REVERSE IDLER GEAR</li> <li>29. TRANSMISSION CASE</li> <li>30. THRUST WASHER (2)</li> <li>31. BEARING RETAINER (2)</li> <li>32. COUNTERSHAFT NEEDLE BEARINGS (50)</li> <li>33. COUNTERSHAFT GEAR</li> <li>34. FRONT BEARING CAP</li> <li>35. BOLT (4)</li> <li>36. FRONT BEARING CAP OIL SEAL</li> <li>37. GASKET</li> <li>38. FRONT BEARING RETAINER SNAP RING</li> <li>39. FRONT BEARING LOCKRING</li> <li>40. FRONT BEARING</li> <li>41. CLUTCH SHAFT</li> <li>42. MAINSHAFT PILOT ROLLER BEARINGS</li> <li>43. ROLL PIN</li> <li>44. COUNTERSHAFT</li> </ul> |
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Fig. 2B-3 Model T150—Exploded View



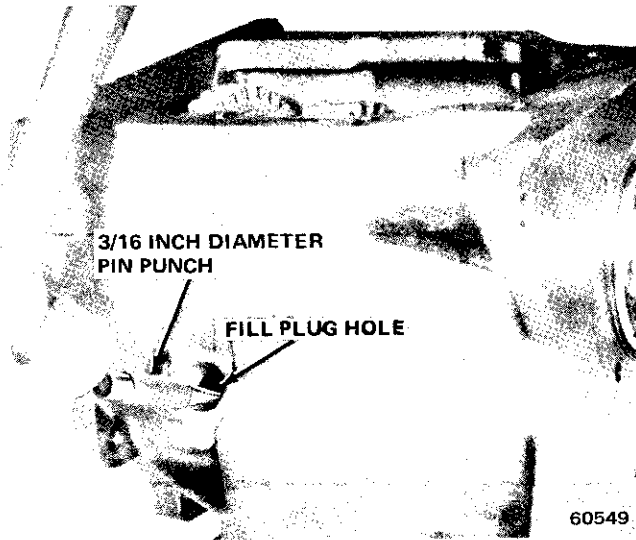


Fig. 2B-4 Countershaft Roll Pin Removal-Installation

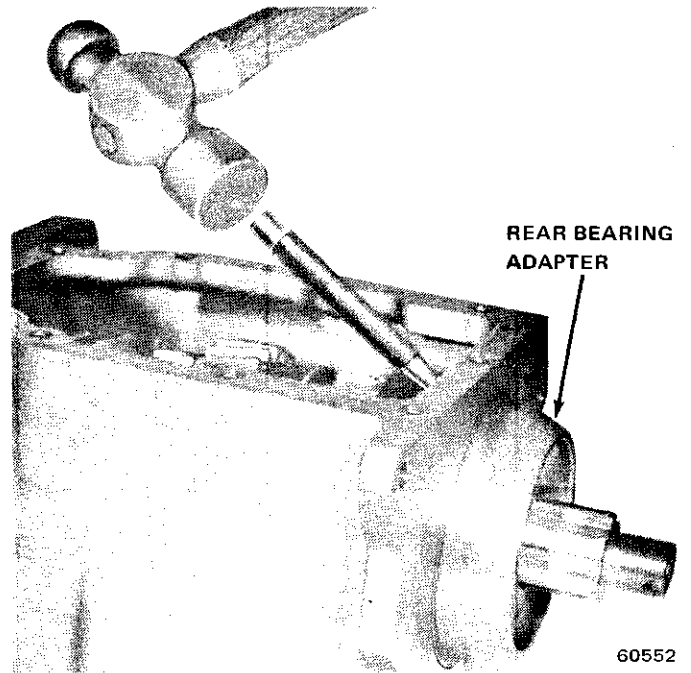


Fig. 2B-7 Rear Bearing and Adapter Removal

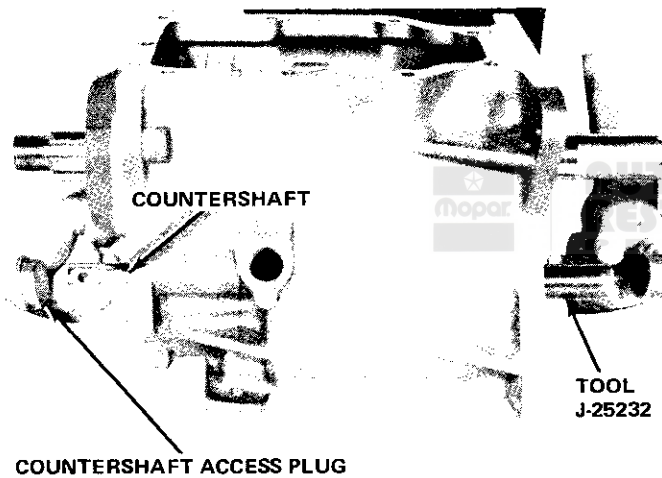


Fig. 2B-5 Countershaft Removal-Installation

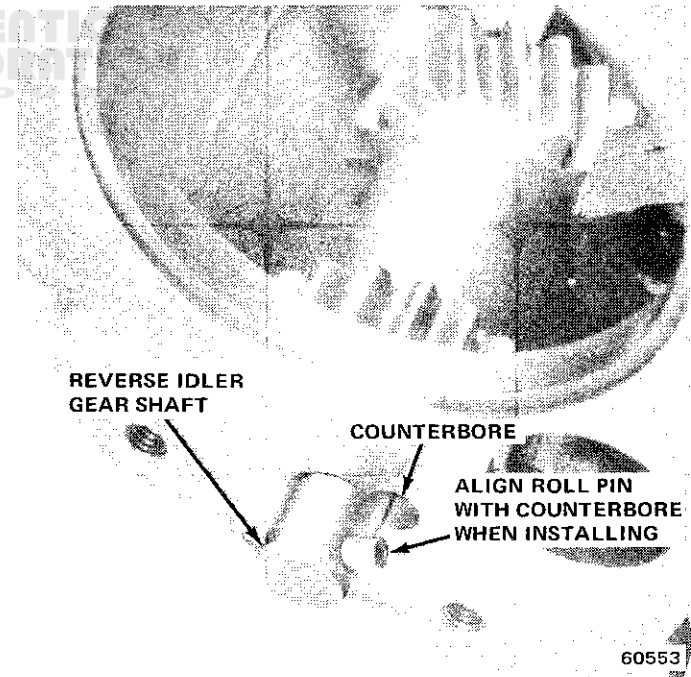


Fig. 2B-8 Reverse Idler Gear Shaft Removal-Installation

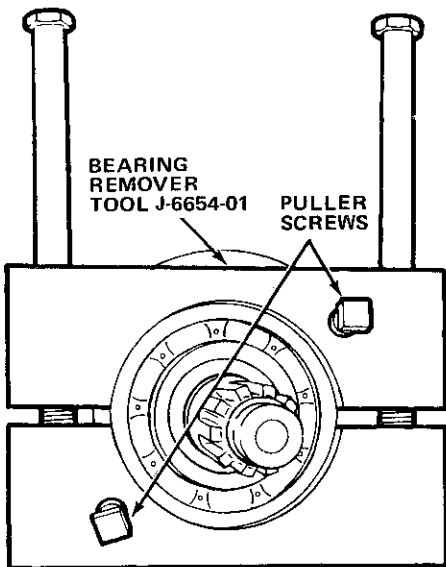


Fig. 2B-6 Clutch Shaft Removal

**Main Shaft Gear Train—Disassembly**

(1) Remove retaining snap ring from front of main shaft and remove second-third synchronizer assembly and second gear. Mark hub and sleeve for assembly reference.

**NOTE:** Observe the position of the insert springs and inserts for assembly reference.

(2) Remove insert springs from second-third synchronizer, remove three inserts, and separate sleeve from synchronizer hub (fig. 2B-3).

(3) Remove snap ring and tabbed thrust washer from shaft and remove first gear and blocking ring.

(4) Remove first-reverse hub retaining snap ring.

**NOTE:** *Observe the position of the inserts and spring for assembly reference.*

(5) Remove sleeve and gear, insert spring, and three inserts from hub (fig. 2B-3).

(6) Remove oil slinger and spacer from rear of main shaft.

(7) Remove hub from output shaft using arbor press.

**CAUTION:** *Do not attempt to hammer the press-fit hub from the shaft. Hammer blows will damage the hub and shaft.*

### Clutch Shaft Disassembly

(1) Remove front bearing retaining snap ring and any remaining roller bearings.

(2) Press front bearing from shaft using arbor press and tool J-6654-01.

**CAUTION:** *Do not attempt to drive the bearing from the shaft using a hammer. Hammer blows will damage the bearing and shaft.*

### Rear Bearing and Adapter Disassembly

(1) Clamp rear bearing adapter in vise but do not overtighten vise.

(2) Remove rear bearing retaining snap ring using pointed-type tool.

(3) Remove bearing adapter from vise.

(4) Press bearing out of adapter using arbor press.

(5) Remove bearing adapter lockring.

## CLEANING AND INSPECTION

### Cleaning

Thoroughly wash all parts in solvent and dry using compressed air. However, do not dry the bearings with compressed air. Air dry the bearings or wipe them dry using a clean shop cloth only.

Clean the needle and clutch shaft roller bearing by wrapping the bearings in a clean cloth and submerging them in solvent. Or, place the bearings in a shallow parts cleaning tray and cover them with solvent. Allow the bearings to air dry on a clean cloth.

### Inspection

Inspect the transmission components. Replace any components that exhibit the following conditions:

### Case

- Cracks in bores, sides, bosses, or at bolt holes.
- Stripped threads in bolt holes.
- Nicks, burrs, rough surfaces in shaft bores or on gasket surfaces.

### Gear and Synchronizer Assemblies

- Broken, chipped, or worn gear teeth.
- Damaged splines on synchronizer hubs or sleeves.
- Broken or worn teeth or excessive wear of blocking rings
- Bent or broken inserts.
- Damaged needle bearings or bearing bores in countershaft gear.
- Wear or galling of countershaft, clutch shaft, or idler gear shafts.
- Worn thrust washers.
- Nicked, broken, or worn main shaft or clutch shaft splines.
- Bent, distorted, broken, or weak snap rings.
- Worn bushings in reverse idler gear. Replace gear if bushings are worn. Bushings are supplied as part of gear only.
- Rough, galled, worn, or broken front or rear bearing.

### ASSEMBLY

(1) Lubricate reverse idler gear shaft bore and bushings with transmission lubricant.

(2) Coat transmission case reverse idler gear thrust washer surfaces with petroleum jelly and install thrust washers in case.

**NOTE:** *Be sure to engage the locating tabs on the thrust washers in the locating slots in the case.*

(3) Install reverse idler gear. Align gear bore, thrust washers, case bores, and install reverse idler gear shaft from rear of case. Be sure to align and seat roll pin in shaft into counterbore in rear of case (fig. 2B-8).

(4) Measure reverse idler gear end play by inserting feeler gauge between thrust washer and gear. End play should be 0.004 to 0.018 inch (0.10 to 0.45 mm). If end play exceeds 0.018 inch (0.45 mm), remove idler gear and replace thrust washers.

(5) Coat needle bearings and bearing bores in countershaft gear with petroleum jelly. Insert Arbor Tool J-25232 in bore of gear and install 25 needle bearings and one retainer in each end of gear (fig. 2B-3).

(6) Coat countershaft gear thrust washer surfaces with petroleum jelly and position thrust washers in case.

**NOTE:** *Be sure to engage the locating tabs on the thrust washers in the locating slots in the case.*

(7) Insert countershaft into rear case bore just far enough to hold rear thrust washer in position. This will prevent thrust washer from being displaced when countershaft gear is installed.

(8) Install countershaft gear but do not install roll pin at this time. Align gear bore, thrust washers, bores in case, and install countershaft.

**NOTE:** Do not remove Countershaft Arbor Tool J-25232 completely.

(9) Measure countershaft gear end play by inserting feeler gauge between washer and countershaft gear. End play should be 0.004 to 0.018 inch (0.10 to 0.45 mm). If end play exceeds 0.018 inch (0.45 mm), remove gear and replace thrust washers. After correct end play has been obtained, install arbor tool fully in countershaft gear. Allow gear to remain at bottom of case. Leave countershaft in rear case bore to hold rear thrust washer in place.

**NOTE:** The countershaft gear must remain at the bottom of the case to provide sufficient clearance for installation of the main shaft and clutch shaft assemblies.

(10) Coat all mainshaft splines and machined surfaces with transmission lubricant and start first-reverse synchronizer hub on output shaft splines by hand. End of hub with slots should face front of shaft. Use arbor press to complete hub installation on shaft and install retaining snap ring in most rearward groove (fig. 2B-9).

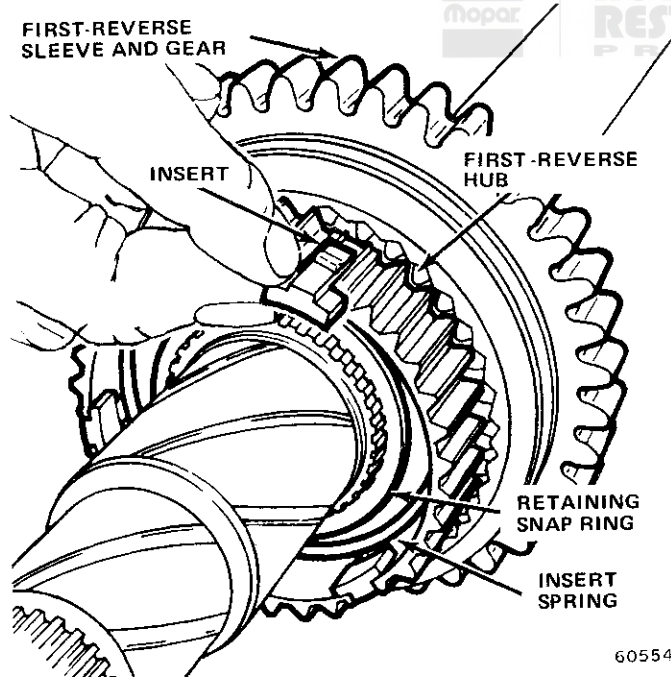
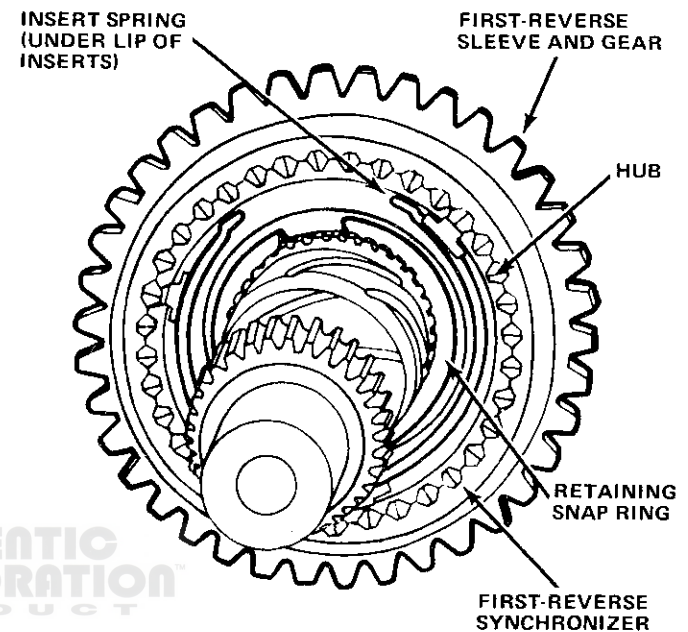


Fig. 2B-9 First-Reverse Hub Insert Installation

**CAUTION:** Do not attempt to drive the hub onto the shaft with a hammer. Hammer blows will damage the hub and splines.

(11) Coat first-reverse hub splines with transmission lubricant and install first-reverse sleeve and gear half-way onto hub. Gear end of sleeve must face rear of shaft. Align sleeve and hub using alignment marks made during disassembly.

(12) Install insert spring in first-reverse hub. Make sure spring is bottomed in hub and covers all three insert slots. Position three T-shaped inserts in hub with small ends in hub slots and large ends inside hub (fig. 2B-9). Push inserts fully into hub so they seat on insert spring, then slide first-reverse sleeve and gear over inserts until inserts engage in sleeve (fig. 2B-10).



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Fig. 2B-10 Snap Ring and Insert Spring Position in First-Reverse Hub

(13) Coat bore and blocking ring surface of first gear with transmission lubricant and place first gear blocking ring on tapered surface of gear.

(14) Install first gear on main shaft. Rotate gear until notches in blocking ring engage inserts in first-reverse hub, then install tabbed thrust washer (sharp edge facing out) and retaining snap ring on main shaft (fig. 2B-11).

(15) Coat bore and blocking ring surface of second gear with transmission lubricant and place second gear blocking ring on tapered surface of gear.

(16) Install second gear on main shaft with tapered surface of gear facing front of main shaft (fig. 2B-12).

(17) Install one insert spring into second-third hub. Be sure spring covers all three insert slots in hub. Align second-third sleeve to hub using marks made during disassembly, and start sleeve onto hub.

(18) Place three inserts into hub slots and on top of insert spring, then push sleeve fully onto hub to engage inserts in sleeve (fig. 2B-13). Install remaining insert spring in exact same position as first spring. Ends of both springs must cover same slots in hub and not be staggered.

**NOTE:** The inserts have a small lip on each end. When correctly installed, this lip will fit over the insert spring (fig. 2B-13).

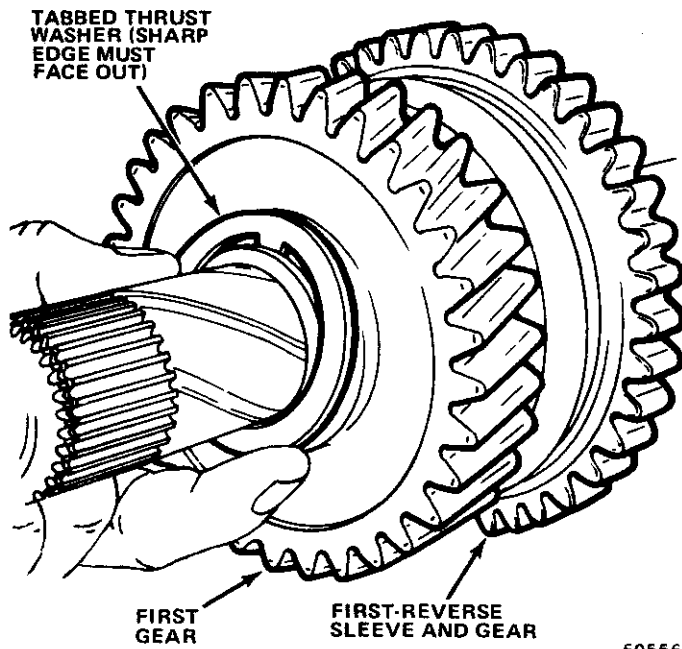


Fig. 2B-11 First Gear Thrust Washer Installation

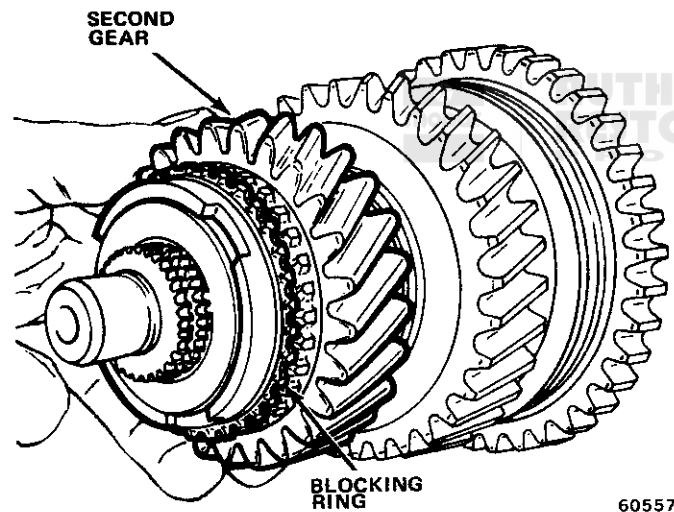


Fig. 2B-12 Second Gear Installation

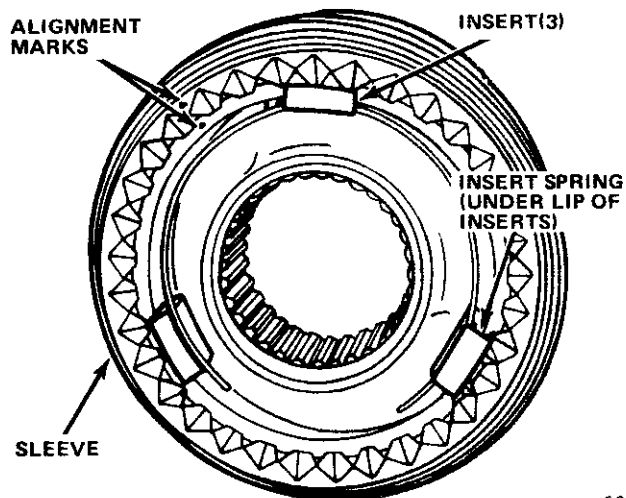


Fig. 2B-13 Second-Third Synchronizer Assembly

(19) Install second-third synchronizer assembly on main shaft. Rotate second gear until notches in blocking ring engage inserts in second-third synchronizer assembly.

(20) Install retaining snap ring on main shaft and measure end play between snap ring and second-third synchronizer hub with feeler gauge (fig. 2B-14). End play should be 0.004 to 0.014 inch (0.10 to 0.35 mm). If end play exceeds 0.014 inch (0.35 mm), replace thrust washer and all snap rings on output shaft assembly.

(21) Install spacer and oil slinger on rear of main shaft.

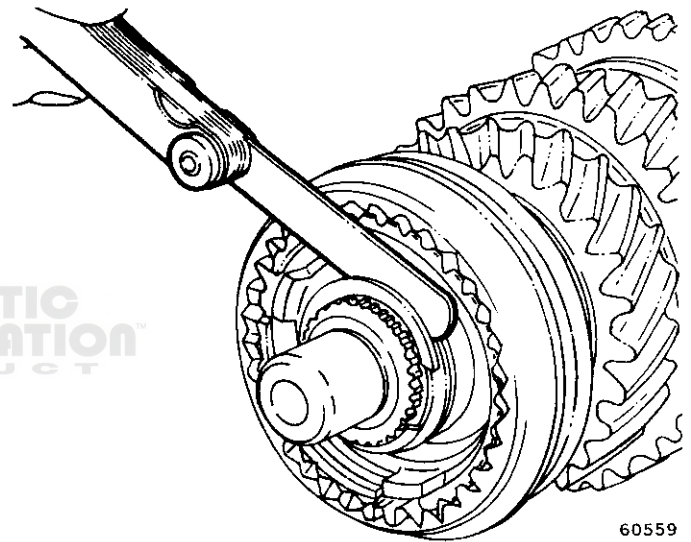


Fig. 2B-14 Measuring Main Shaft End Play

(22) Install main shaft assembly in case. Be sure first-reverse sleeve and gear is in Neutral (centered) position on hub so gear end of sleeve will clear top of case when output shaft assembly is installed.

(23) Press rear bearing into rear bearing adapter using arbor press.

(24) Install rear bearing retaining ring and bearing adapter locking in adapter.

(25) Support main shaft assembly and install rear bearing and adapter assembly in case. Use plastic hammer to seat adapter in case.

(26) Press front bearing onto clutch shaft. Install bearing retaining snap ring on clutch shaft and locking in front bearing groove.

**NOTE:** When correctly installed, the snap ring groove in the front bearing will be nearest to the front of the clutch shaft.

## 2B-10 MANUAL TRANSMISSION

(27) Coat bearing bore of clutch shaft with petroleum jelly and install 15 roller bearings in clutch shaft bore.

**CAUTION:** Do not use chassis grease or a similar "heavy" grease in the clutch shaft bore. Use petroleum jelly only. Heavy grease will plug the lubrication holes in the shaft and prevent proper lubrication of the roller bearings.

(28) Coat blocking ring surface of clutch shaft with transmission lubricant and position blocking ring on shaft.

(29) Support main shaft assembly and insert clutch shaft through front bearing bore in case. Seat main shaft pilot in clutch shaft roller bearings and tap bearing into position in case using rawhide mallet.

(30) Apply thin film of sealer to front bearing cap gasket and position gasket on case. Be sure gasket notch is aligned with oil return hole in case.

(31) Remove front bearing cap oil seal using screwdriver and install replacement oil seal using tool J-25233 (fig. 2B-15).

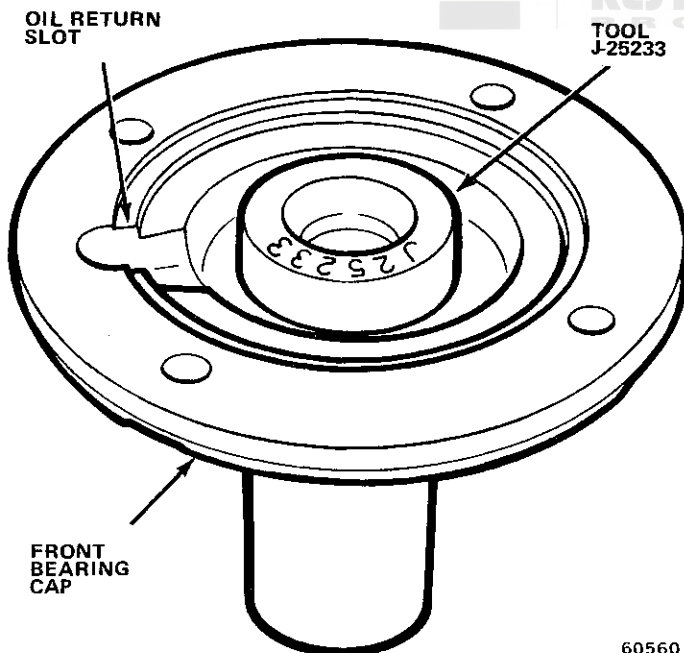


Fig. 2B-15 Front Bearing Cap Oil Seal Installation

(32) Install front bearing cap and tighten attaching bolts to 33 foot-pounds (45 N•m) torque.

**NOTE:** Before installing the front bearing cap, be sure to align the cap and case index marks. Also be sure the cap oil return slot and case oil return hole are aligned.

(33) Make wire loop about 18 to 20 inches (45.7 to 50.8 cm) long and pass wire under countershaft gear assembly. Wire loop will raise and support gear assembly when loop is pulled upward.

(34) Raise countershaft gear with wire loop (fig. 2B-16), align bore in countershaft gear with front thrust washer and countershaft, and start countershaft into gear using plastic hammer (fig. 2B-16).

(35) Align roll pin hole in countershaft and roll pin holes in case (fig. 2B-16) and complete installation of countershaft.

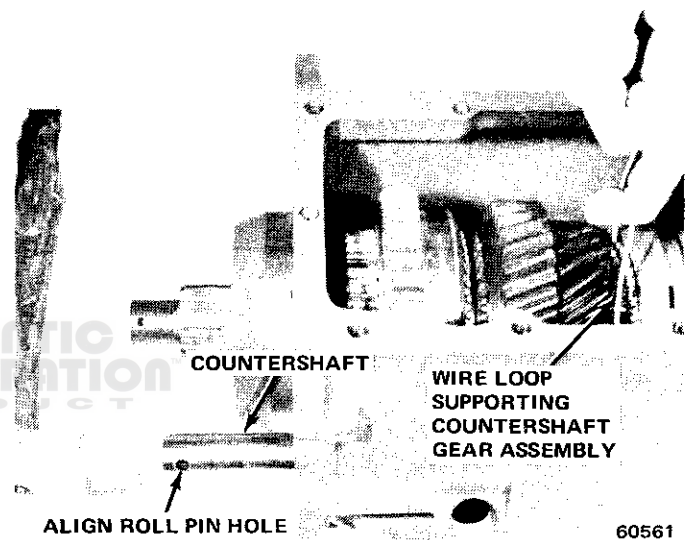


Fig. 2B-16 Countershaft Installation

(36) Install countershaft access plug in rear of case and seat plug with plastic hammer.

(37) Install countershaft roll pin in case. Use magnet or needlenose pliers to insert and start pin in case. Use 1/2 inch (12.7 mm) diameter punch to seat pin and install fill plug.

(38) Shift synchronizer sleeves into all gear positions and check operation. If clutch shaft and main shaft appear to bind in Neutral position, check for blocking rings sticking on first or second speed gear tapers.

(39) Shift both synchronizers into gear to prevent gears from turning.

(40) Install transfer case drive gear and gear retaining nut on mainshaft. Tighten nut to 150 foot-pounds (203 N•m) torque.

(41) Shift synchronizers to neutral position.

(42) Attach transmission to transfer case. Tighten attaching bolts to 30 foot-pounds (41 N•m) torque.

## SHIFT CONTROL HOUSING

### Disassembly

(1) Remove backup lamp switch and TCS switch if equipped.

(2) Unthread shift lever cap and remove cap, gasket, spring seat and shift lever as assembly (fig. 2B-17).

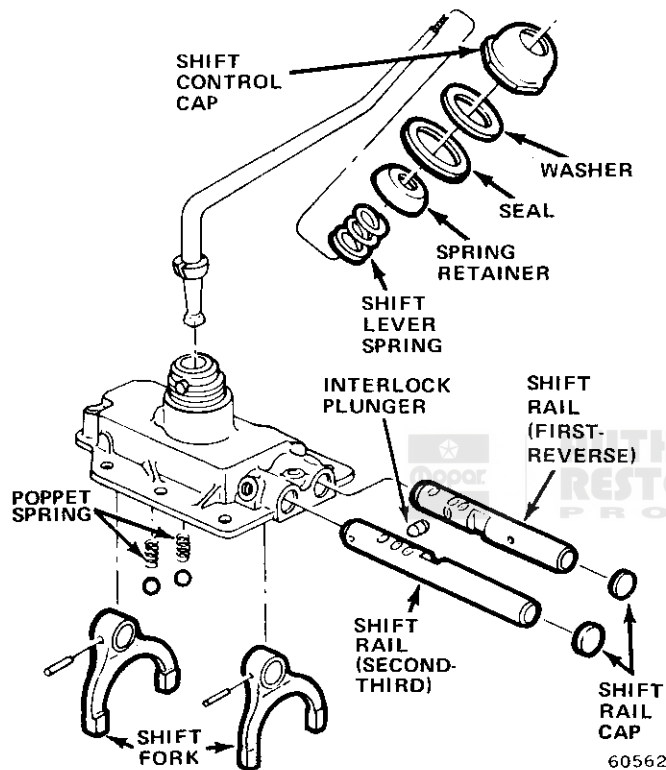


Fig. 2B-17 Shift Control Housing—Transmission Model T-150

(3) Turn housing over and mount in vise. Clamp housing at shift lever tower but do not overtighten.

(4) Move second-third shift rail to rear of housing and rotate shift fork toward first-reverse rail until roll pin is accessible. Tap roll pin out of fork and rail using pin punch and remove shift fork and roll pin.

**NOTE:** The roll pin hole in the first-reverse shift fork is offset. Mark or note shift fork position for assembly reference before removing the fork.

(5) Mark location of both shift rails for assembly reference.

(6) Remove second-third shift rail using brass drift and hammer. Catch shift rail plug as rail forces plug from housing. Do not lose poppet ball during removal.

Cover housing poppet ball holes with cloth or tape before removing rail.

(7) Rotate first-reverse shift fork away from housing notch until roll pin is accessible. Drive roll pin out of fork and rail using pin punch. Remove shift fork and roll pin.

**NOTE:** The shift fork roll pin hole is offset. Mark the position of the shift fork for assembly reference.

(8) Remove first-reverse shift rail using brass drift or hammer. Catch shift rail plug as rail forces plug from housing. Do not lose poppet ball during removal. Cover housing shift tower and poppet ball holes with cloth or tape before removing rail.

(9) Remove poppet balls, springs, and interlock plunger from housing.

### Assembly

(1) Install poppet springs and detent plug in housing.

(2) Insert first-reverse shift rail into housing, and install shift fork on rail.

(3) Install poppet ball on top of spring in first-reverse shift rail bore.

(4) Press poppet ball and spring downward into housing bore using punch or wooden dowel and install first-reverse shift rail.

(5) Align roll pin holes in first-reverse shift rail and fork and install roll pin. Move shift rail to Neutral (center) detent.

(6) Insert second-third shift rail into housing and install poppet ball on top of spring in second-third shift rail bore.

(7) Press poppet ball and spring downward into housing bore and install second-third shift rail.

(8) Align roll pin holes in second-third shift rail and shift fork and install roll pin. Move shift rail to Neutral (center) detent.

(9) Install shift rail plugs in housing, and remove housing from vise.

(10) Install shift lever, spring, spring seat, gasket and shift lever cap as assembly and tighten cap securely.

(11) Install backup lamp switch and TCS switch if equipped.

## SPECIFICATIONS

### Transmission Specifications

Model . . . . .	T150
Type . . . . .	Synchromesh
Speeds . . . . .	3 Forward, 1 Reverse
Gear Ratios:	
First . . . . .	2.99:1
Second . . . . .	1.75:1
Third . . . . .	1.00:1
Reverse . . . . .	3.17:1
End Play Tolerances:	
Countershaft Gear to Case . . . . .	.0004 to 0.018 inch (0.10 to 0.45 mm)
Reverse Idler Gear To Case . . . . .	.0004 to 0.018 inch (0.10 to 0.45 mm)
Mainshaft Gear Train . . . . .	.0004 to 0.018 inch (0.10 to 0.45 mm)
Lubricant Capacity . . . . .	2-3/4 Pints (1.30 liters)
Lubricant Type . . . . .	SAE 90 Gear Lubricant

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### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Backup Lamp Switch . . . . .	18	15-20	24	20-27
Drain Plug . . . . .	15	10-20	20	14-27
Fill Plug . . . . .	15	10-20	20	14-27
Front Bearing Cap Bolt . . . . .	33	30-36	45	41-49
Shift Control Housing-to-Case Bolt . . . . .	22	20-25	30	27-34
Transfer Case Drive Gear Locknut . . . . .	150	145-155	203	197-210
Transfer Case-to-Transmission Case Bolts . . . . .	30	25-35	41	34-47
TCS Switch . . . . .	18	15-20	24	20-27

All torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Marking chart in Chapter A for torque values not listed above.

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# MODEL T-15A 3-SPEED TRANSMISSION

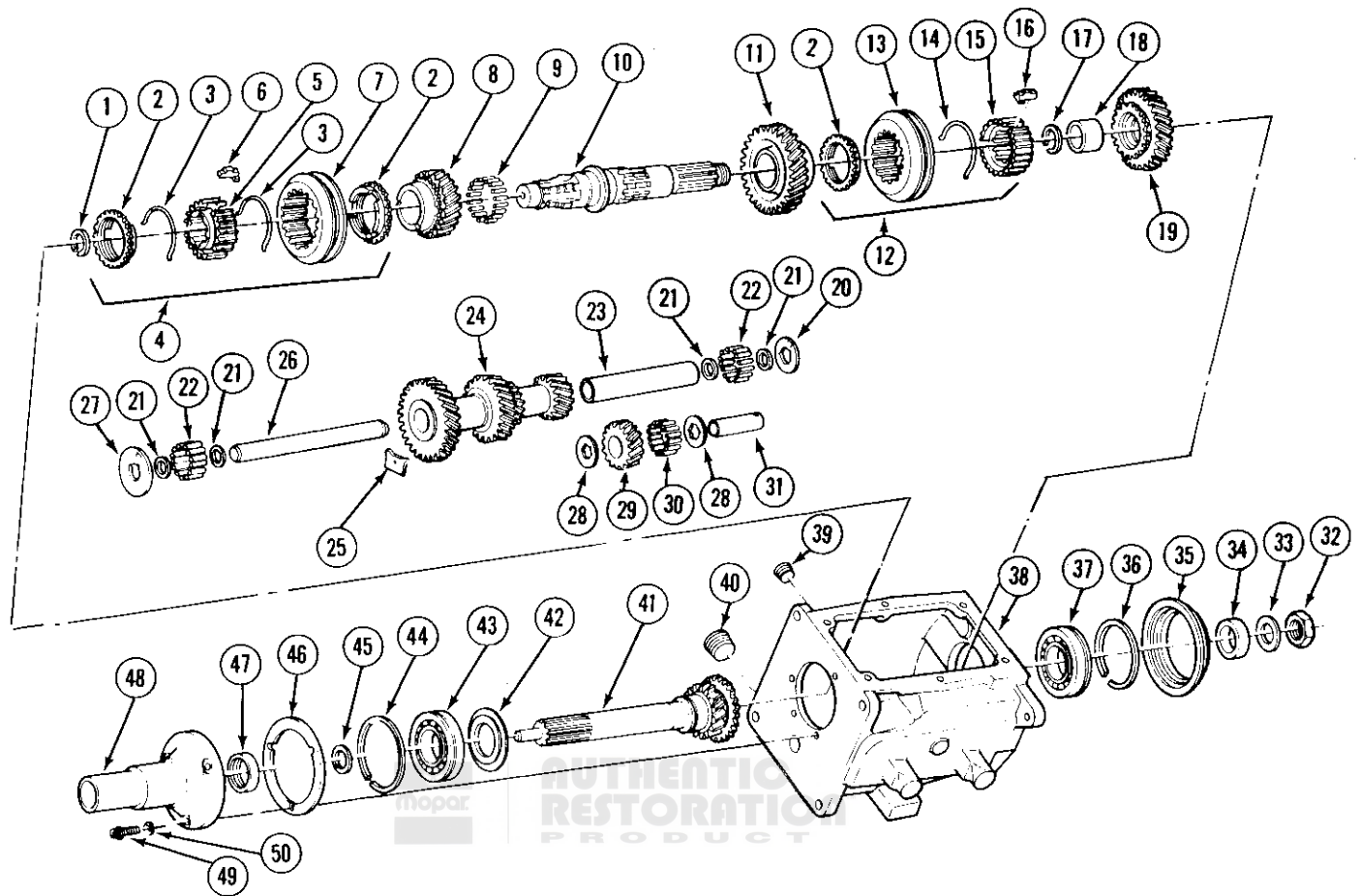
	Page		Page
Assembly	2B-16	Shift Control Housing	2B-18
Cleaning and Inspection	2B-15	Specifications	2B-19
Disassembly	2B-12		

## DISASSEMBLY

- (1) Remove bolts attaching transfer case to transmission and remove transfer case from transmission.
- (2) Remove and discard transfer case-to-transmission gasket.
- (3) Remove nut and washer attaching transfer case drive gear to main shaft (fig. 2B-18).

**NOTE:** Move second-third synchronizer sleeve forward and first-reverse sleeve rearward before attempting to remove nut.

- (4) Remove drive gear, adapter and spacer.
- (5) Punch alignment marks in front bearing cap and transmission case for assembly reference.
- (6) Remove front bearing cap and gasket.



- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. SECOND-THIRD SYNCHRONIZER SNAP RING</li> <li>2. BLOCKING RINGS (3)</li> <li>3. SYNCHRONIZER SPRINGS (2)</li> <li>4. SECOND-THIRD SYNCHRONIZER ASSEMBLY</li> <li>5. SECOND-THIRD CLUTCH HUB</li> <li>6. SECOND-THIRD SHIFTING PLATE (3)</li> <li>7. SECOND-THIRD CLUTCH SLEEVE</li> <li>8. SECOND GEAR</li> <li>9. MAINSHAFT PILOT BEARING ROLLERS (21)</li> <li>10. MAINSHAFT</li> <li>11. FIRST GEAR</li> <li>12. FIRST GEAR SYNCHRONIZER ASSEMBLY</li> <li>13. FIRST-REVERSE CLUTCH SLEEVE</li> <li>14. SYNCHRONIZER SPRING (1)</li> <li>15. FIRST GEAR CLUTCH HUB</li> <li>16. FIRST GEAR SHIFTING PLATE (3)</li> <li>17. FIRST GEAR SNAP RING</li> <li>18. REVERSE GEAR BUSHING (INCLUDED WITH REVERSE GEAR)</li> <li>19. REVERSE GEAR</li> <li>20. COUNTERSHAFT GEAR THRUST WASHER (FRONT)</li> <li>21. COUNTERSHAFT GEAR THRUST WASHER (REAR)</li> <li>22. COUNTERSHAFT GEAR BEARING ROLLERS (44)</li> <li>23. COUNTERSHAFT GEAR BEARING SPACER</li> <li>24. COUNTERSHAFT GEAR</li> <li>25. COUNTERSHAFT-REVERSE IDLER SHAFT LOCKPLATE</li> </ol> | <ol style="list-style-type: none"> <li>26. COUNTERSHAFT</li> <li>27. COUNTERSHAFT GEAR THRUST WASHER (FRONT)</li> <li>28. REVERSE IDLER GEAR THRUST WASHER (2)</li> <li>29. REVERSE IDLER GEAR</li> <li>30. REVERSE IDLER GEAR BUSHING ROLLERS</li> <li>31. REVERSE IDLER GEAR SHAFT</li> <li>32. MAINSHAFT LOCKNUT</li> <li>33. MAINSHAFT WASHER</li> <li>34. MAINSHAFT BEARING SPACER</li> <li>35. REAR BEARING ADAPTER</li> <li>36. REAR BEARING LOCK RING</li> <li>37. REAR BEARING</li> <li>38. TRANSMISSION CASE</li> <li>39. FILL PLUG</li> <li>40. DRAIN PLUG</li> <li>41. CLUTCH SHAFT</li> <li>42. FRONT BEARING RETAINER</li> <li>43. FRONT BEARING</li> <li>44. FRONT BEARING LOCK RING</li> <li>45. FRONT BEARING SNAP RING</li> <li>46. FRONT BEARING CAP GASKET</li> <li>47. FRONT BEARING CAP OIL SEAL</li> <li>48. FRONT BEARING CAP</li> <li>49. FRONT BEARING CAP BOLT</li> <li>50. LOCKWASHER</li> </ol> |
|---|--|

Fig. 2B-18 Model T-15A—Exploded View

(7) Remove front and rear bearing retaining snap rings.

(8) Remove front and rear bearings using Puller J-25152 (fig. 2B-19 and 2B-20).

(9) Remove clutch shaft from case.

(10) Move second-third synchronizer sleeve to second gear position and remove main shaft and gear train assembly.

(11) Remove reverse idler shaft and countershaft lock plate. Tap both shafts toward rear of case to ease removal.

(12) Remove countershaft using Arbor Tool J-25199 (fig. 2B-21). Insert arbor tool from front of case and tap countershaft shaft out rear of case.

(13) Remove countershaft gear and arbor tool as assembly.



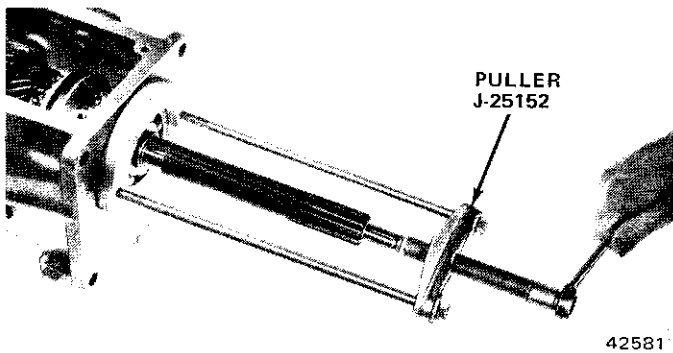


Fig. 2B-19 Front Bearing Removal

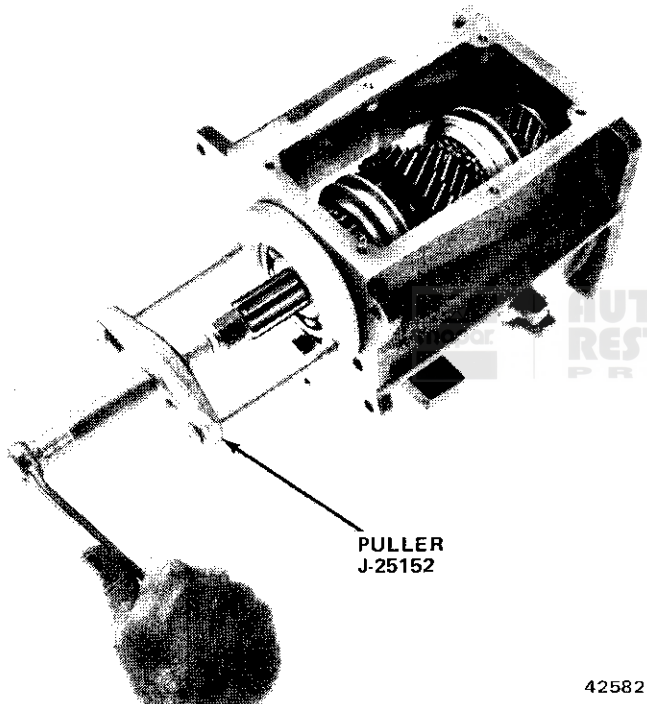


Fig. 2B-20 Rear Bearing Removal

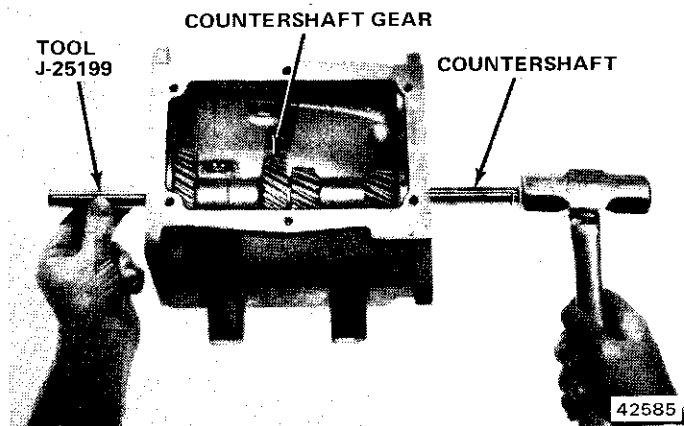


Fig. 2B-21 Countershaft Removal/Installation

(14) Remove countershaft gear thrust washers from case.

(15) Remove arbor tool, spacer washers, bearing rollers and center spacer from countershaft gear.

(16) Remove reverse idler gear shaft using tool J-25203 (fig. 2B-22).

(17) Remove reverse idler gear, thrust washers, and roller bearings as assembly.

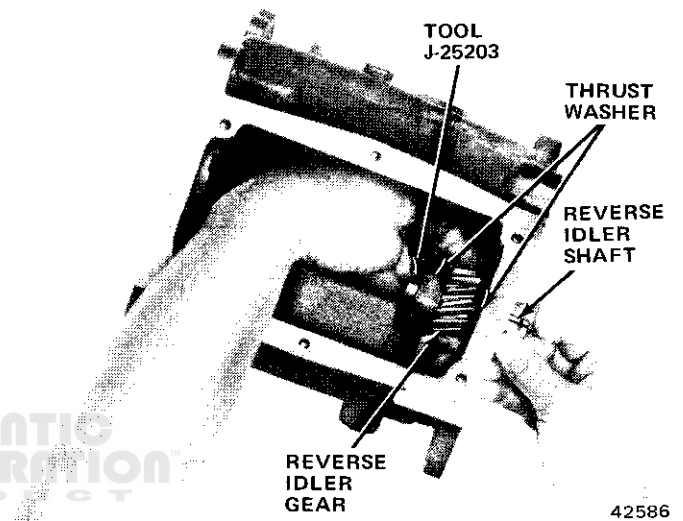


Fig. 2B-22 Reverse Idler Gear Removal/Installation

### Main Shaft Gear Train Disassembly

(1) Remove second-third synchronizer retaining snap ring and remove synchronizer assembly (fig. 2B-23).

(2) Remove second gear and blocking ring.

(3) Remove reverse gear.

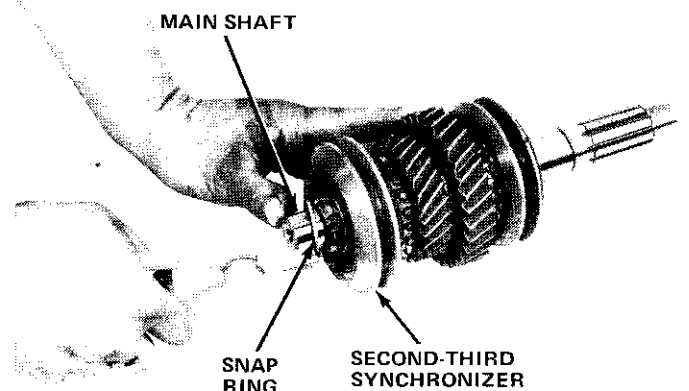
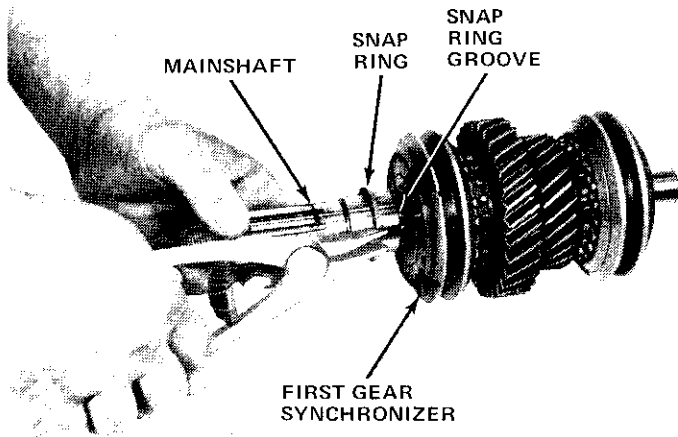


Fig. 2B-23 Second-Third Clutch Hub Snap Ring Removal/Installation



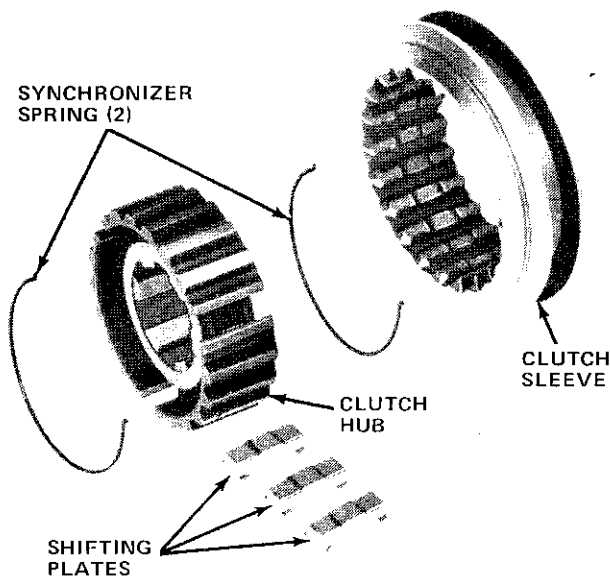
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**Fig. 2B-24 First Gear Synchronizer Hub Snap Ring Removal/Installation**

(4) Remove first gear clutch hub retaining snap ring and remove first gear synchronizer assembly (fig. 2B-24).

(5) Remove first gear and blocking ring.

(6) Remove synchronizer springs from second-third synchronizer assembly (fig. 2B-25). Mark synchronizer sleeve and hub for assembly reference and remove sleeve and shifting plates from hub.

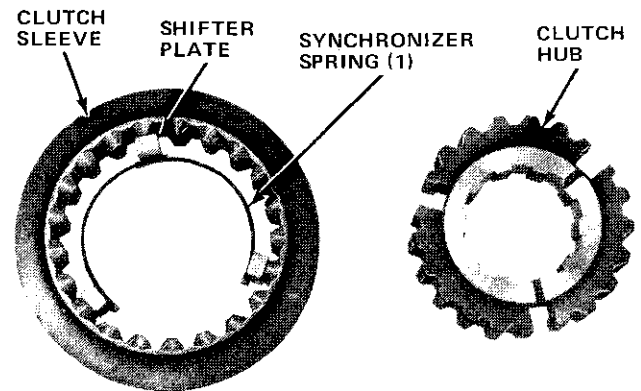


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**Fig. 2B-25 Second-Third Synchronizer Assembly**

(7) Remove synchronizer spring from first gear synchronizer assembly (fig. 2B-26). Mark synchronizer sleeve and hub for assembly reference and remove sleeve and shifting plates from hub.

**NOTE:** *The first gear synchronizer assembly uses only one synchronizer spring (fig. 2B-26).*



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**Fig. 2B-26 First Gear Synchronizer Assembly**

## CLEANING AND INSPECTION

### Cleaning

Thoroughly wash all parts in solvent and dry with compressed air. Do not dry the ball bearings with compressed air. Air dry the bearings or use a clean cloth only.

Clean needle and clutch shaft roller bearings by wrapping the bearings in a clean cloth and submerging them in solvent. Or, place the bearings in a shallow parts cleaning tray and cover them with solvent. Allow the bearings to air dry on a clean cloth.

### Inspection

Inspect the transmission components. Replace any components exhibiting the following conditions:

#### Case

- Cracks in bores, sides, bosses, or at bolt holes.
- Stripped threads in bolt holes.
- Nicks, burrs, rough surfaces in shaft bores or on gasket surfaces.

**Gear and Synchronizer Assemblies**

- Broken, chipped, or worn gear teeth.
- Damaged splines on hubs or sleeves.
- Broken or worn teeth or excessive wear of blocking rings.
- Bent or broken inserts.
- Weak insert springs.
- Damaged needle bearings or bearing bores in countershaft gear.
- Wear or galling of countershaft, clutch shaft, or idler gear shafts.
- Worn thrust washers.
- Nicked, broken, or worn main shaft or clutch shaft splines.
- Bent, distorted, weak snap rings.
- Worn bushings in reverse idler gear.
- Rough, galled, or broken front or rear bearing.

**NOTE:** If any transmission gear requires replacement, also replace the gear with which it meshes. In addition, if either synchronizer assembly must be replaced the shift fork that operates that synchronizer must have the identifying letter A stamped on it. The letter appears just under the shaft hole on the side opposite the pin. In addition, if the letter A does not appear on the existing fork, replace the fork.

**ASSEMBLY**

- (1) Lubricate all parts with transmission lubricant unless noted otherwise.
- (2) Install reverse idler gear, roller bearings, and thrust washer using tool J-25203.
- (3) Install reverse idler gear shaft. Shaft will force tool J-25203 out during installation. Be sure slotted end of shaft is correctly aligned with lock plate.
- (4) Install center spacer and Arbor Tool J-25199 in countershaft gear bore.
- (5) Install bearing washer at each end of center spacer. Slide washers over arbor tool until seated against spacer.
- (6) Install 22 roller bearings at each end of countershaft gear and install bearing washer over roller bearings at each end of gear (fig. 2B-27 and 2B-28).

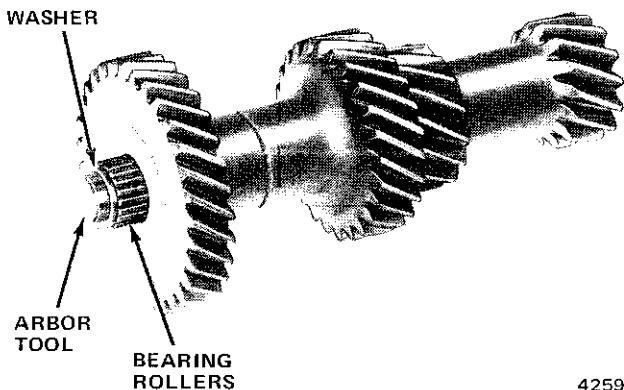
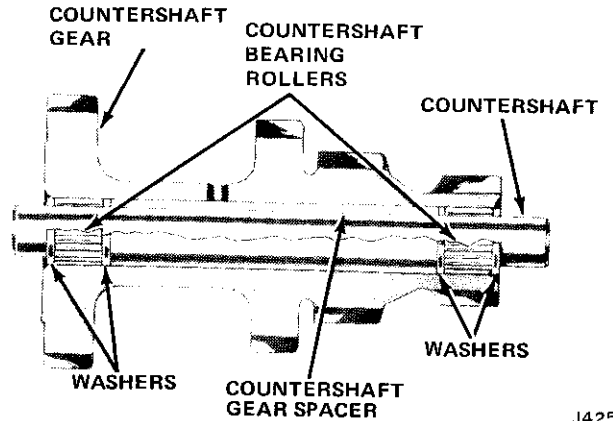


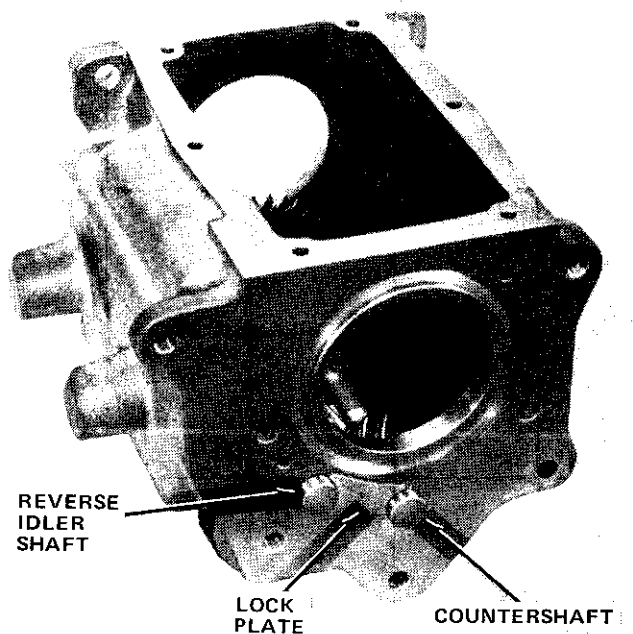
Fig. 2B-27 Countershaft Gear Arbor Tool Installed



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Fig. 2B-28 Bearing/Spacer/Washer Location

- (7) Coat large countershaft gear thrust washer with petroleum jelly and install at front of case.
- (8) Coat small countershaft gear thrust washer with petroleum jelly and install on countershaft gear hub with lip facing groove in case.
- (9) Position countershaft gear assembly in case. Align gear bores with case bores and install countershaft from rear of case. Be sure lock plate slot in shaft is correctly aligned with slot in reverse idler gear shaft. Arbor tool will be forced out as countershaft is installed.
- (10) Install lock plate in slots of reverse idler shaft and countershaft (fig. 2B-29). Tap ends of both shafts until lock plate is seated against case.
- (11) Install first gear and blocking ring on main shaft.



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Fig. 2B-29 Lock Plate Installation

(12) Assemble first gear synchronizer assembly (fig. 2B-26). Align sleeve and hub using alignment marks made at disassembly. Install sleeve shifting plates and insert spring and install assembly on main shaft.

(13) Install first gear clutch hub snap ring (fig. 2B-24).

**NOTE:** *The main shaft snap rings are select-fit to eliminate clutch hub and main shaft bearing end play. Be sure the correct snap ring is installed.*

(14) Install second gear and blocking ring on main shaft.

(15) Assemble second-third synchronizer assembly (fig. 2B-25). Align sleeve and hub using alignment marks made at disassembly. Install shifting plates and insert springs. Be sure insert springs are installed with open ends opposite one another or approximately 120° apart.

(16) Install second-third synchronizer assembly on main shaft and install synchronizer snap ring and blocking ring.

**NOTE:** *The main shaft snap rings are select-fit to eliminate clutch hub and main shaft bearing end play. Be sure the correct snap ring is installed.*

(17) Install reverse gear on main shaft.

(18) Install main shaft and gear assembly in case.

(19) Install main shaft pilot bearing rollers in clutch shaft bore. Use petroleum jelly to hold rollers in place.

**CAUTION:** *Do not use chassis grease or similar heavy grease in the clutch shaft bore. This type of grease may plug the clutch shaft lubricant holes preventing proper lubrication of the roller bearings. Use petroleum jelly only.*

(20) Position clutch shaft in case so cutaway portion of shaft faces downward (fig. 2B-30) and guide clutch shaft onto main shaft. Do not displace pilot bearing rollers during installation.

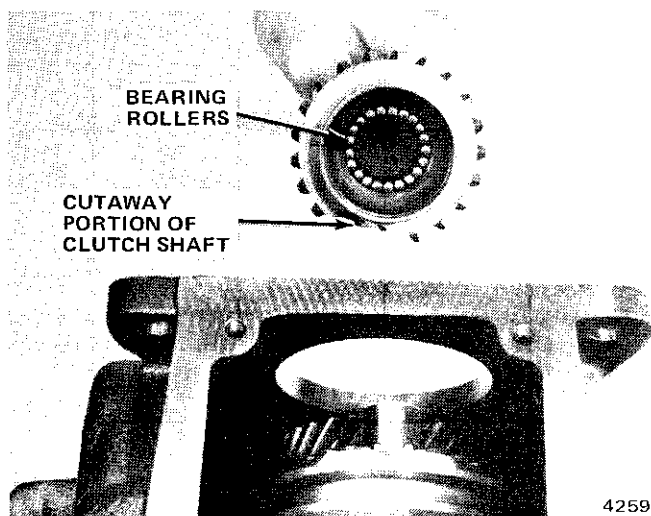


Fig. 2B-30 Clutch Shaft Installation

(21) Install front bearing retainer on clutch shaft.  
 (22) Install Thrust Yoke Tool J-25200. Insert tool yokes in second gear groove and between clutch shaft teeth and blocking ring (fig. 2B-31).

(23) Install front and rear bearing lock rings.

(24) Install front bearing using tools J-26092 and J-22828 and wood backup block (fig. 2B-31).

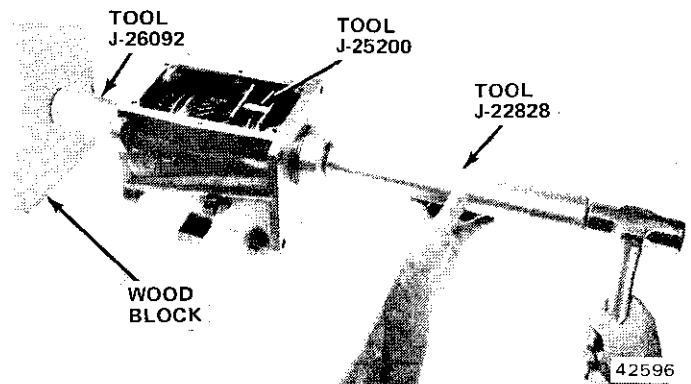


Fig. 2B-31 Front Bearing Installation

**CAUTION:** *Be sure to use Thrust Yoke Tool J-25200 to prevent damaging synchronizer components during bearing installation.*

(25) Install rear bearing using bearing driver tools and wood backup block (fig. 2B-32).

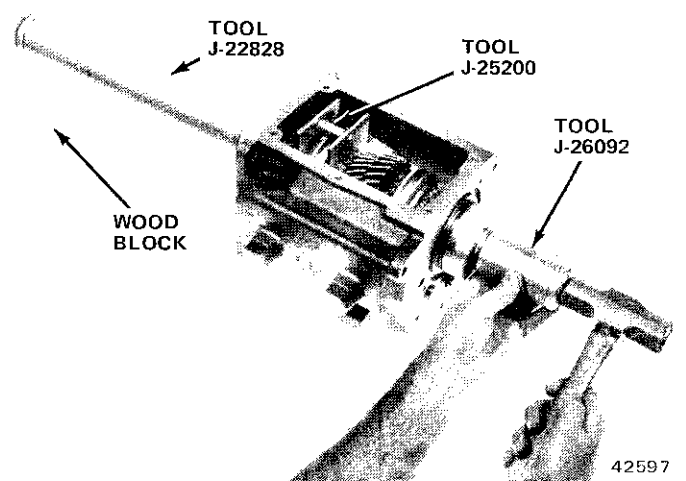


Fig. 2B-32 Rear Bearing Installation

(26) Install front and rear bearing retaining snap rings.

**NOTE:** *The rear bearing snap ring is 0.010-inch (0.25 mm) thicker than the front bearing snap ring. Be sure the correct snap ring is installed.*

(27) Inspect front bearing cap oil seal. Replace seal if cut, worn, loose, or distorted (fig. 2B-33).

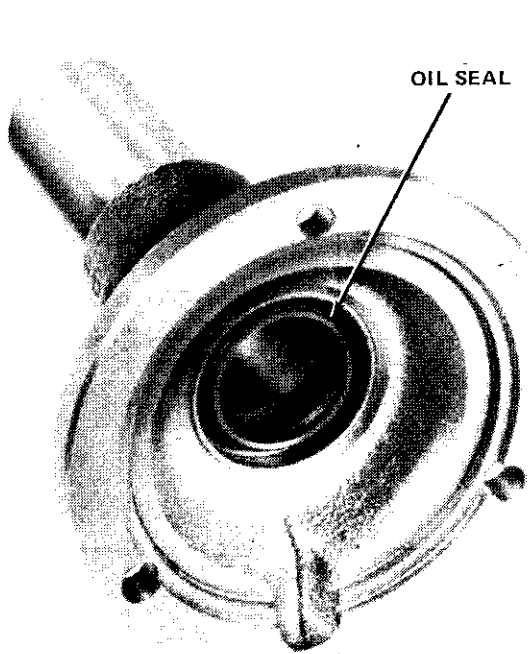


Fig. 2B-33 Front Bearing Cap Oil Seal

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(28) Install front bearing cap and gasket. Be sure oil drain slot in cap and gasket are aligned with hole in case. Tighten bearing cap bolts to 15 foot-pounds (20 N•m) torque.

(29) Shift both synchronizers into gear to prevent main shaft from turning.

(30) Install rear bearing adaptor, spacer, transfer case drive gear, flat washer, and drive gear retaining nut. Tighten retaining nut to 150 foot-pounds (203 N•m) torque.

(31) Shift synchronizers into Neutral.

(32) Check operation of gears in all positions. Be sure gears are in Neutral position before installing case cover and gasket.

(33) Install replacement transmission-to-transfer case gasket.

(34) Install transmission on transfer case. Tighten attaching bolts to 30 foot-pounds (41 N•m) torque.

## SHIFT CONTROL HOUSING

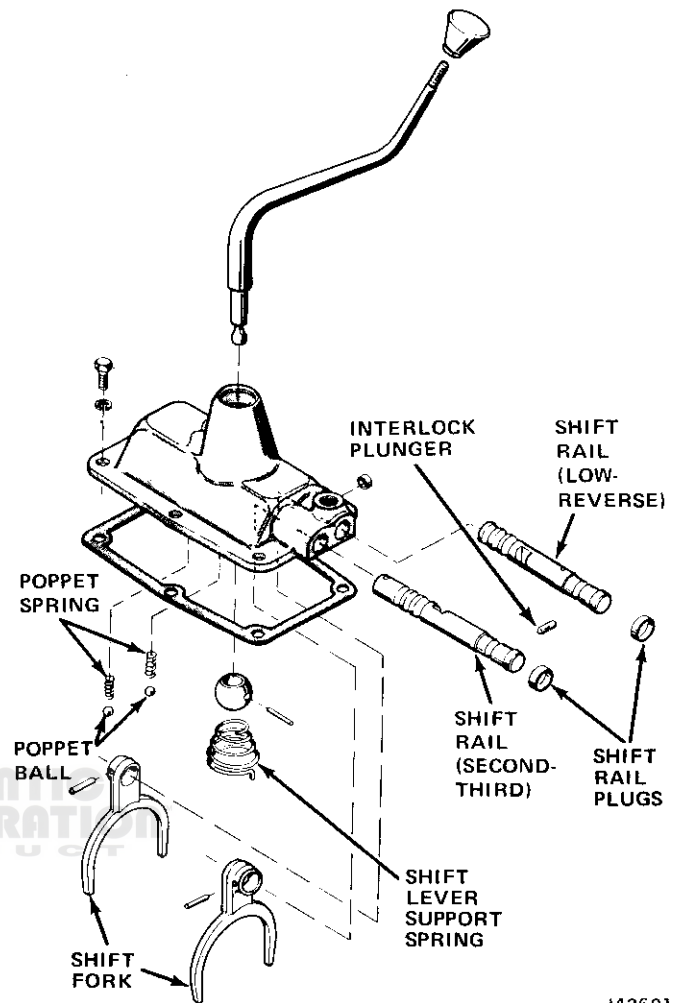
### Disassembly

(1) Remove TCS switch, if equipped, and backup lamp switch.

(2) Remove shift rail plugs from rear of housing (fig. 2B-34). Remove plugs by driving them sideways (into bore) then prying out.

(3) Move first-reverse shift rail to first gear position.

(4) Remove roll pin from first-reverse shift fork and rail.



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Fig. 2B-34 Shift Control Housing—Transmission Model T-15A

(5) Slide first-reverse fork rearward to expose roll pin hole in rail.

(6) Insert tapered punch in roll pin hole in shaft.

(7) Rotate first-reverse rail toward second and third rail to align groove at rear of first-reverse rail with interlock plunger. Slide first-reverse rail forward as far as possible.

(8) Remove interlock plunger.

**NOTE:** Before removing rail, cover poppet ball holes with cloth to prevent loss of ball and spring.

(9) Rotate first-reverse rail away from second-third rail and, at same time, push rail rearward out of housing.

(10) Remove roll pin from second-third shift fork and rail.

**NOTE:** Before removing the rail, cover the poppet ball holes with cloth to prevent loss of the ball and spring.

(11) Remove second-third shift rail.

(12) Remove shift lever retainer spring and shift lever.

**Assembly**

- (1) Install shift lever and retainer spring.

**NOTE:** *The small end of the spring cone should be against the lever ball. Be sure the spring is snapped in behind the cover shoulders.*

- (2) Slide second-third shift rail into housing to poppet boss.
- (3) Insert poppet spring and ball.
- (4) Compress ball and spring and slide rail just through boss.
- (5) Rotate rail to position shift lever slot toward center of housing.
- (6) Install second-third fork with flanged side of fork toward front of housing.
- (7) Install roll pin.

- (8) Hold first-reverse shift fork in position, with flange side of fork toward rear of housing.
- (9) Slide first-reverse shift rail into housing, through fork, to poppet boss.
- (10) Insert and compress poppet spring and ball.
- (11) Push shift rail as far forward as possible.
- (12) Install interlock plunger. Be sure second-third shift rail is in Neutral position and that interlock end of rod faces away from housing.
- (13) Move rail backward until end of rail contacts interlock plunger.
- (14) Rotate rail to align notch with interlock plunger, then move rail as far backward as possible.
- (15) Rotate rail to align roll pin holes in rail and fork.
- (16) Install roll pin.
- (17) Install shift rail plugs, backup lamp switch, and TCS switch.

**SPECIFICATIONS**

**Transmission Specifications**

Model	T15A
Type	Synchromesh
Speeds	3 Forward, 1 Reverse
Gear Ratios:	
First	2.997:1
Second	1.832:1
Third	1.000:1
Reverse	2.997:1
End Play Tolerances	All end play controlled by selective thickness snap rings. Use thickest snap rings available.
Lubricant Capacity	2-3/4 Pints (1.30 liters)
Lubricant Type	SAE 90 Gear Lubricant

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**Torque Specifications**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Backup Lamp Switch	18	15-20	24	20-27
Drain Plug	15	10-20	20	14-27
Fill Plug	15	10-20	20	14-27
Front Bearing Cap Bolt	15	12-18	20	16-24
Shift Control Housing-to-Case Bolt	12	10-15	16	14-20
Transfer Case Drive Gear Locknut	150	145-155	203	197-210
Transfer Case-to-Transmission Case Bolt	30	25-35	41	34-47
TCS Switch	18	15-20	24	20-27

All torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Marking chart in Chapter A for torque values not listed above.

# MODEL T-18A

## 4-SPEED TRANSMISSION

	Page		Page
Assembly	2B-23	Shift Control Housing	2B-27
Cleaning and Inspection	2B-22	Specifications	2B-28
Disassembly	2B-20		

### DISASSEMBLY

(1) Remove transmission-to-transfer case attaching bolts and remove transmission from transfer case.

(2) Remove and discard transmission-to-transfer case gasket.

(3) Remove shift control housing.

(4) Remove transfer case drive gear locknut and washer and remove drive gear and spacer.

**NOTE:** Before removing the drive gear locknut, move the third-fourth clutch sleeve forward and the first-second clutch sleeve rearward to lock the mainshaft.

(5) Move clutch sleeves back to Neutral position.

(6) Remove transmission-to-transfer case adapter (if equipped). Remove and discard oil seal from adapter.

(7) Remove reverse shifting arm pivot pin.

**CAUTION:** The pin is tapered and must be driven out toward the rear of the case only.

(8) Remove reverse shifting arm, shifting arm shoe, and pivot. Remove O-ring from pivot and discard O-ring.

(9) Move first-second clutch sleeve to Neutral position.

(10) Punch alignment marks in front bearing cap and case for assembly reference and remove bearing cap and gasket.

(11) Remove lockring from clutch shaft and snap ring from front bearing (fig. 2B-35).

(12) Remove front bearing from clutch shaft using Puller J-25152 (fig. 2B-36).

(13) Remove front bearing retainer washer from clutch shaft.

(14) Remove bearing roller spacer from mainshaft pilot hub (fig. 2B-35).

### Legend

- |  |  |
|--|--|
| 1. MAINSHAFT PILOT BEARING ROLLER SPACER                         | 38. BOLT (TRANSMISSION-TO-CLUTCH HOUSING)      |
| 2. THIRD-FOURTH BLOCKING RING                                    | 39. C-WASHER                                   |
| 3. THIRD-FOURTH RETAINING RING                                   | 40. REVERSE IDLER GEAR SNAP RING               |
| 4. THIRD-FOURTH SYNCHRONIZER SNAP RING                           | 41. REVERSE IDLER GEAR THRUST WASHER           |
| 5. THIRD-FOURTH SHIFTING PLATE (3)                               | 42. REVERSE IDLER SHAFT SLEEVE                 |
| 6. THIRD-FOURTH CLUTCH HUB                                       | 43. REVERSE IDLER GEAR BEARING ROLLERS (74)    |
| 7. THIRD-FOURTH RETAINING RING                                   | 44. REVERSE IDLER GEAR BEARING WASHER          |
| 8. THIRD-FOURTH CLUTCH SLEEVE                                    | 45. REVERSE IDLER GEAR                         |
| 9. THIRD-FOURTH BLOCKING RING                                    | 46. LOCKWASHER (6)                             |
| 10. THIRD-FOURTH GEAR SYNCHRONIZER ASSEMBLY                      | 47. ADAPTER PLATE BOLTS (6)                    |
| 11. THIRD GEAR   | 48. DRIVE GEAR LOCKNUT                         |
| 12. MAINSHAFT SNAP RING  | 49. WASHER                                     |
| 13. SECOND GEAR THRUST WASHER                                    | 50. ADAPTER PLATE                              |
| 14. SECOND GEAR  | 51. COUNTERSHAFT-REVERSE IDLER SHAFT LOCKPLATE |
| 15. MAINSHAFT  | 52. REVERSE IDLER GEAR SHAFT                   |
| 16. SECOND GEAR BLOCKING RING                                    | 53. COUNTERSHAFT                               |
| 17. MAINSHAFT SNAP RING  | 54. ADAPTER PLATE GASKET                       |
| 18. FIRST-SECOND CLUTCH HUB                                      | 55. ADAPTER PLATE SEAL                         |
| 19. FIRST-SECOND SHIFTING PLATE (3)                              | 56. SPEEDOMETER GEAR SPACER                    |
| 20. POPPET BALL (3)  | 57. REAR BEARING LOCATING SNAP RING            |
| 21. POPPET SPRING (3)  | 58. REAR BEARING                               |
| 22. FIRST-SECOND INSERT SPRING                                   | 59. REVERSE SHIFTING ARM PIVOT PIN             |
| 23. MAINSHAFT SNAP RING  | 60. REVERSE SHIFTING ARM PIVOT                 |
| 24. FIRST-SECOND CLUTCH SLEEVE                                   | 61. REVERSE SHIFTING ARM PIVOT O-RING          |
| 25. SECOND GEAR SYNCHRONIZER ASSEMBLY                            | 62. WASHER (6)                                 |
| 26. COUNTERSHAFT GEAR THRUST WASHER (STEEL) (REAR)               | 63. SIDE COVER BOLT (6)                        |
| 27. COUNTERSHAFT GEAR THRUST WASHER (STEEL BACKED BRONZE) (REAR) | 64. SIDE COVER                                 |
| 28. COUNTERSHAFT GEAR BEARING WASHER                             | 65. TRANSMISSION CASE                          |
| 29. COUNTERSHAFT GEAR BEARING ROLLERS (88)                       | 66. MAINSHAFT PILOT BEARING ROLLERS (22)       |
| 30. COUNTERSHAFT GEAR BEARING SPACER                             | 67. CLUTCH SHAFT                               |
| 31. COUNTERSHAFT GEAR  | 68. FRONT BEARING RETAINER WASHER              |
| 32. COUNTERSHAFT GEAR THRUST WASHER (FRONT)                      | 69. FRONT BEARING                              |
| 33. REVERSE SHIFTING ARM   | 70. FRONT BEARING LOCATING SNAP RING           |
| 34. REVERSE SHIFTING ARM SHOE                                    | 71. FRONT BEARING LOCK RING                    |
| 35. FILLER PLUG  | 72. FRONT BEARING CAP GASKET                   |
| 36. DRAIN PLUG   | 73. FRONT BEARING CAP                          |
| 37. LOCKWASHER   | 74. FRONT BEARING CAP BOLTS (4)                |
|  | 75. LOCKWASHER (4)                             |

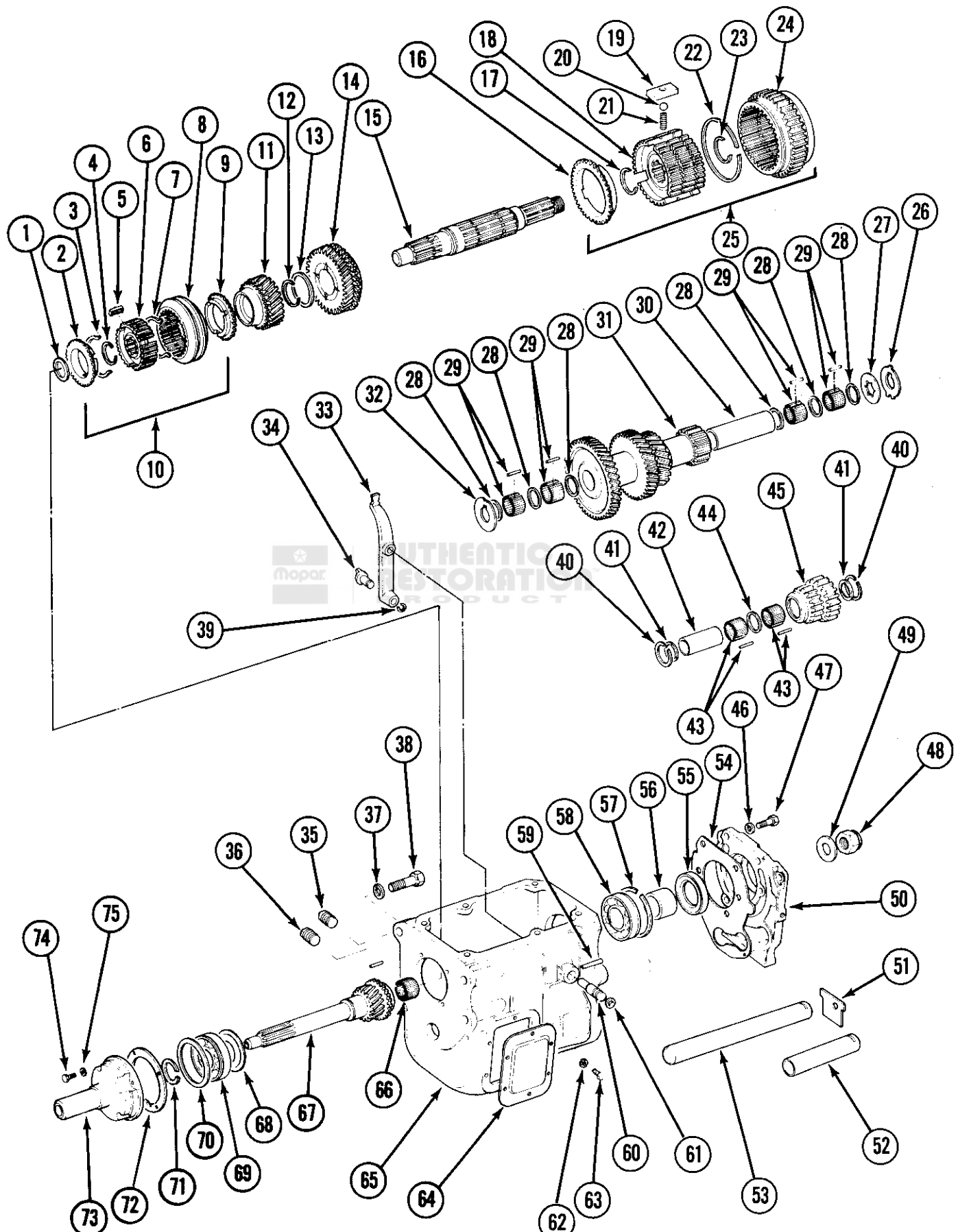
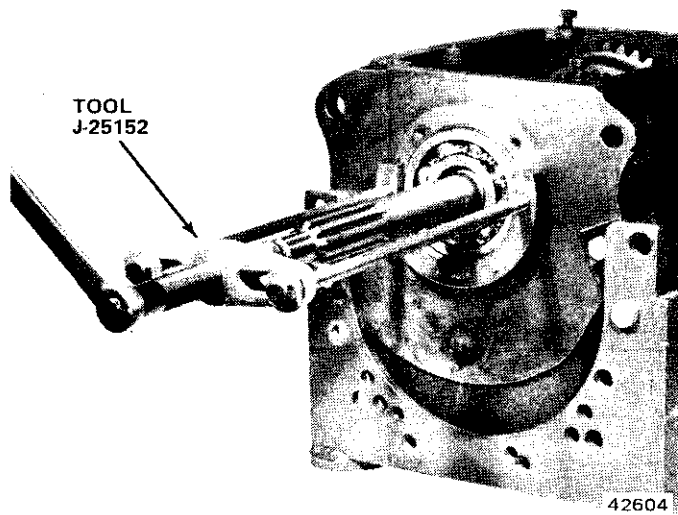


Fig. 2B-35 Model T-18A 4-Speed Transmission





**Fig. 2B-36 Front Bearing Removal**

(15) Remove locating snap ring from rear bearing and remove rear bearing using Puller J-25152.

**NOTE:** *If the bearing puller plates will not seat in the bearing snap ring groove, tap the end of the clutch shaft with a lead hammer to move the main shaft rearward and expose the bearing groove fully.*

(16) Move third-fourth clutch sleeve rearward and disengage main shaft from clutch shaft.

(17) Remove main shaft and geartrain assembly.

(18) Remove clutch shaft.

(19) Remove main shaft pilot bearing rollers from clutch shaft.

(20) Remove lock plate from countershaft and reverse idler gear shaft.

(21) Remove reverse idler gear shaft. Position pry bar in shaft lock plate slot and pry shaft out of gear and case.

(22) Remove reverse idler gear assembly.

(23) Tap countershaft toward rear of case using brass drift and hammer. Stop when end of shaft is approximately even with front inside edge of case bore.

(24) Complete countershaft removal as follows:

(a) Make arbor tool from steel rod 1.115 inches (2.83 cm) in diameter by 9.85 inches (25.01 cm) long.

(b) After making tool, remove all burrs or sharp edges using file.

(c) Insert tool into shaft bore at front of case and drive countershaft out rear of case. Keep tool in constant contact with shaft to avoid displacing bearing rollers or washers.

(25) Tip case on side and remove countershaft gear and arbor tool as assembly.

(26) Remove countershaft gear thrust washers and any mainshaft pilot bearing rollers that may have fallen into case during mainshaft removal.

(27) Remove arbor tool from countershaft gear and remove bearing rollers, washers, and spacer.

(28) Remove snap rings, bearing rollers, washers, and sleeve from reverse idler gear.

(29) Remove power takeoff cover.

(30) Remove fill plug and drain plug.

### Main Shaft Gear Train Disassembly

(1) Scribe alignment marks on main shaft splines and clutch hubs for assembly reference.

(2) Remove pilot bearing spacer from front of main shaft (fig. 2B-35).

(3) Remove third-fourth synchronizer snap ring and remove third-fourth synchronizer assembly and third gear (fig. 2B-35).

(4) Remove first-second synchronizer snap ring and remove first-second synchronizer assembly (fig. 2B-35).

(5) Remove second gear snap ring and remove thrust washer and second gear.

(6) Scribe alignment marks on clutch hubs and sleeves for assembly reference.

(7) Remove insert springs and shifting plates from third-fourth clutch sleeve and remove sleeve from hub. Observe position of springs and plates for assembly reference.

(8) Place first-second synchronizer assembly on work bench and wrap cloth around clutch sleeve. Cloth is necessary to prevent losing shift plate lock balls during disassembly.

(9) Remove clutch sleeve from hub.

(10) Remove cloth from sleeve and remove lock balls, insert spring and shift plates from hub.

### Cleaning and Inspection

Clean and inspect the transmission case and all components thoroughly. If any transmission gear requires replacement, also replace the gear with which it meshes. Use new gaskets, oil seals, and snap rings during assembly.

Inspect the transmission case for cracks and worn or scored bearing bosses. Examine the ball bearings for cracked races, excessive wear, looseness, and for tight fit in the case bores. Inspect all gear teeth for cracks, chips, or spots where gear hardening has worn through. Main shaft gears must not bind on the shaft and should not exhibit excessive play. Inspect the synchronizer blocking rings for cracks, excessive wear, or pitting in the tapered area of the ring. If thrust washer condition is doubtful, replace them.

Check all bearing rollers for flat spots, pitting, cracks, or other damage. Replace rollers as required. Inspect the countershaft and reverse idler shafts for pitting, wear, scores, nicks, cracks, and flat spots. Small nicks or scores can be reduced using crocus cloth or a fine-tooth file. Replace shafts if severely worn or damaged. Inspect the main shaft and synchronizer hubs and sleeves for damaged or worn splines, cracks, worn mainshaft pilot hub, and damaged mainshaft threads. Replace parts as required. Check reverse shifting arm and pivot pin for wear or other damage, and replace if necessary.

**ASSEMBLY**

**NOTE:** *Prelubricate all components with petroleum jelly during assembly.*

**Reverse Idler Gear**

- (1) Install snap ring in one end of reverse idler gear.
- (2) Install thrust washer in gear bore against snap ring.
- (3) Insert sleeve in gear bore.
- (4) Install 37 roller bearings in one end of gear and install bearing spacer (fig. 2B-35).
- (5) Install remaining 37 roller bearings in opposite end of gear and install remaining thrust washer and snap ring.

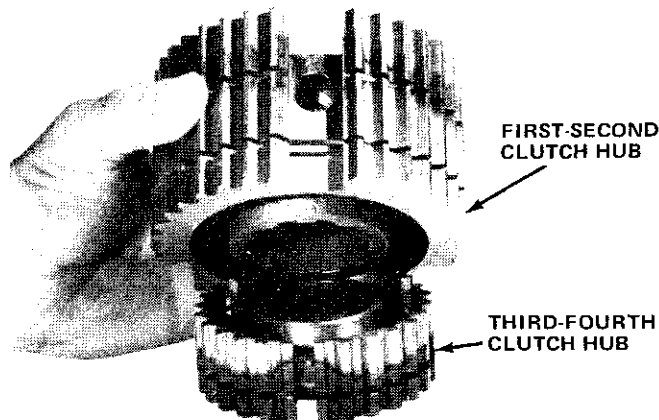
**Countershaft Gear Assembly**

- (1) Install bearing spacer sleeve in gear and insert arbor tool into gear and through sleeve.
- (2) Slide one bearing spacer onto arbor tool and seat spacer against sleeve.
- (3) Insert 22 roller bearings into gear bore and seat bearings against spacer just installed.
- (4) Slide second bearing spacer onto arbor tool and seat spacer against bearings.
- (5) Install 22 more roller bearings in gear bore and seat bearings against second spacer.
- (6) Install third bearing spacer on arbor tool and seat spacer against bearings.
- (7) Repeat spacer/bearing installation procedure at opposite end of gear.

**First-Second Synchronizer Assembly**

**NOTE:** *The third-fourth clutch hub is used to help assemble the first-second synchronizer assembly.*

- (1) Place third-fourth clutch hub on work bench.
- (2) Install insert spring in first-second clutch hub spring groove.



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**Fig. 2B-37 Supporting First-Second Clutch Hub**

(3) Position first-second clutch hub on top of third-fourth hub so lock ball holes in first-second hub are in uppermost position (fig. 2B-37).

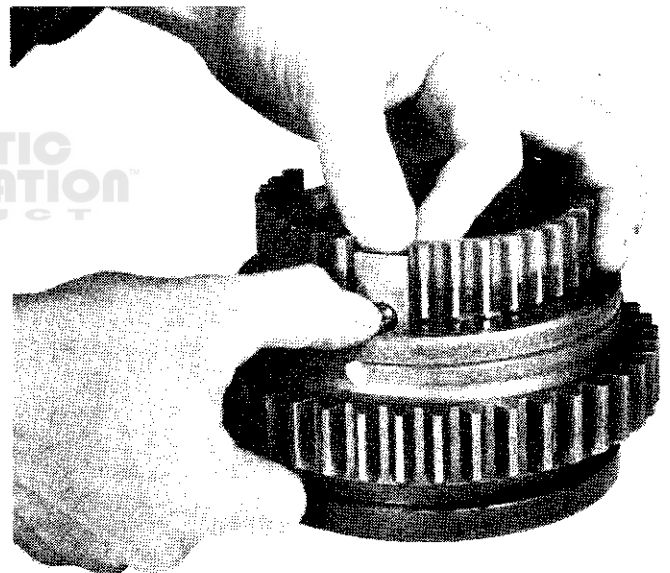
(4) Align scribe marks on first-second hub and sleeve and install sleeve on hub (fig. 2B-38). Allow sleeve to bottom against work bench.

(5) Install each shifting plate, poppet spring, and lock ball assembly one at a time as follows (fig. 2B-38):

- (a) Install shifting plate in hub slot.
- (b) Insert poppet spring through plate.
- (c) Position lock ball on poppet spring, and compress ball and spring (fig. 2B-38).
- (d) Maintain pressure on ball and spring and slide shifting plate downward in hub slot until ball is held in position by clutch sleeve.

(6) Install remaining shift plates, poppet springs and lock balls as described in previous step.

(7) Complete synchronizer assembly by pressing down on hub and pulling up on sleeve.



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**Fig. 2B-38 Assembling First-Second Synchronizer**

**Third-Fourth Synchronizer Assembly**

(1) Align and assemble third-fourth clutch hub and sleeve using reference marks made at disassembly.

- (2) Insert shifting plates in hub slots.
- (3) Install insert springs so one end of each spring is hooked into same shifting plate (fig. 2B-39).

**Clutch Shaft Assembly**

(1) Lubricate mainshaft bearing rollers and clutch shaft bore with generous quantity of petroleum jelly.

(2) Install 22 bearing rollers in clutch shaft bore. Use additional petroleum jelly to help retain rollers in bore if necessary.

(3) Coat blocking ring with petroleum jelly and install ring on clutch shaft.

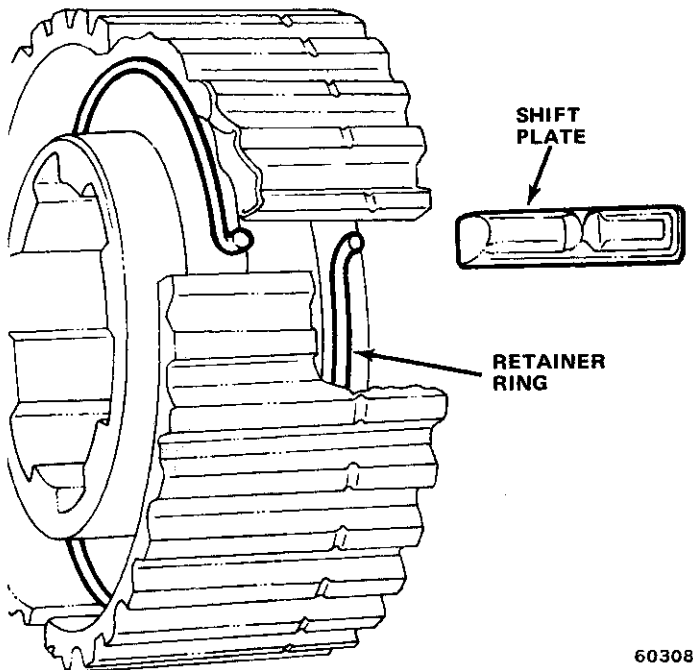


Fig. 2B-39 Third-Fourth Synchronizer Shifting Plate and Retaining Ring Installation

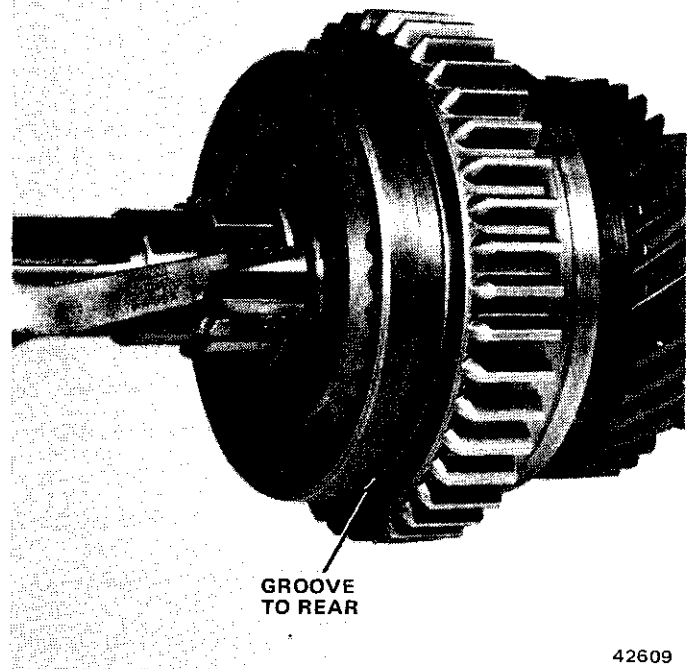


Fig. 2B-41 First-Second Synchronizer Installation

**Mainshaft and Gear Train Assembly**

- (1) Install second gear from front of main shaft (fig. 2B-40).
- (2) Install second gear thrust washer so step bore in washer faces front end of mainshaft.
- (3) Install second gear snap ring. Be sure thrust washer step bore fits over snap ring.

... ..

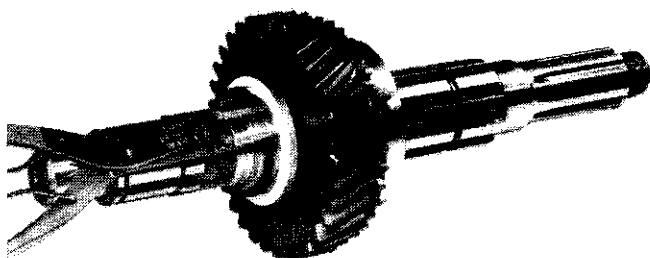


Fig. 2B-40 Second Gear and Thrust Washer Installation

**NOTE:** The first-second synchronizer clutch sleeve shift fork groove must face the rear of the mainshaft (fig. 2B-41).

- (5) Install third gear on mainshaft and install blocking ring on gear.
- (6) Install third-fourth synchronizer assembly on mainshaft (fig. 2B-35).

**NOTE:** The third-fourth synchronizer must be installed with the chamfered side of the hub facing the front of the main shaft (fig. 2B-42).

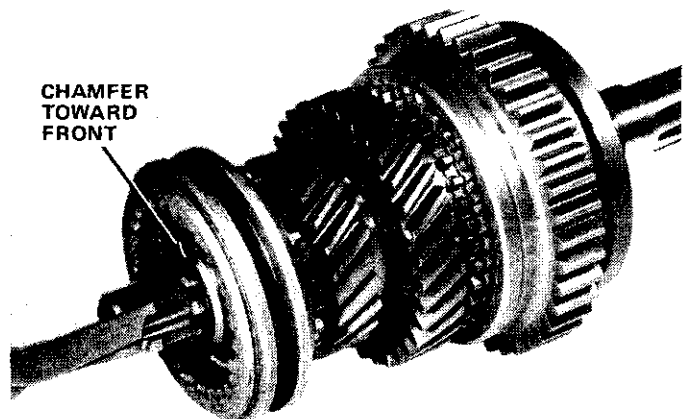


Fig. 2B-42 Third-Fourth Synchronizer Installation

- (4) Install second gear rear snap ring, blocking ring, first-second synchronizer assembly and snap ring from rear of mainshaft.

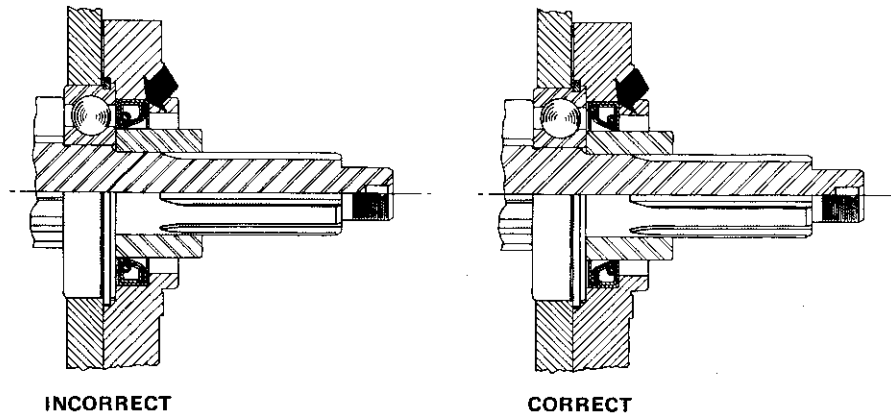


Fig. 2B-43 Adapter Plate Oil Seal Position

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(7) Install third-fourth synchronizer retaining ring (fig. 2B-35).

(8) Install mainshaft bearing roller spacer on shaft pilot hub (fig. 2B-35).

### Transmission Case Assembly

(1) Coat countershaft thrust washers with petroleum jelly and install washers in case. Index tab on large, bronze-faced washer in locating recess in front of case. Index notch in smaller, steel washer with locating lug at rear of case.

(2) Install countershaft gear assembly.

(3) Install remaining countershaft thrust washer between rear of countershaft gear and smaller, steel thrust washer.

(4) Install countershaft from rear of case but do not install shaft completely. Stop installation when shaft just starts into case front bore.

**CAUTION:** When installing the countershaft, keep the shaft and arbor tool in constant contact to avoid displacing any bearing rollers or bearing washers.

(5) Install reverse idler gear. Larger gear end must face rear of case.

(6) Install reverse idler gear shaft from rear of case. Tap shaft forward until lock plate slot in shaft is aligned with lock plate slot in countershaft.

(7) Install lockplate in countershaft and reverse idler gear shaft slots.

(8) Tap ends of countershaft and reverse idler gear shafts alternately until shafts are fully installed.

(9) Insert assembled clutch shaft and fourth gear blocking ring in case front bearing bore. Insert shaft from case interior, not from front or outside of case.

(10) Install mainshaft and gear train assembly.

(11) Install mainshaft pilot bearing roller spacer on mainshaft pilot hub if not installed previously.

(12) Insert mainshaft pilot hub in clutch shaft bore. Be sure bearing rollers in clutch shaft are not displaced and that fourth gear blocking ring notches are aligned with shifting plates.

(13) Install front bearing cap temporarily to support clutch shaft.

(14) Install retaining snap ring on rear bearing and drive bearing onto mainshaft and into case rear bore. Seat snap ring against case.

(15) Install replacement oil seal in transfer case adapter plate.

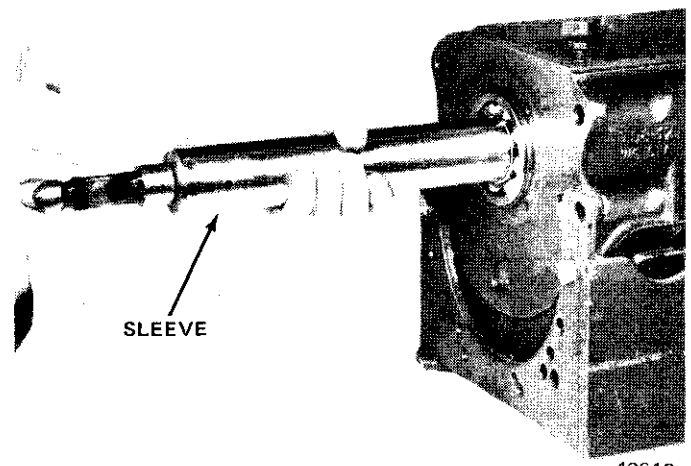
**CAUTION:** The adapter plate oil seal must be installed correctly to prevent lubricant flow from the transfer case into the transmission. When correctly positioned, the seal lip will face the transfer case (fig. 2B-43).

(16) Coat lip of adapter plate oil seal with petroleum jelly.

(17) Position replacement transmission-to-adapter gasket on transmission and install adapter plate. Apply nonhardening sealer to adapter plate attaching bolts and install bolts.

(18) Remove front bearing cap and install front bearing retaining washer on clutch shaft with dished side of washer facing mainshaft.

(19) Slide front bearing onto clutch shaft and tap bearing into case bore using section of pipe or driver sleeve (fig. 2B-44). Be sure to seat bearing against clutch shaft gear shoulder and front bearing retainer washer.



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Fig. 2B-44 Front Bearing Installation

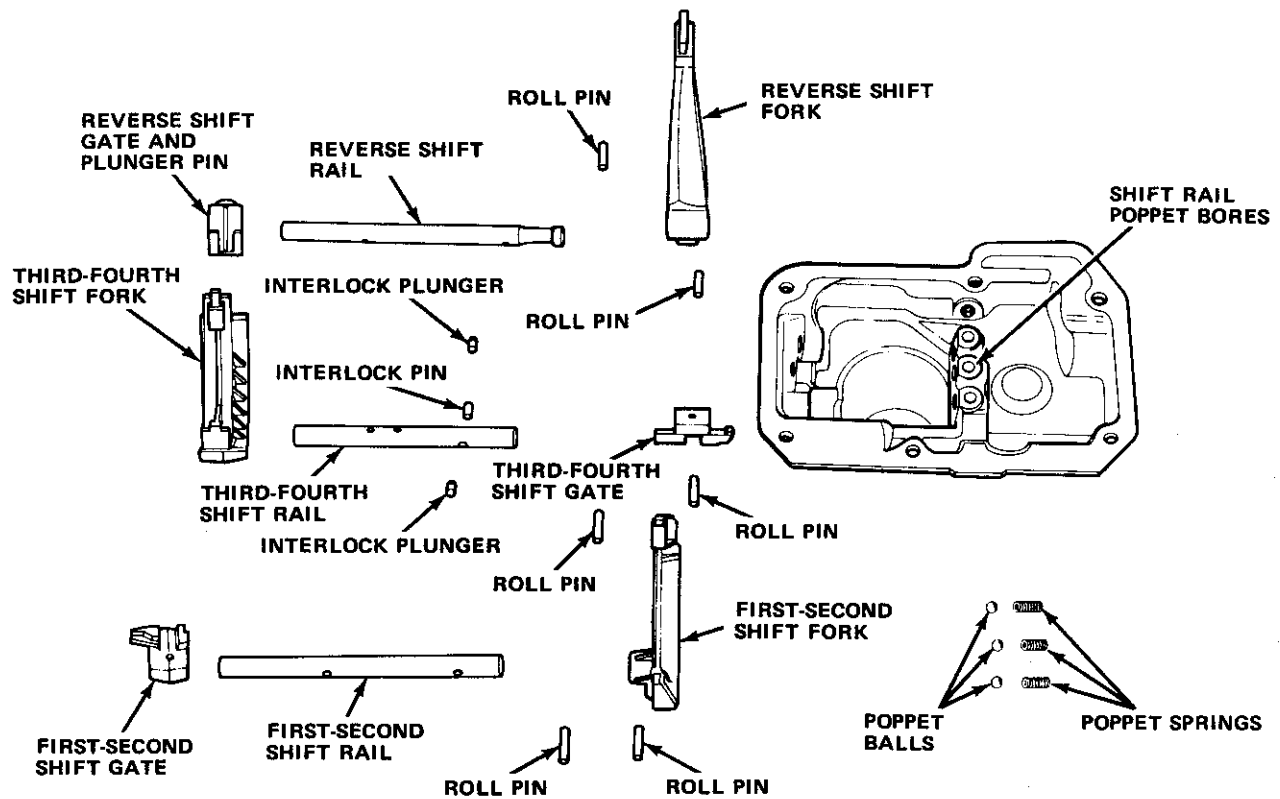
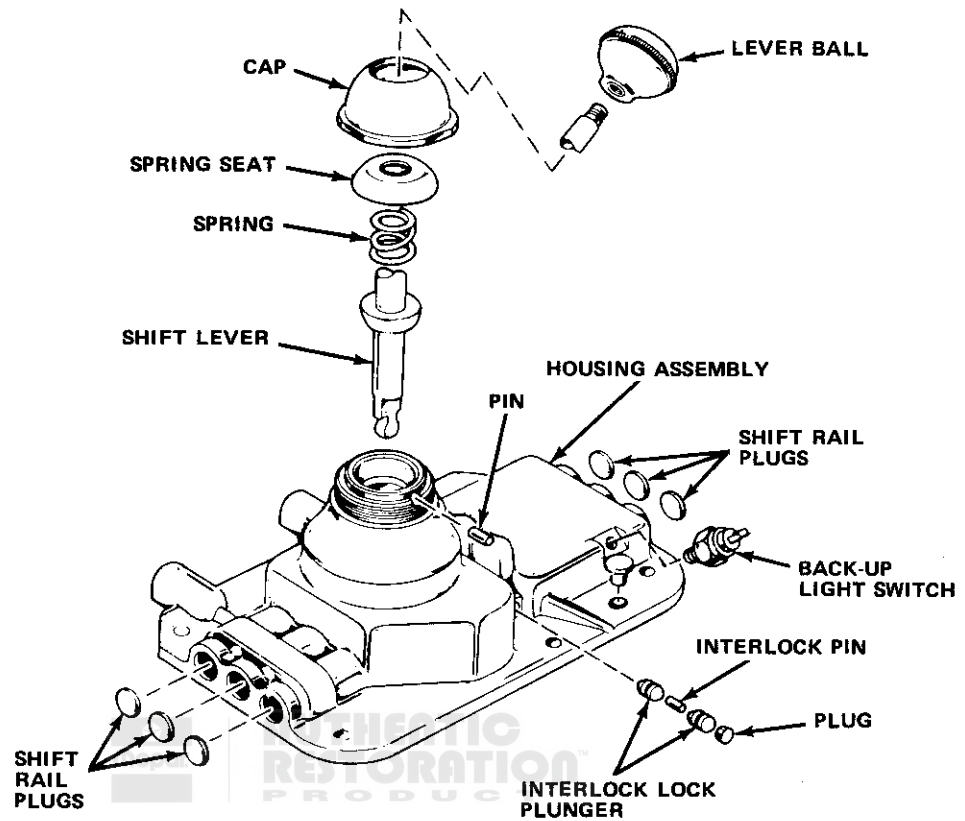


Fig. 2B-45 Shift Control Housing—Transmission Model T-18A

(20) Install thickest front bearing lock ring in clutch shaft ring groove.

**NOTE:** *The front bearing lock rings are available in four thicknesses.*

(21) Pull clutch shaft and front bearing forward just far enough to expose locating snap ring groove in bearing. Install locating snap ring and push clutch shaft rearward until locating snap ring seats against case.

(22) Position front bearing cap gasket on front bearing cap. Coat threads of bearing cap attaching bolts with nonhardening sealer. Align oil return holes in cap, gasket, and case, and install attaching bolts. Tighten bolts to 15 foot-pounds (20 N•m) torque.

(23) Check all synchronizer blocking rings for free movement. If blocking rings were wedged onto the tapered hubs of the clutch shaft, third, and second speed gears during bearing installation, pry them free using screwdriver.

(24) Install reverse shifting arm. Move first-second synchronizer rearward to provide clearance.

(25) Install replacement O-ring on reverse shifting arm pivot.

(26) Engage reverse shifting arm shoe in groove of reverse idler gear.

(27) Align pivot bores in reverse shifting arm and case and install pivot. Install tapered pivot pin from rear of pivot boss in case. Tap pivot pin with hammer until seated.

(28) Coat mating surface of power takeoff cover with RTV-type sealer and position cover on case.

(29) Apply nonhardening sealer to power takeoff cover attaching bolts. Install and tighten bolts to 12 foot-pounds (16 N•m) torque.

(30) Install transfer case drive gear spacer, drive gear, flat washer and locknut on mainshaft.

(31) Move third-fourth synchronizer sleeve forward and first-second synchronizer sleeve rearward to prevent main shaft from turning and tighten drive gear locknut to 150 foot-pounds (203 N•m) torque.

(32) Move synchronizer sleeves to Neutral position.

(33) Install fill and drain plugs and pour two pints of gear lubricant over all gears while rotating main shaft.

(34) Coat shift control housing with RTV silicone sealer and install housing on case. Be sure shift forks engage synchronizer sleeves and that reverse shift arm engages flat on reverse shift rail.

(35) Coat shift lever housing attaching bolts with nonhardening sealer and install bolts. Tighten bolts to 12 foot-pounds (16 N•m) torque.

(36) Shift gears through all positions to check operation.

(37) Assemble transfer case and transmission and tighten attaching bolts to 30 foot-pounds (41 N•m) torque.

## SHIFT CONTROL HOUSING

### Disassembly

(1) Unthread shift lever cap and remove cap, gasket if equipped, spring seat, spring and shift lever as assembly (fig. 2B-45).

(2) Remove shift lever locating pins from housing (fig. 2B-45).

(3) Mount housing in vise with shift forks facing upward.

(4) Remove backup lamp switch and TCS switch, if equipped.

(5) Remove shift rail bore plugs using hammer and punch.

(6) Move shift rails to Neutral position.

(7) Remove roll pins that fasten shift forks and shift gates to shift rails. Use hammer and pin punch to drive pins out.

(8) Cover poppet ball holes in housing with tape to prevent ball or spring loss during removal.

(9) Remove shift rails. Tap rails out of housing using hammer and brass punch.

(10) Remove interlock pin from third-fourth shift rail.

(11) Remove shift forks and shift gates. Be sure to mark or note position of forks and gates for assembly reference before removal.

(12) Remove poppet balls and springs from housing.

(13) Remove interlock plungers from housing.

(14) Remove retaining clip from reverse shift gate and remove spring and plunger from gate.

(15) Inspect housing breather. Remove breather if damaged or restricted in any way.

### Assembly

(1) Install replacement breather in housing if removed.

(2) Install spring and plunger in reverse shift gate. Compress plunger and install plunger retaining clip.

(3) Insert reverse shift rail into housing. Install reverse shift fork on rail and slide rail up to but not into shift rail poppet bore.

(4) Install poppet spring and ball in reverse shift rail poppet bore. Compress ball and spring using punch and slide rail through bore.

(5) Install reverse shift gate on opposite end of shift rail and slide rail into housing until poppet ball engages in rail notch. Install shift gate so plunger pin boss faces rear of housing (fig. 2B-46).

(6) Align and install roll pins that fasten reverse shift fork and shift gate to shift rail.

(7) Install interlock plungers in pockets located between housing shift rail poppet bores.

## 2B-28 MANUAL TRANSMISSION

(8) Insert first-second shift rail into housing. Install first-second shift fork on rail so fork offset faces rear of housing (fig. 2B-46). Slide shift rail up to but not into shift rail poppet bore.

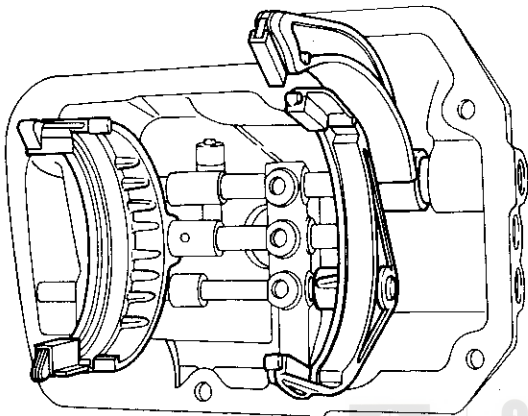


Fig. 2B-46 Shift Fork/Shift Gate Position

(9) Install poppet spring and ball in first-second shift rail poppet bore. Compress ball and spring using punch and slide shift rail through bore.

(10) Install first-second shift gate on opposite end of shift rail and slide rail into housing until poppet ball engages in rail notch.

(11) Align and install roll pins that fasten first-second shift fork and shift gate to shift rail.

(12) Insert third-fourth shift rail through center bore in housing. Install third-fourth shift gate on rail so flat tang on gate faces front of housing (fig. 2B-46).

(13) Coat interlock pin with petroleum jelly (to hold it in place) and install pin in third-fourth shift rail pin bore.

(14) Install poppet spring and ball in third-fourth shift rail poppet bore. Compress ball and spring using punch and slide rail through bore.

(15) Install third-fourth shift fork on shift rail and slide rail into housing until poppet ball engages in rail notch.

(16) Align and install roll pins that fasten third-fourth shift fork and shift gate to shift rail.

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**NOTE:** To avoid hard shifting after assembly, be sure the third-fourth shift gate roll pin is installed so it is flush with the bottom of the shift gate notch.

## SPECIFICATIONS

### Transmission Specifications

Model	T18A
Type	Synchromesh
Speeds	4 Forward, 1 Reverse
Gear Ratios:	
First	6.32:1
Second	3.09:1
Third	1.69:1
Fourth	1.00:1
Reverse	7.44:1
End Play Tolerances	All end play controlled by selective thickness snap rings. Use thickest snap rings available.
Lubricant Capacity	6-1/2 Pints (3.07 liters)
Lubricant Type	SAE 90 Gear Lubricant

**Torque Specifications**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Backup Lamp Switch . . . . .	18	15-20	24	20-27
Drain Plug . . . . .	15	10-20	20	14-27
Fill Plug . . . . .	15	10-20	20	14-27
Front Bearing Cap Bolt . . . . .	15	12-18	20	16-24
Shift Control Housing-to-Case Bolt . . . . .	12	10-15	16	14-20
Transfer Case Drive Gear Locknut . . . . .	150	145-155	203	197-210
Transfer Case-to-Transmission Case Bolt . . . . .	30	25-35	41	34-47
TCS Switch . . . . .	18	15-20	24	20-27

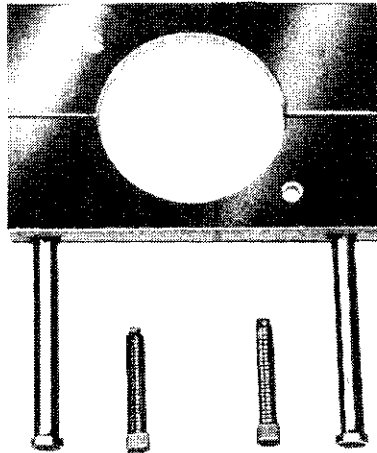
All torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Marking chart in Chapter A for torque values not listed above.

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**Tools**  
**AUTHENTIC RESTORATION**  
**PRODUCT**



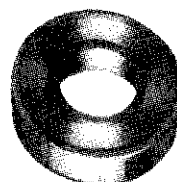
**J-6654-01  
 BEARING REMOVER**



**J-25232  
 ARBOR TOOL**



**J-26852  
 MAINSHAFT REAR  
 SEAL INSTALLER**



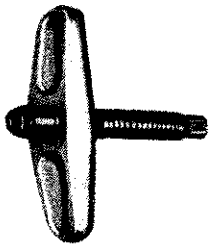
**J-25233  
 FRONT BEARING CAP  
 SEAL INSTALLER**



**2B-30 MANUAL TRANSMISSION**

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**Tools**



**J-25200  
THRUST YOKE TOOL**



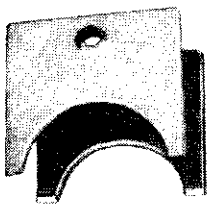
**J-25152  
BEARING REMOVER  
TOOL SET**



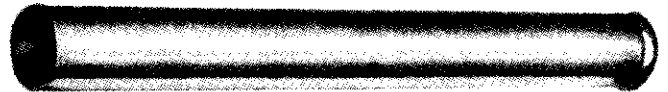
**J-25199  
COUNTERSHAFT  
ARBOR TOOL**



**J-26092  
BEARING INSTALLER TOOL**



**J-25203  
REVERSE IDLER GEAR  
ARBOR TOOL**



**J-22828  
BEARING INSTALLER**

## NOTES



**AUTHENTIC  
RESTORATION™**



# AUTOMATIC TRANSMISSION 2C

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## GENERAL INFORMATION

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### GENERAL

The automatic transmission used in all Jeep models is a fully automatic, hydraulically operated, three-speed unit combining a torque converter and compound planetary gear system. The transmission case and converter housing are a one-piece aluminum casting (fig. 2C-1).

The transmission consists of a three element torque converter, two planetary gear sets, three multiple disc clutches, two roller clutches, and two bands, all of which combine to provide one reverse and three forward gear ratios. The hydraulic system consists of a single oil pump, two band actuating servos, a valve body, and a governor valve.

A mechanical linkage is used to select desired gear range. Shift speed and quality are controlled by a vacuum modulator connected between the engine and transmission, and by a centrifugal governor valve mounted on the output shaft. An electrically operated detent solenoid valve and detent switch provide detent downshift capabilities.

### Power Flow

The direct transmission-to-engine connection is through the torque converter, which is connected to the engine crankshaft by a driveplate. In operation, engine torque is transmitted through the converter to the turbine shaft and then to the main shaft through multiple disc clutches in the transmission. From the mainshaft, engine torque is further transmitted through the com-

pound planetary gear set and to the transmission output shaft.

### IDENTIFICATION

The transmission serial number is stamped on a metal plate attached to the right side of the transmission case. The serial number must be included in any communication involving parts ordering or requests for transmission information.

### INTERNAL COMPONENTS AND CONTROLS

#### Oil Cooler and Fluid Filter

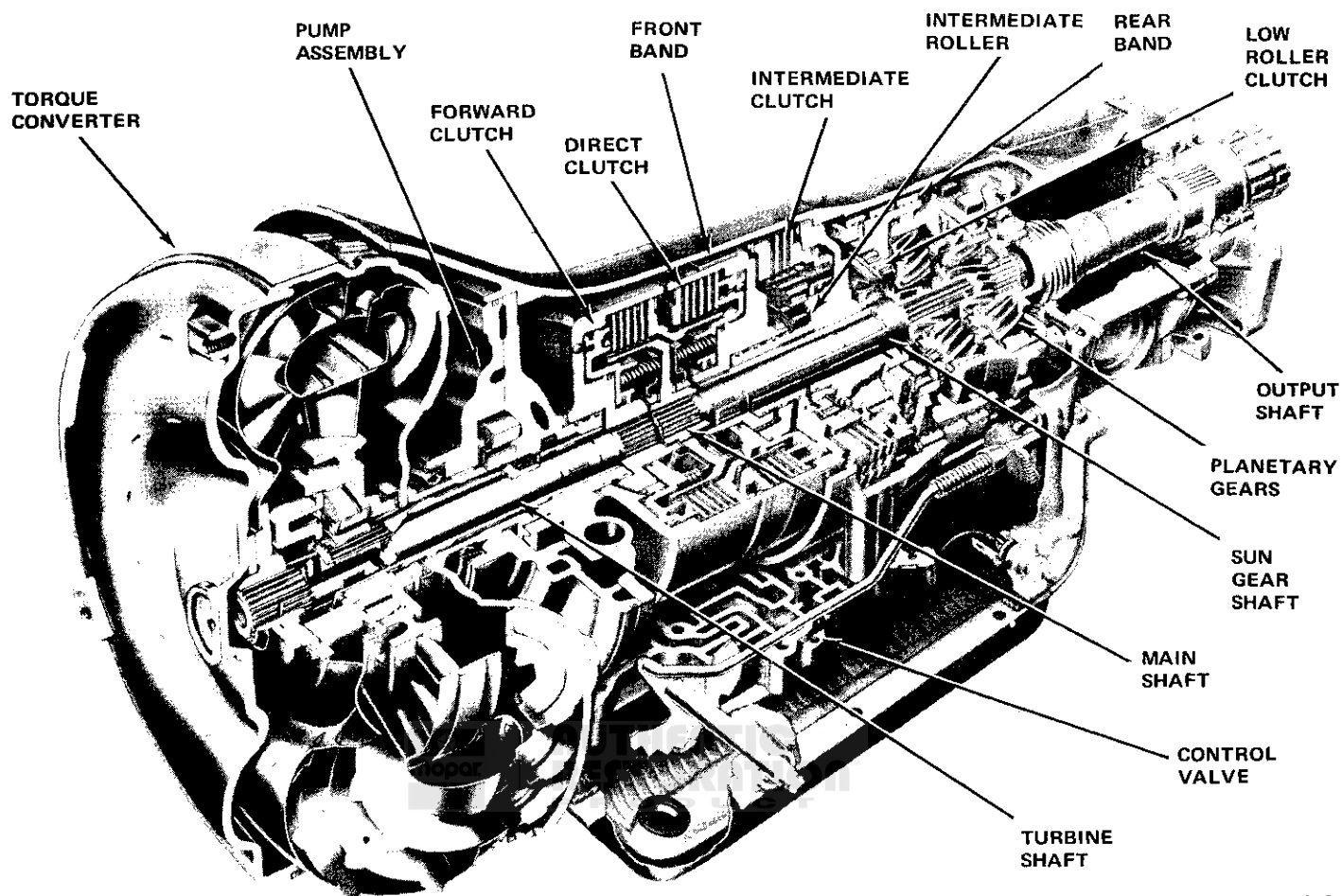
The transmission fluid is cooled by circulating the fluid through an external oil cooler located in the radiator lower tank. Fluid pressure and return lines connected to hydraulic fittings on the left-side of the transmission case, are used to conduct fluid to and from the oil cooler.

Transmission fluid is filtered through a Dacron element filter which is attached to the valve body. The filter is submerged in the transmission oil sump and also functions as the transmission sump-oil pickup.

#### Venting

The transmission is vented through a plastic tube mounted in the transmission case. The tube is located just above the vacuum modulator.

## 2C-2 AUTOMATIC TRANSMISSION



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Fig. 2C-1 Jeep Automatic Transmission

### Torque Converter

The three-element torque converter consists of a pump or driving member, a turbine or driven member and a stator assembly. The stator is mounted on a one-way roller clutch which allows the stator to turn in a clockwise direction only (fig. 2C-2). The converter is welded together during manufacture and cannot be disassembled for service.

As oil passes through the turbine, it travels in such a direction that if it were not redirected by the stator it would hit the rear of the converter pump blades and impede pumping action (fig. 2C-2). At low turbine rotating speeds, oil is redirected by the stator to the converter pump to assist the converter pump in multiplying engine torque.

As turbine rotating speed increases, the direction of the oil leaving the turbine changes and flows against the rear side of the stator vanes in a clockwise direction. Since the stator is now impeding the smooth flow of oil, the stator roller clutch releases allowing the stator to revolve freely on the stator shaft. When the stator free-wheels, there is no further multiplication of engine torque within the converter which has now achieved

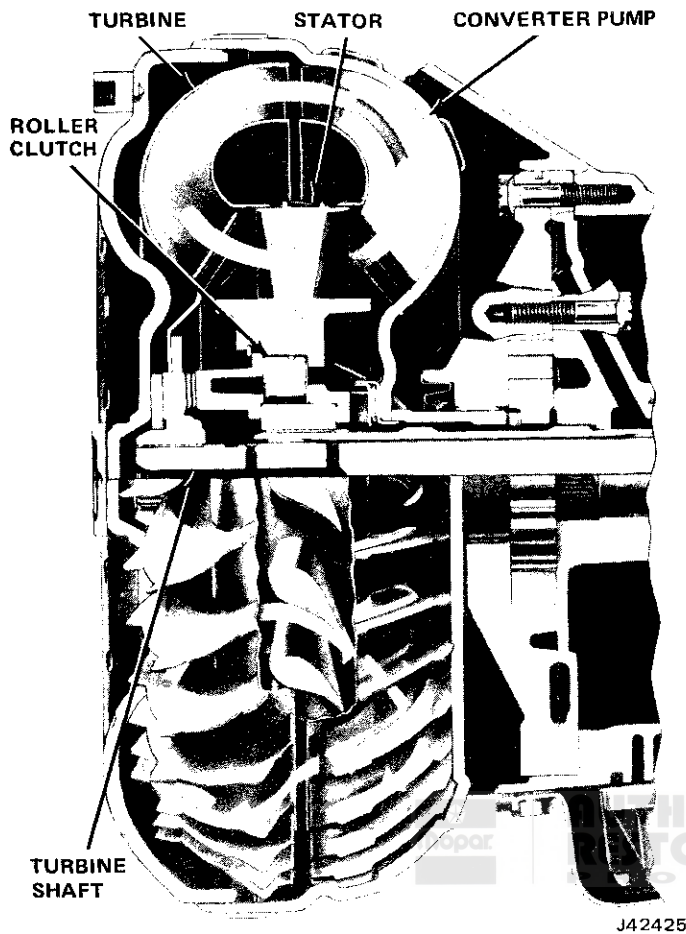
coupling speed. At this point, the converter functions as a fluid coupling as both the converter pump and turbine are being driven at approximately the same speed.

### Manual Linkage-Vacuum Modulator-Detent Solenoid

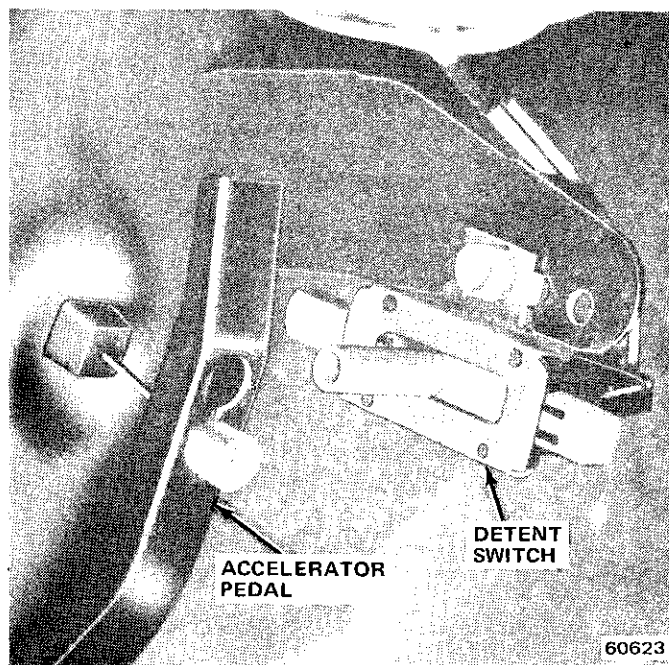
External and internal transmission controls consist of: a manual linkage to select the desired gear range, a modulator valve, operated by engine vacuum to sense engine torque changes, and an electrically operated detent solenoid and detent switch to provide full throttle downshift capability.

The vacuum operated modulator senses changes in engine torque input to the transmission. The modulator transmits this signal to the pressure regulator which controls line pressure to the 1-2 accumulator valve and to the shift valves in the valve body.

The detent solenoid is mounted on the valve body and is activated by the detent switch which is mounted under the dash panel. The switch is operated by the accelerator pedal (fig. 2C-3). When the pedal is moved to full throttle position, the switch contacts close completing the circuit to the solenoid. The solenoid then releases



**Fig. 2C-2 Torque Converter**



**Fig. 2C-3 Detent Switch**

direct clutch apply pressure, reroutes apply pressure into the intermediate clutch and downshifts the transmission to second gear. Downshifts occur at speeds below approximately 65 mph (105 km/h).

The manual linkage provides the mechanical connection between valve body manual valve and column-mounted gearshift lever. The linkage allows the driver to select the desired transmission gear range.

**Planetary Gear Train**

The planetary gear train consists of four members: a sun gear, two planet carriers, each having four pinion gears, and an internal gear (fig. 2C-1). The sun gear meshes with the planet pinion gears, which rotate freely on pins attached to a common support called the planet carrier. An internal gear encases the assembly and meshes with the planet pinion gears.

**Roller Clutches**

A roller clutch permits rotation of a unit in one direction only. Roller clutches are used to lock one member of each planetary gear set for gear reduction. The intermediate roller clutch is effective in second gear D or 2-range only. The low roller clutch is effective in first gear D or 1-range only. In direct drive (third gear), the roller clutches allow free rotation of all members.

**HYDRAULIC SYSTEM OPERATION**

**Pressure Control**

Hydraulic system pressure is developed and supplied by the gear-type oil pump which is driven by the torque converter pump. Main line pressure is determined by a pressure regulator valve located in the pump housing. This valve regulates line pressure automatically and in response to vacuum signals from the modulator valve.

**Vacuum Modulator**

The engine-to-transmission vacuum signal is provided by the vacuum modulator which consists of an evacuated metal bellows, a diaphragm, and two springs. The bellows and one spring apply a force which acts on the modulator valve to increase modulator pressure. Engine vacuum and the second spring act in the opposite direction to decrease modulator pressure. Low engine vacuum results in high modulator pressure, while high engine vacuum results in low modulator pressure.

**Governor**

The vehicle speed signal to the modulator valve is supplied by the centrifugal governor which is driven by the transmission output shaft. The governor consists of two sets of centrifugal weights, two springs, and a regulator valve. Centrifugal force acting on the governor

weights is transmitted to the regulator valve causing the valve to send a pressure signal that increases with vehicle speed.

### Front Servo

The front servo applies the front band to provide engine braking action in second gear in the 2 and 1 gearshift positions. The front servo also functions as an accumulator in applying the direct clutch. In conjunction with a series of check balls and controlling orifices, the servo also assists in timing direct clutch release.

To prevent front band application in Neutral, Drive and Reverse, oil is directed from the manual valve to the release side of the servo piston.

In Drive range, servo release oil from the manual valve is used to charge the servo in preparation for direct clutch application.

Direct clutch oil is applied to the front servo accumulator piston where spring force, plus direct clutch pressure, moves the piston upward against the force of servo release oil. This decreases clutch apply pressure for smoother engagement.

The release of the direct clutch and exhausting of the front servo accumulator is slowed by three check balls and three orifices for smoother return of drive load to the intermediate roller clutch.

### Drive Range—First Gear

Front servo oil from the manual valve charges the accumulator by moving the servo and accumulator pistons against the accumulator spring. This prepares the accumulator for controlled direct clutch apply on 2-3 upshifts. Charging the accumulator in Drive range-first gear also provides controlled 1-3 lift-foot upshifts as the accumulator is prepared for direct clutch apply in first gear.

Servo oil and servo release spring tension prevent band application in Drive range-second gear when intermediate clutch apply oil is directed between the servo and accumulator pistons.

### Drive Range—Second Gear

Servo oil charging the accumulator is present in first and second gears and moves the servo and accumulator pistons against the accumulator spring.

In second gear, intermediate clutch oil is directed between the servo and accumulator pistons but does not separate the pistons. At this point, the force of servo oil holding the piston down is equal to the force of intermediate clutch oil attempting to move the piston upward.

### Drive Range—Third Gear

An increase in direct clutch pressure, plus accumula-

tor spring force overcomes servo pressure and moves the accumulator piston to the accumulator piston pin stop. This moves the servo piston at the same amount of travel allowing the piston to just contact the band-apply washer on the servo pin, but not move the pin and apply the band.

Movement of the accumulator piston absorbs some direct clutch oil and permits reduced pressure direct clutch application for smoother 2-3 upshifts.

### Drive Range—3-2 Downshift

Direct clutch release is softened by the front servo, three orifices, and three check balls for a smoother transfer of drive load to the intermediate roller clutch. The controlled release pressure permits an increase in engine rpm during detent downshifts to prepare for the lower gear ratio of second gear, resulting in a smoother shift and acceleration.

Servo oil and intermediate clutch oil seat two check balls which direct oil through two orifices, slowing movement of the servo and accumulator pistons. Direct clutch oil that is exhausted from the accumulator and direct clutch seats a third check ball. This channels oil being exhausted from the direct clutch through an orifice which controls direct clutch pressure during clutch release.

### Drive-2 Range—First Gear

Intermediate clutch oil from the 1-2 shift valve seats the check ball and is directed through an orifice to apply the front band. Band apply pressure is reduced by accumulator piston movement which is prompted by intermediate clutch oil. It is further resisted by accumulator spring tension and by oil exhausted from the direct clutch.

### Rear Servo

The rear servo applies the rear band for overrun engine braking in Drive-1 range. It applies the band in Reverse to hold the reaction carrier to provide the reverse gear ratio.

On the 1-2 shift in Drive and Drive-2 ranges, the rear servo operates as an accumulator for the intermediate clutch to provide smoother shifts.

### Rear Servo—Drive-1 Range

In Drive-1 and Drive-2 ranges, 1-2 accumulator oil is directed to the rear servo accumulator piston in preparation for the 1-2 shift.

### Rear Servo—Drive-2 Range

Intermediate clutch apply oil is directed to the rear servo accumulator piston moving the piston against 1-2 accumulator oil and the accumulator spring. This action absorbs some intermediate clutch apply oil permitting

reduced pressure intermediate clutch application for smooth 1-2 shifts.

### Drive-1 Range—Overrun Braking

Overrun engine braking in Drive-1 range first gear is obtained by charging the rear servo, which applies the rear band preventing the reaction carrier from rotating in a clockwise direction (as viewed from the front of the vehicle).

The 1-2 accumulator oil is directed to the accumulator piston, which attempts to prevent the servo from applying. However, 1-range oil directed to the larger servo piston will apply the band. Because 1-2 accumulator oil is present, band apply force is decreased providing smoother application.

### Drive-2 Range—Second Gear

In second gear, the rear band is released. Intermediate clutch oil is directed to the release side of the servo piston along with 1-2 accumulator oil. This balances first gear oil acting on the apply side of the servo piston, and allows servo spring tension to move the servo piston to the released position.

### Reverse

In reverse, the rear band is applied to hold the reaction carrier. Reverse oil is directed to the servo piston to apply the band. To ensure that the band holds the reaction carrier, line pressure is increased and no other oil pressure is present in the servo to resist servo piston movement.

### 1-2 Accumulator

In first gear, 1-2 accumulator oil charges the rear servo accumulator preparatory to application of the intermediate clutch on 1-2 upshifts. Line oil pressure is directed to the 1-2 accumulator valve and is further regulated to become 1-2 accumulator oil. Modulator pressure is directed to the 1-2 accumulator valve, causing 1-2 accumulator pressure to become sensitive to engine torque. This provides smoother shifts in response to engine torque output.

Detent oil is directed to the 1-2 accumulator valve to raise 1-2 accumulator pressure during detent 1-2 shifts to improve clutch life. In Drive-1 range, oil is directed to the 1-2 accumulator valve to raise 1-2 accumulator pressure to the same value line pressure. This increased pressure, directed to the rear servo accumulator piston, resists servo apply pressure and slows down the apply of the rear band for a smoother manual shift to Drive-1 range first gear, or for a 2-1 downshift in Drive-1 range.

### Detent and Detent Regulator Valves

When the accelerator pedal is fully depressed, the detent valve train replaces the modulator as a controller

of shift points. Line pressure is fed through a small orifice to one end of the detent valve. In normal throttle operation, the cavity at this end of the valve is sealed by a needle valve in the detent solenoid assembly. This line pressure holds the detent valve train in an inoperative or neutral position.

When the throttle is opened wide, the detent switch on the accelerator pedal is closed, energizing the detent solenoid. The needle valve is opened by the solenoid, causing a pressure drop on the end of the detent valve. The detent regulator valve spring then shifts the detent valve causing the detent regulator to regulate detent oil at a fixed pressure of approximately 60 psi (414 kPa). When the detent valve shifts, it routes this fixed pressure into the modulator passages. The detent valve train also routes detent pressure into the detent passages to the shift valve train. The detent upshift points are controlled by detent pressure in the modulator passages, and the detent downshifts by detent pressure in the detent passages.

Detent pressure is directed to the 1-2 accumulator valve to increase 1-2 accumulator pressure for clutch durability during detent shifting. Detent pressure is prevented from dropping below approximately 60 psi (414 kPa) which, in turn, prevents line pressure from dropping below approximately 105 psi (724 kPa).

In Drive-1 range, oil is directed to the detent regulator valve and spacer; the spring then moves the detent and regulator valves to the opposite end of the valve bore. Oil pressure is also directed to the detent regulator valve passage which is used as an exhaust when the valve is regulating. Low range oil in these two areas prevents the detent valve from regulating, and drive range oil then passes through the detent regulator valve into the detent and modulator passages at Drive-1 range pressure of 150 psi (1 034 kPa). This increase in detent and modulator pressures downshifts the 1-2 valve at speeds below approximately 40 mph (64 km/h), and prevents the transmission from upshifting regardless of vehicle speed except in those vehicles which have a high numerical axle ratio or are able to develop high engine rpm.

### Park-Neutral

In Park and Neutral, pump supplied oil is routed to and from the release side of the front servo through the manual valve; then through the detent regulator valve, modulator valve orifice, and back to the sump. Clutch and band application does not occur in either of these gearshift lever positions.

### TOWING

#### Emergency Towing

If the vehicle is to be towed with the **front or rear wheels off the ground**, towing speed must be limited to 30 mph (48 km/h) and the vehicle towed for a distance no greater than 15 miles (24 km).



### Automatic Transmission with Quadra-Trac Less Low Range Reduction Unit

**Ignition Key Available:** Turn ignition key to Off position to unlock steering column and gearshift linkage. Place gearshift lever in Neutral. If the vehicle is to be towed with all four wheels on the ground, disconnect both propeller shafts at the axle yokes (be sure to mark the shafts and yokes for assembly alignment reference), secure the shafts to the underside of the vehicle and proceed with towing. However, if the vehicle is to be towed with the front end raised, disconnect the rear propeller shaft only.

**Ignition Key Not Available:** Place a dolly under the rear wheels and tow the vehicle with the front end raised. Or, disconnect the rear propeller shaft at the axle yoke (be sure to mark the shaft and yoke for assembly alignment reference), secure the shaft to the underside of the vehicle and tow with the front wheels raised.

### Automatic Transmission With Quadra-Trac and Low Range Reduction Unit

**Ignition Key Available:** The vehicle can be towed with all four wheels on the ground without disconnecting either of the the propeller shafts. Turn the ignition key to the Off position to unlock the steering wheel. Place the transmission gearshift lever in Neutral and shift the low range lever to Neutral.

**CAUTION:** *If the Emergency Drive control (in the glove box) was in the Emergency Drive position when the engine was stopped, restart the engine and turn the control knob to the Normal position. If the engine will not restart, place a dolly under the rear wheels and tow with the front wheels raised. Never tow the vehicle with the Emergency Drive control activated or the reduction unit in low range.*

**Ignition Key Not Available:** Place a dolly under the

rear wheels and tow the vehicle with the front wheels raised. Or, disconnect the rear propeller shaft at the axle yoke (be sure to mark the shaft and yoke for assembly alignment reference), secure the shaft to the underside of the vehicle and tow with the front wheels raised.

### Recreational Towing

Jeep vehicles can be towed behind a recreational vehicle such as a motor home, however, the following instructions must be followed explicitly in order to avoid damaging driveline components. In addition, be sure to check and comply with federal, state and local requirements/ordinances regarding vehicle lighting, tow bars and trailer hitches.

### Automatic Transmission Without Quadra-Trac Low Range Unit

Turn the ignition key to the Off position to unlock the steering wheel. Shift the transmission into **Neutral**. Disconnect both propeller shafts at the axle yokes and secure the shafts to the underside of the vehicle or remove the shafts completely. Be sure to mark the shafts and yokes for assembly alignment reference before disconnecting them.

### Automatic Transmission With Quadra-Trac Low Range Reduction Unit

Turn the ignition key to the Off position to unlock the steering wheel. Shift the **transmission** into **Park**. Shift the **low range unit** into **Neutral**. Tow the vehicle with all four wheels on the ground. It is not necessary to disconnect either of the propeller shafts in this case.

**CAUTION:** *If the Emergency Drive control (in the glove box) was in the Emergency Drive position when the engine was stopped, restart the engine and turn the control knob to Normal position. Never tow the vehicle with the control knob in the Emergency Drive position or with the low range reduction unit in low range.*

## DIAGNOSIS AND TEST PROCEDURES

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### PRELIMINARY DIAGNOSIS

In all automatic transmission repair, the logical and

proper procedure is diagnosis before disassembly. A systematic diagnosis procedure is necessary and practical for two important reasons. First, in locating the cause of

a malfunction and second, to avoid repair delays resulting from incorrect or unnecessary repairs.

Jeep automatic transmission malfunctions may be caused by one or more of the following general conditions:

- Poor engine performance.
- Loss of vacuum or insufficient vacuum.
- Loss of electrical signal.
- Incorrect fluid level.
- Incorrect linkage, switch, or band adjustment.
- Hydraulic system malfunctions.
- Mechanical component malfunctions.

Two basic preliminary diagnosis procedures are required. One for vehicles in operating condition (can be driven) and one for vehicles not in operating condition (cannot be driven).

### Vehicle In Operating Condition

(1) Check engine performance. If engine performs poorly, transmission operation will be affected equally.

(2) Check and correct fluid level as necessary. Refer to Fluid Level and Condition.

**NOTE:** *If the fluid level was low, check for leaks and correct as necessary. However, if the fluid was dark, smelled burnt, and contained heavy accumulation of metal or clutch friction material particles, an overhaul may be required. Remove the oil pan and check for further accumulation of particles in the pan and fluid.*

(3) Check and correct manual linkage and neutral switch adjustment as necessary. Engine should start in Park and Neutral only.

(4) Check condition of modulator vacuum line. Replace line if cut, cracked or broken.

**NOTE:** *The metal portion of the modulator vacuum supply line is crimped during manufacture to provide a slight restriction in the line. This restriction causes the vacuum modulator to be less sensitive to fluctuations in engine vacuum.*

(5) If complaint is based on delayed, erratic, no-upshift, or full throttle upshift only, check vacuum modulator and governor. Refer to modulator and control valve and governor tests.

(6) If complaint is based on loss of detent downshift (no kickdown) or delayed or no upshift, check wires connecting detent switch to detent solenoid and check switch and solenoid continuity. Refer to diagnosis charts.

(7) Road test car and analyze results. Refer to road test and clutch and band application chart.

(8) Perform hydraulic system pressure test and analyze results. Refer to hydraulic pressure test, pressure test analysis, and test gauge installation charts.

(9) Consult diagnosis charts and guides for further assistance in pinpointing cause of malfunction.

(10) Repair transmission as necessary.

### Vehicle Not In Operating Condition

(1) Check fluid level. Refer to fluid level and condition and step (2) and Note under Vehicle In Operating Condition.

(2) Check for broken or disconnected manual linkage.

(3) Check for broken or malfunctioned neutral start switch or broken, loose, or open switch wires.

(4) Raise vehicle on twin post-type hoist. All wheels must be free to rotate.

(5) Check for broken or loose oil cooler lines or cooler line fittings, loose or broken modulator, and loose or missing pressure port plug.

(6) Start engine, shift transmission into Drive and check for following:

(a) If propeller shafts turn but wheels do not, problem is with differentials or axle shafts.

(b) If propeller shafts do not turn and transmission is noisy, remove converter housing inspection cover and oil pan. Check for broken drive plate-to-crankshaft bolts, broken drive plate-to-converter bolts, and damaged components or debris in oil pan. If broken bolts, components, or debris in pan are not found, remove transmission and check for broken converter hub, drive plate, input shaft, or oil pump.

(c) If propeller shafts do not turn and transmission is not noisy, perform hydraulic system pressure test to determine if problem is related to hydraulic or mechanical component.

(7) Shift transmission into neutral, stop engine, and repair transmission as necessary.

### FLUID LEVEL AND CONDITION

A correct fluid level is important to proper transmission operation. A low level allows the pump to take in air along with the fluid. This aerates the fluid resulting in slow pressure buildup, fluid overheating and oxidation, and sluggish operation. An overfilled transmission will produce the same conditions occurring with a low level. In this case, the transmission internal components aerate the fluid by churning it into foam. In addition, foaming can result in fluid loss from the transmission fill tube and vent.

### Checking Fluid Level

(1) Drive vehicle until fluid is at normal operating temperature of 170°F (77°C). At required temperature, gauge end of dipstick will be heated to such a degree that it cannot be grasped with fingers.

(2) Place vehicle on level surface.

(3) Apply parking brake.

(4) Operate engine at hot idle speed.

(5) Move gearshift lever through all gear ranges.

(6) Shift transmission into Park.

(7) Check fluid level and condition. Level should be between ADD and FULL marks on dipstick when fluid

## 2C-8 AUTOMATIC TRANSMISSION

is operating temperature of approximately 170°F (77°C).

**NOTE:** If the transmission fluid level is checked at room temperature of 75°F (24°C), instead of at operating temperature, the level should be about 1/4 inch (6.35 mm) below the ADD mark on the dipstick. If the fluid level is correctly established at room temperature, it should be at the FULL mark on the dipstick when the fluid reaches operating temperature.

(8) If fluid level is low, add fluid as necessary, reinstall and seat dipstick, and check for leaks.

**CAUTION:** Do not overfill the transmission. Overfilling will result in fluid foaming (aeration) and consequent loss of fluid from the vent and fill tube. In addition, foaming will cause fluid overheating, oxidation, and varnish buildup, which can interfere with valve, clutch, and servo operation.

### Fluid Condition

Along with fluid level, it is equally important to check fluid condition. If the fluid is dark, smells burnt, or contains heavy accumulations of metal and clutch plate material, an overhaul may be indicated. Examine the fluid withdrawn on the dipstick carefully. If any doubt about its condition exists, drain out a sample for further inspection.

**CAUTION:** After completing any repairs that required draining the transmission, add six quarts of Jeep, Dexron, or equivalent automatic transmission fluid to the transmission before starting the engine.

### ROAD TEST

Before road testing, be sure the fluid level and manual linkage adjustment is checked and corrected if necessary.

Note engine performance when road testing. Poor performance will have an adverse effect on transmission operation.

During the test, operate the transmission in all gear ranges to check for shift variations and shift speeds. Refer to the shift speed chart in the specifications section. Note whether shifts are erratic, harsh, or spongy, and if slippage or engine speed flareup occurs during shifts. Slippage or flareup may indicate clutch, band or roller clutch problems.

In most cases, a clutch, band or roller clutch that is malfunctioning can be determined by comparing which internal units are applied in each gearshift lever position as shown in the clutch and band application chart.

**NOTE:** Analyzing road test results through use of the Clutch and Band Application Chart will help in determining which internal unit has malfunctioned.

**Clutch and Band Application Chart**

	P	R	N	D			2		1
				1	2	3	1	2	
Forward Clutch				●	●	●	●	●	●
Direct Clutch		●				●			
Front Band								●	
Intermediate Clutch					●			●	
Intermediate Sprag					●			●	
Rear Band		●							●
Lo Clutch Roller				●					●

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### Road Test Procedure

#### D-Range

(1) Shift transmission into D-range and accelerate vehicle from zero mph.

(2) A 1-2 and 2-3 shift should occur at all throttle openings. Shift points will vary with throttle opening.

(3) Decelerate vehicle. As vehicle speed approaches zero mph or km/h, 3-2 and 2-1 downshifts should occur.

#### 2-Range

(1) Shift transmission into 2-range and accelerate vehicle from zero mph or km/h.

(2) A 1-2 shift should occur at all throttle openings. Shift points will vary with throttle opening. A 2-3 upshift should not occur in this range.

(3) Decelerate vehicle. As vehicle speed approaches zero mph or km/h, 2-1 downshift should occur.

**NOTE:** The 1-2 upshift in 2-range is somewhat firmer than in D-range. This is normal.

#### 1-Range

(1) Shift transmission into 1-range and accelerate vehicle from zero mph or km/h.

(2) A 1-2 upshift should not occur in this range.

#### 2-Range—Overrun Braking

(1) Shift transmission into D-range and increase vehicle speed to approximately 30 mph (48 km/h).

(2) At 30 mph (48 km/h), shift transmission into 2-range. Downshift to second gear should occur immediately. An increase in engine rpm and an engine braking effect should also occur.

**NOTE:** If a hydraulic system pressure test gauge has been installed, line pressure should change from approximately 70 psi (483 kPa) to approximately 150 psi (1 034 kPa) when the transmission is downshifted to 2-range.

**1-Range—Overrun Braking**

(1) Shift transmission into 2-range and increase vehicle speed to 30-40 mph (48-64 km/h).

(2) Close throttle and shift transmission into 1-range. A 2-1 downshift should occur at 40-20 mph (64-32 km/h). A 2-1 downshift at closed throttle will be accompanied by increased engine rpm, and an engine braking effect should be noticed.

**NOTE:** *If a pressure test gauge has been installed, line pressure should be approximately 150 psi (1 034 kPa) after downshifting.*

**Reverse Range**

(1) Shift transmission into reverse.

(2) Transmission should engage in reverse promptly when gearshift lever is moved to R.

(3) Accelerate vehicle lightly and check reverse operation.

**HYDRAULIC PRESSURE TEST**

**WARNING:** *Do not permit anyone to stand in front of, or at the rear of the vehicle during the pressure test.*

(1) Check and correct fluid level.

(2) Check and adjust manual linkage if necessary.

(3) Check engine performance. A poorly tuned engine will affect transmission operation adversely.

(4) Raise vehicle on twin post-type hoist or hoist that will allow all wheels to rotate freely.

(5) Connect Oil Pressure Test Gauge J-5907 to transmission and connect tachometer to engine. Refer to Test Gauge Installation Chart.

(6) Lower vehicle and position tachometer and oil pressure gauge so they can be viewed from drivers seat.

(7) Raise hoist until vehicle wheels are at least 10-12 inches off floor. Do not raise vehicle completely.

(8) Shift transmission into Park and start engine.

(9) Apply parking brakes and wheel brakes firmly.

**CAUTION:** *Until noted otherwise, do not perform any of the following test steps unless the wheel brakes are firmly applied.*

(10) Shift transmission into neutral and increase engine speed to 1000 rpm. Record gauge pressure and close throttle. Pressure should be 55-70 psi (379-483 kPa).

(11) Shift transmission into D-range and record pressure with engine at hot idle speed. Pressure should be 60-85 psi (413-586 kPa).

(12) With transmission still in D-range, increase engine speed to 1000 rpm. Record gauge pressure and close throttle. Pressure should be 60-90 psi (413-620 kPa).

(13) Shift transmission into 1-range and increase engine speed to 1000 rpm. Record gauge pressure and close throttle. Pressure should be 135-165 psi (931-1 138 kPa).

(14) Shift transmission into reverse and increase en-

gine speed to 1000 rpm. Record gauge pressure and close throttle. Pressure should be 95-150 psi (655-1 034 kPa).

(15) Shift transmission into D-range. Increase engine speed to 1000 rpm, and activate detent switch under dash. Record gauge pressure, close throttle, deactivate switch, and shift transmission into neutral. Pressure should be 90-110 psi (620-758 kPa).

**NOTE:** *A wire loop can be used to activate the detent switch for this test step. Wrap the loop around the switch contact arm and pull the arm rearward until the switch contacts close.*

(16) Shift transmission into D-range and release brakes but do not open throttle. Record gauge pressure when speedometer registers approximately 30 mph with throttle closed. Pressure should be 55-70 psi (379-483 kPa).

(17) If complaint is based on delayed or erratic shifts or no 2-3 upshift, check governor and control valve operation. Refer to Control Valve and Governor Test.

(18) If line pressures recorded are well above specified pressures, refer to Control Valve and Governor Test-High Line Pressure.

(19) Consult pressure test analysis chart, hydraulic flow charts, and diagnosis charts and guides to analyse results of pressure test.

**CONTROL VALVE AND GOVERNOR TEST**

(1) Position vehicle on twin post hoist or hoist that will allow all wheels to rotate freely when hoist is raised.

(2) Connect tachometer to engine.

(3) Raise vehicle.

(4) Connect Oil Pressure Test Gauge J-5907 to transmission.

(5) Disconnect and plug modulator vacuum line.

(6) Lower vehicle.

(7) Position oil pressure test gauge and tachometer so they can be viewed from drivers seat.

(8) Raise vehicle until vehicle wheels are 10-12 inches (25-30 cm) off floor.

(9) Shift transmission into Park and start engine.

**NOTE:** *Do not apply the brakes during this test.*

(10) Shift transmission into D-range and increase engine speed to 1000 rpm. Record line pressure and close throttle. Pressure should be 60-90 psi (413-620 kPa).

(11) Slowly increase engine speed to 3000 rpm and check for line pressure drop as follows:

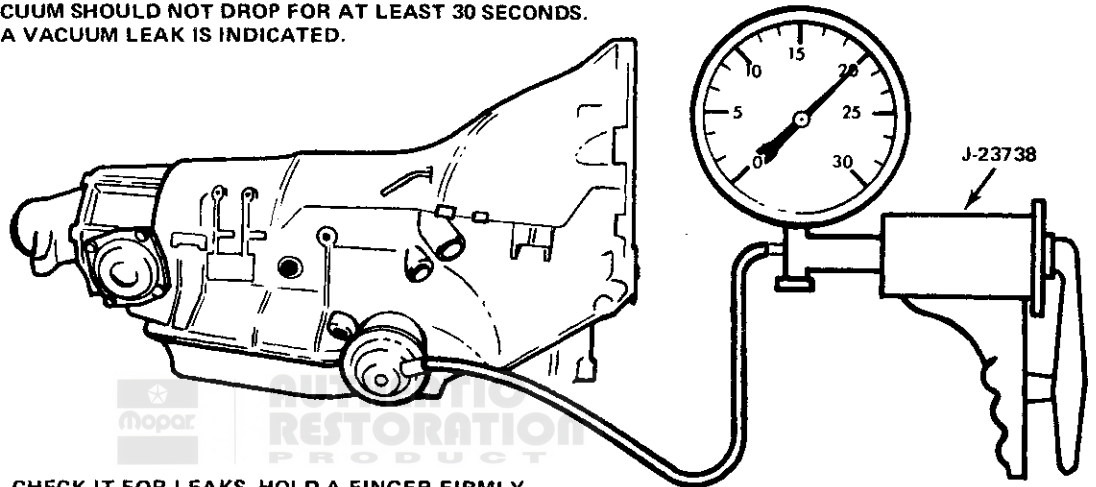
(a) If line pressure drops 10 psi (69 kPa) or more at 3000 rpm, remove, disassemble, clean and inspect control valve assembly.

(b) If line pressure drop is less than 10 psi (69 kPa) at 3000 rpm, remove and inspect governor for stuck valve, sticking weight(s), restricted valve orifice, insufficient valve entry and exhaust port minimum clearance of 0.020 inch (0.50 mm), restricted or damaged

## 2C-10 AUTOMATIC TRANSMISSION

### Test Gauge Installation USING HAND OPERATED VACUUM TESTER

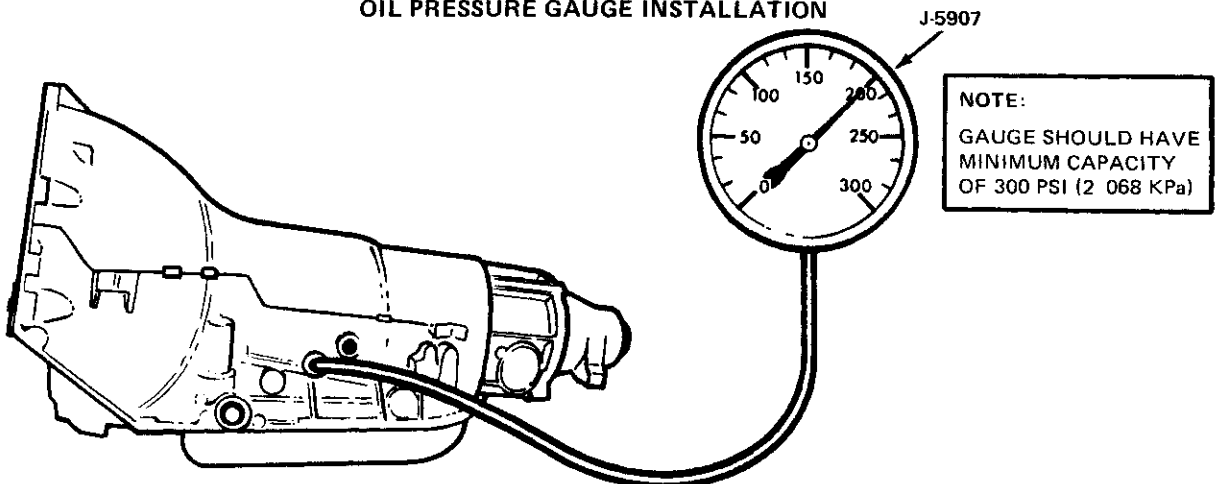
WHEN USING THE HAND OPERATED VACUUM TESTER TO PROVIDE A CONSISTENT VACUUM FOR LINE PRESSURE CHECKS AND/OR WHEN CHECKING A MODULATOR APPLY 20" OF VACUUM. VACUUM SHOULD NOT DROP FOR AT LEAST 30 SECONDS. IF A BLEED DOWN OCCURS, A VACUUM LEAK IS INDICATED.



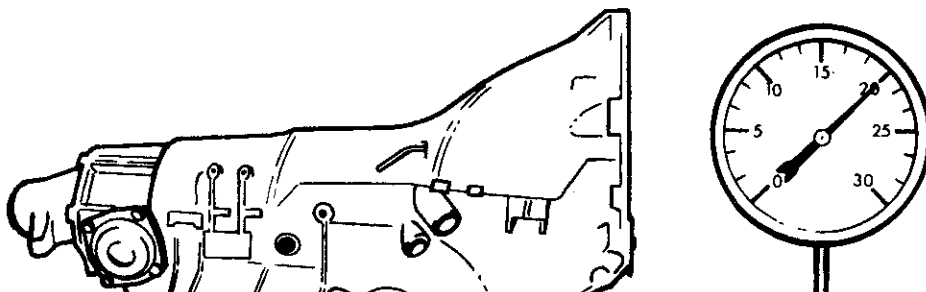
**NOTE:**

BEFORE USING THE TESTER, CHECK IT FOR LEAKS. HOLD A FINGER FIRMLY AGAINST THE END OF THE HOSE AND APPLY 20" OF VACUUM. VACUUM MUST NOT DROP ANY FOR AT LEAST 30 SECONDS. ALSO, MAKE SURE THE VACUUM MODULATOR HOSE IS VERY TIGHT.

### OIL PRESSURE GAUGE INSTALLATION



### VACUUM GAUGE INSTALLATION



**Hydraulic Pressure Test Analysis**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	
<b>MALFUNCTION</b>	NEUTRAL BRAKES APPLIED 1000 RPM	DRIVE IDLE	DRIVE BRAKES APPLIED 1000 RPM	DRIVE -1 BRAKES APPLIED 1000 RPM	REVERSE BRAKES APPLIED 1000 RPM	DRIVE-BRAKES APPLIED 1000 RPM DETENT SWITCH ACTIVATED	PRESSURE DROP OCCURS WHILE ENGINE RPM INCREASES FROM 1000 TO 3000 RPM WHEELS FREE TO MOVE*	DRIVE 30 MPH CLOSED THROTTLE	<b>POSSIBLE CAUSE OF MALFUNCTION</b>
	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	
<b>NO 1-2 UPSHIFT AND/OR DELAYED UPSHIFT</b>	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	10 PSI DROP OR MORE	NORMAL	MALFUNCTION IN CONTROL VALVE ASSY.
	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	10 PSI DROP OR MORE (69 KPa)	NORMAL	MALFUNCTION IN GOVERNOR OR GOVERNOR FEED SYSTEM
	NORMAL	HIGH	HIGH	NORMAL	NORMAL	NORMAL	DROP	HIGH	MALFUNCTION IN DETENT SYSTEM
	HIGH	HIGH	HIGH	NORMAL	HIGH	-	-	-	MALFUNCTION IN MODULATOR OR VACUUM FEED SYSTEM TO MODULATOR
<b>SLIPPING-REVERSE</b>	NORMAL	NORMAL	NORMAL	NORMAL	LOW	NORMAL	DROP	NORMAL	OIL LEAK IN FEED SYSTEM TO THE DIRECT CLUTCH
<b>SLIPPING-1ST GEAR</b>	NORMAL	LOW TO NORMAL	LOW TO NORMAL	LOW TO NORMAL	NORMAL	LOW TO NORMAL	-	LOW TO NORMAL	OIL LEAK IN FEED SYSTEM TO THE FORWARD CLUTCH
<b>NOT DETENT DOWNSHIFTS</b>	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	LOW	NORMAL	NORMAL	MALFUNCTION IN DETENT SYSTEM

\* DRIVE RANGE, VACUUM LINE DISCONNECTED FROM MODULATOR.  
NOTE: A DASH (-) IN THE ABOVE CHART MEANS THAT THE OIL PRESSURE READING HAS NO MEANING UNDER THE TEST CONDITION.

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governor pipe or screen in control valve or case, or governor pipes loose in case holes.

(12) If line pressures are high, proceed to High Line Pressure Check.

**High Line Pressure Check**

On vehicles with an EGR valve, the throttle is open enough in D-range at 1000 rpm to cause the EGR valve to open. When the valve opens, exhaust gas enters the intake manifold and decreases manifold vacuum. When manifold vacuum is decreased, transmission line pressure increases accordingly and may exceed the upper specification limit. For this reason, if high line pressures are obtained, proceed as follows:

- (1) Disconnect and plug EGR vacuum line at EGR valve.
- (2) Recheck line pressures according to test being performed.
- (3) If line pressures are still high, connect Vacuum Tester J-23738 to modulator and apply 20 inches of vacuum (67.3 kPa) to modulator.
- (4) Recheck line pressures according to test being performed and note following:
  - (a) If line pressures are still high, consult diagnosis charts and guides for probable cause.
  - (b) If line pressures are normal with external vacuum applied, check engine vacuum and vacuum systems for leaks.
- (5) Remove test gauges and tachometer and lower vehicle.
- (6) Perform repairs as necessary.

**MODULATOR TEST**

**Vacuum Diaphragm Leak Test**

(1) Check for presence of transmission fluid in modulator using pipe cleaner. Insert pipe cleaner into modulator vacuum connector pipe as far as possible. Withdraw pipe cleaner and check for presence of transmission fluid on pipe cleaner.

(2) Replace modulator if fluid is found in connector pipe (fig. 2C-4). Transmission fluid may be lost through diaphragm and burned in engine.

**NOTE:** Gasoline or water condensation may settle in the vacuum side of the modulator. If condensation is found but without the presence of transmission fluid, do not replace the modulator.

**Plunger Travel and Vacuum Holding Test**

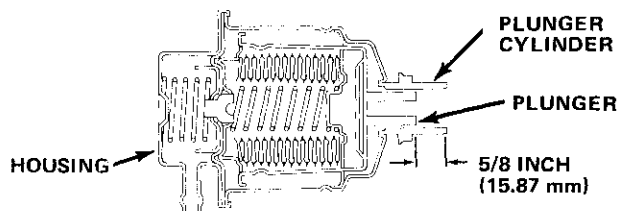
(1) Connect Vacuum Test Tool J-23738 to modulator.

(2) Slowly apply maximum of 21 inches vacuum and note when modulator plunger travel begins and ends. On models with 258/304 CID engines (transmission models JC, JS, JK), plunger travel should begin at approximately 16 inches vacuum and end at approximately 21 inches. On models with 360 CID engine (transmission models JR, JM), plunger travel should begin at approximately 12 inches vacuum and end at approximately 16 inches.

## 2C-12 AUTOMATIC TRANSMISSION

**CAUTION:** To avoid damaging the modulator vacuum diaphragm, do not apply more than 21 inches of vacuum at any time.

(3) Apply 21 inches vacuum to modulator and measure plunger travel (fig. 2C-4). At this vacuum level, distance from end of plunger to end of modulator cylinder should be 5/8 inch (15.8 mm).



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Fig. 2C-4 Vacuum Modulator

(4) Test holding ability of modulator vacuum diaphragm. Apply and maintain 21 inches vacuum to modulator for at least 30 seconds and check for plunger movement. Replace modulator if diaphragm will not hold vacuum for at least 30 seconds.

### Plunger Cylinder Concentricity Check

(1) Position cylinder portion of modulator on flat, level surface.

(2) Roll modulator back and forth and compare concentricity of plunger cylinder to modulator housing and plunger movement within cylinder.

(3) Reuse modulator if cylinder is concentric with housing and plunger moves freely.

(4) Replace modulator if plunger binds in cylinder or cylinder is not concentric (out of round) with modulator housing.

### CONVERTER HOUSING LEAK DIAGNOSIS

When diagnosing leaks in the converter housing area, two facts must be established before attempting repair. First, it must be verified that a leak condition does actually exist, and second, the real leak source must be determined. Failure to establish these facts beforehand can result in unnecessary or ineffective repair.

In some cases, suspected converter housing area fluid leaks may not be leaks at all. They may be the result of residual fluid in the converter housing or excess fluid spilled during factory filling or initial transmission operation. These conditions may be incorrectly diagnosed as leaks.

Converter housing area leaks may have several sources. Through careful observation, it is possible to pinpoint the leak source before removing the transmission. The paths that various types of fluid leaks follow are shown in Figure 2C-5 and are described as follows:

- Oil Pump Seal—leaks past the seal lip tend to move along the converter hub and onto the rear of the

converter housing. However, if total seal failure occurs, fluid will be deposited inside the converter housing only, near the housing outside diameter.

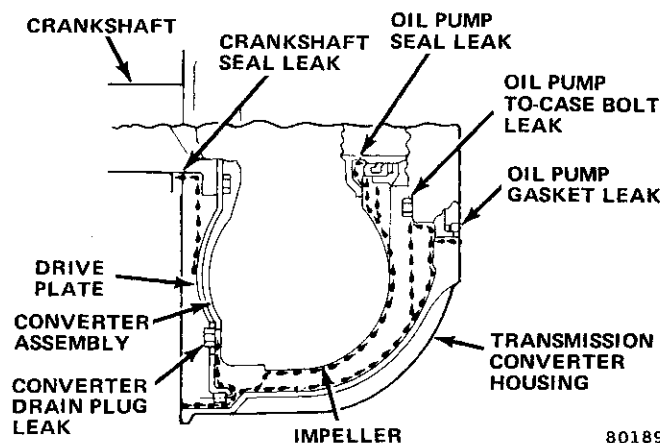
- Oil Pump Body—leaks from the pump body follow the same path as do pump seal leaks, or they may flow down the pump body face and into the converter housing.
- Oil Pump-to-Case Bolt—leaks past any one of these bolts are deposited on the inside of the converter housing only and not on the converter itself.
- Oil Pump-to-Case Gasket—leaks past the gasket are deposited inside the converter housing only.
- Converter Drain Plug—leaks past the plug threads are deposited on the converter, converter drive plate, and inside the converter housing near the drive plate.

Engine oil leaks are sometimes mistaken for transmission oil pump seal leaks. The following areas should be inspected to determine the actual leak source:

- Cylinder Head Cover and Gasket—leaks past the cover or gasket may flow down the engine block and onto the converter housing. Or, they may seep into the converter housing between the housing and engine block.
- Oil Gallery Plug—oil leaking past the plug will flow down the rear face of the engine block and into the bottom of the converter housing.
- Crankshaft Rear Main Seal—leaks past the seal collect on the converter drive plate and are thrown off onto the inside of the converter housing.

Fluid leaks from components located forward of the transmission, such as the power steering pump, could result in fluid collecting on the converter housing exterior due to road draft-blow back.

Engine oil or transmission fluid leaks can sometimes be differentiated by the coloration of these two lubricants. Engine oil usually has a brownish-green cast to it while transmission fluid is usually red or reddish orange in color.



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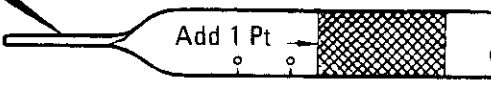



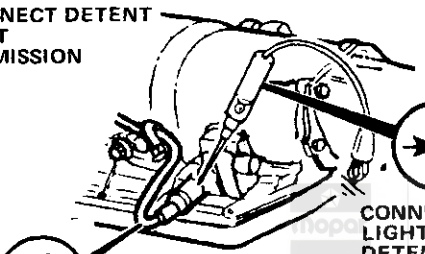






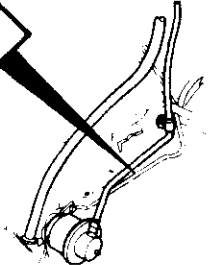




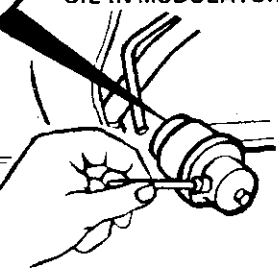




Fig. 2C-5 Converter Housing Fluid Leak Diagram

**DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHART**

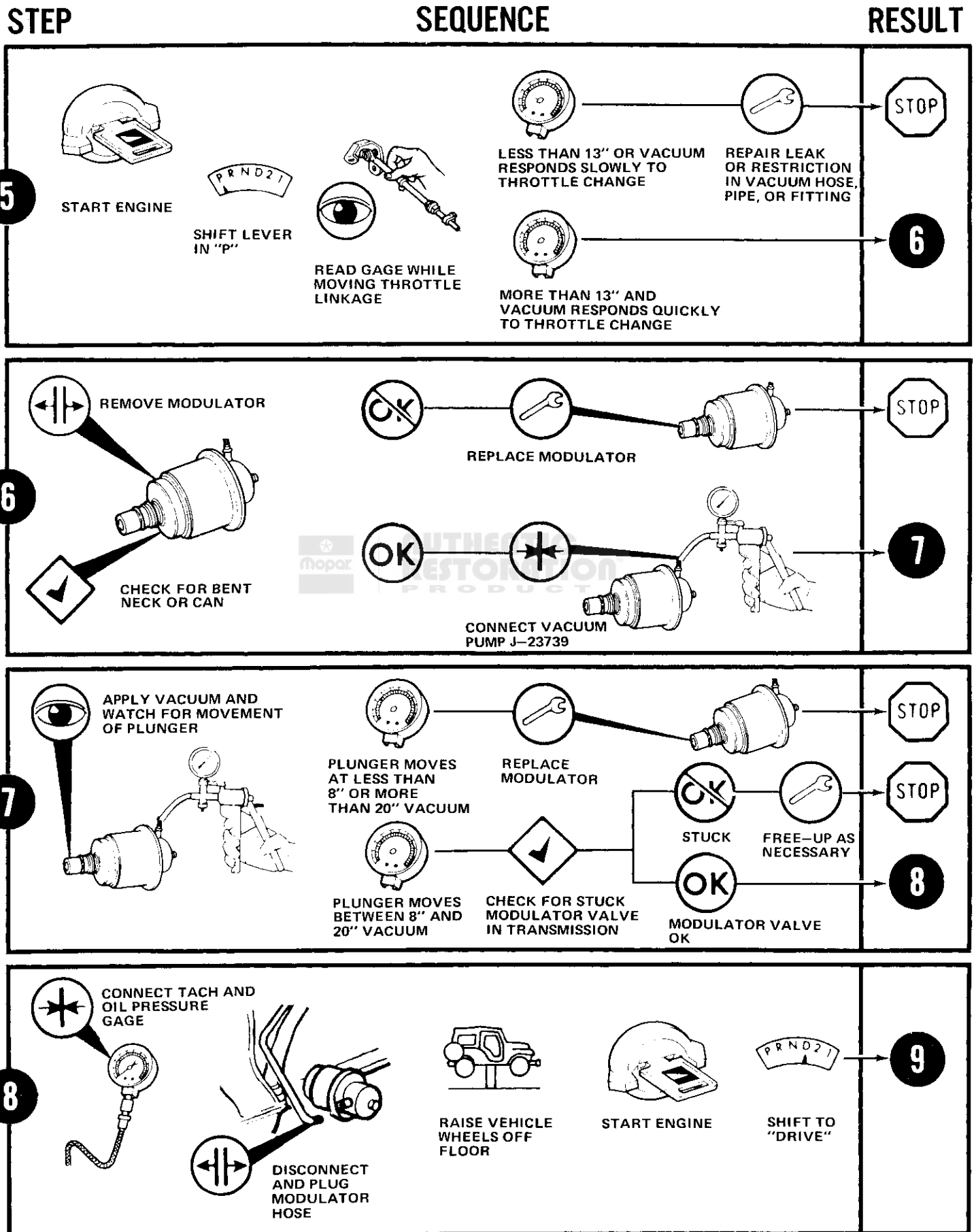
Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

**PROBLEM: LATE/HARSH UPSHIFT**

Note: Poor engine performance can also cause this symptom.

STEP	SEQUENCE	RESULT
<p><b>1</b></p> <p> CHECK FLUID LEVEL</p> <p></p>	<p>  → ADD FLUID AS NECESSARY</p> <p></p>	<p><b>2</b></p> <p><b>2</b></p>
<p><b>2</b></p> <p>DISCONNECT DETENT WIRE AT TRANSMISSION</p> <p></p> <p> CONNECT TEST LIGHT FROM DETENT WIRE TO GROUND</p>	<p> LIGHT "ON" →  → ADJUST OR REPLACE DETENT SWITCH</p> <p> LIGHT "OFF" → </p>	<p>STOP</p> <p><b>3</b></p>
<p><b>3</b></p> <p> CHECK MODULATOR HOSE AND PIPE FOR LEAKS OR RESTRICTIONS</p> <p></p>	<p>  → REPAIR AS NECESSARY</p> <p></p>	<p>STOP</p> <p><b>4</b></p>
<p><b>4</b></p> <p> CHECK FOR OIL IN MODULATOR</p> <p></p>	<p> OIL →  → REPLACE MODULATOR</p> <p> NO OIL →  → CONNECT VACUUM GAGE TO MODULATOR END OF PIPE</p>	<p>STOP</p> <p><b>5</b></p>





STEP

SEQUENCE

RESULT

**9**

RUN ENGINE AT 1000 RPM

NOTE OIL PRESSURE

RUN ENGINE AT 3000 RPM

NOTE OIL PRESSURE

PRESSURE DROPS LESS THAN 10 PSI

REPAIR OR REPLACE GOVERNOR

PRESSURE DROPS MORE THAN 10 PSI

**10**

STOP

**10**

RECONNECT MODULATOR HOSE

APPLY SERVICE BRAKES

SHIFT TO "DRIVE"

RUN ENGINE AT 1000 RPM

NOTE OIL PRESSURE

**11**

**11**

60 TO 90 PSI

REPAIR VALVE BODY

OVER 90 PSI

**12**

STOP

**12**

SHIFT TO NEUTRAL

RUN AT 1000 RPM

NOTE OIL PRESSURE

55 TO 70 PSI

REPAIR OR REPLACE LEAKING DETENT SOLENOID

OVER 70 PSI

REPAIR OIL PRESSURE REGULATOR VALVE

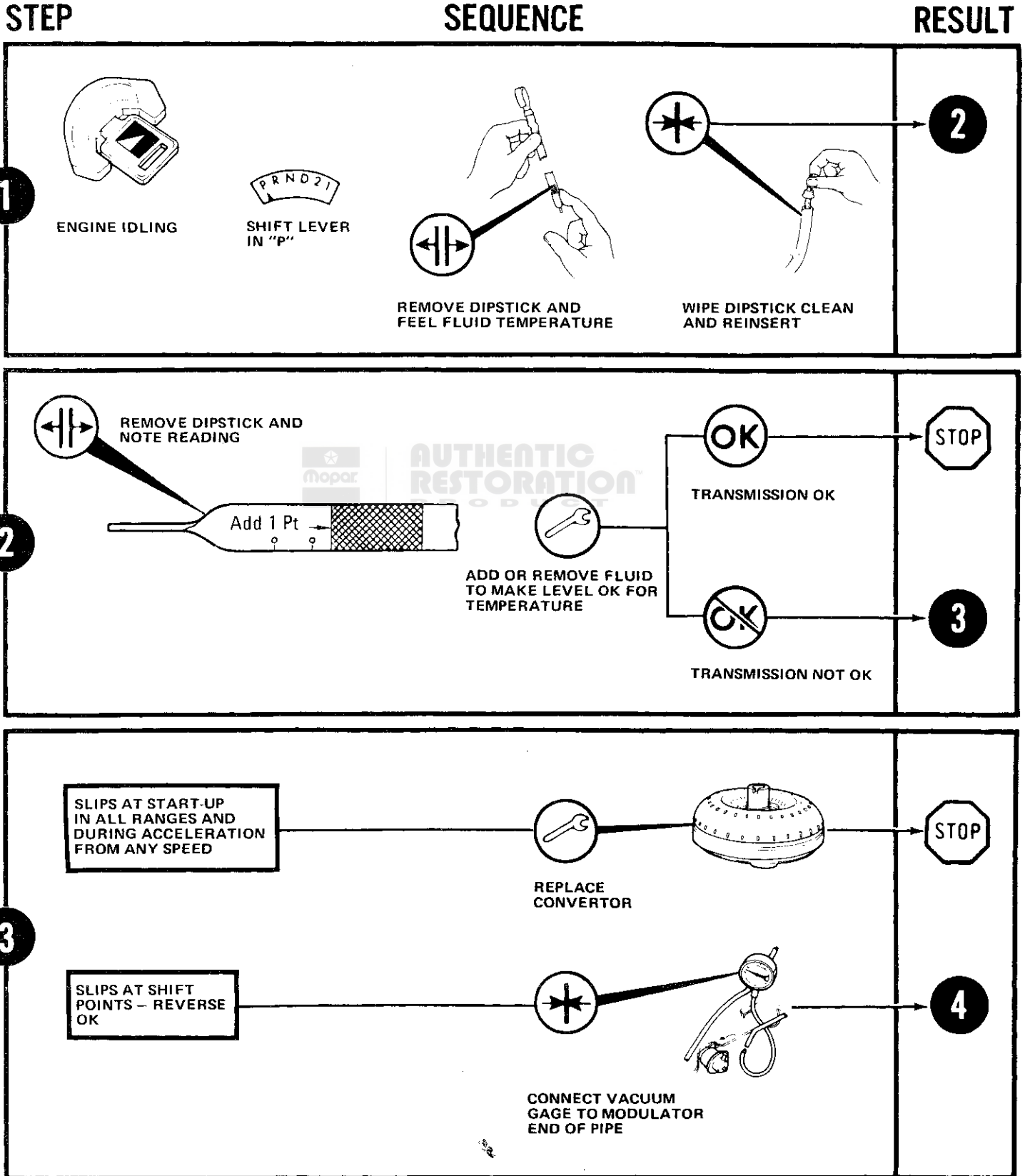
STOP

STOP

DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHARTS

Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

**PROBLEM: SLIPPING (ENGINE FLARES)**





DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHARTS

Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

**PROBLEM: NO DRIVE/REVERSE**

**STEP** **SEQUENCE** **RESULT**

**1**

ENGINE IDLING

SHIFT LEVER IN "P"

REMOVE DIPSTICK AND FEEL FLUID TEMPERATURE

WIPE DIPSTICK CLEAN AND REINSERT

**2**

**2**

REMOVE DIPSTICK AND NOTE READING

Add 1 Pt

ADD OR REMOVE FLUID TO MAKE LEVEL OK FOR TEMPERATURE

TRANSMISSION OK

TRANSMISSION NOT OK

**3**

STOP

**3**

CHECK MANUAL LINKAGE ADJUSTMENT

ADJUST AS NECESSARY

REMOVE TRANSMISSION FOR REPAIRS


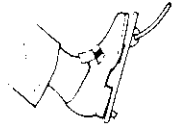
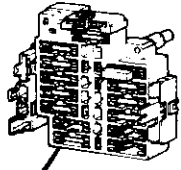
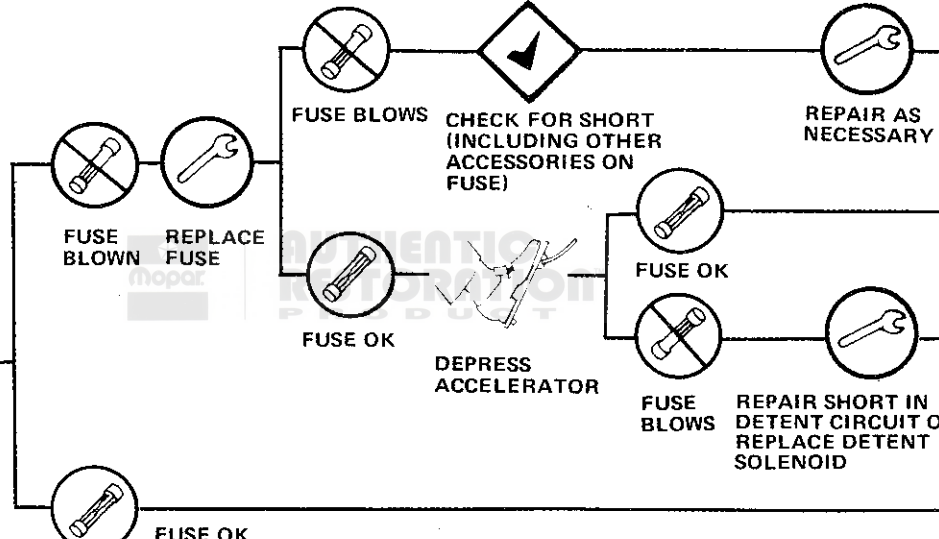
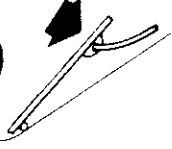
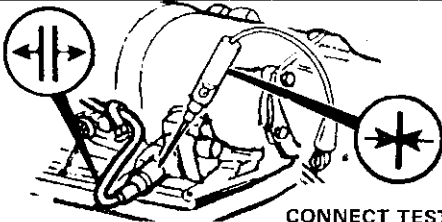
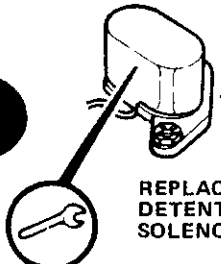
STOP

STOP

DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHARTS

Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

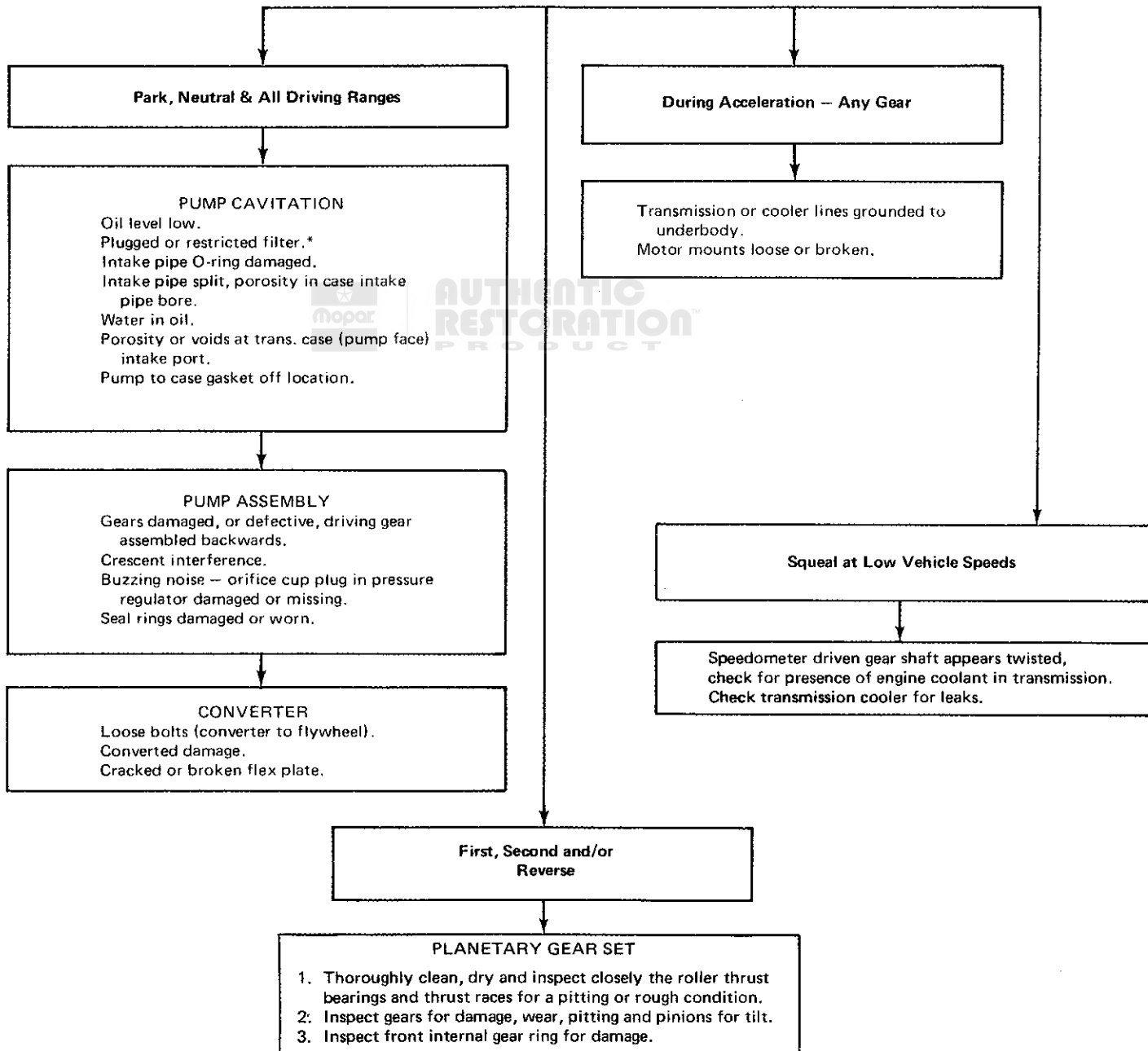
**PROBLEM: NO DETENT DOWNSHIFT**

STEP	SEQUENCE	RESULT
<p><b>1</b></p>  <p>IGNITION "ON" RADIO "ON" AM NEAR 1400 (OFF STATION)</p>	<p>MOVE ACCELERATOR TO FLOOR AND LISTEN FOR "POP" IN RADIO AS ACCELERATOR IS RELEASED</p>  <p>POP REPAIR DETENT VALVE TRAIN (VALVE BODY)</p> <p>NO POP OR NO RADIO</p>	<p>STOP</p> <p><b>2</b></p>
<p><b>2</b></p>  <p>CHECK DETENT FUSE</p>	 <p>FUSE BLOWN REPLACE FUSE</p> <p>FUSE OK</p> <p>FUSE OK DEPRESS ACCELERATOR</p> <p>FUSE BLOWN REPAIR SHORT IN DETENT CIRCUIT OR REPLACE DETENT SOLENOID</p> <p>FUSE BLOWS CHECK FOR SHORT (INCLUDING OTHER ACCESSORIES ON FUSE)</p> <p>REPAIR AS NECESSARY</p>	<p>STOP</p> <p><b>3</b></p> <p>STOP</p> <p><b>3</b></p>
<p><b>3</b></p>  <p>BLOCK ACCELERATOR PEDAL FULL OPEN</p>	 <p>DISCONNECT DETENT WIRE AT TRANSMISSION</p> <p>CONNECT TEST LIGHT FROM DETENT WIRE TO GROUND</p> <p>LIGHT "OFF" ADJUST OR REPLACE DETENT SWITCH</p> <p>LIGHT "ON"</p>	<p>STOP</p> <p><b>4</b></p>
<p><b>4</b></p>  <p>REPLACE DETENT SOLENOID</p>	<p>TRANSMISSION OK</p> <p>TRANSMISSION NOT OK REPAIR DETENT VALVE TRAIN (VALVE BODY)</p>	<p>STOP</p> <p>STOP</p>

Diagnosis Chart

TRANSMISSION NOISY

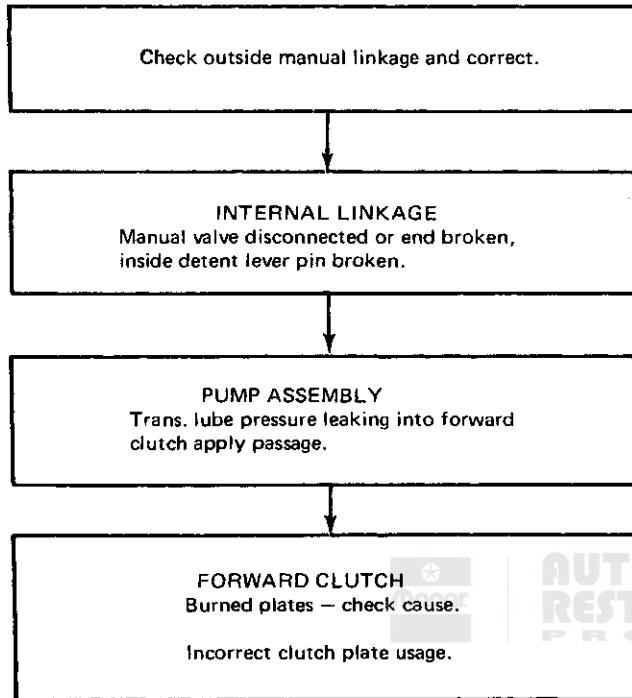
**CAUTION:** Before checking transmission for what is believed to be transmission noise, make certain the noise is not from the water pump, alternator, air conditioner, power steering, etc. These components can be isolated by removing the proper belt and running the engine not more than two minutes at one time.



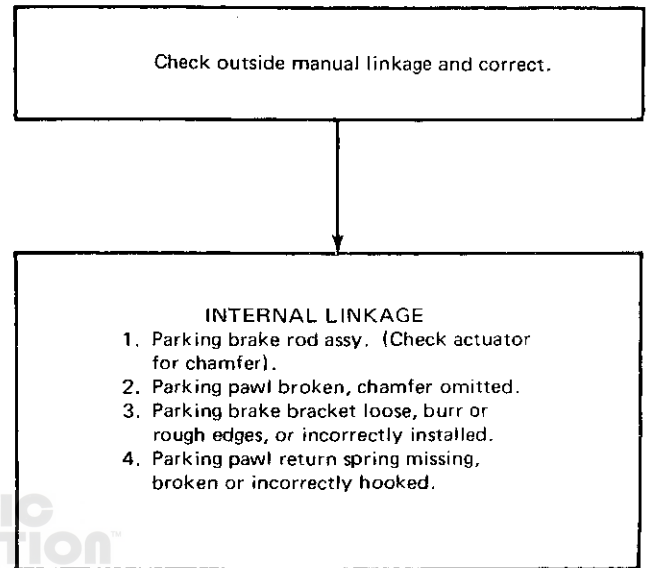
\*There is no approved way of checking or cleaning the filter. If the filter is suspected of being plugged or restricted, it must be replaced.

**Diagnosis Chart**

**DRIVE IN NEUTRAL**



**WON'T HOLD IN PARK OR WON'T RELEASE FROM PARK**



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**DIAGNOSIS GUIDES**

**Causes of Oil Leaks**

**Transmission Oil Pan Leak**

- Attaching bolts not correctly tightened.
- Improperly installed or damaged oil pan gasket.
- Oil pan gasket mounting face not flat.

**Extension Housing Leak**

- Attaching bolts not correctly tightened.
- Rear seal assembly damaged or improperly installed or propeller shaft yoke damaged.
- Extension housing gasket or seal damaged or improperly installed.
- O-ring on output shaft damaged (oil leak at yoke).

**Transmission Case Leak**

- Filler pipe O-ring seal damaged or missing; misalignment of filler pipe bracket to engine, loading one side of O-ring.
- Modulator O-ring seal damaged or improperly installed.

- Connector O-ring seal damaged or improperly installed.
- Governor cover, gasket, and bolts damaged, loose; case face damaged or porous.
- Leak at speedometer driven gear housing or seal. Leak at speedometer hole plug.
- Valve body manual shaft seal damaged or improperly installed.
- Line pressure plug stripped or shy or sealer compound.
- Case porous or cracked at pressure plug boss.

**Converter Area Leak**

- Front seal damaged. Check converter neck for nicks and pump bushing for having moved forward, or for missing seal garter spring.
- Pump attaching bolts and seals damaged, missing, or bolts loose.
- Leak at welded seam of converter.
- Pump O-ring seal damaged. Also check pump oil ring groove and case bore.
- Casting porous (pump or case).
- Pump drain back hole not open.



**Vent Pipe Leak**

- Transmission overfilled.
- Water in fluid.
- Filter O-ring damaged or improperly assembled causing oil to foam.
- Foreign material between pump and case or between pump cover and body holding pump halves apart.
- Case porous or pump face improperly machined.
- Pump-to-case gasket mispositioned.
- Pump breather hole blocked or missing.
- Hole in intake pipe.
- Check ball in forward clutch housing stuck open or missing.

**Oil Cooler Lines**

- Connections at radiator loose or stripped.
- Connections at case loose or stripped.

**Modulator**

- Diaphragm defective.

**Causes of Burned Clutch Plates****Forward Clutch**

- Check ball in clutch housing damaged, stuck or missing.
- Clutch piston cracked or seals damaged or missing.
- Low line pressure.
- Manual valve mispositioned.
- Restricted oil feed to forward clutch (clutch housing to inner and outer areas not drilled or restricted or porous pump).
- Pump cover oil seal rings missing, broken, or undersize; ring groove oversized.
- Case valve body face not flat or porosity between channels.
- Manual valve bent and or center land not ground properly.

**Intermediate Clutch**

- Constant bleed orifice in center support missing.
- Rear accumulator piston oil ring damaged or missing.
- One-two accumulator valve stuck in control valve assembly.
- Intermediate clutch piston seals damaged or missing.
- Center support bolt loose.
- Low line pressure.
- Intermediate clutch cup plug in case missing.
- Case valve body face not flat or porosity between channels.
- Manual valve bent and center land not ground properly.

**Direct Clutch**

- Restricted orifice in vacuum line to modulator (poor vacuum response).
- Check ball in direct clutch piston damaged, stuck or missing.
- Defective modulator bellows.
- Center support bolt loose. Bolt may be tight in support but not holding support tight to case.
- Center support oil rings or grooves damaged or missing.
- Clutch piston seals damaged, missing, or improperly installed.
- Front and rear servo pistons and seals damaged.
- Manual valve bent and center land not cleaned.
- Case valve body face not flat or porosity between channels.
- Intermediate roller clutch installed backward.
- Three-two valve, valve spring, or valve spacer pin installed in wrong sequence in valve bore.
- Incorrect combination of front servo and accumulator parts. If direct clutch plates and front band are burned, also check manual linkage. Burned clutch plates can be caused by incorrect usage of clutch plates. Also, antifreeze in transmission fluid can cause severe damage (e.g., large pieces of composition clutch plate material peeling off).

**Causes of Low Line Pressure**

- Low fluid level
- Oil filter plugged or restricted.
- O-ring on oil filter intake pipe omitted or damaged.
- Split or leaking intake pipe.
- Incorrect oil filter.

**Oil Pump**

- Pressure regulator or boost valve stuck.
- Excessive gear clearance, damaged or worn gears, pump drive gear installed backward, or converter pilot does not enter crankshaft freely and completely.
- Pressure regulator spring too weak.
- Not enough spacers in pressure regulator.
- Pump-to-case gasket mispositioned.
- Defective pump body and cover.
- Mismatched pump cover/pump body.

**Internal Circuit Leaks**

- Forward clutch leak (pressure normal in neutral and reverse—pressure low in drive). Check pump rings or forward clutch seals.
- Direct clutch leak (pressure normal in neutral, low, intermediate, and drive—pressure low in reverse). Check center support oil seal rings.
- Check direct clutch outer seal for damage. Check rear servo and front accumulator pistons and rings for damage or missing parts.

**Transmission Case**

- Porosity in intake bore area.
- Check case for intermediate clutch plug leak or other leaking or loose plugs.
- Drive-1—Reverse check ball mispositioned or missing causing loss of reverse and overrun braking in Drive-1.
- If filter is suspected of being plugged or restricted, replace it.

**Causes of High Line Pressure**

**Vacuum Leak**

- Vacuum line disconnected.
- Partial leak in line from engine to modulator.
- Insufficient engine vacuum.
- Vacuum-operated accessory leak (hoses, vacuum advance, etc.).

**Modulator**

- Hole in diaphragm.
- Stuck valve.
- Water in modulator.
- Modulator inoperative.

**Detent System**

- Detent switch plunger stuck, shorted, or misadjusted.
- Detent wiring shorted.
- Detent solenoid stuck open.
- Detent feed orifice in valve body spacer plate blocked.
- Detent solenoid loose.
- Detent valve bore plug damaged.
- Detent regulator valve pin short.

**Pump**

- Pressure regulator or boost valve stuck.
- Incorrect pressure regulator spring or valve.
- Too many pressure regulator valve spacers.
- Pump casting poor.
- Pressure boost valve installed backwards or defective.
- Aluminum bore plug has hole or otherwise defective.
- Pressure boost bushing broken or otherwise defective.

**Control Valve Assembly**

- Check balls mispositioned.
- Control valve assembly-to-spacer gasket off location.
- Gaskets installed in reverse order.

**Causes of Improper Vacuum at Modulator**

**Engine**

- Poor engine operation.
- Loose vacuum fittings.
- Vacuum-operated accessory leak (hoses, vacuum advance, etc.).
- Engine exhaust system restricted.

**Vacuum Line to Modulator**

- Hole in line.
- Loose fitting.
- Restricted orifice or incorrect orifice size.
- Carbon buildup at modulator vacuum fitting.
- Pinched line.
- Grease in pipe (delayed or no upshift cold).



**TEST SPECIFICATIONS**

**Hydraulic Pressure Test Specifications**

Gear Range	Engine Speed (RPM)	Normal Pressure (PSI)	Wheel and Parking Brakes Applied During Test
Neutral	1000	55-70 (379-483 KPa)	Yes
D-Range	Hot idle speed	60-85 (413-586 KPa)	Yes
D-Range	1000	60-90 (413-620 KPa)	Yes
1-Range	1000	135-160 (931-1103 KPa)	Yes
Reverse	1000	95-150 (655-1034 KPa)	Yes
D-Range with detent & switch on	1000	90-110 (620-758 KPa)	Yes
D-Range	30 MPH on speedometer with throttle closed	55-70 (379-483 KPa)	No

## 2C-24 AUTOMATIC TRANSMISSION

### Control Valve and Governor Test Specifications

Gear Range	Engine Speed (RPM)	Normal Pressure (PSI)	Wheel and Parking Brakes Applied During Test
D-Range*	1000	60-90 (413-620 KPa)	No
D-Range*	3000	Check for Pressure drop of 10 PSI (69 KPa) or more	No
D-Range**	1000	60-90 (413-620 KPa)	No
D-Range***	1000	60-90 (413-620 KPa)	No

\*Vacuum Line to Modulator disconnected and plugged.

\*\*Vacuum Lines to Modulator and EGR valve disconnected and plugged.

\*\*\*20-inches of Vacuum applied to Modulator using Tool J-23738.

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### Shift Speed Chart

Series	CJ-7				Wagoneer Cherokee		J-10 Truck		J-10 and J-20 Truck				
	400-JC		400-JS		400-JM		400-JK		400-JR				
Transmission	400-JC		400-JS		400-JM		400-JK		400-JR				
Engine	258		304		360		258		360				
Axle	3.54	4.09	3.54	4.09	3.07	3.54	3.54	4.09	3.54	3.73	4.09	4.09	
Tire Size	F78 x 15 HR78 x 15		F78 x 15 HR78 x 15		H78 x 15 HR78 x 15		H78 x 15 HR78 x 15		H78 x 15 HR78 x 15	8.00 x 16.5 8.75 x 16.5	9.50 x 16.5	H78 x 15 HR78 x 15	
Tire Rev. Per Mile	750		750		728		728		728	707	677	728	
Closed Throttle:	1-2 2-3	3-11 10-18	2-10 8-16	3-11 11-19	2-10 9-17	6-14 20-28	5-13 17-25	4-12 15-23	3-11 12-20	4-12 10-18	4-12 10-18	3-11 9-17	3-11 8-16
Part Throttle:	1-2 2-3	6-16 17-27	5-15 14-24	6-16 25-35	5-15 21-31	18-28 41-51	16-24 36-44	11-21 25-35	9-19 21-31	9-19 32-42	9-19 32-42	8-18 30-40	7-17 27-37
To Detent:	1-2 2-3	16-26 33-43	13-23 28-38	19-29 41-51	16-26 35-45	30-40 52-62	25-35 45-55	20-30 39-49	16-26 33-43	23-33 45-55	23-33 44-54	21-31 42-52	19-29 38-48
Wide Open Throttle:	1-2 2-3	24-36 43-55	20-32 38-48	29-41 54-66	24-36 46-58	36-48 65-77	31-43 56-68	26-38 49-61	21-33 42-54	31-43 61-73	30-42 60-72	28-40 57-69	26-38 52-64
Kickdown: Wide Open Throttle	3-1 3-2	10-22 41-53	8-20 35-47	11-23 52-64	9-21 44-56	20-32 61-73	17-29 52-64	15-27 47-59	12-24 40-52	24-36 59-71	23-35 57-69	22-34 54-66	20-32 50-62
Kickdown: Part Throttle	3-2	26-38	22-34	34-46	29-41	43-55	36-48	32-44	27-39	31-43	30-42	29-41	26-38

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# IN-VEHICLE SERVICE AND ADJUSTMENT

	Page		Page
Control Valve and Oil Filter	2C-27	Modulator	2C-28
Detent Solenoid	2C-27	Neutral Switch	2C-26
Governor	2C-27	Parking Linkage	2C-28
Manual Linkage	2C-25	Pressure Regulator Valve	2C-26

## MANUAL LINKAGE

### Adjustment

- (1) Place gearshift lever in Neutral.
- (2) Raise vehicle on hoist.
- (3) Loosen gearshift rod trunnion locknut just enough to permit movement of rod in trunnion (fig. 2C-6).

(4) Place transmission outer range selector lever fully into neutral detent position and tighten gearshift rod trunnion locknut to 9 foot-pounds (12 N•m) torque.

(5) Lower car and operate gearshift lever in all ranges. Vehicle should start in Park and Neutral only and gearshift lever should engage properly in all detent positions. Readjust linkage if operation is not satisfactory.

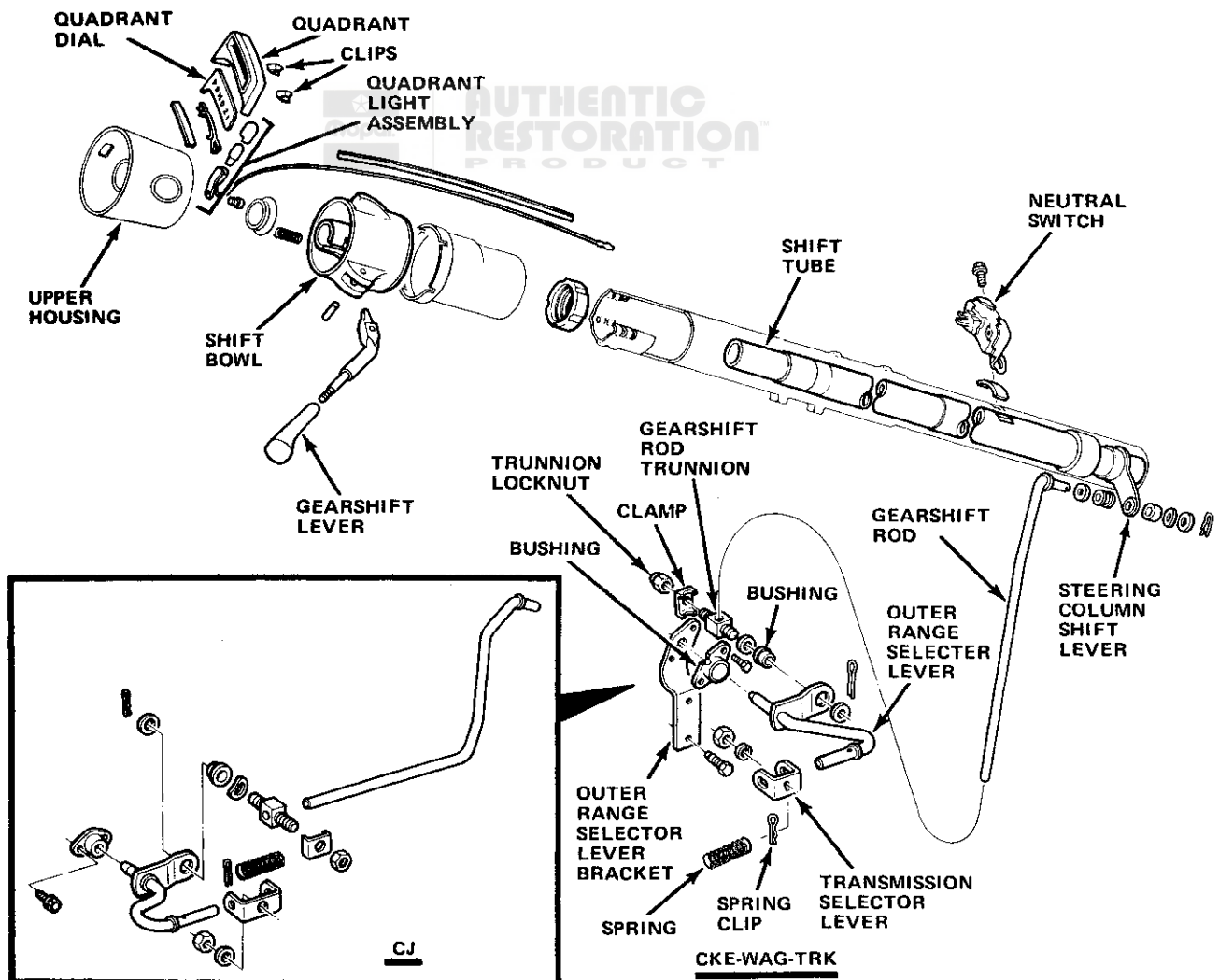


Fig. 2C-6 Manual Linkage and Neutral Switch

**NEUTRAL SWITCH**

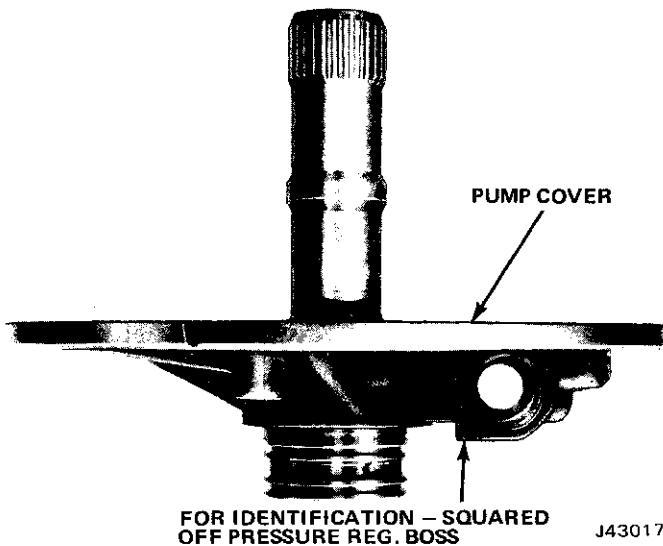
**Adjustment**

- (1) Apply parking brake.
- (2) Check and adjust manual linkage if necessary.
- (3) Remove neutral switch from steering column. Switch is located at base of column (fig. 2C-6).
- (4) Place gearshift lever in Park and lock column.
- (5) Move neutral switch actuating lever until lever aligns with letter "P" stamped on back of switch.
- (6) Insert 3/32 (2.38 mm) drill in hole located below letter "N" stamped on back of switch.
- (7) Move switch actuating lever until it stops against drill.
- (8) Position neutral switch on column, install switch attaching screws, and remove drill.
- (9) Check switch operation. Engine should start in Park and Neutral positions only. Backup lamp should light when gearshift lever is in Reverse position only.

**PRESSURE REGULATOR VALVE**

**Removal**

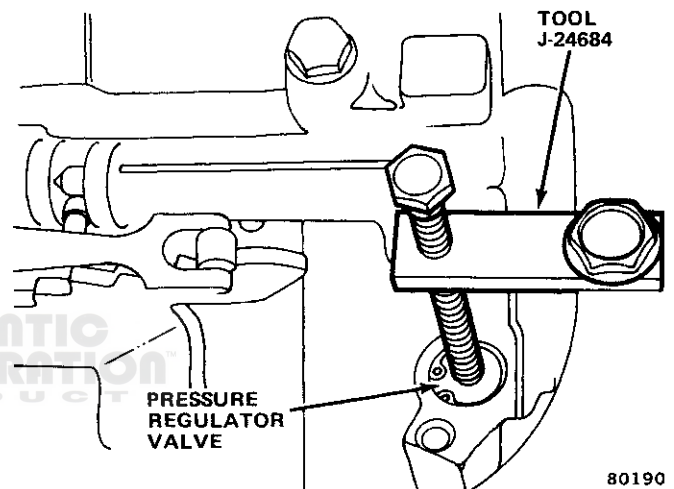
**CAUTION:** The solid-type pressure regulator valve does not contain oil holes and an orifice cup plug like the previous type pressure regulator valve. The solid-style valve must ONLY be used in the pump cover with the squared off pressure regulator boss (pressure boost bushing end) (fig. 2C-7). The previous pressure regulator valve with the oil holes and orifice cup plug will be used to service either type pump cover.



**Fig. 2C-7 Pressure Regulator Valve Application**

- (1) Raise vehicle.
- (2) Position drain pan under transmission.
- (3) Remove oil pan and gasket and drain oil.
- (4) Remove oil filter retaining bolt and remove pump intake pipe and oil filter assembly.
- (5) Remove and discard intake pipe O-ring and oil pan gasket.
- (6) Compress regulator boost valve bushing against pressure regulator spring using tool J-24684 (fig. 2C-8).

**NOTE:** If tool J-24684 is not available, compress valve against spring tension using a steel rod.



**Fig. 2C-8 Pressure Regulator Valve Removal**

**CAUTION:** The pressure regulator spring is tightly compressed and will force the valve bushing out of the bore when the snap ring is removed if the bushing is not held securely.

- (7) Remove snap ring using Plier Tool J-5403.
- (8) Remove tool J-24684 and remove pressure regulator valve, bushing, and spring.
- (9) Remove valve and spring retainer and remove spacers, if equipped.

**Installation**

- (1) Install spring retainer on pressure regulator spring and install spacers, if equipped.
- (2) Install pressure regulator valve on spring, stem end first.
- (3) Insert valve into bushing, stem end out, and assemble parts with pressure regulator spring against valve bushing.
- (4) Insert pressure regulator valve assembly in pressure regulator valve bore in pump cover.
- (5) Install tool J-24684, compress valve against spring, and install snap ring (fig. 2C-8).

**NOTE:** *If tool J-24684 is not available use a steel rod to compress regulator valve bushing against pressure regulator spring until bushing is beyond snap ring groove, and install snap ring.*

**NOTE:** *To ease snap ring installation, place the snap ring on a steel rod, compress the snap ring using snap ring pliers, and slide the snap ring upward into the ring groove in the bore.*

- (6) Install intake pipe O-ring on intake pipe and install pipe and oil filter. Install oil filter retainer bolt.
- (7) Install gasket on oil pan and install oil pan.
- (8) Install oil pan attaching bolts. Tighten bolts to 12 foot-pounds (16 N•m) torque.
- (9) Lower vehicle.
- (10) Fill transmission with Jeep transmission fluid, Dexron, or equivalent.

## **DETENT SOLENOID**

### **Removal**

- (1) Raise vehicle.
- (2) Position drain pan under transmission.
- (3) Remove oil pan and oil filter.
- (4) Remove and discard oil pan gasket and remove and discard intake pipe O-ring seal if seal was not removed with filter and intake pipe.
- (5) Disconnect detent solenoid lead at electrical connector in case.
- (6) Remove bolts attaching solenoid to valve body and remove solenoid.

### **Installation**

- (1) Position solenoid on valve body and install solenoid attaching bolts. Tighten bolts to 7 foot-pounds (10 N•m) torque.
- (2) Connect solenoid wire to electrical connector in case.
- (3) Install O-ring seal on intake pipe.
- (4) Install intake pipe and filter.
- (5) Install oil pan gasket and oil pan. Tighten oil pan bolts to 12 foot-pounds (16 N•m) torque.
- (6) Lower vehicle.
- (7) Fill transmission with Jeep transmission fluid, Dexron, or equivalent.

## **CONTROL VALVE AND OIL FILTER**

### **Removal**

- (1) Raise vehicle.
- (2) Position drain pan under transmission oil pan.
- (3) Remove oil pan and oil filter.
- (4) Remove and discard intake pipe O-ring and oil pan gasket.

(5) Disconnect detent solenoid lead at electrical connector in case.

(6) Remove detent roller spring assembly.

(7) Remove control valve attaching bolts, but do not remove detent solenoid attaching bolts.

(8) Remove control valve and governor pipes. Do not allow manual valve to fall out of valve body during removal.

(9) Remove governor screen. Note location and position of screen for assembly reference.

(10) Insert piece of 0.020 inch thick (0.50 mm) shim stock or feeler gauge between spacer plate and front servo pistons to prevent assembly from falling out after control valve removal.

(11) Remove governor pipes and manual valve from valve body. If governor screen came out with governor pipes, note location of screen for assembly reference.

(12) Remove and discard control valve to spacer gasket.

(13) Disassemble, clean, inspect, service, and reassemble control valve. Refer to Out-of-Vehicle Service and Overhaul section for procedures.

### **Installation**

(1) Position control valve-to-spacer plate gasket on control valve.

(2) Install governor pipes and manual valve in valve body.

(3) Install governor screen in governor pipe.

(4) Remove shim stock or feeler gauge from between spacer plate and front servo piston. Install control valve and governor pipes. Be sure governor pipes are aligned in case bores.

(5) Install control valve attaching bolts. Tighten bolts alternately and evenly to 8 foot-pounds (11 N•m) torque.

(6) Install detent roller spring assembly.

(7) Connect detent solenoid wire to electrical connector in case.

(8) Install O-ring on intake pipe and install oil filter and intake pipe.

(9) Position gasket on oil pan and install oil pan. Tighten oil pan bolts to 12 foot-pounds (16 N•m) torque.

(10) Lower vehicle.

(11) Fill transmission with Jeep transmission fluid, Dexron, or equivalent.

## **GOVERNOR**

### **Removal**

- (1) Raise vehicle.
- (2) Remove governor cover attaching screws and remove cover and gasket. Discard gasket.
- (3) Remove governor assembly.
- (4) Refer to Out-of-Vehicle Service and Overhaul section for governor service procedures.

**Installation**

- (1) Install governor assembly.
- (2) Install gasket, cover, and cover attaching screws.
- (3) Lower vehicle.
- (4) Add transmission fluid as necessary.

**MODULATOR**

**Removal**

- (1) Raise vehicle.
- (2) Disconnect vacuum hose from modulator.
- (3) Remove modulator adapter attaching screw and retainer (fig. 2C-9).

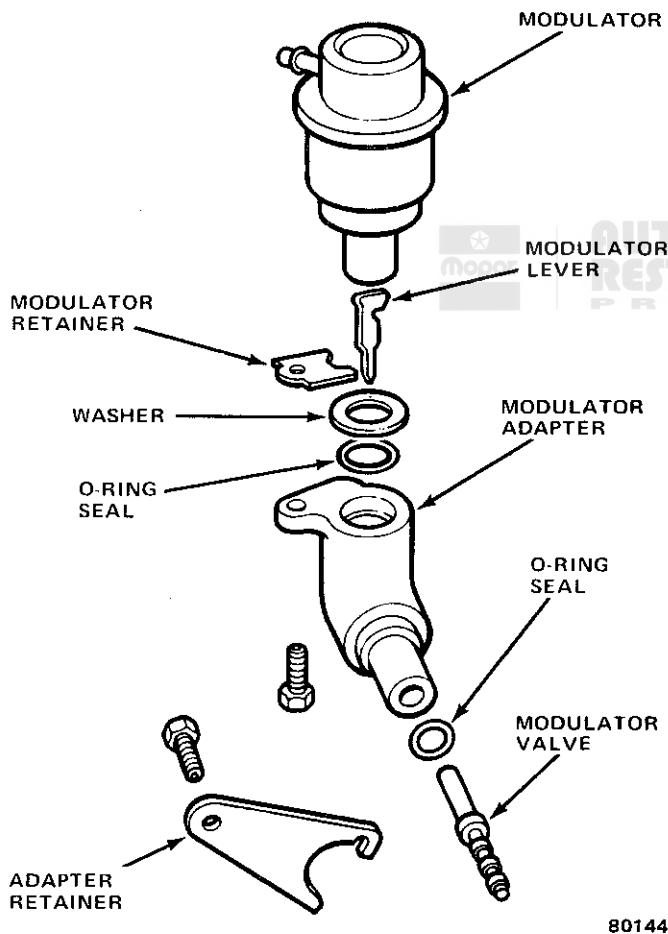


Fig. 2C-9 Modulator Assembly

- (4) Remove modulator and adapter as assembly. Discard O-ring seal.
- (5) Remove modulator valve from case.
- (6) Remove modulator-to-adapter attaching screw and retainer.
- (7) Separate modulator and adapter. Discard modulator washer and O-ring seal.
- (8) Remove modulator lever from adapter.

**Installation**

- (1) Insert modulator lever in modulator (fig. 2C-9).
- (2) Install replacement washer and O-ring seal on modulator.
- (3) Install modulator in adapter.
- (4) Install modulator retainer and attaching screw.
- (5) Install modulator valve in case.
- (6) Install replacement O-ring seal on modulator adapter.
- (7) Install modulator assembly in case.
- (8) Install adapter retainer and attaching screw.
- (9) Connect vacuum line to modulator.
- (10) Lower vehicle. Check and correct fluid level as necessary.

**PARKING LINKAGE**

**Removal**

- (1) Raise vehicle.
- (2) Disconnect manual linkage and remove manual lever from manual shaft.

**NOTE:** The manual lever attaching nut is a metric size nut.

- (3) Remove oil pan and oil filter. Discard pan gasket.
- (4) Unthread jamnut retaining detent lever on manual shaft (fig. 2C-10).

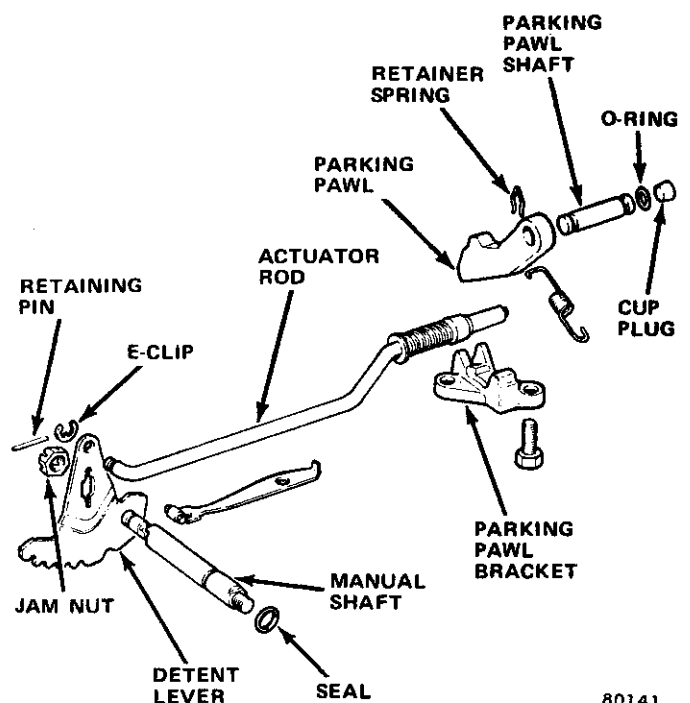


Fig. 2C-10 Parking Linkage

- (5) Remove manual shaft retaining pin (bend pin using pliers).
- (6) Remove manual shaft and jamnut.
- (7) Remove parking actuator rod and detent lever assembly.
- (8) Remove parking pawl bracket attaching screws and bracket.
- (9) Remove parking pawl return spring.
- (10) Remove parking pawl shaft retainer.
- (11) Remove cup plug, parking pawl shaft, and parking pawl.

**Installation**

- (1) Install parking pawl, parking pawl shaft, and cup plug. Apply nonhardening sealant to cup plug before installation.

- (2) Install parking pawl retainer spring.
- (3) Install parking pawl return spring.
- (4) Install parking pawl bracket and bracket attaching screws.
- (5) Install parking actuator rod and detent lever assembly.
- (6) Install manual shaft and jamnut.
- (7) Install manual shaft retaining pin.
- (8) Install manual shaft retaining jamnut.
- (9) Install oil filter, oil pan gasket, and oil pan. Tighten oil pan bolts to 12 foot-pounds (16 N•m) torque.
- (10) Install manual lever and connect manual linkage.
- (11) Lower vehicle.
- (12) Fill transmission with Jeep transmission fluid, Dexron, or equivalent.

# OUT-OF-VEHICLE SERVICE AND OVERHAUL

	Page		Page
Band Adjustment	2C-32	Transmission Assembly	2C-71
Bushing Replacement	2C-64	Transmission Disassembly	2C-30
Specifications	2C-79	Transmission Installation	2C-30
Subassembly Overhaul	2C-40	Transmission Removal	2C-29
Torque Converter	2C-30		

**TRANSMISSION REMOVAL**

- (1) Remove transmission dipstick.
- (2) If radiator is equipped with shroud, remove bolts attaching shroud to core support.
- (3) Raise vehicle on hoist.
- (4) Mark front and rear universal joints and axle yokes for assembly reference.
- (5) On Cherokee, Wagoneer and Truck models, remove parking brake cable jamnut and adjuster nut, remove clip attaching parking brake cable to crossmember and pull cable out of crossmember.
- (6) On Cherokee and Wagoneer models with low range reduction unit, remove reduction unit shift lever from shift shaft and remove reduction unit.
- (7) On CJ and Truck models with low range reduction unit, disconnect shift rod at reduction unit shift lever and remove reduction unit.
- (8) Disconnect speedometer cable.
- (9) Mark Emergency Drive control vacuum lines for assembly reference and disconnect lines.
- (10) Disconnect Emergency Drive indicator lamp wire.
- (11) Remove bolt attaching vacuum line routing bracket to rear of transfer case.
- (12) Disconnect detent solenoid wire at transmission case connector.
- (13) Remove starter.
- (14) Remove converter housing inspection cover.
- (15) Mark torque converter and drive plate for assembly reference.
- (16) Remove torque converter-to-drive plate attaching bolts.
- (17) Remove rear support cushion-to-crossmember attaching nuts.
- (18) Support transmission using transmission jack. Secure transmission to jack using safety chain.
- (19) Remove rear crossmember.
- (20) Remove spring clip and flat washer attaching transmission gearshift rod trunnion to outer range selector lever. Do not loosen trunnion locknut.
- (21) Disengage gearshift rod and trunnion from outer range selector lever (fig. 2C-6).
- (22) Remove spring clip and spring attaching outer range selector lever to transmission selector lever (fig. 2C-6).
- (23) Remove bolts attaching outer range selector lever bracket and bushing to frame and remove bracket, bushing, and lever as assembly (fig. 2C-6).
- (24) Disconnect front propeller shaft at transfer case yoke and secure shaft to frame using wire.
- (25) Disconnect transmission oil cooler lines at transmission case fittings.



- (26) Disconnect engine-to-modulator vacuum hose at modulator.
- (27) Position support stand under engine.
- (28) Remove converter housing-to-engine attaching bolts.
- (29) Remove transmission filler tube.
- (30) Move transmission rearward until it clears crankshaft.
- (31) Hold converter in position and lower transmission until it clears engine.
- (32) If necessary, the following components can now be serviced:
  - Torque converter
  - Drive plate
  - Oil pump and seal
  - Engine core hole plugs
  - Engine oil galley plugs.

### TRANSMISSION INSTALLATION

- (1) Raise transmission and align torque converter and drive plate using reference marks made during transmission removal.
- (2) Move transmission forward and maneuver transmission as necessary to align engine dowels with converter housing dowel holes.
- (3) Install two converter housing-to-engine lower attaching bolts and tighten bolts alternately and evenly to pull transmission into place against engine.
- (4) Install remaining converter housing-to-engine bolts and tighten bolts to 28 foot-pounds (38 N•m) torque.
- (5) Install transmission filler tube.
- (6) Remove engine support stand.
- (7) Connect vacuum hose to modulator.
- (8) Connect transmission oil cooler lines to transmission fittings.
- (9) Connect front propeller shaft to transfer case yoke and tighten universal joint U-bolts to 15 foot-pounds (20 N•m) torque.
- (10) Mount bellcrank and bracket assembly on frame and install attaching bolts.
- (11) Install bellcrank-to-transmission shift lever retaining spring clip.
- (12) Install rear crossmember.
- (13) Remove transmission jack.
- (14) Install rear support cushion-to-crossmember attaching nuts.
- (15) Install torque converter-to-drive plate attaching bolts.
- (16) Install converter housing inspection cover.
- (17) Install starter.
- (18) Connect detent solenoid wire to transmission connector.
- (19) Install vacuum hose routing bracket attaching bolt.
- (20) Connect Emergency Drive indicator lamp wire to switch.
- (21) Connect Emergency Drive vacuum lines to transfer case vacuum control.
- (22) Connect speedometer cable.
- (23) On Wagoneer and Cherokee models with reduction unit, install reduction unit and install shift lever on reduction unit shift shaft.
- (24) On CJ and Truck models with reduction unit, install reduction unit and connect shift rod to shift lever.
- (25) On Wagoneer, Cherokee and Truck models, insert parking brake cable through crossmember, install retaining clip and install cable adjuster nut and jamnut. Adjust parking brake as outlined in Chapter 2G.
- (26) Install rear propeller shaft. Refer to alignment reference marks made during shaft removal.
- (27) Install outer range selector lever bracket and bushing on frame.
- (28) Connect gearshift rod and trunnion to outer range selector lever. Install spring and clip in lever.
- (29) Adjust manual linkage as outlined in this section.
- (30) Lower vehicle.
- (31) If radiator is equipped with shroud, install shroud attaching bolts.
- (32) Fill transmission to correct level using Jeep Automatic Transmission Fluid, Dexron or equivalent.
- (33) Road test vehicle to verify proper transmission operation.

### TORQUE CONVERTER

With the transmission removed and mounted on a transmission jack, remove the torque converter by pulling it straight out of the converter housing.

**NOTE:** *It is not necessary to replace the converter when a transmission malfunction has occurred unless the converter has malfunctioned or is damaged. However, it is recommended that the transmission and converter be properly cleaned, oil filter replaced and cooler and cooler lines flushed after any problem that generates sludge, dirt, or chips.*

### TRANSMISSION DISASSEMBLY

- (1) Remove transfer case.
- (2) Install Holding Fixture J-8763-01 on transmission case with modulator positioned on side of holding fixture nearest bench.

**CAUTION:** *Do not overtighten the holding fixture clamp screw. This will bind the center support.*

- (3) Install fixture and transmission in Holding Tool Base J-3289-20 with oil pan facing upward (fig. 2C-11).
- (4) Remove modulator attaching screw and retainer.
- (5) Remove modulator and O-ring seal from adapter and remove adapter.
- (6) Remove modulator valve.

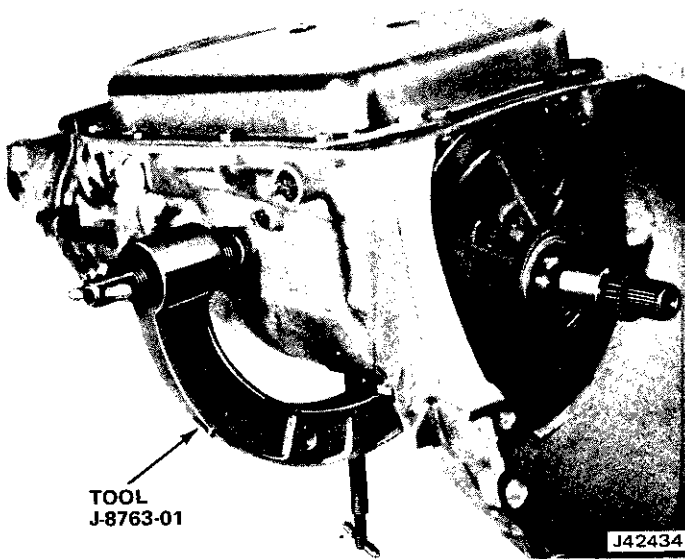


Fig. 2C-11 Transmission Mounted in Holding Fixture

### Governor-Oil Pan-Oil Filter-Intake Pipe

#### Removal

(1) Remove governor cover attaching screws and remove cover and gasket (fig. 2C-12). Discard gasket.

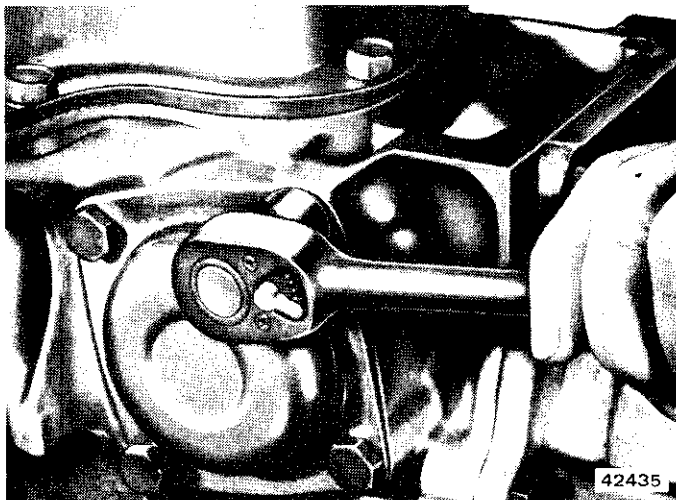


Fig. 2C-12 Governor Cover Removal/Installation

- (2) Remove governor assembly.
- (3) Remove oil pan and gasket (fig. 2C-13). Discard gasket.
- (4) Remove oil filter retainer bolt and remove oil filter and intake pipe (fig. 2C-14). Discard filter.
- (5) Remove intake pipe-to-case O-ring from intake pipe or case. Discard O-ring.

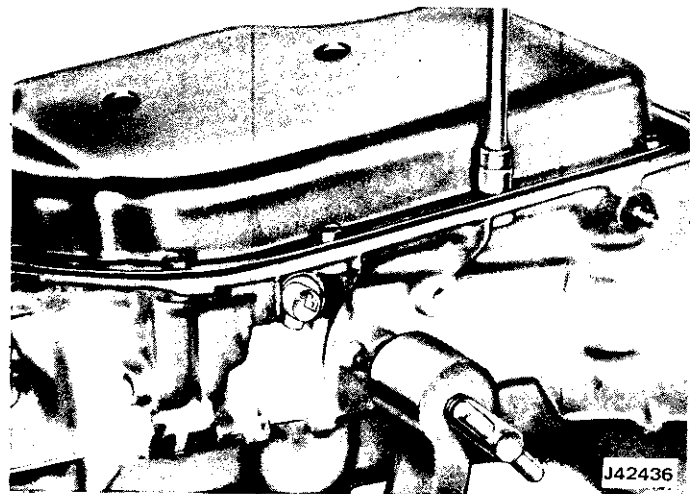


Fig. 2C-13 Oil Pan Removal/Installation

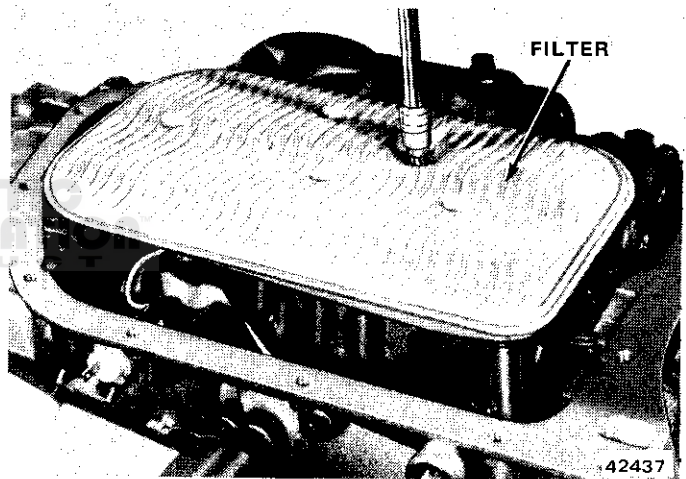


Fig. 2C-14 Oil Filter Removal/Installation

### Detent Roller and Spring-Control Valve-Governor Screen-Governor Pipes

#### Removal

- (1) Remove detent roller spring (fig. 2C-15). Do not remove detent solenoid bolts.
- (2) Disconnect detent solenoid wire at electrical connector in case.
- (3) Remove control valve attaching bolts and remove control valve and governor pipes (fig. 2C-16).

**CAUTION:** Do not allow the manual valve to fall out of the control valve body during control valve removal.

- (4) Remove governor screen from end of governor pipe or governor pipe hole in case (fig. 2C-17). Clean screen in solvent and allow it to air dry.
- (5) Remove governor pipes from control valve assembly.
- (6) Remove control valve-to-spacer gasket.

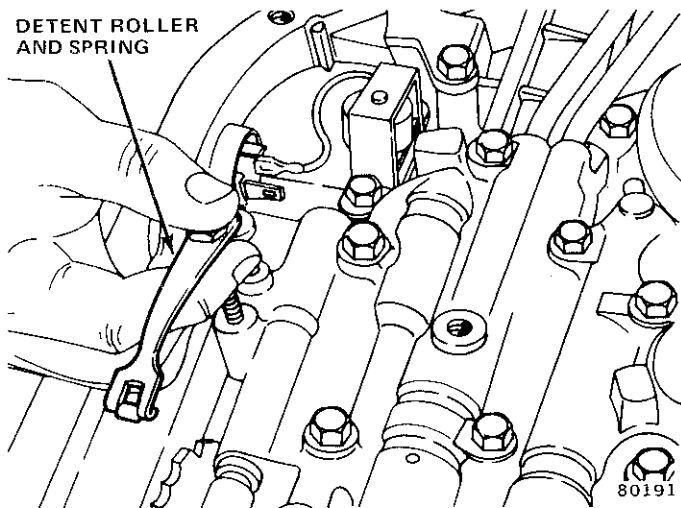


Fig. 2C-15 Detent Roller and Spring Removal/Installation

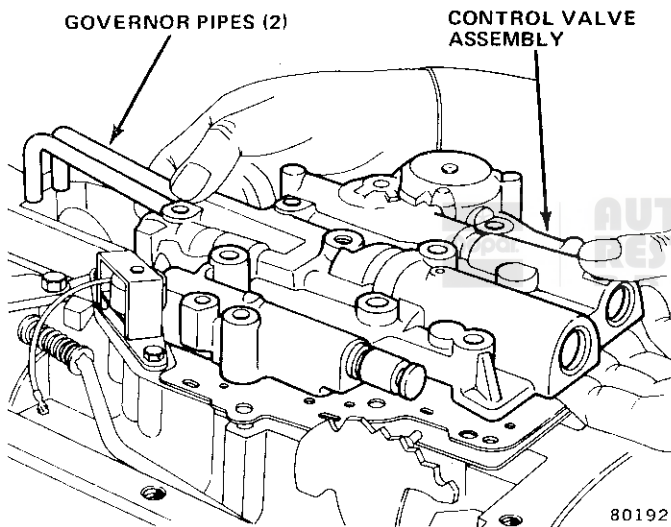


Fig. 2C-16 Control Valve and Governor Pipe Removal

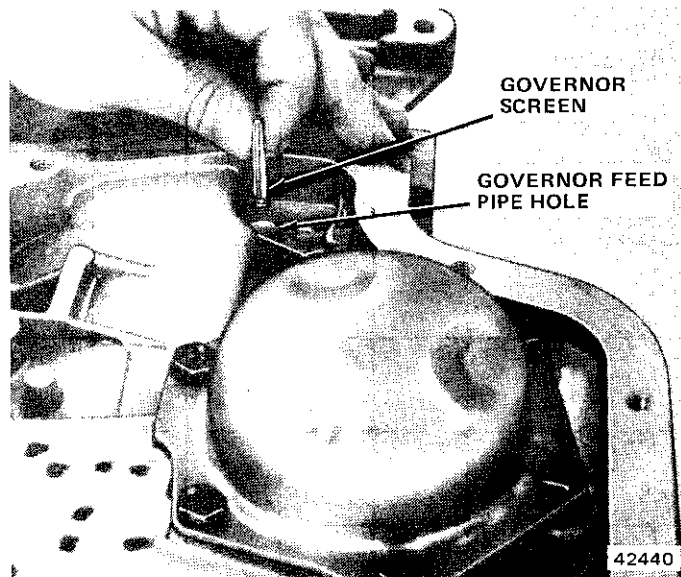


Fig. 2C-17 Governor Screen Removal/Installation

## Rear Servo

### Removal

- (1) Remove rear servo cover and gasket. Discard gasket (fig. 2C-18).
- (2) Remove rear servo assembly (fig. 2C-19).
- (3) Remove rear servo accumulator spring from case.

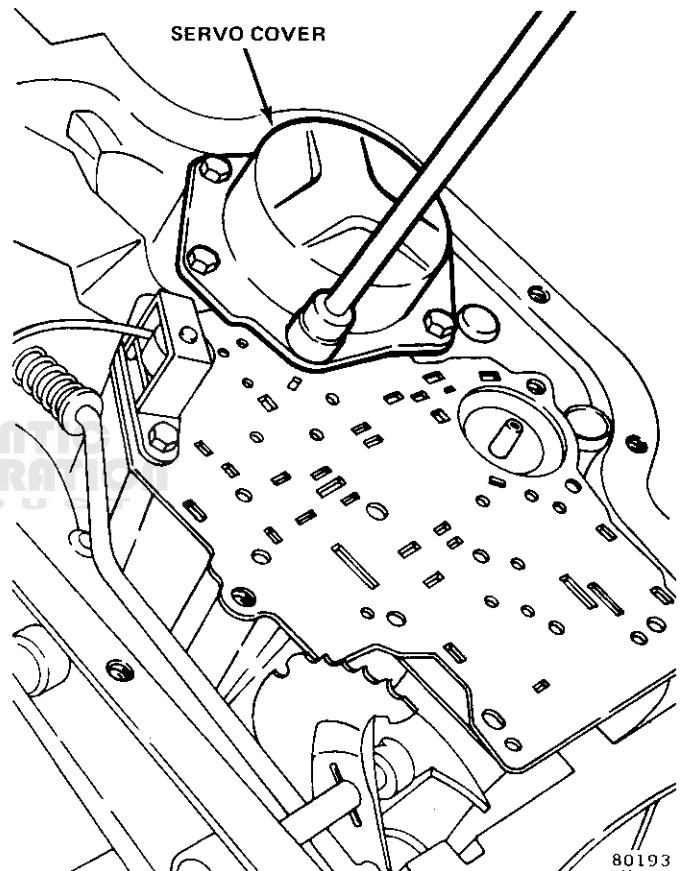


Fig. 2C-18 Rear Servo Cover Removal/Installation

### Band Adjustment

In the Jeep automatic transmission, only the rear band is adjustable. The front band does not have any provision for adjustment.

Rear band adjustment is determined by band apply pin length. Three different length apply pins are available for adjustment purposes.

**NOTE:** The required length apply pin must be selected before the transmission is completely disassembled. This is necessary because the rear servo, rear band, and geartrain must be in the installed position in order to measure and select the pin length needed.

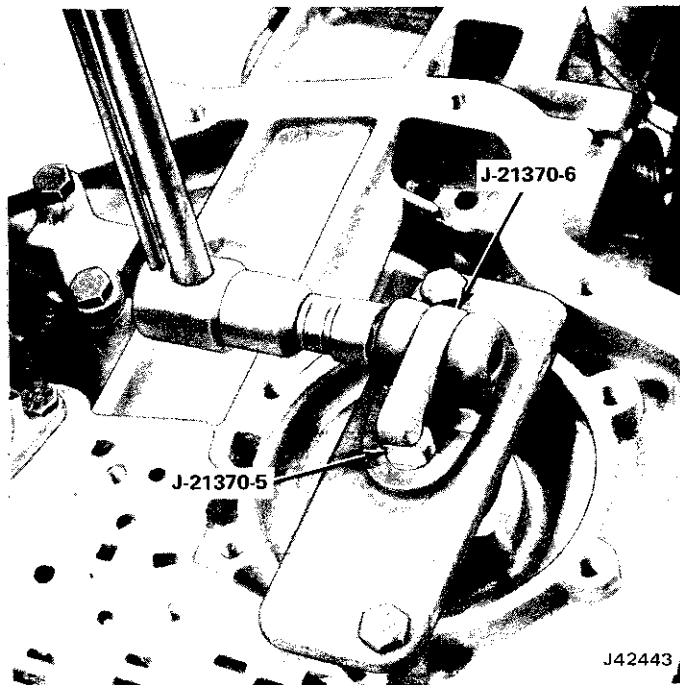
The apply pin selection procedure is as follows.



**Fig. 2C-19 Rear Servo Removal/Installation**

**Rear Band Apply Pin Selection Procedure**

(1) Install Gauge Pin J-21370-5 in rear servo pin bore as shown in Fig. 2C-20.



**Fig. 2C-20 Rear Band Adjustment**

(2) Install Gauge Plate J-21370-6 on transmission case and over rear servo bore as shown in Figure 2C-20. Use rear servo cover bolts to attach gauge plate to case.

Tighten bolts to 8 foot-pounds (11 N•m) torque.

(3) Apply 25 foot-pounds (34 N•m) torque to Gauge Fixture J-21370-6 (fig. 2C-20) and determine required length apply pin as follows:

(a) If both steps of Gauge Pin J-21370-5 are below surface of Gauge Plate J-21370-6, use long apply pin which has three identifying rings.

(b) If gauge plate surface is between steps on gauge pin, use medium length apply pin which has two identifying rings.

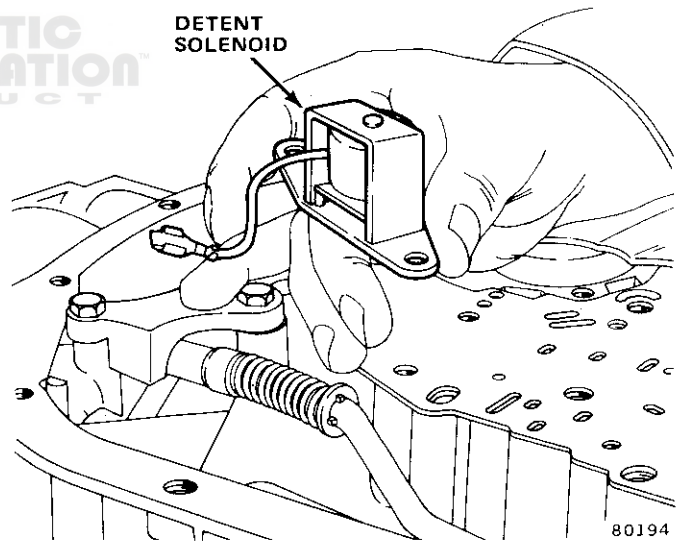
(c) If both steps of gauge pin are above gauge plate surface, use short pin which has one identifying ring.

**NOTE:** The identifying rings are located on the band lug-end of each apply pin.

**Detent Solenoid-Electrical Connector-Control Valve Spacer-Front Servo**

**Removal**

(1) Remove detent solenoid (fig. 2C-21).



**Fig. 2C-21 Detent Solenoid Removal**

(2) Remove electrical connector and O-ring seal from case (fig. 2C-22).

(3) Remove control valve spacer plate and gasket.

(4) Remove six check balls from passages in case. Note location of check balls for assembly reference (fig. 2C-23).

(5) Remove front servo piston, washer, pin, retainer and spring (fig. 2C-24).

**Extension Housing—Rear Bearing**

**Removal**

(1) Remove bolts attaching extension housing to case.

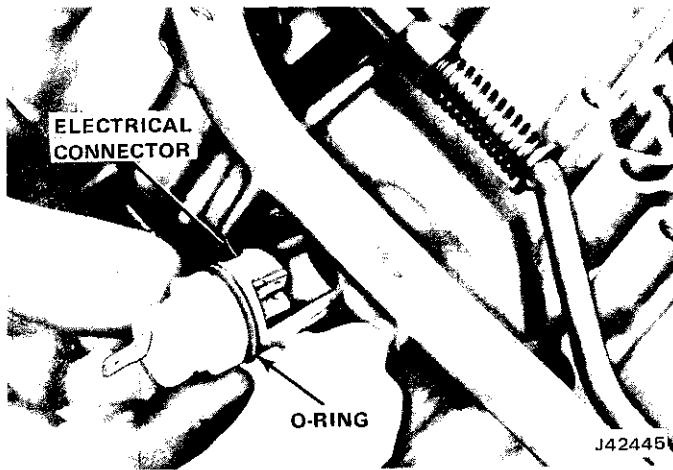


Fig. 2C-22 Electrical Connector and O-Ring Removal/Installation

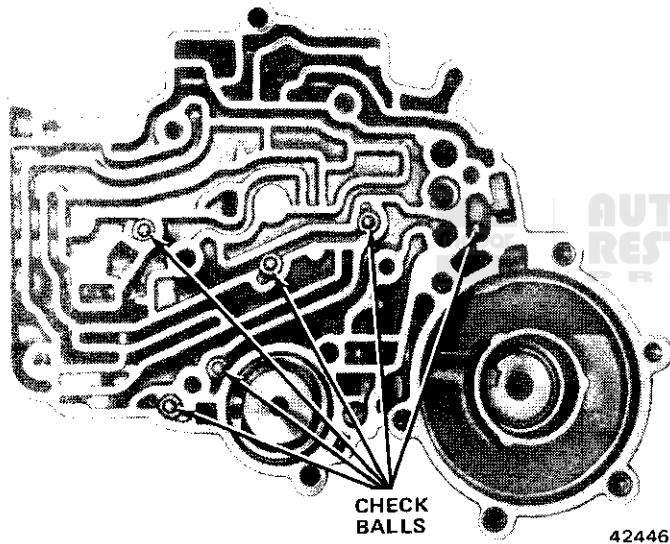


Fig. 2C-23 Control Valve Check Ball Location

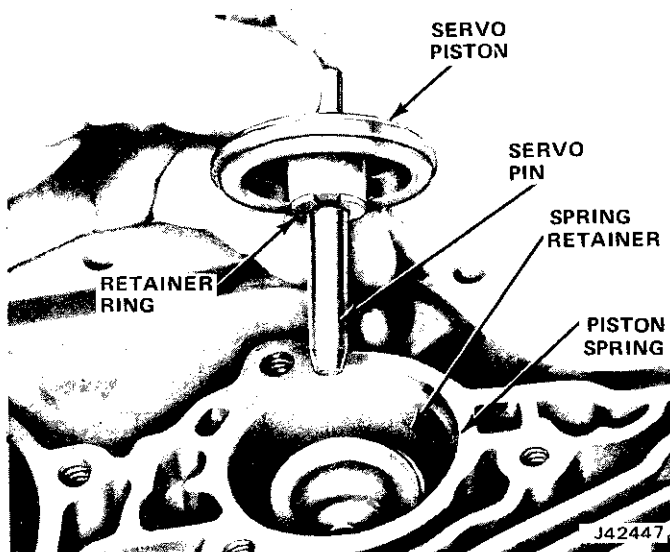


Fig. 2C-24 Front Servo Piston Removal/Installation

- (2) Remove extension housing from transmission output shaft. Tap housing off shaft using plastic mallet.
- (3) Remove bearing from extension housing. Tap bearing out of housing using plastic mallet.
- (4) Remove snap ring from bearing (fig. 2C-25).

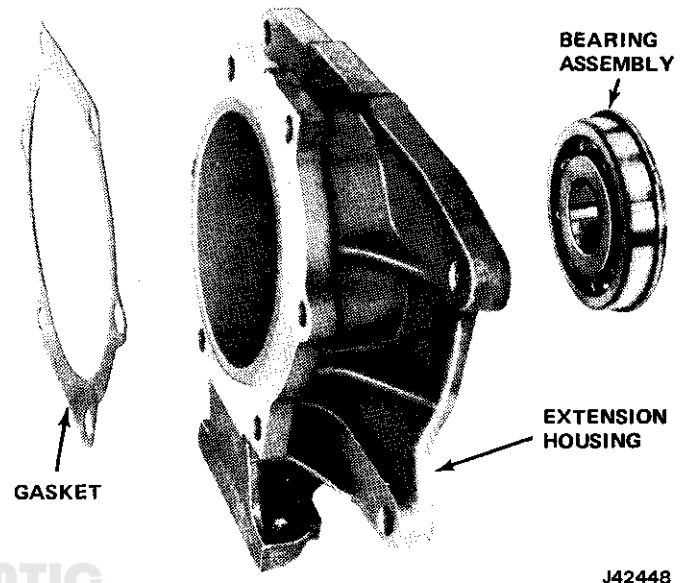


Fig. 2C-25 Extension Housing and Rear Bearing

### Front Unit End Play Measurement

- (1) Remove one oil pump attaching bolt and washer from 5 or 10 o'clock position on pump.
- (2) Install 3/8-16 slide hammer bolt in bolt hole.
- (3) Mount dial indicator on slide hammer bolt and position indicator stylus so it contacts end of turbine shaft (fig. 2C-26).
- (4) Push turbine shaft rearward.
- (5) Move output shaft forward to remove front unit end play.

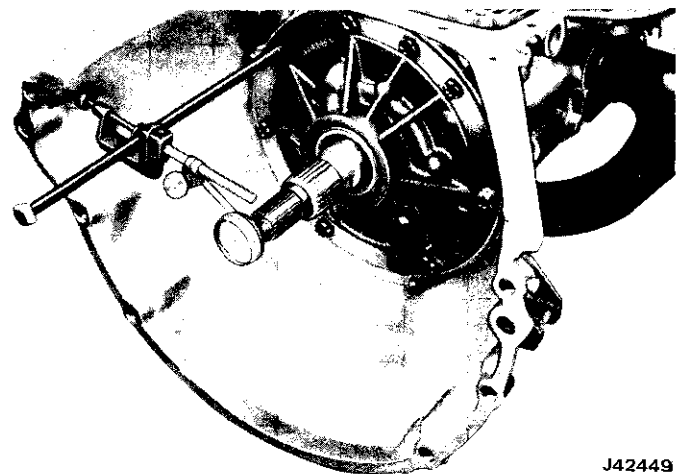


Fig. 2C-26 Measuring Front Unit End Play

- (6) Insert screwdriver between case and rear gear unit and pry gear unit and output shaft forward.
- (7) Set dial indicator to zero.
- (8) Pull turbine shaft forward and measure end play. Front unit end play should be 0.003 to 0.024 inch (0.07 to 0.60 mm). Record reading for assembly reference.

**NOTE:** The selective thrust washer that determines front unit end play is located between the pump cover and forward clutch housing. If increased or decreased washer thickness is required to adjust end play to within specifications, select the necessary thrust washer from one of the following:

**Front Unit Thrust Washer Chart**

THICKNESS	COLOR/NO.
0.060 to 0.064 (1.52-1.62 mm)	Yellow - 0
0.071 to 0.075 (1.80-1.90 mm)	Blue - 1
0.082 to 0.086 (2.08-2.18 mm)	Red - 2
0.093 to 0.097 (2.36-2.46 mm)	Brown - 3
0.104 to 0.108 (2.64-2.74 mm)	Green - 4
0.115 to 0.119 (2.92-3.02 mm)	Black - 5
0.126 to 0.130 (3.20-3.30 mm)	Purple - 6

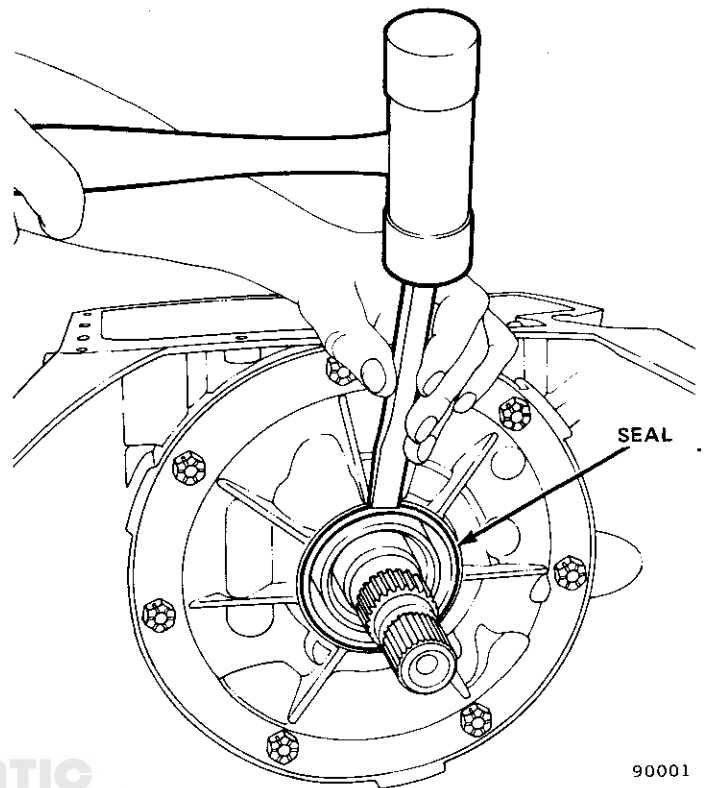
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**NOTE:** An oil-soaked washer will tend to discolor, so it may be necessary to measure the existing washer in order to determine the actual thickness.

**Oil Pump-Forward Clutch-Turbine Shaft-Direct Clutch**

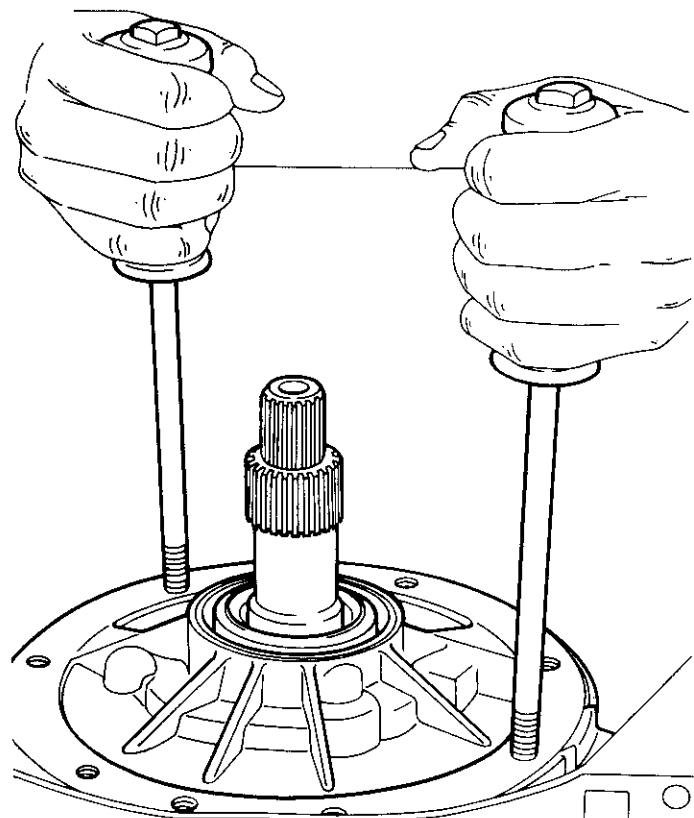
**Removal**

- (1) Remove front seal from oil pump (fig. 2C-27).
- (2) Remove pump attaching bolts and washers.
- (3) Install two 3/8-16 slide hammer bolts in threaded holes in pump body at 5 and 10 o'clock positions.
- (4) Bump outward evenly with slide hammers and remove pump (fig. 2C-28).
- (5) Remove and discard pump-to-case seal ring and gasket.
- (6) Remove forward clutch and turbine shaft (fig. 2C-29).
- (7) Remove forward clutch hub to direct clutch housing thrust washer if it did not come out with forward clutch housing.
- (8) Remove direct clutch (fig. 2C-30).



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**Fig. 2C-27 Oil Pump Seal Removal**



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**Fig. 2C-28 Oil Pump Removal**

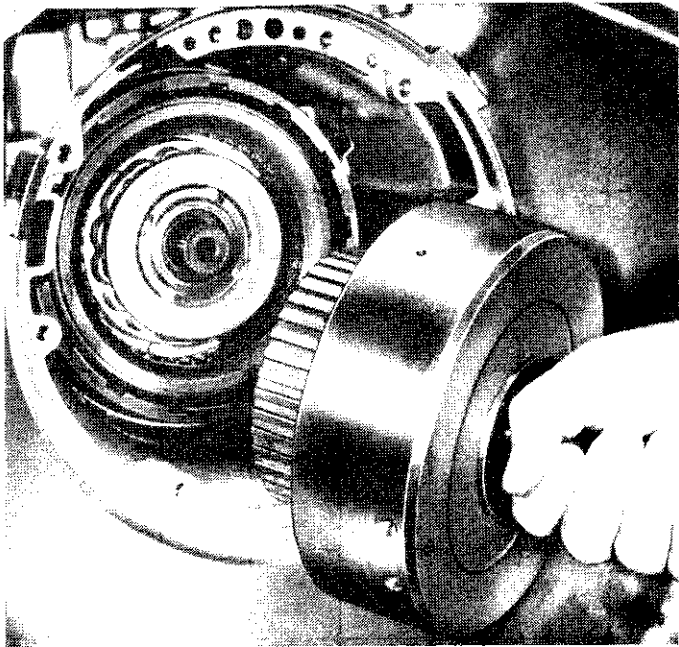


Fig. 2C-29 Forward Clutch Removal/Installation

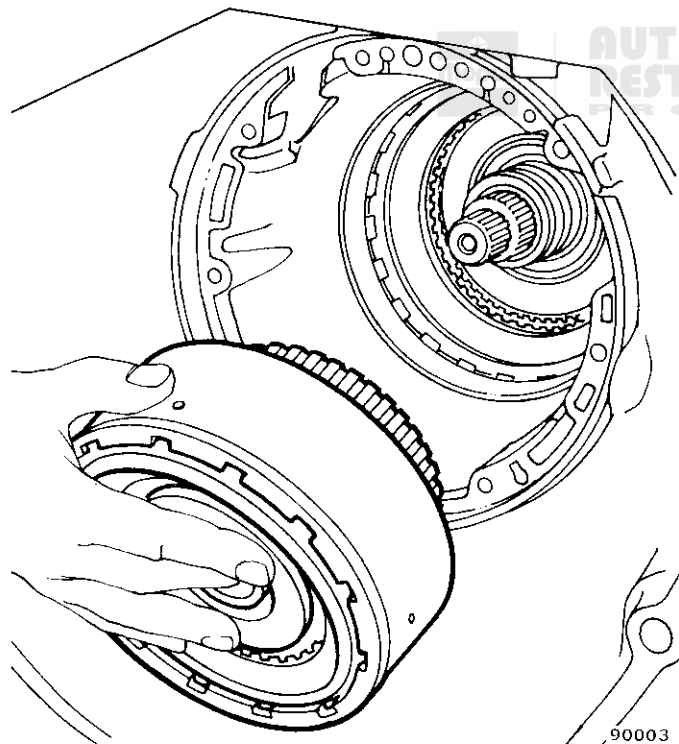


Fig. 2C-30 Direct Clutch Removal/Installation

### Manual Shaft-Parking Pawl

#### Removal

- (1) Unthread jamnut retaining detent lever on manual shaft.
- (2) Remove manual shaft retaining pin (fig. 2C-31).

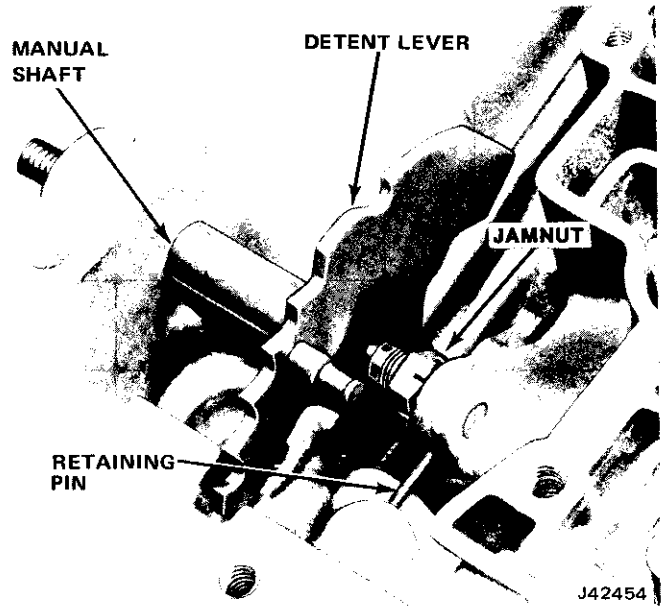


Fig. 2C-31 Manual Shaft and Retaining Pin

**CAUTION:** Do not unthread the jamnut as it comes off the manual shaft.

- (3) Remove jamnut, manual shaft and seal.
- (4) Remove manual shaft-to-case seal using screwdriver.
- (5) Remove parking actuator rod and detent lever assembly.
- (6) Remove parking bracket attaching screw and remove bracket (fig. 2C-32).

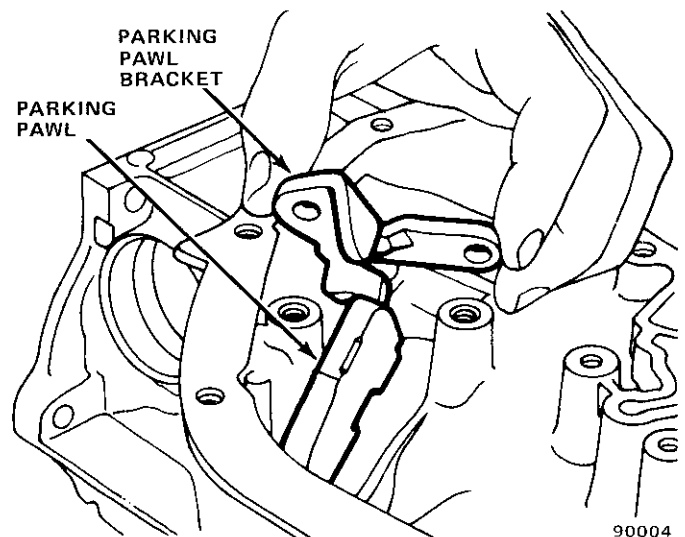


Fig. 2C-32 Parking Pawl Bracket Removal

(7) Remove retainer spring from parking pawl shaft (fig. 2C-33).

(8) Remove parking pawl shaft cup plug. Insert screwdriver between parking pawl shaft and case rib and pry outward on shaft to remove plug (fig. 2C-34).

(9) Remove parking pawl return spring, parking pawl shaft, and parking pawl (fig. 2C-35).

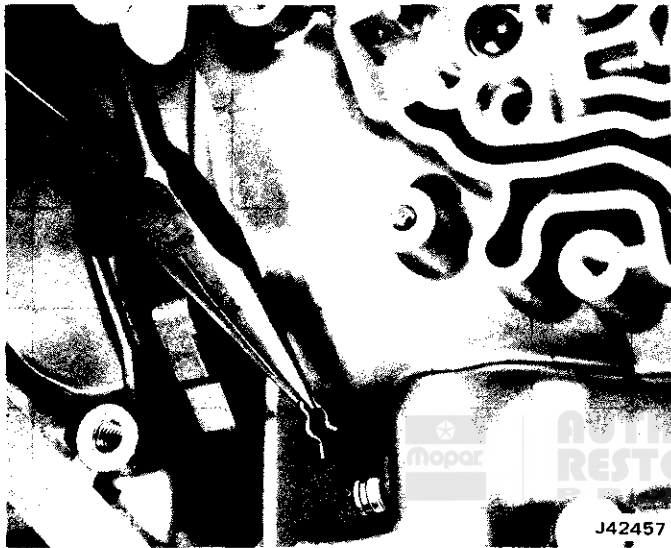


Fig. 2C-33 Parking Pawl Shaft Retainer Spring Removal/Installation

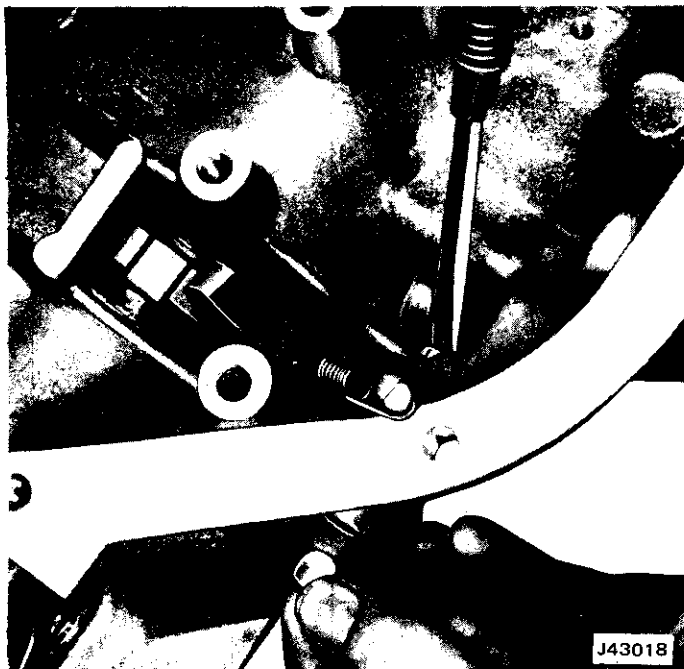


Fig. 2C-34 Parking Pawl Shaft Cup Plug Removal

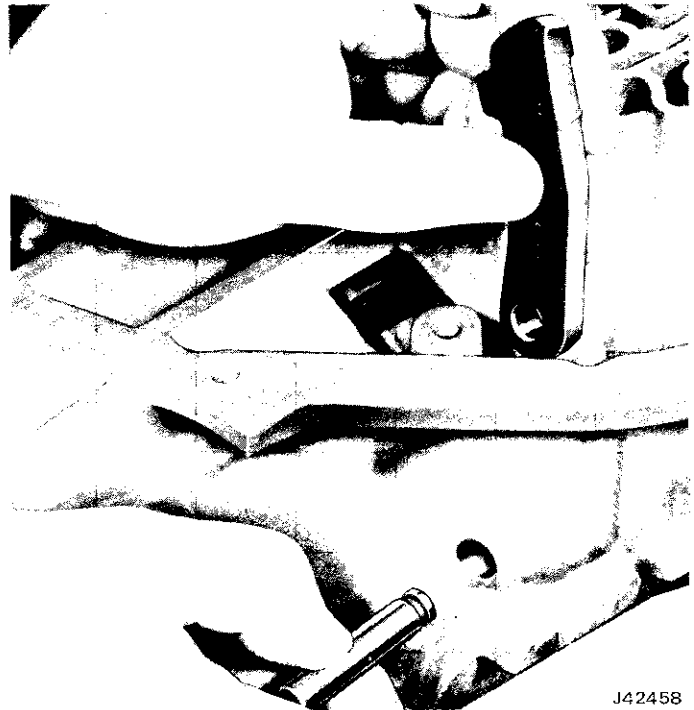


Fig. 2C-35 Parking Pawl and Shaft Removal

### Front Band-Sun Gear Shaft

#### Removal

- (1) Remove front band assembly (fig. 2C-36).
- (2) Remove sun gear shaft (fig. 2C-37).

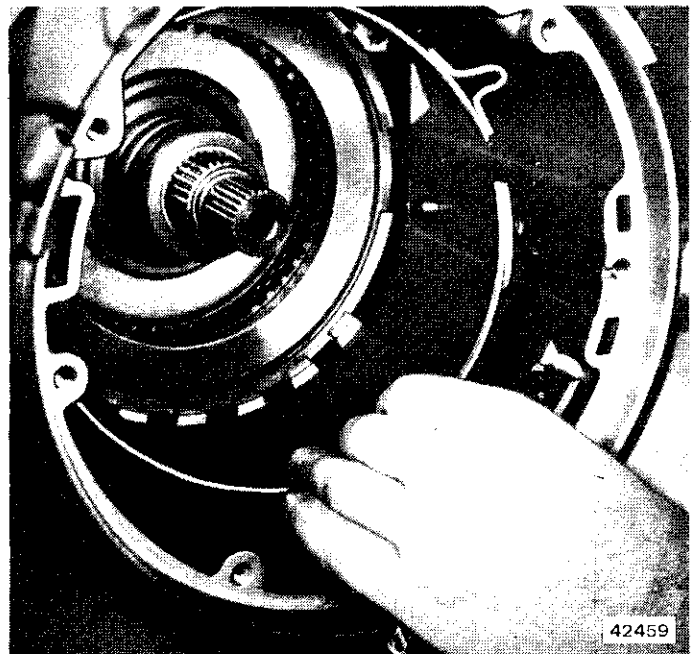


Fig. 2C-36 Front Band Removal/Installation



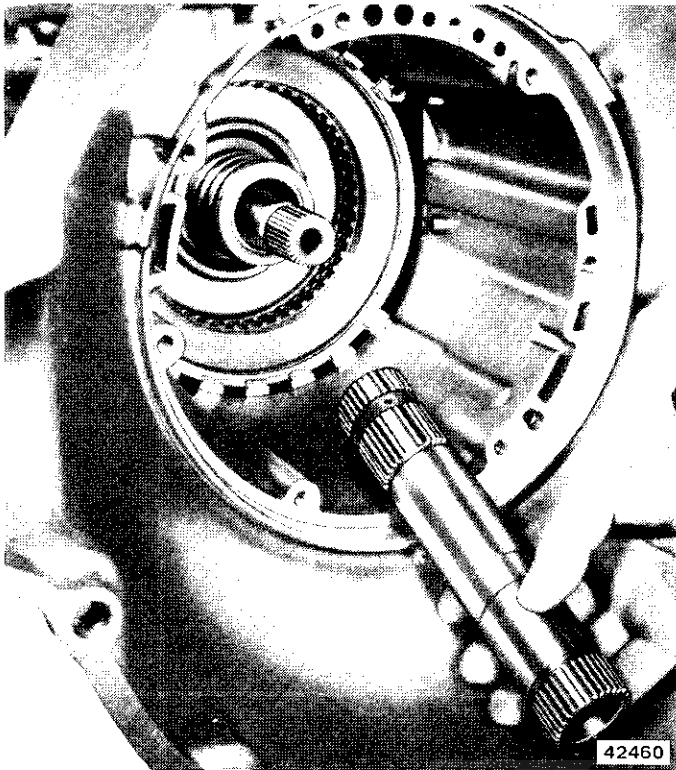


Fig. 2C-37 Sun Gear Shaft Removal

**Rear Unit End Play Measurement**

- (1) Install rod from tool J-25118 in extension housing attaching bolt hole.
- (2) Mount dial indicator on rod and position indicator so stylus contacts end of output shaft (fig. 2C-38).

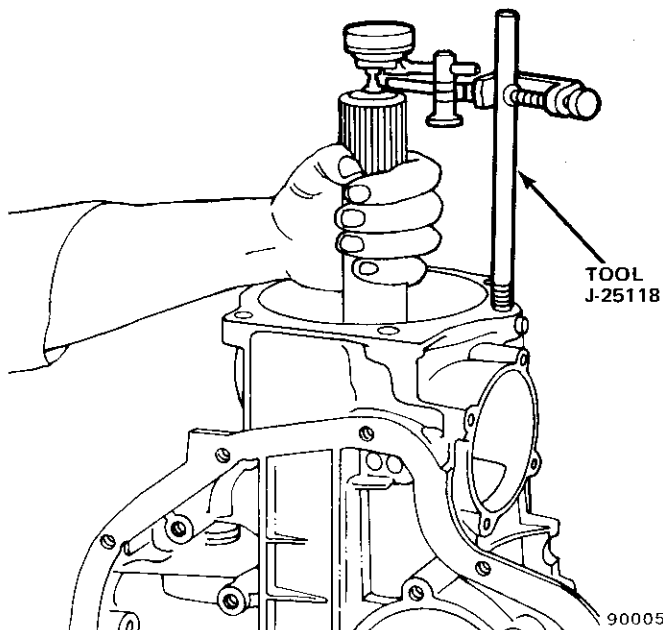


Fig. 2C-38 Measuring Rear Unit End Play

(3) Move output shaft inward and outward and measure end play. End play should be 0.007 to 0.019 inch (0.17 to 0.48 mm). Selective washer that determines rear unit end play is made of steel, has three lugs, and is located between thrust washer and rear face of transmission case. If different selective washer thickness is required to adjust end play select it from following rear unit thrust washer chart:

**Rear Unit Thrust Washer Chart**

Thickness (Inch)	Notches and/or Numeral	
0.074 to 0.078 (1.87-1.98 mm)	None	1
0.082 to 0.086 (2.08-2.18 mm)	1 Tab Side	2
0.090 to 0.094 (2.28-2.38 mm)	2 Tab Side	3
0.098 to 0.102 (2.48-2.59 mm)	1 Tab OD	4
0.106 to 0.110 (2.69-2.79 mm)	2 Tabs OD	5
0.114 to 0.118 (2.89-2.99 mm)	3 Tabs OD	6

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**Intermediate Clutch**

**Removal**

- (1) Remove center support-to-case retaining bolt using a 3/8 drive, 12 point, thin wall deep socket (fig. 2C-39).
- (2) Remove intermediate clutch backing plate-to-case snap ring.
- (3) Remove intermediate clutch backing plate, three composition clutch plates and three steel clutch plates (fig. 2C-40).

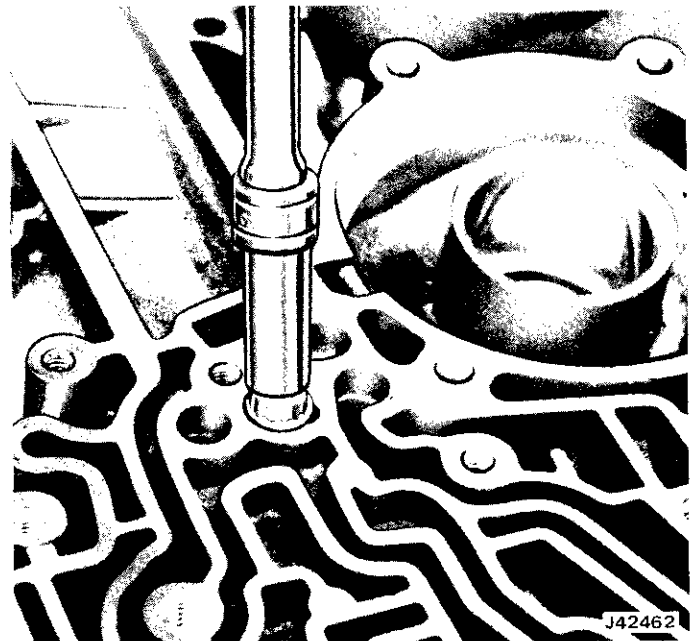


Fig. 2C-39 Center Support Bolt Removal/Installation

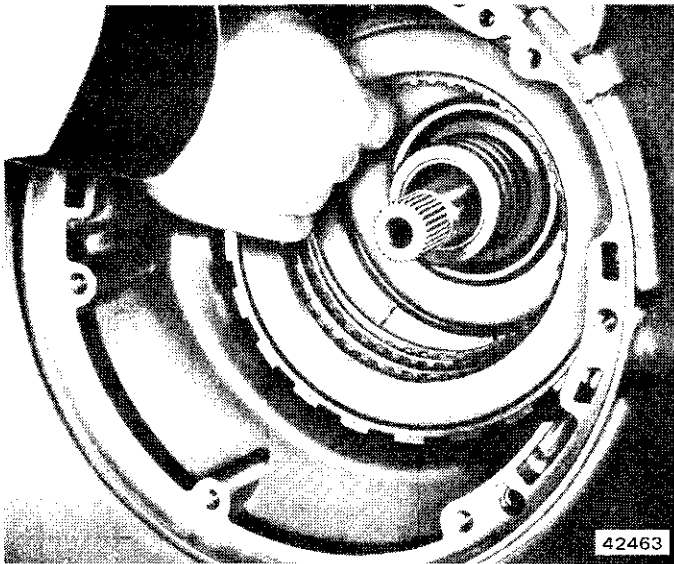


Fig. 2C-40 Intermediate Clutch Plate Removal

**Center Support-Gear Unit-Rear Band-Center Support Spacer Ring**

**Removal**

- (1) Remove center support to case snap ring (fig. 2C-41).
- (2) Remove center support and gear unit from transmission case using Remover and Installer Tool J-21795 and Slide Hammer J-25118 (fig. 2C-42).
- (3) Remove metal output shaft-to-case thrust washer from rear of output shaft or from case.
- (4) Place gear unit assembly, with output shaft fac-

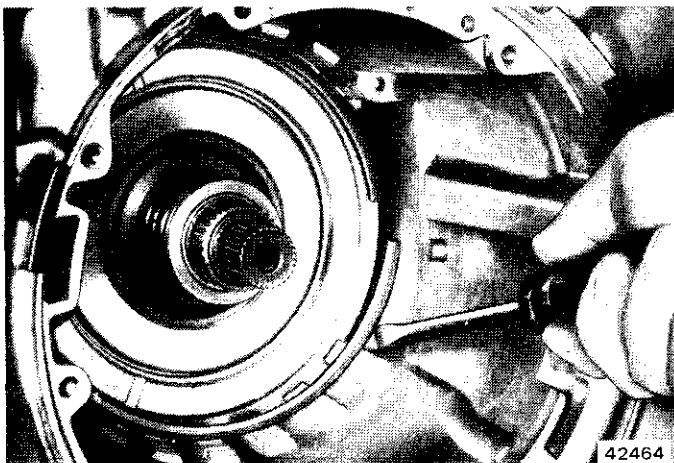


Fig. 2C-41 Center Support Snap Ring Removal

ing downward, in hole in work bench and Holding Fixture J-21364.

- (5) Remove rear unit selective washer from transmission case (fig. 2C-43).
- (6) Remove support-to-case spacer ring (fig. 2C-43).
- (7) Remove rear band (fig. 2C-44).

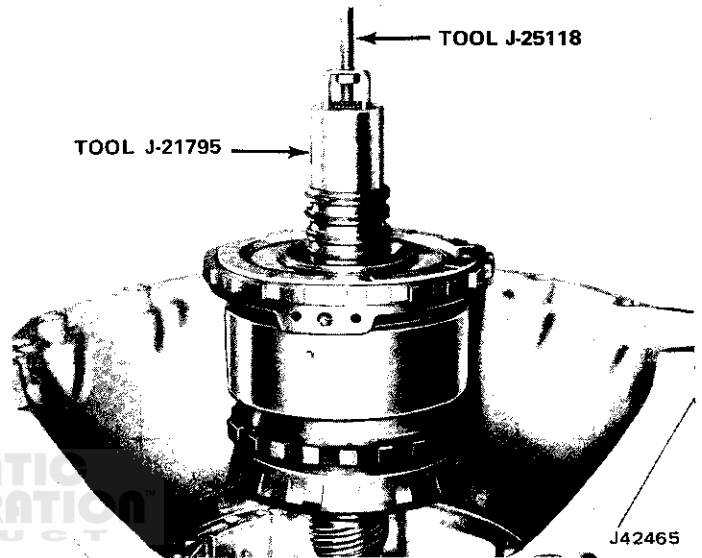


Fig. 2C-42 Center Support and Gear Unit Removal

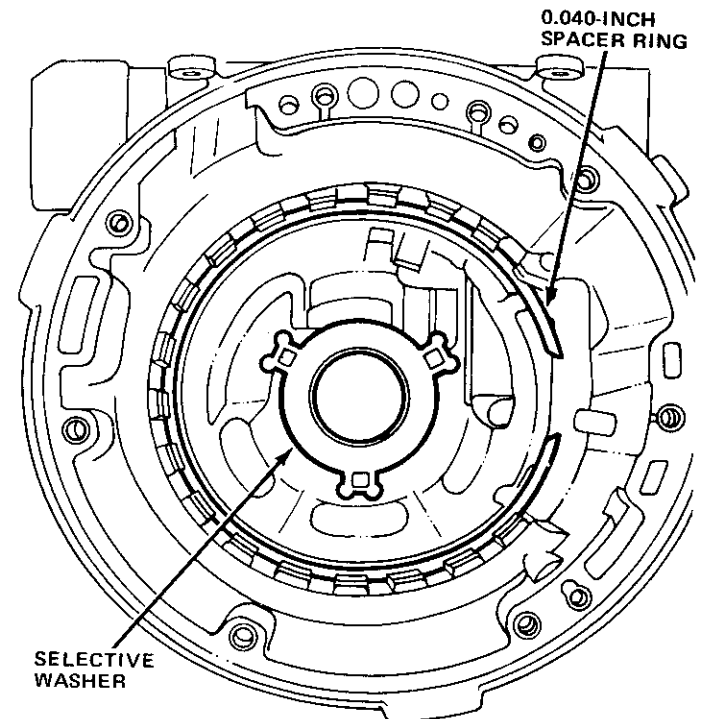


Fig. 2C-43 Selective Washer and Spacer Ring

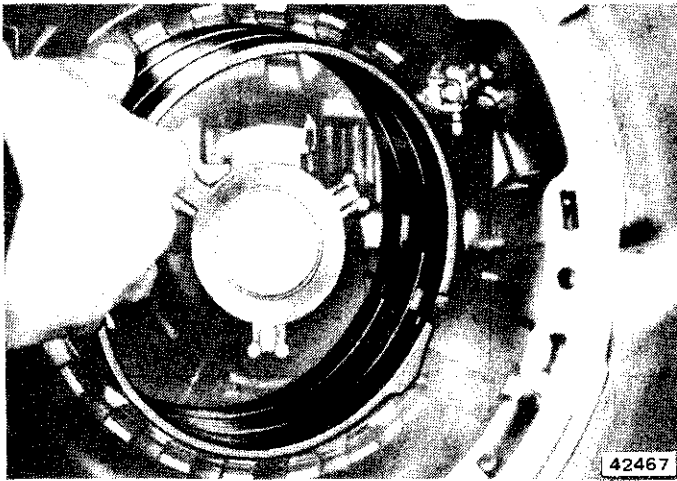


Fig. 2C-44 Rear Band Removal

## SUBASSEMBLY OVERHAUL

### Center Support and Gear Unit

- (1) Lift and remove center support from gear unit (fig. 2C-45).
- (2) Remove thrust washer located between center support and reaction carrier (fig. 2C-46).
- (3) Remove center support-to-sun gear races and thrust bearing.
- (4) Remove reaction carrier and roller clutch from output carrier as assembly (fig. 2C-47).
- (5) Remove front internal gear ring from output carrier (fig. 2C-48).
- (6) Remove sun gear from output carrier (fig. 2C-48).
- (7) Remove plastic or metal thrust washer located between reaction carrier and output carrier.

**NOTE:** The plastic washer is factory installed only. Service replacement washers are made of metal.

- (8) Turn output carrier over.
- (9) Remove snap ring retaining output shaft to output carrier.
- (10) Remove shaft from carrier.
- (11) Remove output shaft-to-rear internal gear thrust bearing and two races from rear internal gear and main shaft.
- (12) Remove rear internal gear and main shaft from output carrier (fig. 2C-49).
- (13) Remove rear internal gear to sun gear thrust bearing and two races from main shaft.
- (14) Remove rear internal gear-to-main shaft snap ring and remove gear from shaft (fig. 2C-50).

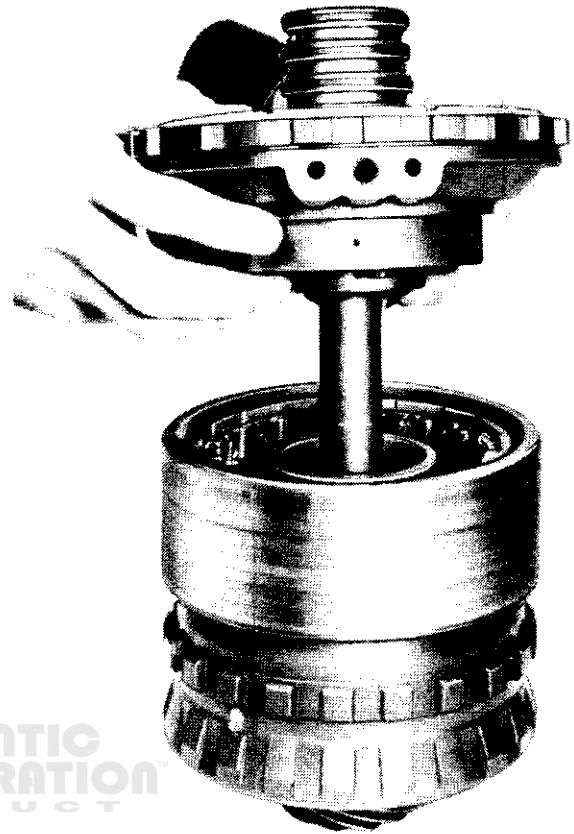


Fig. 2C-45 Removing Center Support from Gear Unit

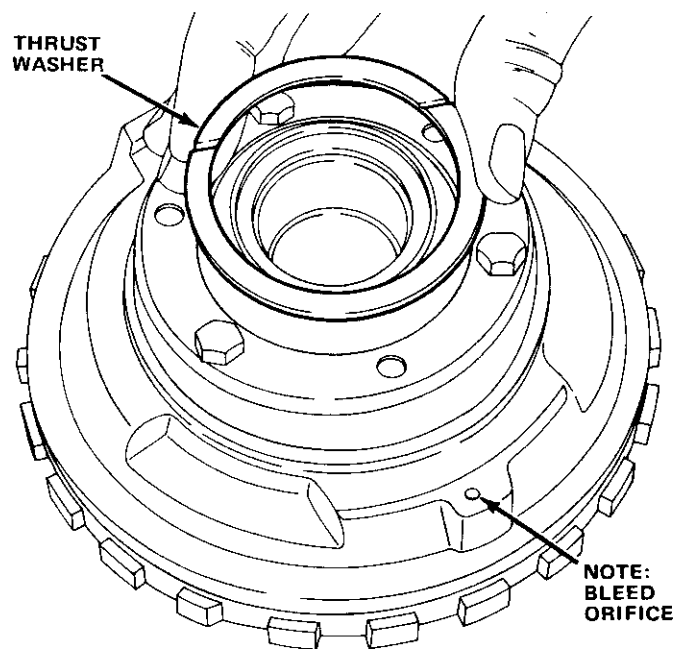
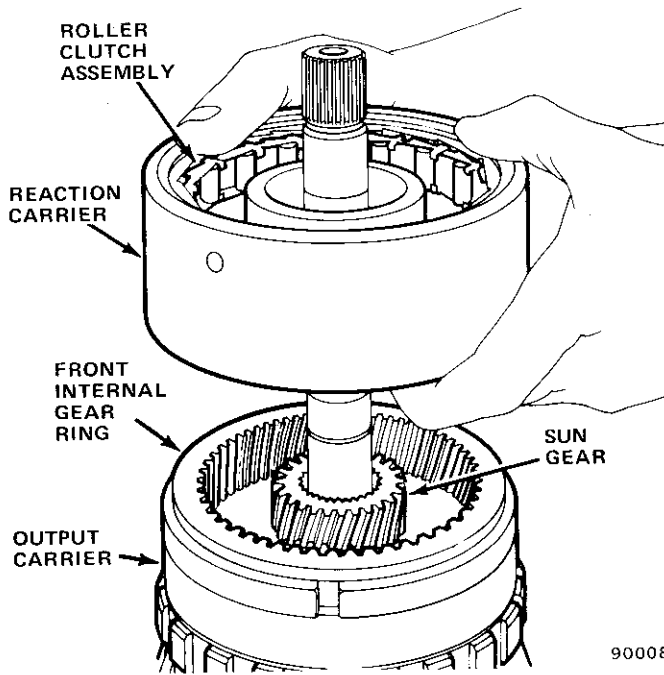
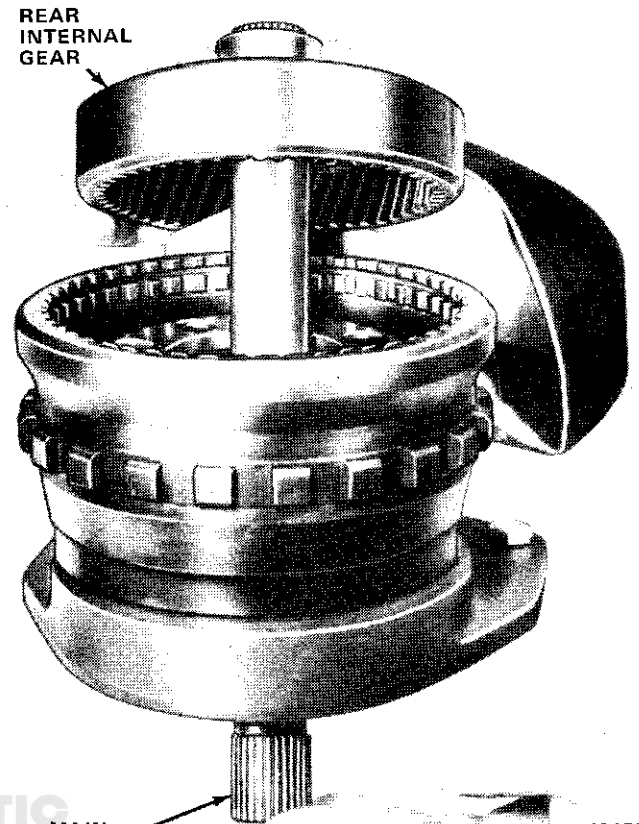


Fig. 2C-46 Center Support Thrust Washer Removal-Installation



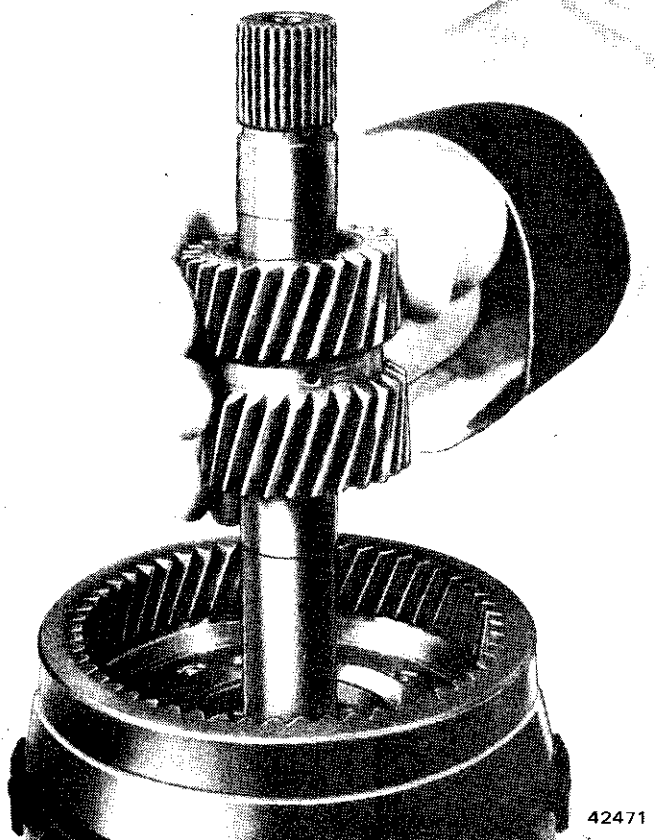
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Fig. 2C-47 Removing Reaction Carrier and Roller Clutch from Output Carrier



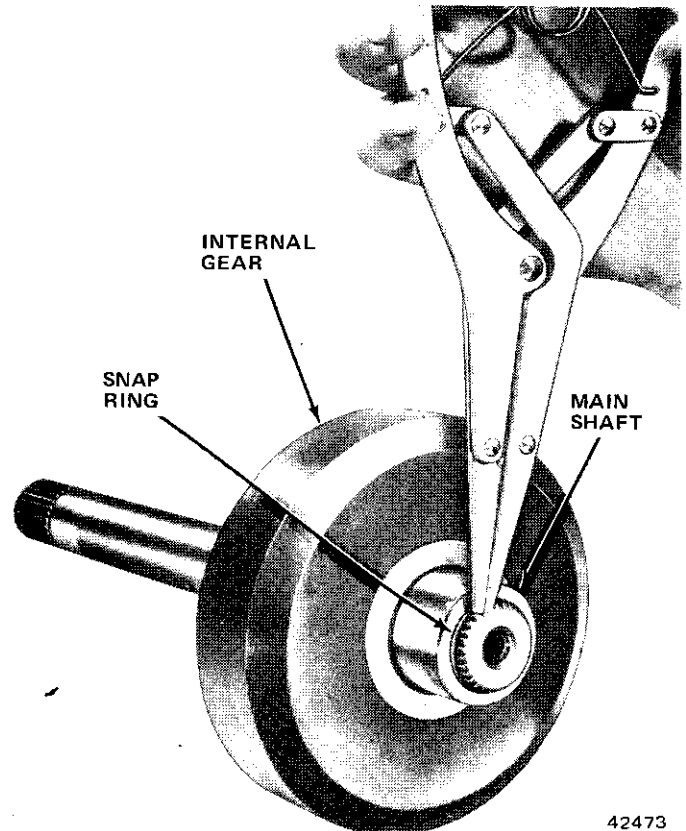
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Fig. 2C-49 Removing Rear Internal Gear and Main Shaft from Output Carrier



42471

Fig. 2C-48 Sun Gear Removal



42473

Fig. 2C-50 Main Shaft Snap Ring Removal



### Governor

All governor components, except the driven gear, are select-fit components and are individually calibrated assemblies. **The governor, including the driven gear, is serviced as a complete assembly only.** However, the driven gear may be serviced separately if required.

In order to replace the driven gear, it is necessary to disassemble the governor assembly.

**NOTE:** *Disassembly may also become necessary if dirt or foreign material has entered the governor causing improper operation.*

### Disassembly

(1) Cut off one end of each governor weight pin and remove pins, thrust cap, weights and springs (fig. 2C-51).

**NOTE:** *The governor weights are interchangeable from side to side and need not be identified.*

(2) Remove governor valve from governor sleeve. Do not damage valve.

### Cleaning and Inspection

Wash all parts in clean solvent, air dry the parts and blow out all passages using compressed air.

Inspect the governor sleeve for nicks, burrs, scoring, or galling.

Check the governor sleeve for free operation in the case bore.

Inspect the governor valve for nicks, burrs, scoring or galling.

Check the governor valve for free operation in the governor sleeve bore. Inspect the governor driven gear for nicks, burrs or damage.

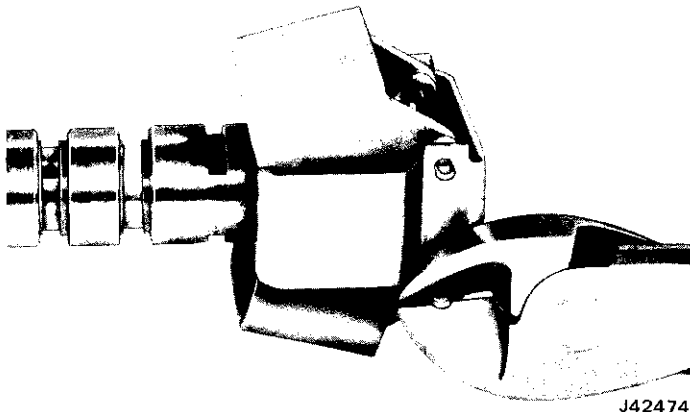


Fig. 2C-51 Removing Governor Weight Pins

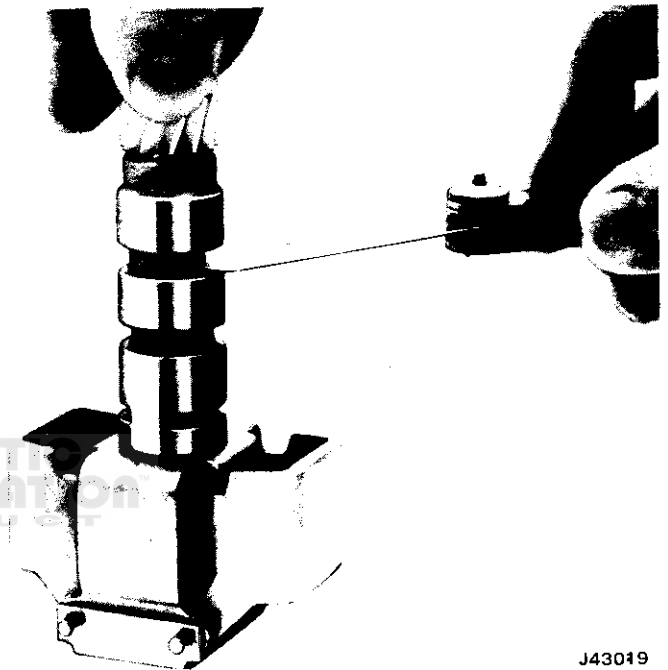
Check the governor driven gear for looseness on the governor sleeve. The sleeve must be tight on the carrier.

Inspect the governor weight springs for distortion or damage.

Check the governor weights for free operation in their retainers.

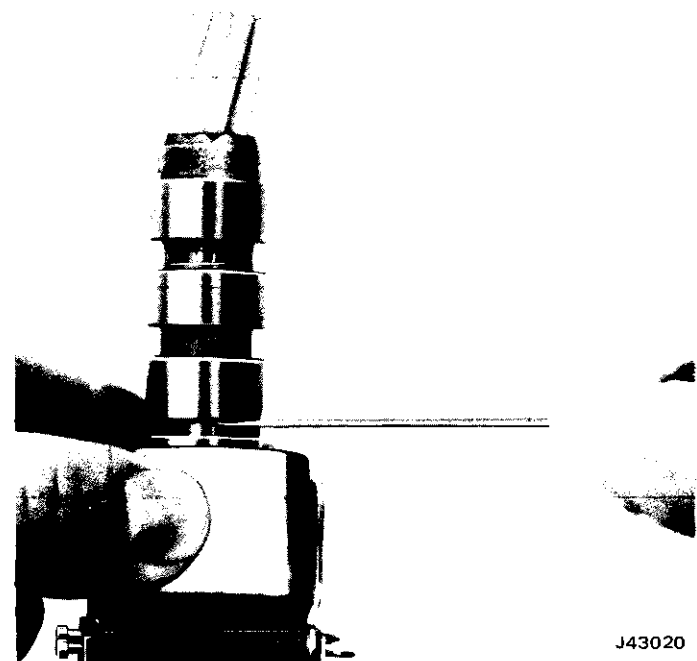
Check the valve opening at entry using a feeler gauge. Hold the governor so the weights are fully extended (fig. 2C-52). Valve opening should be 0.020 inch (0.50 mm) minimum.

Check the valve opening at exhaust using a feeler gauge. Hold the governor so the weights are fully retracted (fig. 2C-53). Valve opening should be 0.020 inch (0.50 mm) minimum.



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Fig. 2C-52 Measuring Valve Opening at Entry



J43020

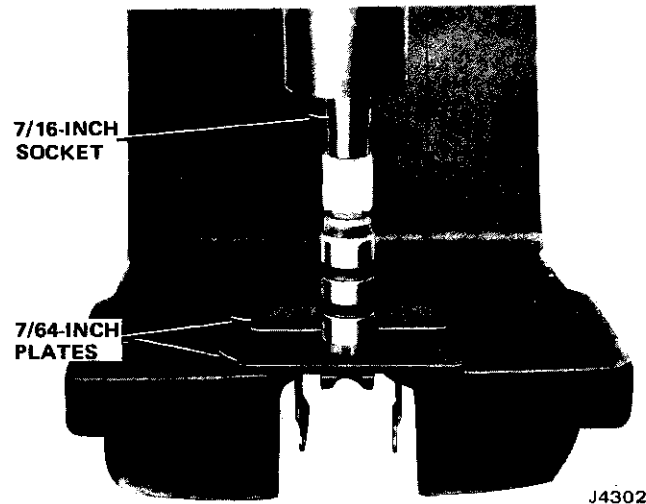
Fig. 2C-53 Measuring Valve Opening at Exhaust

**Governor Driven Gear Replacement**

A governor driven gear and replacement pins are available for service use.

The service package contains a nylon driven gear, two governor weight retaining pins and a governor gear retainer split pin. Gear replacement must be performed carefully and in the following sequence:

- (1) Remove split pin that retains governor gear on governor sleeve using small punch (fig. 2C-54).
- (2) Support governor using 7/64 inch (2.77 mm) thick plates installed in exhaust slots of governor sleeve (fig. 2C-55).
- (3) Mount assembled parts in arbor press and use long punch to press gear out of sleeve.
- (4) Clean chips from governor sleeve.
- (5) Support governor on 7/64 inch (2.77 mm) plates installed in exhaust slots of sleeve.
- (6) Insert replacement gear in sleeve.
- (7) Press gear into sleeve using suitable size socket until gear is nearly seated (fig. 2C-55).



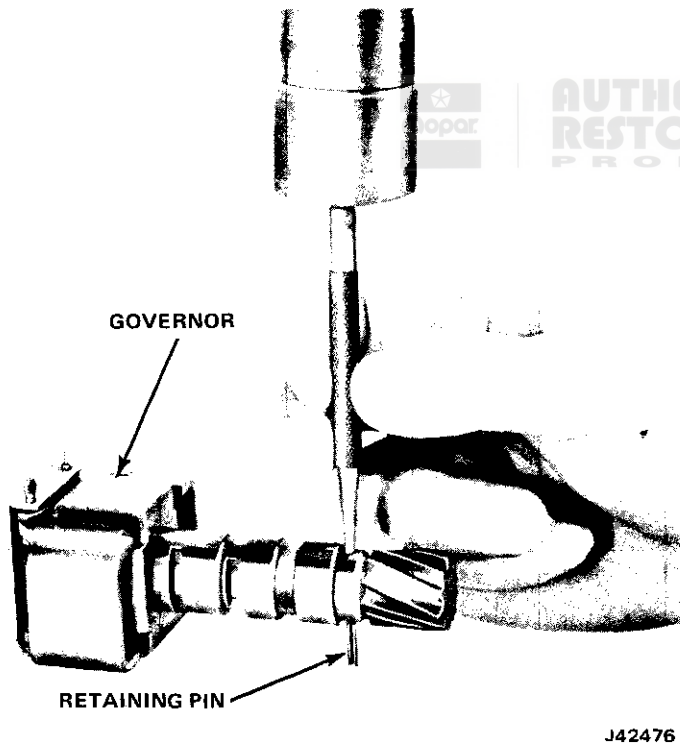
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**Fig. 2C-55 Governor Driven Gear Removal/Installation**

- (10) Drill new hole through sleeve and gear using 1/8-inch drill.
- (11) Install retaining pin through gear and sleeve.
- (12) Wash governor assembly thoroughly to remove chips.

**Assembly**

- (1) Install governor valve in bore of governor sleeve (fig. 2C-56).
- (2) Install weights and springs.
- (3) Install thrust cap on governor sleeve.
- (4) Align pin holes in thrust cap, governor weight assemblies and governor sleeve and install replacement pins. Crimp ends of pins to prevent them from falling out.
- (5) Check governor weight assemblies for free operation on pins and check governor valve for free operation in sleeve.

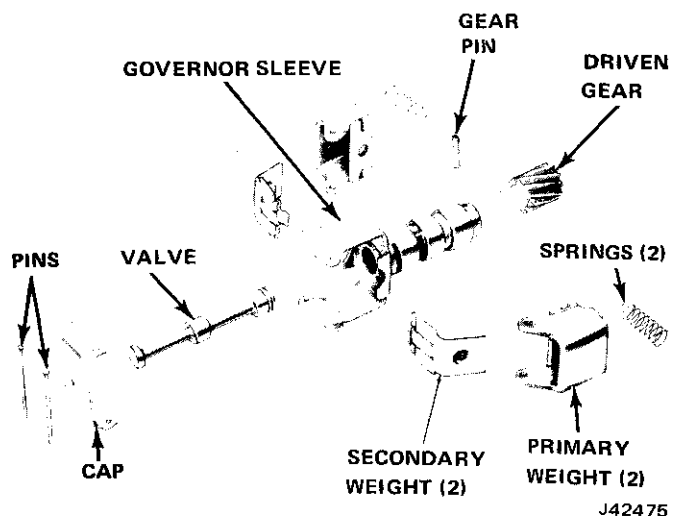


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**Fig. 2C-54 Governor Driven Gear Retaining Pin Removal**

- (8) Remove any chips that may have shaved off gear hub and press gear inward until it bottoms on shoulder of sleeve.
- (9) Mark location of new pin hole in gear and sleeve. Center punch gear and sleeve and mount gear and sleeve in drill press.

**NOTE:** Locate the new pin hole 90° from the original hole.



J42475

**Fig. 2C-56 Governor Assembly**

**Front Servo**

**NOTE:** Do not remove the teflon oil seal ring from the front servo piston unless the seal ring requires replacement. Service oil seal rings are aluminum instead of teflon.

**CAUTION:** The spring retainer, servo pin, retainer ring and servo piston are identical for 1971 through 1979 transmissions but are not interchangeable with pre-1971 parts.

**Inspection**

Inspect the servo pin for damage.

Inspect the piston, oil seal ring and seal ring groove for damage. Check for free movement of the ring in the ring groove.

Inspect the piston for cracks or porosity and check the fit of the servo pin in the piston (fig. 2C-57).

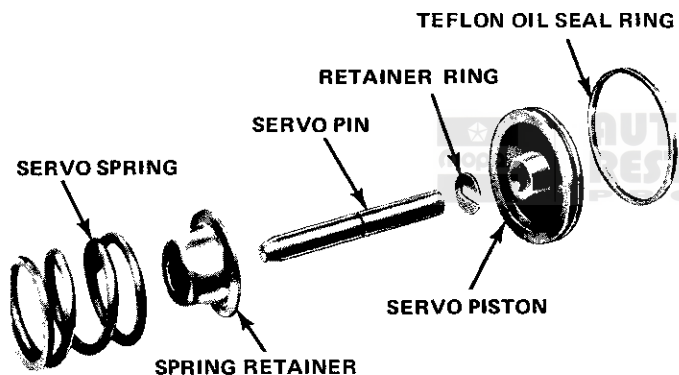


Fig. 2C-57 Front Servo Assembly

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**Rear Servo-Accumulator**

**Disassembly**

- (1) Remove rear accumulator piston from rear servo piston (fig. 2C-58).
- (2) Remove E-ring retaining rear servo piston to servo pin (fig. 2C-59).
- (3) Remove rear servo piston and seal from servo pin (fig. 2C-59).
- (4) Remove washer, spring and retainer.

**Inspection**

**NOTE:** Do not remove the teflon oil seal rings from the rear accumulator piston unless the oil seal rings require replacement. If the teflon inner oil seal ring (small diameter) requires replacement, use the aluminum oil seal ring supplied in the service replacement kit. The depth of the large diameter ring groove in the rear accumula-

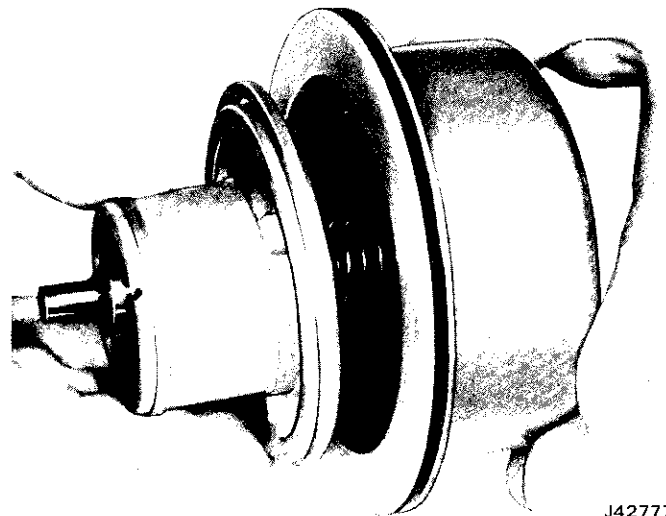


Fig. 2C-58 Accumulator Piston Removal

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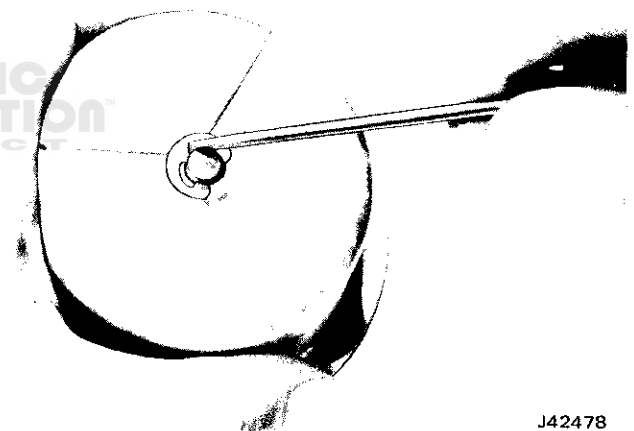


Fig. 2C-59 E-Ring Retainer Removal

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tor piston is machined shallower to accept the large teflon oil seal ring. If this ring requires replacement, use only a teflon oil seal ring as a replacement.

Inspect the servo piston and piston oil grooves for damage (fig. 2C-60).

Check for free movement of the seal rings in the piston grooves.

Check for free movement of the accumulator piston in the servo piston.

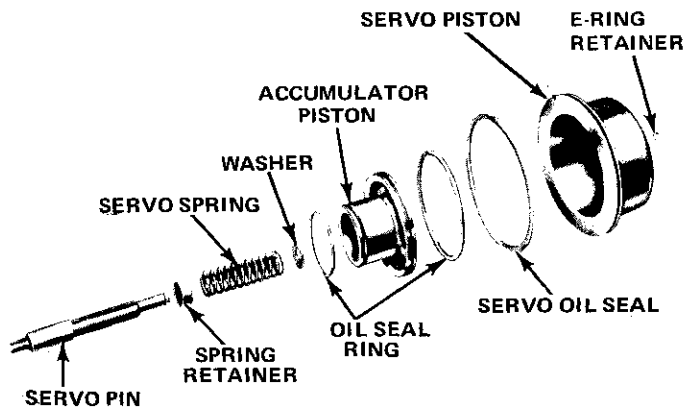
Inspect the servo pin for scores or cracks.

Inspect the accumulator and servo piston for cracks and porosity.

**Assembly**

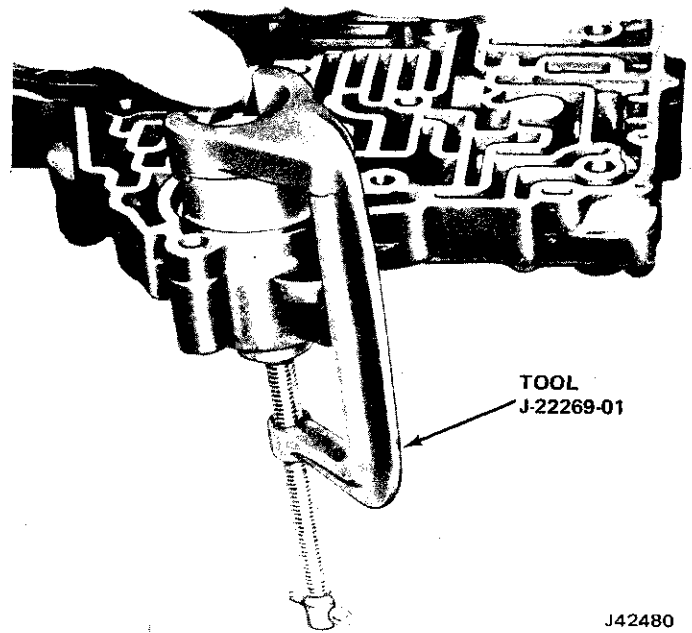
- (1) Install spring retainer with cap facing downward and install spring, and flat washer on servo pin (fig. 2C-60).

- (2) Insert servo pin into bore of servo piston and install E-Ring retainer.
- (3) Install inner and outer oil rings on accumulator piston if removed.
- (4) Install accumulator piston in bore of servo piston.



J43023

Fig. 2C-60 Rear Servo and Accumulator Assembly



J42480

Fig. 2C-61 E-Ring Retainer Removal

## Control Valve



AUTHENTIC RESTORATION PRODUCT

### Disassembly

- (1) Position control valve assembly so transmission mating surface of valve faces upward.
- (2) Remove manual valve from upper bore.
- (3) Remove accumulator piston retaining ring using Tool J-22269-01 (fig. 2C-61).
- (4) Remove accumulator piston and spring (fig. 2C-62).
- (5) Remove retaining pin, at right side of valve body and remove 1-2 bushing, 1-2 regulator valve, 1-2 regulator spring, 1-2 detent valve and 1-2 valve (fig. 2C-63).
- (6) Remove retaining pin from next bore and remove 2-3 bushing, 2-3 valve spring, 2-3 modulator valve, 2-3 spring and 2-3 valve (fig. 2C-64).
- (7) Remove retaining pin from next bore and remove bore plug, 3-2 spring, spacer and 3-2 valve (fig. 2C-64).
- (8) Remove retaining pin, bore plug detent valve, detent regulator, detent spring and spacer from upper bore in opposite side of valve body.
- (9) Remove retaining pin from next bore and remove bore plug, 1-2 accumulator valve and 1-2 accumulator primary spring or secondary spring (fig. 2C-63).

**NOTE:** The 1-2 accumulator primary spring is not used in CJ models with six-cylinder engine.

### Inspection

Wash all components thoroughly in clean solvent and dry using compressed air.

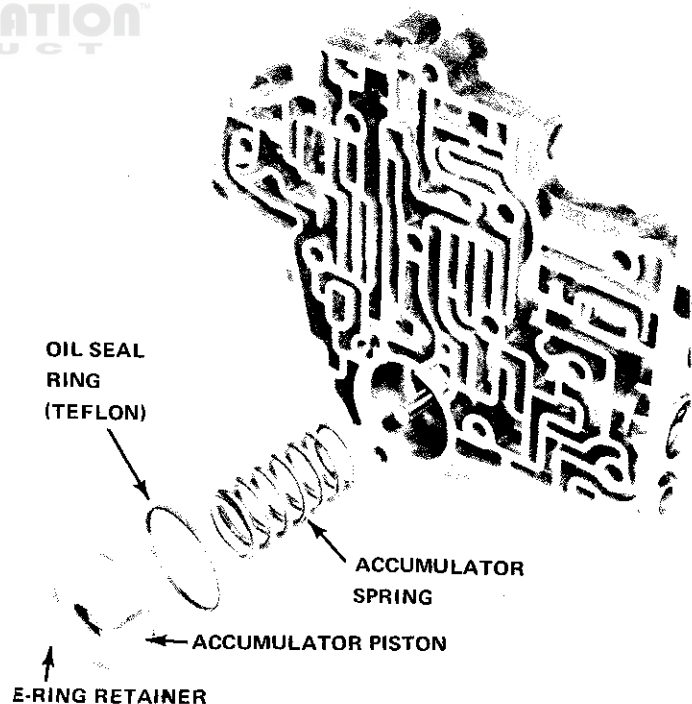


Fig. 2C-62 Accumulator Piston and Spring

Inspect all valves for scoring, cracks, and for free movement in their bores.

Inspect all bushings for cracks, scratches or distortion.

Inspect the valve body for cracks or scored bores. Check all springs for distortion or collapsed coils.



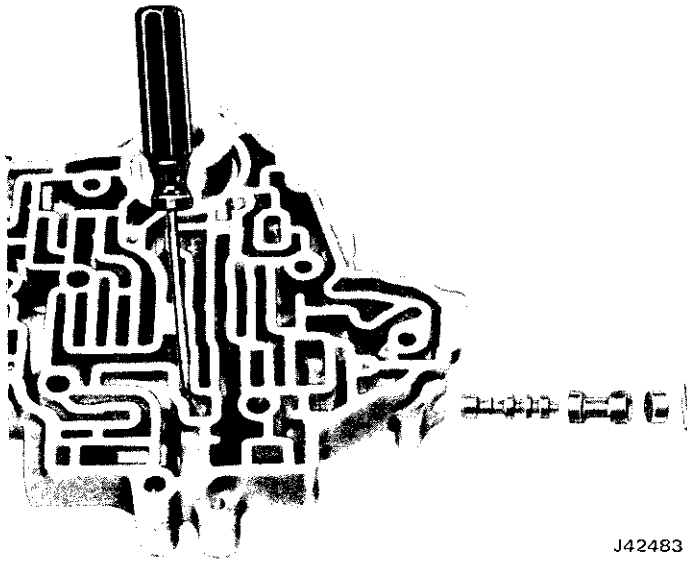


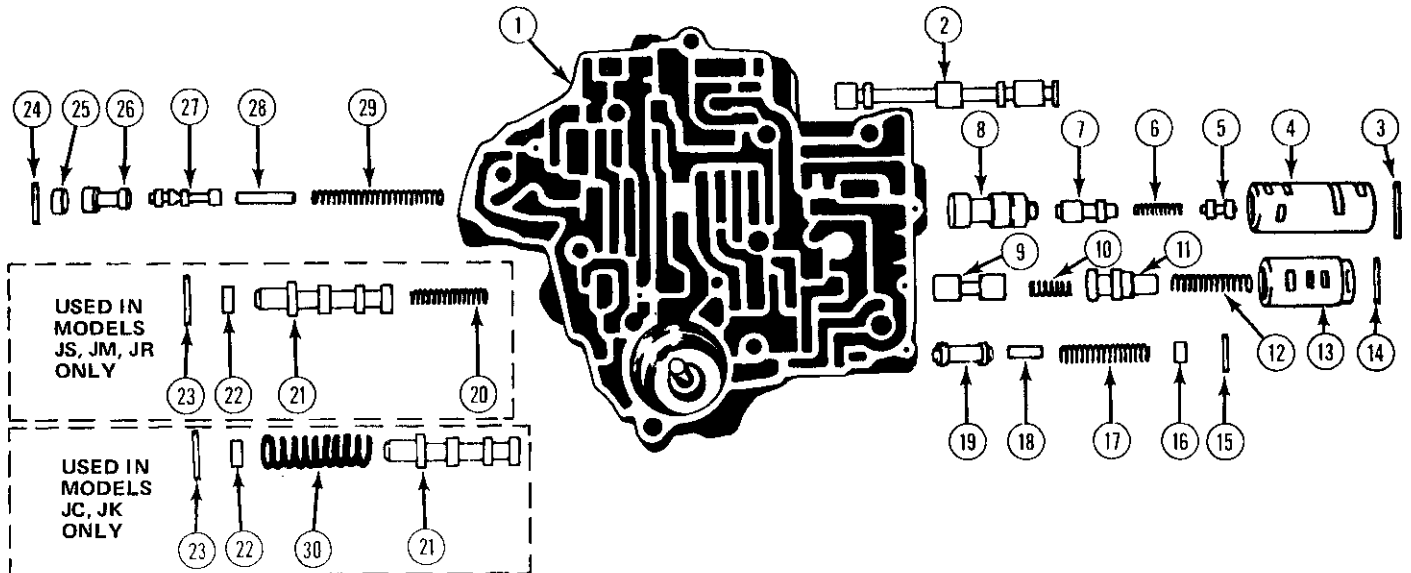
Fig. 2C-63 Detent and Regulator Valve

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**Assembly**

- (1) Install front accumulator spring and piston (fig. 2C-58).
- (2) Install spring and piston. Install tool J-22269-01, compress piston and install E-ring retainer (fig. 2C-61).
- (3) Install 1-2 accumulator primary spring or secondary spring, if equipped, and install 1-2 accumulator valve in lower left bore.
- (4) Install bore plug.
- (5) Install grooved retaining pin from cast surface

- side of control valve, with grooves entering pin hole last. Tap pin with hammer until flush with cast surface.
- (6) Install detent spring and spacer in next bore.
- (7) Compress spring and retain spring and spacer using small screwdriver (fig. 2C-63).
- (8) Insert detent regulator valve, wide land first; then install detent valve, narrow land first.
- (9) Install bore plug with cup end facing outward (fig. 2C-64).
- (10) Push plug inward to compress spring, install bore plug pin and remove screwdriver.
- (11) Insert 3-2 valve, 3-2 valve spring, spacer and bore plug (cup end out) in lower right-hand bore. Push plug into control valve to compress spring and install retaining pin.
- (12) Install 2-3 shift valve (stem end out) and 3-2 spring into next bore.
- (13) Insert 2-3 modulator control valve in bushing and install both parts in valve bore.
- (14) Install 2-3 shift control valve spring, compress spring and install retaining pin.
- (15) Install 1-2 shift valve (stem end out) in next bore.
- (16) Install 1-2 regulator valve, 1-2 regulator valve spring and detent valve in bushing.
- (17) Align spring in bore of detent control valve and install parts in valve bore.
- (18) Press bushing into control valve to compress spring, and install retaining pin.
- (19) Install manual valve with detent pin groove facing to right.



- |                         |   |   |  |
|-------------------------|---|---|--|
| 1. Control Valve        | 10. 2-3 Spring                              | 17. 3-2 Spring  | 24. Retaining Pin  |
| 2. Manual Valve         | 11. 2-3 Modulator Valve                     | 18. Spacer  | 25. Bore Plug  |
| 3. Retaining Pin        | 11. 2-3 Modulator Valve                     | 19. 3-2 Valve   | 26. Detent Valve   |
| 4. 1-2 Bushing          | 12. 2-3 Valve Spring (Not used in JC Model) | 20. 1-2 Accumulator Primary Spring (Used in Models JM, JS, JR only) | 27. Detent Regulator   |
| 5. 1-2 Regulator Valve  | 13. 2-3 Bushing                             | 21. 1-2 Accumulator Valve   | 28. Spacer   |
| 6. 1-2 Regulator Spring | 14. Retaining Pin                           | 22. Bore Plug   | 29. Detent Spring  |
| 7. 1-2 Detent Valve     | 15. Retaining Pin                           | 23. Retaining Pin   | 30. 1-2 Accumulator Secondary Spring (Used in Model JC only) |
| 8. 1-2 Valve            | 16. Bore Plug                               |   |  |
| 9. 2-3 Valve            |   |   |  |

Fig. 2C-64 Control Valve Assembly

## Oil Pump

### Disassembly

- (1) Mount oil pump assembly in Adapter J-21364 and into hole in work bench.
- (2) Compress pressure boost valve bushing against pressure regulator spring and remove snap ring from pump cover (fig. 2C-65).
- (3) Remove pressure boost valve bushing and valve and remove pressure regulator spring from pump cover.
- (4) Remove spring retainer washer, pressure regulator spacer (if equipped) and pressure regulator valve.
- (5) Remove pump cover attaching bolts and remove cover from pump body.
- (6) Remove retaining pin and bore plug from pressure regulator bore in pump cover (fig. 2C-66).
- (7) Remove oil rings and thrust washer from pump cover (fig. 2C-65).
- (8) Mark oil pump drive and driven gears for assembly alignment reference and remove gears (fig. 2C-67).

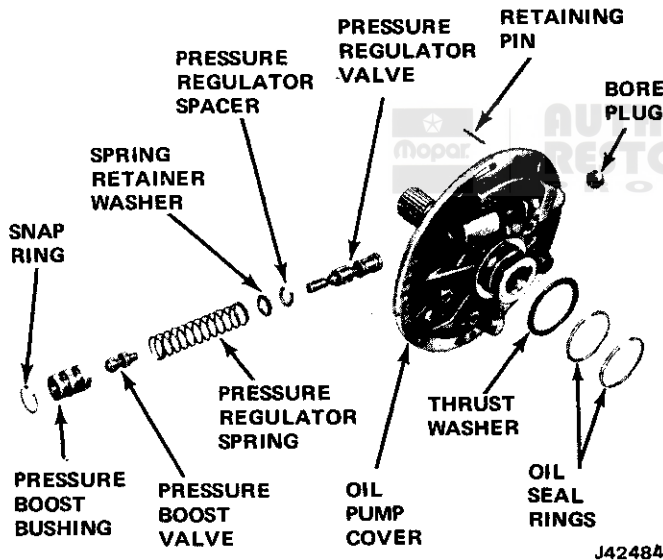


Fig. 2C-65 Oil Pump Cover Assembly

### Inspection

**CAUTION:** The solid-type pressure regulator valve does not contain oil holes and an orifice cup plug like earlier-type pressure regulator valves. The solid style valve must **only** be used in pump covers that have a squared off pressure regulator boss at the pressure boost bushing end of the cover (fig. 2C-7). The earlier-type pressure valve with the oil holes and orifice cup plug will be used to service either type pump cover.

Inspect the drive gear, driven gear, gear pocket, and crescent for scoring, galling, or other damage.

Position the pump gears in the pump body and check pump body face-to-gear clearance. Clearance should be 0.0008 to 0.0035 inch (0.020 to 0.088 mm) (fig. 2C-68).

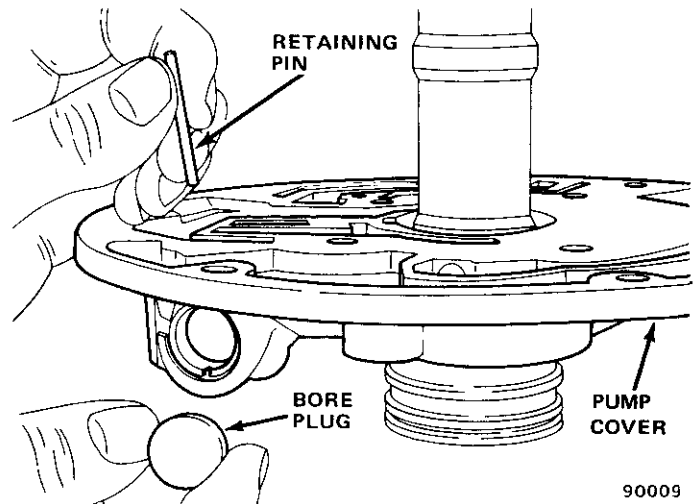


Fig. 2C-66 Pressure Regulator Plug and Retaining Pin

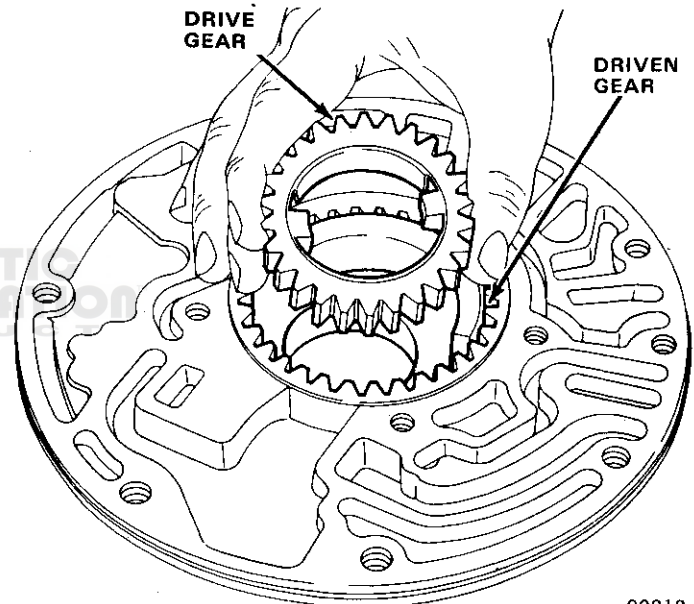


Fig. 2C-67 Oil Pump Gear Removal-Installation

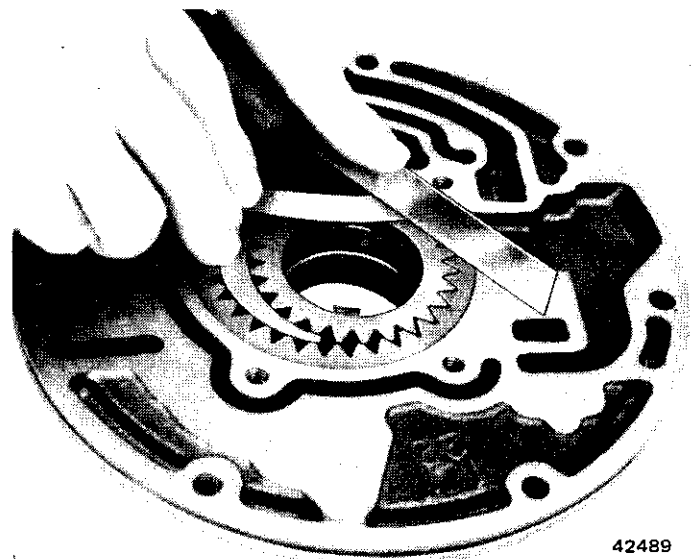


Fig. 2C-68 Checking Pump Body Face-To-Gear Clearance

Check the pump body face for scores or nicks. Inspect the oil passages for restrictions. Check for damaged cover bolt attaching threads. Check the pump face surface flatness and check the bushing for scores or nicks (fig. 2C-69).

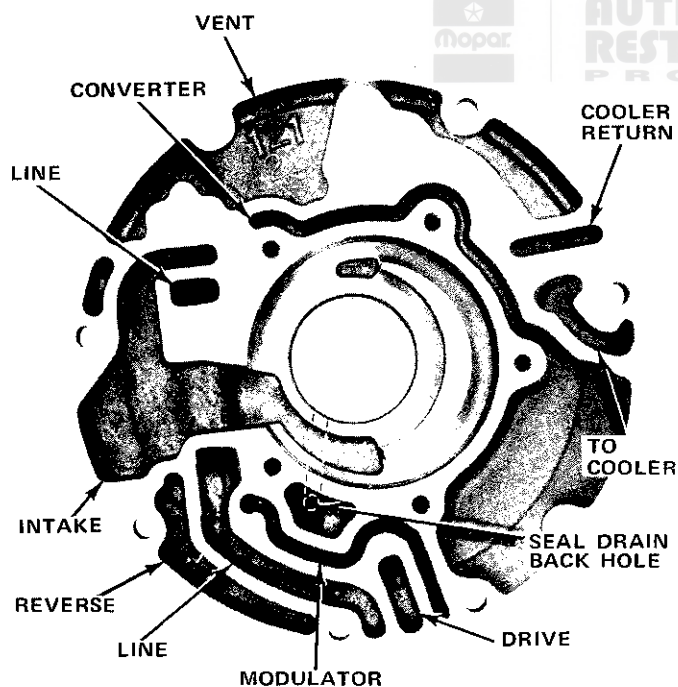
Inspect the pump attaching bolts for damage and replace as necessary.

Inspect the surface flatness of the pump cover face. Check for scores or chips in the pressure regulator bore and be sure all passages are open and not interconnected. Check for scoring or damage at the pump gear face. Inspect the stator shaft for damaged splines or scored bushings. Inspect the oil ring grooves for damage or wear. Inspect the selective thrust washer face for wear or damage and inspect the pressure regulator and boost valve for free travel through the pump cover bore.

Inspect the 1/8 inch (3.17 mm) breather hole in the pump cover for restrictions (fig. 2C-70). Be sure the hole is clear before assembly.

Inspect the oil rings for damage or wear. Replace the rings if damaged.

**NOTE:** All service replacement pump cover oil seal rings are hook-type cast iron.



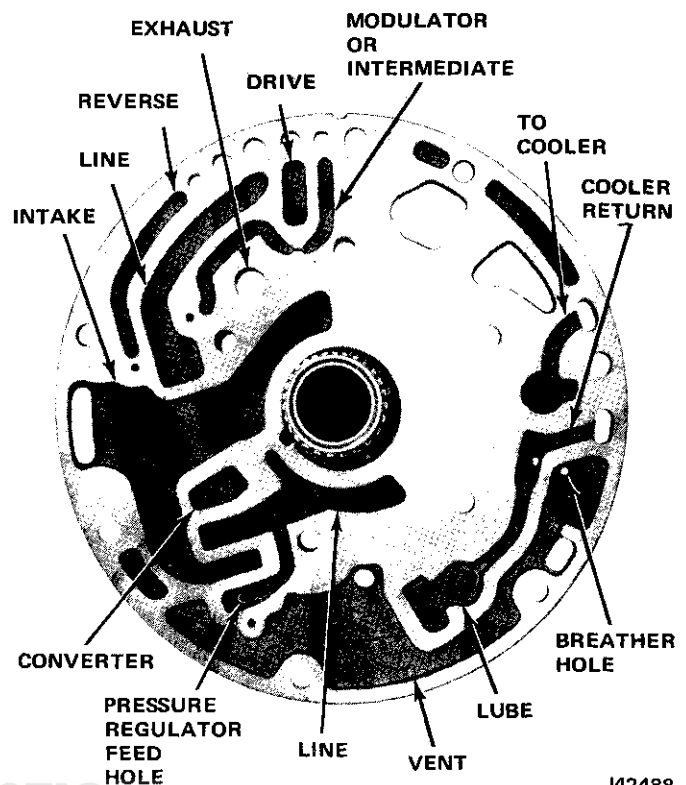
J43024

Fig. 2C-69 Pump Body Oil Passages

**Assembly**

(1) Install drive and driven gears in pump body with alignment marks facing upward (fig. 2C-67).

**NOTE:** Position the drive gear with the drive tangs facing upward.



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Fig. 2C-70 Pump Cover Oil Passage

(2) Protect stator shaft and clamp pump cover in vise.

(3) Insert spacer(s), if used, spring retainer washer and spring in pressure regulator bore of pump cover (fig. 2C-65).

(4) Install pressure regulator valve, stem end first, from opposite end of bore.

(5) Install boost valve in bushing, stem end out, and install valve and bushing in pump cover.

(6) Compress bushing against spring and install retaining snap ring.

(7) Install pressure regulator valve bore plug at opposite end of bore and install retaining pin.

(8) Install selective thrust washer over pump cover delivery sleeve.

(9) Install oil seal rings if removed.

**NOTE:** If teflon rings are reused, be sure the slit ends are assembled in the same relation as cut (fig. 2C-71).

(10) Install pump cover on pump body and install attaching bolts.

**NOTE:** Do not tighten the bolts completely. Leave the bolts one turn loose at this time.

(11) Place pump Aligning Strap J-21368 over assembled pump body and cover and tighten strap (fig. 2C-72).

(12) Tighten pump cover bolts to 15 to 20 foot-pounds (20 to 27 N•m) torque.

(13) Remove Aligning Strap J-21368 and install pump-to-transmission case O-ring oil seal in pump.

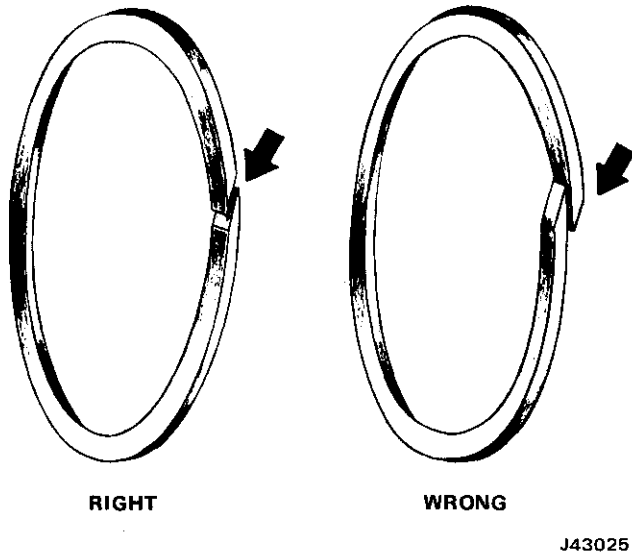


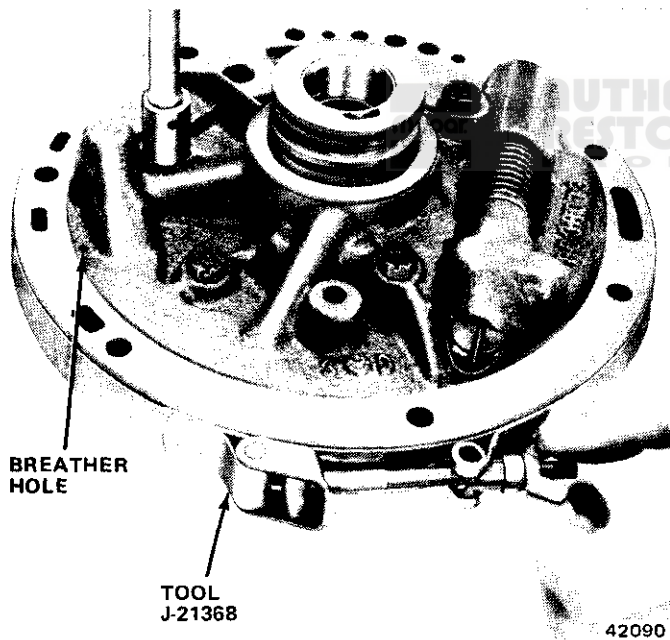
Fig. 2C-71 Correct Ring Installation

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J42491

Fig. 2C-73 Forward Clutch Housing Snap Ring Removal



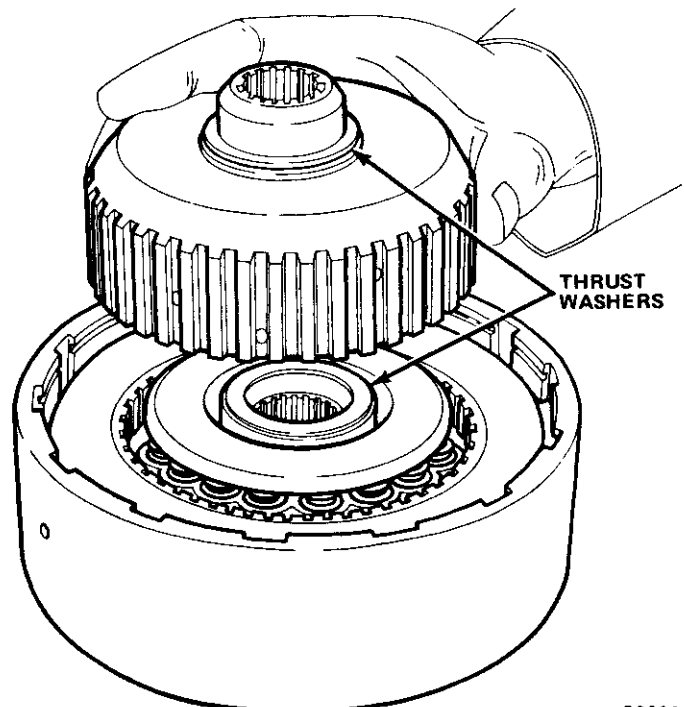
42090

Fig. 2C-72 Aligning Oil Pump Cover and Body

## Forward Clutch

### Disassembly

- (1) Place forward clutch and turbine shaft in hole in bench and remove snap ring which retains forward clutch housing to direct clutch hub (fig. 2C-73).
- (2) Remove clutch hub from housing.
- (3) Remove forward clutch hub and thrust washers (fig. 2C-74).



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Fig. 2C-74 Removing Hub and Thrust Washers from Forward Clutch Assembly

## 2C-50 AUTOMATIC TRANSMISSION

(4) Remove four composition-faced and four steel clutch plates.

(5) Position forward clutch and turbine shaft in arbor press, and press turbine shaft out of clutch housing (fig. 2C-75).

(6) Compress spring retainer using Clutch Spring Compressor J-25148 and arbor press, and remove snap ring which fastens spring retainer to clutch piston.

(7) Remove snap ring, spring retainer, and 16 clutch release springs.

**NOTE:** Keep springs separate from direct clutch release springs.

(8) Remove forward clutch piston.

(9) Remove clutch inner and outer piston seals (fig. 2C-76).

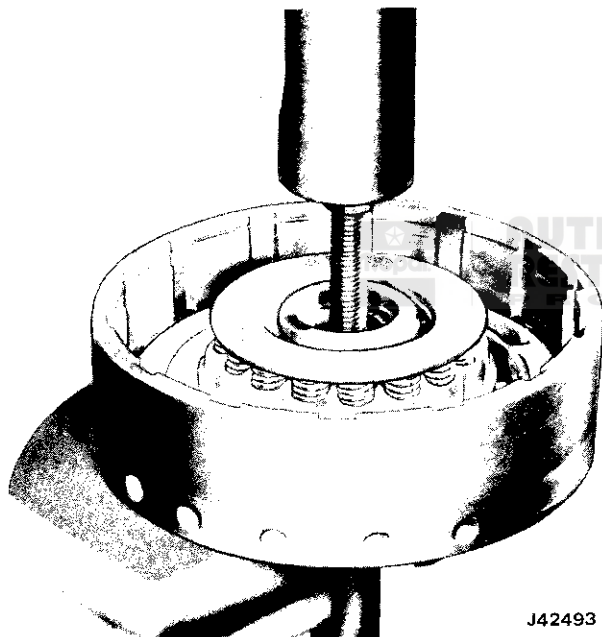


Fig. 2C-75 Pressing Turbine Shaft Out Of Forward Clutch Housing

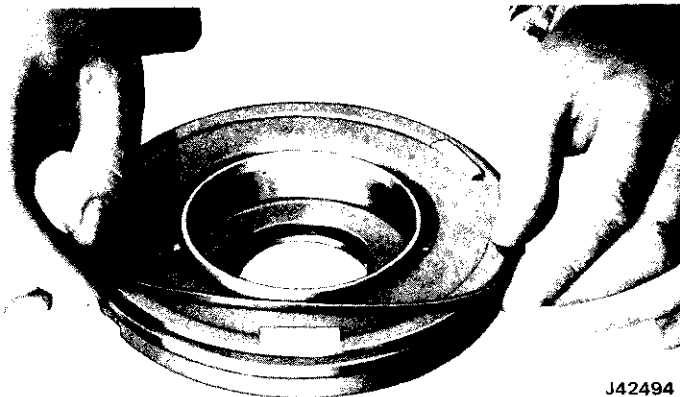


Fig. 2C-76 Forward Clutch Piston Outer Seal Removal

**CAUTION:** Production-built transmissions use a direct clutch piston without a check ball. The forward and direct clutch pistons are similar in appearance. Be sure the forward clutch piston is identified during disassembly so it will be installed correctly. Also, the production-built forward clutch piston will be aluminum or stamped steel.

(10) Remove center piston seal from forward clutch housing (fig. 2C-77).

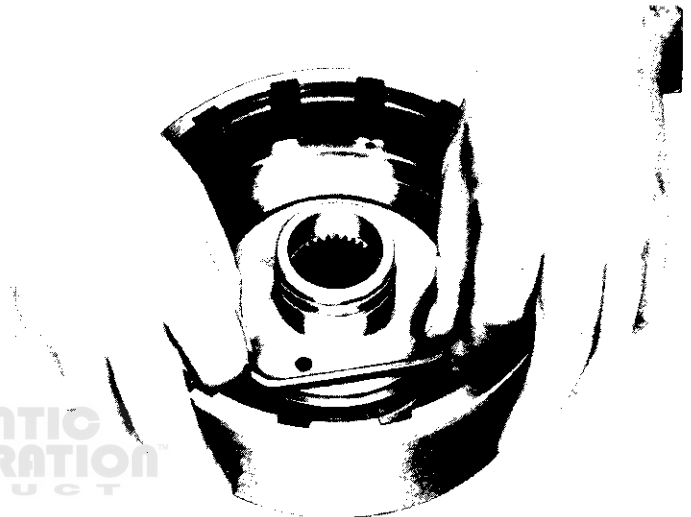


Fig. 2C-77 Forward Clutch Center Seal Installation

### Inspection

Inspect composition-faced and steel clutch plates for burning, scoring or wear.

Inspect the 16 clutch springs for collapsed coils or signs of distortion.

Inspect the direct clutch hub and forward clutch hub for worn splines, restricted lubrication holes or scored thrust faces.

Inspect the clutch piston for cracks and porosity and inspect the clutch housing for wear, scoring, restricted oil passages and for free operation of the check ball.

Inspect the turbine shaft for open lubrication passages at each end, damaged splines or damaged bushing journals and for cracks or distortion.

**NOTE:** The turbine shaft and clutch housing are serviced separately. The shaft may be removed from the housing by using a suitable size bolt in an arbor press (fig. 2C-75).

**CAUTION:** A lip-type forward clutch center seal is used in 1979 Jeep automatic transmissions. When servicing these transmissions, do not attempt to use the beveled edge seal that was used in 1977/1978 transmissions. To be sure the correct seal is installed, verify the

*transmission build date before ordering a replacement part. Refer to the transmission serial number stamped on the ID tag attached to the right-side of the transmission case. The first two digits of the serial number denote the build date.*

**Assembly**

(1) Lubricate seals and clutch plates with automatic transmission fluid before assembly.

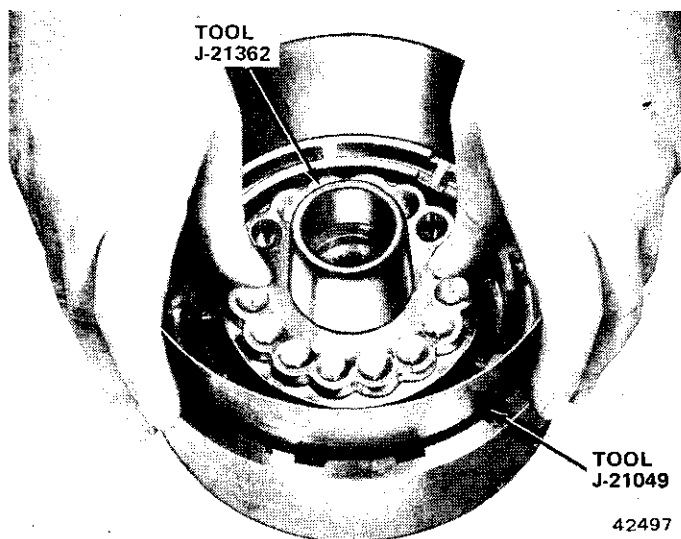
(2) Install inner and outer oil seals on clutch piston with seal lips facing away from spring pockets (fig. 2C-76).

(3) Install center seal in clutch housing with seal lip facing upward and toward open end of clutch housing (fig. 2C-77).

(4) Place Seal Protector Tool J-21362 over clutch hub and install outer clutch Piston Seal Protector Tool J-21049 in clutch housing. Assemble piston and housing, and rotate piston in housing until seated (fig. 2C-78).

(5) Install 16 clutch release springs in piston pockets, and place spring retainer over springs.

**NOTE:** *Be sure the clutch release springs are straight. If necessary, straighten the springs using small screwdriver.*



**Fig. 2C-78 Forward Clutch Piston Installation**

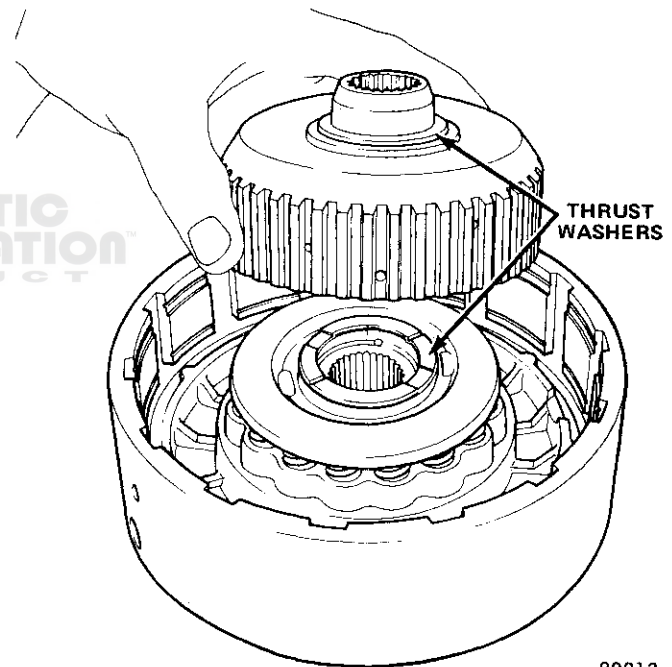
(6) Compress springs using Clutch Spring Compressor J-25148 and arbor press and install spring retainer-to-piston snap ring.

(7) Press short-spline end of turbine shaft into forward clutch housing using arbor press if shaft was removed.

(8) Place thrust washers on forward clutch hub. Be sure bronze washer is installed on side of hub facing forward clutch housing. Use petroleum jelly to retain washers.

(9) Install hub and washers in clutch housing (fig. 2C-79).

(10) Install four composition-faced, three flat steel, and one waved steel clutch plate (plate with U-notches) in clutch housing. Install waved steel plate first, then alternately install composition-faced plates and flat steel plates (fig. 2C-80 and 2C-81).



**Fig. 2C-79 Forward Clutch Hub and Washer Installation**

**CAUTION:** *Do not confuse the flat steel clutch plate (plate with V-notch) with the waved steel clutch plate (plate with U-notch) (fig. 2C-82).*

**NOTE:** *Radially grooved composition-faced clutch plates are installed at the factory only. All service composition-faced plates have a smooth surface configuration.*

(11) Install direct clutch hub in clutch housing and install retaining snap ring (fig. 2C-73).

(12) Install forward clutch assembly on delivery sleeve of oil pump, and apply compressed air to check clutch operation (fig. 2C-83).

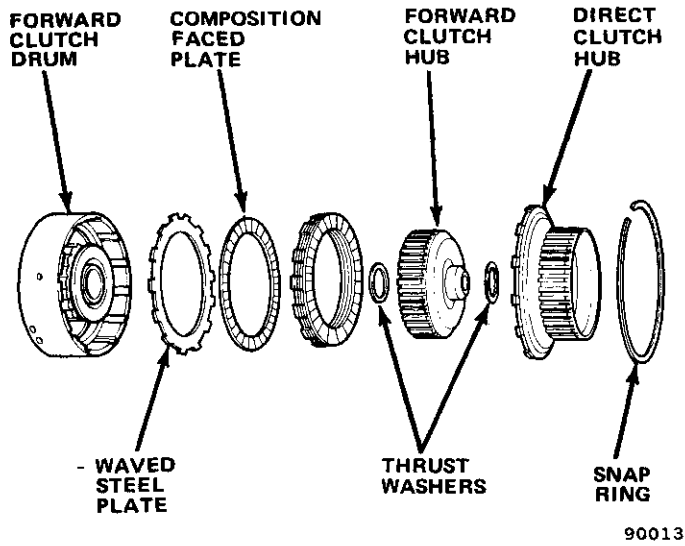
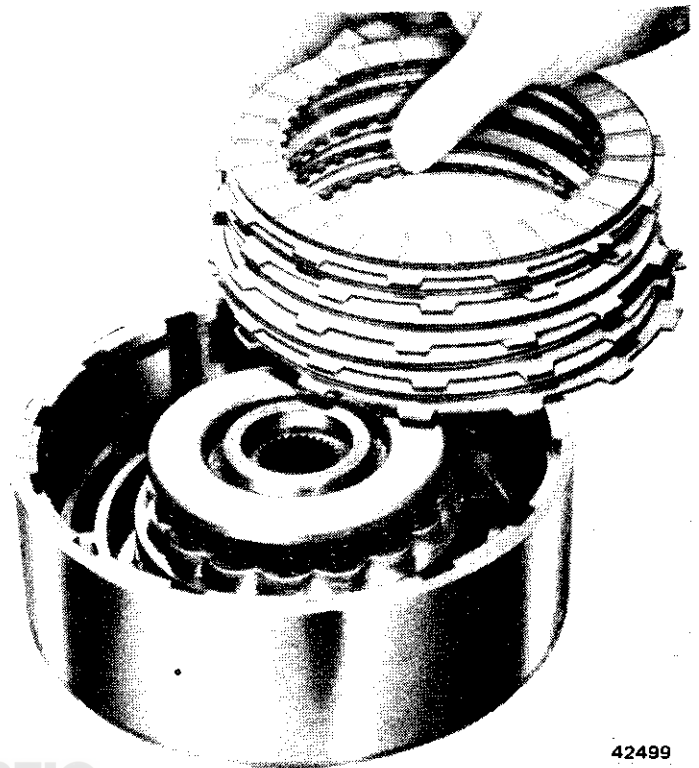
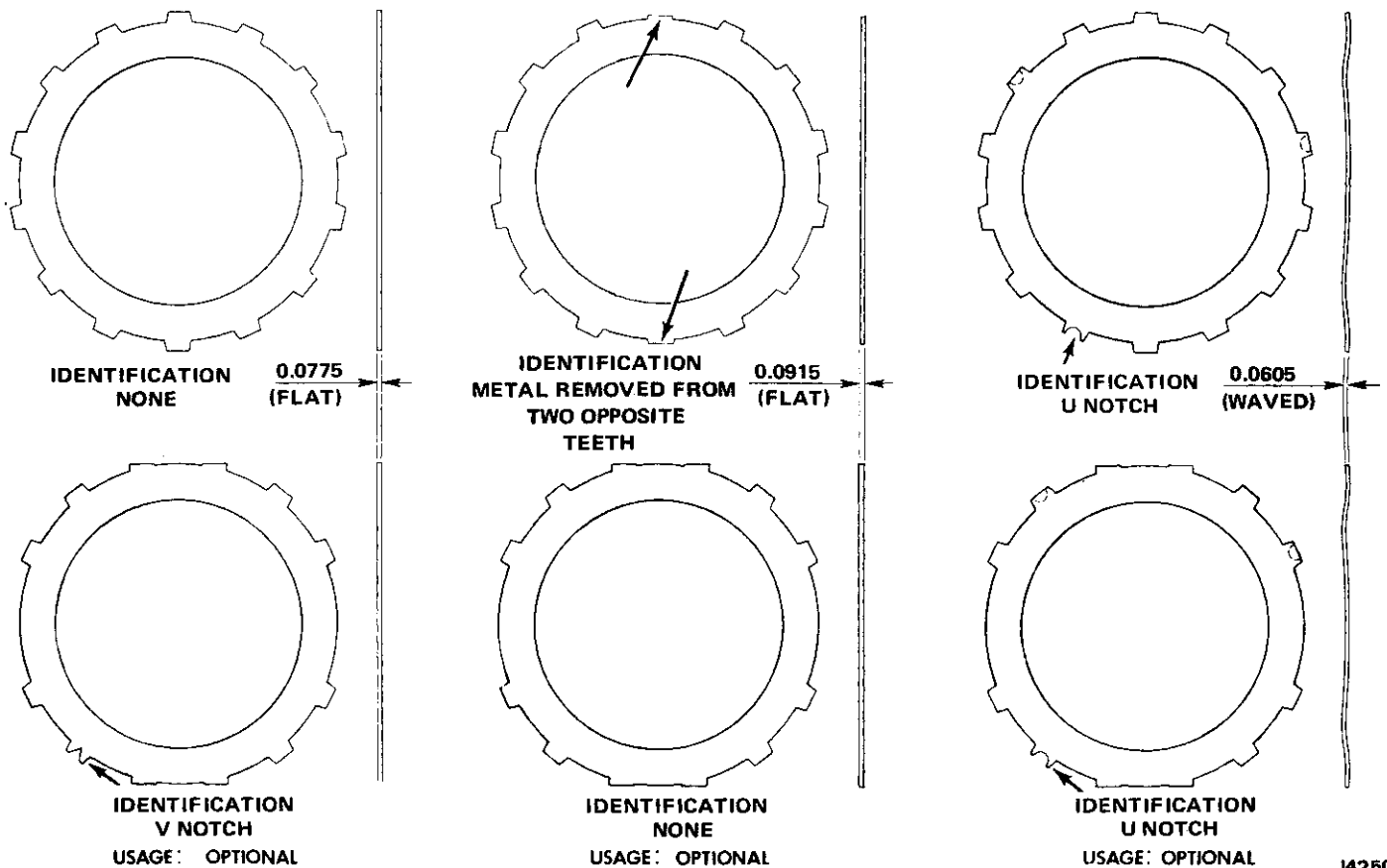


Fig. 2C-80 Forward Clutch Assembly



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Fig. 2C-81 Forward Clutch Plate Installation



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Fig. 2C-82 Clutch Plate Identification

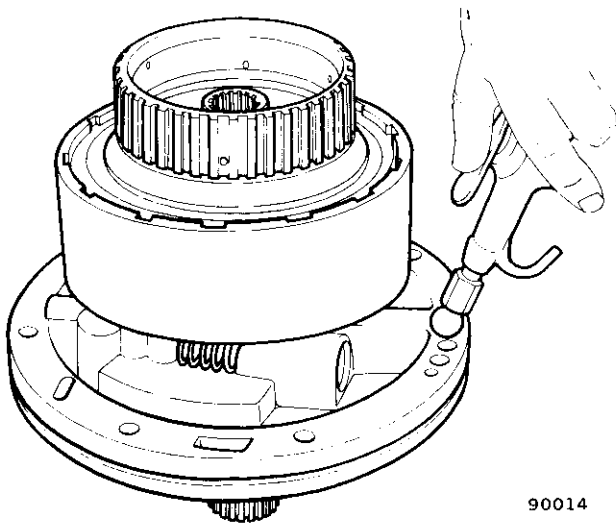


Fig. 2C-83 Checking Forward Clutch Operation



Fig. 2C-84 Intermediate Roller Clutch Snap Ring Removal

**Direct Clutch—Intermediate Roller Clutch**

**Disassembly**

- (1) Remove snap ring attaching intermediate clutch retainer to direct clutch housing (fig. 2C-84).
- (2) Remove retainer, intermediate clutch outer race, and intermediate roller clutch (fig. 2C-85).
- (3) Remove snap ring attaching backing plate to direct clutch housing (fig. 2C-86).
- (4) Remove backing plate, four composition-faced and four steel clutch plates (fig. 2C-87).

**NOTE:** Some transmission models use five composition-faced and five steel clutch plates. Refer to the Clutch Plate Application Chart at the end of this section for details.

- (5) Using Clutch Spring Compressor Tool J-25149 and arbor press, compress spring retainer and remove snap ring attaching spring retainer to direct clutch housing.

- (6) Remove spring retainer, release springs, and piston (fig. 2C-88).

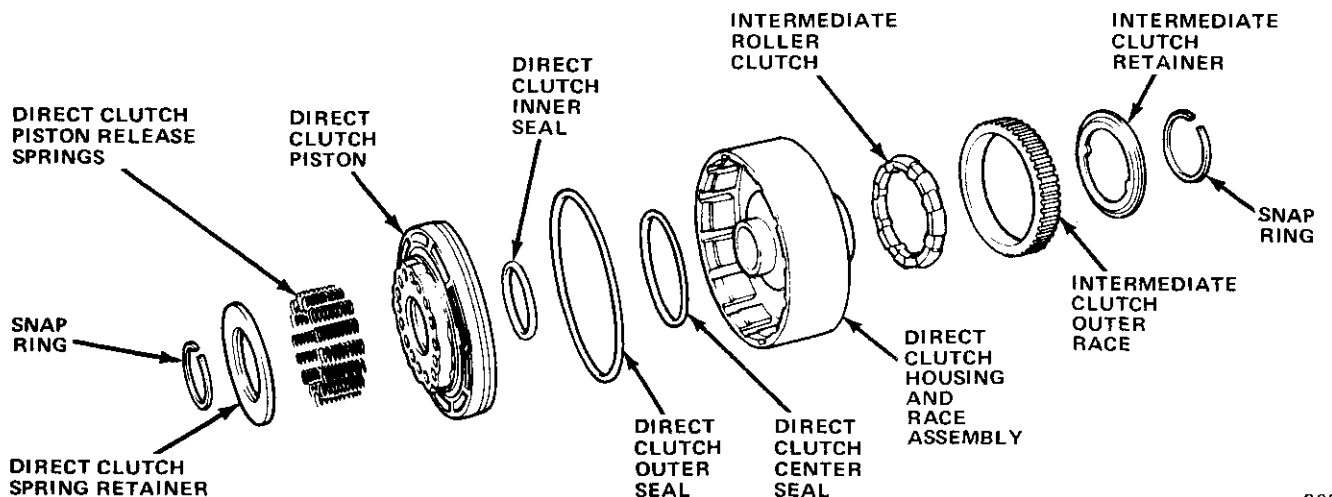
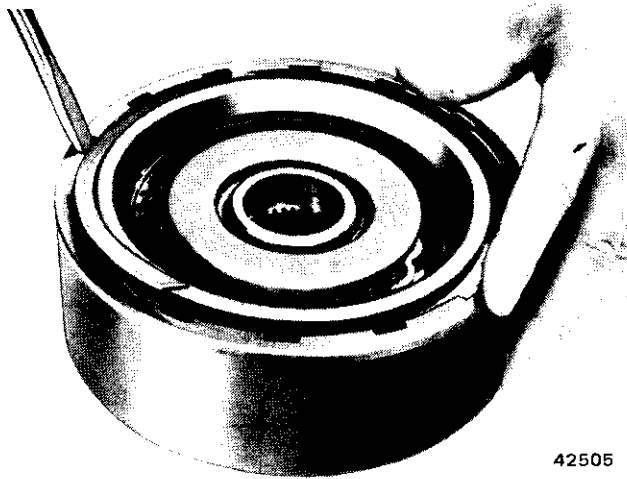


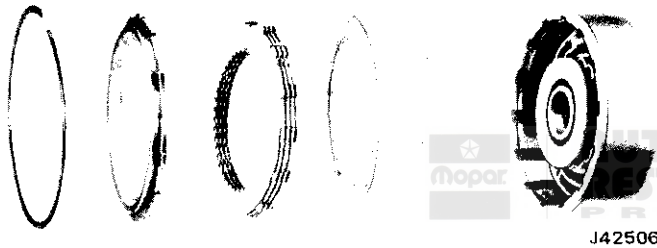
Fig. 2C-85 Direct Clutch-Intermediate Roller Clutch Components





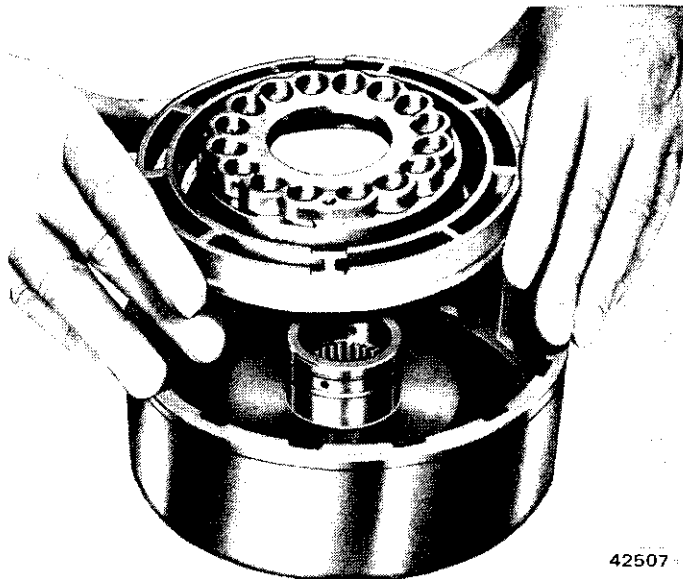
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Fig. 2C-86 Direct Clutch Snap Ring Removal



J42506

Fig. 2C-87 Direct Clutch Housing Assembly



42507

Fig. 2C-88 Direct Clutch Piston Removal

**NOTE:** Production-built transmissions use a direct clutch piston without a check ball. The forward and direct clutch pistons are similar in appearance. Be sure the direct clutch piston is identified during disassembly

so it will be installed correctly. The service replacement direct clutch piston contains a check ball. Also, the production-built direct clutch piston will be aluminum or stamped steel.

(7) Remove outer seal and inner seal from piston (fig. 2C-85).

(8) Remove center seal from direct clutch housing.

**Inspection**

Inspect the roller clutch for damaged rollers and inspect the inner cam and outer races (inner cam on clutch housing) for scratches or wear.

Inspect the direct clutch housing for cracks, wear, restricted oil passages, or wear of the clutch plate drive lugs.

Inspect the composition-faced and steel plates for signs of wear or burning. Inspect the backing plate for scratches or other damage. Inspect the piston for cracks and for free operation of the check ball. Inspect the springs for distortion or signs of collapse.

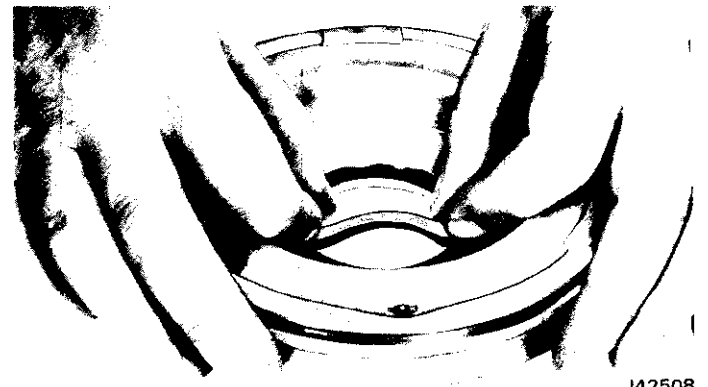
**NOTE:** If one or more of these springs require replacement, discard all of them and install 16 service replacement springs.

**Assembly**

(1) Lubricate seals and clutch plates using transmission fluid.

**CAUTION:** Be sure the clutch piston is equipped with a check ball.

(2) Install inner seal on piston with lip of seal facing away from spring pockets (fig. 2C-89).



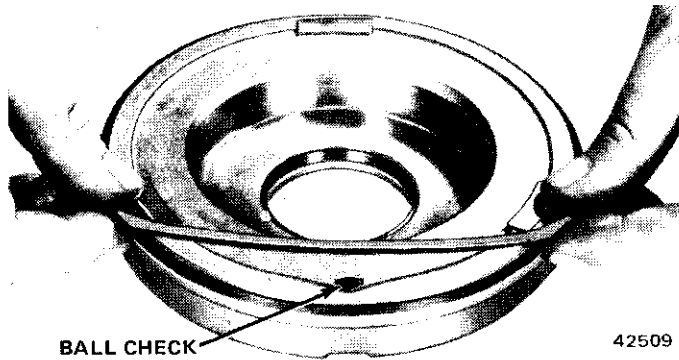
J42508

Fig. 2C-89 Direct Clutch Piston Inner Seal Installation

(3) Install outer seal on piston with lip facing away from spring pocket (fig. 2C-90).

(4) Install center seal in clutch housing with lip of seal facing upward (fig. 2C-91).

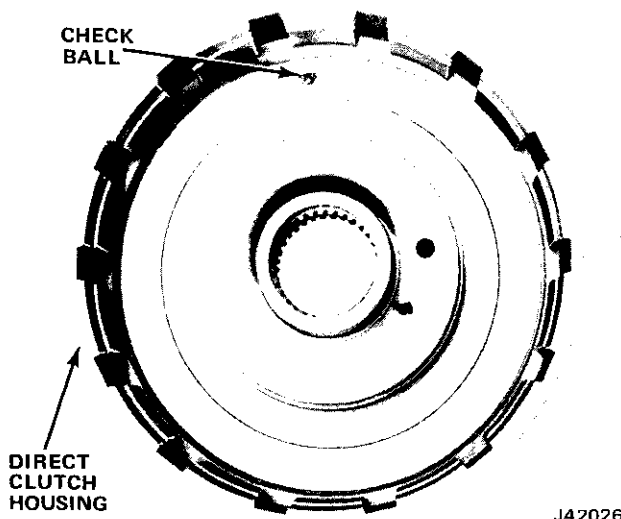
**CAUTION:** A check ball is used in the direct clutch housing (fig. 2C-92). If the housing requires replacement and the replacement housing does not contain a check ball, replace the direct clutch piston with a service piston which has a check ball.



**Fig. 2C-90 Direct Clutch Piston Outer Seal Installation**



**Fig. 2C-91 Installing Direct Clutch Center Seal In Housing**



**Fig. 2C-92 Check Ball Location**

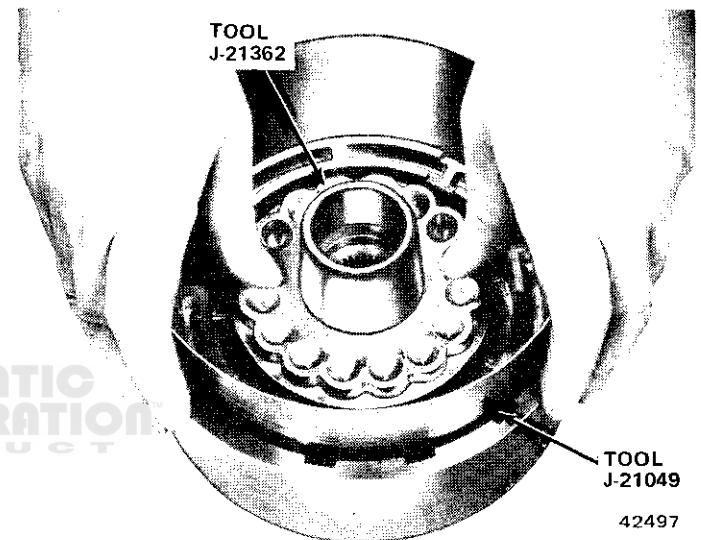
(5) Place Inner Seal Protector J-21362 and Outer Seal Protector J-21409 over hub and clutch housing.

(6) Install direct clutch piston in housing with rotating motion (fig. 2C-93).

(7) Install 16 release springs in recesses of piston and position spring retainer over springs (fig. 2C-85).

(8) Compress springs using Spring Compressor J-25149 and arbor press and install retaining snap ring.

**NOTE:** Be sure the clutch release springs are straight. If necessary, straighten the springs using a small screwdriver.



**Fig. 2C-93 Direct Clutch Piston Installation**

(9) Install waved steel and composition-faced clutch plates. Start with waved steel plate and alternately install remaining composition-faced and flat steel plates (fig. 2C-94).

**NOTE:** All direct clutch flat steel plates are 0.0195 inch thick. Refer to the Clutch Plate Application Chart in the Specifications section for the number of steel and composition plates required for each transmission model.

(10) Install backing plate in clutch housing and install retaining snap ring (fig. 2C-87).

(11) Install rollers in cage by compressing energizing spring with forefinger and inserting rollers from outer side of cage.

(12) Install clutch roller and outer race on housing using clockwise rotary motion (fig. 2C-95 and 2C-96).

**NOTE:** When installed, the outer race should not turn counterclockwise.

(13) Install retainer over intermediate clutch roller components (fig. 2C-97) and install snap ring.

(14) Install direct clutch assembly on center support assembly and apply compressed air to check direct clutch operation (fig. 2C-98).

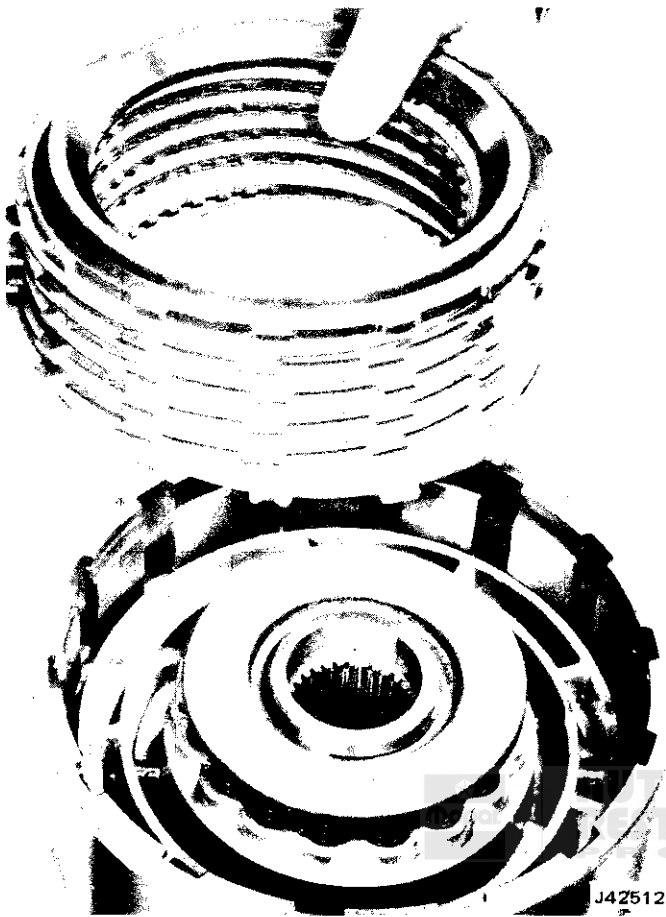


Fig. 2C-94 Direct Clutch Plate Installation

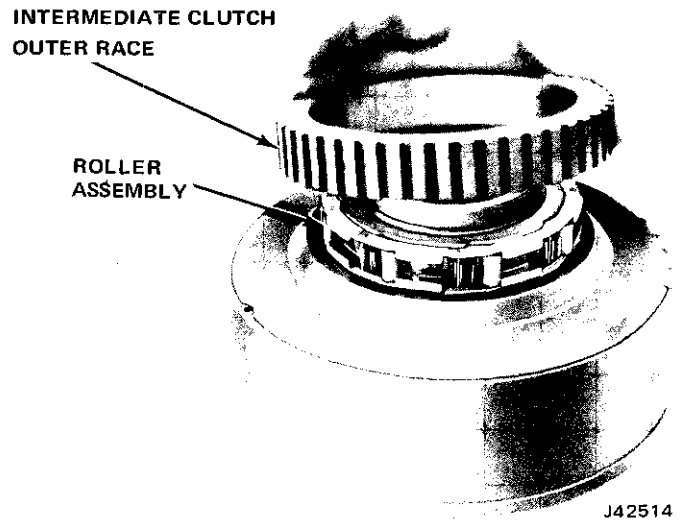


Fig. 2C-96 Outer Race Installation

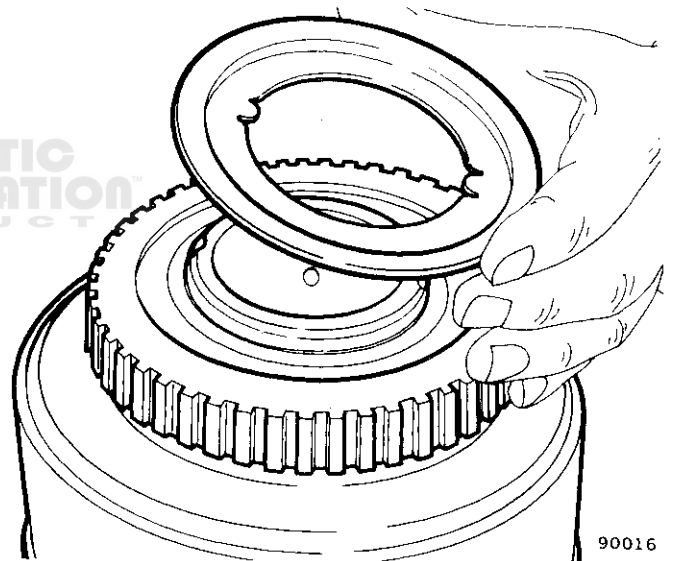


Fig. 2C-97 Retainer Installation

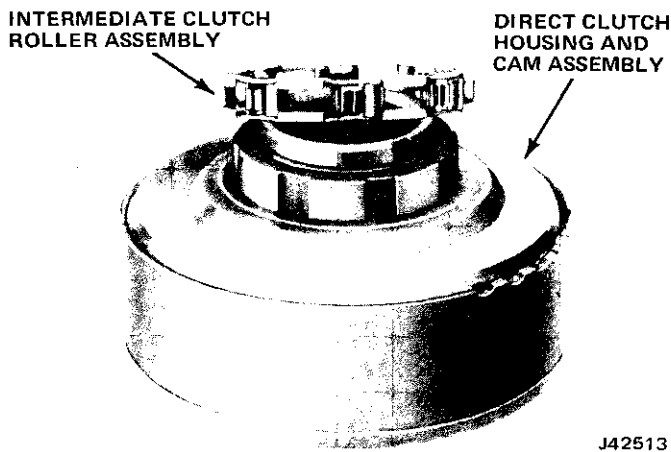


Fig. 2C-95 Roller Clutch Installation

**NOTE:** Apply air through the left oil feed hole only to actuate the clutch piston. If air is applied through the reverse passage (right oil feed hole), it will escape from the direct clutch passage. This is considered normal.

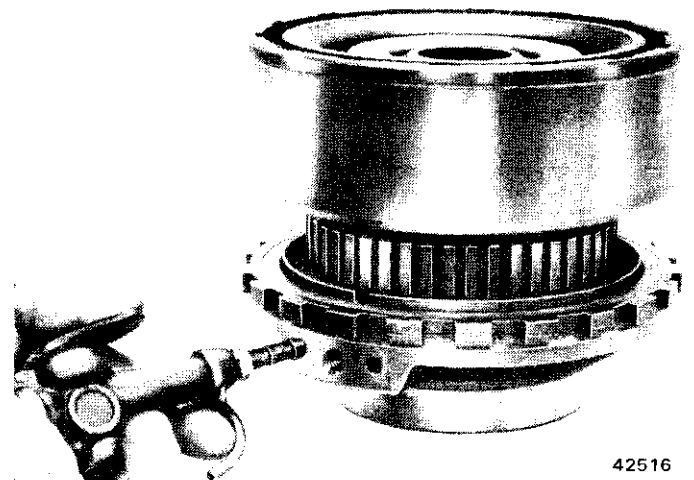


Fig. 2C-98 Checking Direct Clutch Operation

## Center Support

### Disassembly

- (1) Remove four oil seal rings (fig. 2C-99).

**NOTE:** All service replacement rings are hook-type cast iron.

- (2) Compress spring retainer to center support assembly, remove snap ring, and carefully release pressure on spring retainer.

- (3) Remove spring retainer, three release springs, intermediate clutch spring guide and piston.

- (4) Remove inner and outer seals from intermediate clutch piston.

**NOTE:** Do not remove the three screws attaching the roller clutch inner race to the center support.

### Inspection

Inspect the roller clutch inner race (on center support) for scratches or indentations and be sure the lubrication hole is open.

**NOTE:** Also be sure the constant bleed plug orifice which is approximately 0.020 inch (0.50 mm) in diameter is open (fig. 2C-46).

Check the clutch piston oil ring grooves for damage. Using compressed air check the oil passages to be sure they are not interconnected. Inspect the piston sealing surfaces for scratches; inspect the piston seal grooves for nicks or other damage; and inspect the piston for cracks.

Inspect the release springs for cracks, fatigue, and distortion.

Inspect the support-to-case spacer for burrs or raised edges. Remove any burrs using an oilstone or fine sandpaper. Inspect the oil rings for damage.

### Assembly

- (1) Install inner seal on intermediate clutch piston, with lip of seal facing away from spring pocket (fig. 2C-100).

- (2) Install outer seal on piston with lip of seal facing away from spring pocket (fig. 2C-101).

- (3) Place Inner Seal Protector J-21363 on hub of center support.

- (4) Install intermediate clutch piston on center support. Index spring pockets of piston with cored areas of center support (fig. 2C-102). Use screwdriver with very smooth blade to install seal.

- (5) Install spring guide (fig. 2C-103).

- (6) Install three release springs in spring holes of spring guide (fig. 2C-104). Space springs equally.

- (7) Place spring retainer over springs (fig. 2C-105).

- (8) Compress spring retainer to center support assembly and install snap ring (fig. 2C-106).

- (9) Install four oil rings on center support assembly.

**NOTE:** If teflon rings are reused, be sure the split ends are assembled in the same relation as cut (fig. 2C-71).

- (10) Check intermediate clutch operation using compressed air (fig. 2C-107).

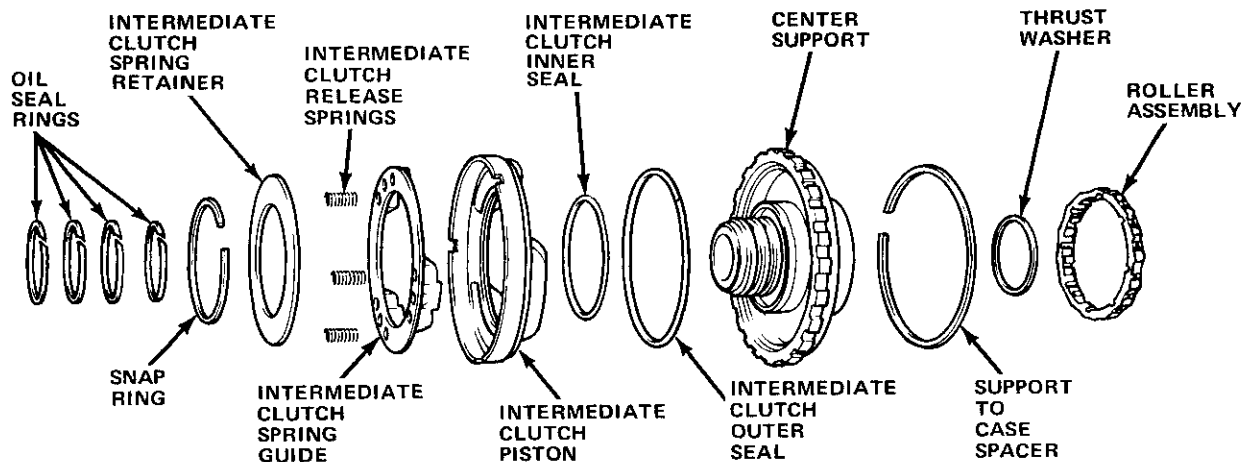


Fig. 2C-99 Center Support Components

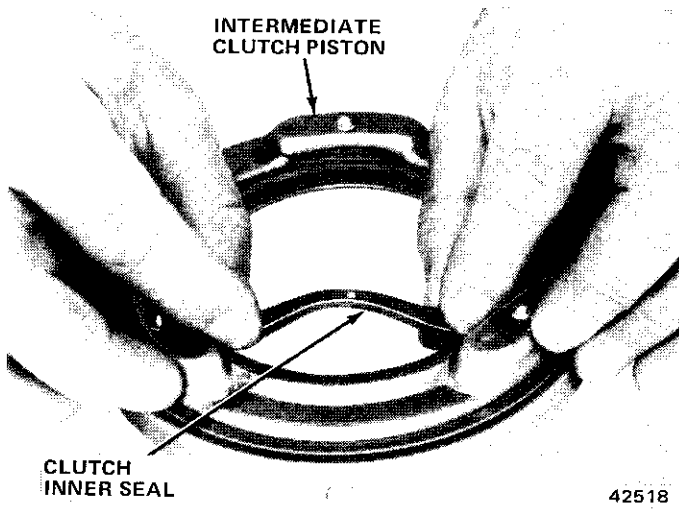


Fig. 2C-100 Intermediate Clutch Piston Seal Installation

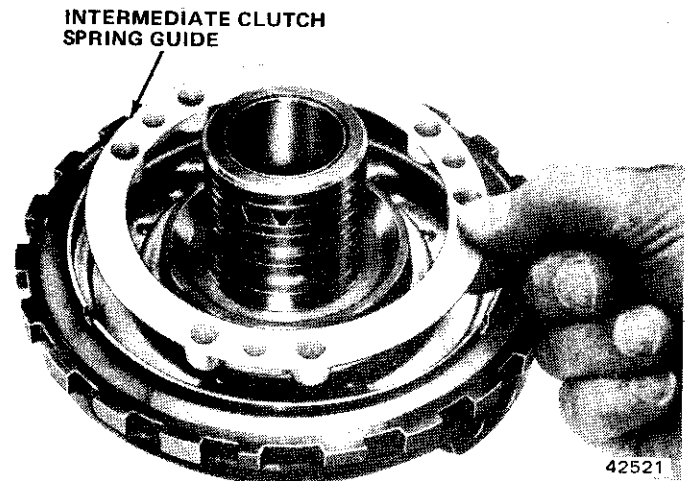


Fig. 2C-103 Spring Guide Installation

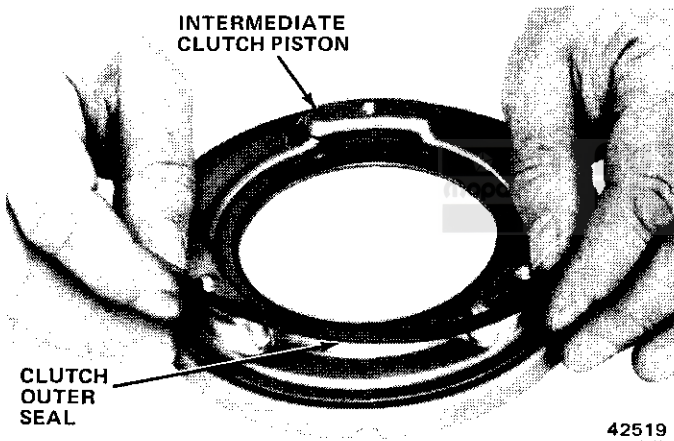


Fig. 2C-101 Intermediate Clutch Piston Outer Seal Installation

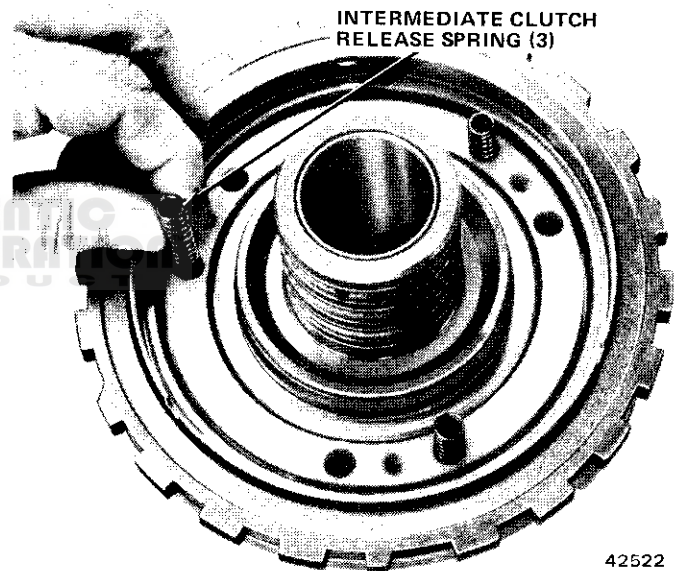


Fig. 2C-104 Intermediate Clutch Release Spring Installation

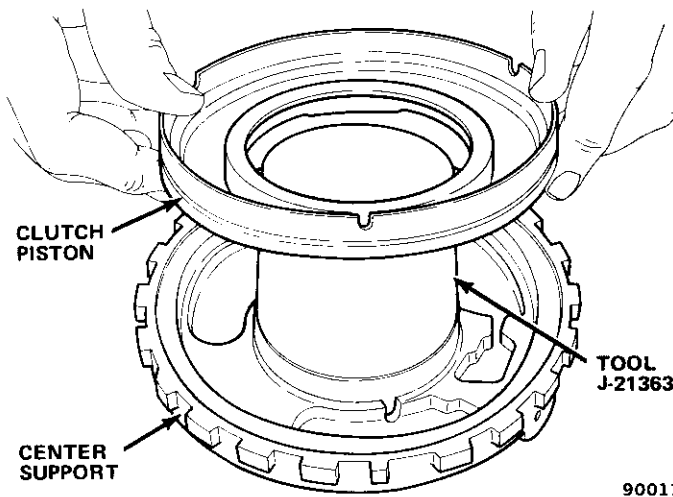


Fig. 2C-102 Intermediate Clutch Piston Installation

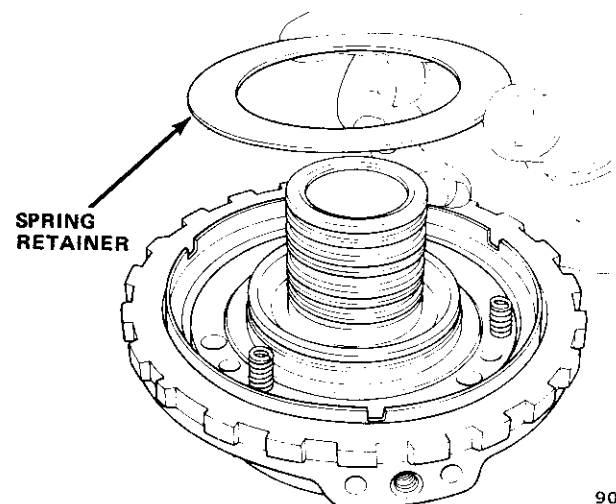
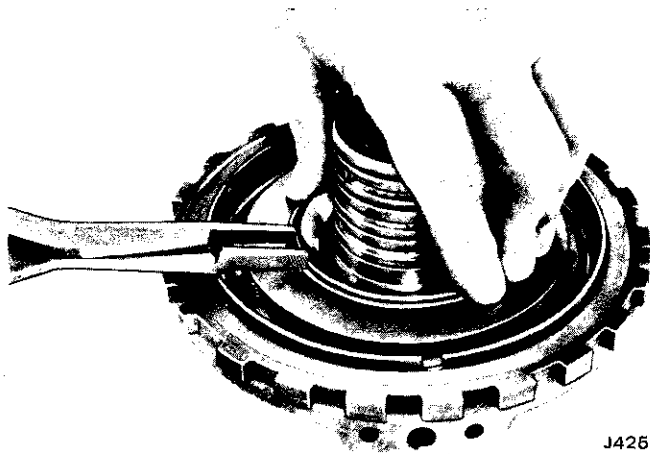
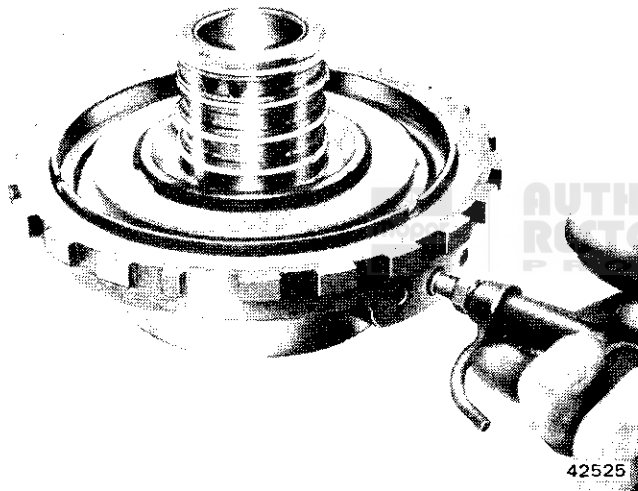


Fig. 2C-105 Spring Retainer Installation



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**Fig. 2C-106 Spring Retainer Snap Ring Installation**



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**Fig. 2C-107 Checking Intermediate Clutch Operation**

**Reaction Carrier-Roller Clutch-Output Carrier**

**Inspection**

**NOTE:** If the reaction carrier has a spacer ring in an undercut at the the bottom of the roller cam ramps, inspect it for damage (fig. 2C-108).

**NOTE:** The reaction carrier with the undercut and spacer ring is used optionally and interchangeably with the reaction carrier which does not have an undercut and spacer ring.

Inspect the band surface of the reaction carrier for burning or scoring.

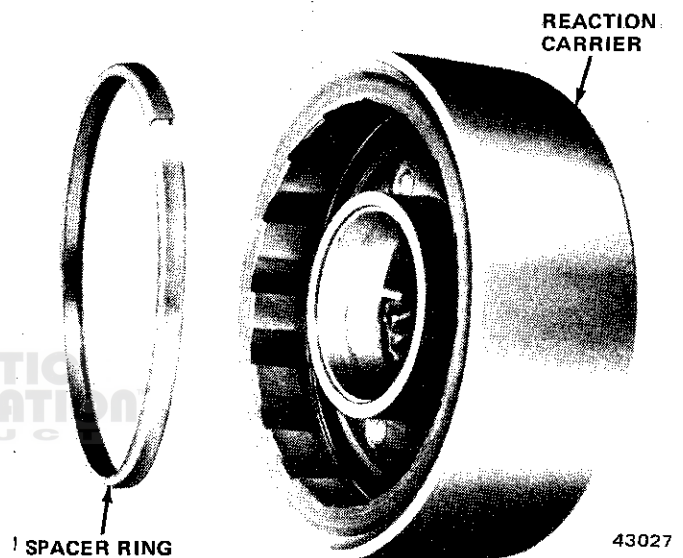
Inspect the roller clutch outer race for scoring or wear.

Inspect the thrust washer surfaces for signs of scoring or wear. Inspect the roller clutch for damaged components. Inspect the roller clutch cage and retaining spring for damage. Inspect the front internal gear ring

for chipping or flaking and inspect the carrier bushing for damage.

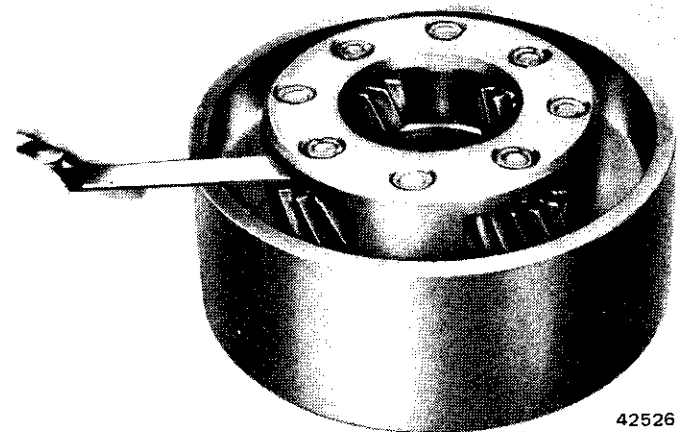
**NOTE:** If the reaction carrier bushing is damaged, refer to *Bushing Replacement* in this section.

Inspect the reaction carrier pinions for damage, rough bearings, or excessive tilt. Check pinion end play. Pinion end play should be 0.009 to 0.024 inch (fig. 2C-109). Inspect the front internal gear (output carrier) for damaged teeth.



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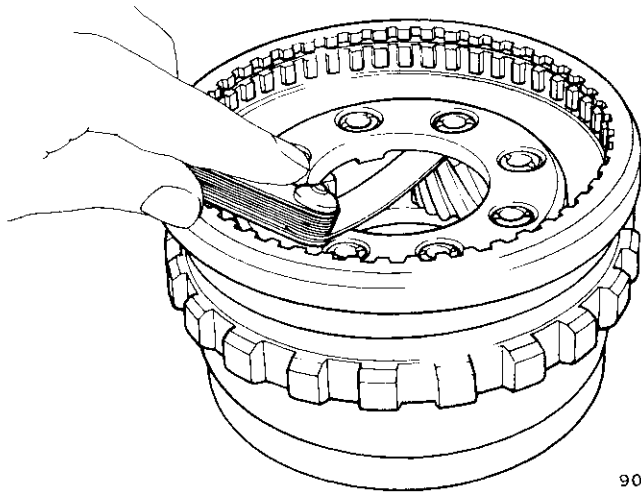
**Fig. 2C-108 Reaction Carrier Spacer Ring**



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**Fig. 2C-109 Checking Pinion End Play**

Inspect the output carrier pinions for damage, rough bearings, or excessive tilt and check pinion end play. Pinion end play should be 0.009 to 0.024 inch (fig. 2C-110). Inspect the parking pawl lugs for cracks or damage and inspect the output locating splines for damage.



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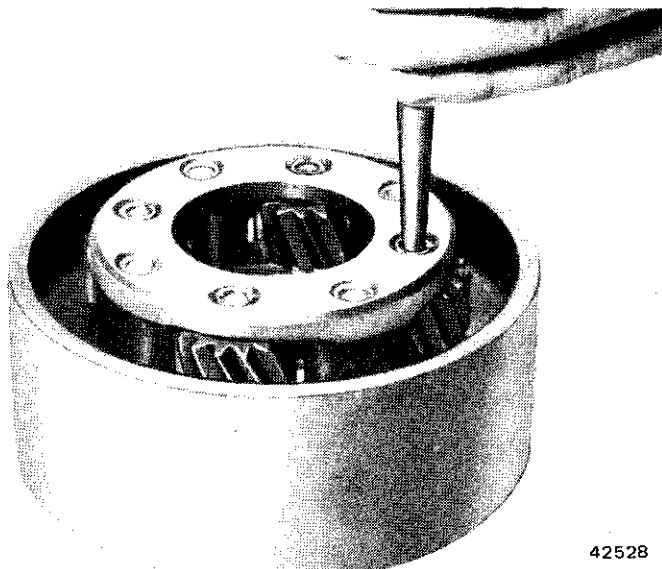
Fig. 2C-110 Checking Output Carrier Pinion End Play

**Reaction and Output Carrier Pinion Pin Replacement**

- (1) Position and support carrier assembly on front face.
- (2) Using 1/2 inch (12.7 mm) diameter drill, remove stake marks from end of pinion pin(s) to be replaced. This will reduce probability of cracking carrier when pinion pins are pressed out.

**CAUTION:** Do not allow the drill to remove any stock from the carrier as this will weaken the part.

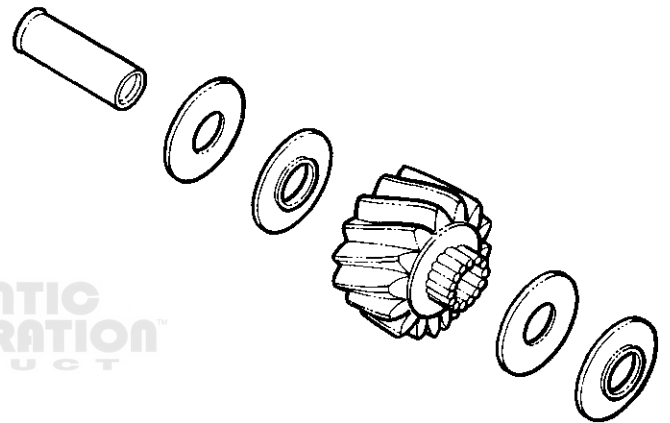
- (3) Press pinion pins out of carrier using tapered punch (fig. 2C-111).
- (4) Remove pinions, thrust washers, and roller needle bearings (fig. 2C-112).
- (5) Inspect thrust faces of pinion pockets in carrier for burrs. Remove any burrs using crocus cloth.



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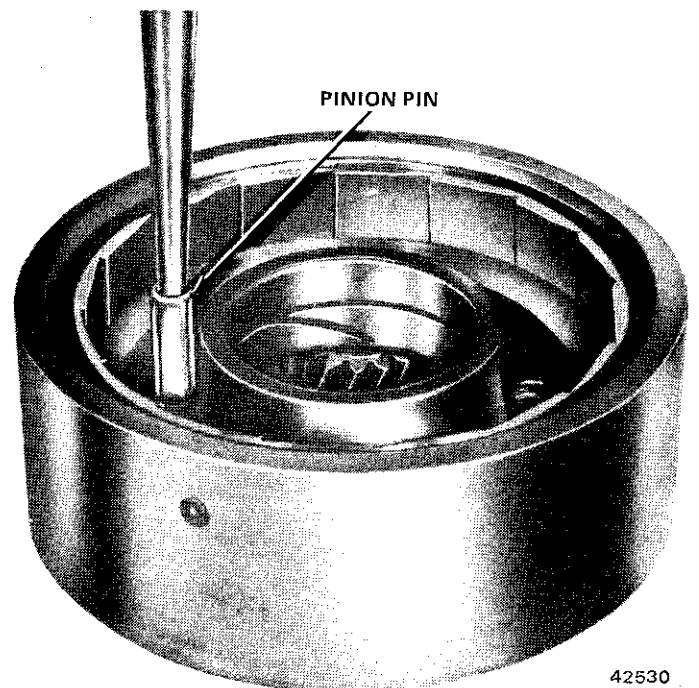
Fig. 2C-111 Pinion Pin Removal

- (6) Install 18 needle bearings in each pinion gear. Use petroleum jelly to retain bearings and use pinion pin as guide (fig. 2C-112).
- (7) Place one steel and one bronze washer on each side of pinion. Install steel washers first. Use petroleum jelly to retain washers.
- (8) Install pinion assembly in carrier, and install a pilot shaft through rear face of assembly to hold parts in place.
- (9) Press pinion pin(s) in place while rotating pinion from front. Be sure headed end of pin is flush with or below face of carrier (fig. 2C-113).



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Fig. 2C-112 Pinion Gear assembly



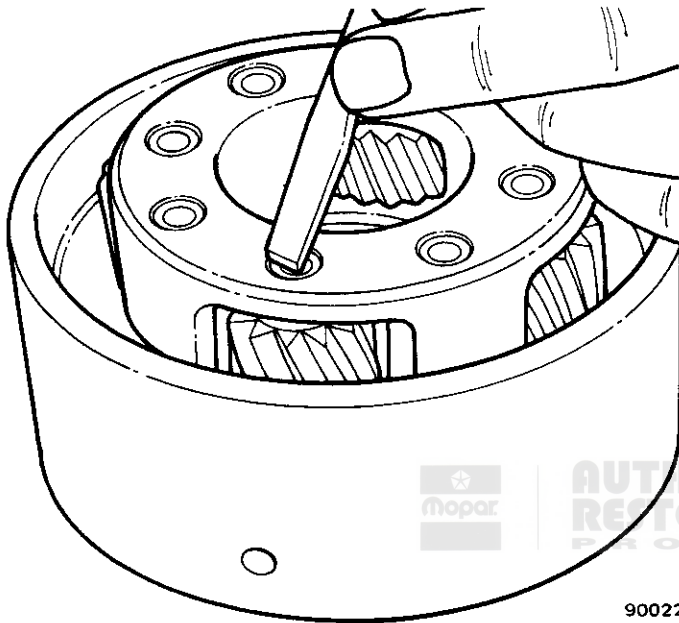
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Fig. 2C-113 Pinion Pin Installation

**NOTE:** *Headed end of pin must face upward when pin is pressed into carrier.*

(10) Install large punch in bench vise to serve as anvil and stake opposite end of pinion pin in three places (fig. 2C-114).

**NOTE:** *Both ends of the pin must be below the face of the carrier or interference may occur.*



**Fig. 2C-114 Staking Pinion Pin**

### **Output Shaft**

#### **Inspection**

Inspect the bearing and thrust washer surfaces for damage, the governor drive gear for rough or damaged teeth, the splines for damage, and the drive lugs for damage. Inspect the bushing for wear, scoring or galling. Replace the bushing if damaged or worn. Refer to Bushing Replacement in this section.

### **Rear Internal Gear**

#### **Inspection**

Inspect the gear for cracks, the gear teeth for damage or wear, and the splines for damage.

### **Sun Gear and Shaft**

#### **Inspection**

Inspect the gear teeth for damage or wear and check the splines for damage. Be sure that the oil lubrication holes in the gear and shaft are not restricted.

Inspect the shaft for cracks or splits, the splines for damage, and the bushings for wear, scoring, galling, or other damage. Replace the bushings if worn or damaged. Refer to Bushing Replacement in this section.

### **Main Shaft**

#### **Inspection**

Inspect the shaft for cracks or distortion, the splines for damage, the bushing journals for damage, and the snap ring groove for damage. Be sure the oil lubrication holes are open.

### **Front and Rear Band**

#### **Inspection**

Inspect the lining for cracks, flaking, burning, or looseness. Check the band for cracks or distortion and check the end of the band for damage at the anchor lugs or apply lugs. Replace any band exhibiting these conditions.

### **Extension Housing**

#### **Inspection**

Inspect the housing for cracks or porosity and inspect the gasket mounting face for damage or flatness.

Inspect the ball bearing. If necessary, remove the bearing from the extension housing.

**NOTE:** *Although the bearing is not a press-fit in the extension housing, it may be necessary to remove the bearing using a brass drift and hammer.*

Install the ball bearing assembly from the rear of the case extension with the snap ring groove side facing out. It may be necessary to tap the bearing outer race with a rubber mallet to install it.

### **Modulator and Valve**

#### **Inspection**

Check for vacuum diaphragm leaks by turning the modulator so the vacuum line stem points downward. If transmission fluid comes out, the vacuum diaphragm is leaking and the modulator must be replaced.

**NOTE:** *Gasoline or water vapor may settle in the vacuum side of the modulator. If vapor is found without the presence of oil, the modulator should not be replaced.*

Inspect the modulator for any signs of bending or distortion (fig. 2C-9).

Inspect the reaction lever and O-ring seal seat for damage (fig. 2C-15 and 2C-116).

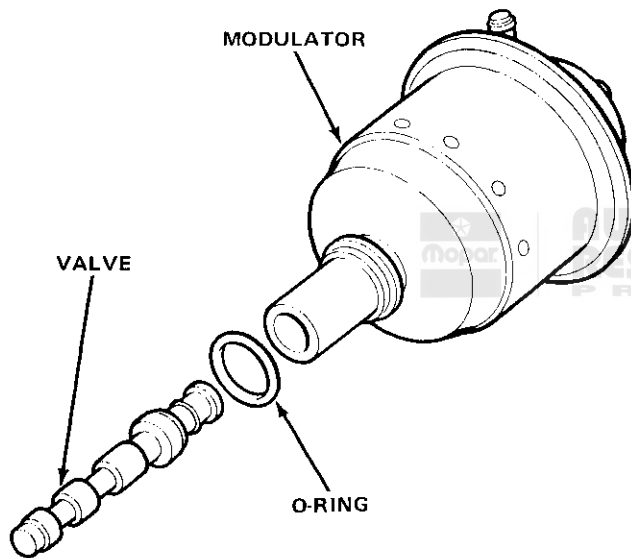


Apply suction to the vacuum tube and check for diaphragm leaks.

Check the modulator bellows plunger. The plunger is under a pressure of 16 pounds. If the bellows are damaged, the plunger will have very little pressure on it.

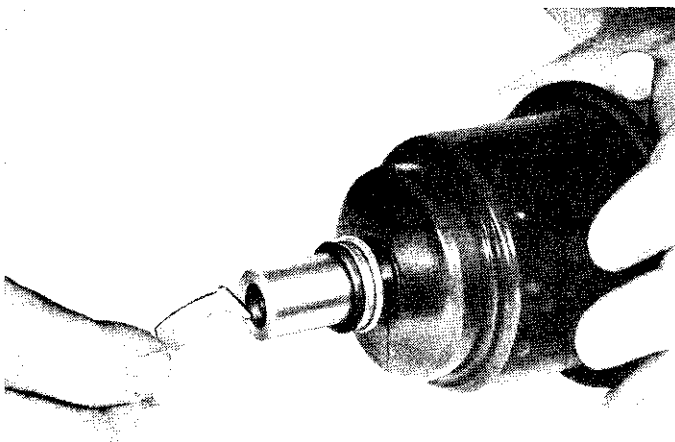
Inspect the modulator valve for nicks or damage. However, note that the second spool on the small end of the valve has a flat spot machined on it. The flat spot allows a slight bleed and permits some oil to bypass. This results in a more constant line pressure and produces smoother shifts.

Check for smooth movement of the valve in the case bore.



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Fig. 2C-115 Modulator O-Ring and Valve



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Fig. 2C-116 Modulator Lever Installation

## Manual Linkage-Parking Linkage

### Inspection

Inspect the parking actuator rod for cracks or broken spring retainer lugs (fig. 2C-6).

Inspect the actuator rod spring for damage. Inspect the actuator for a free fit on the actuator rod.

Inspect the parking pawl for cracks or wear and inspect the pawl shaft for damaged retainer grooves. Inspect the pawl return spring for deformed coils or coil ends.

Inspect the manual shaft for damaged threads or a loose lever.

Inspect the inside detent lever for cracks or a loose pin.

Inspect the parking pawl bracket for cracks or wear. Inspect the detent roller and spring assembly for damage.

## Transmission Case

### Inspection

Inspect the case for cracks, porosity, or interconnected or restricted oil passages (fig. 2C-117).

Check for good retention of the band anchor pins.

Inspect all threaded holes for thread damage. Inspect the intermediate clutch driven plate lugs for damage or signs of wear and inspect the two snap ring grooves for damage.

Inspect the governor and modulator bores for scratches or scoring.

Inspect the intermediate clutch cup plug (inside case) for good staking and sealing (fig. 2C-118).

Inspect the case bushing for wear, scoring, or galling. Replace the bushing if worn or damaged. Refer to Bushing Replacement in this section.

**NOTE:** If the case requires replacement, be sure to remove the center support-to-case spacer from the existing case and install it in the replacement case. In addition, if a replacement case is required, be sure to remove the nameplate from the existing case and transfer it to the replacement case. Attach the nameplate to the replacement case using the truss head-type screws supplied with the service replacement case.

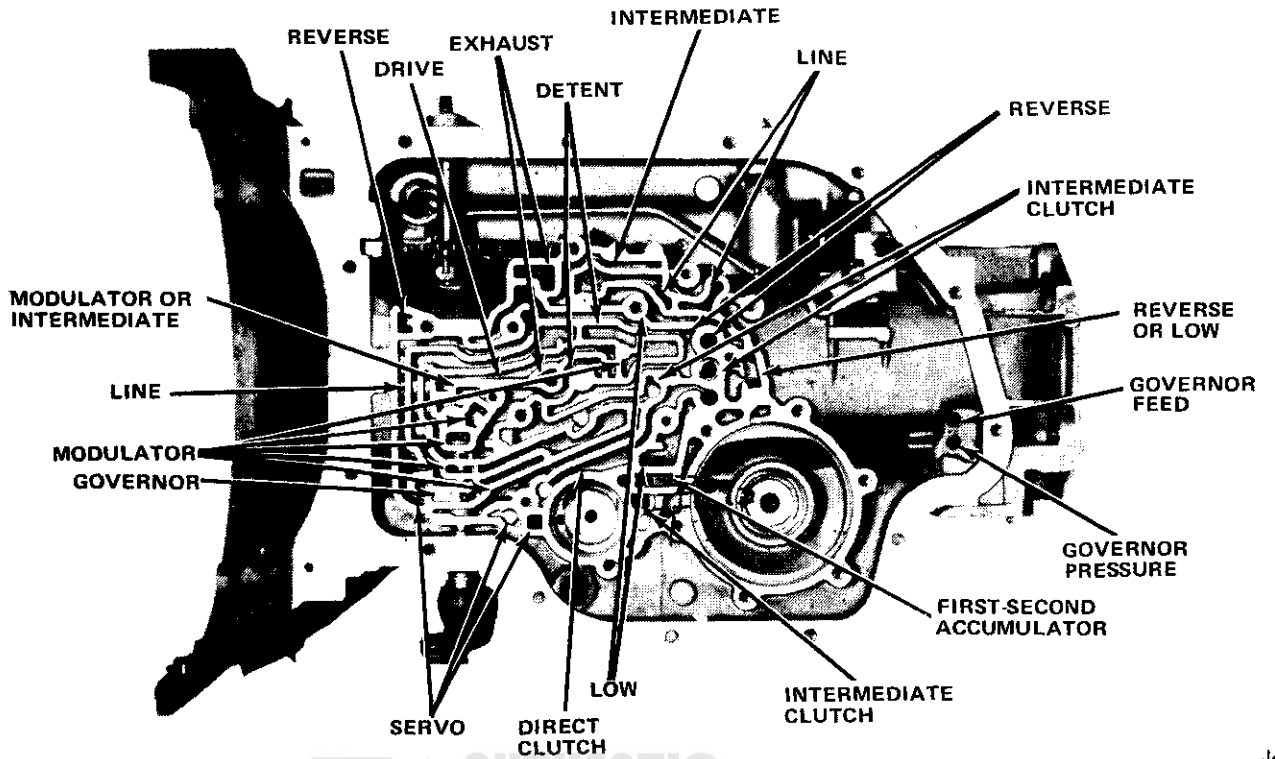


Fig. 2C-117 Transmission Case Passages

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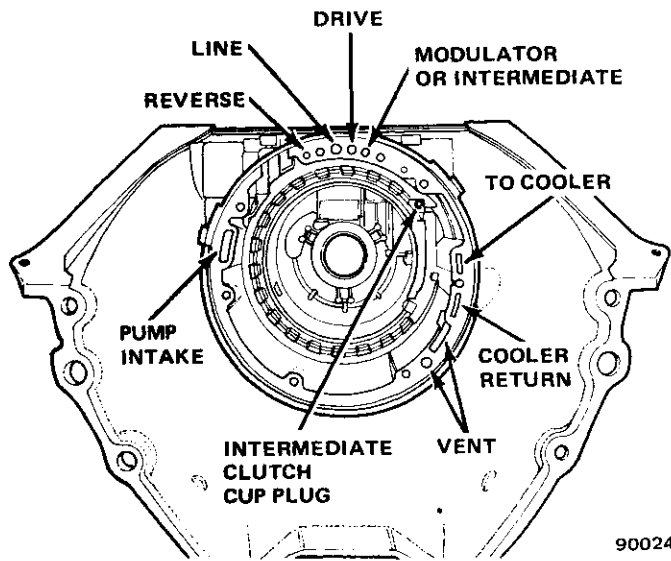


Fig. 2C-118 Intermediate Clutch Cup Plug Location

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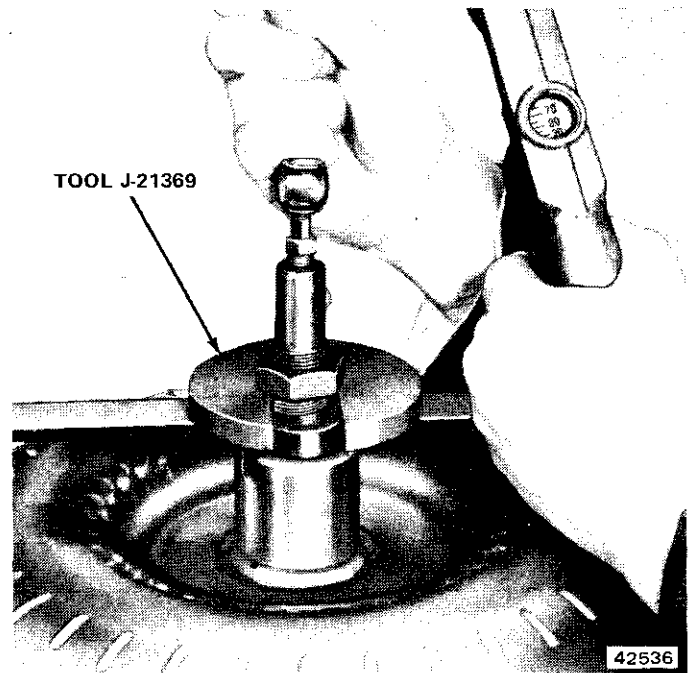


Fig. 2C-119 Torque Converter Air Pressure Test

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## Torque Converter

### Inspection

Check the hub surfaces for scoring or wear and check the drive lugs for damage.

Check the torque converter housing for leaks as follows:

- (1) Install and tighten Leak Detecting Fixture J-21369 on torque converter housing (fig. 2C-119).
- (2) Apply 80 psi air pressure to fixture.
- (3) Submerge housing in water and check for leaks.

**BUSHING REPLACEMENT**

Replacement bushings are available for the following components:

- Oil pump body.
- Oil pump stator shaft.
- Sun gear shaft.
- Center Support.
- Output shaft flange.
- Transmission case.

When inspecting bushings, check them for evidence of wear, scoring, galling, or other damage. Replace any bushing that exhibits these conditions.

To check bushing wear, insert the mating part into the bushing and measure bushing-to-mating part clearance using a wire-type feeler gauge. Replace the bushing if a clearance of 0.008 inch (0.20 mm) or more exists.

Bushing replacement procedures are as follows:

**Output Shaft Flange Bushing**

(1) Assemble Adapter J-2619-4, Slide Hammer J-2619, and Remover J-21465-16 (fig. 2C-120).

(2) Mount output shaft in vise with shaft flange facing outward (fig. 2C-120).

**CAUTION:** To avoid damaging the shaft bearing journal surface, the vise must be equipped with protective jaws and must not be overtightened.

(3) Thread Remover J-21465-16 into bushing. Remove bushing by bumping outward with Slide Hammer J-2619 (fig. 2C-120).

(4) Remove output shaft from vise.

(5) Clean flange bushing bore.

(6) Position output shaft on wood blocks so flange faces upward and shaft downward.

(7) Assemble Installer J-21465-1 and Driver Handle J-8092.

(8) Position replacement bushing on Installer J-21465-1.

**NOTE:** If the bushing has a notch in it, be sure to position the bushing so the notch faces outward (away from flange) after the bushing is installed.

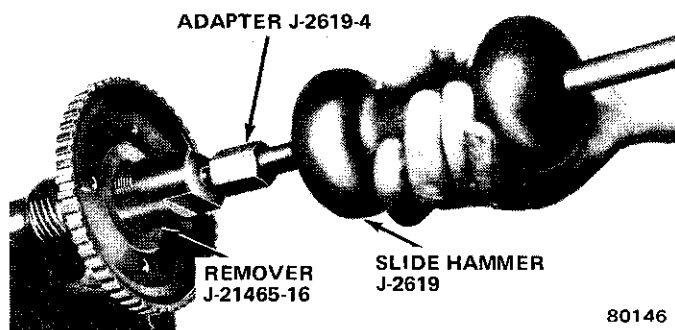


Fig. 2C-120 Output Shaft Flange Bushing Removal

(9) Align bushing oil hole with oil feed hole in flange.

**CAUTION:** If the bushing and flange oil holes are not aligned, the supply of lubricating oil to some transmission components will be cut off.

(10) Drive bushing into flange bore until installer tool bottoms.

(11) Remove bushing tools.

(12) Flush shaft and flange with solvent to remove any chips or shavings generated by bushing installation.

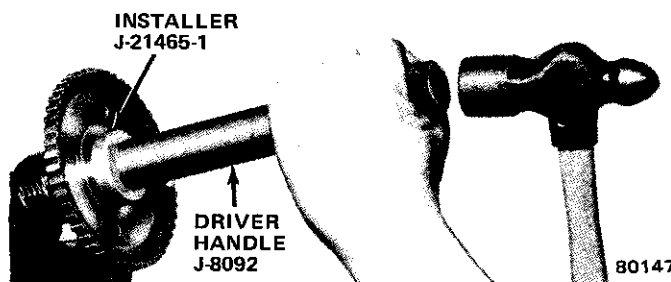


Fig. 2C-121 Output Shaft Flange Bushing Installation

**Sun Gear Shaft Front-Rear Bushings**

(1) Mount shaft in vise (fig. 2C-122).

**CAUTION:** To avoid damaging the shaft, the vise must be equipped with protective jaws and must not be overtightened.

(2) Assemble Adapter J-2619-4, Slide Hammer J-2619, and Remover J-21465-15 (fig. 2C-122).

(3) Thread Remover J-21465-15 into bushing. Remove bushing by bumping outward with Slide Hammer J-2619 (fig. 2C-122). Reposition shaft in vise and repeat procedure to remove opposite bushing.

(4) Remove shaft from vise.

(5) Clean shaft bushing bores.

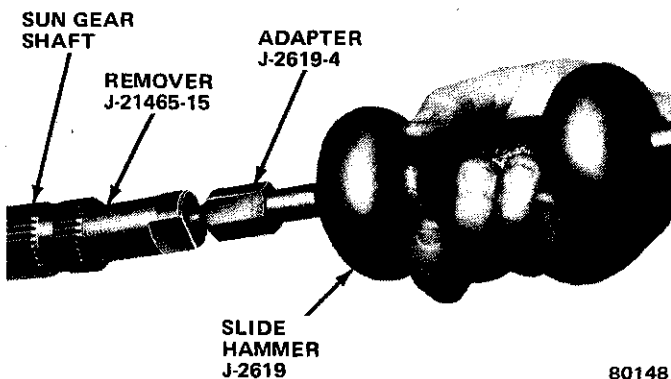


Fig. 2C-122 Sun Gear Shaft Bushing Removal

(6) Assemble Installer J-21465-5 and Driver Handle J-8092 and position replacement bushing on Installer J-21465-5.

(7) Support shaft on wood block (fig. 2C-123).

(8) Center bushing in shaft bore and drive bushing into bore until installer tool bottoms (fig. 2C-123). Reposition shaft in vise and repeat procedure to install opposite bushing.

(9) Flush shaft with solvent to remove any chips or shavings generated by bushing installation.

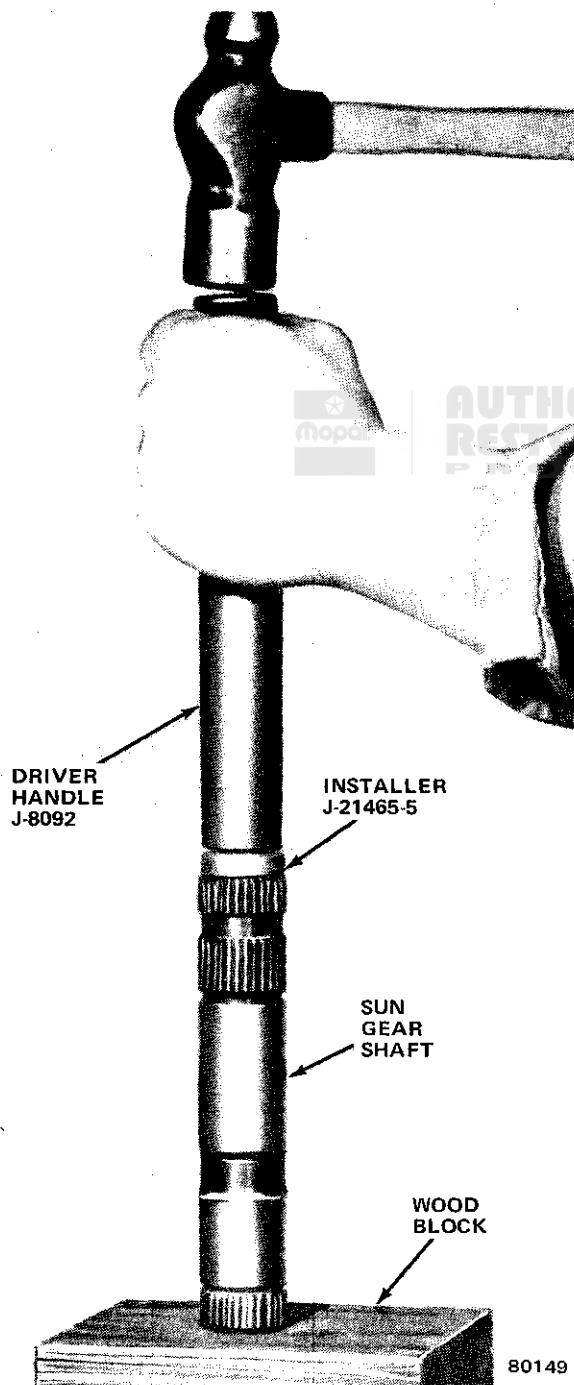


Fig. 2C-123 Sun Gear Shaft Bushing Installation

### Center Support Bushing

(1) Position center support on wood blocks so seal-ring hub faces downward.

(2) Assemble Remover-Installer J-21465-6 and Driver Handle J-8092 (fig. 2C-124).

(3) Insert Remover-Installer J-21465-6 into center support bushing and drive bushing out of support (fig. 2C-124).

(4) Reposition center support on wood blocks so seal-ring hub faces upward.

(5) Align slot in replacement bushing with slot and oil feed hole in center support bore (fig. 2C-125, View A and View B).

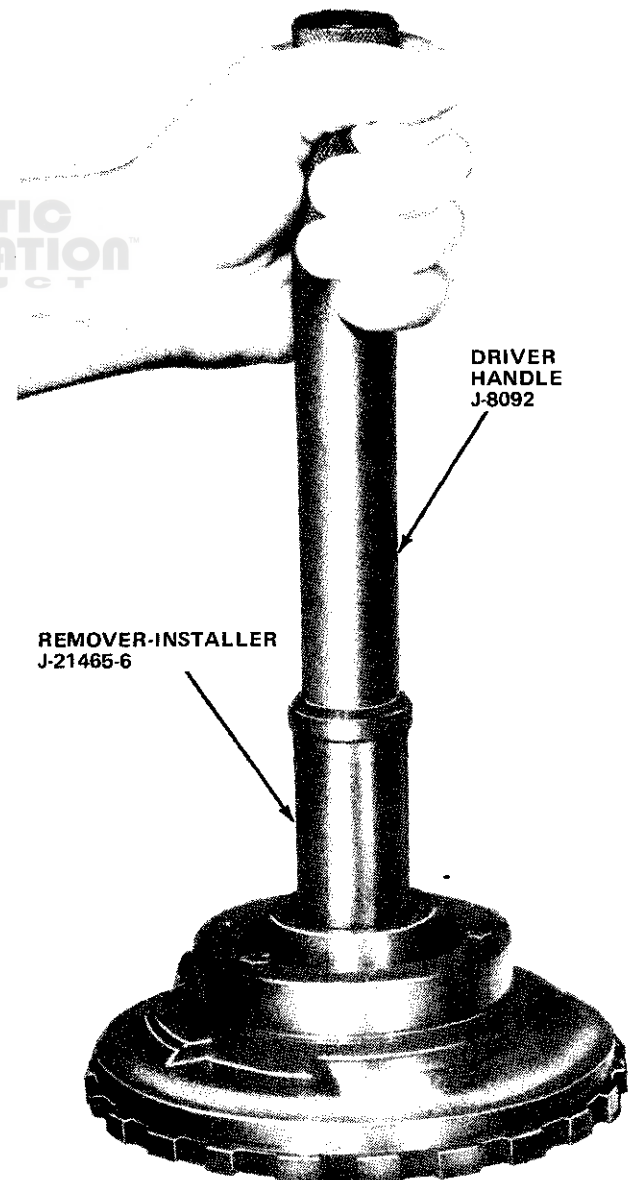
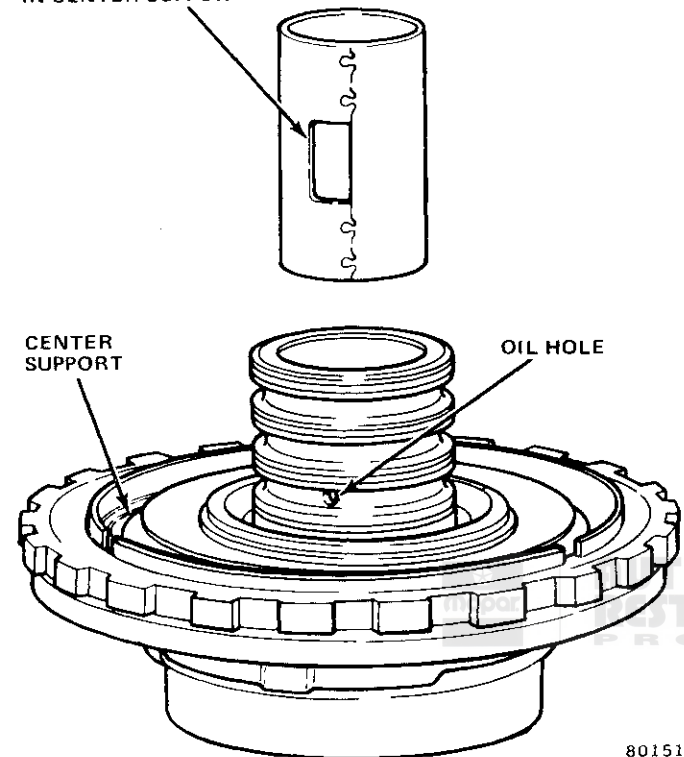


Fig. 2C-124 Center Support Bushing Removal

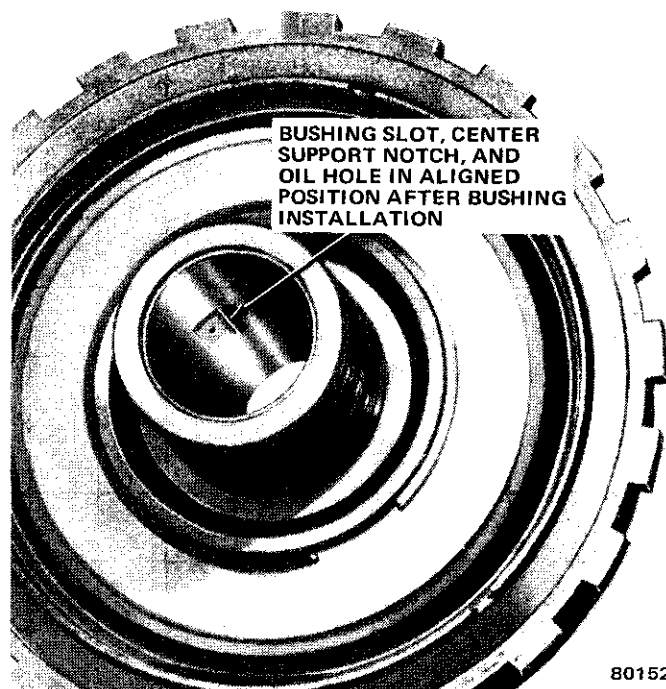
## 2C-66 AUTOMATIC TRANSMISSION

**CAUTION:** *If the slots and oil feed hole are not aligned (fig. 2C-125), the supply of lubricating oil to some transmission components will be cut off.*

BUSHING SLOT MUST ALIGN WITH OIL HOLE AND NOTCH IN CENTER SUPPORT BORE.



VIEW A



VIEW B

Fig. 2C-125 Center Support Bushing Alignment (View A and B)

(6) Insert Remover-Installer J-21465-6 into bushing. Drive bushing into bore until bushing is flush with, or no more than 0.010 inch (0.25 mm) below face of hub (fig. 2C-126).

(7) Remove bushing tools.

(8) Flush center support with solvent to remove any chips or shavings generated by bushing installation.

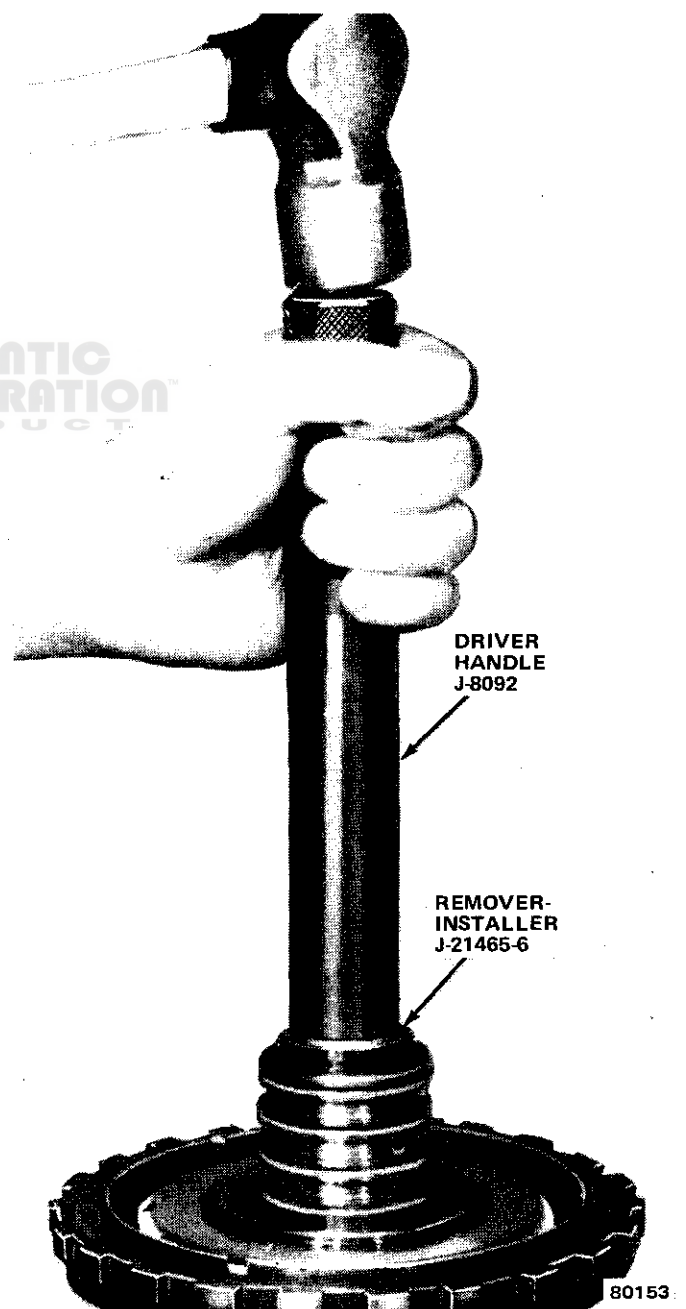


Fig. 2C-126 Center Support Bushing Installation

### Oil Pump Body Bushing

- (1) Position pump body on wood blocks so seal ring hub faces upward (fig. 2C-127).
- (2) Assemble Remover-Installer J-21465-17 and Driver Handle J-8092.
- (3) Insert remover tool into bushing and drive bushing out of pump body (fig. 2C-127).
- (4) Reposition pump body on wood blocks so pump cover mating surface of pump body faces upward (fig 2C-128).
- (5) Clean pump body bushing bore.
- (6) Position replacement bushing on Remover-Installer J-21465-17 and install bushing. Drive bushing into bore until bushing is flush with, or no more than 0.010 inch (0.25 mm) below surface of gear pocket in pump body.
- (7) Remove bushing tools.
- (8) Flush oil pump body with solvent to remove any chips or shavings generated by bushing installation.

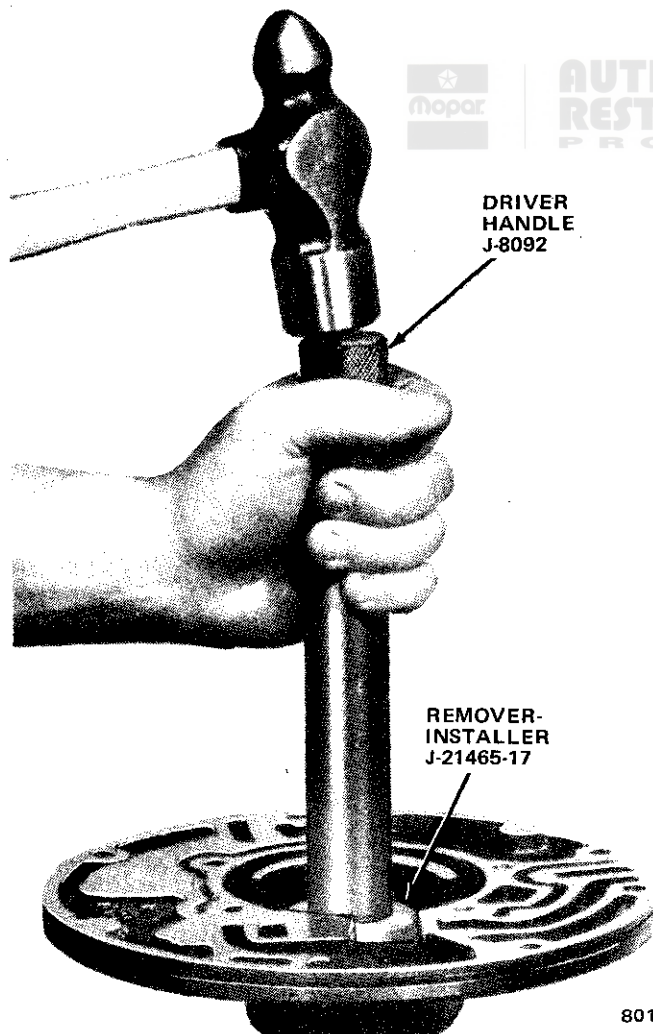


Fig. 2C-127 Oil Pump Body Bushing Removal

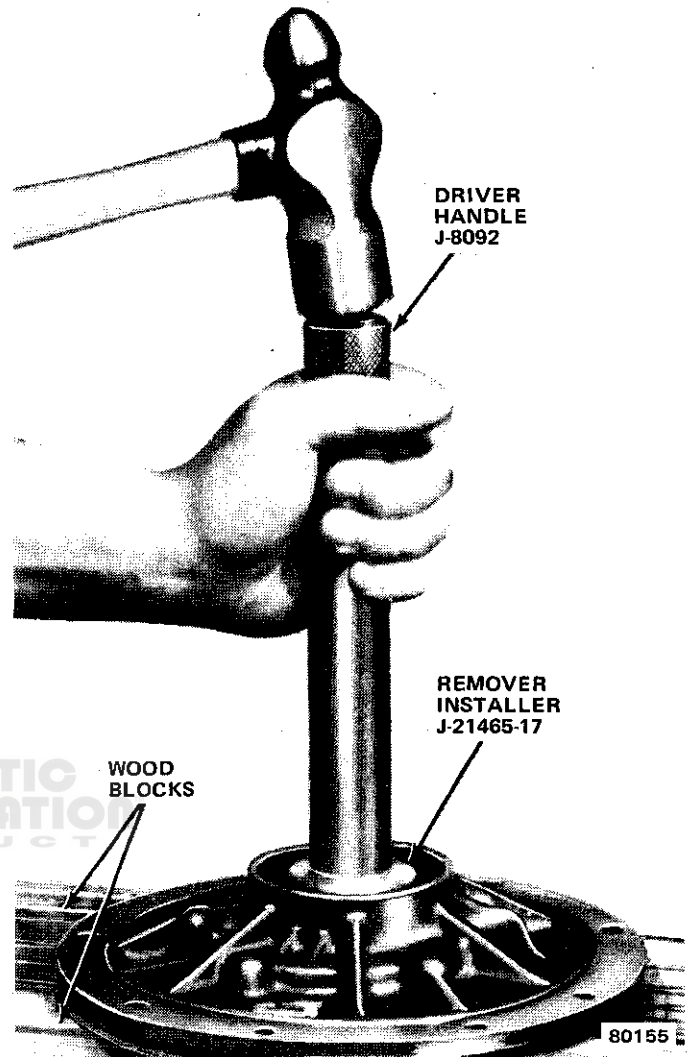


Fig. 2C-128 Oil Pump Body Bushing Installation

### Stator Shaft Front-Rear Bushings

#### Front Bushing

- (1) Mount stator shaft and pump cover assembly in vise so stator shaft faces outward (fig. 2C-129). Clamp pump cover seal ring hub in vise jaws.

**CAUTION:** To avoid damaging the pump cover seal ring hub, the vise must be equipped with protective jaws and must not be overtightened.

- (2) Assemble Adapter J-2619-4, Slide Hammer J-2619, and Remover J-21465-15 (fig. 2C-129).
- (3) Thread Remover J-21465-15 into bushing. Remove bushing by bumping outward with Slide Hammer J-2619 (fig. 2C-129).
- (4) Remove shaft and pump cover assembly from vise. Support assembly on wood block. Position wood block under pump cover seal ring hub.
- (5) Clean bushing bore.

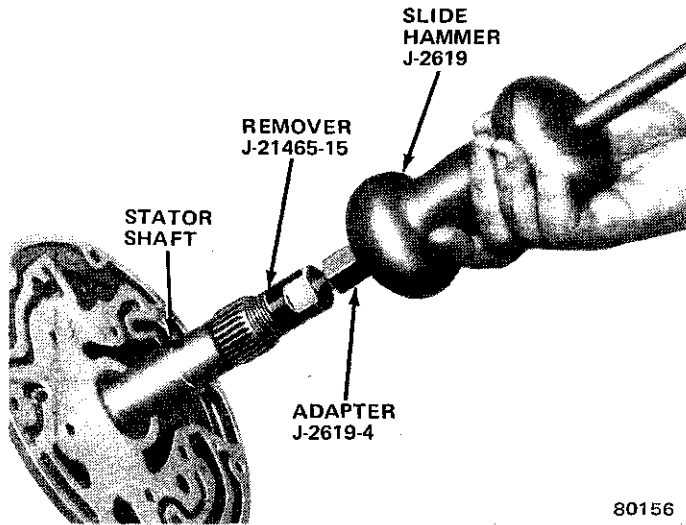


Fig. 2C-129 Stator Shaft Front Bushing Removal

(6) Assemble Installer J-21465-3 and Driver Handle J-8092 (fig. 2C-130).

(7) Position replacement bushing on Installer J-21465-3 and install bushing (fig. 2C-130). Drive bushing into shaft until installer tool bottoms.

(8) Remove bushing tools.

(9) Flush shaft with solvent to remove any chips or shavings generated by bushing installation.

**Rear Bushing**

(1) Mount stator shaft in vise so pump cover seal ring hub faces outward (fig. 2C-131).

**CAUTION:** To avoid damaging the shaft, the vise must be equipped with protective vise jaws and must not be overtightened.

(2) Assemble Adapter J-2619-4, Slide Hammer J-2619, and Remover J-21465-15 (fig. 2C-131).

(3) Thread Remover J-21465-15 into bushing. Remove bushing by bumping outward with Slide Hammer J-2619 (fig. 2C-131).

(4) Remove shaft and cover assembly from vise.

(5) Support pump cover on wood blocks with cover seal ring hub facing upward.

(6) Clean bushing bore.

(7) Assemble Installer J-21465-3 and Driver Handle J-8092.

(8) Position replacement bushing on Installer J-21465-3 and install bushing (fig 2C-132). Drive bushing into bore until bushing is 19/32 inch (15.08 mm) below hub surface.

(9) Remove bushing tools.

(10) Flush cover and shaft assembly with solvent to remove any chips or shavings generated by bushing installation.

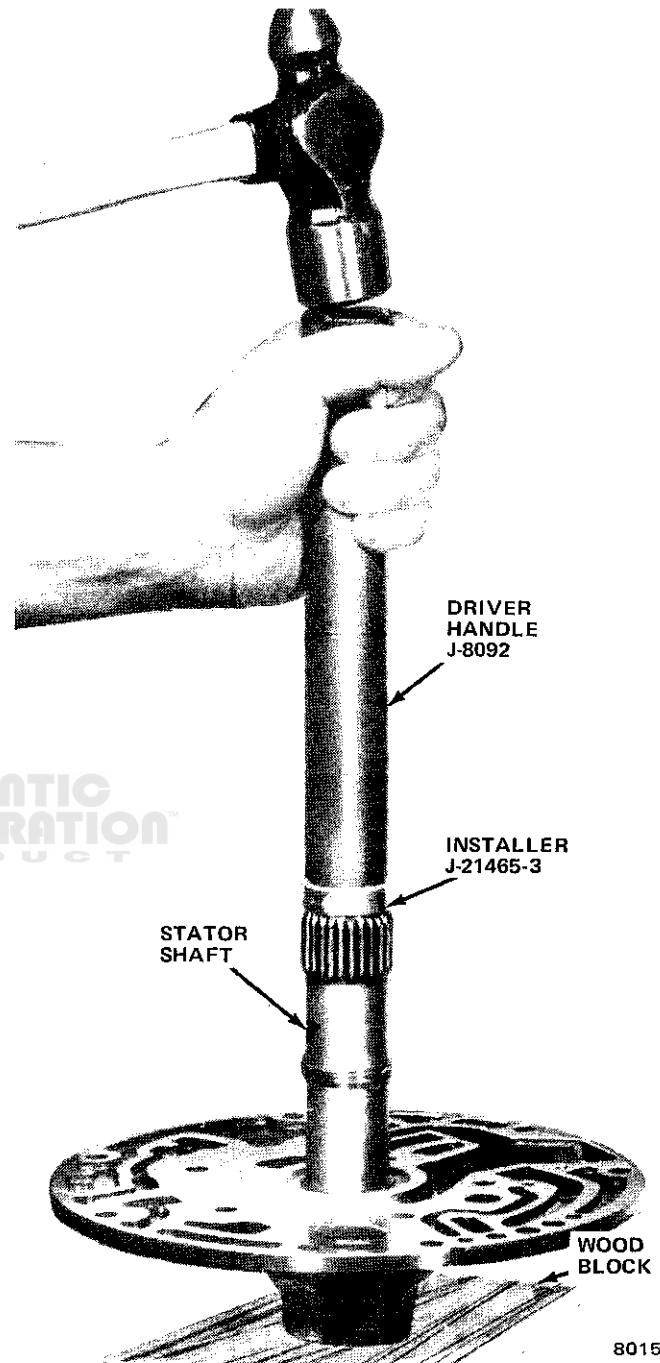


Fig. 2C-130 Stator Shaft Front Bushing Installation

**Transmission Case Bushing**

(1) Mount transmission case in Holding Fixture J-8763-01 (fig. 2C-11). Position case so converter housing is facing downward.

(2) Assemble Remover-Installer J-21465-8 and Driver Handle J-8092 (fig. 2C-133).

(3) Insert Remover J-21465-8 into bushing and drive bushing out of case (fig. 2C-133).

(4) Clean case bushing bore.

(5) Reposition transmission case in holding fixture so converter housing is facing upward.

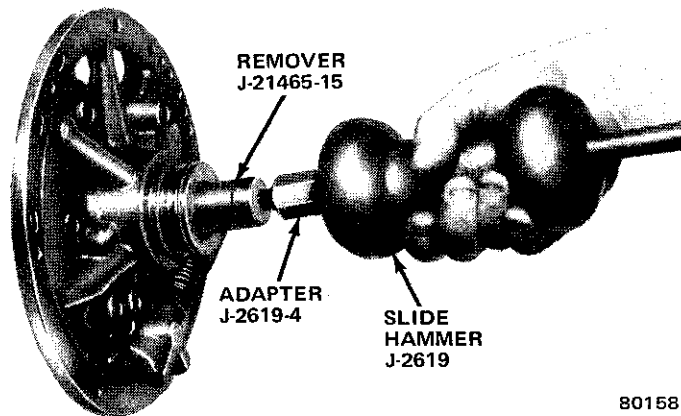


Fig. 2C-131 Stator Shaft Rear Bushing Removal

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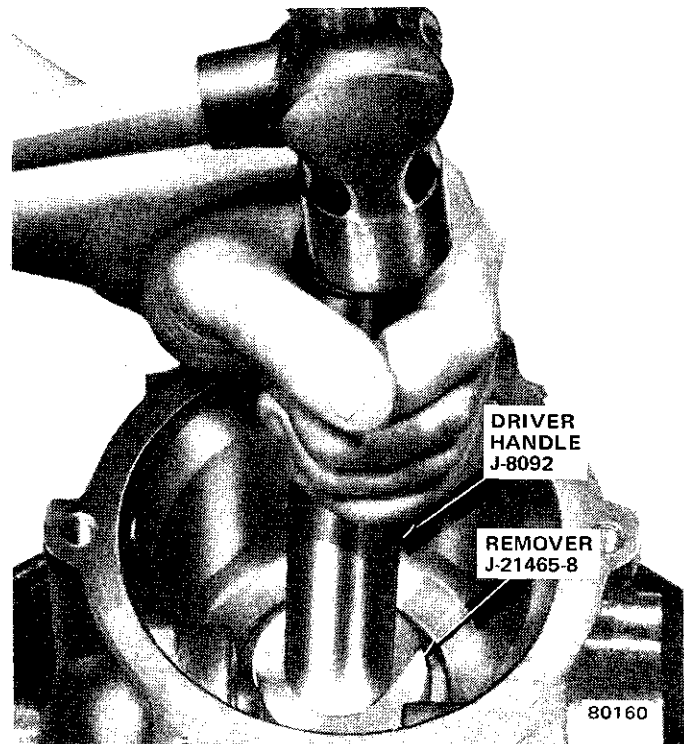


Fig. 2C-133 Transmission Case Bushing Removal

80160

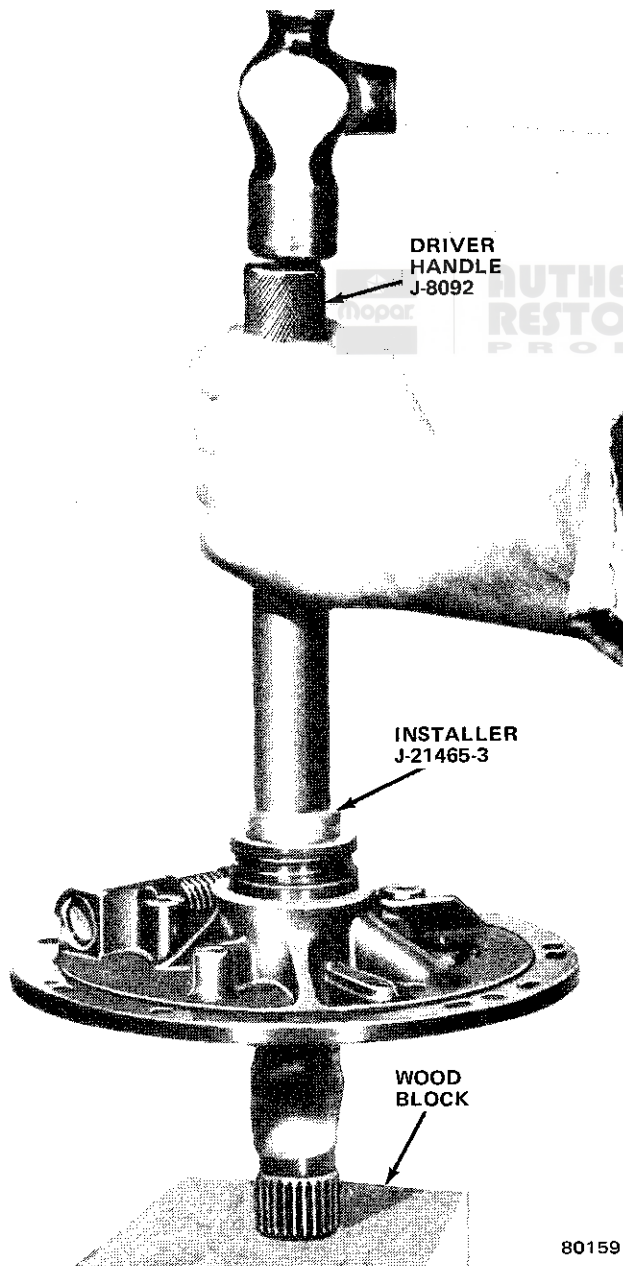


Fig. 2C-132 Stator Shaft Rear Bushing Installation

80159

(6) Thread Driver Handle Extension J-21465-13 onto Driver Handle J-8092.

(7) Assemble Remover-Installer J-21465-8 and Adapter Ring J-21465-9 on driver handle extension.

(8) Position replacement bushing on Remover-Installer J-21465-8 (fig. 2C-134).

**NOTE:** If the bushing has notches in it, be sure the notches will face to the rear of the transmission case after bushing installation.

(9) Center replacement bushing in case bore and install bushing. Drive bushing into case bore until Adapter Ring J-21465-9 bottoms against case (fig. 2C-134).

**CAUTION:** Do not attempt to install the case bushing without using Adapter Ring J-21465-9. This tool positions the bushing 0.040 to 0.055-inch above the selector thrust washer surface in the case. If the bushing is incorrectly positioned, the thrust washer will not locate properly and the supply of bushing lubricating oil can be impaired.

(10) Remove bushing tools.

(11) Reposition case in holding fixture so converter housing faces downward.

(12) Stake transmission case bushing in place using Staking Tool J-21465-10 (fig. 2C-135). Stake marks must be made in bushing oil groove.

(13) Remove transmission case from holding fixture.

(14) Flush case with solvent to remove any chips or shavings generated by bushing installation.



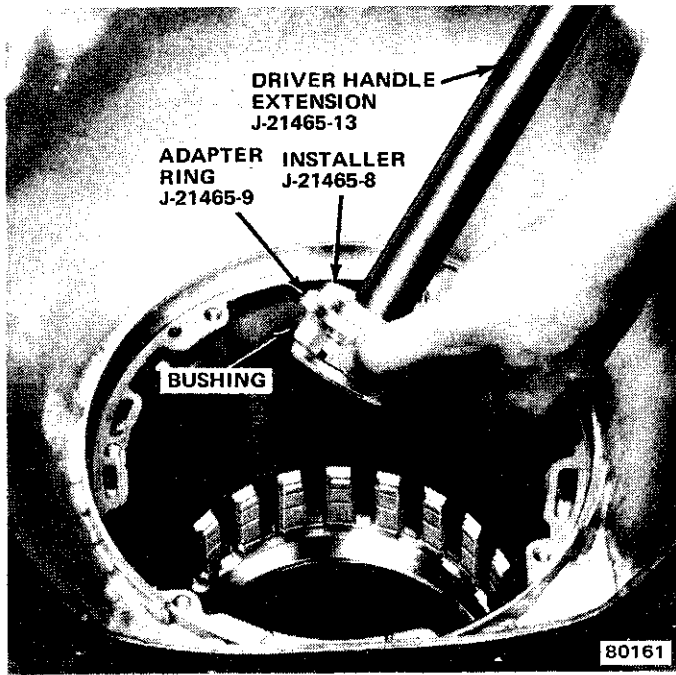


Fig. 2C-134 Transmission Case Bushing Installation

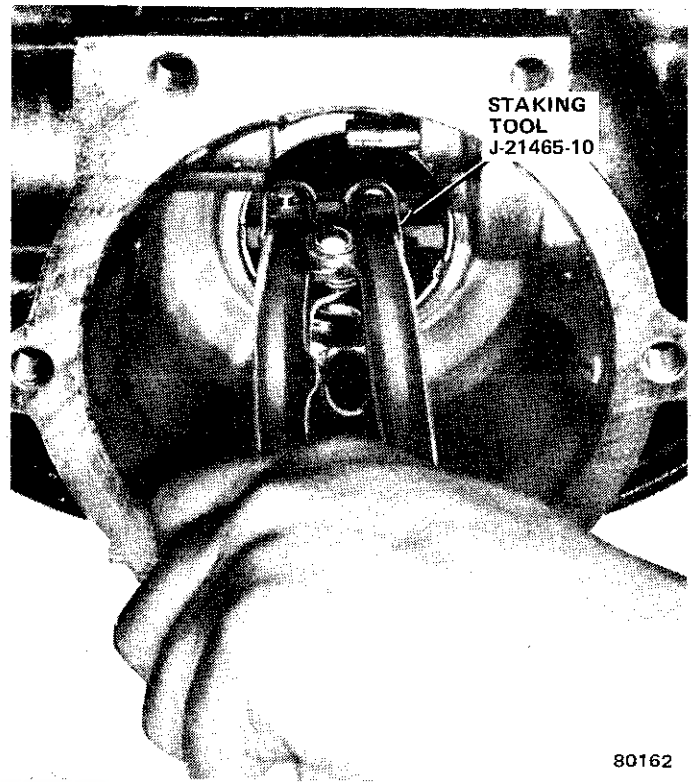


Fig. 2C-135 Staking Transmission Case Bushing

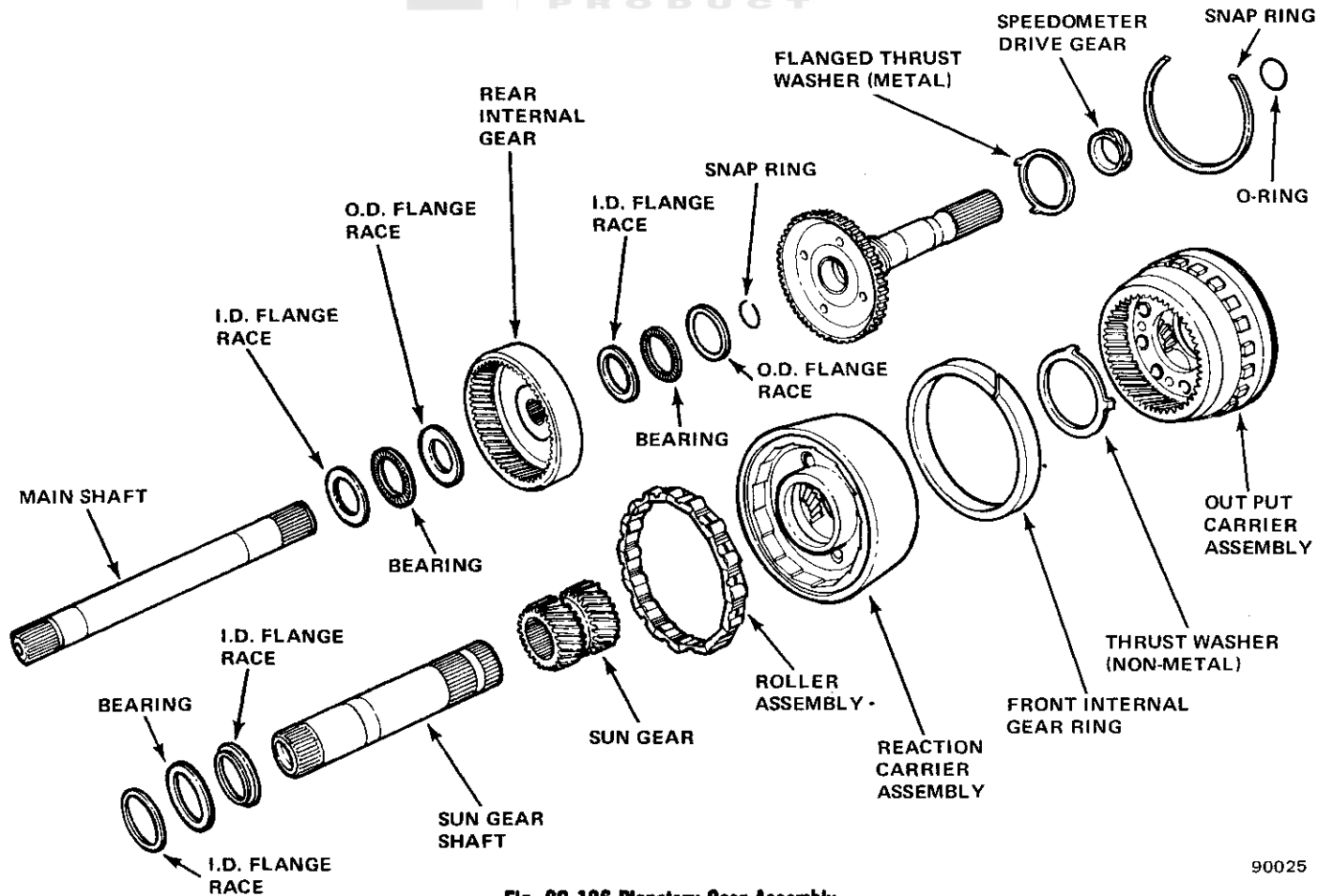


Fig. 2C-136 Planetary Gear Assembly



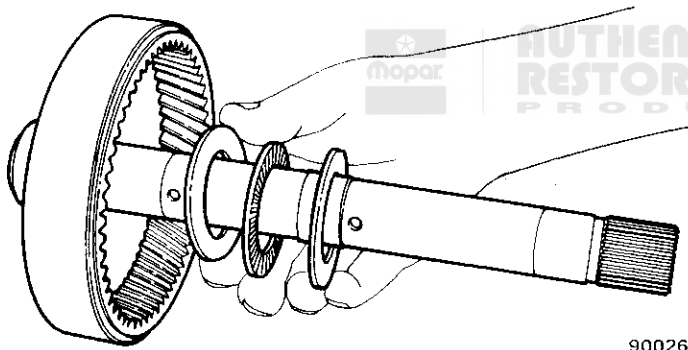
AUTHENTIC RESTORATION PRODUCT

**TRANSMISSION ASSEMBLY**

**NOTE:** When assembling the transmission and sub-assembly units, lubricate all bushings, bearings and bearing thrust surfaces with transmission fluid and lubricate both sides of all thrust washers with petroleum jelly.

**Planetary Gear Assembly**

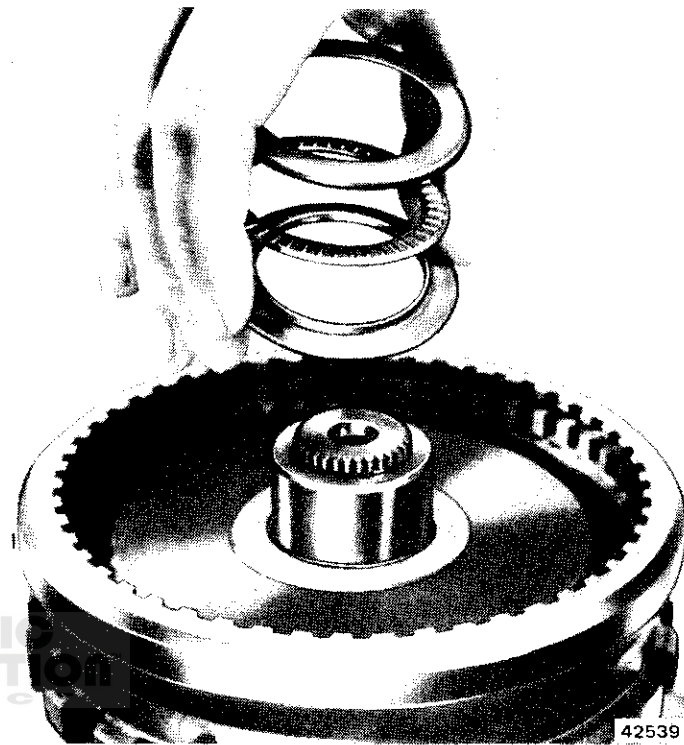
- (1) Insert rear spline of main shaft into rear internal gear and install snap ring (fig. 2C-136).
- (2) Install sun gear-to-internal gear bearing races and thrust bearings against inner face of rear internal gear as follows:
  - (a) Coat bearings and washers with petroleum jelly.
  - (b) Install large bearing race against internal gear with flange facing forward or upward (fig. 2C-137).
  - (c) Install thrust bearing in race and place small race against bearing with inner flange facing into bearing, or downward.



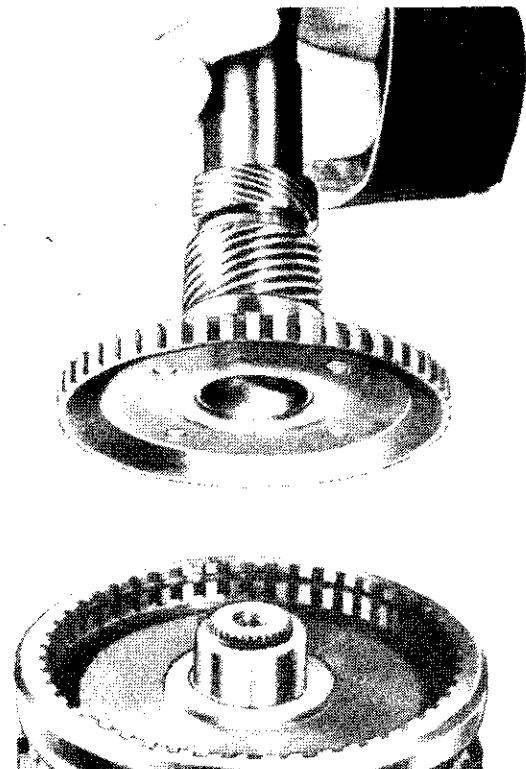
**Fig. 2C-137 Installing Thrust Bearing and Bearing Races On Main Shaft**

- (3) Install output carrier over main shaft and mesh carrier pinions with rear internal gear.
- (4) Position assembled components so that main shaft extends downward through hole in bench and rear surface of rear internal gear faces upward.
- (5) Install rear internal gear-to-output shaft races and thrust bearing (fig. 2C-138). Use petroleum jelly to retain parts.
- (6) Place small race against internal gear with center flange facing upward.
- (7) Install thrust bearing in race and place large race over small race, with outer flange of race cupped over bearing.
- (8) Install output shaft in output carrier assembly (fig. 2C-139).
- (9) Install shaft-to-carrier snap ring (fig. 2C-136).
- (10) Position and support assembled components so that output shaft extends downward.
- (11) Install reaction carrier-to-output carrier thrust

washer on output carrier with washer tabs facing downward and located in corresponding pockets of carrier. Use petroleum jelly to retain parts.



**Fig. 2C-138 Rear Internal Thrust Bearing and Bearing Race Installation**



**Fig. 2C-139 Installing Output Shaft in Output Carrier**

**NOTE:** Service replacement washers are metal.

(12) Install sun gear in output carrier, with chamfer facing downward, and mesh sun gear with planet pinion gears.

(13) Install front internal gear ring on output carrier (fig. 2C-140).

(14) Install reaction carrier assembly on output carrier and ring, so that output carrier planet pinion gears mesh with sun gear (fig. 2C-141).

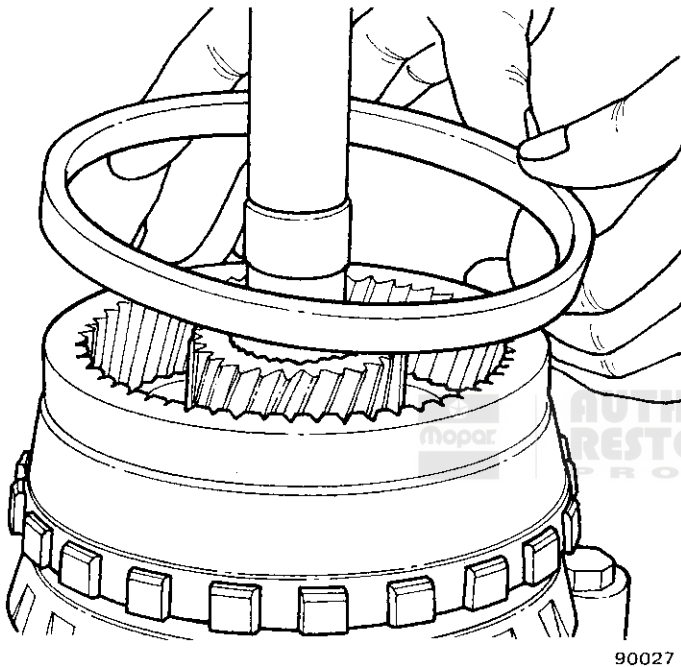


Fig. 2C-140 Front Internal Gear Ring Installation

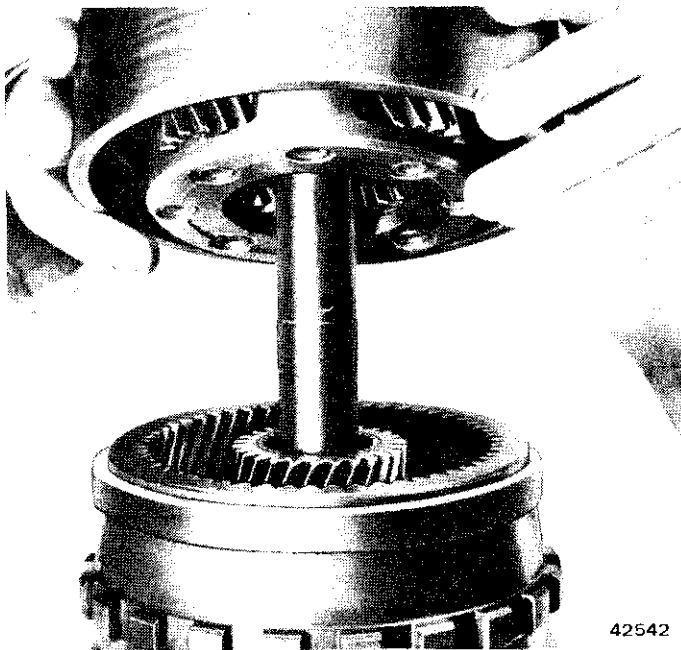


Fig. 2C-141 Reaction Carrier Installation

**NOTE:** When a replacement output or reaction carrier is being installed and the front internal gear ring prevents installation of either carrier, it will be necessary to install a service replacement front internal gear ring.

(15) Install center support-to-sun gear thrust bearing and races as follows:

(a) Coat bearings and races with petroleum jelly.

(b) Install large race over main shaft with center flange of race facing upward and seat race against sun gear.

(c) Install thrust bearing over race and seat remaining race with center flange facing upward on washer (fig. 2C-142).

(16) Install clutch rollers in roller cage by compressing energizing spring with forefinger and inserting rollers from center-outer side of cage (fig. 2C-143 and 2C-144).

(17) Install roller clutch on reaction carrier outer race (fig. 2C-145).

(18) Install center support-to-reaction carrier thrust washer in recess in center support. Use petroleum jelly to retain thrust washer.

(19) Install center support in reaction carrier and roller clutch (fig. 2C-146).

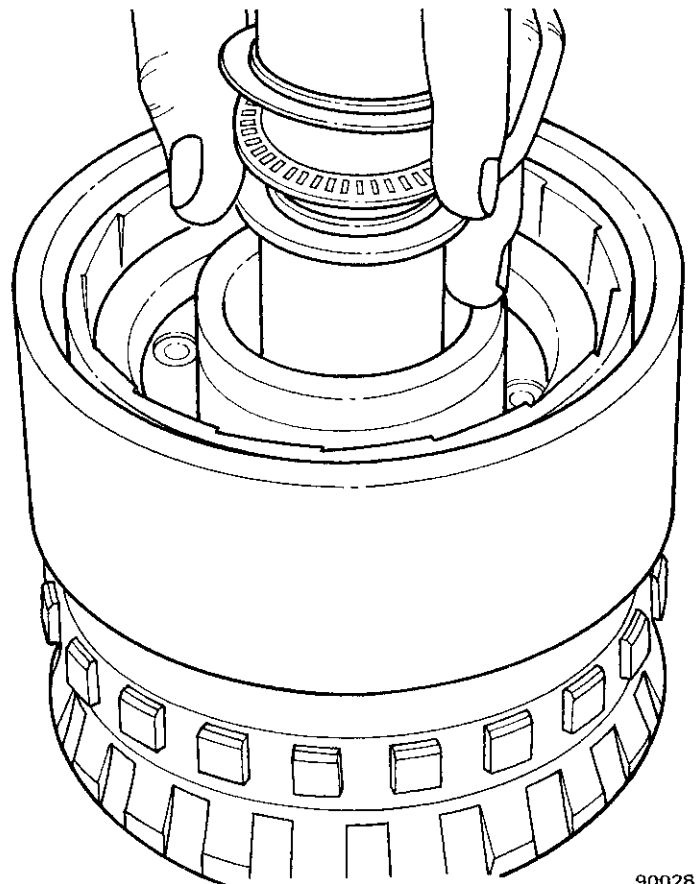
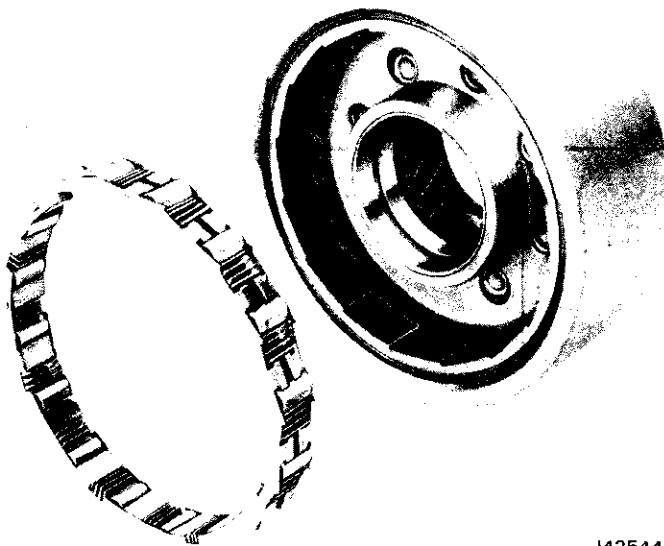


Fig. 2C-142 Installing Center Support-to-Sun Gear Thrust Bearing and Races



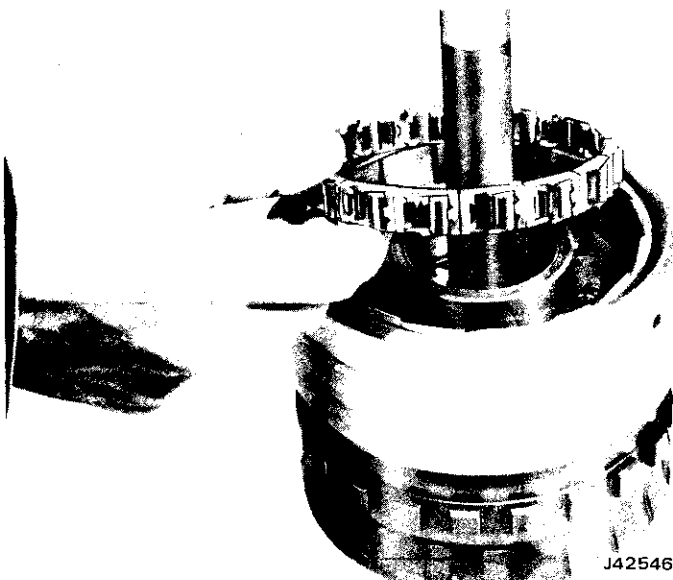
**Fig. 2C-143 Roller Clutch Assembly**

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**Fig. 2C-144 Installing Clutch Rollers In Cage**

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**Fig. 2C-145 Roller Clutch Installation**

J42546

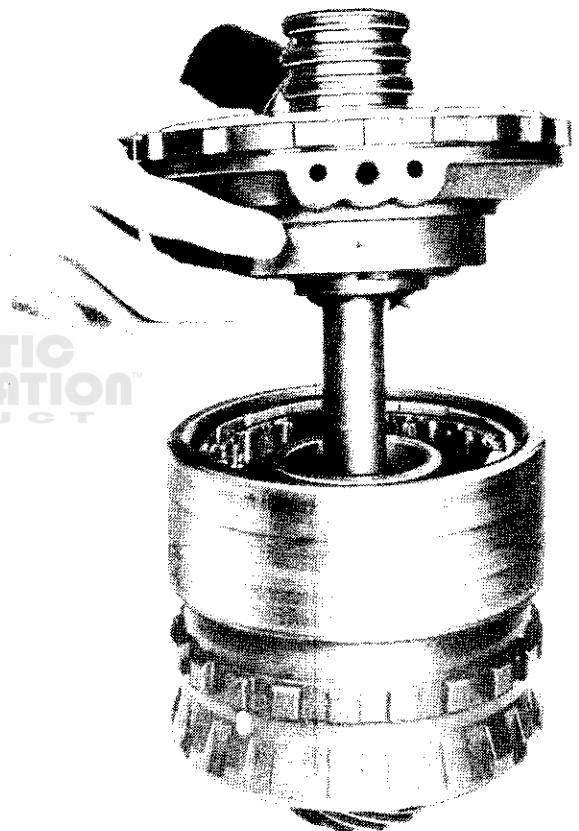
(20) Insert rear spline (longest spline) of sun gear-shaft into sun gear spline.

**NOTE:** When the reaction carrier is held stationary, the center support should turn counterclockwise only.

(21) Using Gear Assembly Clamp Set J-21795, clamp gear unit assembly together until it is installed.

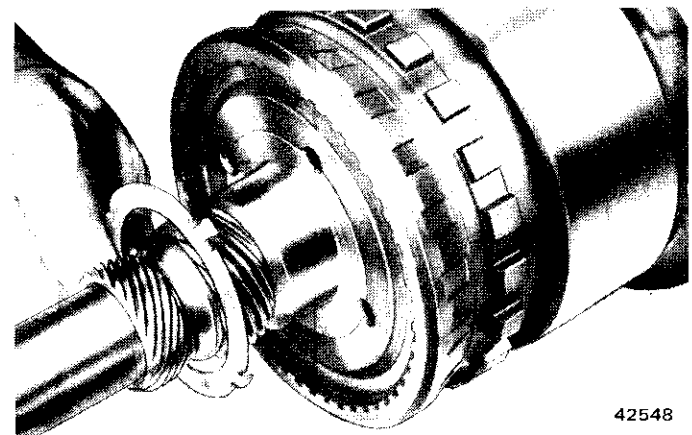
(22) Install output shaft-to-case thrust washer and seat washer so washer tabs are inserted into corresponding holes of shaft (fig. 2C-147). Use petroleum jelly to retain thrust washer.

**NOTE:** Do not use a plastic thrust washer.



**Fig. 2C-146 Center Support Installation**

42468



**Fig. 2C-147 Output Shaft-to-Case Thrust Washer Installation**

42548

**Gear Unit and Intermediate Clutch**

- (1) Install parking pawl with tooth facing toward inside of case and parking pawl shaft.
- (2) Install parking pawl shaft retainer clip (fig. 2C-148).
- (3) Apply nonhardening sealer to cup plug.
- (4) Install cup plug using 3/8-inch diameter rod, and install plug in case until parking pawl shaft bottoms on case rib (fig. 2C-148).
- (5) Install parking pawl return spring, with square end hooked on pawl, on opposite end of case (fig. 2C-10).
- (6) Install parking pawl bracket guides over pawl and install two attaching bolts. Tighten bolts to 18 foot-pounds torque (24 N•m)(fig. 2C-149).
- (7) Install rear band in case so that two band lugs index with two anchor pins. Be sure band is seated on lugs.

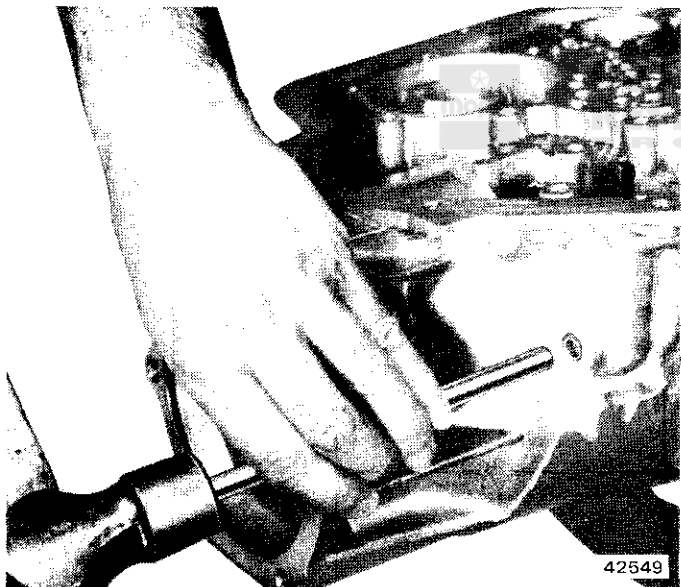


Fig. 2C-148 Cup Plug Installation

- (8) Install support-to-case spacer against shoulder at bottom of case splines so that end gap of snap ring is adjacent to band anchor pin (fig. 2C-150).

**CAUTION:** Do not confuse this spacer which is 0.040 inch (1.01 mm) thick and both sides flat with either the center support-to-case snap ring (one side beveled) or the backing plate-to-case snap ring which is 0.093 inch (2.36 mm) thick and both sides flat. Do not attempt to install the early-type center support with the 0.040 inch (1.01 mm) spacer ring in the case, and do not install the new center support until the 0.040 inch (1.01 mm) spacer ring is installed in the case.

- (9) Install required thickness rear unit selective washer (washer thickness determined by end play check made during disassembly) into corresponding slots in rear of transmission case.

- (10) Install center support and gear unit in case. Be sure center support bolt hole is properly aligned with hole in case. Use Tool Kit J-21795 to install assembly.

- (11) Install center support-to-case retaining snap ring, **with beveled side of ring facing upward**. Locate snap ring end gap adjacent to band anchor pin to secure center support in case. Be sure ring is properly seated in case (fig. 2C-151).

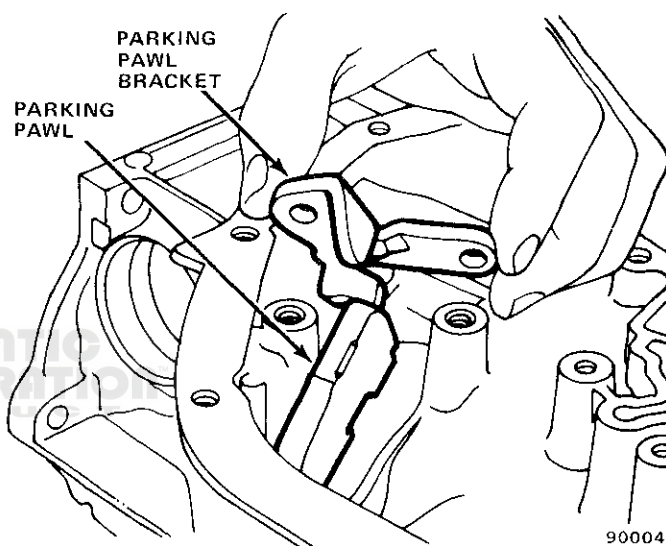


Fig. 2C-149 Parking Pawl Bracket Installation

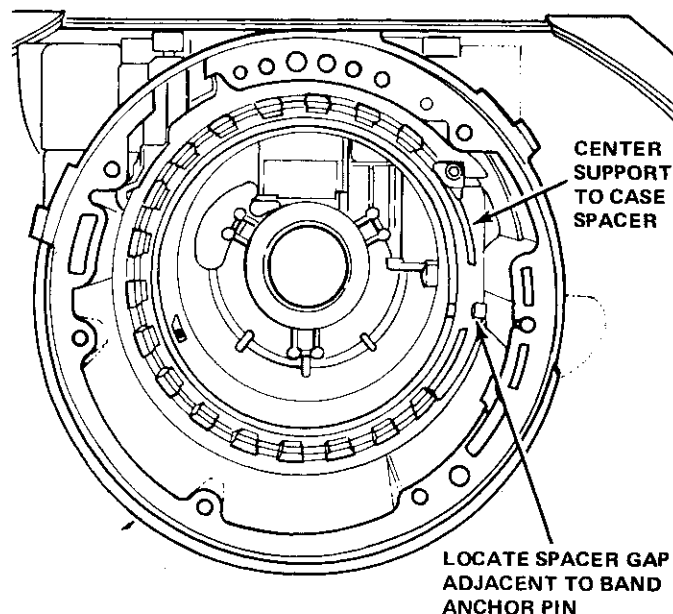
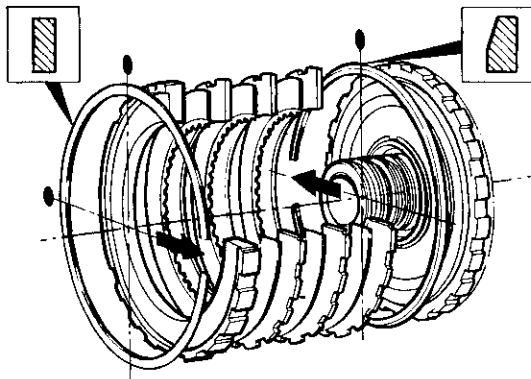


Fig. 2C-150 Center Support Spacer Installation



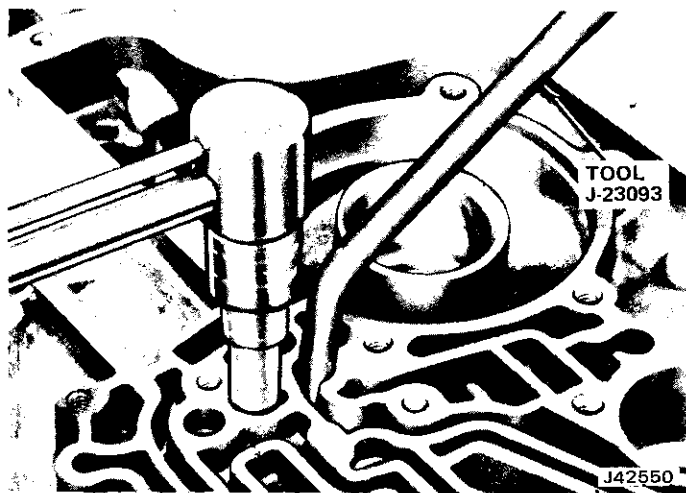
J42551

**Fig. 2C-151 Snap Ring Installation**

(12) Install case-to-center support bolt. Place Center Support Locating Tool J-23093 in case direct clutch passage with handle of tool pointing to right (as viewed from front of transmission) and parallel to converter housing mounting face (fig. 2C-152).

(13) Apply downward pressure on tool handle to rotate center support counterclockwise as viewed from front of transmission.

(14) Hold center support counterclockwise against case splines and tighten case to center support bolt to 23 foot-pounds (31 N•m) torque. Use 3/8-inch, 12-point, thin-wall deep socket to tighten bolt (fig. 2C-152).



**Fig. 2C-152 Center Support Bolt Installation**

**CAUTION:** When using the locating tool, do not create any burrs on the case valve body mounting face. In addition, the piston in the center support applies the intermediate clutch. If the bolt is overtightened or the piston seals leak, clutch slippage or loss of second gear range may result.

(15) Lubricate two flat and one waved steel plates and three composition-faced intermediate clutch plates with transmission fluid. Install plates starting with waved steel plate and alternating composition-faced and steel plates.

(16) Install intermediate clutch backing plate, with ridge facing upward or forward, and install backing plate-to-case snap ring. **This snap ring is flat on both sides. Locate gap of snap ring opposite band anchor pin (fig. 2C-151).**

**Measuring Rear Unit End Play**

(1) Install Slide Hammer J-25118 in extension housing attaching bolt hole (fig. 2C-153).

(2) Mount dial indicator on rod and position indicator stylus against end of output shaft.

(3) Move output shaft inward and outward and note end play. End play should be 0.007 to 0.019 inch (0.17 to 0.48 mm).

**NOTE:** The selective washer that determines end play is located between the thrust washer and rear face of the transmission case. The washer is steel and has three lugs.

(4) If different washer thickness is required to adjust end play, select washer from following chart:

Thickness (Inch)	Notches and/or Numeral	
0.074 to 0.078 (1.87-1.98 mm)	None	1
0.082 to 0.086 (2.08-2.18 mm)	1 Tab Side	2
0.090 to 0.094 (2.28-2.38 mm)	2 Tab Side	3
0.098 to 0.102 (2.48-2.59 mm)	1 Tab OD	4
0.106 to 0.110 (2.69-2.79 mm)	2 Tabs OD	5
0.114 to 0.118 (2.89-2.99 mm)	3 Tabs OD	6

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**Rear Unit Thrust Washer Chart**

**Front Band**

Install front band with band anchor hole positioned over band anchor pin and band apply lug facing servo hole.

**Manual Linkage**

(1) Install O-ring on manual shaft.

(2) Install parking actuator rod in manual detent lever from side opposite pin.

(3) Install parking actuator rod plunger under parking bracket and over parking pawl (fig. 2C-154).

(4) Install manual shaft assembly through case and detent lever, and install jamnut and retaining pin.

(5) Install retaining pin. Index pin with groove in manual shaft.

(6) Install shaft seal using socket and hammer.

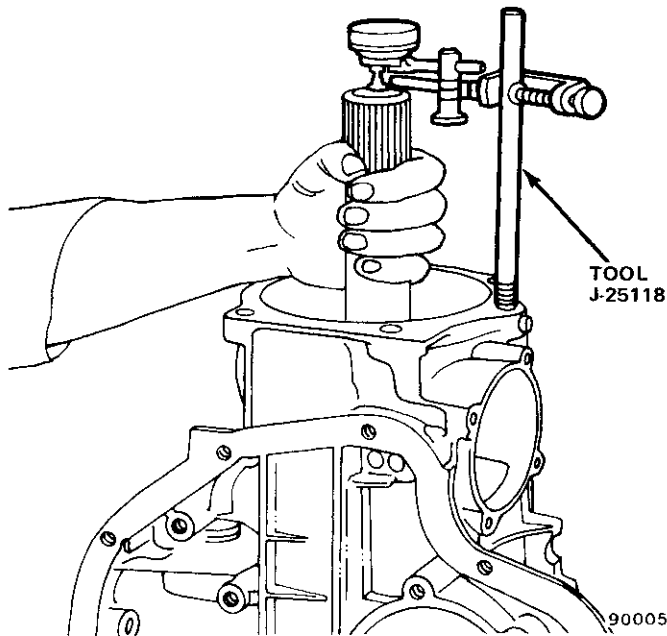


Fig. 2C-153 Measuring Rear Unit End Play

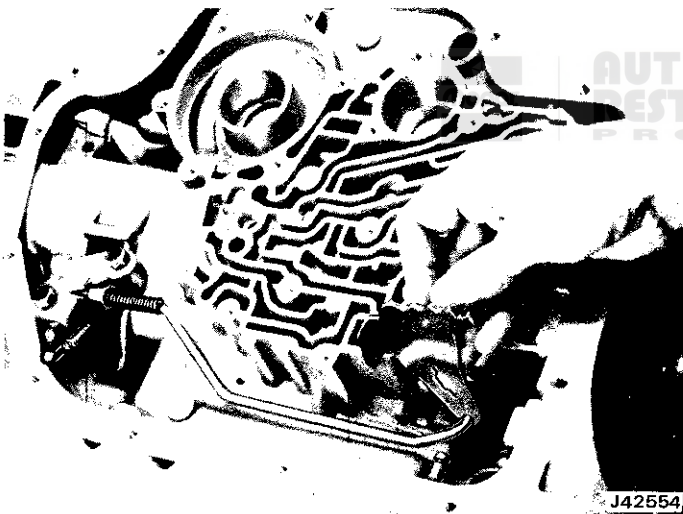


Fig. 2C-154 Manual Shaft Installation

### Direct Clutch-Forward Clutch

(1) Install direct clutch and intermediate roller clutch assembly.

(2) Rotate direct clutch housing until outer race of roller clutch contacts intermediate clutch plates and hub of clutch housing contacts sun gear shaft.

**NOTE:** Use Clutch Plate Alignment Tool J-24396 to align the plates to ease installation. However, if an alignment tool is not available, it may be helpful to remove the composition plates and steel plates from the direct clutch housing while seating the assembly.

(3) Install forward clutch hub-to-direct clutch housing thrust washer on hub of forward clutch if not installed previously. Use petroleum jelly to retain washer.

(4) Install forward clutch and turbine shaft. Position direct clutch hub so end of main shaft will bottom on end of forward clutch hub. When forward clutch is seated, it will be approximately 1-1/4 inch (31.75 mm) from case oil pump face.

### Oil Pump

(1) Fabricate guide pins by grinding heads from two spare 5/16-18 valve body bolts.

(2) Install guide pins in pump mounting bolt holes of transmission case.

(3) Position oil pump gasket on pump face of transmission case. Use petroleum jelly to retain gasket.

(4) Install pump assembly and all but one pump attaching bolt and washer. Omit bolt and washer from either 5 or 10 o'clock position.

(5) Tighten installed pump attaching bolts to 22 foot-pounds (30 N•m) torque.

**CAUTION:** If the turbine shaft cannot be rotated as the pump is pulled into place, either the forward or direct clutch housing has been improperly installed and will not index with the clutch plates. This condition must be corrected before the pump can be installed.

(6) Install oil pump seal. Use nonhardening sealer on outside of seal and install seal using tool J-21359 (fig. 2C-155).

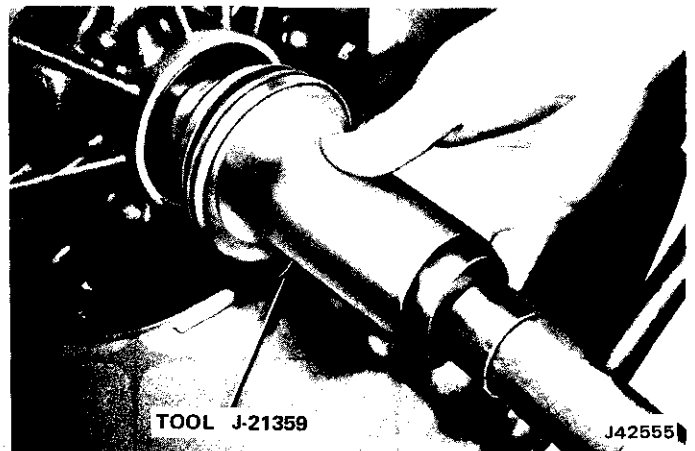


Fig. 2C-155 Oil Pump Seal Installation

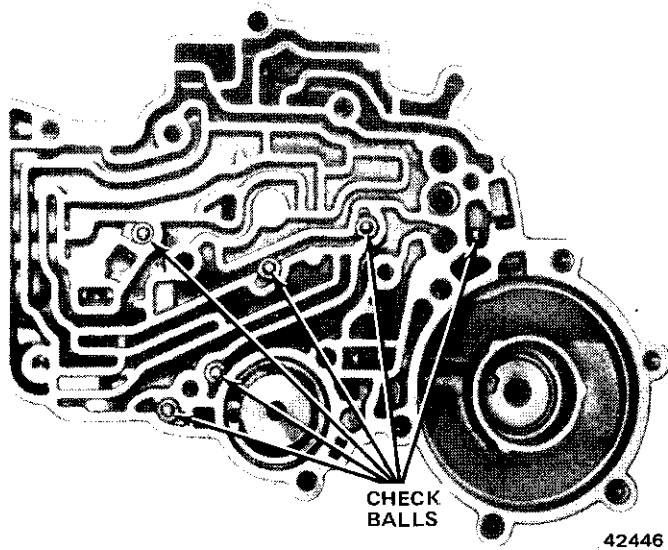
(7) Measure front unit end play, and replace selective washer if necessary.

(8) Install remaining oil pump attaching bolt and washer. Tighten bolt to 22 foot-pounds (30 N•m) torque.

### Check Balls-Control Valve Spacer Plate and Gaskets-Depot Solenoid-Front Servo-Electrical Connector

(1) Install guide pins (fabricated previously) in valve body mounting holes in transmission case.

(2) Install six check balls into ball seat pockets in transmission case (fig. 2C-23 and 2C-156).



**Fig. 2C-156 Spacer Plate Check Ball Location**

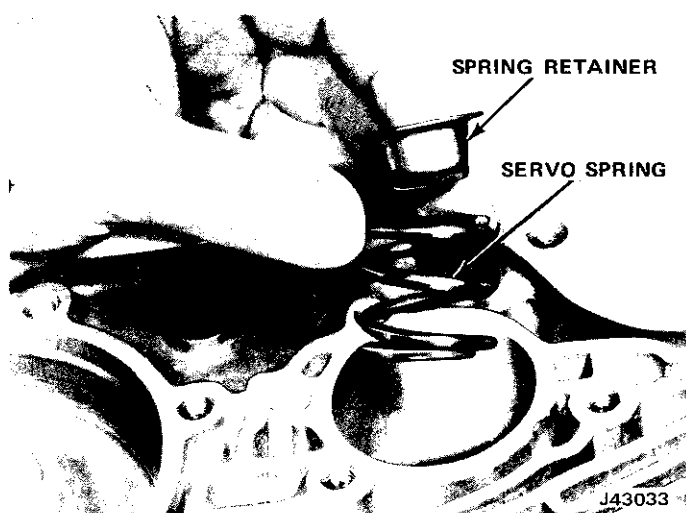
(3) Install front servo spring and spring retainer in servo bore (fig. 2C-157).

(4) Install retainer ring in front servo pin groove and install pin in case so that tapered end contacts band. Be sure retainer does not become dislodged during installation (fig. 2C-24 and 2C-57).

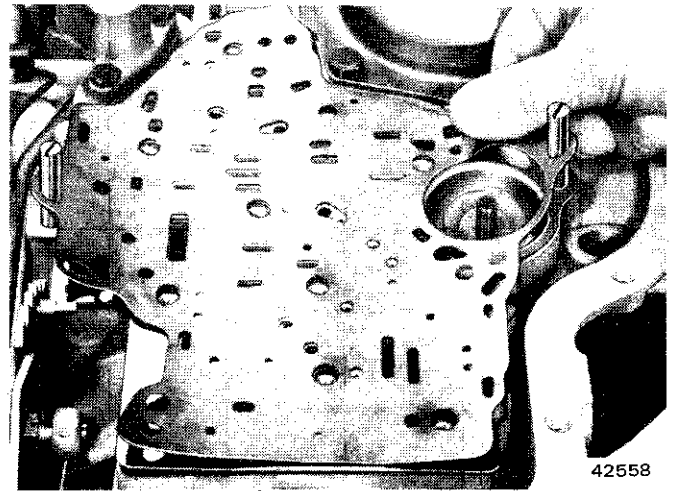
(5) Install seal ring on servo piston (if removed) and install piston on servo pin with flat side of piston facing oil pan (fig. 2C-24 and 2C-57).

(6) Install control valve spacer plate to case gasket (this gasket has extension for detent solenoid and has a "C" mark near front servo location).

(7) Install control valve spacer plate and spacer plate-to-control valve gasket (fig. 2C-158).



**Fig. 2C-157 Servo Spring and Retainer Installation**



**Fig. 2C-158 Control Valve Spacer Gasket Installation**

(8) Install detent solenoid with solenoid wire facing outer edge of case. Tighten solenoid bolts finger-tight only.

(9) Install O-ring seal on electrical connector (fig. 2C-22).

(10) Install electrical connector in case with lock tabs facing into case and locating tab in locating notch on side of case.

(11) Connect detent solenoid wire to electrical connector. Be sure wire is solidly connected to terminal on connector.

### Rear Servo

(1) Install proper length band-apply pin. Refer to Band Adjustment-Rear Band Apply Pin Selection.

(2) Install rear accumulator spring (fig. 2C-159).



**Fig. 2C-159 Rear Accumulator Spring Installation**

(3) Lubricate rear servo assembly with transmission fluid and install servo assembly.

(4) Install rear servo gasket and cover (fig. 2C-160). Install cover attaching bolts and tighten bolts to 18 foot-pounds (24 N•m) torque.



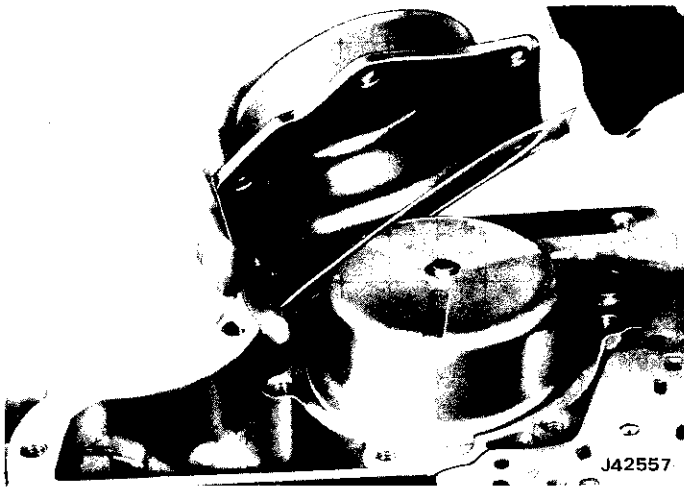


Fig. 2C-160 Rear Servo Cover and Gasket Installation

### Control Valve-Governor Screen-Governor Pipes

(1) Insert governor pipes into valve body and install governor screen in case.

**NOTE:** Be sure the governor screen is in position before installing the control valve and governor pipes. The open end of the screen must face the interior of the transmission case.

(2) Install control valve and governor pipes (fig. 2C-161).

**NOTE:** Be sure the manual valve is properly indexed with the manual detent lever pin and be sure the governor pipes are properly installed in the case.

(3) Install control valve attaching bolts, and manual detent and roller assembly.

(4) Tighten detent solenoid and control valve attaching bolts to 10 foot-pounds (14 N•m) torque.

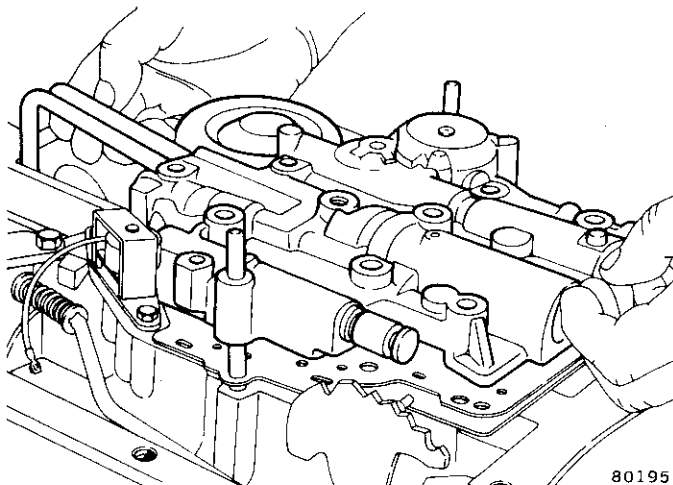


Fig. 2C-161 Control Valve Installation

### Oil Filter-Oil Pan

(1) Install case-to-intake pipe O-ring seal on intake pipe.

(2) Install replacement filter on intake pipe. Install filter on end of intake pipe marked "filter."

(3) Install assembled filter and intake pipe and install filter-to-control valve retainer bolt (fig. 2C-162).

**CAUTION:** The oil filter must be replaced after any major repair.

(4) Position oil pan gasket on case.

(5) Position oil pan on case and install oil pan bolts. Tighten oil pan bolts to 13 foot-pounds (18 N•m) torque.

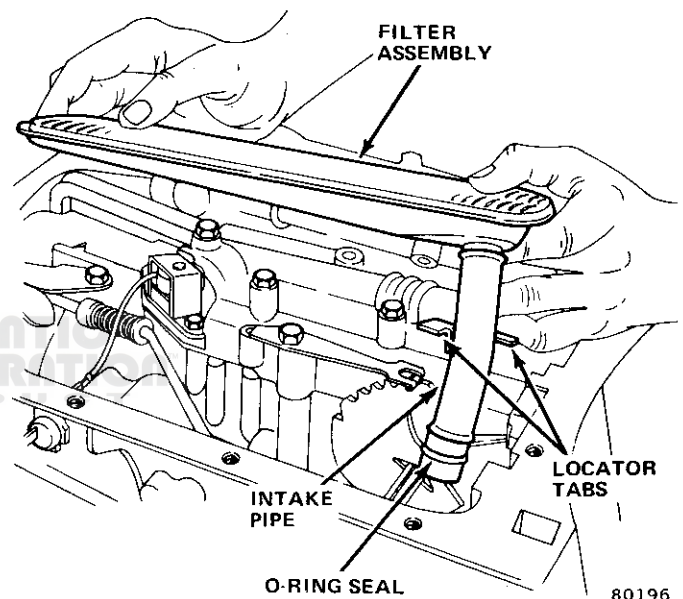


Fig. 2C-162 Oil Filter and Intake Pipe Installation

### Modulator-Modulator Valve

(1) Insert modulator valve into case bore with stem end of valve facing outward.

(2) Install modulator adapter and adapter retainer on case. Tighten attaching bolt to 18 foot-pounds (24 N•m) torque (fig. 2C-163).

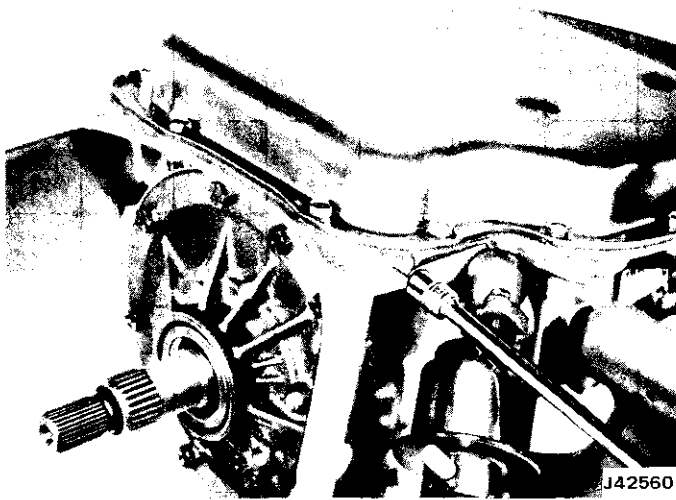
(3) Install O-ring seal on modulator and install modulator in adapter.

(4) Install modulator retainer and modulator-to-adapter attaching bolt. Tighten bolt to 18 foot-pounds (24 N•m) torque (fig. 2C-9).

### Governor

(1) Insert governor assembly into transmission case and mesh driven gear of governor with drive gear in case (fig. 2C-164).

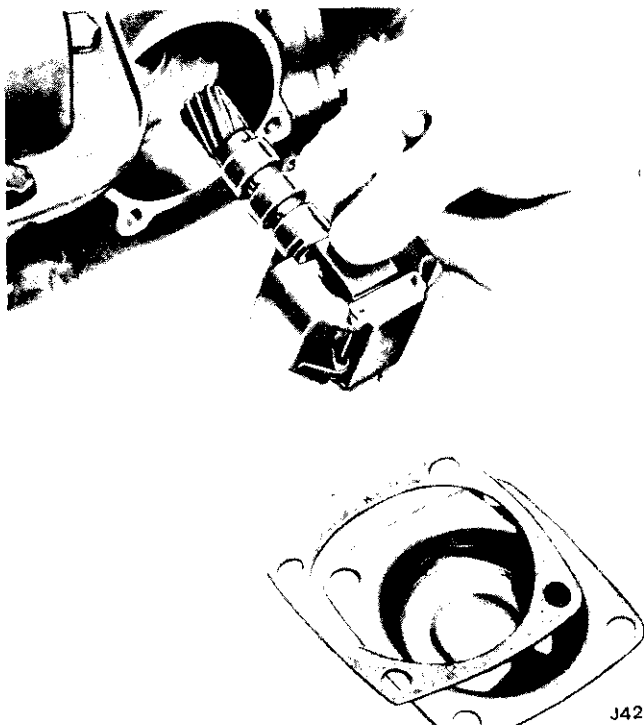
(2) Install gasket on governor cover and install cover on transmission case. Tighten cover bolts to 18 foot-pounds (24 N•m) torque.



**Fig. 2C-163 Modulator Adapter Retainer Installation**

**Extension Housing**

- (1) Position replacement gasket on extension housing.
- (2) Position extension housing and gasket on transmission and install housing attaching bolts.
- (3) Tighten housing attaching bolts to 20 foot-pounds (27 N•m) torque.
- (4) Install snap ring on bearing.
- (5) Slide bearing onto output shaft and start bearing into extension housing.
- (6) Seat bearing in housing using plastic tip hammer.



**Fig. 2C-164 Governor Installation**

**Transfer Case**

- (1) Install replacement extension housing-to-transfer case gasket.
- (2) Inspect transfer case output shaft seals. Replace seals if damaged.
- (3) Install transfer case on transmission. Tighten transfer case attaching bolts to 42 foot-pounds (57 N•m) torque.

**SPECIFICATIONS**

**Transmission Specifications**

Model . . . . .	400
Ratios:	
Low . . . . .	2.4815 to 1
Intermediate . . . . .	1.4815 to 1
High . . . . .	1 to 1
Reverse . . . . .	2.0769 to 1
Converter Stall Ratio . . . . .	2.4 to 1
Oil Capacity . . . . .	22 pt. (10.4 liters)
Modulator . . . . .	Vacuum Control
Converter Elements . . . . .	3
Cooling . . . . .	Water
Carrier Pinion End Play . . . . .	0.009 to 0.024 inch (0.22-0.60 mm)
Pump Face to Rotor End Play . . . . .	0.0008 to 0.0035 inch (0.02-0.07 mm)
Front Unit End Play . . . . .	0.003 to 0.024 inch (0.07-0.60 mm)
Bushing Clearance (Max.) . . . . .	0.008 inch (0.20 mm)

70520A

**Torque Specifications**

Service Set-To Torques should be used when assembling components.

	Metric (N•m)	USA (ft. lbs.)
	<b>Service Set-To Torque</b>	<b>Service Set-To Torque</b>
Case Center Support Bolt . . . . .	34	25
Control Valve Body Bolts . . . . .	14	10
Converter Dust Shield Screws . . . . .	11	8
Converter to Drive Plate Bolts . . . . .	41	30
Detent Solenoid Bolts . . . . .	14	10
Extension Housing Bolts . . . . .	27	20
Governor Cover Bolts . . . . .	27	20
Linkage Swivel Clamp Nut . . . . .	5	4
Manual Lever to Manual Shaft Nut . . . . .	11	8
Manual Shaft to Inside Detent Lever . . . . .	27	20
Modulator Retaining Bolt . . . . .	27	20
Oil Pan Attaching Bolts . . . . .	18	13
Parking Pawl Bracket Bolts . . . . .	27	20
Pump Cover Bolts . . . . .	27	20
Pump to Case Attaching Bolts . . . . .	27	20
Rear Servo Cover Bolts . . . . .	27	20
Transmission to Engine		
Mounting Bolts . . . . .	47	35
Transfer Case-to-Transmission Bolts . . . . .	57	42
Shift Lever-to-Manual Shaft Nut (metric nut) . . . . .	27	20

All torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified. Refer to the Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

70520B

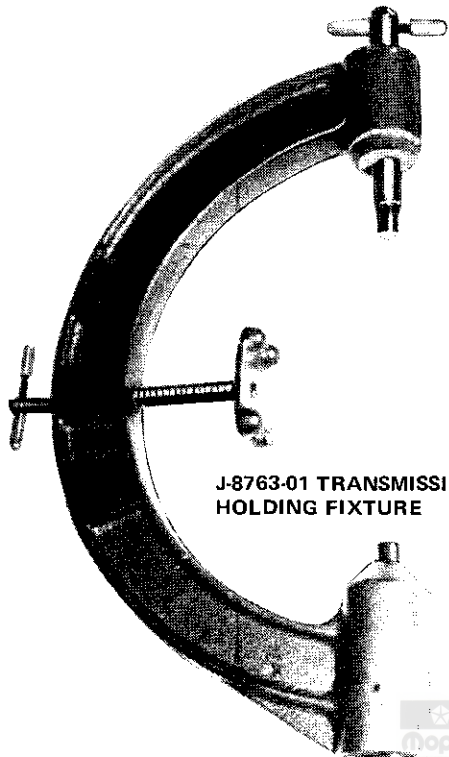
## 2G-80 AUTOMATIC TRANSMISSION

### Clutch Plate Application

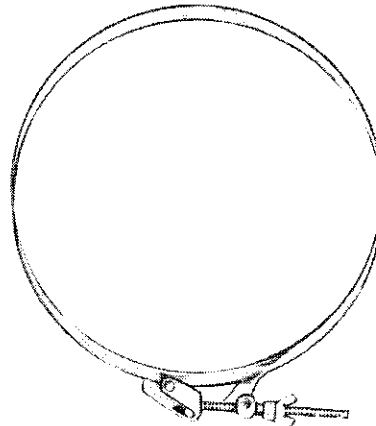
Series	Engine CID	Trans. Model	Forward Clutch			Direct Clutch			Intermediate Clutch		
			Flat Steel Plates*	Waved Steel Plates	Composition Plates	Flat Steel Plates	Waved Steel Plates	Composition Plates	Flat Steel Plates	Waved Steel Plates	Composition Plates
CJ-7	258	400-JC	3	1	4	3	1	4	2	1	3
	304	400-JS	3	1	4	3	1	4	2	1	3
Cherokee and Wagoneer	360	400-JM	3	1	4	4	1	5	2	1	3
J-10 Truck	258	400-JK	3	1	4	3	1	4	2	1	3
J-10 and J-20 Truck	360	400-JR	3	1	4	4	1	5	2	1	3

\*Forward clutch flat steel plates are all 0.0775 thick.

**Tools**

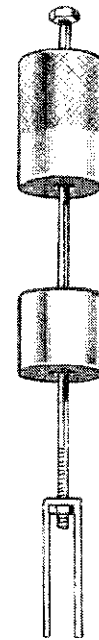


**J-8763-01 TRANSMISSION  
HOLDING FIXTURE**

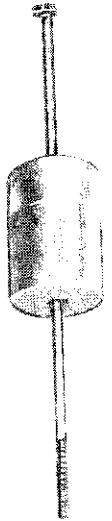


**J-21368 ALIGNMENT STRAP  
PUMP AND BODY**

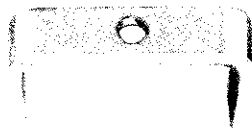
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INNER SEAL  
PROTECTOR**



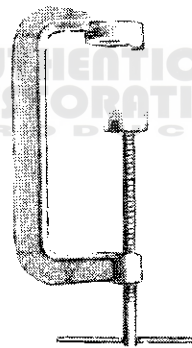
**J-21795  
GEAR ASSEMBLY  
REMOVING AND  
INSTALLING TOOL**



**J-25118 SLIDE  
HAMMERS**



**J-25149 DIRECT CLUTCH  
SPRING COMPRESSOR**



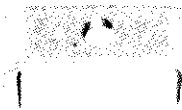
**J-21885 ACCUMULATOR PISTON  
RETAINER RING REMOVER-INSTALLER**



**J-21370-6 REAR BAND APPLY  
PIN SELECTOR FIXTURE**



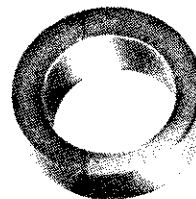
**J-21370-5 PIN-REAR BAND APPLY**



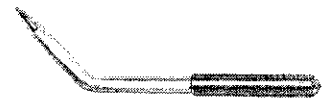
**J-25148 FORWARD CLUTCH  
SPRING COMPRESSOR**



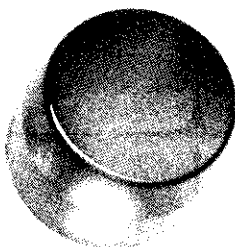
**J-24684  
COMPRESSOR TOOL**



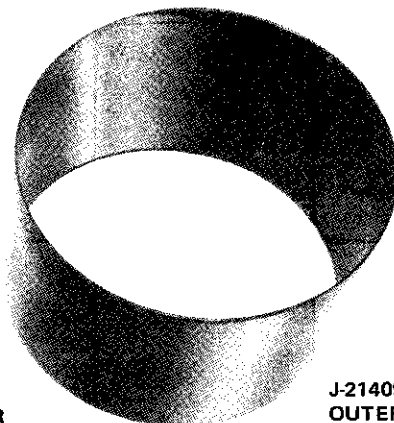
**J-21364  
REAR UNIT  
AND PUMP  
PROTECTOR  
HUB**



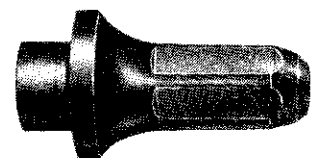
**J-23093 CENTER SUPPORT  
LOCATING TOOL**



**J-21362 FORWARD AND DIRECT  
CLUTCH INNER SEAL  
PROTECTOR**

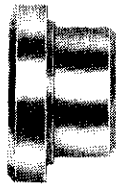


**J-21409 FORWARD CLUTCH  
OUTER SEAL PROTECTOR**

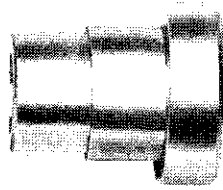


**J-21359 PUMP OIL SEAL  
DRIVER**

Tools (Continued)



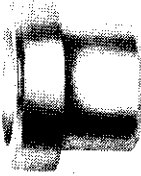
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INSTALLER



J-21465-3  
INSTALLER



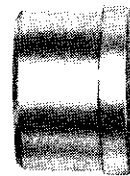
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ADAPTER



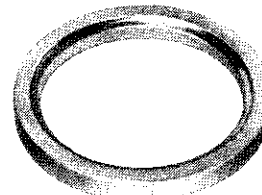
J-21465-5  
INSTALLER



J-8092  
DRIVER  
HANDLE



J-21465-8  
REMOVER  
INSTALLER



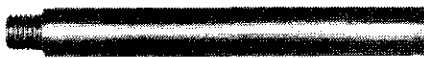
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ADAPTER RING



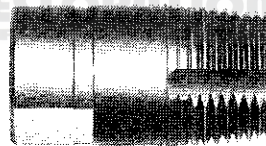
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STAKING TOOL



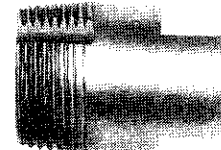
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REMOVER  
INSTALLER



J-21465-13  
DRIVER HANDLE  
EXTENSION



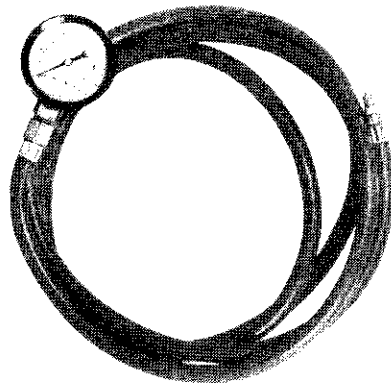
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REMOVER



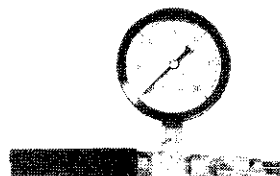
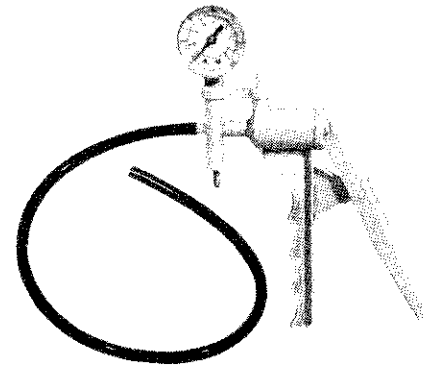
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REMOVER



J-21465-17  
REMOVER  
INSTALLER



J-5907  
OIL PRESSURE GAUGE



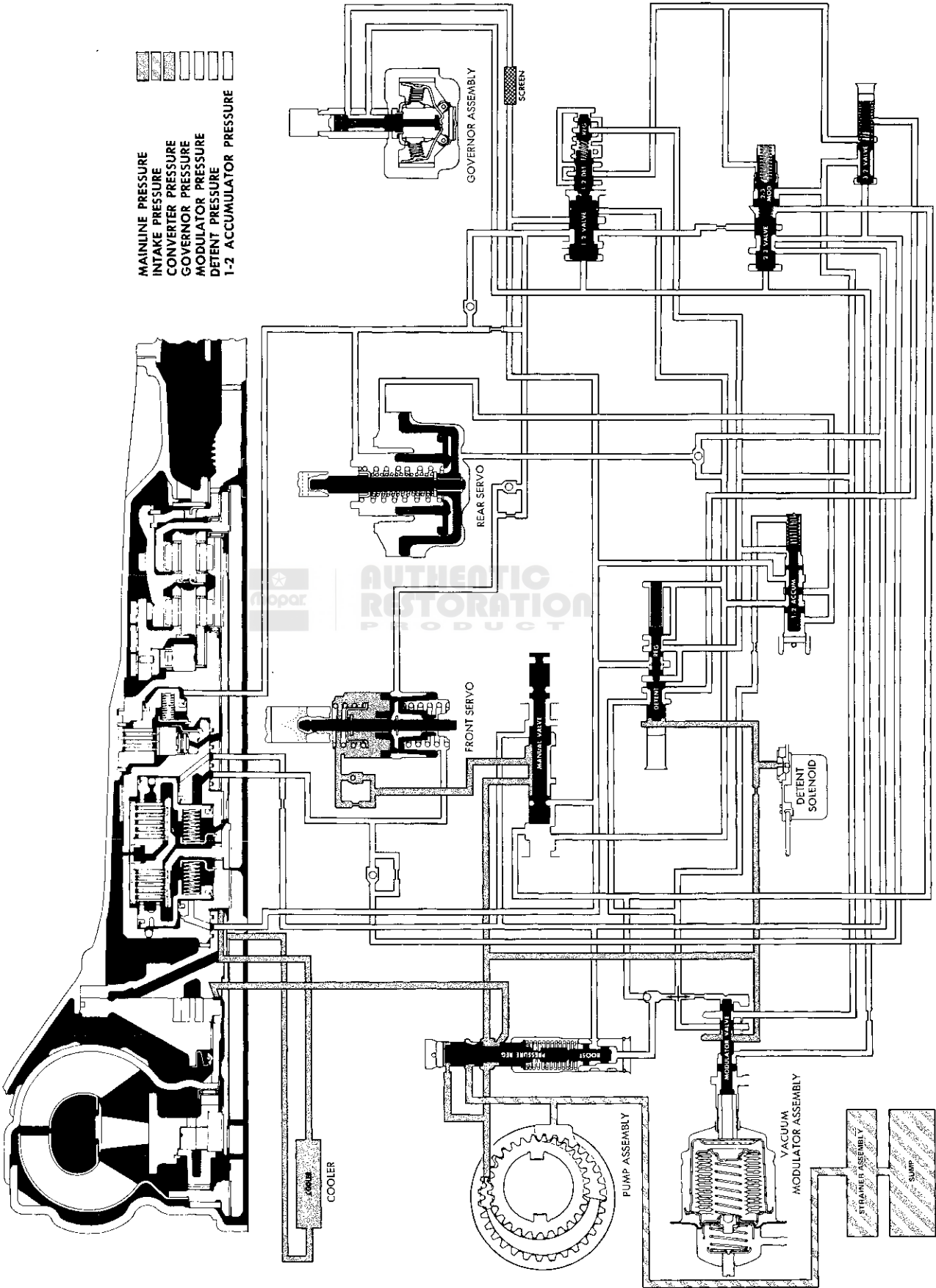
J-23108  
VACUUM GAUGE



# **HYDRAULIC FLOW CHARTS**

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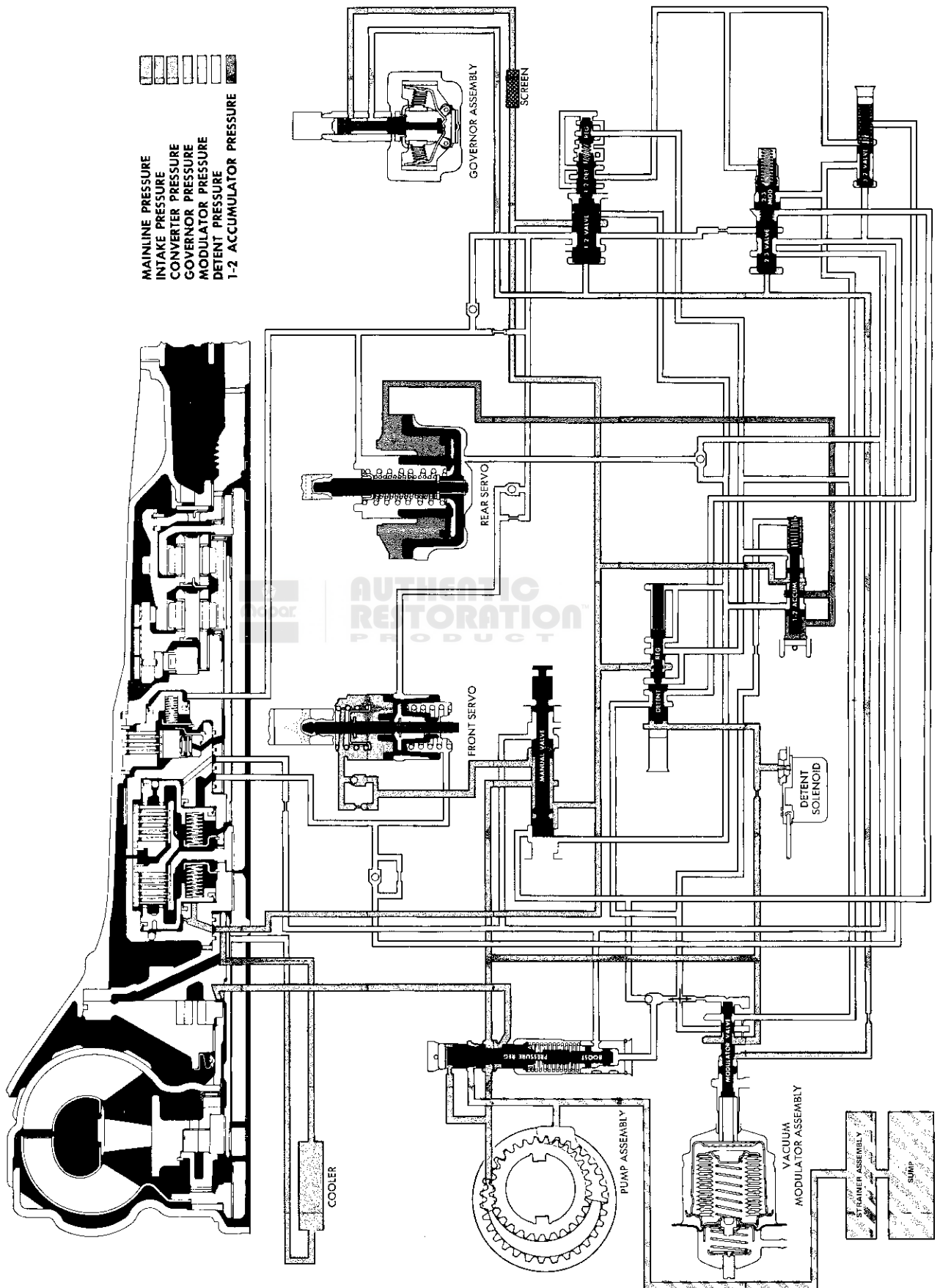


- MAINLINE PRESSURE
- INTAKE PRESSURE
- CONVERTER PRESSURE
- GOVERNOR PRESSURE
- MODULATOR PRESSURE
- DETENT PRESSURE
- 1-2 ACCUMULATOR PRESSURE

Hydraulic Flow Chart—NEUTRAL



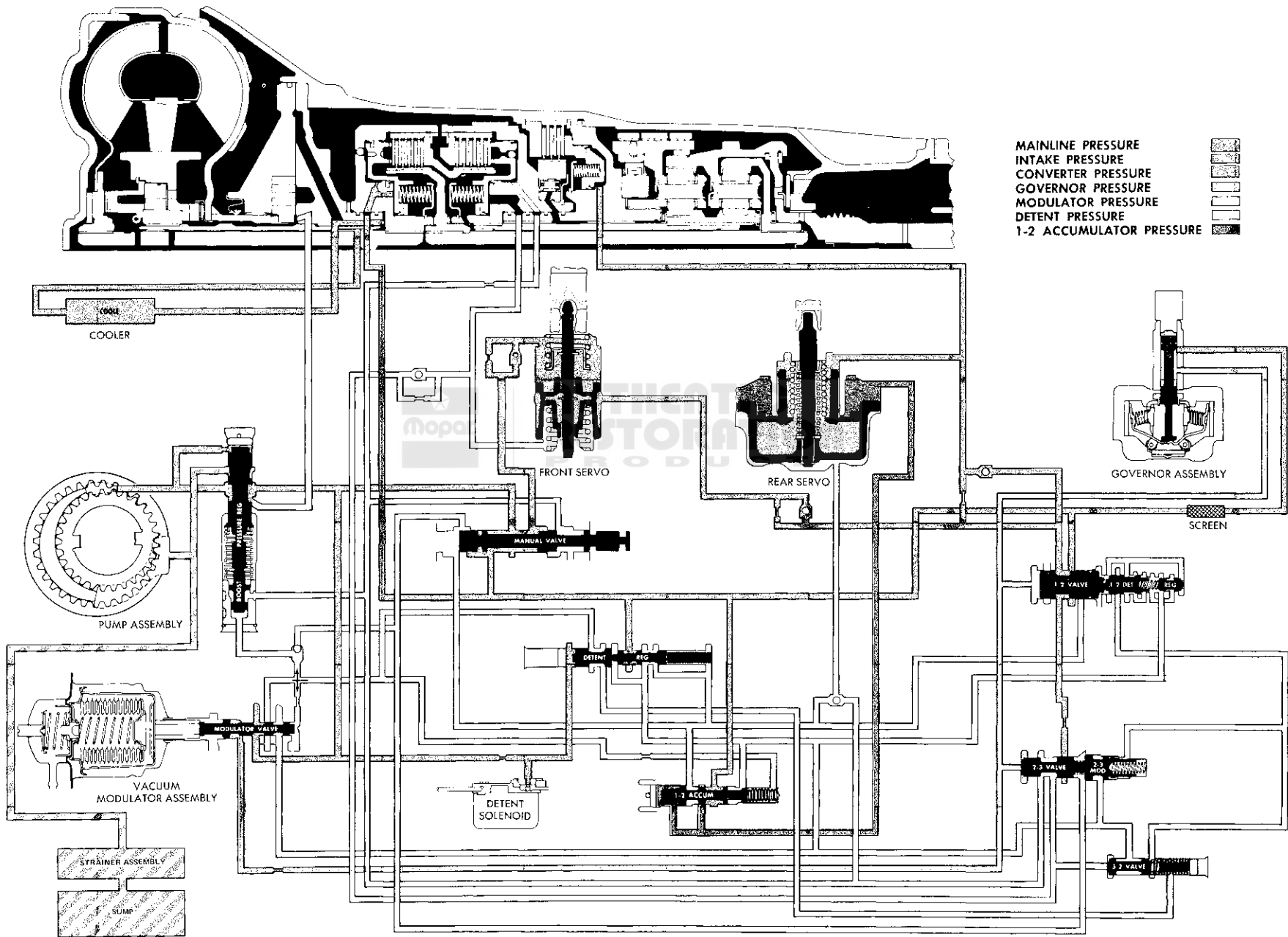
2C-86 AUTOMATIC TRANSMISSION



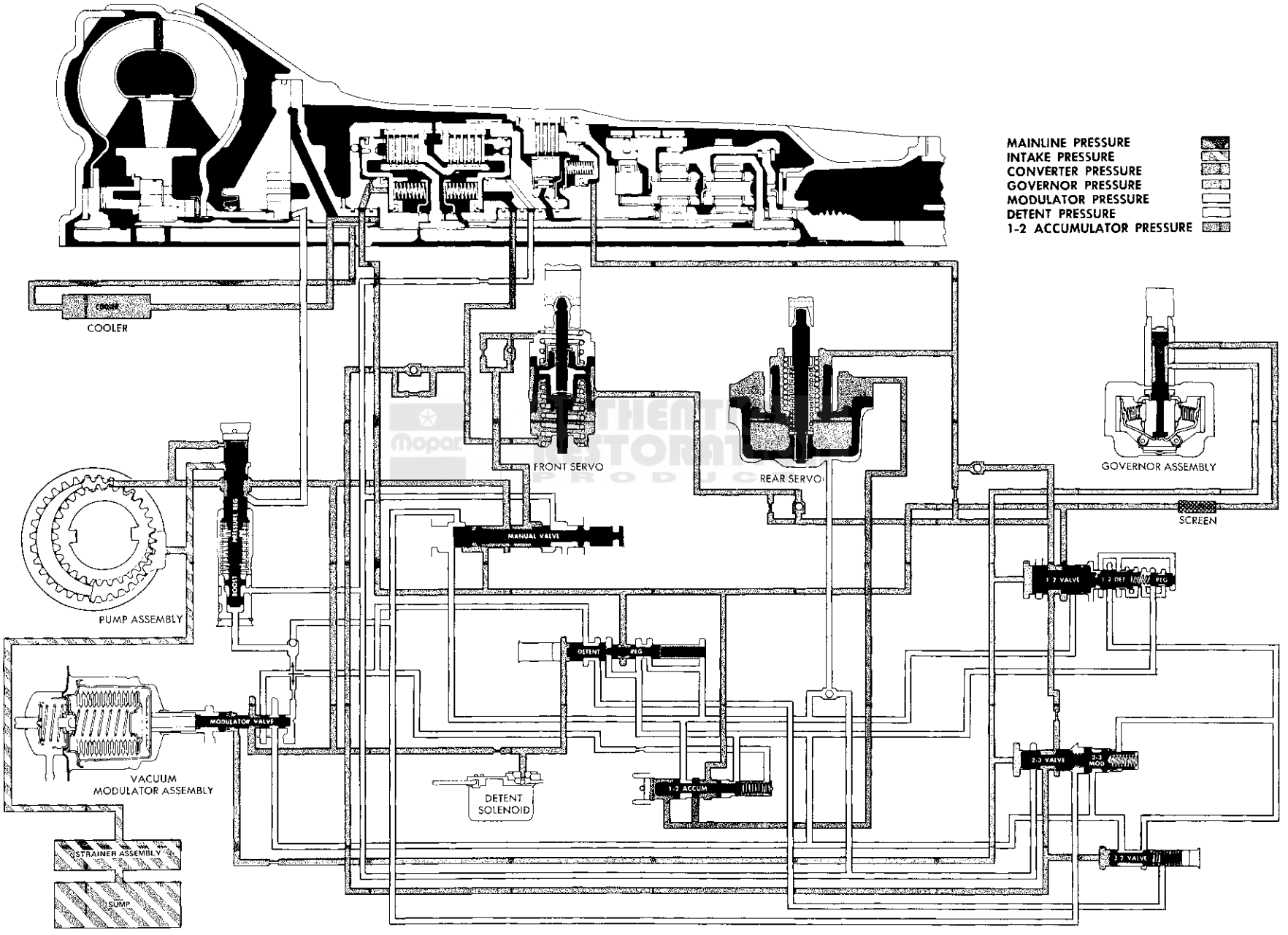
- MAINLINE PRESSURE
- INTAKE PRESSURE
- CONVERTER PRESSURE
- GOVERNOR PRESSURE
- MODULATOR PRESSURE
- DETENT PRESSURE
- 1-2 ACCUMULATOR PRESSURE

Hydraulic Flow Chart—DRIVE RANGE—FIRST GEAR

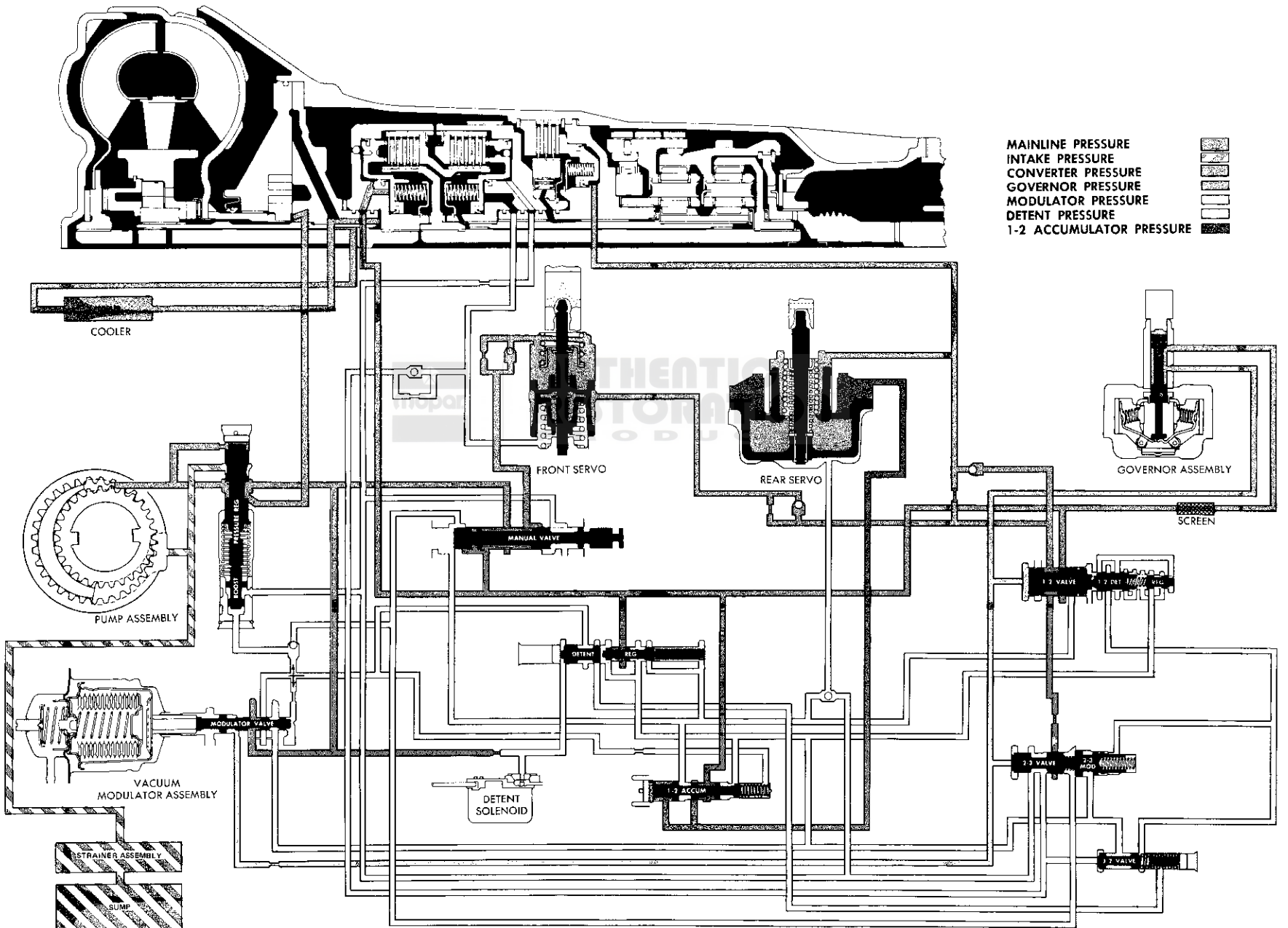
Hydraulic Flow Chart—DRIVE RANGE—SECOND GEAR



Hydraulic Flow Chart—DRIVE RANGE—THIRD GEAR

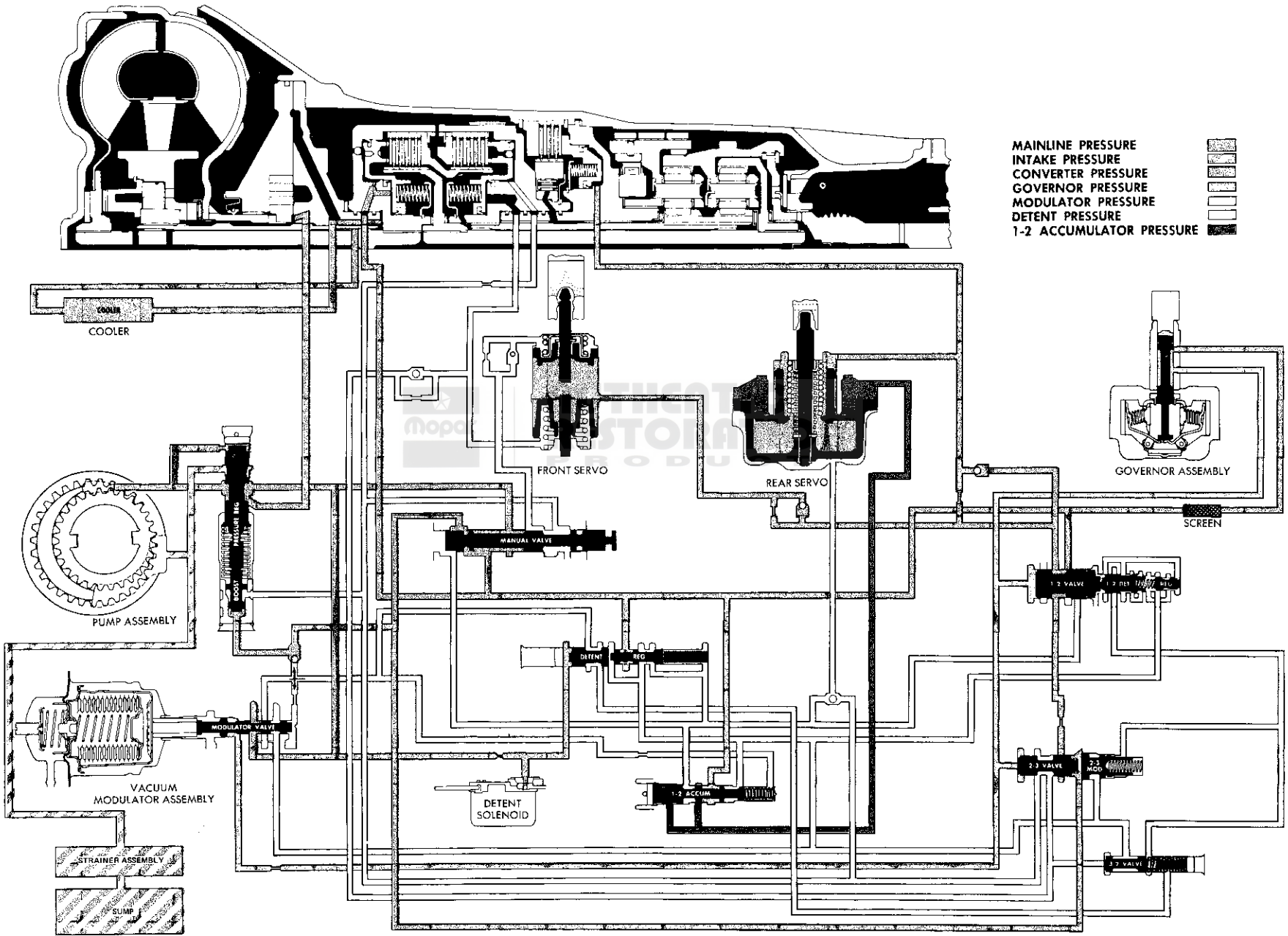


Hydraulic Flow Chart—DRIVE RANGE—3-2 DOWNSHIFT

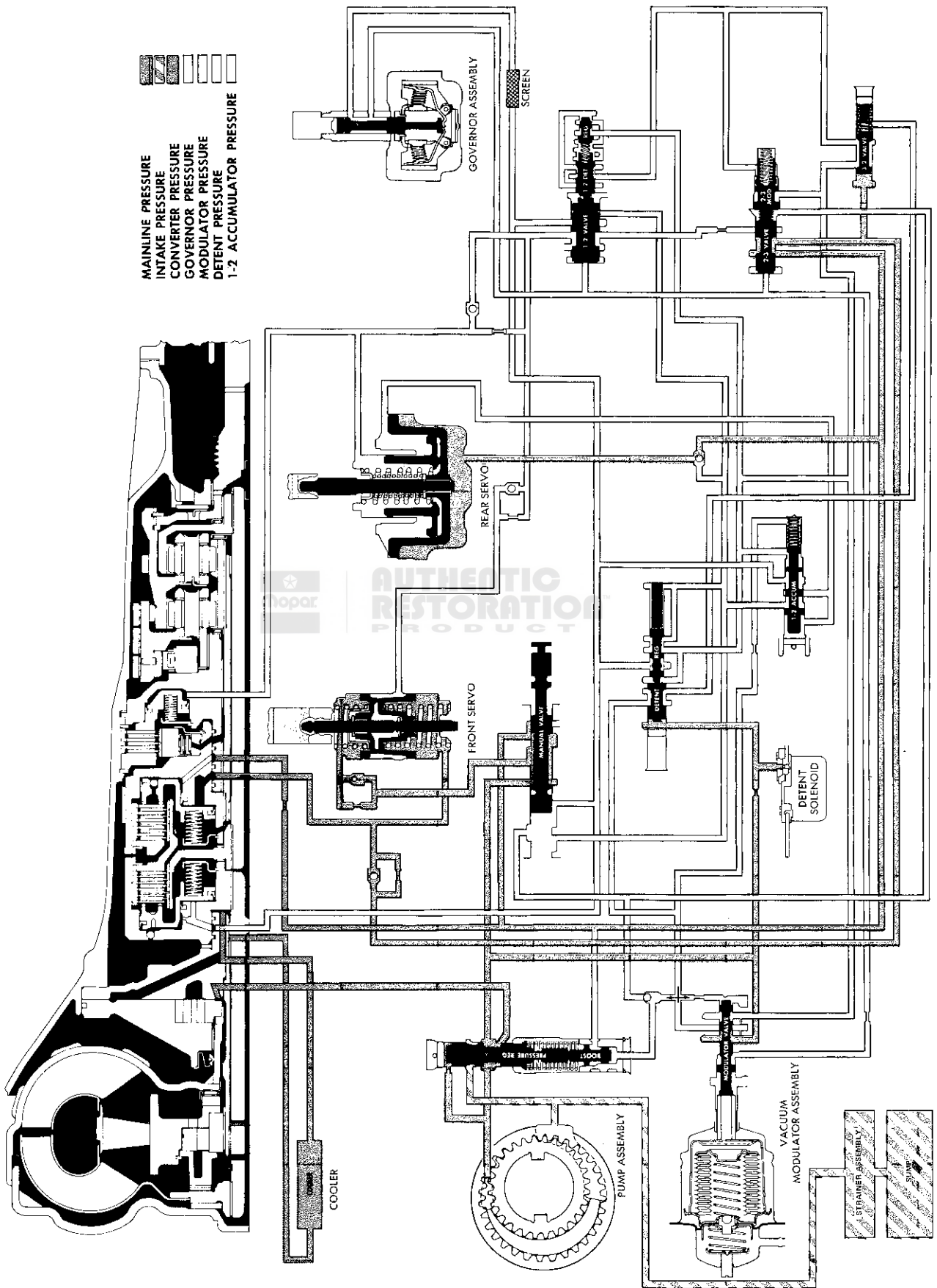




Hydraulic Flow Chart—2 RANGE—MANUAL SECOND GEAR



- MAINLINE PRESSURE
- INTAKE PRESSURE
- CONVERTER PRESSURE
- GOVERNOR PRESSURE
- MODULATOR PRESSURE
- DETENT PRESSURE
- 1-2 ACCUMULATOR PRESSURE



Hydraulic Flow Chart—REVERSE

# TRANSFER CASE

# 2D

## SECTION INDEX

	Page		Page
Model 20 Transfer Case	2D-1	Tools	2D-39
Quadra-Trac Transfer Case	2D-12		

## MODEL 20 TRANSFER CASE

	Page		Page
General	2D-1	Shift Control Case—Cherokee and Truck	2D-9
Identification	2D-1	Shift Linkage—CJ Models	2D-11
In-Vehicle Service	2D-3	Specifications	2D-11
Out-of-Vehicle Service	2D-6	Towing	2D-2
Power Flow	2D-1	Transfer Case Shift Sequence	2D-1
Service Diagnosis	2D-3		

### GENERAL

The Model 20 Transfer Case is a four position gearbox providing two gear ratios in four wheel drive, one ratio in two wheel drive, and a neutral position. Four wheel drive low provides a reduction ratio of 2.03:1 for off-road use and applications that require increased pulling power. Four wheel drive high and two wheel drive high both provide a 1:1 ratio in the transfer case. Neutral position is used for stationary power takeoff applications such as winching. In neutral, power is not transmitted to the wheels.

### IDENTIFICATION

An identification tag that displays the vendor and Jeep part numbers is attached to the intermediate shaft lockplate bolt. This information is necessary to obtain correct service replacement parts.

### POWER FLOW

Power flow through the transfer case in each position is shown in figures 2D-1 through 2D-4. The darkened areas of the illustrations show what gears are engaged in the various drive ranges.

### TRANSFER CASE SHIFT SEQUENCE

Transfer case shifting is controlled by a floor mounted lever located next to the transmission gearshift lever.

The lever is connected to the transfer case shift rods by a linkage and must be moved only through the shift sequence indicated on the shift knob (fig. 2D-5).

Lubricant circulates between the transfer case and transmission on all 3-speed manual transmissions.

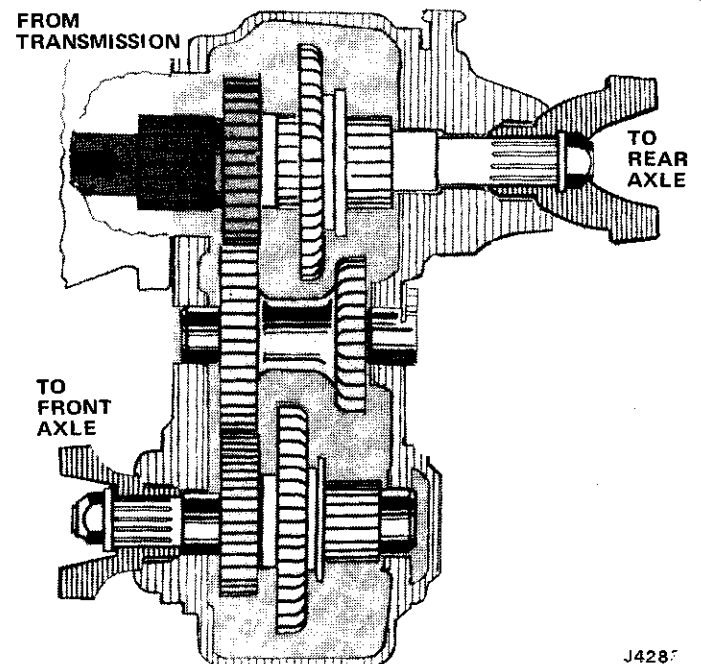


Fig. 2D-1 Neutral



## 2D-2 TRANSFER CASE

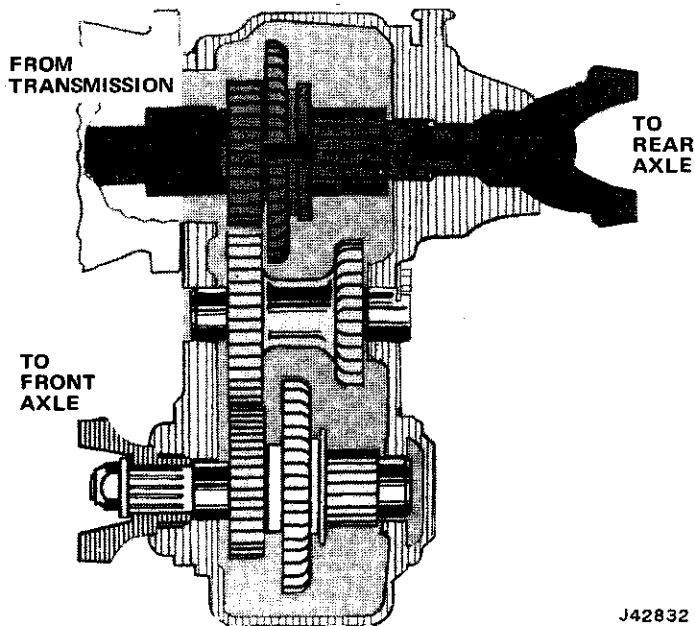


Fig. 2D-2 Two Wheel Drive High

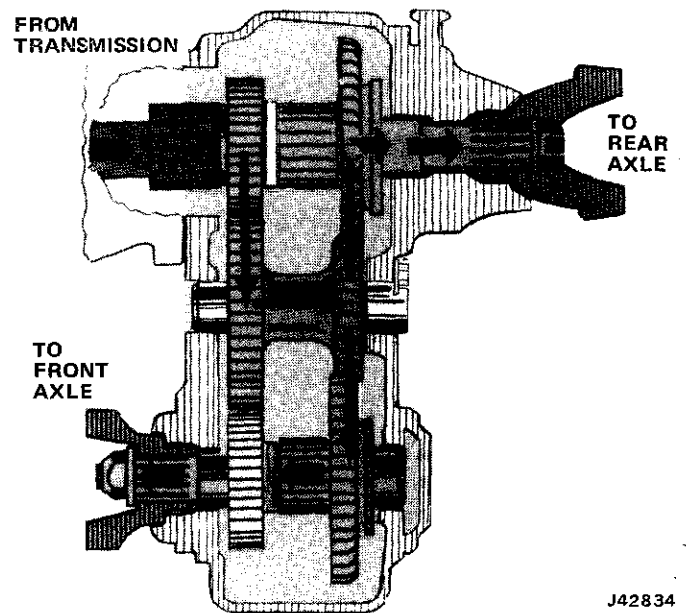


Fig. 2D-4 Four Wheel Drive Low

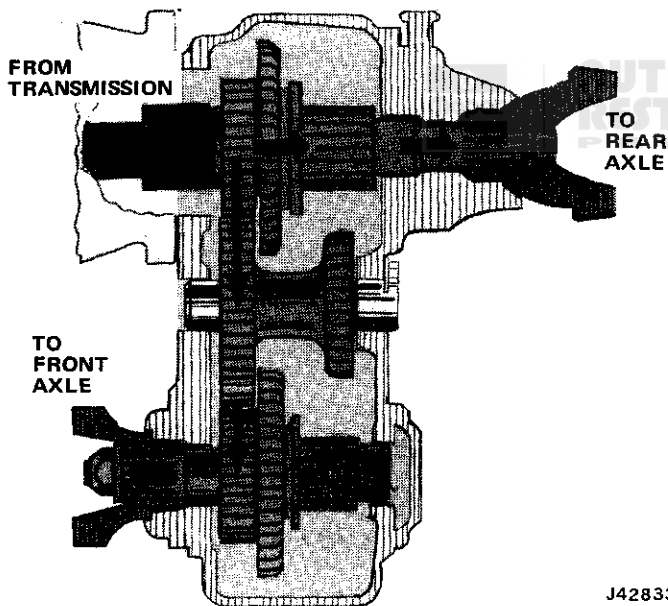
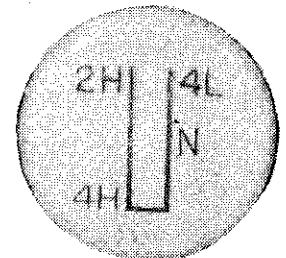


Fig. 2D-3 Four Wheel Drive High



CJ MODELS



CHEROKEE AND TRUCK

J42352

Fig. 2D-5 Transfer Case Shift Knob

## TOWING

If the vehicle is disabled and must be towed with the front wheels off the ground, towing speed and distance must be limited. Towing speed must not exceed 30 mph (48 km/h) for a distance no greater than 15 miles (24 km).

**Ignition Key Available:** Shift transmission and transfer case into Neutral. Vehicle can now be towed with all four wheels on the ground or with front or rear wheels raised. If vehicle is equipped with locking hubs, set them in LOCK position.

**Ignition Key Not Available and Vehicle is Unlocked:** Shift transmission and transfer case into Neu-

tral and tow vehicle with front wheels raised. Turn ignition key to Off position to unlock steering wheel.

**Ignition Key Not Available and Vehicle is Locked:** Place dolly under rear wheels and tow vehicle with front end raised. Or, disconnect rear propeller shaft at rear axle yoke (be sure to index mark propeller shaft and yoke for proper alignment at assembly), secure shaft to underside of vehicle, and tow with front end raised.

## Recreational Towing

Jeep vehicles can be towed behind a recreational vehicle such as a motor home, but be sure you comply with the following instructions to avoid damage to drivetrain components. Be sure to check federal, state, and local laws.

## Manual Transmission

- Turn ignition key to Off position to unlock steering wheel.
- Shift transmission and transfer case into Neutral position.
- Turn locking hubs to LOCK position, if equipped.

## Trailer Towing and Campers

The Jeep Corporation new vehicle warranty includes conditions and limitations for vehicles used in towing trailers or campers or installation of slide-in campers on Jeep Trucks. The requirements and recommendations in this manual and other factory literature must be followed in order to maintain this coverage.

In addition to the vehicle maintenance and servicing requirements set forth in this manual, the GVW and GAW ratings are of special significance. When a Jeep vehicle is to be used for trailer or camper towing or slide-in camper installations in Jeep Trucks, it is extremely important that the GVW or GAW ratings not be exceeded by the addition of:

- The tongue weight of a trailer.
- The weight transferred to a Truck model by the mounting of a fifth-wheel trailer.
- The weight of a slide-in camper or any other type of truck camper.
- The weight of any other type of vehicle put in or on the towing vehicle.

Remember that additional items placed in or on the trailer or mounted camper will add to the load.

**CAUTION:** *Jeep Corporation will not be responsible for brake performance if the Jeep vehicle and trailer hydraulic brake systems are interconnected in any way. A separate brake system is recommended, and actually required in some states, for all trailers weighing over 1,000 pounds (453.6 kg) gross.*

## IN-VEHICLE SERVICE

### Shift Rod Oil Seal Replacement

#### Cherokee-Truck

(1) On models with 3-speed transmission, shift transfer case into 2H position and remove shift lever knob and boot.

### Service Diagnosis—Model 20 Transfer Case

Condition	Possible Cause	Correction
JUMPS OUT OF 2 WD	(1) Mainshaft gear disengaged from rear output shaft sliding gear.	(1) Check torque on mainshaft gear nut.
	(2) Shift lever torsion spring not holding.	(2) Replace spring.
JUMPS OUT OF 4 WD HIGH	(1) Front output shaft sliding gear disengaged from front output shaft gear.	(1) Excessive end play, worn or bent shift fork.
	(2) Mainshaft gear disengaged from rear output shaft sliding gear.	(2) Check torque on mainshaft gear nut.
	(3) Shift lever torsion spring not holding.	(3) Replace torsion spring.
	(4) Rear shift rod poppet spring not holding.	(4) Replace poppet spring.

## 2D-4 TRANSFER CASE

(2) Remove bolts attaching transfer case shift housing to support tube and pull shift lever straight back to 4H position.

(3) Raise vehicle.

(4) On models with eight-cylinder engine, place support stand under transmission and remove rear crossmember.

(5) Disconnect front propeller shaft at transfer case yoke. Mark shaft and yoke for assembly alignment reference.

(6) Remove clevis pins connecting control links to transfer case shift rods.

(7) On models with 3-speed transmission, remove transfer case shift housing from support tube using brass drift and hammer.

(8) Remove shift rod seal using tool J-25175 (fig. 2D-6).

(9) Install replacement seal using Thimble and Driver Tools J-25167 (fig. 2D-7).

(10) On models with 3-speed transmission, install transfer case shift housing on support tube.

(11) Install clevis pins connecting control links to transfer case shift rods. Use replacement cotter pins to secure pins.

(12) Connect propeller shaft to transfer case yoke. Align shaft and yoke using alignment marks made during disassembly.

(13) On models with eight-cylinder engine, install rear crossmember and remove transmission support stand.

(14) Lower vehicle.

(15) On models with 3-speed transmission, install shift housing-to-support tube attaching bolts and install shift lever boot and knob.

### CJ Models

(1) If left-side shift rod seal is to be replaced, shift transfer case into 4L position.

(2) Raise vehicle.

(3) Remove clevis pins connecting control links to transfer case shift rods.

(4) Remove shift rod oil seal using tool J-25175 (fig. 2D-6).

(5) Install replacement seal using Thimble and Driver Tools J-25167 (fig. 2D-7).

(6) Install clevis pins connecting control links to transfer case shift rods. Use replacement cotter pins to secure pins.

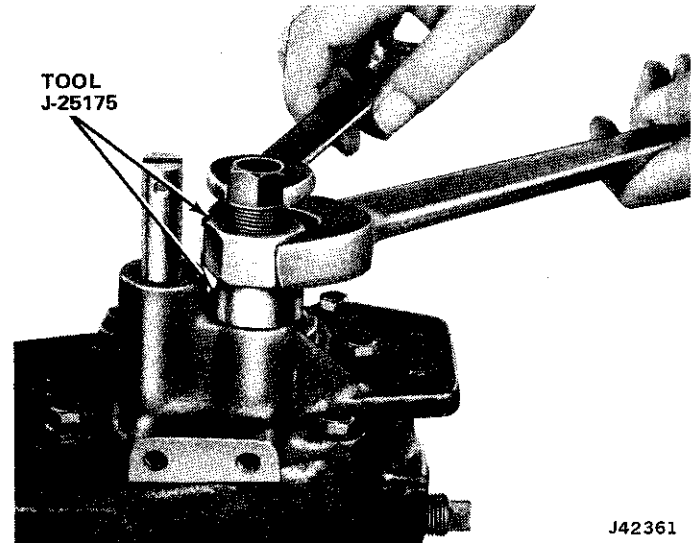
(7) Lower vehicle.

### Front-Rear Yoke Oil Seal Replacement

(1) Raise vehicle.

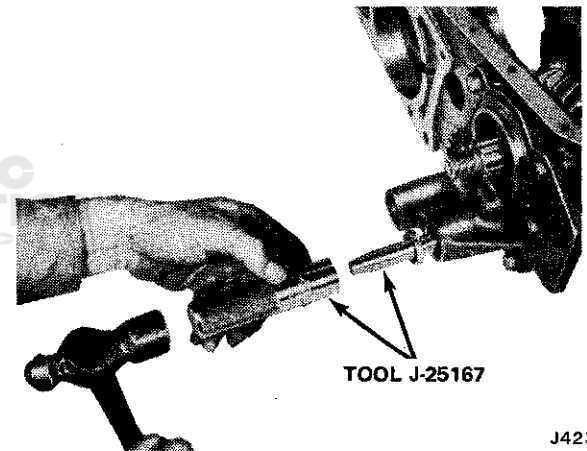
(2) Place support stand under transmission and remove rear crossmember.

(3) Disconnect front or rear propeller shaft at transfer case yoke. Place alignment marks on shaft and yoke for assembly reference before disconnecting shaft.



J42361

Fig. 2D-6 Shift Rod Oil Seal Removal



J42362

Fig. 2D-7 Shift Rod Oil Seal Installation

(4) Remove transfer case yoke nut and washer using tool J-8614-01 (fig. 2D-8).

(5) Remove transfer case yoke using tools J-8614-01,02,03 (fig. 2D-9).

(6) Remove oil seal using tool J-25180 (fig. 2D-10).

(7) Install replacement seal using tool J-25160.

(8) Install yoke, washer, and nut. Tighten nut to 140 foot-pounds (163 N•m) torque. Use tool J-8614-01 to hold yoke while tightening nut.

### Rear Bearing Cap-Speedometer Drive Gear Service

#### Removal

(1) Disconnect rear propeller shaft at transfer case yoke. Tie propeller shaft to frame with wire.

(2) Disconnect speedometer cable.

(3) Remove bearing cap-to-transfer case bolts and remove bearing cap.

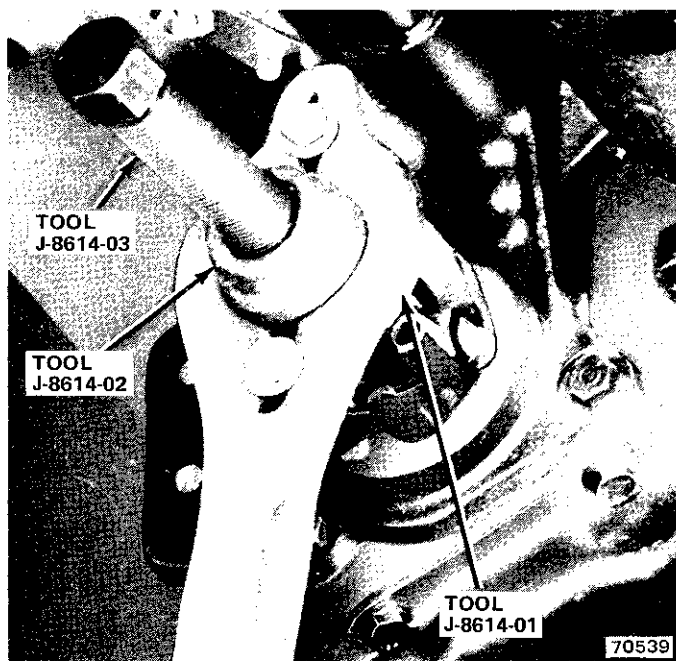


Fig. 2D-8 Output Shaft Nut Removal

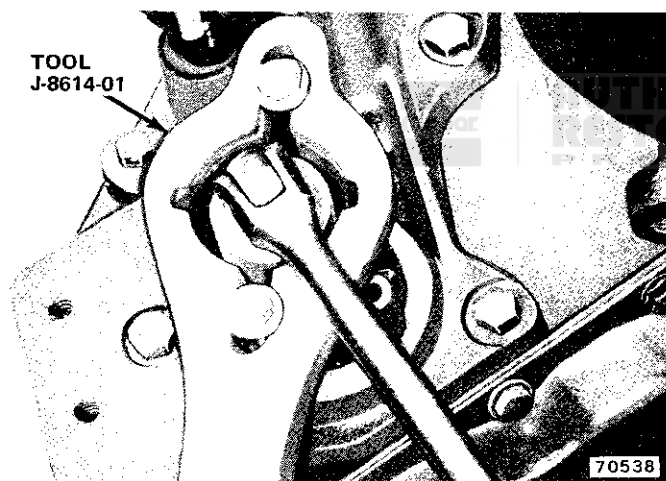


Fig. 2D-9 Yoke Removal

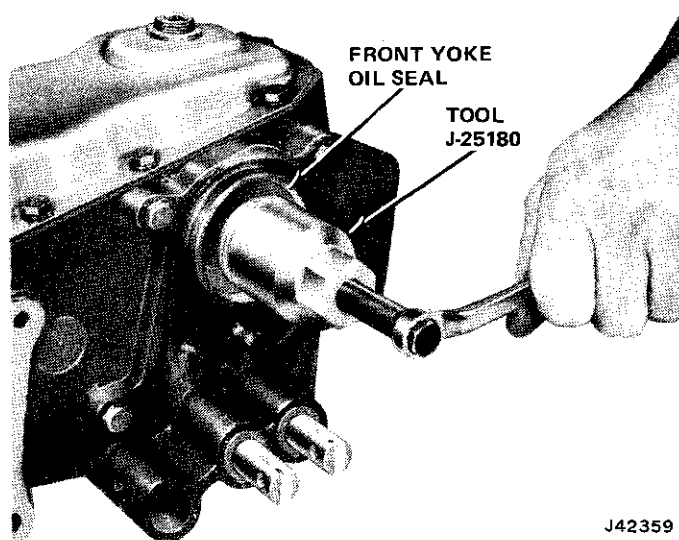


Fig. 2D-10 Yoke Oil Seal Removal

### Disassembly

- (1) Remove speedometer driven gear sleeve and driven gear from bearing cap.
- (2) Mount bearing cap assembly in vise.
- (3) Remove output shaft nut using Yoke Holding Wrench J-8614-01 (fig. 2D-8).
- (4) Remove yoke from shaft using tools J-8614-01,02,03 (fig. 2D-9).
- (5) Remove seal from bearing cap bore using tool J-25180 (fig. 2D-10).
- (6) Remove bearing cap assembly from vise, and using rear face of cap as support, drive output shaft from bearing cap using brass drift and hammer.
- (7) Lift tapered bearing and drive bearing cup out of bearing cap rear bore.
- (8) Drive front bearing cup from bearing cap front bore.
- (9) Remove speedometer drive gear and shims from shaft.

**NOTE:** *Keep the shims together for use in assembly.*

- (10) Remove front bearing from shaft.
- (11) If necessary, remove speedometer driven gear bushing from bearing cap.

### Assembly

- (1) If removed, install speedometer driven gear bushing using Bushing Installer Tool J-25169.
- (2) Install front bearing cup in bore.
- (3) Install front bearing on shaft.
- (4) Install rear bearing cup in bore.
- (5) Install speedometer drive gear and shims on shaft.
- (6) Place output shaft in bearing cap and place end of output shaft on firm surface.
- (7) Place rear cone and roller on output shaft and drive bearing onto shaft and seat it against shims.
- (8) Install yoke seal using tool J-25132.
- (9) Install yoke, flat washer, and nut. Tighten nut to 140 foot-pounds (163 N•m) torque. Use tool J-8614-01 to hold yoke while tightening nut.
- (10) Clamp dial indicator onto bearing cap and position indicator against output shaft (fig. 2D-11).
- (11) Pry output shaft back and forth to check end play. End play should be 0.002 to 0.005 inch (0.05 to 0.12 mm).
- (12) If end play is excessive, it can be corrected by removing shims between speedometer drive gear and output shaft front bearing.
- (13) Place speedometer driven gear in bearing cap and install driven gear sleeve.

### Installation

- (1) Install bearing cap and install bearing cap-to-transfer case bolts. Tighten bolts to 30 foot-pounds (41 N•m) torque.

## 2D-6 TRANSFER CASE

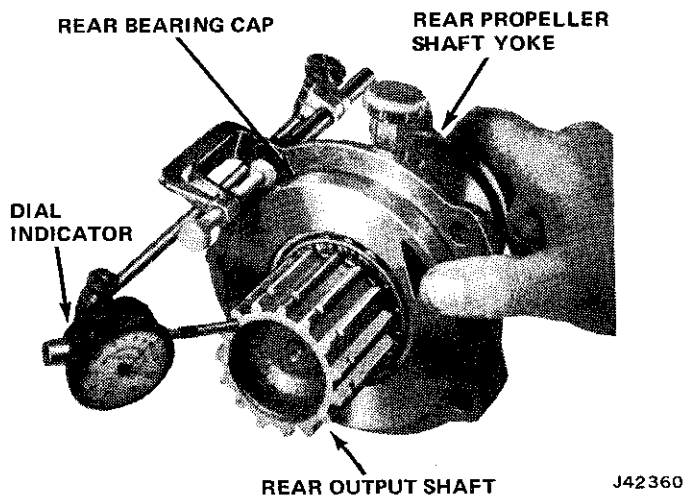


Fig. 2D-11 Measuring Rear Bearing Cap End Play

(2) Connect speedometer cable.

(3) Connect propeller shaft to yoke and tighten U-bolts to 15 foot-pounds (20 N•m) torque. If equipped with ball and trunnion-type propeller shaft, tighten flange bolts to 30 foot-pounds (41 N•m) torque.

### OUT-OF-VEHICLE SERVICE

#### Transfer Case Removal—All Models

(1) Remove shift lever knob, trim ring, and boot from transmission and transfer case shift levers.

(2) Remove floor covering, if equipped, and remove transmission access cover from floorpan.

(3) Raise vehicle and drain lubricant from transfer case. On CJ models, drain transmission lubricant also.

(4) Disconnect torque reaction bracket from crossmember, if equipped.

(5) On CJ models, position support stand under clutch housing to support engine and transmission and remove rear crossmember.

(6) Disconnect front and rear propeller shafts at transfer case. Mark propeller shaft yokes for assembly reference.

(7) Disconnect speedometer cable at transfer case.

(8) On Cherokee and Truck models, disconnect parking brake cable at equalizer and disconnect exhaust pipe support bracket at transfer case.

(9) Remove bolts attaching transfer case to transmission and remove transfer case. Remove transfer case gasket.

**NOTE:** One transfer case attaching bolt must be removed from the front end of the case. This bolt is located at the bottom right corner of the transmission.

#### Transfer Case Installation

(1) Install transmission-to-transfer case gasket on transmission.

(2) Shift transfer case to 4L position.

(3) Install a 3/8-16 by 4 inch (10.1 cm) long dowel pin at each side of transmission to assist in guiding transfer case into place during installation.

(4) Position transfer case on dowel pins.

(5) Rotate transfer case output shaft (by turning yoke) until transmission main shaft gear engages transfer case rear output shaft sliding gear. Move transfer case forward until case seats against transmission.

**CAUTION:** Be sure the transfer case is flush against the transmission. Severe damage to the transfer case will result if the attaching bolts are tightened while the transfer case is cocked or in a bind.

(6) Install two transfer case attaching bolts but do not tighten completely.

(7) Remove dowel pins and install remaining transfer case attaching bolts. Tighten all bolts to 30 foot-pounds (41 N•m) torque.

(8) On CJ models, fill transmission and transfer case with SAE 90W gear lubricant, grade API GL-4.

(9) On Cherokee and Truck models, check and correct transmission fluid level as necessary. If fluid must be added, use SAE 90W gear lubricant, grade API GL-4.

(10) Connect speedometer driven gear to transfer case.

(11) Connect front and rear propeller shafts to transfer case. Be sure to align shafts-to-yokes using reference marks made during removal. Tighten shaft-to-yoke clamp strap nuts to 15 foot-pounds (20 N•m) torque. If equipped with ball and trunnion-type propeller shaft, tighten flange bolts to 30 foot-pounds (41 N•m) torque.

(12) On CJ models, install rear crossmember and remove support stand from under clutch housing.

(13) On Cherokee and Truck models, connect parking brake cable to equalizer and connect exhaust pipe support bracket to transfer case.

(14) Connect torque reaction bracket, if equipped.

(15) Lower vehicle.

(16) Install transmission access cover plate on floorpan. Install floor covering if equipped.

(17) Install boots, trim rings, and shift knobs.

#### Transfer Case Disassembly

(1) Remove shift lever assembly.

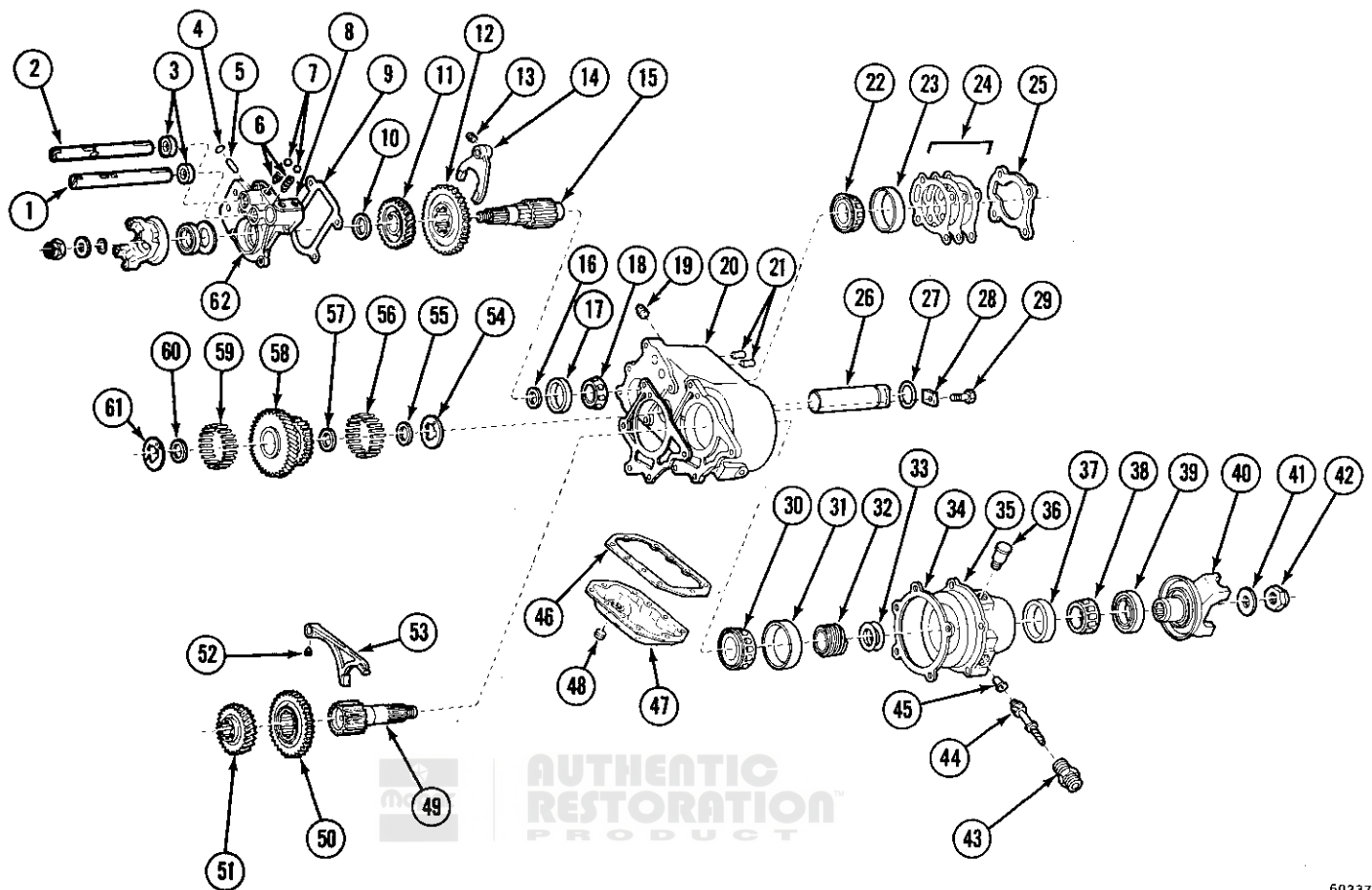
(2) Remove bottom cover and gasket (fig. 2D-12).

(3) Remove bolts attaching rear bearing cap assembly to transfer case and remove assembly (fig. 2D-12).

**NOTE:** Refer to Rear Bearing Cap-Speedometer Drive Gear Service for overhaul procedures.

(4) Remove intermediate shaft lock plate (fig. 2D-12).

(5) Tap intermediate shaft out rear of case using Arbor Tool J-25142 and plastic mallet (fig. 2D-13).



- 1. SHIFT ROD - REAR OUTPUT SHAFT SHIFT FORK
- 2. SHIFT ROD - FRONT OUTPUT SHAFT SHIFT FORK
- 3. SHIFT ROD OIL SEAL
- 4. INTERLOCK PLUG
- 5. INTERLOCK
- 6. POPPET BALL SPRING
- 7. POPPET BALL
- 8. FRONT BEARING CAP
- 9. FRONT BEARING CAP GASKET
- 10. FRONT OUTPUT SHAFT THRUST WASHER
- 11. FRONT OUTPUT SHAFT GEAR
- 12. FRONT OUTPUT SHAFT SLIDING GEAR
- 13. SETSCREW
- 14. FRONT OUTPUT SHAFT SHIFT FORK
- 15. FRONT OUTPUT SHAFT
- 16. FRONT OUTPUT SHAFT SPACER
- 17. FRONT OUTPUT SHAFT FRONT BEARING CUP
- 18. FRONT OUTPUT SHAFT FRONT BEARING
- 19. FILLER PLUG
- 20. TRANSFER CASE
- 21. THIMBLE COVER
- 22. FRONT OUTPUT SHAFT REAR BEARING
- 23. FRONT OUTPUT SHAFT REAR BEARING CUP
- 24. FRONT OUTPUT SHAFT REAR BEARING CUP SHIMS
- 25. COVER PLATE
- 26. INTERMEDIATE SHAFT
- 27. INTERMEDIATE SHAFT O-RING
- 28. LOCK PLATE
- 29. LOCK PLATE BOLT
- 30. REAR OUTPUT SHAFT FRONT BEARING

- 31. REAR OUTPUT SHAFT FRONT BEARING CUP
- 32. SPEEDOMETER DRIVE GEAR
- 33. REAR OUTPUT SHAFT BEARING SHIM
- 34. REAR BEARING CAP GASKET
- 35. REAR BEARING CAP
- 36. BREATHER
- 37. REAR OUTPUT SHAFT REAR BEARING CUP
- 38. REAR OUTPUT SHAFT REAR BEARING
- 39. REAR BEARING CAP OIL SEAL
- 40. REAR YOKE
- 41. REAR YOKE WASHER
- 42. REAR YOKE NUT
- 43. SPEEDOMETER SLEEVE
- 44. SPEEDOMETER DRIVEN GEAR
- 45. SPEEDOMETER BUSHING
- 46. BOTTOM COVER GASKET
- 47. BOTTOM COVER
- 48. DRAIN PLUG
- 49. REAR OUTPUT SHAFT
- 50. REAR OUTPUT SHAFT SLIDING GEAR
- 51. MAINSHAFT GEAR
- 52. SETSCREW
- 53. REAR OUTPUT SHAFT SHIFT FORK
- 54. INTERMEDIATE GEAR THRUST WASHER
- 55. INTERMEDIATE GEAR BEARING SPACER
- 56. INTERMEDIATE GEAR SHAFT NEEDLE BEARINGS
- 57. INTERMEDIATE GEAR BEARING SPACER
- 58. INTERMEDIATE GEAR
- 59. INTERMEDIATE GEAR SHAFT NEEDLE BEARINGS
- 60. INTERMEDIATE GEAR BEARING SPACER
- 61. INTERMEDIATE GEAR THRUST WASHER
- 62. FRONT BEARING CAP

Fig. 2D-12 Model 20 Transfer Case

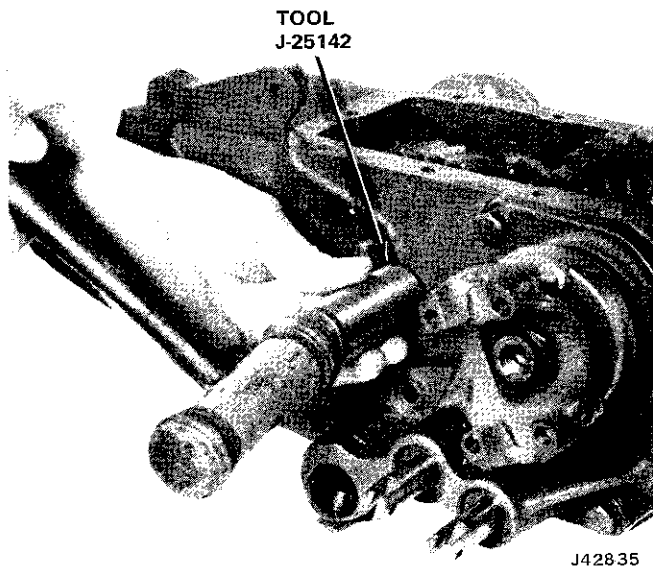


Fig. 2D-13 Intermediate Shaft Removal

(6) Align Arbor Tool J-25142 in intermediate gear assembly and remove gear assembly and thrust washers.

(7) Remove front output shaft nut and washer (fig. 2D-8).

(8) Remove front output shaft yoke (fig. 2D-9).

(9) Remove front oil seal using tool J-25180 (fig. 2D-10).

(10) Remove cover plate attaching screws and remove cover.

**CAUTION:** When removing the cover plate, do not damage the gaskets and shims.

(11) Remove front output shaft rear bearing.

(12) Move rear output shaft shift rod rearward.

(13) Remove rear output shaft shift fork setscrew.

(14) Remove poppet ball and spring plugs.

(15) Insert punch through pin hole in rear output shaft shift rod, rotate rod 1/4-turn counterclockwise, and pull rod out of case.

**NOTE:** When the shift fork is free of the rod, do not lose the shift rod poppet ball and spring.

(16) Remove front bearing cap attaching bolts and slide bearing cap off transfer case and shift rod.

(17) Remove rear output shaft sliding gear and shift fork.

(18) Support transfer case on wood blocks.

(19) Drive front output shaft out rear of case using hammer and brass drift.

(20) Remove gears, spacer, and bearing from case.

(21) Remove front output shaft shift fork setscrew.

(22) Pull shift rod out of shift fork.

(23) Remove shift rod thimbles using 3/8 drive, 7/16 socket and extension.

(24) Remove arbor tool, thrust washers, spacers, and roller bearings from intermediate gear.

(25) Remove front output shaft front bearing cup using brass drift and hammer.

(26) Remove shift rod seals from housing using tool J-25175.

(27) Remove front output shaft rear bearing. Use sliding gear as support. Mount gear in vise with shaft lever groove facing downward. Insert shaft through gear splines and drive shaft out of bearing using brass drift and hammer.

### Cleaning and Inspection

Clean the case and components with solvent. Remove all gasket material from gasket surfaces and dry all components completely using compressed air.

Inspect the bearings, thrust washers, shafts and gears for excessive wear, pitting, or scoring. Replace any part that is damaged or worn.

### Assembly

(1) Install front output shaft front bearing cup in case. Seat cup flush with exterior surface of case.

(2) Install shift rail thimbles.

(3) Install front bearing cap. Tighten attaching bolts to 30 foot-pounds (41 N•m) torque.

(4) Support front output shaft rear bearing on 1-1/4, 1/2 drive socket and install shaft into bearing using brass drift and hammer.

(5) Install front output shaft shift rail poppet ball and spring.

(6) Compress ball and spring and install front output shaft rod part way into case.

(7) Install and position front output shaft shift fork so setscrew offset faces front of case.

(8) Insert front output shaft shift rod through shift fork.

(9) Align setscrew holes in fork and rod and install setscrew. Tighten setscrew to 14 foot-pounds (19 N•m) torque.

(10) Install front output shaft front bearing, bearing spacer, front output shaft sliding gear, and front output shaft gear. Be sure shift fork groove in sliding gear faces rear of case.

(11) Install front output shaft through gears, spacer, and bearing.

(12) Support case on wood blocks and drive front output shaft into front housing using brass drift and hammer. Be sure bearing is seated against shoulder on front output shaft.

(13) Install front output shaft rear bearing cup using wood block and hammer.

(14) Install rear bearing, cover plate, and shims. Tighten cover plate bolts to 30 foot-pounds (41 N•m) torque.

(15) Check front output shaft end play as follows (fig. 2D-14):

(a) Seat rear bearing cup against cover plate by striking end of front output shaft with lead hammer.

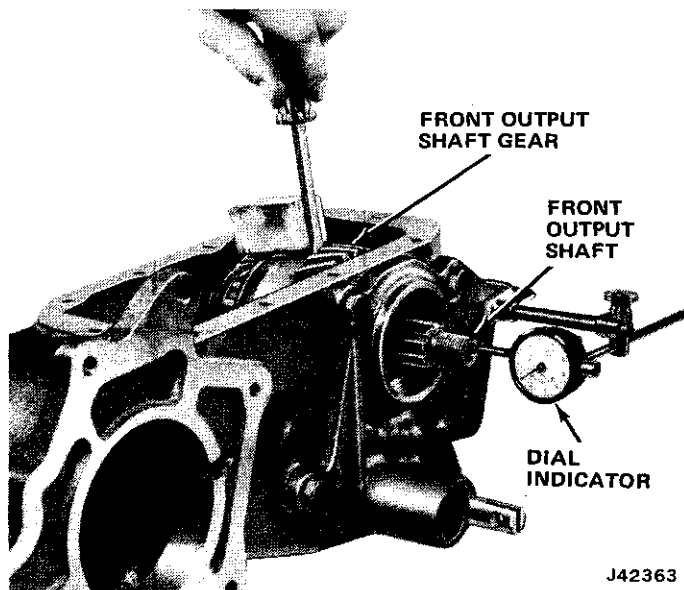


Fig. 2D-14 Checking Front Output Shaft End Play

(b) Mount dial indicator on front bearing cap and position indicator stylus against end of output shaft.

(c) Pry shaft rearward and zero dial indicator.

(d) Pry shaft forward and observe dial indicator reading. End play should be 0.002 to 0.005 inch (0.05 to 0.12 mm). If necessary, adjust end play by adding or removing shims between cover plate and case. If shims are added, seat rear bearing cup as outlined in step (a) before checking end play.

(16) Install rear output shaft shift rail poppet ball and spring in shift rod housing.

(17) Compress ball and spring and install rear output shaft shift rail part way in case.

**NOTE:** Before installing shift rail, be sure front output shaft shift rail is in Neutral and that interlock is seated in housing bore.

(18) Install rear output shaft shift fork and sliding gear. Be sure shift fork groove in gear faces rear of case.

(19) Align setscrew holes in fork and rail and install setscrew. Tighten setscrew to 14 foot-pounds (19 N•m) torque.

(20) Assemble intermediate gear rollers and spacers using Arbor Tool J-25142.

(21) Install intermediate gear thrust washers in case. Be sure washer tangs are aligned with grooves in case.

**NOTE:** The rear washer can be held in place by starting the intermediate shaft into the case and positioning the washer on the shaft. Hold the front washer in position using petroleum jelly.

(22) Install O-ring on intermediate shaft and insert intermediate gear in case.

(23) Insert intermediate shaft into case bore. Tap shaft into intermediate gear until shaft forces Arbor

Tool J-25142 out front of case. Use plastic or rawhide mallet or lead hammer only to tap shaft into place.

(24) Install intermediate shaft lock plate, identification tag, lockwasher, and lockplate bolt. Tighten bolt to 14 foot-pounds (19 N•m) torque.

(25) Position replacement rear bearing cap gasket on case.

(26) Install rear bearing cap assembly and slide rear output shaft through gear. Tighten bearing cap bolts to 30 foot-pounds (41 N•m) torque.

(27) Install replacement front yoke seal using tool J-25132.

(28) Install front propeller shaft yoke and tighten locknut to 140 foot-pounds (163 N•m) torque. Use tool J-8614-01 to hold yoke while tightening nut.

(29) Install bottom cover and gasket. Tighten bolts to 14 foot-pounds (19 N•m) torque.

(30) Install shift rod oil seals using Tool Set J-25167.

## SHIFT CONTROL CASE—CHEROKEE AND TRUCK

The control case shift rods are connected to the transfer case shift rods through nonadjustable links (fig. 2D-15). The lever assembly is mounted on a support tube attached to the transfer case. The support tube has locating holes drilled in it to maintain alignment of the transfer case, support tube, and lever assembly.

Refer to figure 2D-16 for shift control lever and rod position in relation to the transfer case gears in 2H, 4H, and 4L positions.

In 2H, the inner rail is fully forward, the pawl on the outer rail is to the rear of the inner rail slot, and the torsion spring legs are in the inner rail notches.

In 4H, the inner rail is fully forward, the pawl on the outer rail is to the rear of the inner rail slot, and torsion spring legs are in the inner rail notches. The shift lever ball is forward and the shift lever pin is engaged in the pawl slot. The outside rail is in the forward position.

In 4L, both rails are moved fully rearward, the pawl is to the front of the inner rail slot, the shift lever ball is in (and to the rear of) the inner rail slot, and the spring legs are out of the notches. The pin on the shift lever is disengaged from the slot in the pawl.

## Removal

(1) Remove shift lever, knob, trim ring, and boot.

(2) Remove clevis pins attaching control case shift rods to shift rod links.

(3) Remove control-case-to-support-tube attaching screws and remove control case.

**NOTE:** On vehicles with eight-cylinder engine and 4-speed transmission, the transfer case must be removed in order to remove the control case.





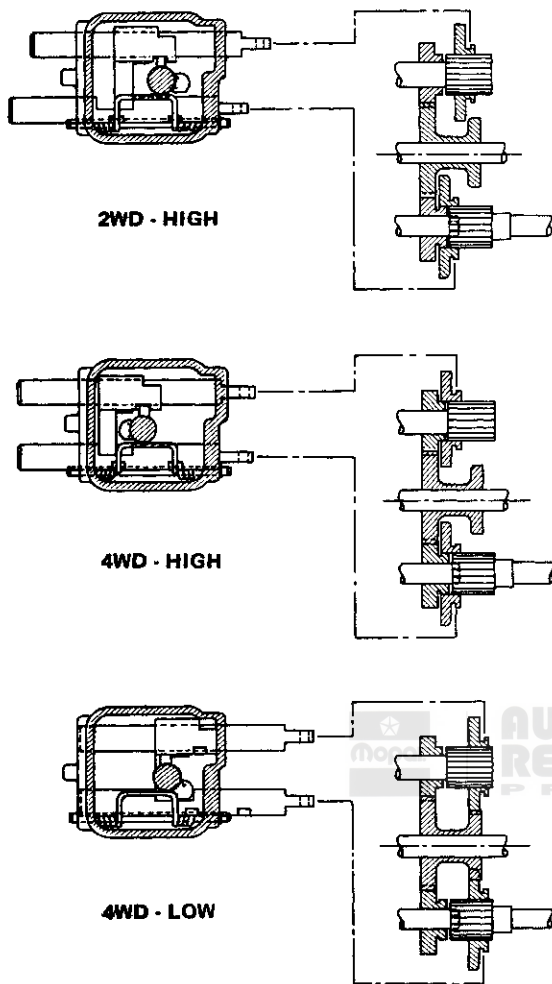


Fig. 2D-16 Shift Positions

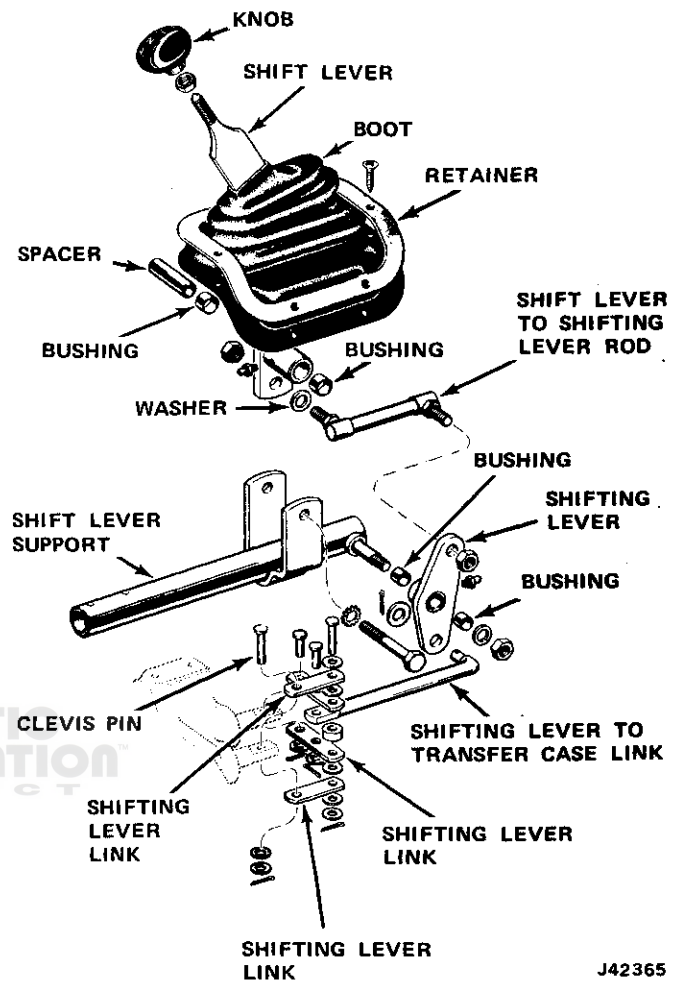


Fig. 2D-17 Shift Linkage—CJ Models

**SHIFT LINKAGE—CJ MODELS**

The shift lever is connected to the transfer case shift rails through rods and nonadjustable links (fig. 2D-17). The support tube connects to the transfer case and is

retained by capscrews. Locating holes are drilled in the support tube at the transfer case end to maintain linkage alignment.

On CJ models with 3-speed transmission, the transfer case must be removed in order to remove the shift lever support tube.

**SPECIFICATIONS**

**Model 20 Transfer Case Specifications**

Type .....	Four-Position
Make .....	Spicer
Model .....	.20
Gear Ratio:	
High .....	1:1
Low .....	2.03:1
Two-Wheel Drive .....	1:1
	60631

**Lubricants**

Model 20 Transfer Case .....	SAE 90 Gear Lubricant API Grade GL-4
	60635

## 2D-12 TRANSFER CASE

### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Front/Rear Output Shaft Nuts . . . . .	120	90-150	163	122-203
Front Bearing Cap-to-Case Bolts . . . . .	30	28-32	41	38-43
Intermediate Shaft Lockplate Bolts. . . . .	14	12-15	19	16-20
Bottom Cover Bolts. . . . .	14	12-15	19	16-20
Rear Bearing Cap-to-Case Bolts . . . . .	30	28-32	41	38-43
Shift Fork Setscrews . . . . .	14	12-15	19	16-20
Shift Rod Housing-to-Case Bolts . . . . .	30	28-32	41	38-43
Transfer Case-To-Transmission Bolts . . . . .	30	28-32	41	38-43

All torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Marking chart in Chapter A for torque values not listed above.

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# QUADRA-TRAC TRANSFER CASE

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## GENERAL

The Quadra-Trac transfer case provides full time, fully-differentiated, four wheel drive in all operating conditions. The two piece aluminum transfer case contains two drive sprockets, an unloading cone-type limited slip differential, and two output shafts. The sprockets are connected and operated by a drive chain (fig. 2D-18). Engine torque is transmitted to the front and rear axles through the limited slip differential contained within the differential sprocket.

An Emergency Drive system is built into every Quadra-Trac transfer case. This feature locks the front and rear wheel drives together to provide undifferentiated four wheel drive. The device is designed for use in extreme situations only and must not be used for normal operation.

A gear reduction unit, which provides maximum engine braking and additional torque at low speeds, is available as an option with Quadra-Trac. The unit is attached to the rear of the transfer case and is operated by a floor mounted shift lever and connecting linkage.

## OPERATION

### Transfer Case

Engine torque is transmitted to the transfer case by the transmission output shaft which is splined to the case drive sprocket. The drive sprocket is connected to the differential sprocket by the drive chain. The transfer case front and rear output shafts are driven through the limited slip differential in the differential sprocket.

The limited slip differential has two brake cones which are preloaded by Belleville springs. The differential is not a positive lock-type unit and the cones will release when excessive or variable torque loads are applied. Spring pressure on the cones is designed to be ineffective under variable torque loads, such as when turning corners, or during extreme differences in traction force between axles. Under these conditions, the differential will function in the same manner as a standard-type unit.

In operation, the brake cones are pressed against the cone friction surfaces of the differential sprocket by spring load. When traction at either the front or rear

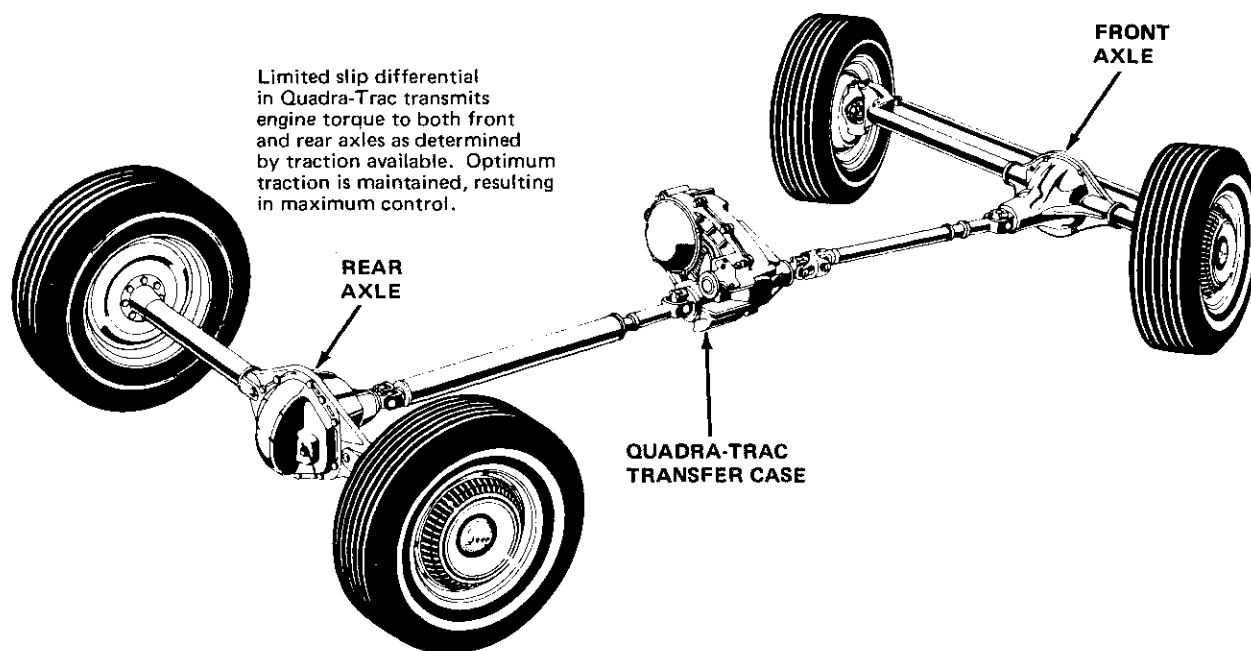


Fig. 2D-18 Quadra-Trac Transfer Case

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wheels is insufficient, the brake cone connecting the low traction wheels to the differential will release momentarily. This allows full torque transfer to the high-traction wheels through the opposite brake cone. Locking action on this cone is automatically increased by differential pinion reaction. During operation, this sequence of apply-release force on the cones occurs constantly to compensate for the variances in tractive force at either axle.

Because the cones will release under excessive or variable torque loads, torque windup can be dissipated regularly throughout normal operation. This feature permits full-time four wheel drive at all speeds and in most driving conditions.

Lubricant pressure buildup within the transfer case is relieved through a vent located in the diaphragm cover. This vent must remain open at all times to prevent loss of lubricant from the vent or past the seals and gaskets in the transfer case.

### Emergency Drive

Emergency Drive is a vacuum operated control system which locks the front and rear wheel drives together resulting in undifferentiated four wheel drive. This feature allows the vehicle to be moved from a high centered condition, permits continued operation in two wheel drive in the event of an axle or propeller shaft failure, and assists in maintaining traction in soft sand or mud, or on extremely icy surfaces.

**CAUTION:** *Emergency Drive is provided for extreme situations only and must not be used for normal operation. The Quadra-Trac Transfer Case is designed to*

*dissipate torque windup in the fully differentiated mode only. If the vehicle is driven at normal road speeds with Emergency Drive engaged, the transfer case could be damaged severely. The only situations where Emergency Drive should be engaged are when plowing snow on extremely slippery surfaces, when one axle or propeller shaft has malfunctioned (permits continued operation in two wheel drive), when driving on extremely icy surfaces, when mired in soft sand or mud, or when the vehicle has become high centered.*

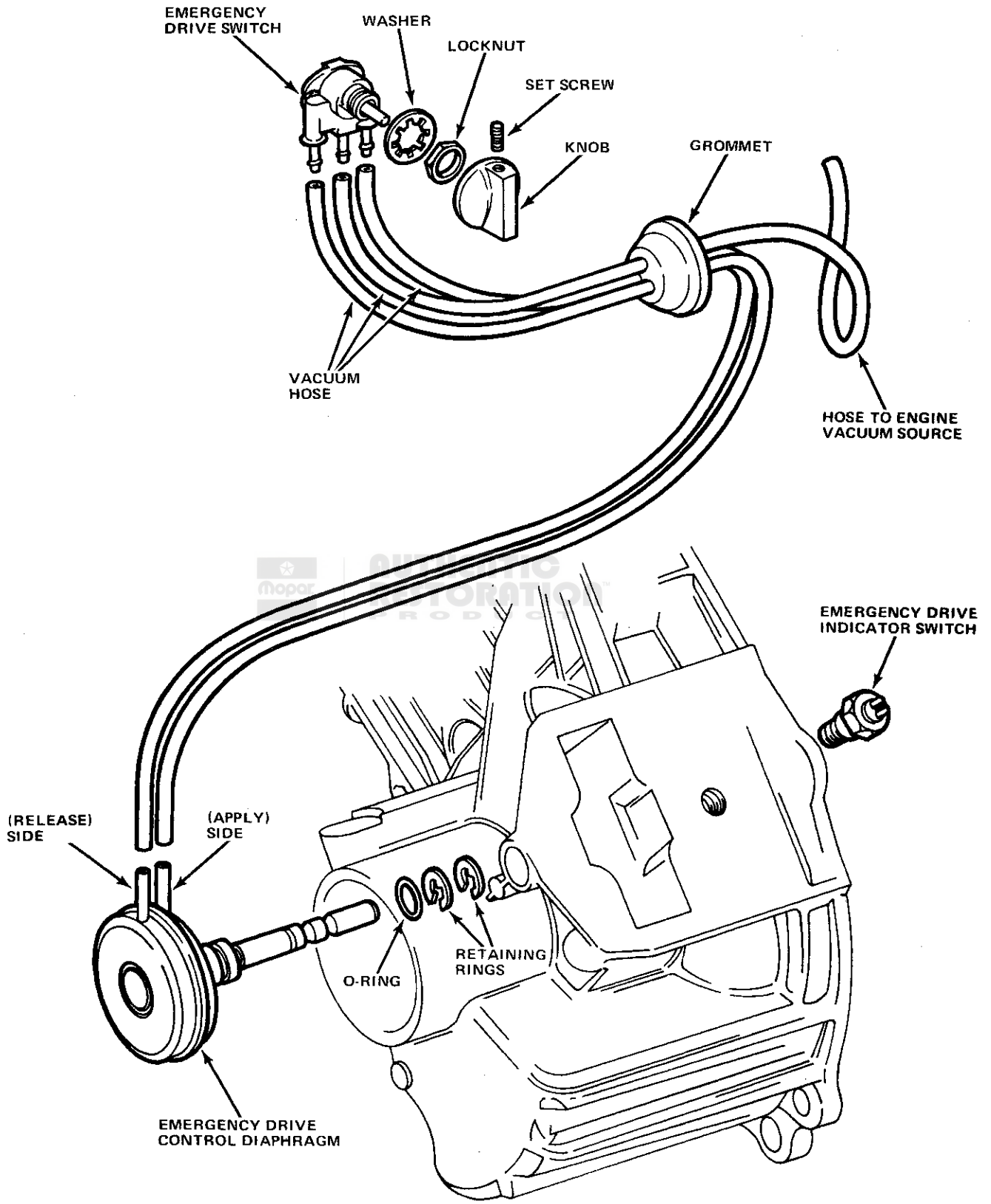
The Emergency Drive system is operated by engine vacuum. System controls consist of a vacuum switch located in the glove box, a vacuum control diaphragm located in the transfer case front cover, interconnecting vacuum hoses, and a plunger-type indicator switch mounted in the transfer case front cover (figs. 2D-19, 2D-20). An indicator light mounted in the instrument panel is used to signal the driver when Emergency Drive is engaged. The indicator light, which is activated by the indicator switch in the transfer case, remains illuminated until Emergency Drive is disengaged.

The transfer case internal mechanical components operated by the vacuum system and which effect lockup consist of: the lockup hub shift fork, lockup hub, and differential case rear end cap. The shift fork is located on the control diaphragm piston by two retaining rings. The fork engages in a groove machined in the lockup hub and the hub is splined to the rear output shaft.

### Emergency Drive Operation

When the glove box switch is turned to Emergency Drive position, the switch allows engine vacuum to enter the apply side of the control diaphragm. As the apply

**2D-14 TRANSFER CASE**



**Fig. 2D-19 Emergency Drive Vacuum Control System**

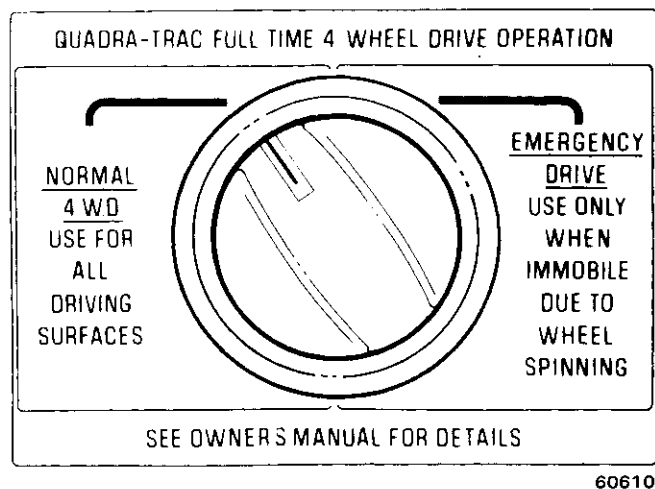


Fig. 2D-20 Emergency Drive Switch

side fills with engine vacuum, atmospheric pressure acting upon the opposite side of the diaphragm moves the diaphragm piston and shift fork inward. As the fork moves inward, it moves the lockup hub into engagement with the case rear end cap. At this point, the hub is now splined to both output shafts through the case rear end cap. This results in a direct axle-to-axle connection which nullifies differential action.

As the control diaphragm piston moves inward, it contacts the indicator switch plunger ball forcing the ball and plunger upward closing the switch internal contacts. This completes the electrical circuit to the indicator light which illuminates signalling the operator that Emergency Drive is engaged.

When the glove box switch is turned to the normal 4WD position, vacuum is applied to the release side of the control diaphragm. Atmospheric pressure on the opposite side of the diaphragm moves the piston and shift fork outward disengaging the lockup hub from the case rear end cap. As the piston moves outward, contact between the indicator switch plunger ball and piston is broken. The switch ball and plunger are then returned to the open position by internal spring pressure. This opens the circuit between indicator light and switch causing the light to go off.

If a front or rear propeller shaft assembly or front or rear axle shaft failure should ever occur, activating Emergency Drive will permit two wheel drive operation until repairs can be made.

#### Engaging Emergency Drive

**CAUTION:** Never attempt to engage Emergency Drive while the wheels are spinning or if vehicle speed is more than 5 mph (8 km/h). If engagement is attempted under these conditions, the lockup hub, coupling, and gears could be damaged severely. If Emergency Drive is needed to move the vehicle out of a particular position, do not attempt engagement until the wheels have stopped all movement. In addition, do not drive the

vehicle on dry pavement or at speeds above 20 mph (32 km/h), or spin the wheels excessively with Emergency Drive engaged. This will result in harsh operation and accelerated wear or damage to the transfer case internal components.

(1) Decrease vehicle speed to 5 mph (8 km/h) or less. If vehicle is high centered and wheels are spinning, release accelerator, shift transmission into Neutral and allow wheels to stop all movement.

(2) Turn control knob on glove box switch clockwise to Emergency Drive position.

(3) When indicator light in instrument cluster illuminates, Emergency Drive is engaged. Indicator light will remain illuminated until Emergency Drive is disengaged.

**NOTE:** A slight delay in indicator light illumination may occur until the front and rear axles become synchronized.

#### Disengaging Emergency Drive

(1) Decrease vehicle speed to 5 mph (8 km/h) or less.

(2) Turn control knob on glove box switch counterclockwise to normal 4WD position.

(3) When indicator light in instrument cluster goes off, Emergency Drive is disengaged.

**NOTE:** If the indicator light does not go off immediately, back the vehicle in an "S" pattern for approximately 15 feet (4.5 m) to synchronize the front and rear axles. Repeat this maneuver as necessary until the light goes off.

Because emergency drive is infrequently used, it is recommended that the system be activated and deactivated at least once each month.

#### Reduction Unit

The reduction unit consists of an aluminum case containing a planetary geartrain and reduction engagement gears. The pinion gears, sun gear, and lock plate are located within the internal tooth ring gear. The unit is engaged/disengaged by a floor mounted shift lever and linkage.

When engaged, the shift fork moves the shift collar into engagement with the collar plate hub. This locks the engagement and planetary gears together through the collar plate and pinion cage lockplate which are splined to the ring gear. Engine torque is transmitted to the reduction unit through the sun gear which is connected to the transfer case drive sprocket by the drive hub and lock sleeve.

For operation during unusually severe on or off-road conditions, the reduction unit provides maximum engine braking and additional torque at low speeds. When engaged, the unit provides a gear reduction ratio of 2.57:1.

### Reduction Unit Shift Lever

The reduction unit shift lever is floor mounted on all models. On CJ-7 models, the lever is located on the driver's side of the floorpan transmission tunnel (fig. 2D-21). On Cherokee, Wagoneer and Truck models, the lever is located on the floorpan just below the driver's seat (fig. 2D-21).

There are three shift lever positions: high range, neutral, and low range. High is used for normal driving. Low range position engages the reduction unit when maximum engine braking and torque are required. The Neutral (center) position is used for towing purposes only. Neutral allows the vehicle to be towed without having to remove or disconnect the propeller shafts.

### Engaging The Reduction Unit

- Release accelerator pedal when vehicle speed is approximately 10-15 mph (16-24 km/h).
- Shift transmission into Neutral while vehicle is still moving.
- When vehicle speed drops below 5 mph (8 km/h), move reduction unit shift lever all the way forward (CJ-7 models) or all the way upward (Cherokee-Wagoneer-Truck Models). Do not stop at the Neutral (center) position, which is for towing use only.

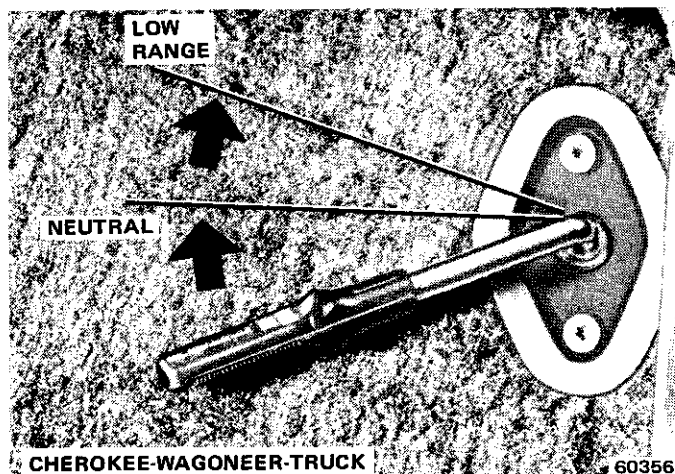
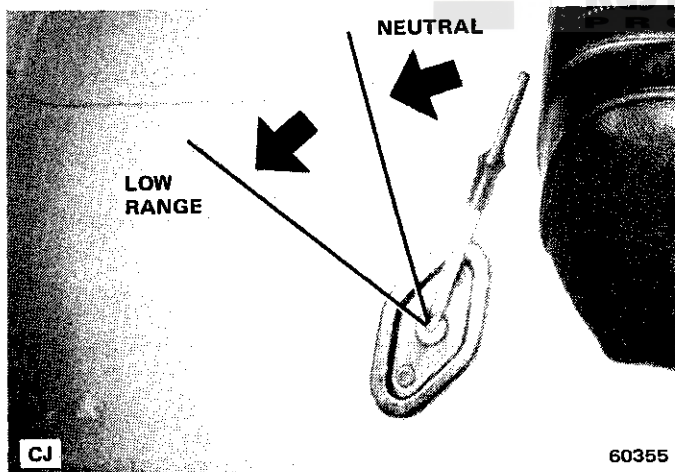


Fig. 2D-21 Reduction Unit Shift Lever

### Disengaging The Reduction Unit

- Release accelerator pedal when vehicle speed is approximately 15-20 mph (24-32 km/h).
- When vehicle speed drops to 5-10 mph (8-16 km/h), shift automatic transmission into Neutral.
- While vehicle is still moving, move the reduction unit shift lever all the way to the rear on CJ-7 models, or all the way down on Cherokee-Wagoneer-Truck models. Do not stop at the Neutral (center) position on any model when disengaging the unit.

### TOWING

If the vehicle is inoperative and must be towed with either the front or rear wheels raised, towing speed must be limited to 30 mph (48 km/h) or less and for a distance no greater than 15 miles (24 km).

### Automatic Transmission with Quadra-Trac Less Reduction Unit

**Ignition Key Available:** Turn ignition key to Off position to unlock steering column and gearshift selector linkage. Place transmission gearshift lever in N (Neutral). If vehicle is to be towed with all four wheels on the ground, disconnect **both** propeller shafts from axle yokes (mark propeller shafts and yokes for assembly alignment reference), secure shafts to underside of vehicle, and proceed with towing. If vehicle is to be towed with front end raised, disconnect rear propeller shaft only (mark shaft and yoke for assembly alignment reference) and secure shaft to underside of vehicle.

**Ignition Key Not Available:** Place dolly under rear wheels and tow vehicle with front end raised; or, disconnect rear propeller shaft at rear axle yoke (mark shaft and yoke for assembly alignment reference), secure shaft to underside of vehicle, and tow with front wheels raised.

### Automatic Transmission with Quadra-Trac and Reduction Unit

**Ignition Key Available:** Vehicle can be towed with all four wheels on the ground without disconnecting propeller shafts. Shift transmission into Park and shift reduction unit shift lever to Neutral (center) position. If the emergency drive control switch (in glove box) was in EMERGENCY DRIVE when the engine was shut down, restart the engine and turn the control knob to the NORMAL position. **Never tow the vehicle with the Emergency Drive control activated or with the reduction unit in low range.**

**Ignition Key Not Available and Vehicle is Locked or Unlocked:** Place dolly under rear wheels and tow vehicle with front wheels raised; or, disconnect rear propeller shaft at rear axle (mark shaft and yoke for assembly alignment reference), secure shaft to underside of vehicle, and tow with front wheels raised.

## SERVICE DIAGNOSIS

The majority of Quadra-Trac operational problems are a result of incorrect lubricant or lubricant level, mismatched tires, uneven tire inflation pressures, insufficient vacuum, incorrect use of Emergency Drive, or improper operation by the driver.

When diagnosing Quadra-Trac problems, follow the preliminary diagnosis procedure and consult the Service Diagnosis Charts before removal or disassembly. A proper diagnosis will not only help to locate the problem cause, it will also help to avoid unnecessary or ineffective repairs.

### Preliminary Diagnosis

(1) Inspect all tires. Tires must be same type, size, make, and tread design.

(2) Check tire inflation pressure. Tires must be inflated to recommended pressures and not vary more than 1/2 to 1 psi (3.45 to 6.895 kPa).

(3) Check lubricant level and condition. If lubricant level is low, add as necessary and check for leaks. If level is high, drain to correct level. If lubricant is severely discolored and smells burnt, drain sample and check for particles and debris.

(4) If complaint was based on noisy operation, road test and check for stick slip condition or excessive play in drive chain. Refer to Stick-Slip Condition, Torque Bias Check, Drive Chain Tension Inspection, and Service Diagnosis charts.

(5) If complaint was based on incorrect Emergency Drive operation, check unit operation first, then refer to Emergency Drive Diagnosis.

(6) If complaint was based on incorrect reduction unit operation, road test vehicle, check unit operation, and refer to Service Diagnosis charts.

### Stick-Slip Condition

When the differential brake cones tend to stick and release suddenly or release at differing torque values, it is caused by a condition similar to torque windup in a conventional transfer case. This condition is referred to as "stick-slip."

Sudden release of the brake cones under this condition results in a pulsating clunking, rasping, or grunt-type noise. This is a low-frequency noise which is most noticeable at slow speeds, such as when slowly turning a corner, or when maneuvering to park the vehicle.

Stick-slip noise will not occur when the vehicle is driven straight-ahead. However, if a noise similar to stick-slip, but much louder, occurs during straight ahead driving, inspect the drive chain for excessive looseness.

Proper lubricant is important in preventing stick-slip noise. Use Jeep Quadra-Trac lubricant or equivalent only. Multigrade, detergent-type oils must never be used. Stick-slip caused by improper lubricants may be corrected by draining the transfer case and reduction unit, if equipped, and refilling with the specified lubricant.

**NOTE:** *If a vehicle has not been driven for a week or more, stick-slip noise may occur during initial operation. This condition is considered normal and should be of no concern, as the noise will usually disappear with continued driving.*

### Service Diagnosis—Quadra-Trac Transfer Case

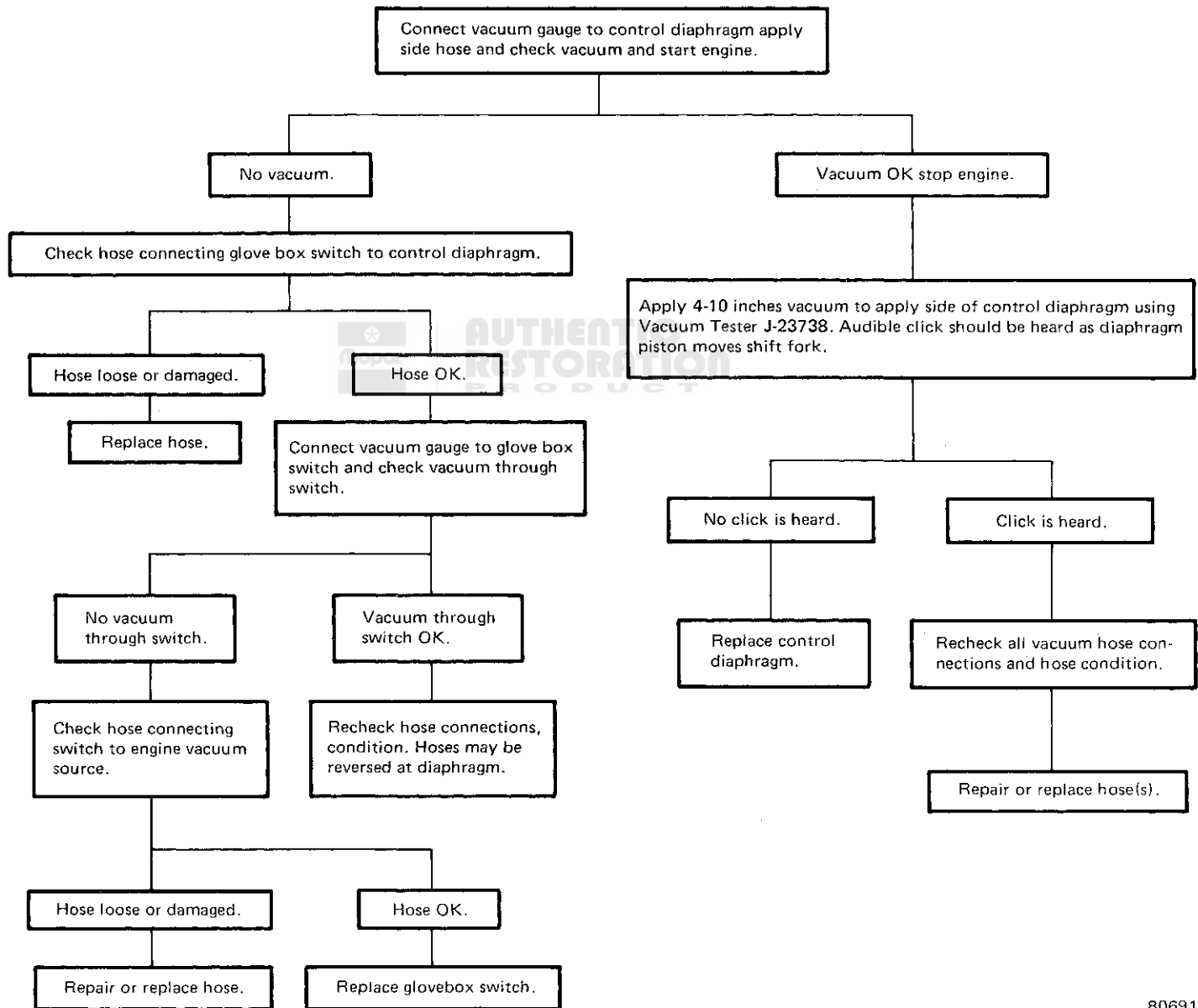
Condition	Possible Cause	Correction
NOISY ON LOW SPEED TURNS (MAKES PULSATING-TYPE CLUNKING OR RASPING NOISE)  <i>NOTE: If the vehicle has not been driven for a week or more, stick-slip may occur during initial operation. This is a normal condition and the noise will usually stop after continued operation.</i>	(1) Uneven tire pressures causing stick-slip-type condition.	(1) Correct inflation pressures. (Pressures must not differ by more than 1/2 to 1 psi.)
	(2) Mismatched tire types, sizes, or tread patterns.	(2) Replace tires. Install same type, size, tread pattern tires on all wheels (spare included).
	(3) Incorrect or insufficient lubricant.	(3) Drain and refill with Jeep Quadra-Trac lubricant or equivalent.
	(4) Stick-slip condition. Differential brake cones releasing at unequal torque values due to torque windup.	(4) Drain and refill with Jeep Quadra-Trac lubricant or equivalent; then drive vehicle in tight circles in both right and left-hand direction for about 5-7 minutes each direction. If condition is not corrected, perform torque bias check as outlined in this section.



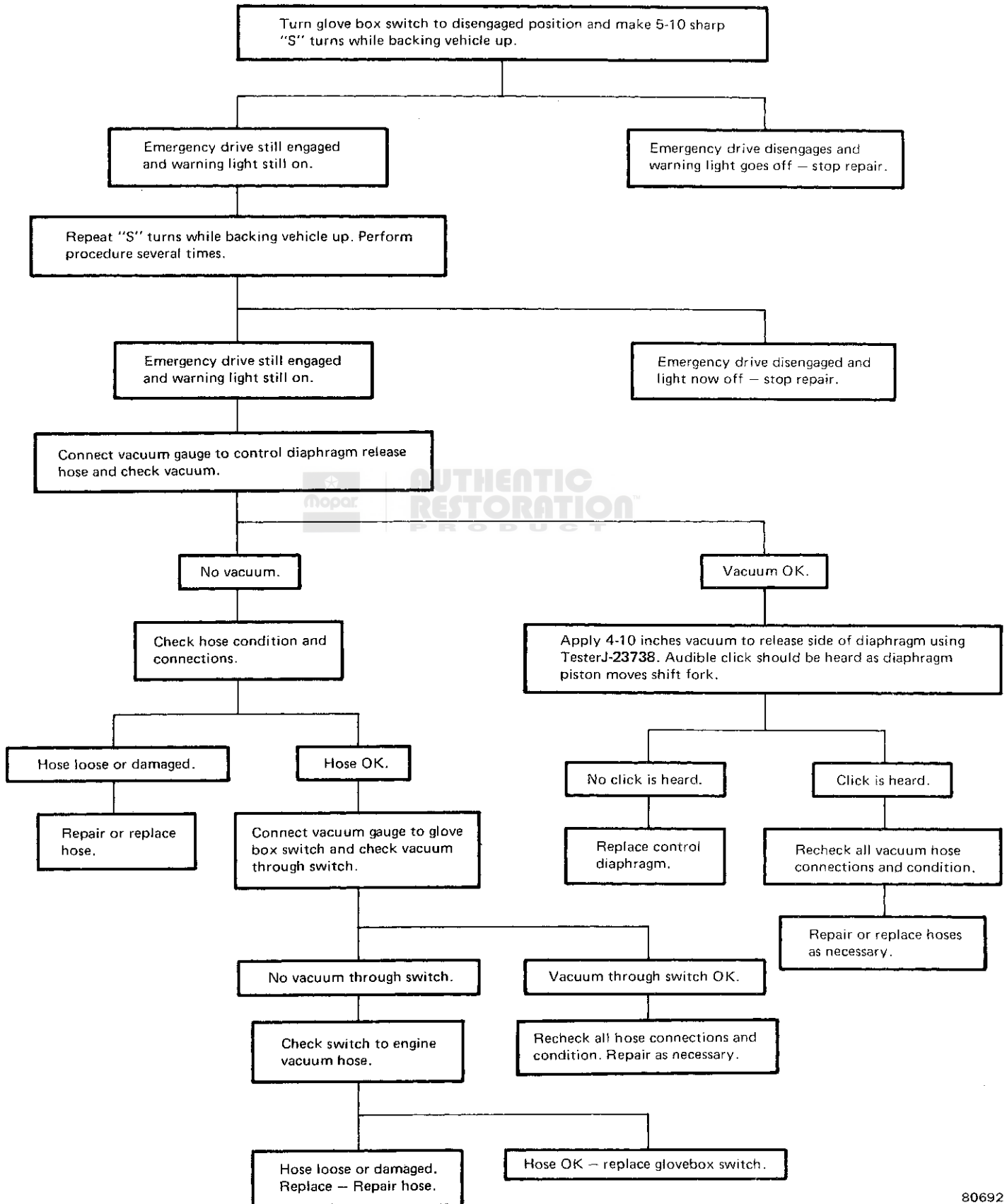
Service Diagnosis—Quadra-Trac Transfer Case (Continued)

Condition	Possible Cause	Correction
FRONT OR REAR OF VEHICLE TENDS TO WANDER OR PULL AT TIMES WHEN DRIVING IN STRAIGHT AHEAD DIRECTION	(1) Condition caused by mismatched tires or incorrect tire inflation pressures.	(1) Install matched set of tires or correct tire inflation pressures. (Inflation pressures must not differ by more than 1/2 to 1 psi.)
NOISY WHEN DRIVING STRAIGHT AHEAD DIRECTION (MAKES PULSATING-TYPE RASPING OR GRUNTING SOUND) ALSO NOISY DURING LOW-SPEED TURNS	(1) Incorrect or insufficient lubricant. (2) Vehicle has not been driven for one week or more. (3) Drive chain losing tension.	(1) Drain and refill with Quadra-Trac lubricant or equivalent. (2) Normal condition. Noise should cease after continued operation. (3) Check chain tension using gauge tool J-25162. (Refer to Drive Chain Tension Inspection.) Replace drive chain if tension is insufficient.
EMERGENCY DRIVE WON'T ENGAGE OR DISENGAGE	(1) Problem in vacuum control system. (2) Internal damage in transfer case.	(1) Refer to emergency drive diagnosis. (2) Disassemble and repair as necessary.
REDUCTION UNIT WON'T ENGAGE OR DISENGAGE	(1) Incorrect engagement or disengagement procedure used. (2) Shift linkage loose, bent, broken. (3) Shift fork worn, damaged, or loose on shift rail (spring pin broken). (4) Reduction unit holding plate, shift collar, collar plate, collar plate hub, or pinion cage lock plate worn or damaged. (5) Reduction unit incorrectly assembled.	(1) Refer to reduction unit operation for correct procedure. (2) Repair linkage as necessary. (3) Disassemble unit and repair as necessary. (4) Disassemble unit and repair as necessary. (5) Disassemble unit, and assemble correctly.
LUBRICANT LEAKS PAST SEALS, GASKETS, OR OUT OF VENT	(1) Transfer case overfilled. (2) Vent closed, or restricted.	(1) Drain to correct level. (2) Clear or replace vent as necessary.

**Service Diagnosis—Emergency Drive System**



**Service Diagnosis—Emergency Drive System (Continued)**



Uneven tire inflation pressures and mismatched tire types or sizes will also cause stick-slip noise. All tires must be inflated equally and must be of the same size and type.

### Lubrication

The Quadra-Trac transfer case lubricant must be changed periodically at the intervals specified in the Maintenance Schedule. In addition, if a stick-slip condition occurs, the transfer case and reduction unit, if equipped, lubricant must be changed. **Use Jeep Quadra-Trac lubricant or equivalent only whenever a lubricant change is necessary.**

If a stick-slip condition has developed, check for mismatched tires or uneven tire pressure before changing lubricant; then drain and refill the transfer case and reduction unit, if equipped, as follows:

#### With Reduction Unit:

(a) Remove fill plugs from transfer case and reduction unit and remove drain plug from transfer case. Allow transfer case to drain completely.

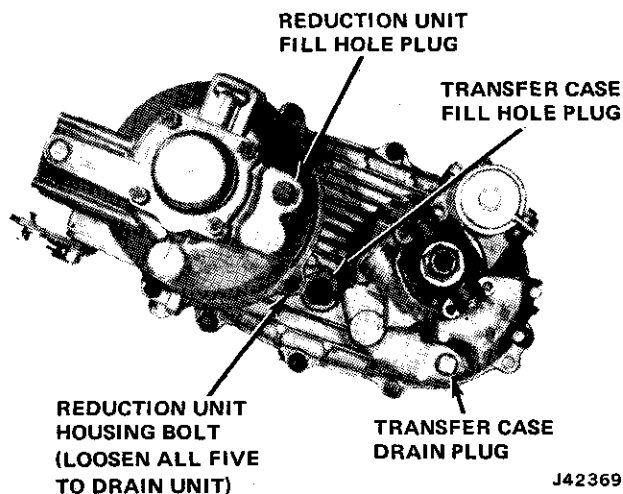
(b) Install transfer case drain plug and tighten to 20 foot-pounds (27 N•m) torque.

(c) Loosen reduction unit housing attaching bolts and pull housing back far enough to drain all lubricant. After lubricant has drained completely, push housing into position and tighten 3/8-16 bolts to 20 foot-pounds (27 N•m) torque and 5/16-18 bolts to 9 foot-pounds (12 N•m) torque.

(d) Fill transfer case to fill hole level (2 quarts U.S., 1.89 liters, or 1.7 quarts Imperial) with Jeep Quadra-Trac lubricant or equivalent only and install fill plug.

(e) Add one pint (0.47 liters) of Quadra-Trac lubricant or equivalent only to reduction unit and install fill plug.

(f) Tighten transfer case and reduction unit fill plugs to 20 foot-pounds (27 N•m) torque.



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Fig. 2D-22 Quadra-Trac Drain and Fill Plug Locations

#### Without Reduction Unit:

(a) Remove fill and drain plugs from transfer case. Allow transfer case to drain completely.

(b) Install transfer case drain plug and tighten to 20 foot-pounds (27 N•m) torque.

(c) Fill transfer case to fill hole level (2 quarts U.S., 1.89 liters, or 1.7 quarts Imperial) with Quadra-Trac lubricant or equivalent only.

(d) Install transfer case fill plug and tighten to 20 foot pounds (27 N•m) torque.

(7) Drive vehicle in circles, both clockwise and counterclockwise for approximately 15 minutes to allow lubricant to circulate throughout differential.

**NOTE:** When driving the vehicle in circles do not turn the wheel to the stop position.

### Torque Bias Test

The torque bias test is a method for checking differential brake cone preload. This test measures the torque at which the differential brake cones will release.

(1) Be sure Emergency Drive is not engaged. Differential must be free to operate and must not be locked.

(2) Shift transmission into Neutral.

(3) Disconnect rear propeller shaft at transfer case yoke.

(4) Have helper apply brakes firmly to lock front wheels.

(5) Assemble socket and torque wrench with minimum capacity of 200 foot-pounds (271 N•m).

(6) Install socket and torque wrench on transfer case rear yoke retaining nut.

(7) Apply torque in tightening direction (clockwise) to retaining nut. Differential brake cones should release when 80 to 170 foot-pounds (108 to 230 N•m) of torque is applied.

**NOTE:** If the brake cones release at a torque value of 80 foot-pounds (108 N•m) or less, the differential unit may require replacement. If the cones do not release when 170 foot-pounds (230 N•m) torque or more is applied, improper lubricant may be the cause. Refer to Stick-Slip Condition and Lubrication in this section.

### Drive Chain Tension Inspection

(1) Remove transfer case drain plug, drain lubricant, and reinstall drain plug.

(2) Remove chain inspection plug.

(3) Thread Chain Tension Gauge J-25162 into inspection hole until gauge stops against case (fig. 2D-23).

(4) Tension gauge plunger should protrude past outer end of checking tool (fig. 2D-23). If gauge plunger is flush or below end of gauge, replace drive chain.

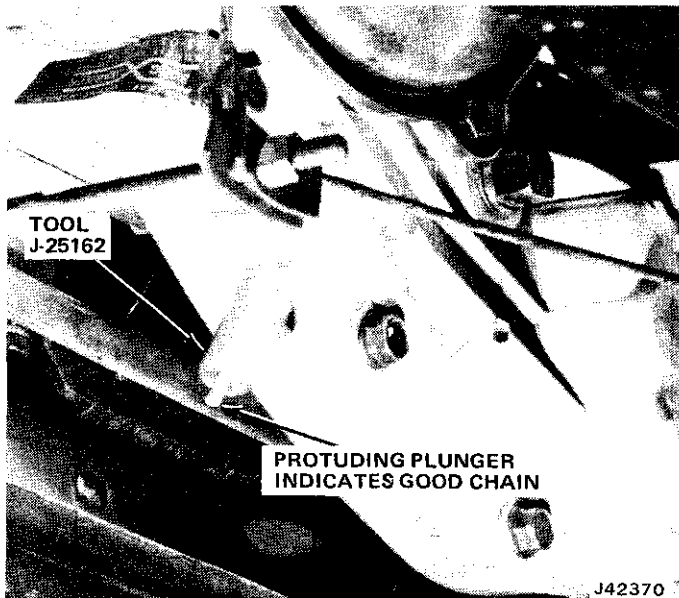


Fig. 2D-23 Inspecting Drive Chain Tension

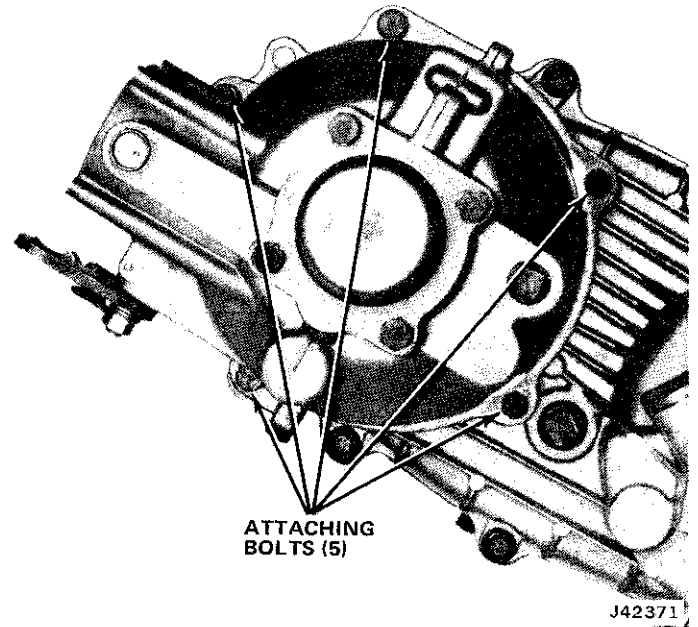


Fig. 2D-24 Reduction Unit Attaching Bolt Locations

## REDUCTION UNIT SERVICE

### Reduction Unit Removal

- (1) Raise vehicle.
- (2) Loosen bolts attaching reduction unit to transfer case cover (fig. 2D-24).
- (3) Move reduction unit rearward just far enough to allow oil to drain from unit.
- (4) Disconnect shift linkage at reduction unit control lever.
- (5) When oil has drained, remove bolts attaching reduction unit to transfer case cover.
- (6) Move reduction unit rearward to clear transmission output shaft and pinion cage which is attached to transfer case drive sprocket.

**NOTE:** The pinion cage should not be removed if the transfer case cover assembly is to be removed. However, the cage may be removed for inspection or replacement if the transfer case cover assembly is to remain in the vehicle. Pinion cage removal involves removing the snap ring which secures the cage to the sprocket and sliding the cage rearward.

### Reduction Unit Installation

- (1) If removed, install pinion cage on transfer case drive sprocket splines (fig. 2D-25).
- (2) Install pinion cage retaining snap ring. Be sure snap ring is seated completely in groove (fig. 2D-25).
- (3) Clean sealing ring groove in transfer case cover and install sealing ring.
- (4) Position reduction unit on transfer case. Mesh pinion cage gears with sun gear and ring gear and align

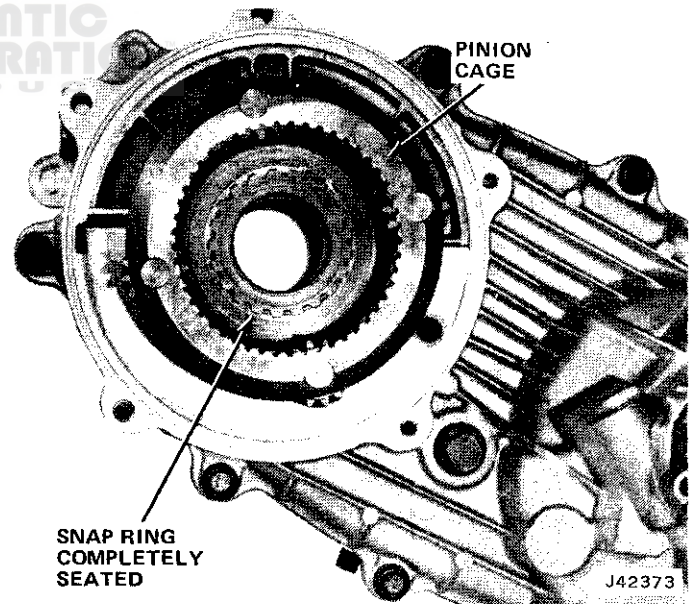


Fig. 2D-25 Pinion Cage and Snap Ring Position

sun gear inner splines with transmission output shaft splines.

- (5) Move reduction unit forward until seal ring is contacted.
- (6) Install reduction unit attaching bolts. Tighten bolts alternately and evenly to 15 foot-pounds (20 N•m) torque.
- (7) Connect shift linkage to reduction unit control lever.
- (8) Fill reduction unit and transfer case with Quadra-Trac lubricant or equivalent only.

## Reduction Unit Disassembly

- (1) Remove power takeoff cover (fig. 2D-26).
- (2) Position 11/16, 1/2 inch drive deep well socket in vise and clamp securely. Allow two inches (5.08 cm) of socket to extend beyond top of vise.
- (3) Mount reduction unit on socket. Be sure socket enters bore of sun gear (fig. 2D-27). Reduction unit should be supported by socket.
- (4) Move reduction unit control lever rearward to high range position.
- (5) Remove snap ring and spacer from main shaft (fig. 2D-28).
- (6) Lift reduction unit housing upward and off gear train (fig. 2D-29).

**NOTE:** If only the shift collar, annular bearing, or housing are to be serviced, do not remove and dis-

assemble the gear train. Leave the gear train in place on the socket to simplify assembly.

- (7) Remove following components as assembly: direct drive sleeve and needle bearing, shift collar hub and needle bearing, reduction collar hub, and ring gear and needle bearings (fig. 2D-30).

**NOTE:** If necessary, the reduction collar plate hub and reduction collar plate can be separated from the ring gear by removing the retaining snap rings.

- (8) Remove pinion cage lock plate and needle bearings.
- (9) Remove sun gear and main shaft from pinion cage (fig. 2D-31). Do not attempt to disassemble sun gear and main shaft.

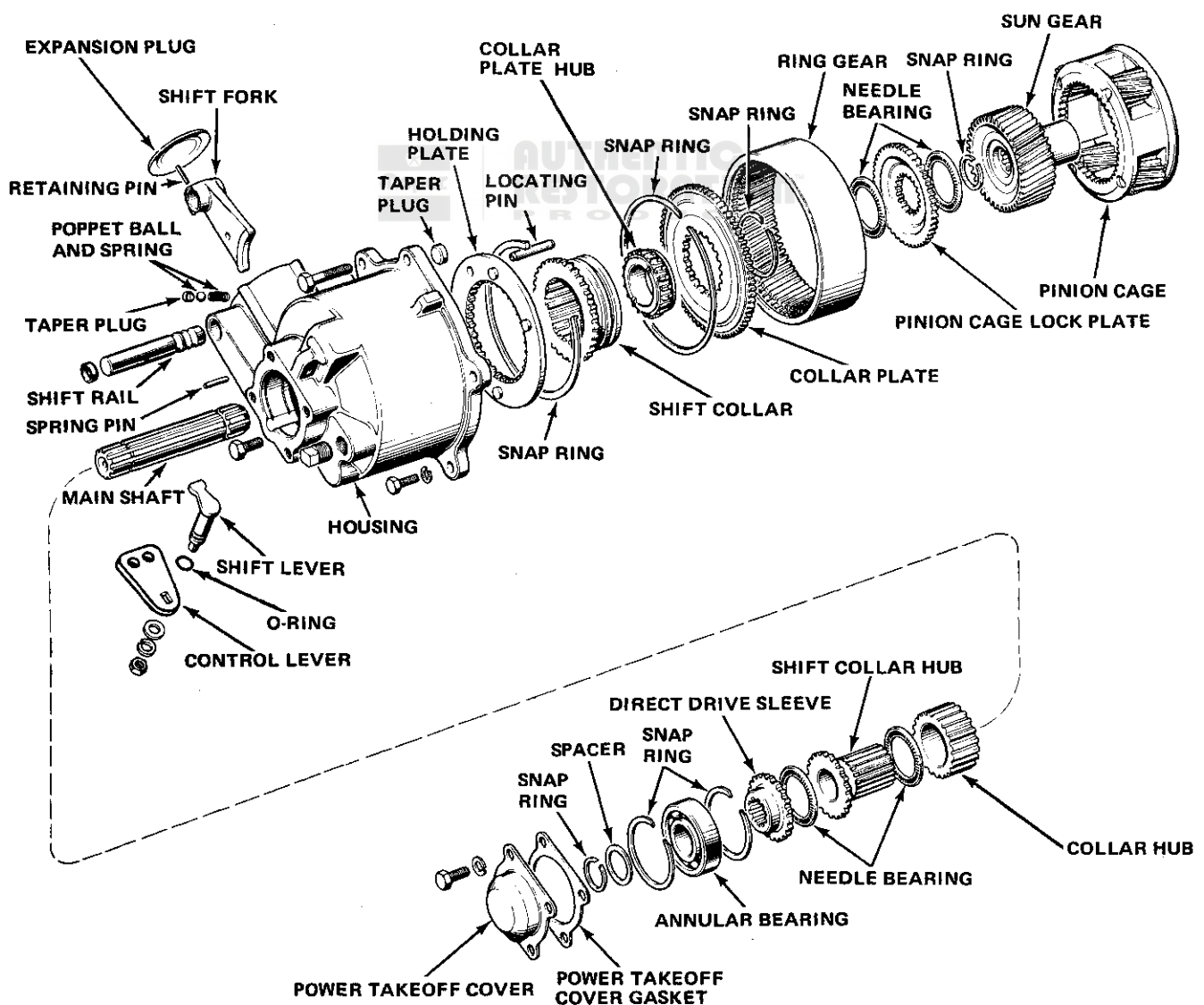


Fig. 2D-26 Reduction Unit Components

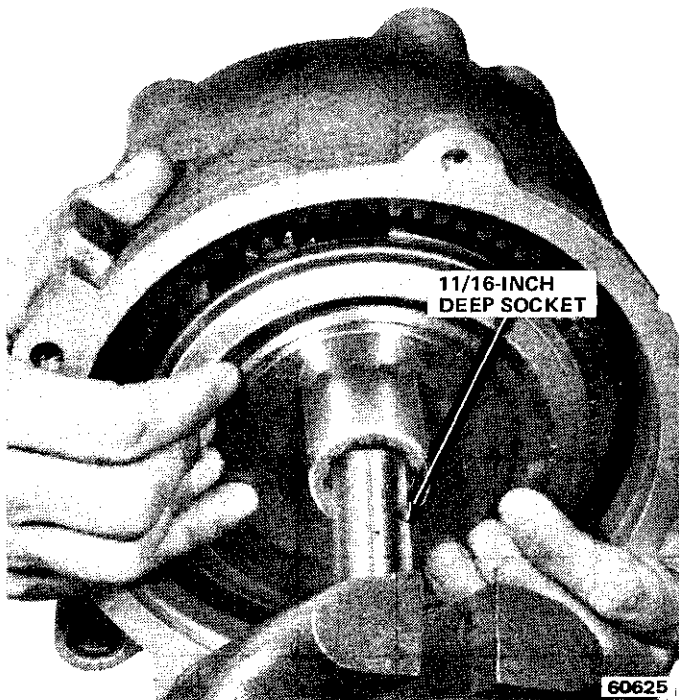


Fig. 2D-27 Mounting Reduction Unit on Socket

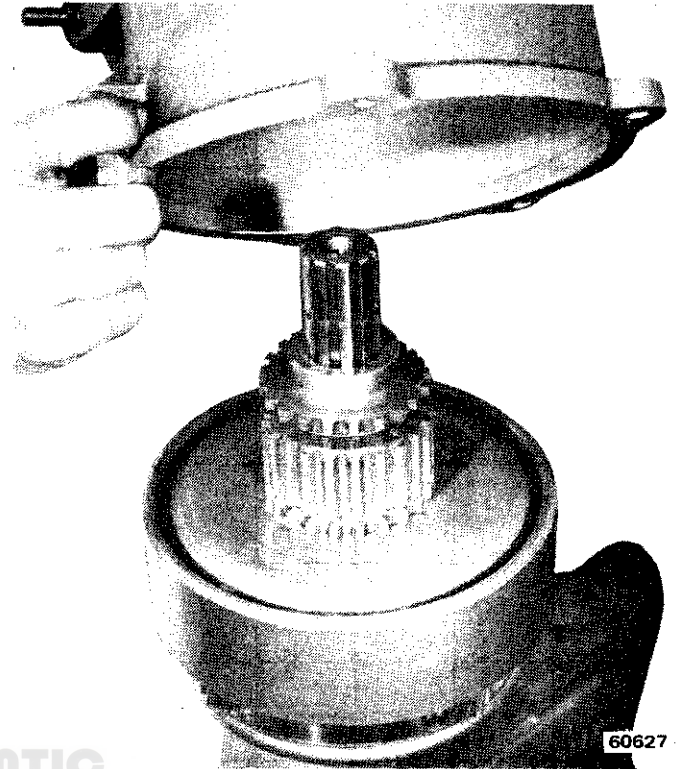


Fig. 2D-29 Housing Removal/Installation

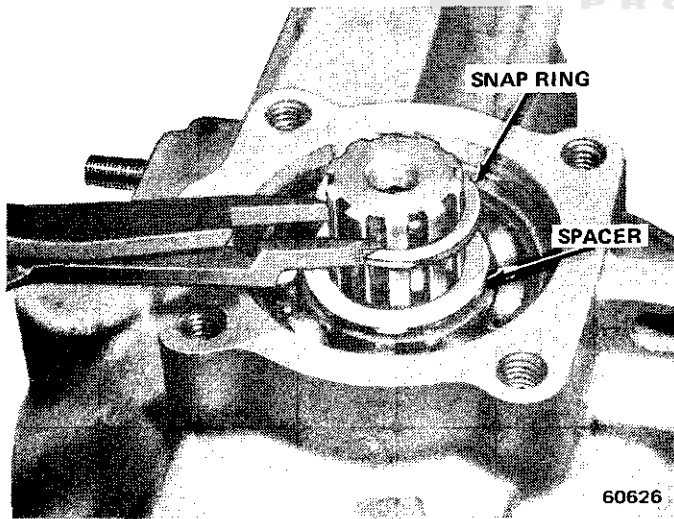


Fig. 2D-28 Main Shaft Snap Ring Removal/Installation

### Shift Collar Removal

- (1) Move control lever to neutral (center) position and disengage shift collar from shift fork.
- (2) Move control lever rearward to high range position and align outer teeth on shift collar with inner teeth on holding plate.
- (3) Move shift fork and shift collar forward to low range position using shift lever and remove shift collar (fig. 2D-32).

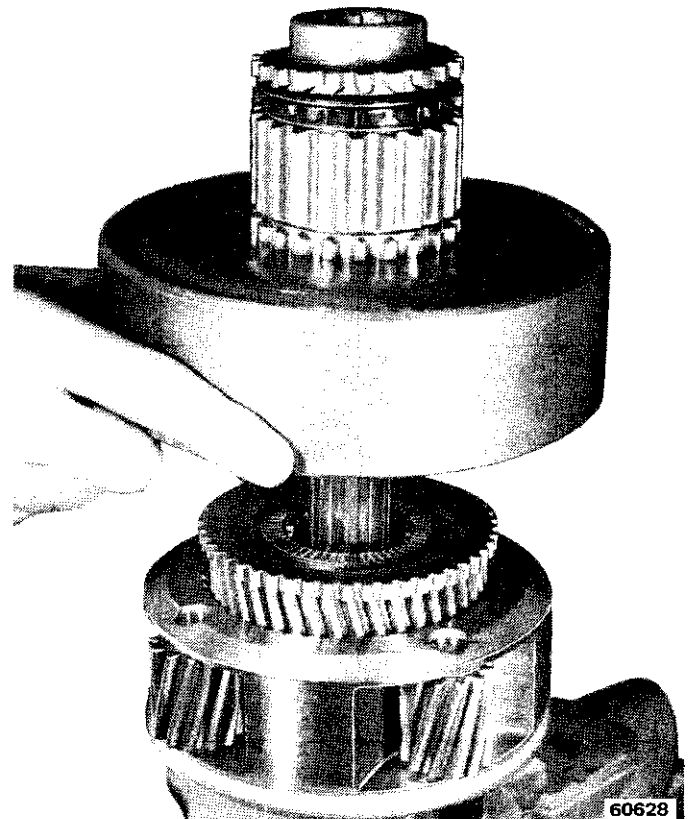


Fig. 2D-30 Sleeve-Hub-Ring Gear Removal

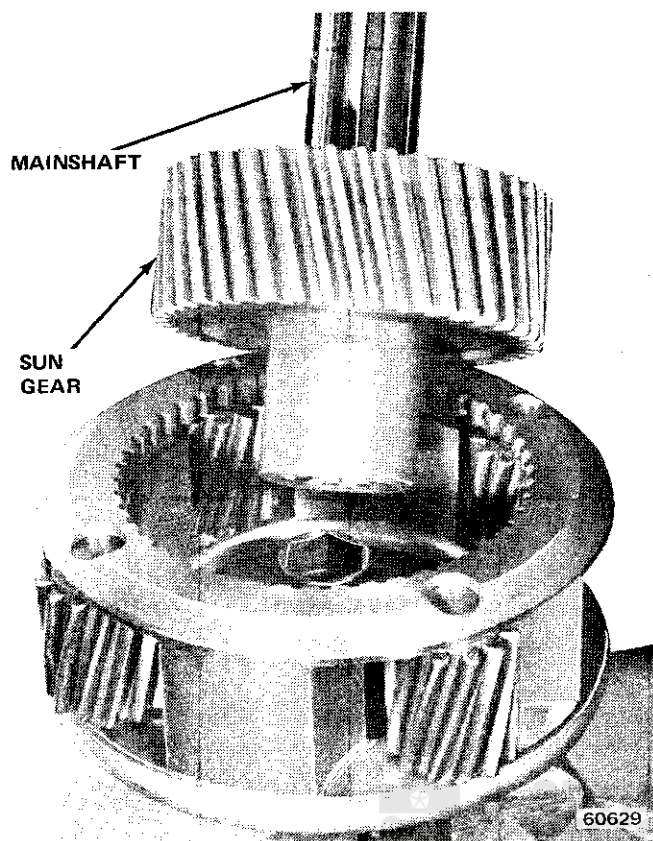


Fig. 2D-31 Sun Gear and Main Shaft Removal

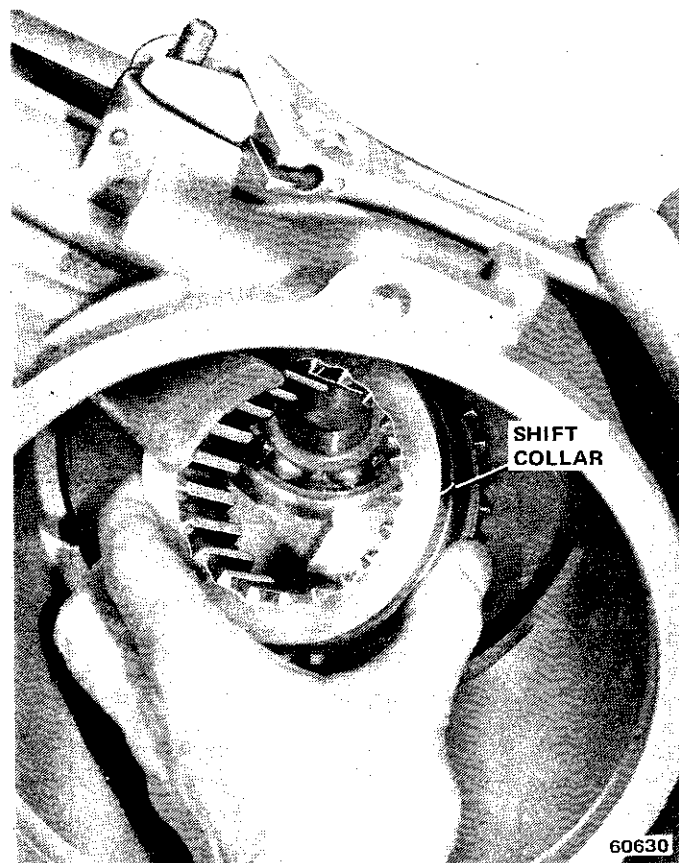


Fig. 2D-32 Shift Collar Removal/Installation

### Annular Bearing Replacement

(1) Remove rear snap ring and annular bearing (fig. 2D-33).

**NOTE:** The rear snap ring is a select-fit component and is available in thickness ranges of: 0.086 to 0.088 inch (2.18 to 2.23 mm), 0.089 to 0.091 inch (2.26 to 2.31 mm), 0.092 to 0.094 inch (2.33 to 2.38 mm), 0.095 to 0.097 inch (2.41 to 2.46 mm), and 0.098 to 0.100 inch (2.48 to 2.54 mm). The front snap ring should be 0.086 to 0.088 inch (2.18 to 2.23 mm).

(2) Install front snap ring and bearing. Install thickest rear snap ring that will seat completely.

### Housing Disassembly

(1) Remove shift fork locating pin with pliers. Use pulling-rotating motion to remove pin (fig. 2D-34).

(2) Remove large expansion plug.

(3) Remove shift rail taper plugs.

(4) Remove control lever from shift lever assembly.

(5) Remove shift fork retaining pin using 3/16-inch pin punch (fig. 2D-35). Drive pin completely out of shift fork and rail.

(6) Slide shift rail forward and out of shift fork. Remove shift fork.

(7) Remove shift rail poppet ball.

(8) Drive poppet taper plug into shift rail bore and remove plug and poppet spring.

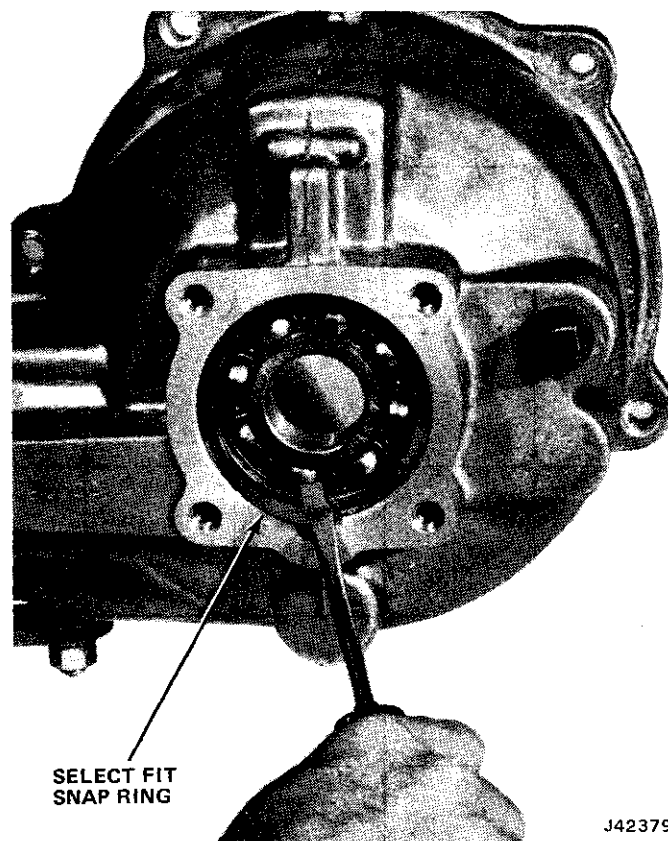


Fig. 2D-33 Rear Annular Bearing Snap Ring Removal



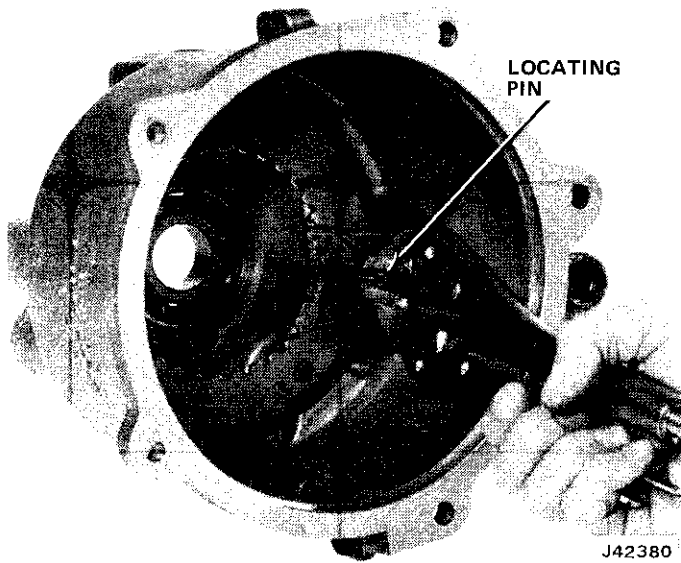


Fig. 2D-34 Shift Fork Locating Pin Removal

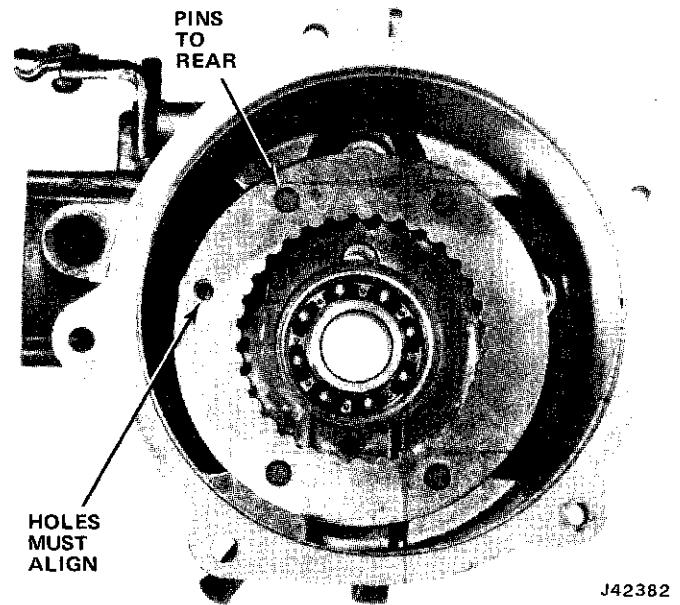


Fig. 2D-36 Holding Plate Installation

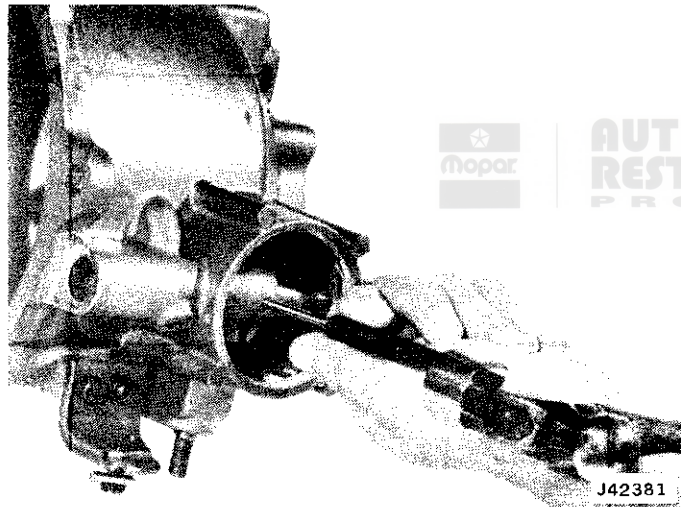


Fig. 2D-35 Shift Fork Retaining Pin Removal

(9) Remove shift lever retaining pin and shift lever assembly.

(10) Remove reduction holding plate retaining snap ring and remove reduction holding plate.

### Reduction Unit Assembly

(1) Install reduction holding plate in case. Holding plate locating pins must face interior of case and index in case (fig. 2D-36).

**NOTE:** Be sure to align the shift fork locating pin holes in the holding plate and housing (fig. 2D-36).

(2) Install reduction holding plate retaining snap ring. Snap ring tabs must face forward. Be sure snap ring seats completely in groove and clears shift fork.

(3) Install shift fork locating pin. Be sure pin is inserted completely through holding plate and is seated in housing.

(4) Insert shift lever (without O-ring) into housing with lever end of fork facing rearward.

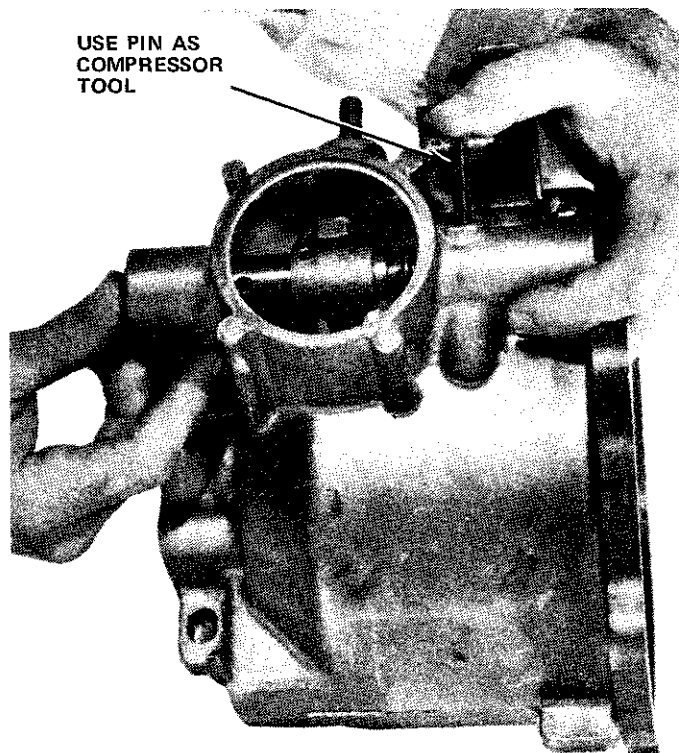
(5) Install O-ring seal in shift lever shaft seal groove (fig. 2D-37).

(6) Move shift lever inward just far enough to allow installation of shaft tapered locating pin.



Fig. 2D-37 Shift Lever O-Ring Installation

- (7) Install shaft tapered locating pin.
- (8) Insert shift rail, grooved end first, into shift fork and into rear shift rail bore in case.
- (9) Rotate shift rail until flat on side of rail is adjacent to poppet spring.
- (10) Slide shift rail inward far enough to allow shift fork to mesh with shift lever and shift rail.
- (11) Push rail through shift fork until end of rail is flush with edge of poppet bore.
- (12) Place poppet ball on end of spring.
- (13) Compress poppet ball and spring using shift fork retaining pin as compressor tool (fig. 2D-38).
- (14) Slide shift rail over poppet ball as far as retaining pin will allow.
- (15) Remove pin and move shift rail to first detent position.
- (16) Rotate shift rail until flat on side of rail faces shift lever and retaining pin bores in rail and fork are aligned.
- (17) Slide shift fork onto shift rail and align retaining pin holes.
- (18) Install retaining pin until pin is flush with exterior surface of shift fork (fig. 2D-39).
- (19) Install shift rail taper plugs, poppet bore taper plug, and shift rail cover expansion plug.
- (20) Install shift fork locating pin.
- (21) Install control lever on shift lever.
- (22) Install shift collar as follows:
  - (a) Position shift fork in neutral (center) detent.



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Fig. 2D-38 Shift Rail and Poppet Ball Installation

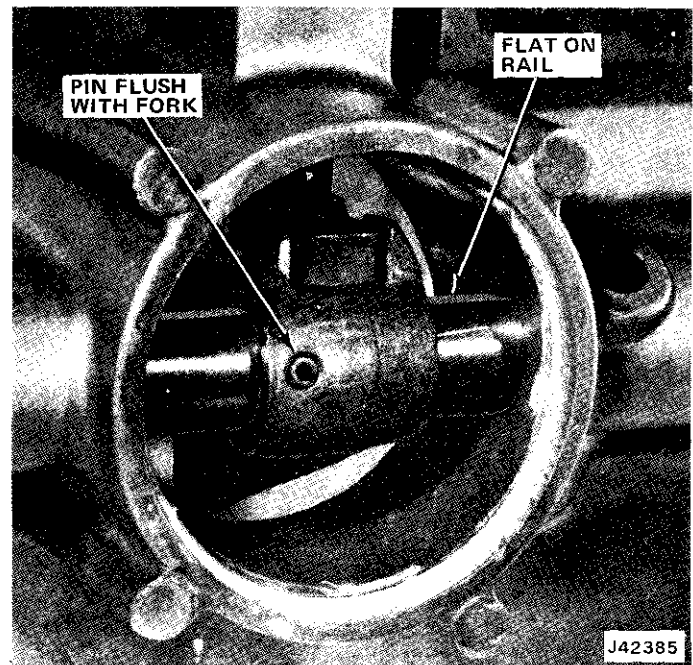


Fig. 2D-39 Shift Rail Installation

- (b) Place shift collar outer teeth in mesh with holding plate inner teeth. Shift fork groove in collar must be positioned just forward of shift fork.
  - (c) Move shift fork to rear detent position.
  - (d) Move shift collar rearward and away from fork until groove in collar aligns with fork.
  - (e) Move collar toward fork to engage shift fork in collar groove.
- (23) Install needle bearing and collar hub on shift collar hub (fig. 2D-40).
  - (24) If ring gear was disassembled, install collar, collar plate hub, and retaining snap rings (fig. 2D-41).
  - (25) Install ring gear assembly on top of collar hub with open end of ring gear facing upward (fig. 2D-42).
  - (26) Install needle bearing, pinion cage lock plate, and another needle bearing on that part of shift collar hub that extends through ring gear.
  - (27) Slide assembled parts toward edge of workbench just far enough to expose bore in shift collar hub.

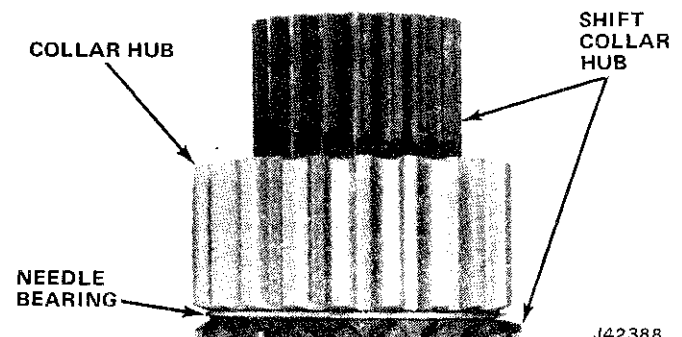
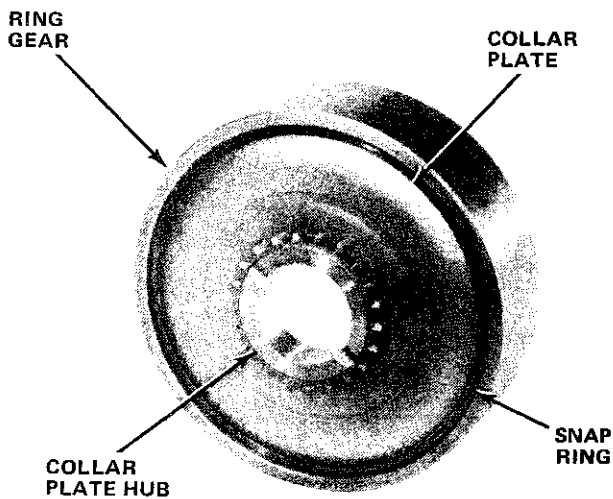
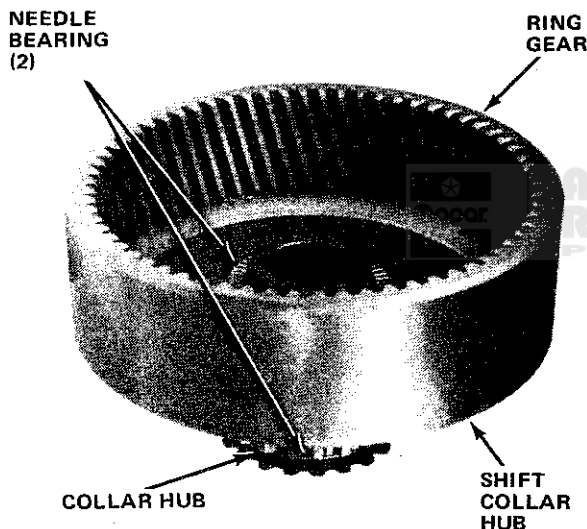


Fig. 2D-40 Needle Bearing and Reduction Collar Hub Installed on Shift Collar Hub



J42387

Fig. 2D-41 Ring Gear Assembly



J42389

Fig. 2D-42 Ring Gear Installed on Reduction Collar Hub

(28) Support assembly with one hand and insert main shaft into bore of shift collar hub with other hand. Be sure main shaft and sun gear are fully seated.

(29) Install main shaft and sun gear through open end of ring gear.

(30) Hold assembled parts firmly together. Raise assembly and position assembly on socket (mounted in vise) used to support reduction unit during disassembly.

(31) Install needle bearing and direct drive sleeve on main shaft.

(32) Align splines on assembled parts and install housing (fig. 2D-29). Be sure housing is seated firmly against direct drive sleeve.

(33) Install rear spacer and snap ring. Be sure snap ring is fully seated in snap ring groove.

**NOTE:** The snap ring is a select-fit component and is available in the following thickness ranges: 0.089 to 0.091 inch (2.26 to 2.31 mm), 0.092 to 0.094 inch (2.33 to 2.38 mm), 0.095 to 0.097 inch (2.41 to 2.46 mm), 0.099 to 0.101 inch (2.51 to 2.56 mm), and 0.103 to 0.105 inch (2.61 to 2.66 mm). Install the thickest snap ring possible to provide 0.004-0.009 inch (0.10-0.22 mm) spacer clearance.

(34) Install power takeoff cover and gasket. Tighten cover attaching bolts to 20 foot-pounds (27 N•m) torque.

(35) Remove assembled unit from support socket and install pinion cage.

(36) Remove socket from vise.

## TRANSFER CASE SERVICE—IN-VEHICLE

### Front/Rear Output Shaft Seal Replacement

(1) Raise vehicle.

(2) If front output shaft seal is to be replaced, place support stand under transmission and remove rear crossmember.

(3) Mark propeller shaft and transfer case yoke for assembly alignment reference.

(4) Disconnect propeller shaft at transfer case yoke. Secure shaft to frame rail using wire.

(5) Remove yoke retaining nut using socket, socket handle, and tool J-8614-01 (fig. 2D-8).

(6) Remove yoke using tools J-8614-01, J-8614-02, and J-8614-03 (fig. 2D-9).

(7) Remove shaft seal using tool J-25180.

(8) Install replacement seal using tool J-25160.

(9) Install yoke, washer, and replacement retaining nut on shaft.

(10) Install tool J-8614-01 on yoke to prevent yoke from turning and tighten yoke retaining nut to 120 foot-pounds (163 N•m) torque.

(11) Connect propeller shaft to yoke. Index yoke to shaft using alignment marks made at disassembly.

(12) If front seal was replaced, install rear crossmember and remove transmission support stand.

(13) Lower vehicle.

### Rear Cover-Sprockets-Drive Chain Removal

(1) Raise vehicle.

(2) Remove reduction unit, if equipped. Refer to Reduction Unit Removal.

**NOTE:** The reduction unit cage will remain in the transfer case when the reduction unit is removed.

(3) Remove transfer case drain plug and drain lubricant.

(4) Mark rear propeller shaft and yoke for assembly alignment reference.

(5) Disconnect rear propeller shaft at transfer case yoke.

- (6) Mark emergency drive control diaphragm vacuum hoses for assembly reference and disconnect hoses.
- (7) Disconnect emergency drive indicator switch wire.
- (8) Disconnect speedometer cable.
- (9) Remove emergency drive indicator switch.
- (10) Disengage parking brake cable guide from pivot on right-side frame rail.
- (11) On CJ-7 models, place support stand under transmission and remove rear crossmember.
- (12) Remove bolts attaching rear cover assembly to front cover.

- (13) Remove rear cover assembly. Slide cover assembly backward until disengaged with transmission output shaft and front output shaft.

**Rear Cover-Sprockets-Drive Chain Disassembly**

- (1) Remove rear output shaft yoke using tools J-8614-01, J-8614-02, and J-8614-03 (fig. 2D-9).
- (2) If not equipped with reduction unit, remove power takeoff cover and seal ring (fig. 2D-43).

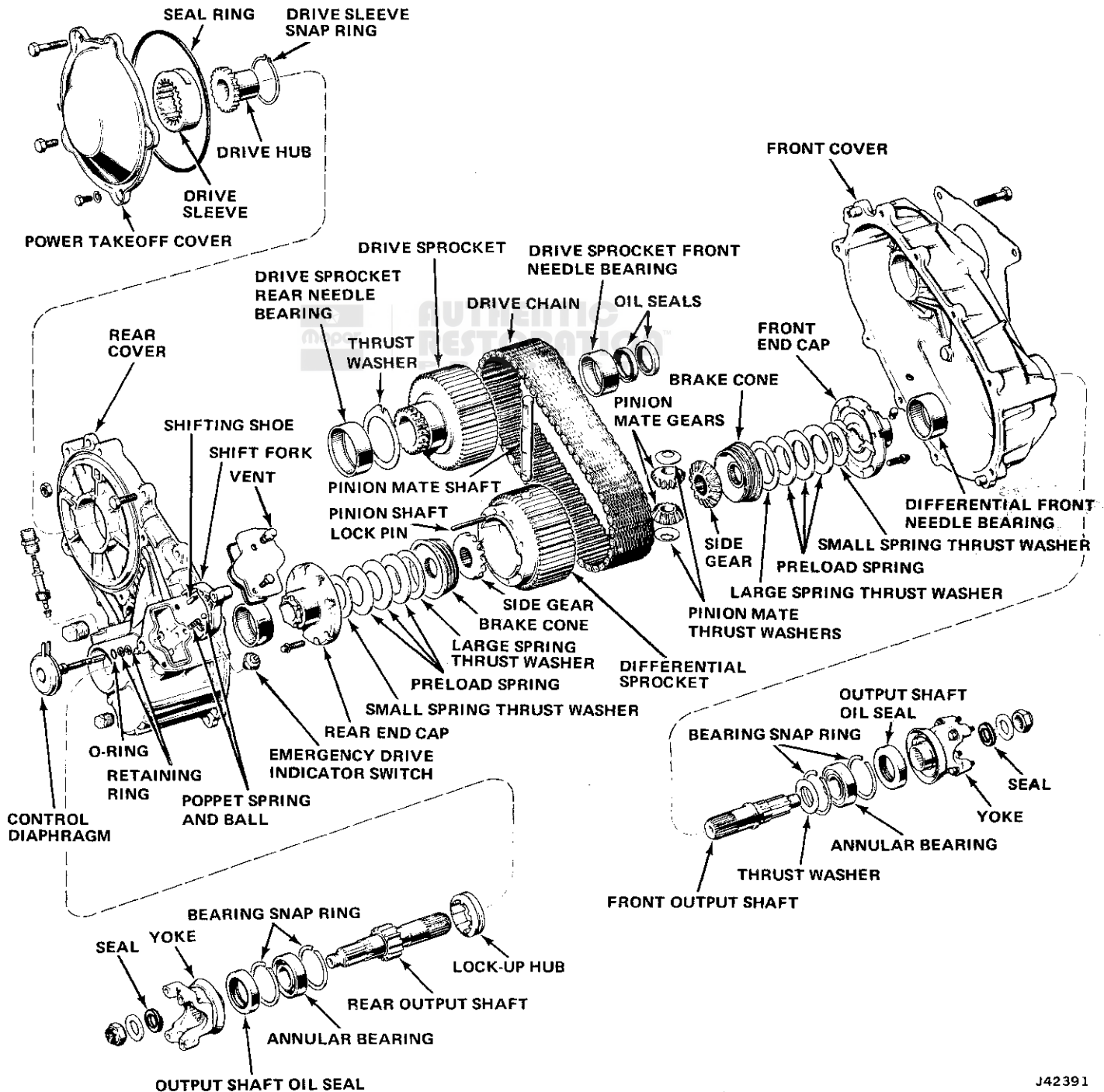


Fig. 2D-43 Quadra-Trac Transfer Case Components

## 2D-30 TRANSFER CASE

(3) Position rear cover assembly so differential sprocket is resting on workbench and drive sprocket is resting on wood block that is 2 X 4 X 6 inches (5.08 X 10.16 X 15.24 cm) long (fig. 2D-44).

(4) If not equipped with reduction unit, expand drive sleeve internal snap ring and remove drive hub and sleeve from drive sprocket rear splines.

**NOTE:** The snap ring expanding tabs are accessible through a slot in the outside edge of the drive sleeve.

(5) If equipped with reduction unit, remove pinion cage snap ring and carrier.

(6) Lift rear cover upward and off drive and differential sprockets.

**NOTE:** The cover, rear output shaft, bearings, and seal, drive sprocket rear needle bearing, and lockup hub may be serviced without disassembling other units. Refer to Transfer Case Disassembly.

(7) Slide drive sprocket toward differential sprocket and remove drive chain from sprockets.

**NOTE:** The differential sprocket may be serviced without disassembling any of the other components. Refer to Transfer Case Disassembly.

(8) Remove sealer from front and rear cover mating surfaces using a razor blade or gasket scraper with sharp blade.

(9) Clean all components thoroughly with solvent and dry using compressed air or clean shop cloths.

(10) Inspect components for wear or damage and replace as necessary.

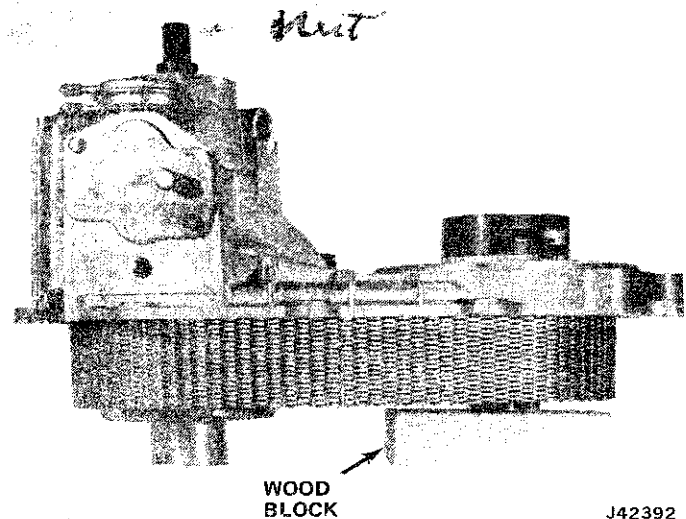


Fig. 2D-44 Rear Cover, Drive Chain and Sprockets Positioned for Disassembly

## Rear Cover-Sprockets-Drive Chain Assembly

(1) Position drive sprocket on wood block.

(2) Position differential sprocket on workbench approximately 2 inches (5.08 cm) from drive sprocket (fig. 2D-45).

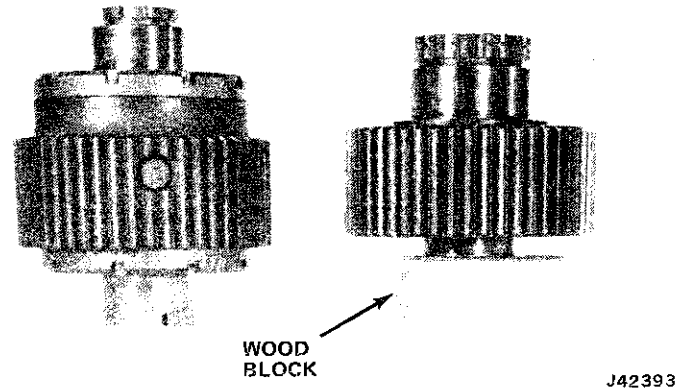


Fig. 2D-45 Differential and Drive Sprockets Positioned for Chain Installation

(3) Install drive chain on drive sprocket and differential sprocket (fig. 2D-46).

**NOTE:** Be sure the drive chain is fully engaged with the sprocket and differential teeth and that all slack is removed from the chain.

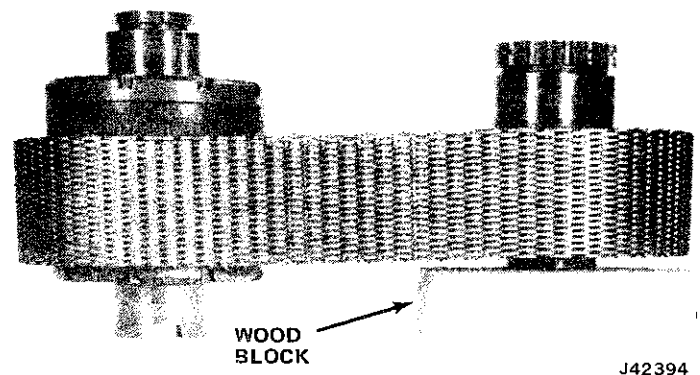


Fig. 2D-46 Drive Chain Installed on Differential and Drive Sprockets

(4) Insert rear output shaft into differential.

(5) Move lockup hub rearward in case cover. Lubricate drive sprocket thrust washer with petroleum jelly and position on case cover (fig. 2D-47).

(6) Align and install rear cover on drive and differential sprockets. Rotate output shaft to align shaft with lockup hub if necessary. Be sure drive sprocket thrust washer is not displaced during installation.

(7) If equipped with reduction unit, install pinion cage. Be sure snap ring is fully seated in groove.

(8) If not equipped with reduction unit, assemble and install drive hub, drive sleeve, and snap ring. Be sure drive sleeve snap ring seats completely in groove.

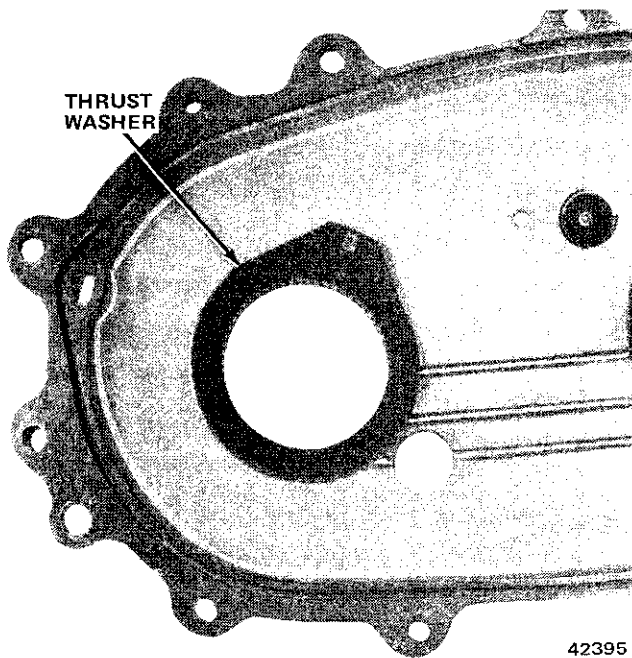


Fig. 2D-47 Drive Sprocket Thrust Washer Installation

(9) Rotate drive sleeve or pinion cage to be sure drive sprocket thrust washer was not displaced during cover installation. Unit must turn easily without binding.

(10) If not equipped with reduction unit, install power takeoff cover seal ring and cover. Tighten cover attaching bolts to 20 foot-pounds (27 N•m) torque.

(11) Install speedometer gear on rear output shaft (fig. 2D-48).

(12) Install rear output shaft oil seal using tool J-25160 (fig. 2D-49).

(13) Install rear yoke, washer, and replacement retaining nut. Tighten nut securely but not to specified torque at this time.

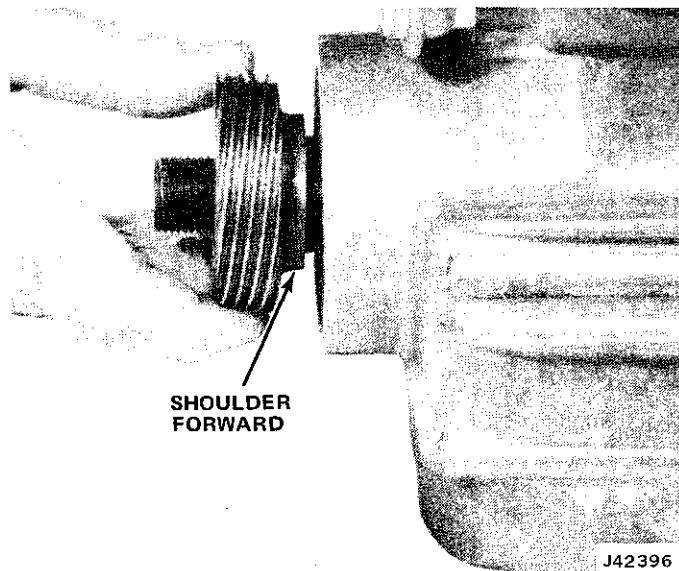


Fig. 2D-48 Speedometer Drive Gear Installation

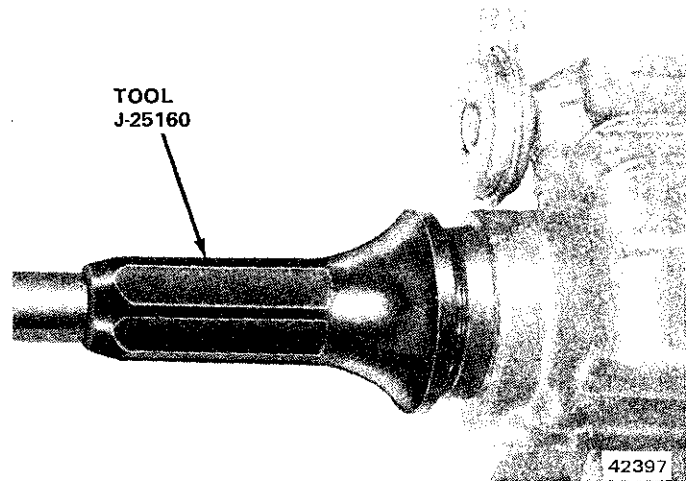


Fig. 2D-49 Rear Output Shaft Seal Installation

### Rear Cover-Sprockets-Drive Chain Installation

(1) Apply 1/16 inch (1.58 mm) wide bead of silicone-type sealer to mating surface of transfer case front cover.

(2) Install two 3/8-16 by 2 inch (5.08 cm) long pilot studs in front cover.

(3) Move rear cover assembly forward and into engagement with front output shaft and transmission output shaft.

**NOTE:** If necessary, rotate the rear output shaft slightly to engage the two sets of splines.

(4) Move rear cover assembly forward until it seats on case.

(5) Remove two pilot studs installed previously and install rear cover-to-front cover attaching bolts. Tighten bolts to 20 foot-pounds (27 N•m) torque.

(6) Install emergency drive indicator switch and connect signal switch wire to switch.

(7) Connect diaphragm control vacuum hoses. Be sure to attach hoses according to index marks made at disassembly.

(8) Connect speedometer cable.

(9) Install tool J-8614-01 on rear yoke and tighten yoke retaining nut to 120 foot-pounds (163 N•m) torque.

(10) Connect rear propeller shaft to yoke. Be sure to align shaft and yoke using alignment marks made at disassembly. If necessary, raise rear wheels so shaft can be turned to permit shaft and yoke alignment.

(11) Connect parking brake cable guide to pivot.

(12) If equipped with reduction unit, install reduction unit and connect shift linkage.

(13) On CJ-7 models, install rear crossmember and remove transmission support stand.

(14) Fill transfer case and reduction unit, if equipped, with specified lubricant. Refer to Lubrication and Stick Slip Correction.

(15) Lower vehicle.

**TRANSFER CASE SERVICE—OUT-OF-VEHICLE****Transfer Case Removal**

Transfer case removal is not required except when the front output shaft, front annular bearing, transmission output shaft seals or the transfer case front cover require service. The drive chain, drive sprocket, differential, diaphragm control, needle bearing, thrust washer, or rear output shaft are serviced in the vehicle by removing the transfer case rear cover. Refer to Rear Cover-Sprockets-Drive Chain Removal under Transfer Case Service—In-Vehicle.

- (1) Raise vehicle.
- (2) On Cherokee, Wagoneer and Truck models equipped with low range reduction unit, remove reduction unit. Refer to Reduction Unit Removal.
- (3) Mark transfer case front and rear output shaft yokes and propeller shafts for assembly alignment reference.
- (4) Mark Emergency Drive control diaphragm vacuum hoses for assembly reference and disconnect hoses.
- (5) Disconnect Emergency Drive indicator switch wire.
- (6) Disconnect speedometer cable.
- (7) On CJ-7 models, place support stand under transmission and remove rear crossmember.
- (8) Mark transfer case front and rear output shaft yokes and propeller shafts for assembly alignment reference.
- (9) Disconnect front and rear propeller shafts at transfer case yokes. Secure shafts to frame rails with wire.
- (10) Disconnect parking brake cable guide from pivot located on right frame rail.
- (11) Remove bolts attaching exhaust pipe support bracket to transfer case.
- (12) Remove two transfer case-to-transmission bolts which enter from front side of vehicle.
- (13) Remove two transfer case-to-transmission bolts which enter from rear of vehicle and install 7/16-14 by 5-inch (12.70 cm) long guide pin in each hole.

**NOTE:** *If the guide pins are difficult to install, the transfer case attaching bolts may have created burrs on the bolt hole edges. Remove these burrs using a penknife or small file.*

(14) Move transfer case assembly rearward until free of transmission output shaft and guide pins and remove assembly.

(15) Remove all gasket material from rear of transmission.

**Transfer Case Installation**

(1) Apply Permatex No. 3, or equivalent sealer, to both sides of transfer case-to-transmission gasket and position gasket on transmission.

(2) Install guide pins in upper and lower threaded holes in transmission adapter.

(3) Align and install transfer case assembly on transmission. Be sure drive hub splines are aligned with transmission output shaft. Align splines by rotating transfer case rear output shaft yoke if necessary.

**NOTE:** *Do not install any transfer case attaching bolts until the transfer case is completely seated against the transmission.*

(4) Install transfer case attaching bolts. Tighten bolts to 40 foot-pounds (54 N•m) torque.

(5) Remove guide pins and install remaining transfer case attaching bolts. Tighten bolts to 40 foot-pounds (54 N•m) torque.

(6) Attach exhaust pipe support bracket to transfer case.

(7) Align and connect propeller shafts.

(8) Connect emergency drive indicator switch wire.

(9) Connect emergency drive control diaphragm vacuum hoses. Be sure to connect hoses according to alignment marks made at disassembly.

(10) Connect parking brake cable guide to pivot bracket on right side frame rail.

(11) On CJ-7 models, install rear crossmember and remove transmission support stand.

(12) On Cherokee, Wagoneer and Truck models, install low range reduction unit, if equipped.

(13) Fill transfer case and reduction unit with specified lubricant. Refer to Lubrication.

(14) Lower vehicle.

**Drive Sprocket Oil Seal Replacement**

**NOTE:** *Although the drive sprocket oil seals can be replaced without disassembling the transfer case, the transfer case must be removed from the vehicle in order to replace these seals.*

(1) Remove seals using J-type puller or smooth-ended pry bar. Do not damage case bore during seal removal.

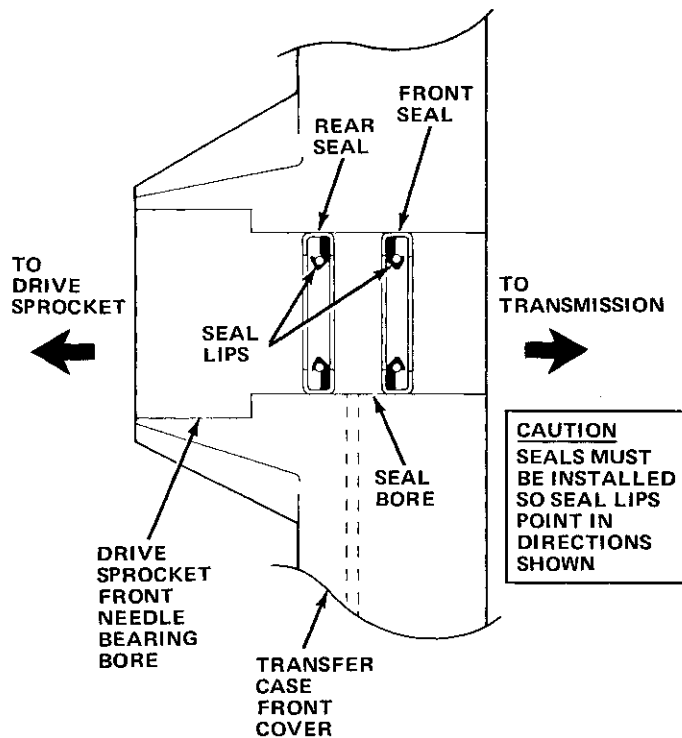
(2) Insert replacement rear seal in case bore with seal lip facing interior of transfer case (fig. 2D-50).

(3) Seat rear seal using Driver Tool J-25213 and Sleeve J-25213-1 (fig. 2D-51). Install seal until shoulder of sleeve tool contacts case front surface.

(4) Remove driver and sleeve tools.

(5) Insert replacement front seal in case bore with seal lip facing away from transfer case and toward open end of case bore (fig. 2D-50).

(6) Seat front seal using Driver Tool J-25213 and Sleeve J-25213-1. Install seal until tool shoulder contacts case front surface (fig. 2D-51).



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Fig. 2D-50 Positioning Drive Sprocket Oil Seals

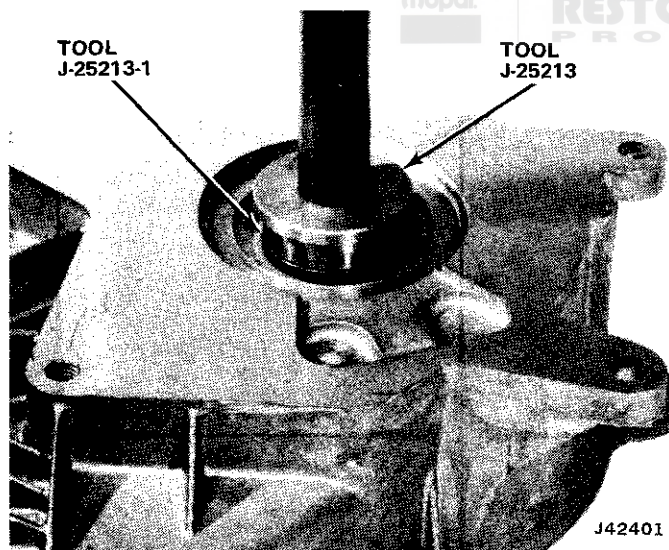


Fig. 2D-51 Seating Drive Sprocket Oil Seals

### Transfer Case Disassembly

- (1) Remove front and rear output shaft yoke retaining nuts and washers using socket, breaker bar, and tool J-8614-01 (fig. 2D-8).
- (2) Remove front and rear yokes using tools J-8614-01, J-8614-02, and J-8614-03 (fig. 2D-9).
- (3) If not equipped with reduction unit, remove power takeoff cover and seal ring.
- (4) Remove transfer case rear cover-to-front cover attaching bolts.
- (5) Separate rear cover assembly from front cover.

**NOTE:** The front cover, front output shaft, bearings, and seals may be serviced at this time without removing the chain or sprockets.

(6) Position rear cover assembly so differential is resting on workbench and drive sprocket is resting on wood block that is 2 by 4 by 6 inches (5.08 by 10.16 by 15.24 cm) long (fig. 2D-44).

(7) If not equipped with reduction unit, expand drive sleeve snap ring and remove drive hub and drive sleeve.

**NOTE:** The snap ring expanding tabs are accessible through a slot in the outside edge of the drive sleeve.

(8) If equipped with reduction unit, remove pinion cage from drive sprocket rear splines.

(9) Remove case cover from drive and differential sprockets. Case cover, rear output shaft, bearings and seal, drive sprocket, rear needle bearings, and lockup hub may be serviced without further disassembly.

(10) Slide drive sprocket toward differential sprocket and remove chain.

### Subassembly Overhaul

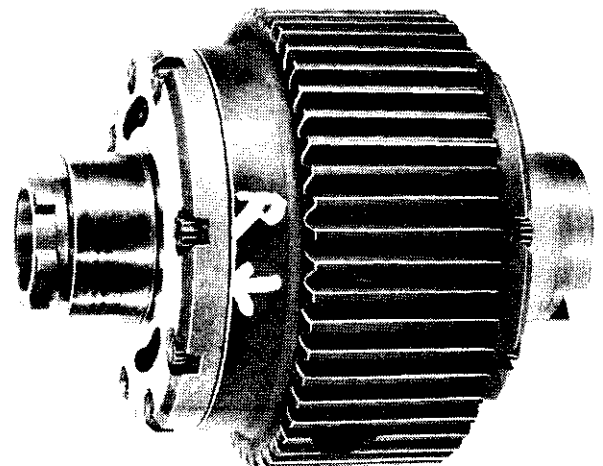
#### Differential Sprocket

The differential sprocket is serviced as an assembly only. However, the differential may be disassembled for inspection and cleaning.

If the differential is disassembled, be sure the side gears, brake cones, preload springs, and thrust washers are identified and kept together as matched sets. The side gears, brake cones, preload springs, and thrust washers must be reinstalled in their original order.

#### Disassembly

- (1) Paint alignment marks on differential sprocket and both end caps for assembly reference (fig. 2D-52).



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Fig. 2D-52 Differential Sprocket and End Caps Marked for Assembly Reference



## 2D-34 TRANSFER CASE

(2) Remove screws attaching front end cap to sprocket and remove end cap.

**NOTE:** *It may be necessary to tap the cap with a plastic hammer to remove it.*

(3) Remove thrust washers, preload springs, brake cone, and side gear from sprocket.

**NOTE:** *Keep these components together and identify them as a matched set.*

(4) Invert sprocket and remove screws attaching rear end cap and remove cap from case sprocket.

**NOTE:** *It may be necessary to tap the end cap with a plastic hammer to remove it.*

(5) Remove thrust washers, preload springs, brake cone and side gear from case sprocket.

**NOTE:** *Keep these components together and identify them as a matched set.*

(6) Raise sprocket off bench. Pinion shaft lockpin should fall free. If necessary, remove pin using 1/4-inch (6.35 mm) pin punch.

(7) Remove pinion mate shaft from case sprocket using brass drift and hammer.

**CAUTION:** *Do not damage the pinion mate thrust washers.*

### Cleaning

Wash all parts thoroughly in clean solvent. Be sure all lubricant and metal particles are removed from all surfaces of every component. Maintain the side gears, brake cones, preload springs, and thrust washers as matched sets.

### Inspection

Inspect the differential sprocket. The tapered brake cone friction surfaces and pinion gear thrust surfaces may be highly polished, however, this is normal. Very small but smooth score marks and original machining marks are permissible. If score marks are deep or wear is excessive, replace the differential as an assembly.

Check the pinion mate shaft bores. If the bores are severely scored or worn, replace the assembly. If the bores appear to be highly polished only, do not replace the assembly, this is a normal condition. Trial fit the shaft in the bores; The shaft should fit tightly.

The differential sprocket teeth may show a polished wear pattern. However, deep ridges and valleys on the teeth indicate excessive wear and replacement is required.

Inspect the pinion mate gears, washers, and shaft. The gear teeth should be free of chip marks, however, machine tool marks or a rough appearance are normal. The thrust surfaces and shaft bores may appear to be highly polished and have some tarnished spots; this is a

normal condition. Replace the assembly only if any component is galled, deeply scored, cracked, broken, or excessively worn.

The thrust washers should be smooth and should conform to their mating surfaces. Distortion or galling is not acceptable. The shaft should be straight and fit tightly in the sprocket. A polished wear pattern is normal. Galling, grooves, or wear on the shaft is not acceptable.

The side gear teeth should be free of chip marks. However, a rough machined look is normal. The thrust surfaces and shaft splines may be highly polished with some slightly tarnished spots, however, this is normal. Galling or measurable wear is not acceptable.

### Brake Cones

It is normal for the spiral tapered cone brake surfaces to be highly polished. Also, very small but smooth score marks and original machining marks are permissible. Replace the assembly if rough score marks or severe wear are in evidence.

The thrust washers should be flat and smooth. Light scratches and a slight circular wear pattern are normal. However, replace the assembly if any component is severely worn, warped, or galled.

The preload springs should be coned to a height of approximately 1/4 inch (6.35 mm) and must also be smooth. Light scratches and a slight circular wear pattern are normal. Replace the assembly if any component exhibits severe wear, warping, galling, or has lost its cone shape (become flat).

The end cap bearing and thrust surfaces must be smooth. Deep pitting, galling, and scoring indicate replacement is required.

### Assembly

**NOTE:** *During assembly, all bearing and thrust surfaces must be prelubricated with Jeep Quadra-Trac Lubricant or equivalent only.*

(1) Slide pinion mate shaft into differential sprocket to depth of 3 inches (7.62 cm).

(2) Install pinion mate thrust washers and gears on shaft in proper order (fig. 2D-43).

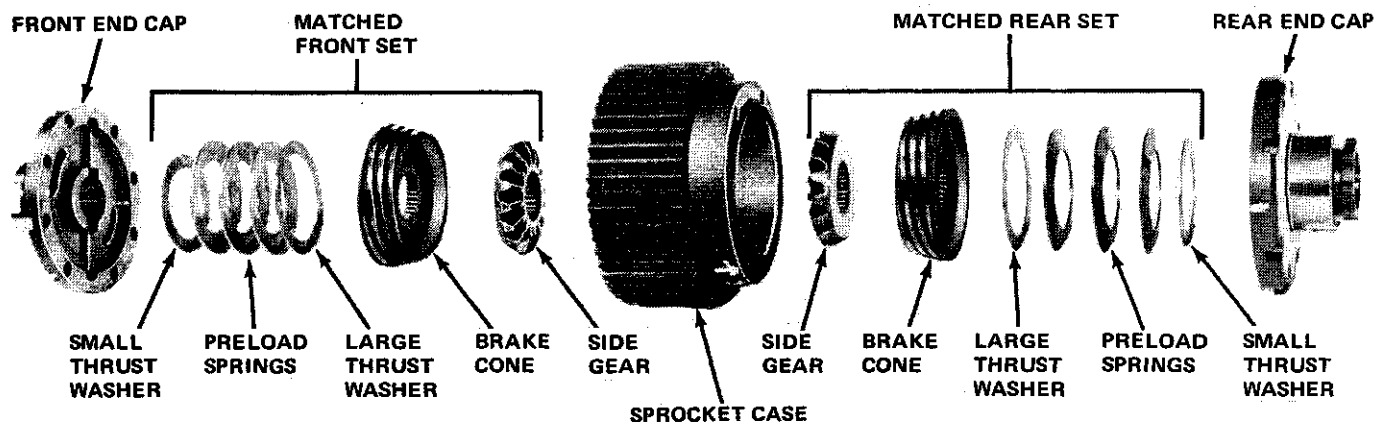
(3) Align pinion mate shaft lockpin hole with lockpin hole in case sprocket. Drive pinion mate shaft into sprocket until lockpin holes are aligned.

**NOTE:** *Alignment can be checked by looking through the lockpin hole in the sprocket.*

(4) Slide pinion mate gears apart until side gears press washers against sprocket (fig. 2D-53).

(5) Mesh appropriate (front or rear) side gear with pinion mate gears.

(6) Position appropriate brake cone over side gear and in sprocket.



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Fig. 2D-53 Differential Sprocket Assembly Sequence

- (7) Place large thrust washer on brake cone.
- (8) Place preload springs against thrust washer. Be sure concave side of springs face brake cone.
- (9) Lubricate small thrust washer and position it on appropriate end cap.
- (10) Place end cap and thrust washer on end of sprocket.

**NOTE:** Be sure the cap is centered in the preload springs and that the cap is rotated to its original alignment on the sprocket.

- (11) Install end cap attaching screws. Tighten screws alternately and evenly to 27 foot-pounds (37 N•m) torque.
- (12) Invert differential sprocket.
- (13) Install pinion shaft lockpin in sprocket and through pinion mate shaft.
- (14) Engage remaining side gear in pinion mate gears.
- (15) Install remaining brake cone over side gear and in sprocket.
- (16) Place large thrust washer on brake cone.
- (17) Place preload springs against thrust washer. Be sure concave side of springs face brake cone.
- (18) Lubricate remaining small thrust washer and install on remaining end cap.
- (19) Place end cap and thrust washer on sprocket. Be sure cap is centered in preload springs and that cap is rotated to its original alignment on sprocket.
- (20) Install end cap attaching screws hand tight only.
- (21) Using front and rear output shafts as assembly tools, insert shafts into differential.
- (22) Rotate shafts until both are aligned and have entered brake cone splines and side gear splines.
- (23) Tighten end cap attaching screws alternately and evenly to 27 foot-pounds (37 N•m) torque.

## Bearing Replacement

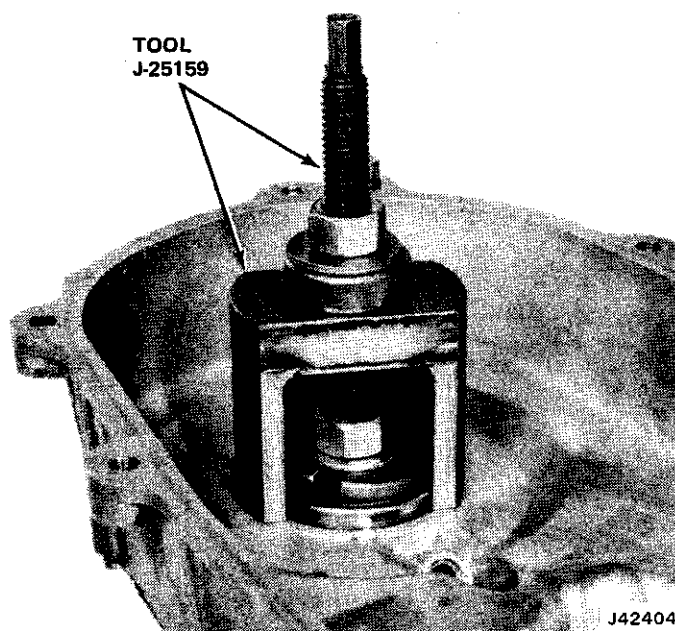
### Needle Bearings

To remove the differential front and rear needle bearings and drive sprocket front needle bearing, use Bearing Remover Tool J-25159 (fig. 2D-54).

Use tool J-25212 (less tool J-25212-1) to install the differential front and rear needle bearings (fig. 2D-55).

Use tool J-25212 with tool J-25212-1 inserted into the case bore to install the drive sprocket front needle bearing.

**NOTE:** The drive sprocket oil seals must be removed in order for the pilot adapter to enter the case bore (fig. 2D-56).



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Fig. 2D-54 Differential Sprocket Front or Rear Needle Bearing Removal

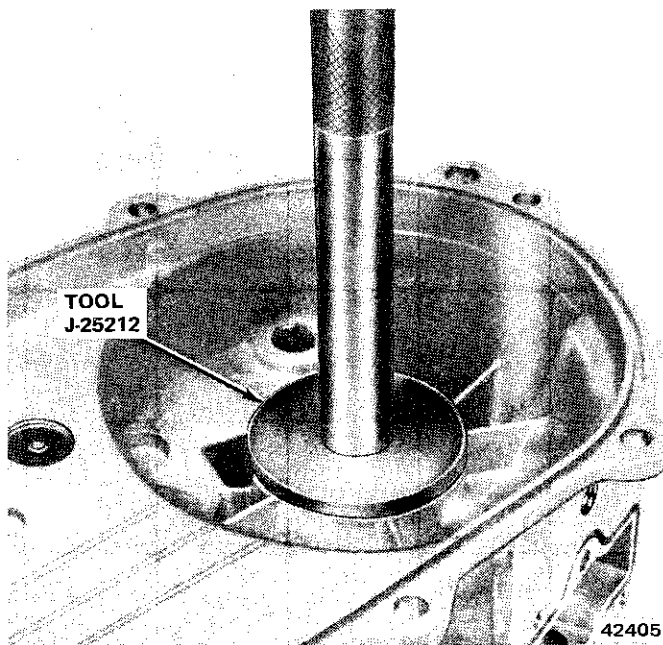


Fig. 2D-55 Differential Sprocket Rear Needle Bearing Installation

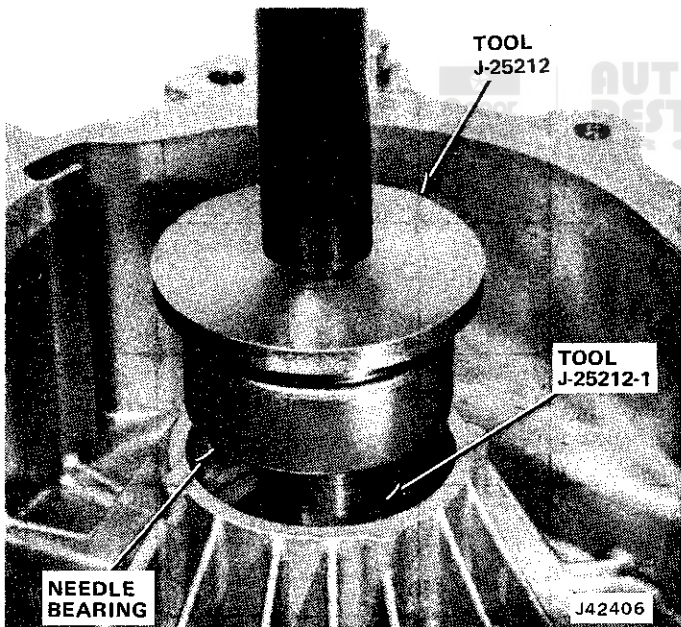


Fig. 2D-56 Drive Sprocket Front Needle Bearing Installation

Remove the drive sprocket rear needle bearing using tools J-25161 and J-25161-1 (fig. 2D-57). It is important that the cover be supported on the side opposite the bearing driver when the bearing is being removed (fig. 2D-57).

Install the drive sprocket rear needle bearing using tools J-25161 and J-25161-1. Tool J-25161 is used to tap the bearing into place while tool J-25161-1 is inserted into the opposite side of the bearing bore to maintain bearing alignment during installation (fig. 2D-58). It is important that the cover be supported on the side opposite the bearing driver when the bearing is installed (fig. 2D-58).

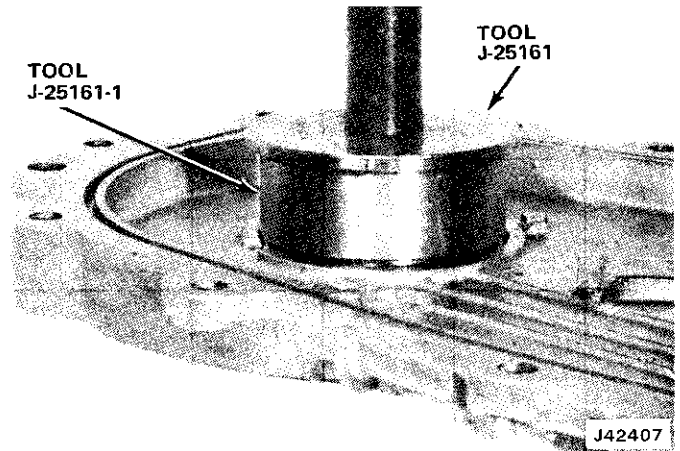


Fig. 2D-57 Drive Sprocket Rear Needle Bearing Removal

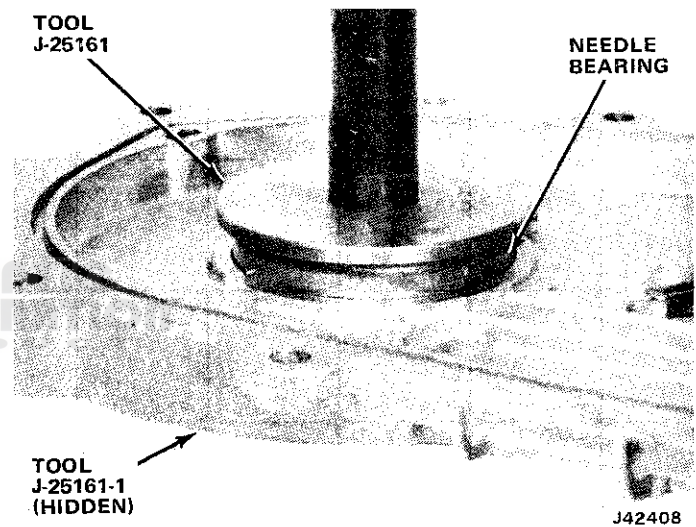


Fig. 2D-58 Drive Sprocket Rear Needle Bearing Installation

### Annular Bearings

**NOTE:** The front and rear output shaft annular bearings are retained in the transfer case front and rear covers by snap rings. The outer snap ring for each bearing is a select-fit part available in four thickness ranges which are: 0.060 to 0.063 inch (1.52 to 1.60 mm), 0.064 to 0.066 inch (1.62 to 1.67 mm), 0.067 to 0.069 inch (1.70 to 1.75 mm), and 0.070 to 0.072 inch (1.77 to 1.82 mm). The inner snap ring for the bearings should always be 0.060 to 0.063 inch (1.52 to 1.60 mm) thick.

- (1) Remove output shaft yoke seal.

**NOTE:** If the rear bearing is being replaced, also remove the speedometer gear.

- (2) Remove outer snap ring.
- (3) Remove annular bearing. Bearing is not a press-fit in bore and can be removed by hand. However, if bearing is tight or if bore is scratched, use brass drift to remove bearing.

(4) Install 0.060-0.063 inch (1.52-1.60 mm) inner snap ring if removed.

(5) Install bearing so shielded side faces interior of bore and tap bearing inward until seated against inner snap ring.

(6) Determine required snap ring thickness using Gauge Tool J-25163. Install thickest snap ring possible that will provide 0.001 to 0.003 inch (0.02 to 0.07 mm) bearing end play.

### Control Diaphragm-Shift Fork-Lockup Hub

#### Removal

(1) Remove vent cover and seal ring.

(2) Remove retaining rings which position shift fork on diaphragm rod.

**NOTE:** The shift fork may be pried slightly forward or rearward to gain access to the retaining rings.

(3) Remove poppet spring from spring bore using magnet.

**NOTE:** The diaphragm control rod is held in position by a poppet ball and spring (fig. 2D-43).

(4) Insert magnet into poppet spring bore and remove control diaphragm (fig. 2D-59).

(5) Remove poppet ball using magnet.

(6) Remove shift fork and shifting shoes.

(7) Remove lockup hub.

#### Installation

(1) Lubricate shifting shoes with Quadra-Trac lubricant, or equivalent, and install shoes in shift fork.

(2) Install lockup hub in shift fork (fig. 2D-60).

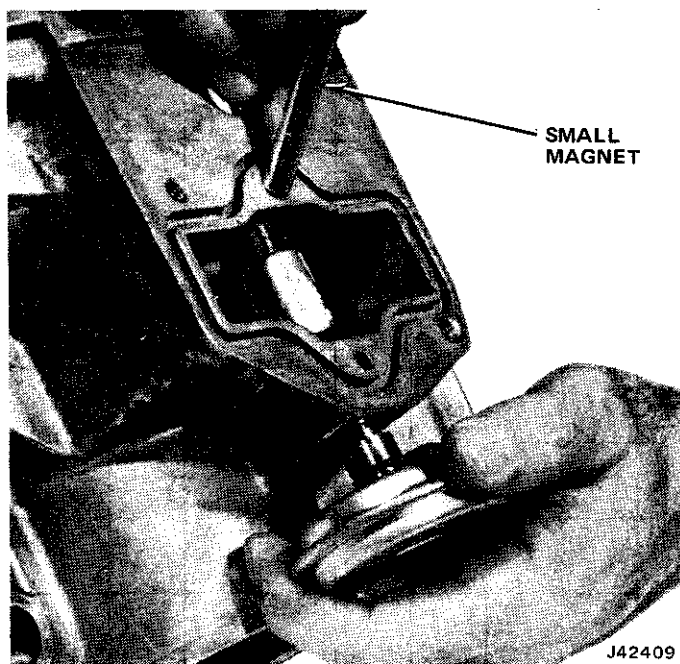


Fig. 2D-59 Control Diaphragm Removal

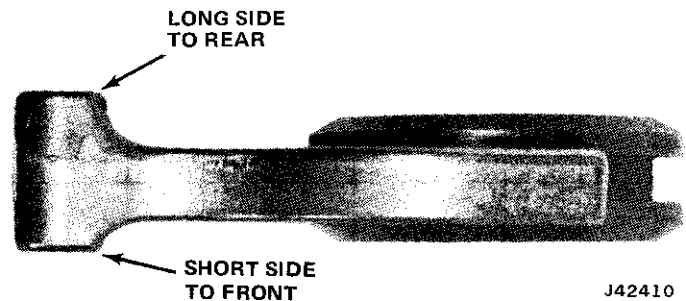


Fig. 2D-60 Assembling Shift Fork and Lockup Hub

(3) Install assembled shift fork and lockup hub in rear cover. Be sure fork is installed so long side of fork boss faces rearward. Reach through differential needle bearing and support fork and hub with fingers to prevent assembly from separating during installation.

(4) Insert control diaphragm rod into cover and through shift fork. Do not insert rod beyond poppet ball and spring bore in cover.

(5) Install poppet spring and ball in cover bore.

(6) Press spring and ball downward using 1/4-inch pin punch and slide control diaphragm rod past poppet ball.

(7) Install shift fork retaining clips.

(8) Install control diaphragm retaining spring. Spring should seat below edge of hole.

(9) Install vent cover seal ring and vent cover.

### Transfer Case Assembly

(1) Remove old sealant from front and rear cover mating surfaces using razor blade or gasket scraper having sharp blade.

(2) Lubricate all bearing and thrust washer surfaces with Jeep Quadra-Trac Lubricant or equivalent only.

(3) Position drive sprocket on wood block (fig. 2D-45).

(4) Position differential sprocket approximately 2 inches (5.08 cm) from drive sprocket and with front end of differential resting on bench.

(5) Install chain around drive and differential sprockets. Be sure chain is properly engaged with sprocket teeth and that all slack is removed from chain (fig. 2D-46).

(6) Insert rear output shaft in differential.

(7) Move lockup hub rearward in case cover.

(8) Lubricate drive sprocket thrust washer with Quadra-Trac lubricant or equivalent only, and install washer on rear cover (fig. 2D-47).

(9) Align and install rear cover on sprockets. Rotate output shaft to align with lockup hub if necessary. Be sure drive sprocket thrust washer is not displaced during cover installation.

(10) Assemble drive hub, drive sleeve, and drive sleeve snap ring (fig. 2D-61).

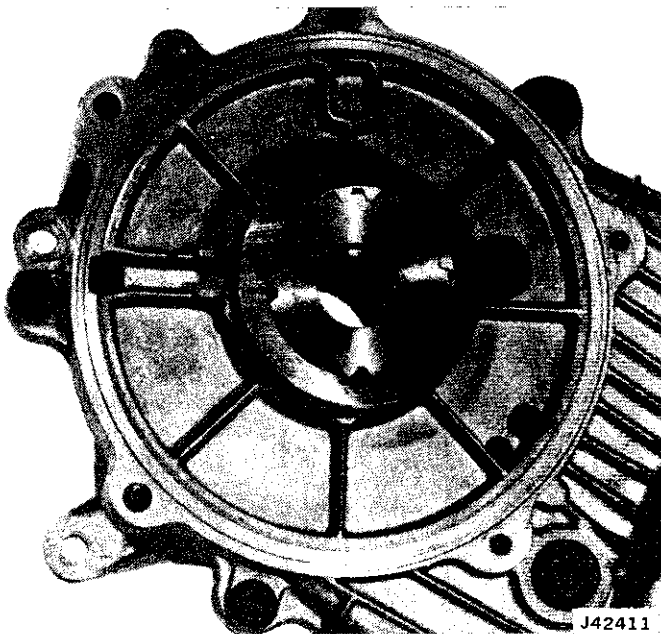


Fig. 2D-61 Drive Hub and Sleeve Installation

(11) If not equipped with reduction unit, install drive sleeve and hub on drive sprocket. Be sure snap ring seats completely.

(12) If equipped with reduction unit, be sure oil baffle is in position, and install pinion cage and snap ring.

(13) Apply 1/16-inch (1.58 mm) thick bead of silicone-type sealer to mating surfaces of transfer case front and rear covers.

(14) Install front output shaft and thrust washer in cover.

(15) Align and install front cover assembly on rear cover assembly.

(16) Install front cover-to-rear cover attaching bolts. Tighten bolts alternately and evenly to 20 foot-pounds (27 N•m) torque.

**CAUTION:** Do not exceed the maximum specified torque for the attaching bolts.

(17) Rotate drive sleeve to be sure drive sprocket thrust washer was not displaced during assembly. The sleeve must turn freely without binding.

(18) Install power takeoff cover seal ring and cover.

(19) Install speedometer gear on rear output shaft (fig. 2D-48).

(20) Install rear output shaft seal using tool J-25160 (fig. 2D-49).

(21) Install rear yoke, washer, and retaining nut. Tighten nut to 120 foot-pounds (163 N•m) torque. Use tool J-8614-01 to hold yoke while nut is tightened.

(22) Install front output shaft seal using tool J-25160.

(23) Install front yoke, washer, and retaining nut. Tighten nut to 120 foot-pounds (163 N•m) torque. Use tool J-8614-01 to hold yoke while nut is tightened.

## SPECIFICATIONS

### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N•m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
<b>Transfer Case</b>				
Breather	8	6-10	11	8-14
Chain Measuring Access Hole Plug	12	6-14	16	8-19
Differential End Cap Bolts	27	24-30	37	33-41
Drain Plug	20	15-25	27	20-34
Fill Plug	20	15-25	27	20-34
Lock-Up Cover to Transfer Case	10	8-10	14	11-14
Emergency Drive Indicator Switch	12	10-15	16	14-20
Output Shaft Nut	120	90-150	163	122-203
Power Takeoff Cover to Transfer Case Bolt:				
3/8-16 Bolts	20	15-25	27	20-34
5/16-18 Bolts	15	10-20	20	14-27
Speedometer Adapter	25	20-30	34	27-41
Front Cover-to-Rear Cover Bolts	20	15-25	27	20-34
Transfer Case to Transmission Extension Bolt	40	30-50	54	41-68
<b>Reduction Unit</b>				
Fill Plug	20	15-25	27	20-34
Reduction Power Takeoff Cover to Case	20	15-25	27	20-34
Reduction Unit to Transfer Case Bolt:				
3/8-16 Bolt/Nut	20	15-25	27	20-34
5/16-18 Bolt/Nut	10	8-10	14	11-14
Shift Lever to Shaft Nut	20	15-25	27	20-34

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Marking chart in Chapter A for torque values not listed above.

**General Specifications**

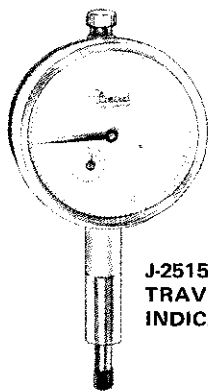
Type . . . . . Automatically Differentiated Constant 4-Wheel Drive  
 Make . . . . . Warner Gear  
 Model . . . . . Quadra-Trac  
 Gear Ratio:  
 High . . . . . 1:1  
 Low (With Reduction Unit) . . . . . 2.57:1

**Lubricants**

Quadra-Trac Transfer Case . . . . . Quadra-Trac Lubricant  
 or equivalent  
 60635

60633

**Tools**



J-25150 ONE-INCH TRAVEL DIAL INDICATOR



J-25167 SHIFT ROD OIL SEAL THIMBLE AND DRIVER INSTALLER TOOLS

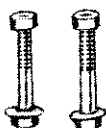


J-25169 SPEEDOMETER DRIVE PINION BUSHING DRIVER

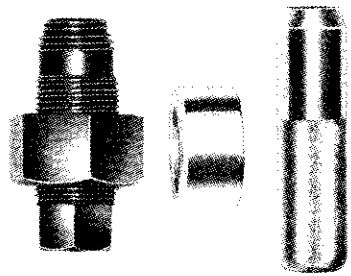
J-25142 INTERMEDIATE SHAFT NEEDLE BEARING ALIGNING ARBOR



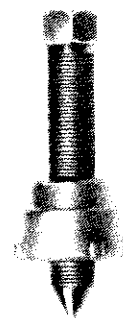
J-25180 OUTPUT SHAFT OIL SEAL REMOVER



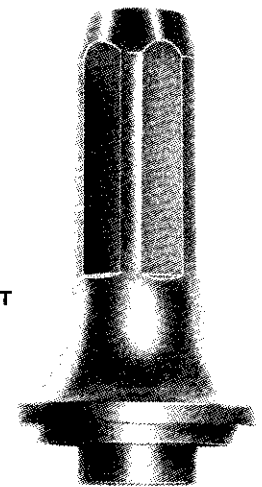
BOLTS (USED WITH J-8614-01)



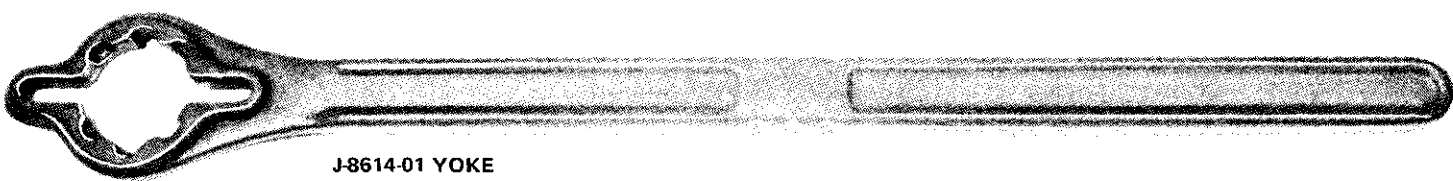
J-25175 SHIFT ROD OIL SEAL REMOVER TOOLS



J-8614-02 AND -03 YOKE REMOVER TOOLS



J-25160 OUTPUT SHAFT OIL SEAL INSTALLER



J-8614-01 YOKE HOLDING WRENCH

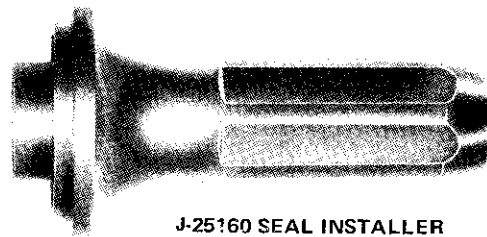
Tools (continued)



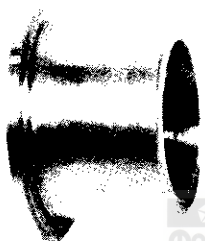
J-25161-1 PILOT



J-25212-1 PILOT ADAPTER



J-25160 SEAL INSTALLER



J-25161 BEARING REMOVER AND INSTALLER



J25212 BEARING INSTALLER



J-25213 SEAL INSTALLER



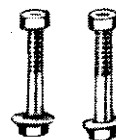
J-25180  
OUTPUT SHAFT  
SEAL REMOVER



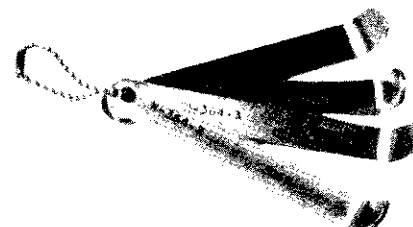
J-25213-1 SLEEVE



J-8614-02 AND -03  
YOKE REMOVER  
TOOLS



BOLTS  
(USED WITH  
J-8614-01)



J-25163 GAUGE SET



J-25162 CHAIN GAUGE



J-25159 BEARING PULLER



J-25122 HANDLE

# PROPELLER SHAFT

# 2E

## SECTION INDEX

	Page		Page
Driveline Vibration	2E-3	Specifications	2E-12
General	2E-1	Tools	2E-13
Lubrication	2E-9	Universal Joint Angle Measurement and Adjustment	2E-9
Propeller Shaft Service	2E-10	Universal Joint Service	2E-10

## GENERAL

Jeep vehicles use tubular propeller shafts to transmit engine torque from the transfer case to the front and rear axles. Universal joints connect each shaft to the transfer case and axle yokes. A splined slip yoke is used at one end of each propeller shaft to compensate for variations in shaft length caused by suspension spring movement.

Because of the various driveline combinations available on Jeep vehicles, several different propeller shaft and universal joint designs are required.

### Propeller Shaft Application

The front propeller shaft on CJ-7, Cherokee, Wagoneer, and Truck models with automatic transmission is connected to the axle yoke with a single cardan universal joint and to the transfer case yoke with a double cardan universal joint (fig. 2E-1).

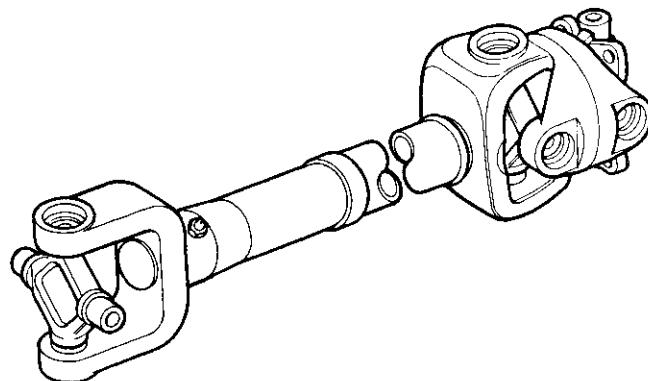
The front propeller shaft on CJ models with manual transmission is connected to both the axle and transfer case yokes with single cardan universal joints. A slip yoke is used at the axle end of the shaft (fig. 2E-2).

The rear propeller shaft on Cherokee and Wagoneer models with automatic transmission and Truck models with manual or automatic transmission is connected to both the axle and transfer case yokes with single cardan universal joints. A slip yoke is used at the transfer case end of the shaft (fig. 2E-3).

The rear propeller shaft on Cherokee models with manual transmission is connected to the transfer case

yoke with a ball and trunnion universal joint and to the axle yoke by a single cardan universal joint (fig. 2E-4). The ball and trunnion joint is a dual-purpose unit serving as both slip yoke and universal joint.

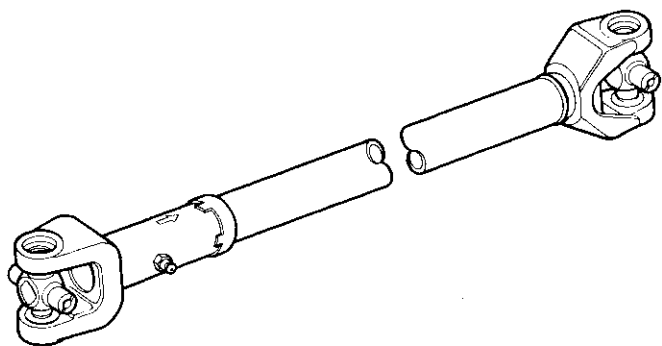
The rear propeller shaft on CJ models with manual or automatic transmission is similar to the front shaft in appearance and construction. Single cardan universal joints connect the shaft to both the axle and transfer case yokes and the slip yoke is located at the transfer case end of the shaft.



80329

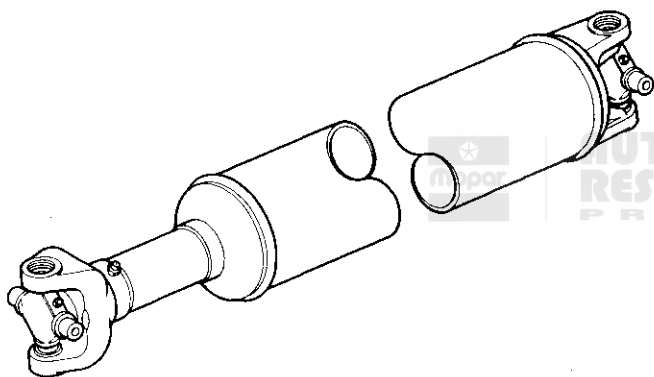
Fig. 2E-1 Front Propeller Shaft Assembly—CJ-7-Cherokee-Wagoneer-Truck With Automatic Transmission





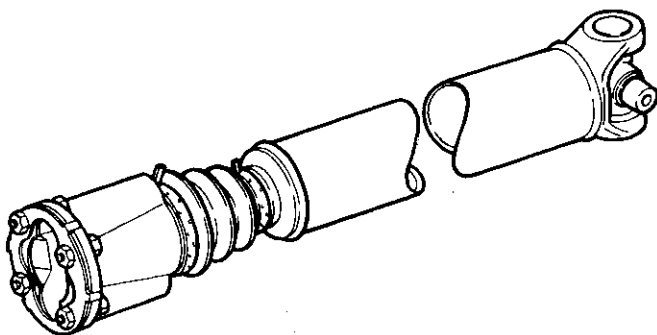
80330

Fig. 2E-2 Front Propeller Shaft Assembly—  
CJ With Manual Transmission



80331

Fig. 2E-3 Rear Propeller Shaft Assembly—Cherokee  
and Wagoneer with Automatic Transmission and All Truck Models



80332

Fig. 2E-4 Rear Propeller Shaft Assembly—  
Cherokee with Manual Transmission

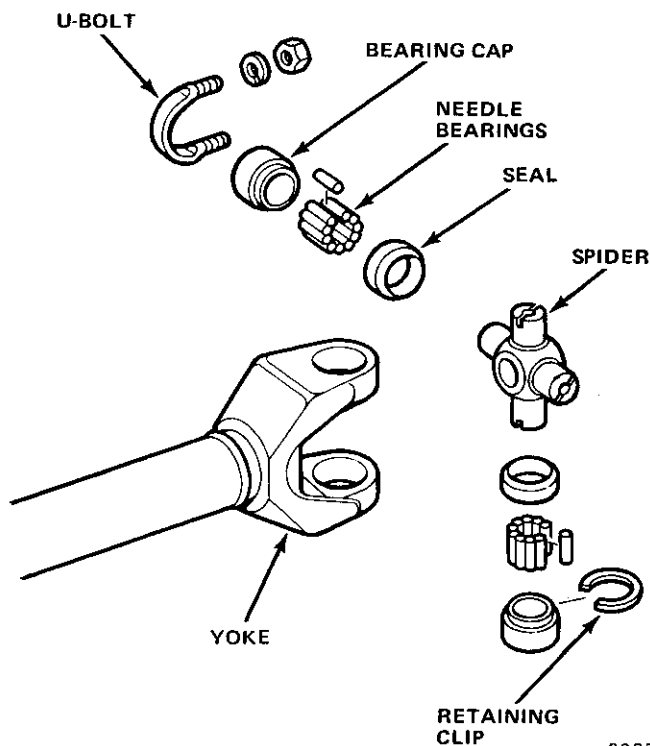
Universal Joint Application

Three different design universal joints are used for the various driveline combinations: a single cardan joint, a double cardan joint, and a ball and trunnion joint.

The single cardan joint is used for most applications and consists of a single spider with four sets of needle bearings, and four bearing seals, bearing caps, and bearing cap retainers (fig. 2E-5). U-bolts are used to attach the joint to the axle and transfer case yokes.

The double cardan joint, also referred to as a constant velocity joint, consists of two spiders, a socket ball, a link yoke, a socket spring and dust seal, a socket yoke, and needle bearings, bearing seals, bearing caps, and bearing retainers for each spider (fig. 2E-6). The double cardan joint is used for front propeller shaft-to-transfer case yoke applications on all Cherokee, Wagoneer, and Truck models and CJ-7 Models with automatic transmission.

The ball and trunnion joint is a combination unit functioning as both slip yoke and universal joint (fig. 2E-7). It is used for rear propeller shaft-to-transfer case applications on Cherokee models with manual transmission only. For this application, a flange is used to connect the shaft to the transfer case rear output shaft. The propeller shaft trunnion housing is bolted directly to this flange.



80333

Fig. 2E-5 Single Cardan Universal Joint

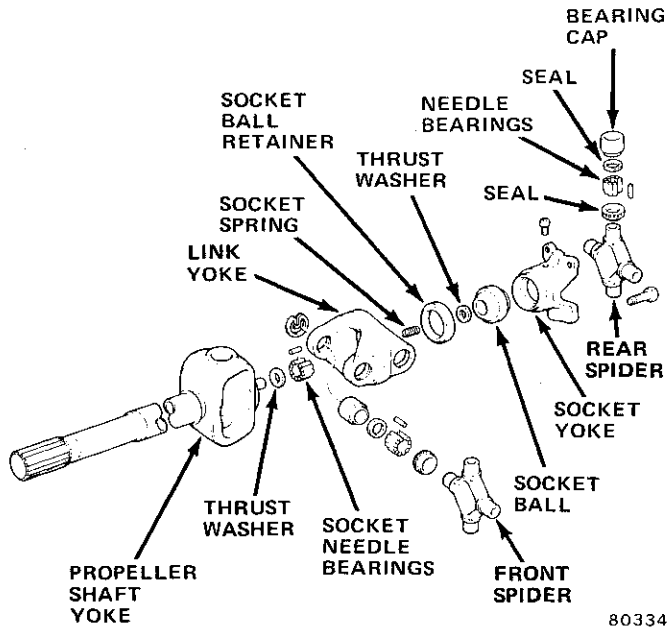


Fig. 2E-6 Double Cardan Universal Joint

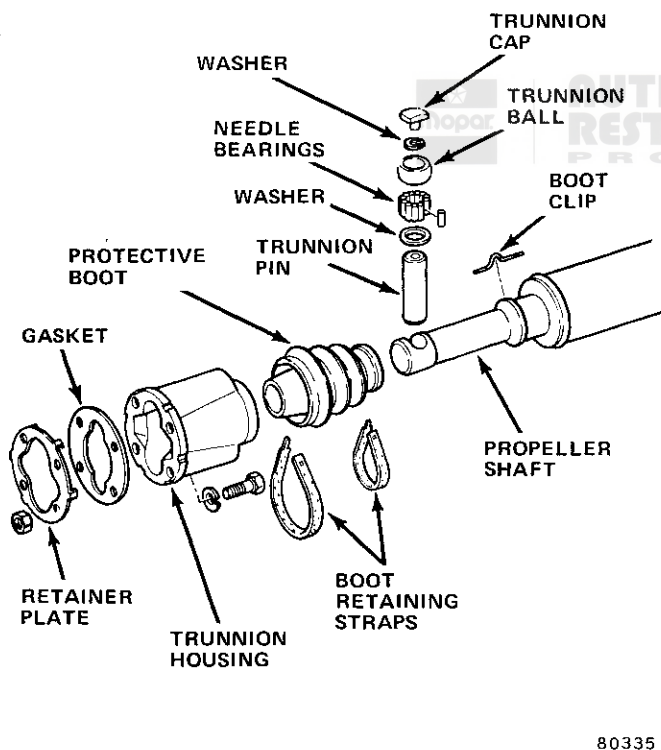


Fig. 2E-7 Ball and Trunnion Universal Joint

## DRIVELINE VIBRATION

Driveline vibration can be divided into two categories: audible or mechanical. Mechanical vibrations produce visible motion in the fenders, rear view mirror, instrument panel, or steering wheel, or can be felt through the seats, floorpan, or steering wheel. Audible vibra-

tions are heard or sensed above normal road and background noise and may be accompanied by mechanical vibration. In some cases, audible vibration occurs as a droning or drumming noise while in other cases, it produces a buffeting sensation that is felt or sensed by the driver rather than heard.

Driveline vibration may be caused by the front or rear propeller shafts, axle or transfer case yokes, universal joints, incorrect front or rear pinion angles, loose engine-transmission-transfer case mountings, or engine driven accessories. Mechanical vibration is usually caused by a damaged or worn driveline component. Audible vibrations are usually caused by an incorrect universal joint angle or binding universal joints and are most noticeable in the 40-60 mph (64-97 km/h) speed range.

Vibration caused by a propeller shaft may be the result of:

- Undercoating on the shaft tube
- Excessive shaft runout
- Cracked or broken shaft seam welds
- Dented, bent, or twisted shaft tube
- Worn or damaged shaft bearing yokes
- Loose universal joint clamp strap bolts, U-bolt nuts, or flange bolts
- Tight, loose, or binding slip yoke
- Tight, worn, binding, or damaged universal joint
- Loose yoke retaining nut

Vibration caused by universal joints may be the result of:

- Loose U-bolt nuts, clamp strap bolts, or flange bolts
- Tight, loose, binding, or worn slip yoke
- Worn or damaged universal joint spider
- Worn or damaged needle bearings or bearing caps

Vibration caused by axle, transfer case, engine, or suspension components may be the result of:

- Loose yoke retaining nut
- Excessive yoke runout
- Incorrect universal joint angle
- Bent, worn, broken, or loose torque reaction bracket or engine rear crossmember
- Damaged or loose suspension springs or suspension components
- Loose engine or transmission/transfer case support cushions or crossmembers, broken spring mounting pad (on axle), broken spring center bolt, or damaged engine driven accessories or drive belts.

## Driveline Vibration Diagnosis


If a driveline vibration condition should develop, do not initiate corrective procedures until the vibration source has been determined. This is important in avoiding unnecessary or ineffective repairs. The following Diagnosis and Repair (DARS) Charts will help to isolate the most common causes of driveline vibration:

Driveline Vibration Diagnosis and Repair (DARS) Charts


Note: Refer to Chapter A – General Information for details on how to use this DARS chart.



**PROBLEM: DRIVE LINE VIBRATION**


**STEP SEQUENCE RESULT**


**1**  **WHEEL/TIRE CONDITION**


- CHECK FOR BENT, CRACKED WHEELS AND CUPPED OR DAMAGED TIRES.
- CHECK FOR MISMATCHED TIRE SIZES OR TREAD PATTERNS.
- CHECK AND CORRECT TIRE INFLATION PRESSURES AS NEEDED.
- ROAD TEST IF REPAIR OR REPLACEMENT WAS NEEDED.





CORRECTION NEEDED – ROAD TEST →  → 

CORRECTION NOT NEEDED →  → **2**



CORRECTION NEEDED – ROAD TEST →  → **2**


**2**  **ROAD TEST**


DRIVE 5 - 10 MPH ABOVE VIBRATION RANGE—THEN—SHIFT TO NEUTRAL, LET ENGINE IDLE AND COAST—THROUGH VIBRATION RANGE.


 

ROAD TEST →


VIBRATION GONE →  → 

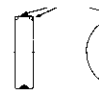
VIBRATES DURING COAST-THROUGH →  → **3**

VIBRATION STOPS DURING COAST-THROUGH (IN NEUTRAL) →  → **4**

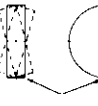
**3**  **WHEEL / TIRE BALANCE**

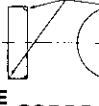
**STATIC UNBALANCE**


HEAVY SPOT →  → TIRE OR WHEEL TRAMP, OR WHEEL HOP

ADD BALANCE WEIGHTS HERE →  → CORRECTIVE WEIGHT LOCATION



**DYNAMIC UNBALANCE**


HEAVY SPOT →  → WHEEL SHIMMY AND VIBRATION

ADD BALANCE WEIGHTS HERE →  → CORRECTIVE WEIGHT LOCATION



CORRECT AS NECESSARY AND ROAD TEST (MAX. WHEEL WEIGHT ALLOWANCE PER WHEEL IS 10 - OUNCES)


IF CORRECTION WAS NEEDED- REPEAT ROAD TEST →  → 

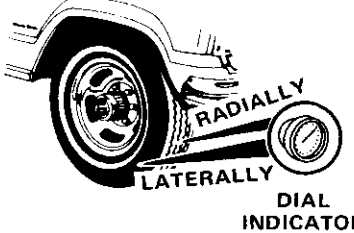
ROAD TEST OR NO CORRECTION NEEDED. →  → **4**


STEP

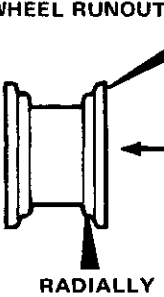
SEQUENCE

RESULT

**4**  CHECK TIRE RUNOUT




**4**  CHECK WHEEL RUNOUT






**TIRE RADIAL RUNOUT:**  
 RADIAL TIRES \_ \_ \_ \_ \_ 0.080  
 CONVENTIONAL TIRES \_ \_ 0.105


**TIRE LATERAL RUNOUT:**  
 ALL TIRES \_ \_ \_ \_ \_ 0.100

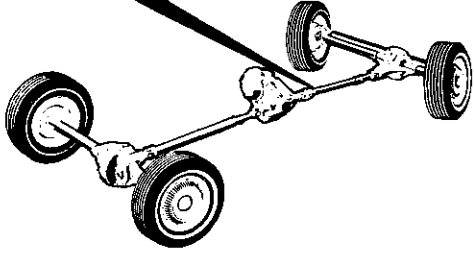
**WHEEL RUNOUT:**  
 LATERAL/RADIAL \_ \_ \_ \_ 0.045

NO CORRECTION NEEDED  → **5**

CORRECTION NEEDED  →  → **2**


ROAD TEST  → **2**


**5**  CHECK FRONT PROPELLER SHAFT OPERATION




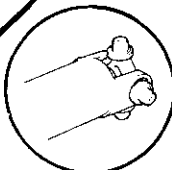
1. REMOVE REAR PROPELLER SHAFT (ALIGN MARK SHAFT AND AXLE YOKE FOR ASSEMBLY REFERENCE).
2. ROAD TEST WITH QUADRA-TRAC IN EMERGENCY DRIVE-OR-MODEL 20 IN 4H AND WITH FRONT HUBS LOCKED (IF EQUIPPED)

ROAD TEST **2** →

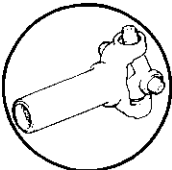
VIBRATION GONE OR NOTICEABLY REDUCED  → **6**

NO CHANGE IN VIBRATION LEVEL  → **10**

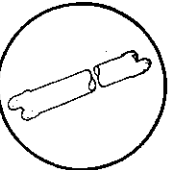
**6**  CHECK REAR PROPELLER SHAFT CONDITION



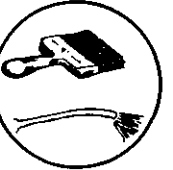
WORN, BINDING BRINELLED U-JOINTS




WORN, LOOSE BINDING SLIP YOKE




BENT TUBE





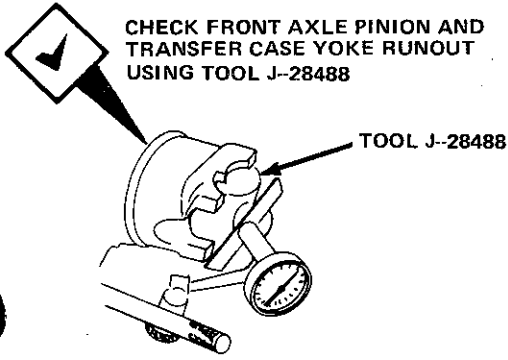

EXCESSIVE PAINT OR UNDERCOATING ON TUBE

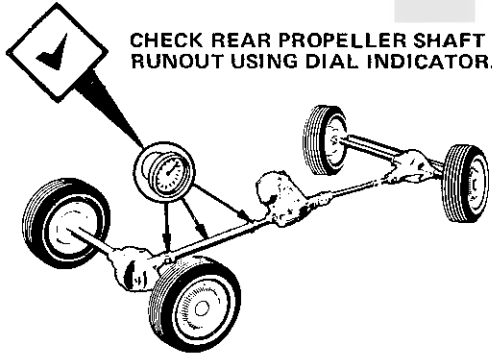

REPAIR OR REPLACE SHAFT  → **2**

ROAD TEST **2** →

OK  → **7**

Not OK  →  → **7**

STEP	SEQUENCE	RESULT
<p><b>7</b></p> <p><b>CHECK FRONT AXLE PINION AND TRANSFER CASE YOKE RUNOUT USING TOOL J-28488</b></p>  <p>MAXIMUM ALLOWABLE RUNOUT AT EITHER YOKE IS 0.006 (0.15 mm)</p> <p>* REPLACEMENT YOKE RUNOUT SHOULD BE CHECKED ALSO.</p>	<p>IF RUNOUT IS 0.007 OR MORE, REINDEX YOKE, AND RECHECK RUNOUT. REPLACE YOKE IF REINDEXING DOES NOT CORRECT RUNOUT.</p> <p>ROAD TEST</p> <p><b>2</b></p>	<p>OK → <b>8</b></p> <p><del>OK</del></p> <p></p> <p>OK → STOP</p> <p><del>OK</del> → <b>8</b></p>

<p><b>8</b></p> <p><b>CHECK REAR PROPELLER SHAFT RUNOUT USING DIAL INDICATOR.</b></p>  <p>MAXIMUM ALLOWABLE RUNOUT SPECIFICATIONS ARE:          FRONT/REAR . . . 0.015 (0.38 mm)          CENTER . . . . . 0.020 (0.51 mm)</p>	<p>REINDEX SHAFT 180° AND RECHECK RUNOUT.</p> <p>ROAD TEST</p> <p><b>2</b></p> <p>REPLACE SHAFT</p>	<p>OK → <b>9</b></p> <p><del>OK</del></p> <p></p> <p>OK → STOP</p> <p><del>OK</del> → <b>9</b></p>
---	---	---

STEP

SEQUENCE

RESULT

**9**

**CHECK REAR AXLE PINION UPWARD ANGLE AND ENGINE DOWNWARD ANGLE**

ENGINE DOWNWARD ANGLE  
6°

AXLE PINION UPWARD ANGLE  
4°

REAR AXLE PINION ANGLE MUST BE 1/2° TO 1 1/2° (1° PREFERRED) BELOW ENGINE ANGLE. USE APPROPRIATE SHIMS TO CORRECT ANGLE

OK → **10**

~~OK~~ →

→ ADJUST ANGLES AS NEEDED

ROAD TEST → **2**

OK → STOP

~~OK~~ → **10**

**10**

**CHECK REAR PROPELLER SHAFT OPERATION**

1. REMOVE FRONT PROPELLER SHAFT (ALIGN MARK SHAFT AND AXLE YOKES FOR ASSEMBLY REFERENCE).

2. ROAD TEST WITH QUADRA-TRAC IN EMERGENCY DRIVE-OR-MODEL 20 IN 4H WITH FRONT HUBS LOCKED (IF EQUIPPED).

ROAD TEST → **2**

VIBRATION GONE OR NOTICEABLY REDUCED → OK → **11**

NO CHANGE IN VIBRATION LEVEL → ~~OK~~ → **12**

**11**

**CHECK FRONT PROPELLER SHAFT CONDITION**

WORN, BINDING BRINELLED U-JOINT

WORN, LOOSE BINDING SLIP YOKE

BENT TUBE

EXCESSIVE PAINT OR UNDERCOATING ON TUBE

OK → **12**

~~OK~~ →

→ REPAIR OR REPLACE SHAFT

ROAD TEST → **2**


OK → STOP

~~OK~~ → **12**

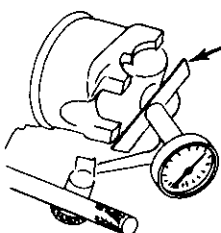
STEP

SEQUENCE

RESULT

**12**  CHECK REAR AXLE PINION AND TRANSFER CASE YOKE RUNOUT USING TOOL J-28488

TOOL J-28488



MAXIMUM ALLOWABLE RUNOUT AT EITHER YOKE IS 0.006 (0.15 mm)

\* REPLACEMENT YOKE RUNOUT SHOULD BE CHECKED ALSO


IF RUNOUT IS 0.007 OR MORE, REINDEX YOKE AND RECHECK RUNOUT. REPLACE YOKE IF REINDEXING DOES NOT CORRECT RUNOUT.\*

ROAD TEST

**2**

OK

~~OK~~




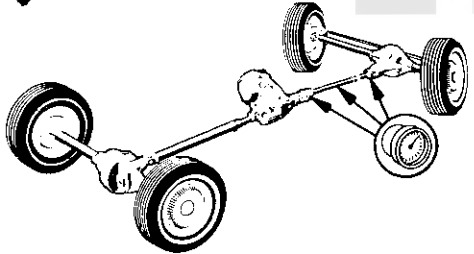
OK

~~OK~~

STOP

**13**

**13**  CHECK FRONT PROPELLER SHAFT RUNOUT USING DIAL INDICATOR



MAXIMUM ALLOWABLE RUNOUT SPECIFICATIONS ARE:


FRONT/REAR	0.015 (0.38 mm)
CENTER	0.020 (0.51 mm)

REINDEX SHAFT 180° AND RECHECK RUNOUT

OK

~~OK~~

~~OK~~

REPLACE SHAFT 

ROAD TEST


**2**

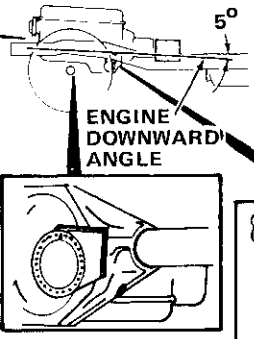
OK

~~OK~~

STOP

**14**

**14**  CHECK FRONT AXLE PINION AND FRONT PROPELLER SHAFT ANGLES



ENGINE DOWNWARD ANGLE

5°

NOTE: Front axle pinion angle is measured using same procedure as rear axle pinion angle. Front propeller shaft angle is measured by placing protractor on front driveshaft. [Do not use engine downward angle as base for adjusting front axle pinion angle.] Record readings.

FRONT AXLE PINION ANGLE MUST BE ½° TO 1½° (1° PREFERRED) ABOVE FRONT PROPELLER SHAFT ANGLE. USE APPROPRIATE SHIMS TO OBTAIN CORRECT ANGLE

ROAD TEST

**2**

STOP

## UNIVERSAL JOINT ANGLE MEASUREMENT AND ADJUSTMENT

When torque is transmitted through single cardan universal joints operating at an angle, the rotating speeds of the driving and driven yoke will differ. In operation, the driving yoke rotates at a constant speed while the driven yoke speeds up and slows down twice every revolution.

This difference in driven yoke rotating speed is proportional to the operating angle of the universal joint. In effect, the greater the universal joint operating angle, the greater the speed fluctuation of the driven yoke.

If fluctuation is excessive, driveline vibration will occur. As a result, the universal joint operating angles must be controlled to minimize this effect.

On some Jeep models with Quadra-Trac, an incorrect rear propeller shaft universal joint angle will generate an audible-type vibration. The vibration occurs as a constant booming or drone-like sound most noticeable in the 40-60 mph (64-97 km/h) speed range.

If a vehicle exhibits this condition, the rear propeller shaft universal joint and engine angles must be checked. If the angles are not within specified limits, shims must be installed between the rear axle spring pads and rear spring to correct the angles. Shims are available in one, two, and three degree increments for this purpose. The angle measurement and correction procedure is as follows:

- (1) Place vehicle on level surface.
- (2) Measure engine downward angle as follows:
  - (a) Position protractor on left side of engine block at transmission mounting ear. Place protractor in fore and aft direction. Use mirror to view protractor if necessary.
  - (b) Record engine downward angle, remove protractor, and proceed to next step.
- (3) Measure pinion upward angle as follows:
  - (a) Place protractor on left side of rear axle housing on flat machined surface of housing that is next to welded plug. Be sure this surface is free of weld flash.
  - (b) Record pinion upward angle, remove protractor, and proceed to next step.
- (4) If pinion upward angle is one degree less than engine downward angle, pinion angle is within specified limits. Check for other causes of vibration.
- (5) If pinion upward angle is greater than engine downward angle by more than one degree, pinion angle must be adjusted as follows.
 

**EXAMPLE:** If the engine angle measures 5 degrees downward and the pinion angle measures 7 degrees upward, the pinion angle must be adjusted downward 3 degrees. This changes the pinion downward angle to 4 degrees which is the required one degree less than the engine downward angle.
- (6) Adjust pinion angle as outlined in following steps.
- (7) Raise rear of vehicle and place support stands under frame rails.

(8) Position hydraulic jack under axle housing and raise jack just enough to support weight of axle.

(9) Remove rear wheels.

(10) Loosen rear spring U-bolt nuts.

(11) Install appropriate degree tapered shim between spring and axle spring pad as follows:

(a) On vehicles with spring mounted above axle, if angle must be adjusted downward, install shim so thickest end is facing front of vehicle. However, if angle must be adjusted upward, install shim so thickest end is facing rear of vehicle.

(b) On vehicles with spring mounted below axle, if angle must be adjusted downward, install shims so thickest end is facing rear of vehicle. However, if angle must be adjusted upward, install shims so thickest end is facing front of vehicle.

(12) Tighten U-bolt nuts to 100 foot-pounds (135 N•m) torque.

(13) Install rear wheels.

(14) Remove support stands and lower vehicle.

## LUBRICATION

The propeller shaft slip yoke and universal joints on all Jeep vehicles require periodic lubrication. Refer to the Maintenance Schedule in Chapter B for specific details.

### Lubricant Type

When lubricating the slip yokes and universal joints, use Jeep Chassis Lubricant or an equivalent lithium-base chassis grease only.

### Lubrication Intervals

On Cherokee, Wagoneer and Truck models, the slip yokes and universal joints must be lubricated at 15,000 mile (24 139 km) intervals in normal service and at 5,000 mile (8 047 km) intervals for heavy duty service.

On CJ models, the slip yoke and universal joints must be lubricated at 5,000 mile (8 047 km) intervals in normal service and at 3,000 mile (4 828 km) intervals for heavy duty service.

### Lubrication Fittings

Externally mounted lubrication fittings are located in the slip yokes and single cardan universal joint spiders for lubrication purposes.

Double cardan universal joints have special ball and spring fittings that require a needle-type lube gun nozzle adapter (fig. 2E-8). When lubricating double cardan joints, use Lube Fitting Adapter J-25512-2 (fig. 2E-9) or Alemite Lube Fitting Adapter 6783 or equivalent.

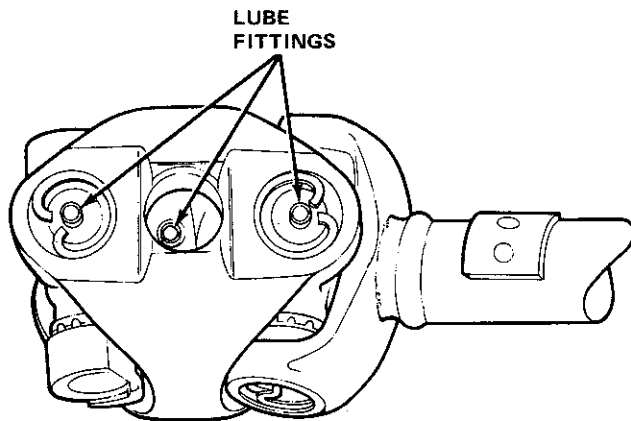
The ball and trunnion universal joint does not have lubrication fittings. To lubricate this assembly, it will be necessary to disconnect the shaft in order to repack the trunnion housing with chassis lubricant.

**CAUTION:** *It is important that the recommended lub-*



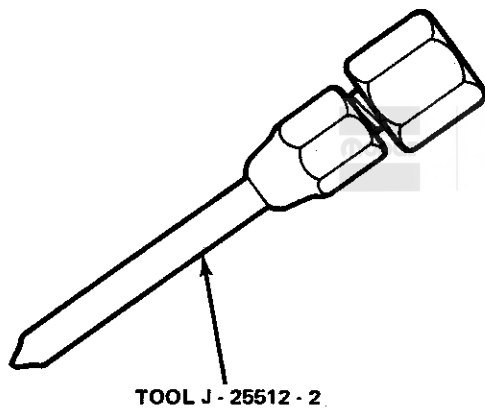
## 2E-10 PROPELLER SHAFT

ricant and lubrication schedule be adhered to. Failure to comply with lubrication requirements may result in premature wear of propeller shaft components.



90143

Fig. 2E-8 Double Cardan Joint Lube Fittings



90144

Fig. 2E-9 Double Cardan Lube Fitting Adapter

### PROPELLER SHAFT SERVICE

#### Removal-Front Shaft

- (1) Raise vehicle.
- (2) Mark propeller shaft yokes, transfer case output shaft yoke, and axle yoke for assembly alignment reference.
- (3) Disconnect propeller shaft at axle and transfer case yokes and remove shaft.

#### Installation-Front Shaft

- (1) Align reference marks on propeller shaft and yokes and install propeller shaft.
- (2) Tighten universal joint U-bolts to 15 foot-pounds (20 N•m) torque.
- (3) Lower vehicle.

#### Removal-Rear Shaft

- (1) Raise vehicle.
- (2) Mark propeller shaft, transfer case yoke or flange, and axle yoke for assembly alignment reference.
- (3) Disconnect shaft at transfer case and axle yokes and remove shaft.

#### Installation-Rear Shaft

- (1) Align reference marks on propeller shaft yokes and install shaft.
- (2) Tighten universal joint U-bolt nuts or clamp strap bolts to 15 foot-pounds (20 N•m) torque. Tighten flange bolts (on ball and trunnion joint) to 35 foot-pounds (47 N•m) torque.
- (3) Lower vehicle.

### UNIVERSAL JOINT SERVICE

The single and double cardan and ball and trunnion universal joints are serviced as assemblies. Each of the three universal joint types can be disassembled for inspection and replacement purposes.

#### Disassembly-Single Cardan Joint

- (1) If slip yoke universal joint is to be replaced, paint alignment marks on slip yoke and propeller shaft for assembly reference and remove slip yoke from shaft.
- (2) Remove loose bearing caps from spider and apply penetrating oil to bearing caps seated in shaft yoke.
- (3) Mount propeller shaft or slip yoke in vise.

**CAUTION:** Do not clamp the propeller shaft tube in the vise. Clamp the forged portion of the slip yoke or propeller shaft yoke in the vise only. Also, to avoid distorting either of the yokes, do not overtighten the vise.

- (4) Remove bearing cap retainers (fig. 2E-5). Tap ends of bearing caps with hammer to relieve pressure on retainers if necessary.

- (5) Reposition shaft in vise so yoke is supported on vise jaws.

- (6) Tap end of one bearing cap with hammer until opposite bearing cap is driven out of yoke.

- (7) Reposition shaft yoke in vise and tap exposed end of spider to drive remaining bearing cap out of yoke.

- (8) Remove spider from yoke.

#### Cleaning and Inspection

Clean the yoke bearing cap bores with solvent and a wire brush. Be sure to remove all rust, corrosion, or dirt. Wash the bearing caps, bearings and spiders in solvent and wipe them dry with a shop cloth.

Inspect the bearing caps, needle bearings, and bearing surfaces of the spider for evidence of brinneling, excessive wear, flat spots, scoring, or cracks. Replace the complete assembly if any part exhibits these conditions.

### Assembly-Single Cardan Joint

(1) Lubricate all needle bearings, bearing caps, and bearing surfaces of spider with chassis grease. Also apply thin film of grease to exterior surface of bearing caps.

(2) Install bearing cap seals on spider.

(3) Install one bearing and needle bearing assembly part-way into shaft yoke.

(4) Position spider in shaft yoke and install opposite bearing cap and needle bearing assembly in yoke.

(5) Support yoke on vise jaws and seat both bearing caps in yoke using hammer.

(6) Install bearing cap retainers. Tap ends of bearing caps to seat caps fully if retainers are difficult to install.

(7) Install two remaining bearing cap and needle bearing assemblies on spider. Use rubber band or tape to retain these caps on spider until shaft is to be installed.

### Disassembly-Double Cardan Joint

**NOTE:** *The socket yoke, ball, spring, needle bearings, retainer, and thrust washers are serviced as an assembly only (fig. 2E-6). When servicing the double cardan joint, do not disassemble these components. If any one component is damaged, replace the assembly.*

(1) Remove all bearing cap retainers.

(2) Mark bearing caps, spiders, propeller shaft yoke, link yoke, and socket yoke for assembly alignment reference.

(3) Remove bearing caps attaching front spider to propeller shaft yoke as follows (fig. 2E-6):

(a) Use 5/8 socket as bearing cap driver and 1-1/16 socket as bearing cap receiver.

(b) Place 5/8 socket on one bearing cap and 1-1/16 socket over opposite bearing cap.

(c) Mount assembly in vise so vise jaws bear directly against sockets positioned on bearing caps.

(d) Tighten vise to press first bearing cap out of link yoke.

(e) Loosen vise, reposition sockets, and press opposite bearing cap out of link yoke.

(4) Disengage propeller shaft yoke from link yoke.

(5) Remove bearing caps attaching front spider to propeller shaft yoke as outlined in step (3).

(6) Remove front spider from yoke.

(7) Remove bearing caps attaching rear spider to link yoke as outlined in step (3) and remove rear spider and socket yoke from link yoke.

### Cleaning and Inspection

Clean the yoke bearing cap bores with solvent and a wire brush. Be sure to remove all rust, dirt, and corrosion from the bores. Wash the universal joint components in solvent and wipe them dry with a shop cloth. Inspect all bearings and bearing surfaces for excessive

wear, galling, brinelling, scoring, flat spots, or cracks. Inspect the yokes for distortion, cracks, or worn bearing cap bores. Replace the complete assembly if any component exhibits these conditions.

### Assembly-Double Cardan Joint

**NOTE:** *When assembling the universal joint, be sure to align the spiders and yokes according to the reference marks made during disassembly.*

(1) Lubricate all bearings and bearing contact surfaces with lithium-base chassis grease.

(2) Install bearing caps on transfer case yoke ends of rear spider. Secure caps to spider using tape.

(3) Assemble socket yoke and rear spider.

(4) Position rear spider in link yoke and install bearing caps. Press caps into yoke using 5/8 socket. Be sure to press caps into yoke bores far enough to expose bearing cap retainer grooves.

(5) Install rear spider-to-link yoke bearing cap retainers.

(6) Position front spider in propeller shaft yoke and install bearing caps. Press caps into yoke using 5/8 socket. Be sure to press caps into yoke bores far enough to expose bearing cap retainer grooves.

(7) Install front spider-to-propeller shaft yoke bearing cap retainers.

(8) Install thrust washer and socket spring in ball socket bearing bore, if removed.

(9) Install thrust washer on ball socket bearing boss (located on propeller shaft yoke), if removed.

(10) Align ball socket bearing boss on propeller shaft yoke with ball socket bearing bore and insert boss into bore.

(11) Align front spider with link yoke bearing cap bores and install bearing caps. Press caps into yoke using 5/8 socket. Be sure to press caps into yoke bores far enough to expose bearing cap retainer grooves.

(12) Install front spider-to-link yoke bearing cap retainers.

### Disassembly-Ball and Trunnion Joint

(1) Straighten retainer plate locktabs and remove plate and gasket from trunnion housing (fig. 2E-7).

(2) Cut and remove protective boot retaining straps.

(3) Push trunnion housing and protective boot toward rear of shaft to expose ball and trunnion assembly.

(4) Remove trunnion cap and cap washer (fig. 2E-7).

(5) Remove trunnion ball, trunnion ball needle bearings, and trunnion ball washer (fig. 2E-7).

(6) Remove trunnion pin from shaft pin bore using arbor press and suitable removal tool.

(7) Remove trunnion housing, protective boot, and boot clip from shaft.

(8) Clean all parts thoroughly in solvent and wipe dry.

## 2E-12 PROPELLER SHAFT

### Assembly-Ball and Trunnion Joint

(1) Lubricate shaft trunnion pin bore, trunnion pin, trunnion ball and needle bearings and trunnion cap with chassis grease. Also pack liberal amount of grease in trunnion housing interior.

(2) Position boot clip on raised, semi-circular boss on shaft. Use rubber bands or string to retain clip during boot installation.

(3) Install protective boot on shaft and install one boot retaining strap. Be sure boot is seated on raised shaft boss and boot clip before installing strap. Also be sure strap is seated in strap groove in boot before tightening.

(4) Install trunnion housing on shaft. Seat protective boot in housing and install remaining boot retaining strap. Be sure boot is fully seated in housing. Also be sure strap is seated in strap groove in boot before tightening.

(5) Position shaft in arbor press and start trunnion pin in shaft bore. Carefully press pin into bore until pin is centered in shaft to within 0.006 inch (0.15 mm) (fig. 2D-10).

**CAUTION:** The trunnion pin must project an equal distance from each side of the shaft pin bore. If the pin is not centered within 0.006 inch (0.15 mm), propeller shaft vibration may result.

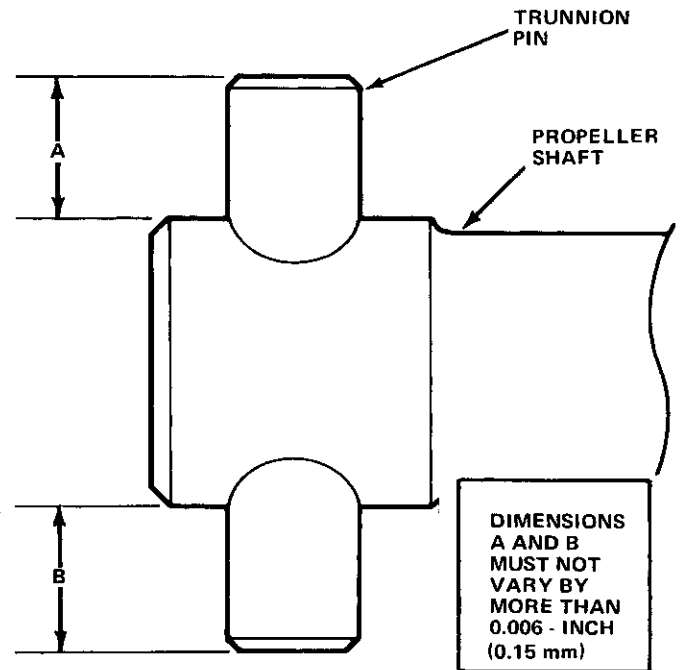
(6) Install trunnion ball washer on pin and install trunnion ball and needle bearings on pin.

(7) Install trunnion cap washer and trunnion cap on pin.

(8) Move housing forward and over ball and trunnion assembly. Be sure assembly is correctly and completely seated in housing.

(9) Install replacement gasket and plate on housing and bend plate locktabs into housing slots to retain plate and gasket.

(10) Cover housing with shop cloth until shaft is to be installed.



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Fig. 2E-10 Centering Trunnion Pin in Shaft Bore

### SPECIFICATIONS

#### Universal Joint Angle Chart

	Front		Rear	
	OK Range	Set-To	OK Range	Set-To
Wagoneer Cherokee (Quadra-Trac)	8°	7°-9°	5°	4°-6°
Cherokee (Dana 20)	8°	7°-9°	5°	4°-6°
Truck (Model 25)	8°	7°-9°	3°30'	2°30'-4°30'
Truck (Model 45)	8°	7°-9°	5°	4°-6°

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### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Pinion Yoke Nut:				
Axle Model 30-44 . . . . .	210	200-220	285	271-298
Axle Model 60 . . . . .	260	250-270	352	339-366
AMC-Jeep Axle . . . . .				
			Add 5 in-lbs. (0.56 N·m) torque measured at disassembly. Refer to Pinion Seal and Yoke Replacement, Chapter 2F- AMC-Jeep Axle.	
Universal Joint Clamp Strap Bolt . . . . .	15	13-18	20	18-24
Universal Joint Flange Bolt . . . . .	35	25-45	47	34-61
Universal Joint U-Bolt Nut . . . . .	13	10-18	18	14-24

All Torques values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

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## NOTES



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# AXLES

# 2F

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## AXLE TESTING AND DIAGNOSIS

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### GENERAL

When diagnosing an axle noise condition, obtain a complete description of the noise and driving conditions when the noise occurred. A preliminary road test with the owner demonstrating the complaint condition is recommended.

The action of transmitting engine torque to the wheels will produce some noise in all axles. Slight axle noises confined to a brief speed range or specific period are considered normal.

Noises produced by the engine, transfer case, transmission, tires, wheel bearings, exhaust system, propeller shaft, or the action of wind on the body or grille may be incorrectly diagnosed as axle noise. It is important to test the vehicle thoroughly in order to isolate the problem component and avoid unnecessary repair.

During the road test, stop vehicle, shift the transmission into neutral, and operate the engine at various speeds. If the noise is heard during this test, the noise is being produced by the engine, exhaust system, clutch, transmission, transfer case, or by engine driven accessory equipment.

Before road testing, check and correct the tire inflation pressures and axle lubricant levels.

### TIRE NOISE TEST

Because certain types of tire tread wear or tread patterns may produce objectionable noises, drive the vehicle on various types of road surfaces and listen for a change in the noise. If the noise varies with the type of road surface, the tires may be causing the noise.

### WHEEL BEARING TEST

Worn, loose, or damaged wheel bearings can be confused with axle noises. Wheel bearing noise is usually more noticeable when coasting at lower vehicle speeds. Applying the brakes gently while the vehicle is moving will usually change wheel bearing noise. Another test involves turning the vehicle alternately left and right while moving straight ahead at relatively low speed. This maneuver side-loads the bearings and should cause the problem bearing to become noisier.

### AXLE TESTS

Before testing the axle, drive the vehicle a distance sufficient to warm the axles and axle lubricant. During the test, operate the transmission and transfer case in every gear combination.

## 2F-2 AXLES

Axle noises are usually related to vehicle speed rather than engine rpm or transmission gear range.

Axle noises may be classified into two types: gear noise and bearing noise.

Gear noise is often described as a whine or high-pitched resonating sound. It is usually more pronounced at certain vehicle speeds and within a narrow speed range under a drive (accelerating load), coast (decelerating load), or float (constant speed) condition.

Axle bearing noise is usually constant and the pitch is related to vehicle speed.

Since the pinion gear rotates faster than the ring gear, the pinion bearings produce a higher pitch sound than the differential bearings. The pinion bearings are usually heard at lower vehicle speeds of 20 to 30 mph (32 to 48 km/h).

Differential bearings produce a lower pitch sound because they are rotating at the same speed as the wheels. Differential bearing noise will not vary when the vehicle is turned alternately left and right or when the brakes are gently applied.

### AXLE NOISY ON PULL AND COAST

- Excessive ring and pinion backlash.
- Excessive pinion end play.
- Worn pinion bearings.
- Incorrect pinion depth adjustment.
- Incorrect lubricant (Trak-Lok differential).

### AXLE NOISY ON PULL

- Incorrect ring and pinion backlash or depth adjustment.
- Damaged or worn pinion bearings.
- Incorrect pinion bearing preload.

### AXLE NOISY ON COAST

- Excessive ring and pinion backlash.
- Excessive pinion end play.

- Worn or damaged pinion or differential bearings.
- Excessive differential bearing preload.

### BACKLASH

Excessive driveline backlash may be the result of backlash in the transmission, transfer case, propeller shaft yokes or slip joint splines, universal joints, ring and pinion gears, differential gears, front axle shaft splines or universal joints, or rear axle shaft splines.

### CHATTER—TRAC-LOK DIFFERENTIAL

Trac-Lok chatter is usually caused by using non-recommended lubricants. If chatter occurs, drain and refill the axle with Jeep Trac-Lok lubricant or equivalent only.

### OTHER AXLE CONDITIONS

A knocking noise heard at low speed or when coasting may be caused by loose fitting differential side gears. If this condition is encountered, operate the vehicle at the speed where noise is loudest and apply the brakes lightly. If loose fitting gears are causing the problem, the noise level will usually decrease when the brakes are applied.

Differential gear noise is considered normal when spinning a wheel with an on-vehicle wheel balancer, or when the wheels are spinning on icy or other types of low traction surface.

Whenever axle noise is caused by worn or damaged bearings, do not replace the gears unless they are also worn or damaged. Similarly, if axle gears are causing noise, do not replace the bearings unless they are worn or damaged.

## FRONT AXLE

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Axle Removal	2F-12	Spindle Bearing	2F-11
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**GENERAL**

A drive-type front axle with steering knuckles and hypoid differential gears is used on all Jeep models. Engine torque is transmitted to the wheels through full floating, two-piece axle shafts which have connecting universal joints (fig. 2F-1). The axle shafts revolve within and are supported by the steering knuckles. Open end steering knuckles which pivot on ball studs are used on all Jeep front axles.

The Model 30 front axle is used on all CJ models. The Model 44 front axle is used on all Cherokee, Wagoneer and Truck models. Service procedures for the two axle models are the same.

On all front axles, toe-in and caster are the only adjustable alignment angles. Camber is built into the axle and cannot be adjusted. Refer to Front End Alignment for adjustment methods.

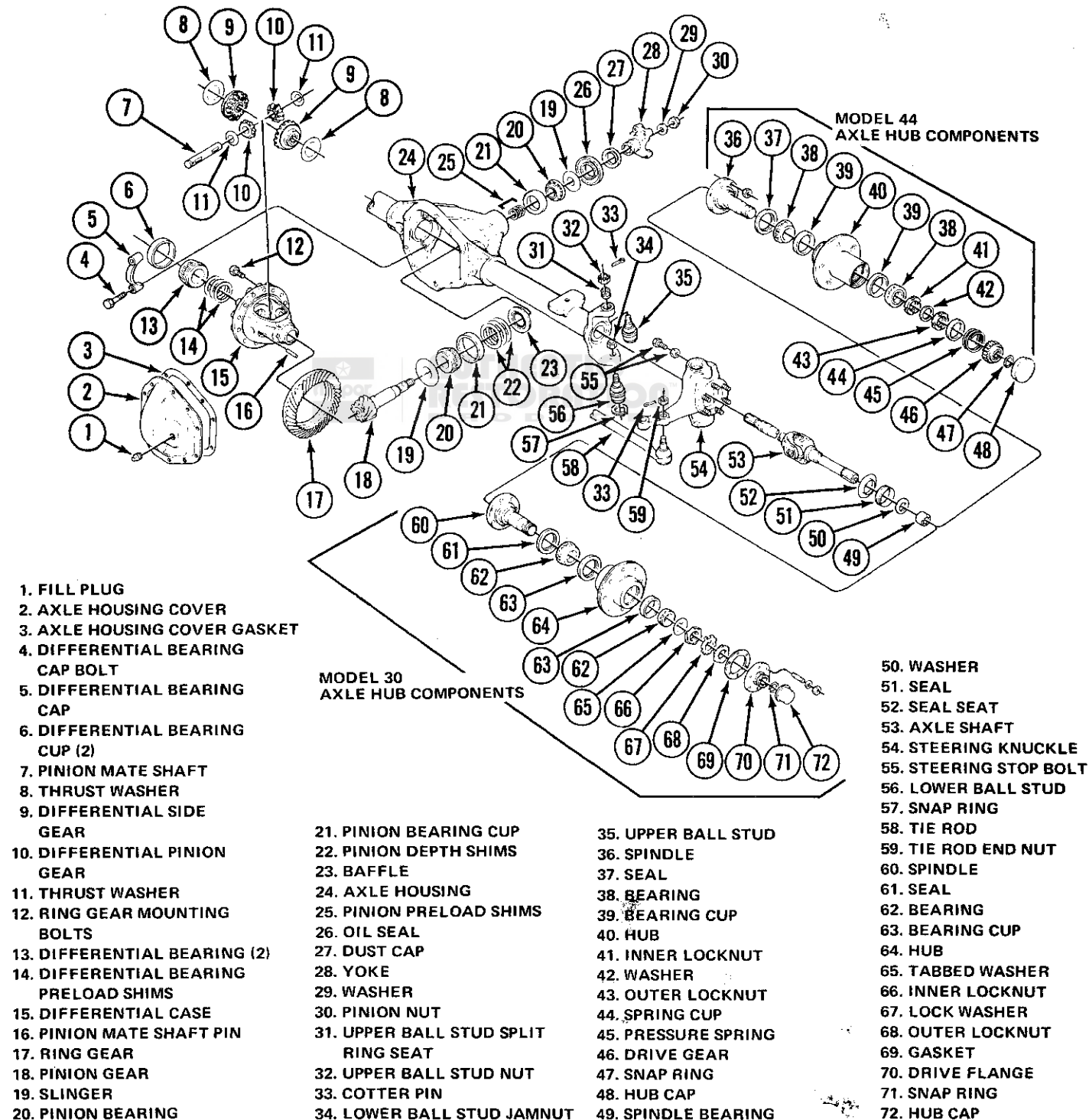


Fig. 2F-1 Front Axle Assembly



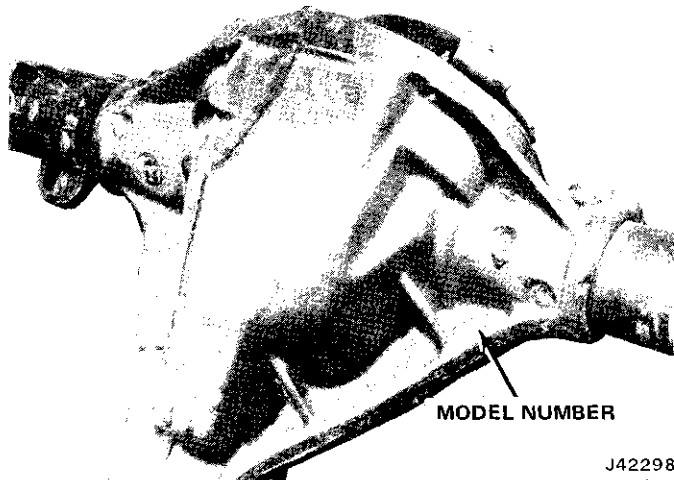


Fig. 2F-2 Model 44 Front Axle Code Number Location

## AXLE IDENTIFICATION

On Model 44 front axles, the axle code number is cast into the upper surface of the reinforcing rib at the left side of the axle housing (fig. 2F-2).

On Model 30 front axles, the axle code number is cast into the bottom surface of the differential housing.

The axle build date and manufacturers build date are stamped on the right-side axle tube adjacent to the axle housing cover.

The axle build date is decoded as follows: The first number represents the month, the second number the day of the month, the third number the year, the letter the shift, and the last number is the assembly line. If there are two build dates, the latter date will indicate when the brake components were installed.

The gear ratio tag attached to the left side of the axle housing cover indicates the Jeep manufacturing reference part number and the numerical tooth combination of the ring and pinion gears.

## AXLE HOUSING SERVICE

The front axle housing should be inspected periodically for weld cracks or other damage that could cause loss of lubricant, affect driving characteristics, or result in front end misalignment.

**NOTE:** *If the vehicle is driven through water that is deep enough to cover the front hubs, the steering knuckles and brake components should be disassembled and inspected for water/dirt contamination and damage. All components should be cleaned thoroughly, examined carefully, and lubricated as necessary before assembly. During the inspection, pay particular attention to the axle bearings and brake components. Damaged or contaminated parts should be replaced.*

## FRONT WHEEL ALIGNMENT

Toe-in and caster are the only adjustable front alignment angles. Camber is built into the axle during manufacture and cannot be adjusted.

An alignment rack should be used to check the alignment angles. The use of a rack will ensure more accurate readings and avoid the possibility of incorrect adjustments.

Toe-in is adjusted by lengthening or shortening the steering tie rod. Caster is adjusted by installing tapered shims between the front axle spring mounting pad and front spring. Refer to Front Wheel Alignment in Chapter 2N for measurement and adjustment procedures.

## HIGH STEERING EFFORT

High steering effort or slow return of the steering mechanism after turns may be the result of excessive steering knuckle ball stud preload. If this condition occurs and all other items affecting steering effort are functioning normally, ball stud preload should be checked as follows:

### Ball Stud Preload Measurement

- (1) Raise vehicle.
- (2) Remove front wheels.
- (3) If vehicle has steering damper, disconnect damper at tie rod and move damper aside.
- (4) Unlock steering column.
- (5) Disconnect steering connecting rod. On CJ models, disconnect rod at right-side steering knuckle. On all other models, disconnect connecting rod at right-side of tie rod.
- (6) Remove cotter pin and retaining nut attaching tie rod to right-side steering knuckle. Discard cotter pin.
- (7) Rotate both steering knuckles through complete arc several times. Work from right-side of vehicle to rotate knuckles.
- (8) Assemble socket and 0-50 foot-pound (0-68 N•m) capacity torque wrench and install wrench on tie rod retaining nut.

**NOTE:** *The torque wrench must be positioned parallel with the steering knuckle arm to obtain an accurate reading.*

(9) Rotate knuckles slowly and steadily through a complete arc and measure torque required to rotate knuckles.

(a) If reading is less than 25 foot-pounds (34 N•m) turning effort is within specifications and fault is not in steering knuckle. Check steering gear, pump, column.

(b) If reading is more than 25 foot-pounds (34 N•m) turning effort is excessive. Proceed to next step.

- (10) Disconnect tie rod from both steering knuckles.
- (11) Install 1/2 by 1 inch (12.7 by 25.4 mm) bolt, flat washer, and nut in tie rod stud mounting hole in one steering knuckle. Tighten bolt and nut securely.
- (12) Assemble and install socket and 0-50 foot-pound (0-68 N•m) capacity torque wrench on bolt previously installed in steering knuckle.
- (13) Rotate steering knuckle slowly and steadily through complete arc and measure torque required to turn knuckle.
- (14) Install bolt, flat washer, nut, torque wrench and socket on opposite steering knuckle and measure torque required to rotate knuckle.
  - (a) If reading is less than 10 foot-pounds (14 N•m) steering effort is within specifications and fault is not in knuckle ball studs. Check for tight or damaged tie rod ends, lubricate or replace as necessary, and proceed to next step.
  - (b) If torque reading is more than 10 foot-pounds (14 N•m), turning effort is excessive. Proceed to Ball Stud Preload Correction procedure.
- (15) Install tie rod. Tighten tie retaining nuts to 35 foot-pounds (47 N•m) torque and install replacement cotter pins.
- (16) Install connecting rod. Tighten connecting rod retaining nuts to 60 foot-pounds (81 N•m) torque on CJ models and 75 foot-pounds (102 N•m) torque on all other models. Install replacement cotter pins.
- (17) Install front wheels.
- (18) Lower vehicle.

### Ball Stud Preload Correction

- (1) Remove front axle shafts as outlined in this chapter.
- (2) Remove cotter pin and slotted nut from upper ball stud.
- (3) Loosen lower ball stud jamnut.
- (4) Unseat upper and lower ball studs by striking studs with lead hammer.
- (5) Remove upper ball stud split ring seat using tool J-25158. Discard seat after removal.
- (6) Remove lower ball stud jamnut and remove steering knuckle. Discard jamnut after removal.
- (7) Clean upper ball stud split ring seat threads, lower ball stud taper in steering knuckle, threads and tapered surfaces of ball studs, and upper ball stud retaining nut threads.
- (8) Position steering knuckle on axle and install replacement lower ball stud jamnut finger tight (only).
- (9) Remove upper ball stud retaining nut.
- (10) Remove upper ball stud split ring seat.
- (11) Install replacement split ring seat using tool J-25158. Tighten seat to 50 foot-pounds (68 N•m) torque.

- (12) Install replacement nut on upper ball stud. Tighten nut to 100 foot-pounds (135 N•m) torque and install replacement cotter pin.

**NOTE:** *If the cotter pin holes in the nut and stud are not aligned, tighten the nut (only) to align the holes. Never loosen the nut to align the holes.*

- (13) Install front axle shafts and steering spindles loosely and measure turning effort of each steering knuckle as described in Ball Stud Preload Measurement.
  - (a) If turning effort is less than 10 foot-pounds (14 N•m) torque, proceed to next step.
  - (b) If turning effort is more than 10 foot-pounds (14 N•m) torque, replace upper and lower ball studs and repeat Ball Stud Preload Correction procedure.
- (14) Install front axle shafts.
- (15) Connect tie rod to steering knuckle arms. Tighten tie rod end retaining nuts to 45 foot-pounds (61 N•m) torque and install replacement cotter pins.
- (16) Attach connecting rod to tie rod. Tighten connecting rod end retaining nut to 60 foot-pounds (81 N•m) torque on CJ models and 75 foot-pounds (102 N•m) torque on all other models.
- (17) Connect steering damper to tie rod, if equipped.
- (18) Install front wheels. Tighten wheel retaining nuts to 80 foot-pounds (108 N•m) torque.
- (19) Lower vehicle.

### PINION SEAL AND YOKE

#### Removal

- (1) Raise vehicle.
- (2) Mark propeller shaft and yoke for assembly alignment reference and disconnect propeller shaft from yoke.
- (3) Remove pinion nut and washer using socket, breaker bar, and tool J-8614-01 (fig. 2F-3).
- (4) Remove yoke using tools J-8614-01, -02, -03 (fig. 2F-4).
- (5) Remove pinion seal using tool J-25180.

#### Installation

- (1) Install replacement seal using tool J-25104.
- (2) Install yoke.
- (3) Install pinion washer and nut. Tighten nut to 210 foot-pounds (285 N•m) torque.
- (4) Align reference marks on propeller shaft and yoke and connect shaft to yoke. Tighten shaft-to-yoke attaching bolts or nuts to 16 foot-pounds (22 N•m) torque.
- (5) Lower vehicle.

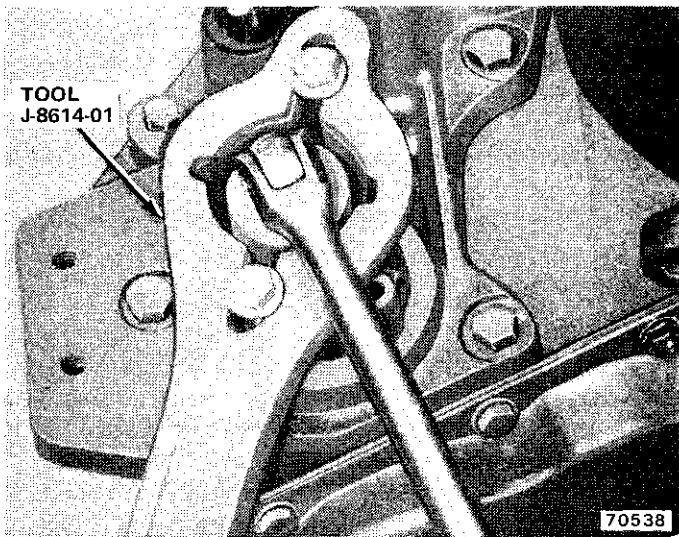


Fig. 2F-3 Pinion Nut Removal

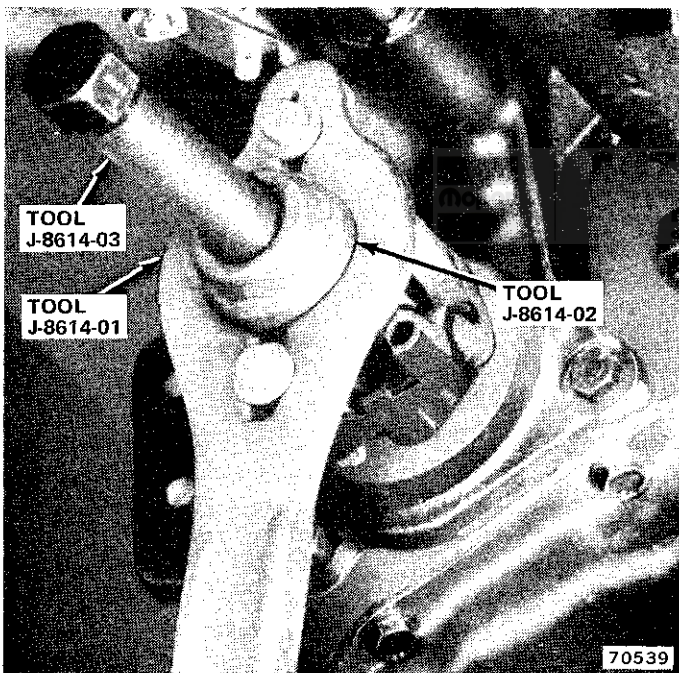


Fig. 2F-4 Pinion Yoke Removal

## AXLE SHAFT

### Removal—CJ Models

- (1) Raise vehicle.
- (2) Remove disc brake caliper. Refer to Chapter 2G.
- (3) Remove drive flange hub cap.
- (4) Remove drive flange snap ring (fig. 2F-1).
- (5) Remove bolts attaching drive flange to disc brake rotor hub.

**NOTE:** The drive flange attaching bolts are coated with a thread locking adhesive-sealant. This substance will normally maintain its torque retention ability

throughout 2 or 3 bolt removal and installation procedures. If it becomes necessary to recoat the drive flange bolts, recoat them with Loctite 242 Adhesive-Sealant or equivalent. Be sure to clean the bolt threads and threaded holes thoroughly before applying a fresh coat of sealant.

- (6) Remove drive flange. Use tool J-25133 to remove flange if necessary.
- (7) Straighten lip of washer and remove outer locknut, washer, inner locknut, and bearing washer. Use tool J-25103 to remove locknuts.
- (8) Remove outer bearing and remove disc brake rotor.
- (9) Remove disc brake caliper adapter and splash shield.
- (10) Remove spindle.
- (11) Remove axle shaft and universal joint assembly.

### Installation—CJ Models

- (1) Clean all parts thoroughly.
- (2) Install axle shaft and universal joint assembly. Insert splined end of axle shaft into differential side gear and push shaft into place.
- (3) Install spindle.
- (4) Install splash shield and disc brake caliper adapter.
- (5) Lubricate and install outer bearing in disc brake rotor.
- (6) Install disc brake rotor.
- (7) Install inner washer and locknut. Tighten locknut, while rotating hub, to 50 foot-pounds (68 N•m) torque using tool J-25103 and back off locknut 1/3 turn (maximum).
- (8) Install outer washer and locknut. Tighten nut to 50 foot-pounds (68 N•m) torque and bend lip of washer over nut.
- (9) Install drive flange and replacement drive flange gasket.
- (10) Install drive flange attaching bolts.
- (11) Install drive flange retaining snap ring in groove at outer end of axle shaft.
- (12) Install disc brake caliper. Refer to Chapter 2G.
- (13) Install hub cap.
- (14) Lower vehicle.

### Removal—Wagoneer-Cherokee-Truck Models

- (1) Raise vehicle.
- (2) Remove disc brake caliper. Refer to Chapter 2G.
- (3) Remove rotor hub cap.
- (4) Remove axle shaft snap ring, drive gear, pressure spring, and spring retainer.
- (5) Remove outer locknut, washer, and inner locknut using tool J-6893.
- (6) Remove rotor. Spring retainer and outer bearing are removed with rotor.

- (7) Remove nuts and bolts attaching spindle and support shield and remove spindle and shield. If necessary, tap spindle with rawhide mallet to remove it from knuckle.
- (8) Remove axle shaft.

**Installation—Cherokee-Wagoneer-Truck Models**

- (1) Install axle shaft. Insert splined end of axle shaft in differential side gear and push shaft into place.
- (2) Install spindle.
- (3) Install support shield and rotor.
- (4) Install inner wheel bearing locknut (nut has peg on one side). Tighten locknut just enough to remove end play.
- (5) Install wheel and tire but do not tighten wheel nuts completely.
- (6) Tighten inner locknut to 50 foot-pounds (68 N•m) torque and rotate wheel while tightening locknut to seat bearings.
- (7) Loosen and retighten inner locknut to 35 foot-pounds (47 N•m) torque. Rotate wheel while tightening locknut to maintain established bearing seating.
- (8) Back off inner locknut 1/3 turn.
- (9) Install washer so inner tab is aligned with spindle keyway. Be sure peg on inner locknut engages in nearest hole in washer.
- (10) Install outer locknut and tighten nut to minimum of 50 foot-pounds (68 N•m) torque.
- (11) Remove wheel and tire.
- (12) Install spring retainer, pressure spring, and drive gear.

**CAUTION:** Install the spring retainer with the cupped side of the retainer facing toward the center of the vehicle.

- (13) Push drive gear inward to provide clearance for axle shaft snap ring and install snap ring.
- (14) Coat rotor hub cap rim with Permatex Adhesive-Sealant number 3 or equivalent and install hub cap in rotor.
- (15) Install disc brake caliper. Refer to Chapter 2G.
- (16) Install wheel and tire.
- (17) Lower vehicle.

**AXLE SHAFT UNIVERSAL JOINT**

**Replacement**

- (1) Remove axle shaft.
- (2) Remove snap rings from bearing cups (fig. 2F-5).
- (3) Press on end of one bearing cup to press opposite bearing from yoke half.

- (4) Turn yoke over and press first bearing out by pressing on exposed end of journal shaft.

**NOTE:** To avoid damaging the bearing, remove the bearing using a brass drift with a flat face that is approximately 1/32-inch smaller in diameter than the hole in the yoke arm.

- (5) Repeat above step to remove remaining bearings and remove bearing cross-journal by sliding it to one side and lifting out.
- (6) Wash all parts in solvent and inspect parts after cleaning. Replace any part that shows extensive wear or damage.
- (7) Pack bearing cups one-third full of bearing lubricant and install bearing rollers.
- (8) Insert bearings into axle shaft yoke half and seat them firmly against bearing shoulders.
- (9) Install bearing cross-journal while holding bearings in a vertical position to prevent bearings from dropping out.
- (10) Press bearing cup on journal from opposite side until firmly seated.
- (11) Repeat steps (9) and (10) on opposite journal.
- (12) Install snap rings on bearing cups.

**NOTE:** If the universal joint binds when assembled, tap the yoke lightly to relieve any pressure on the bearings at each end of the journal.

- (13) Install axle shaft.

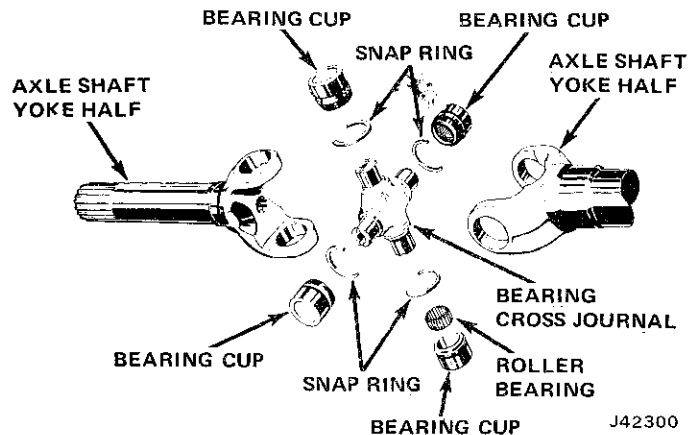
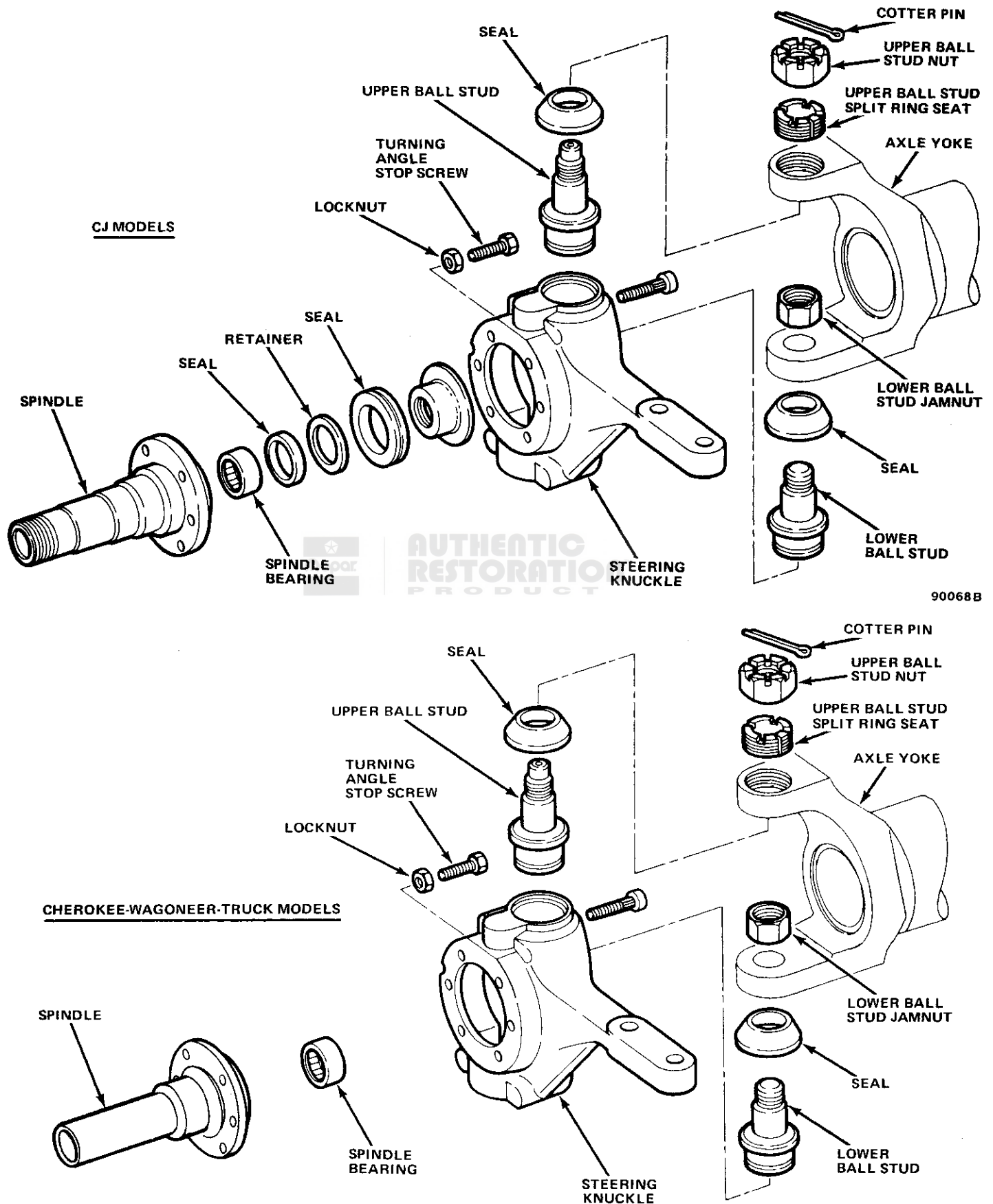


Fig. 2F-5 Axle Shaft Universal Joint

**STEERING KNUCKLE REMOVAL**

**NOTE:** The open-end steering knuckle pivots on ball studs (fig. 2F-6). Stud replacement requires removal of the axle shaft and steering knuckle.

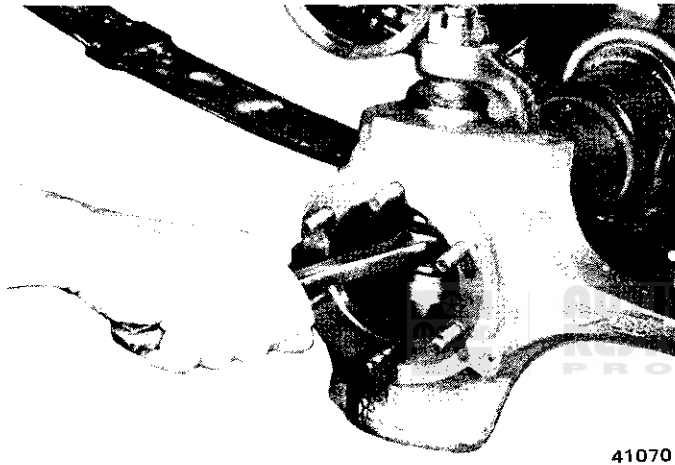


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Fig. 2F-6 Steering Knuckle Components

- (1) Remove axle shaft.
- (2) Disconnect tie-rod end at steering knuckle arm.
- (3) Remove and discard lower ball stud jamnut (fig. 2F-7).
- (4) Remove cotter pin from upper ball stud and loosen stud nut until top edge of nut is flush with top of stud.
- (5) Unseat upper and lower ball studs using lead hammer.
- (6) Remove upper ball stud nut and steering knuckle.
- (7) Remove upper ball stud split ring seat using tool J-25158.



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Fig. 2F-7 Lower Ball Stud Jamnut Removal

## STEERING KNUCKLE BALL STUDS

### Lower Ball Stud Removal

- (1) Remove lower ball stud snap ring.
- (2) Clamp knuckle assembly securely in vise with upper ball stud pointing downward (fig. 2F-8).
- (3) Attach Plate J-25211-1 to spindle mating surface of knuckle assembly (fig. 2F-8).
- (4) Position Button J-25211-3 on lower ball stud (fig. 2F-8).
- (5) Assemble and install Puller J-25215 on steering knuckle (fig. 2F-8). Hook one puller arm in Plate J-25211-1 and hook opposite arm in knuckle.
- (6) Tighten puller screw to press lower stud out of knuckle.
- (7) Remove tools used to press stud from knuckle.

### Upper Ball Stud Removal

- (1) Remove both arms from Puller J-25215.
- (2) Place Button J-25211-3 on upper ball stud (fig. 2F-9).

(3) On CJ models, install Adapter J-25211-4 on nut-end of puller screw so adapter shoulder faces nut-end of screw.

(4) On all models, thread puller frame halfway onto puller screw. Insert nut-end of screw through lower ball stud hole in steering knuckle. Position puller frame against knuckle and puller screw against Button J-25211-3 (fig. 2F-9). On CJ models, be sure Adapter J-25211-4 is positioned between puller frame and steering knuckle.

(5) Tighten puller screw to press upper ball stud out of knuckle.

(6) Remove tools used to press upper ball stud from knuckle. Do not disassemble screw and frame of Puller J-25215 at this time. Tools will be used, as assembled, to install lower ball stud.

### Lower Ball Stud Installation

- (1) Invert steering knuckle in vise.
- (2) Position replacement lower ball stud in steering knuckle.
- (3) Place Adapter J-25211-4 over nut-end of puller screw and against puller frame (fig. 2F-10).
- (4) Insert nut-end of puller screw through upper ball stud hole in knuckle and hold adapter and frame against knuckle (fig. 2F-10).
- (5) Place Installer Cup J-25211-2 on ball stud (fig. 2F-10).
- (6) Tighten puller screw to press lower ball stud into steering knuckle (fig. 2F-10).
- (7) Install replacement lower ball stud retaining snap ring.
- (8) Remove tools used to install lower ball stud.

### Upper Ball Stud Installation

- (1) Install both arms on Puller J-25215 (fig. 2F-11).
- (2) Position replacement upper ball stud in steering knuckle.
- (3) Install Plate J-25211-1 on spindle mounting studs (fig. 2F-11).
- (4) Position Installer Cup J-25211-2 on upper ball stud (fig. 2F-11).
- (5) Install assembled Puller J-25215 on steering knuckle. Hook one puller arm in plate and hook opposite arm in knuckle (fig. 2F-11). Be sure puller screw is centered on installer cup.
- (6) Tighten puller screw to press ball stud into steering knuckle (fig. 2F-11).
- (7) Remove upper ball stud installation tools.

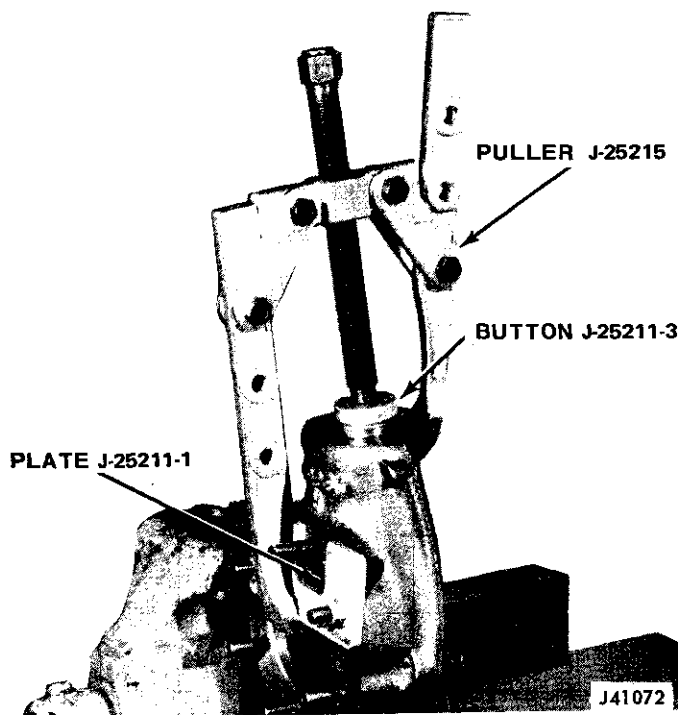


Fig. 2F-8 Lower Ball Stud Removal

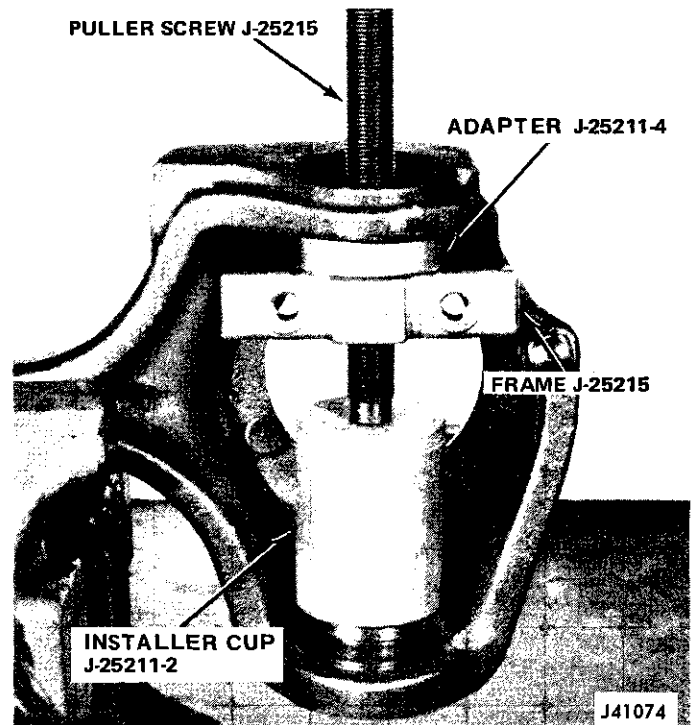


Fig. 2F-10 Lower Ball Stud Installation

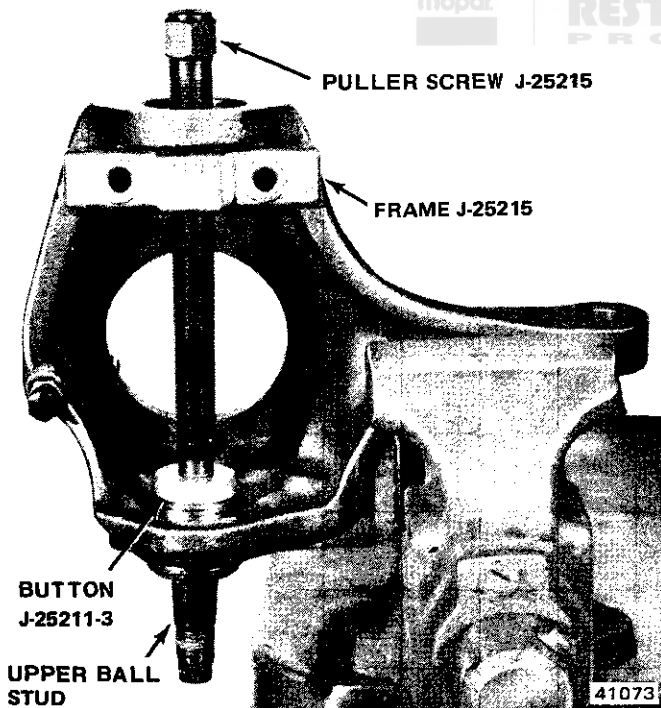


Fig. 2F-9 Upper Ball Stud Removal

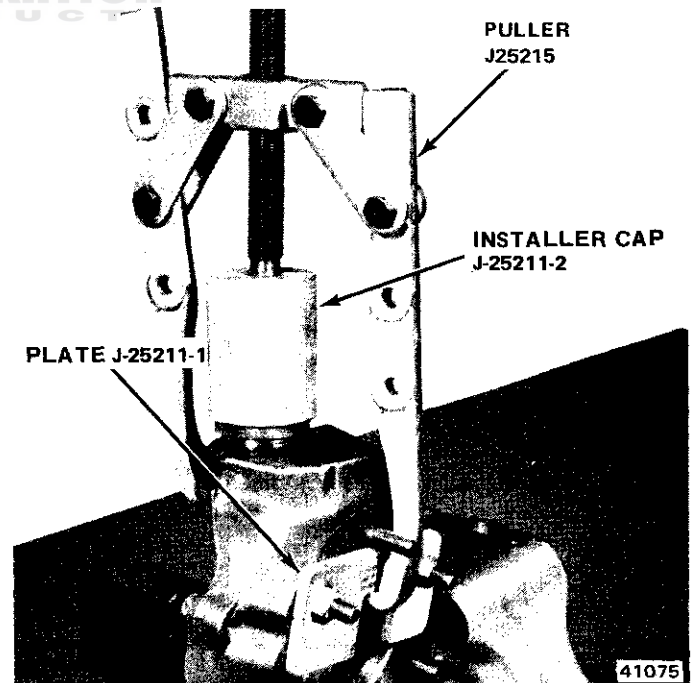


Fig. 2F-11 Upper Ball Stud Installation

### STEERING KNUCKLE INSTALLATION

- (1) Install upper ball stud split ring seat in axle yoke. Top of seat should be flush with top of yoke.
- (2) Install steering knuckle on axle yoke and install lower ball stud stud jamnut finger-tight only.

(3) Position and align Nut Wrench J-25158, Button J-25211-3, Plate J-25211-1, and Puller J-25212 (fig. 2F-12).

(4) Tighten Puller J-25212 until lower ball stud is held firmly in its seat and tighten lower jamnut. Tighten jamnut to 85 foot-pounds (115 N•m) torque on CJ models

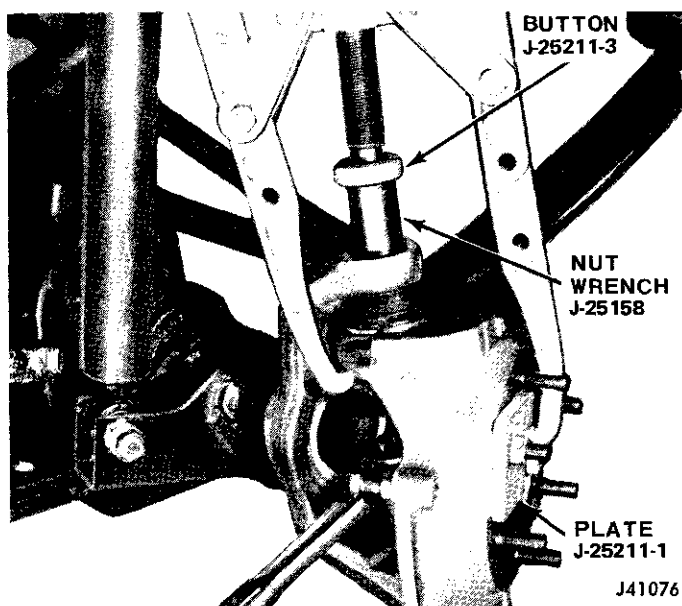


Fig. 2F-12 Steering Knuckle Installation

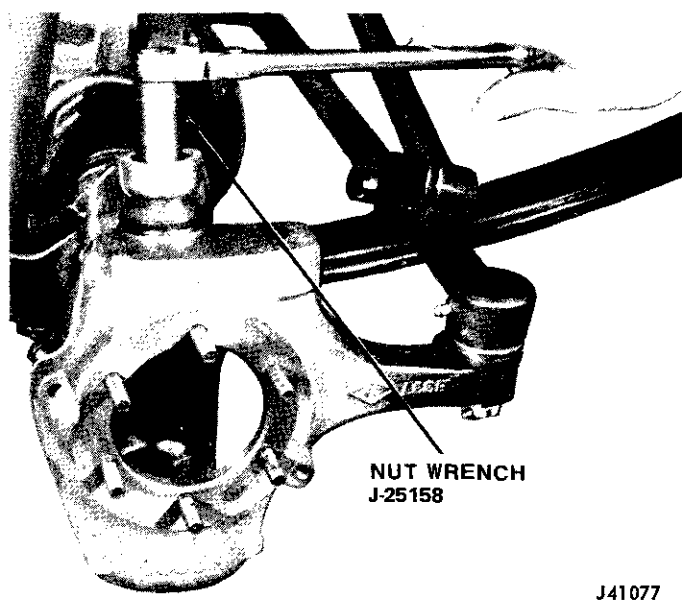


Fig. 2F-13 Tightening Upper Ball Stud Seat

and 75 foot-pounds (102 N•m) torque on all other models.

(5) Remove puller and plate.

(6) Tighten upper ball stud split ring seat to 50 foot-pounds (68 N•m) torque using tool J-25158 (fig. 2F-13).

(7) Install upper ball stud nut. Tighten nut to 100 foot-pounds (136 N•m) torque and install replacement cotter pin.

**NOTE:** If the cotter pin holes do not align, tighten the nut until the holes are aligned. Never loosen the nut to align the holes.

(8) Connect steering tie rod. Tighten tie rod-end nuts to 50 foot-pounds (68 N•m) torque and install replacement cotter pins.

(9) Check and correct front axle turning angle as necessary. Refer to Turning Angle Adjustment in this section for procedure.

(7) Pack wheel bearing grease around thrust face of shaft and seal and fill seal area of spindle with wheel bearing grease.

(8) Install axle shaft. Refer to Axle Shaft-Installation in this section for procedure.



Fig. 2F-14 Axle Shaft Seal Installation

## AXLE SHAFT SEAL

### Replacement

(1) Remove axle shaft. Refer to Axle Shaft Removal in this section for procedure.

(2) Remove seal from shaft (fig. 2F-14).

(3) Remove bronze thrust washer. If washer is worn, replace it.

(4) Clean dirt and foreign matter from seal area.

(5) Install bronze washer with chamfered side toward axle shaft seal.

(6) Install replacement seal with seal lip facing spindle (fig. 2F-14).

## SPINDLE BEARING

### Replacement

**NOTE:** Front axle spindles are equipped with a needle roller bearing which is located in the spindle flange bore (fig. 2F-15).

(1) Wrap machined surfaces of spindle with tape and mount spindle in vise. Do not clamp spindle in vise until protective tape is applied to spindle surfaces.

(2) Remove needle bearing using internal-type puller.



- (3) Clean dirt and foreign matter from spindle bearing surface.
- (4) Install replacement bearing using bearing driver.
- (5) Pack needle bearing with wheel bearing grease.

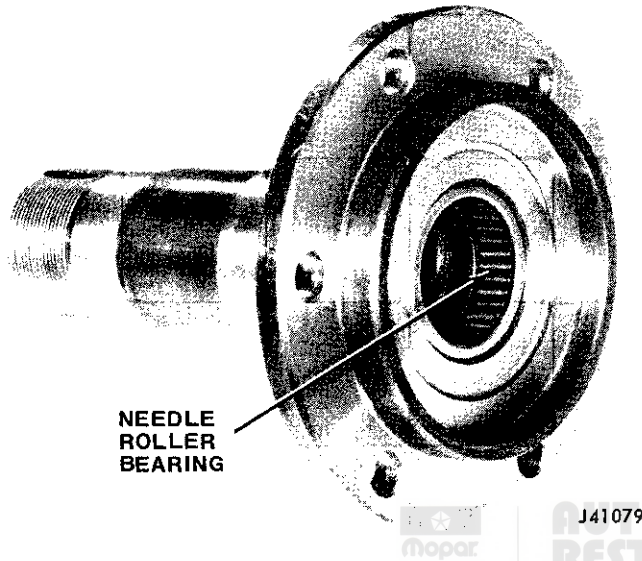


Fig. 2F-15 Spindle Bearing Location

### AXLE REMOVAL

- (1) Raise and support front end. Position frame stands under frame rails at rear of front springs.
- (2) Remove wheels.
- (3) Mark propeller shaft and axle yoke for assembly alignment reference.
- (4) Disconnect propeller shaft at axle yoke. Secure shaft to frame rail using wire.
- (5) Disconnect connecting rod at steering knuckles.
- (6) Disconnect shock absorbers at axle housing.
- (7) On vehicles equipped with sway bar, remove nuts attaching sway bar connecting links to spring tie plates.
- (8) Disconnect breather tube from axle housing.
- (9) Disconnect sway bar link bolts at spring clips.
- (10) Remove disc brake calipers, rotors, and brake shields. Refer to Chapter 2G.
- (11) Remove U-bolts and tie plates.
- (12) Support axle assembly on hydraulic jack and raise jack slightly to relieve spring tension.
- (13) Loosen nuts attaching spring pivot bolts to springs.
- (14) Remove bolts attaching front spring shackles to springs and lower springs to floor.
- (15) Remove hydraulic jack and axle assembly from underneath vehicle.

### AXLE INSTALLATION

- (1) Support axle assembly on hydraulic jack and move assembly into position underneath vehicle.
- (2) Raise springs and install shackle bolts in front springs and shackles. Install shackle bolt retaining nuts hand-tight.
- (3) Lower hydraulic jack until axle is supported by front springs and rotate axle into position on springs.
- (4) Install spring U-bolts and tie plates.
- (5) On vehicles equipped with sway bar, mount sway bar connecting links on tie plates.
- (6) Tighten spring shackle bolts to 24 foot-pounds (33 N•m) torque on CJ models and 100 foot-pounds (136 N•m) torque on all other models.
- (7) On vehicles equipped with sway bar, install nuts attaching sway bar connecting links to tie plates.
- (8) Tighten spring pivot bolts to 100 foot-pounds (136 N•m) torque on all models.
- (9) Install brake shields, rotors, and brake calipers. Refer to Chapter 2G.
- (10) Connect breather tube.
- (11) Connect shock absorbers.
- (12) Connect steering connecting rod at steering knuckles. Use replacement cotter pins to secure nuts.
- (13) Connect propeller shaft to yoke. Align shaft and yoke using alignment marks made during removal.
- (14) Install wheels.
- (15) Remove support stands and lower vehicle.
- (16) Tighten wheel retaining nuts and install wheel covers.
- (17) Check front wheel alignment.
- (18) Check turning angle.

### TURNING ANGLE ADJUSTMENT

The turning angle stopscrews are located at the rear of the steering knuckle just above the axle centerline. If adjustment is necessary, proceed as follows.

- (1) Loosen locknut on turning angle stopscrew.
- (2) Using a turntable to measure angle, adjust stopscrew to obtain proper turning angle (see Specifications).
- (3) Tighten stopscrew locknut.

**NOTE:** Turning adjusting screw inward increases turning angle. Turning screw outward decreases turning angle.

**Turning Angle Specifications:** On CJ models, set turning angle at 31 to 32 degrees. On Cherokee-Wagoner-Truck models, set the turning angle at 36 to 37 degrees.



# REAR AXLE

	Page		Page
	Axle Housing	2F-14	Identification
	Axle Hub—AMC/Jeep Axle	2F-15	Pinion Seal and Yoke—AMC/Jeep Axle
	Axle Shaft and Bearing—AMC/Jeep Axle	2F-16	Pinion Seal and Yoke—Model 44 and 60 Axle
	Axle Shaft and Bearing—Model 44 and 60 Axle	2F-17	Rear Axle Installation
	General	2F-14	Rear Axle Removal
			2F-19

## GENERAL

CJ models are equipped with the AMC/Jeep semi-floating rear axle with tapered axle shafts. This axle has an 8-7/8 inch (22.50 cm) diameter ring gear.

Cherokee, Wagoneer, and Truck models use the Model 44F semi-floating rear axle which has flanged axle shafts. Truck models rated from 6800 to 8400 GVWR (3084 to 3810 kg) use the Model 60 full-floating rear axle. Refer to the Power Train Combination Chart in Chapter A for further information.

## IDENTIFICATION

### AMC/Jeep Axle

The axle ratio identification code letter is located on the axle housing tube boss, adjacent to the dowel hole (fig. 2F-16).

### Letter Codes Chart

	Letter	Ratio	Pinion/Drive Gear Teeth
Standard	X	3.07	14/43
Trac-Lok	N	3.54:1	11/39
Standard	A	3.54:1	11/39
Trac-Lok	Y	3.07	14/43

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### Model 44 and 60 Axle

On Model 44 rear axles, the model number is cast into the upper surface of the left side reinforcing rib of the housing (fig. 2F-2). On the Model 60 rear axle, the model number is cast into a boss on the lower right side of the housing, adjacent to the housing cover.

The axle build date and manufacturer part numbers are stamped on the right-hand tube, adjacent to the cover (fig. 2F-17). The build date of the axle is as follows. First number is the month, second number is the day of the month, third number is the year, the alpha-letter is the shift and the last number is the assembly line. If there are two build dates, the latter will be the date in which the brake components were installed.

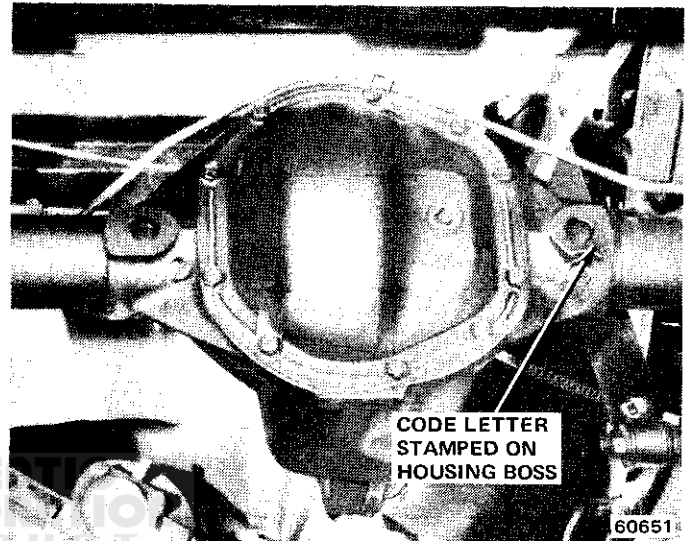


Fig. 2F-16 Axle Ratio Code Location—AMC/Jeep Axle

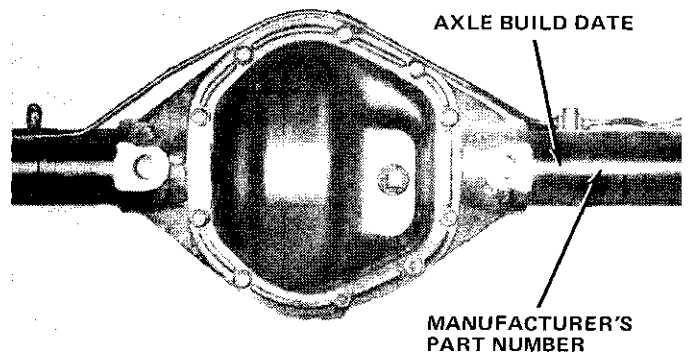


Fig. 2F-17 Axle Part Number and Build Date Location—Model 44 and 60 Axle

## AXLE HOUSING

The rear axle housing should be checked periodically for weld cracks and other damage that may cause loss of lubricant or affect driving characteristics.

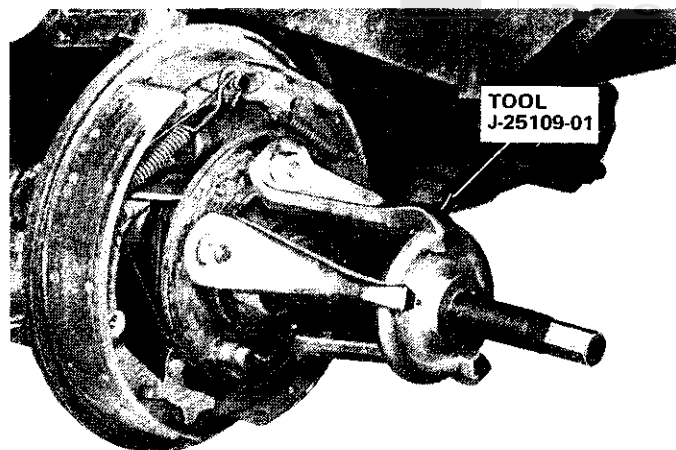
**NOTE:** If the vehicle is driven through water deep enough to cover the hubs, the wheels and drums should be removed and the brake components and axle bearings and seals inspected for water/dirt contamination or damage. All components should be cleaned thoroughly, examined carefully, and lubricated as necessary before assembly. Damaged or contaminated parts should be replaced.

## AXLE HUB—AMC/JEEP AXLE

### Removal

- (1) Remove axle shaft dust cap.
- (2) Remove axle shaft nut and washer.
- (3) Raise and support vehicle.
- (4) Remove wheel and tire.
- (5) Remove screws attaching brake drum to rear hub and remove drum.
- (6) Install Puller Tool J-25109-01 on axle hub and remove hub (fig. 2F-18).

**CAUTION:** Do not use a knockout or slide hammer-type puller to remove the hub. This type of puller may damage axle bearings, axle shaft, or differential thrust block.



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Fig. 2F-18 Axle Hub Removal—AMC/Jeep Axle

### Inspection

Inspect the hub for loose or distorted wheel lug studs. Inspect the keyway and tapered center bore for wear, damaged serrations, or cracks. Replace the hub if worn or damaged.

### Installation

**NOTE:** The procedures for installing an original hub and for installing a replacement hub are different. The installation procedures for both hub-types are as follows:

### Original Hub Installation

- (1) Align keyway in hub with axle shaft key.
- (2) Slide hub onto axle shaft as far as possible.
- (3) Install axle shaft nut and washer.
- (4) Install drum, drum retaining screws, and road wheel.
- (5) Lower vehicle onto wheels.
- (6) Tighten axle shaft nut to 250 foot-pounds (339 N•m) torque. If cotter pin hole is not aligned, tighten nut to the next castellation and install cotter pin. Do not loosen nut to align cotter pin hole.

**NOTE:** When a replacement axle shaft is installed, a replacement hub must also be installed. However, a replacement hub may be installed on an original axle shaft if the serrations on the shaft are not worn or damaged.

### Replacement Hub Installation

- (1) Align keyway in hub with axle shaft key.
- (2) Lubricate two thrust washers with liberal amount of chassis grease and install washers on axle shaft.
- (3) Install axle shaft nut.
- (4) Install drum, drum retaining screws, and road wheel.
- (5) Lower vehicle onto wheels. Tighten axle shaft nut until distance from hub outer face to axle shaft outer end is 1-5/16 inches (33.3 mm) (fig. 2F-19).

**NOTE:** The hub must be pressed onto the axle shaft to the specified dimension in order to form the hub serrations properly.

- (6) Remove axle shaft nut and one thrust washer.
- (7) Install axle shaft nut and tighten to 250 foot-pounds (339 N•m) torque. If cotter pin hole is not aligned, tighten nut to next castellation and install cotter pin. Do not loosen nut to align cotter pin hole.

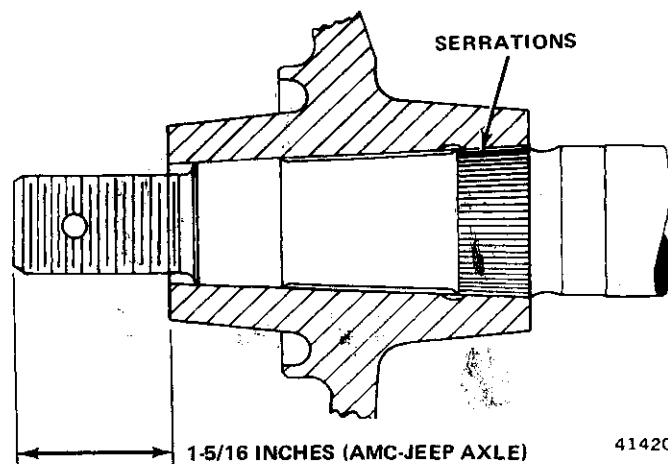


Fig. 2F-19 Replacement Hub Installation Measurement—AMC/Jeep Axle

## AXLE SHAFT AND BEARING—AMC/JEEP AXLE

### Removal

(1) Remove rear wheel, drum, and hub as outlined under Axle Hub-AMC/Jeep Axle.

(2) Disconnect parking brake cable at equalizer.

(3) Disconnect brake line at wheel cylinder and remove brake support plate assembly, oil seal, and shims from axle shaft.

**NOTE:** If both axle shafts are removed, keep the shims separated. Axle shaft end play is adjusted on the left side only.

(4) Remove axle shaft and bearing using tool J-2498 (fig. 2F-20).

**CAUTION:** On vehicles equipped with a Trac-Lok differential, do not rotate the differential gears unless both axle shafts are in place. If one shaft is removed and remaining shaft is rotated, the side gear splines will become misaligned and prevent installation of the replacement shaft.

(5) Remove and discard axle shaft inner oil seal.

(6) Remove axle shaft bearing if bearing is worn or damaged.

**NOTE:** The bearing is a press-fit on the axle shaft and must be removed using an arbor press only (fig. 2F-21). Do not attempt to remove the bearing by any other method.

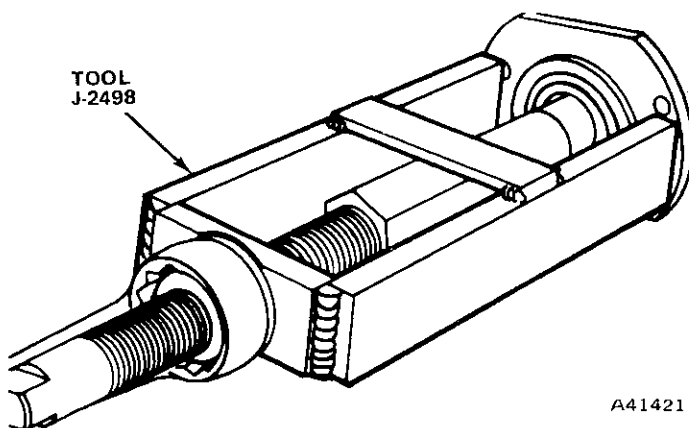


Fig. 2F-20 Axle Shaft Removal—AMC/Jeep Axle

### Installation

**NOTE:** Tapered shaft axle bearings do not have any provision for lubrication after assembly and must be packed with a high quality wheel bearing lubricant before installation.

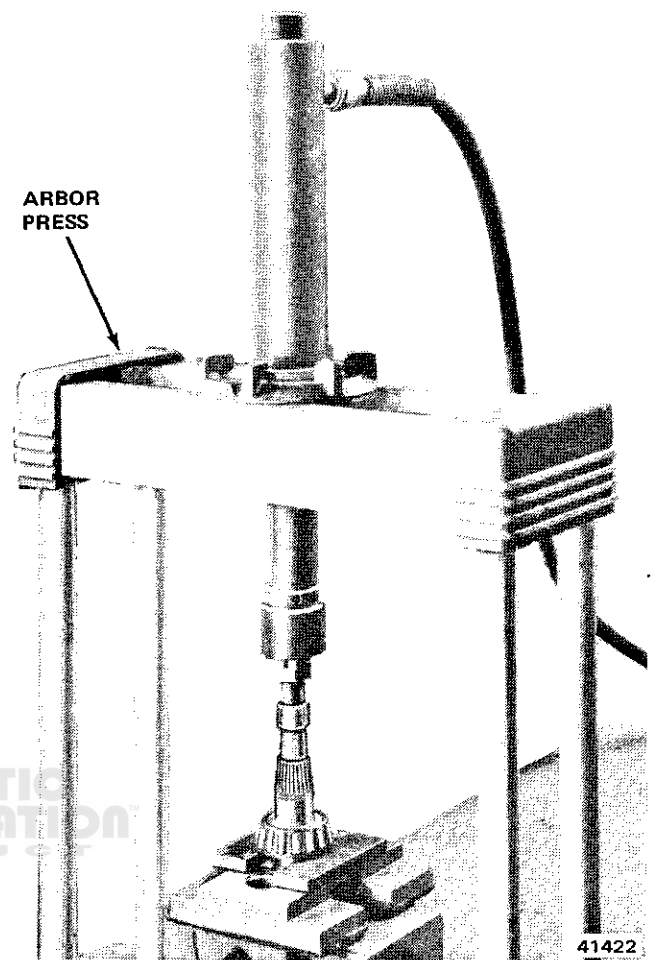


Fig. 2F-21 Axle Shaft Bearing Removal—AMC/Jeep Axle

(1) If axle shaft bearing is to be replaced, pack bearing with generous amount of wheel bearing lubricant and press bearing onto shaft. Small diameter of bearing must face toward outer tapered end of shaft.

(2) Coat inner seal with light lubricating oil.

(3) Coat outer surface of seal metal retainer with nonhardening sealer.

(4) Install inner oil seal using Seal Installer J-21788 (fig. 2F-22).

(5) Install axle shaft. Align shaft splines with differential side gear splines and insert shaft into gear.

(6) Install outer bearing cup.

(7) Inspect brake support plate for elongated bolt holes. Replace support plate if necessary.

**NOTE:** During assembly, apply a silicone-type sealer to the axle tube flange and brake support plate mounting area to prevent entry of dust and water.

(8) Install original axle end play shims, oil seal assembly, and brake support plate. Tighten attaching bolts to 35 foot-pounds (47 N•m) torque.

**NOTE:** The oil seal and retainer are located on the outside of the brake support plate.

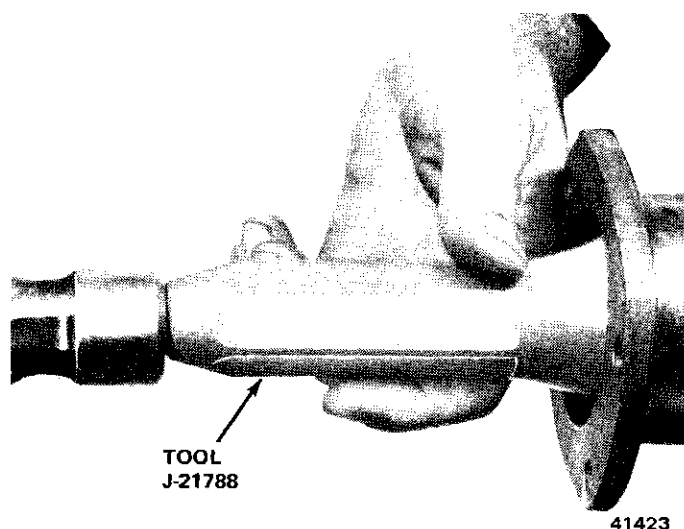


Fig. 2F-22 Inner Oil Seal Installation—AMC/Jeep Axle

### End Play Adjustment—AMC/Jeep Axle Shaft

Axle shaft end play is adjusted at the left side axle shaft only.

- (1) Strike end of each axle shaft with lead hammer to seat bearing cups against support plate.
- (2) Attach Axle Shaft End Play Tool J-2092 to end of left side axle shaft. Mount dial indicator on support plate or tool, and check end play while pushing and pulling on axle shaft (fig. 2F-23).
- (3) End play should be 0.004 to 0.008 inch (0.10 to 0.20 mm), 0.006 inch (0.15 mm) is desired.
- (4) Add shims to increase end play, or remove shims to decrease end play.
- (5) Install axle hub and brakedrum as outlined under Rear Axle Hub—Installation.
- (6) After axle shaft end play is checked and corrected, adjust brakes. Refer to Chapter 2G.

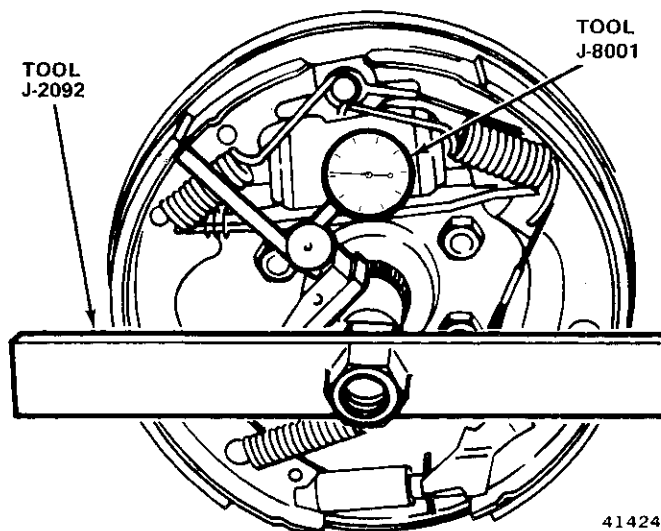


Fig. 2F-23 Measuring Axle Shaft End Play—AMC/Jeep Axle

### AXLE SHAFT AND BEARING—MODEL 44 AND 60 AXLE

#### Removal—Model 44 Axle

- (1) Raise and support vehicle and remove wheels.
- (2) Remove brakedrum.
- (3) Remove nuts attaching support plate and retainer to axle tube flange using access hole in axle shaft flange.
- (4) Assemble Adapter Tool J-21579 and Slide Hammer J-2619-01, install tools on axle shaft flange, and remove axle shaft (fig. 2F-24).
- (5) Remove axle shaft oil seal from axle housing tube.
- (6) Wipe seal bore in axle housing tube clean and install seal using tool J-25135.

#### Axle Shaft Bearing Replacement

**CAUTION:** Under no circumstances should the axle shaft retaining rings or bearings be removed using a torch. Heat will transfer into the axle shaft bearing journal and weaken it.

- (1) Mount axle shaft in vise.
- (2) Drill 1/4 inch (6.35 mm) diameter hole in retainer ring. Hole depth should be approximately three fourths of ring thickness. Do not allow drill to contact axle shaft.
- (3) Position chisel over drilled hole in retainer ring. Cut deep groove in retaining ring using chisel. This will enlarge ring, or split it, allowing ring to be removed from axle shaft (fig. 2F-25).
- (4) Cut through oil seal using hacksaw and remove seal and retainer plate. Do not damage seal contact surface.
- (5) Inspect axle shaft oil seal journal for scratches. Remove scratches using crocus cloth.
- (6) Install retainer plate on axle shaft.
- (7) Pack wheel bearing grease in oil seal cavity and between seal lips and install seal on axle shaft seal seat. Outer face of seal must face axle flange.
- (8) Pack replacement axle bearing with wheel bearing grease.
- (9) Install bearing on axle shaft. Be sure cup rib ring is facing axle flange.
- (10) Install bearing retainer ring on axle shaft.
- (11) Using tool J-23674 and arbor press, press axle shaft bearing and retainer ring on axle shaft simultaneously. Be sure bearing and retainer ring are properly seated against axle shaft shoulder.

#### Installation—Model 44 Axle

- (1) Install axle shaft through support plate. Do not damage axle housing tube inner oil seal.
- (2) Apply coating of wheel bearing grease to outside diameter of bearing cup before installing in bearing bore.

(3) Tap end of flanged shaft lightly with rawhide mallet to position axle shaft bearing in bearing bore of housing.

(4) Attach axle shaft retainer and brake support plate to axle tube flange. Install attaching nuts and lockwashers.

(5) Install brake drum, spring-type locknuts, and rear wheels.

(6) Remove supports and lower vehicle.

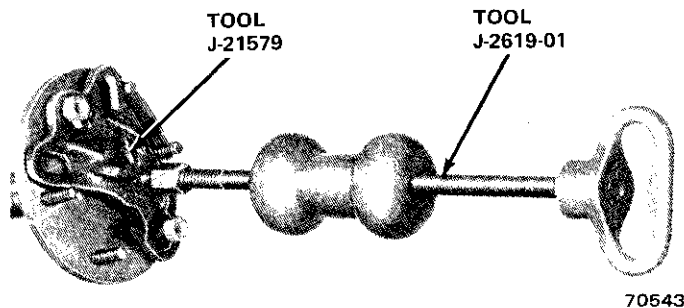


Fig. 2F-24 Axle Shaft Removal—Model 44 and 60 Axle

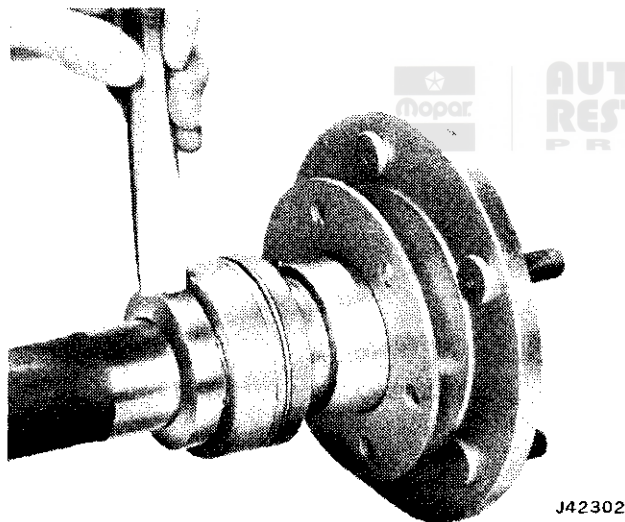


Fig. 2F-25 Notching Bearing Retainer Ring—Model 44 Axle

**Removal—Model 60 Axle**

**NOTE:** It is not necessary to raise the rear wheels in order to remove the rear axle shafts on Model 60 full-floating rear axles.

- (1) Remove axle flange nuts, lockwashers, and split washers retaining axle shaft flange.
- (2) Remove axle shaft from housing.

**Installation—Model 60 Axle**

- (1) Be sure axle flange mating area on hub and axle are clean and free of old gasket material.
- (2) Install replacement flange gasket on hub studs.
- (3) Insert axle shaft into housing.

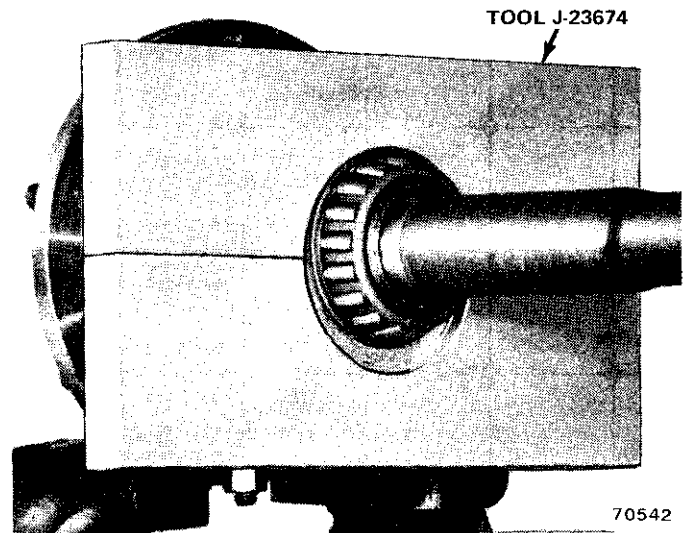


Fig. 2F-26 Axle Shaft Bearing Removal—Model 44 Axle

**NOTE:** It will be necessary to rotate the axle shaft to simultaneously align the shaft splines with the differential gear splines and the flange attaching holes with the hub studs.

- (4) Install split washers, lockwashers, and flange bolts. Tighten bolts.

**PINION SEAL AND YOKE—AMC/JEEP AXLE**

**Removal**

- (1) Raise and support vehicle.
- (2) Remove rear wheels and brake drums.
- (3) Mark propeller shaft and rear axle yokes for assembly alignment reference.
- (4) Disconnect propeller shaft at rear axle yoke.
- (5) Rotate drive pinion several revolutions using Socket Tool J-22575 and inch-pound torque wrench to measure torque required to turn drive pinion.

**NOTE:** The torque required to turn the drive pinion must be recorded for reference at time of assembly.

- (6) Remove pinion nut using tool J-8614-01 (fig. 2F-3). Discard pinion nut.
- (7) Mark yoke and pinion for alignment reference at time of assembly.
- (8) Remove yoke using tools J-8614-01, -02, -03 (fig. 2F-4).
- (9) Inspect seal surface of yoke. If surface is damaged or grooved, replace yoke.
- (10) Remove pinion seal using tool J-9233 (fig. 2F-27).
- (11) Before installing replacement seal, coat seal lip with rear axle lubricant.
- (12) Install seal using tool J-22661 (fig. 2F-28).
- (13) Install yoke on pinion. Note alignment marks.
- (14) Install replacement pinion nut. Tighten nut using tools J-8614-01 and J-22575 to remove pinion bearing end play only. **Do not overtighten nut.**

(15) Check torque required to turn pinion gear. Pinion must be turned several revolutions to obtain accurate torque reading. Refer to torque reading recorded during disassembly and add 5 inch-pounds (0.6 N•m) for proper amount of torque.

(16) If preload torque is less than desired amount, which should equal disassembly torque reading plus 5 inch-pounds (0.6 N•m), tighten pinion nut slightly and recheck torque.

(17) Repeat gradual tightening procedure until desired torque is attained. **Do not loosen and retighten nut.**

**CAUTION:** Do not overtighten the pinion nut. If the desired torque is exceeded, a replacement collapsible pinion spacer sleeve must be installed and the pinion gear preload reset. Refer to *Differential Overhaul*.

(18) Install propeller shaft. Align index marks made at disassembly

(19) Install rear brake drums and wheels.

(20) Remove supports and lower vehicle.

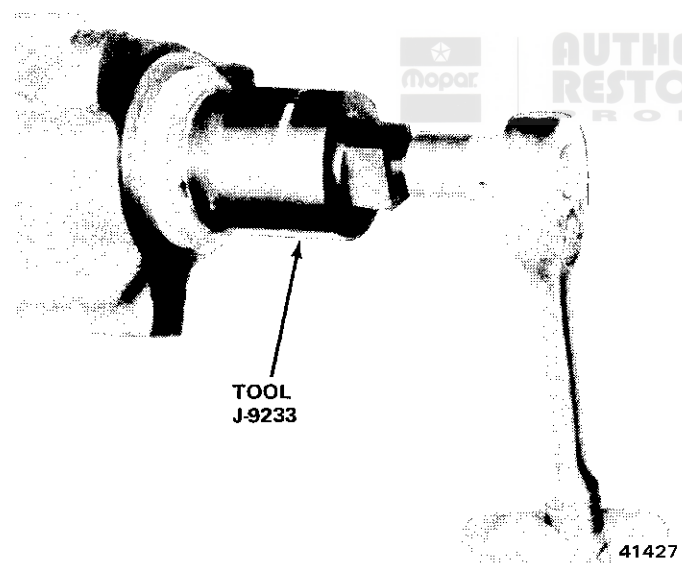


Fig. 2F-27 Pinion Seal Removal

## PINION SEAL AND YOKE—MODEL 44 AND 60 AXLE

### Removal

- (1) Raise and support vehicle.
- (2) Index propeller shaft to front yoke for assembly reference and disconnect shaft at yoke.
- (3) Remove pinion nut and washer using tool J-8614-01 (fig. 2F-3).
- (4) Remove yoke using tools J-8614-01,-02,-03 (fig. 2F-4).
- (5) Remove pinion seal using tool J-25180 on Model 44 axle or tool J-25144 on Model 60 axle.

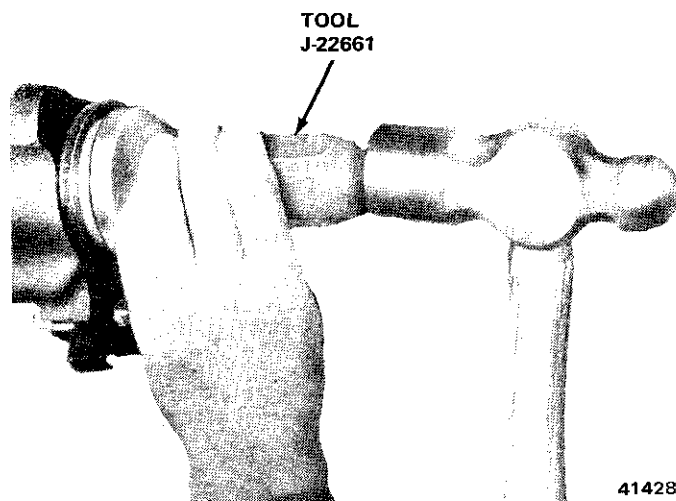


Fig. 2F-28 Pinion Seal Installation

### Installation

- (1) Install replacement pinion seal using tool J-25104.
- (2) Install yoke on pinion.
- (3) Install pinion washer and nut. Tighten nut to 210 foot-pounds (285 N•m) torque on Model 44 axle and 260 foot-pounds (352 N•m) torque on Model 60 axle.
- (4) Align index marks on propeller shaft and yoke and install shaft. Tighten U-bolt nuts to 16 foot-pounds (22 N•m) torque or tighten flange bolts to 35 foot-pounds (47 N•m) torque.
- (5) Remove supports and lower vehicle.

### REAR AXLE REMOVAL

- (1) Raise vehicle and position support stands under frame rails just forward of rear springs.
- (2) Remove wheels.
- (3) Mark propeller shaft and axle for assembly alignment reference.
- (4) Disconnect propeller shaft at rear axle yoke.
- (5) Disconnect shock absorbers at axle tubes.
- (6) Disconnect brake hydraulic hose at rear axle tee fitting. Tape ends of hose and fitting to prevent dirt entry.
- (7) Disconnect parking brake cable at equalizer.
- (8) Support axle using hydraulic jack.
- (9) Remove U-bolts. On vehicle with spring-mounted above axle, disconnect spring at rear shackle.
- (10) Slide axle from under vehicle.

### REAR AXLE INSTALLATION

**NOTE:** All service replacement axle assemblies are shipped from the factory without lubricant in the differential. Lubricant must be added to the differential before the axle is installed. Use gear lubricant grade SAE



## 2F-20 AXLES

90 for standard axles. Use Jeep Trac-Lok Lubricant or equivalent in Trac-Lok axles.

When adding differential lubricant, be sure the pinion bearings receive lubricant. Suspend the axle so the axle shafts are in a horizontal position and the yoke end of the pinion housing is facing downward. Then, turn the pinion gear several times so lubricant will reach the pinion bearings.

(1) Support axle assembly on hydraulic jack and position axle under vehicle.

(2) Align springs with axle spring pads, and install U-bolts and nuts. On vehicles with spring mounted above axle, position spring on shackles and install bolts but do not tighten bolts completely.

(3) Attach brake line hose at tee fitting on top of housing.

(4) Connect parking brake cables.

(5) Connect shock absorbers to axle tubes.

(6) Install propeller shaft. Align reference marks made during removal.

(7) Bleed and adjust brakes. Refer to Chapter 2G.

(8) Install brakedrums and wheels.

(9) Remove supports and lower vehicle.

(10) Check axle lubricant level and add lubricant as necessary.

## SPECIFICATIONS

### Rear Axle Specifications

Axle Type:	
Model 44 . . . . .	Drive-type, semi-floating axle with flanged axle shafts.
Model 60 . . . . .	Drive-type, full-floating axle with flange-type axle.
AMC/Jeep . . . . .	Drive-type, semi-floating axle with tapered axle shaft.
Axle Application:	
Model 44 Rear Axle . . . . .	Cherokee-Wagoneer-J-10 Truck
Model 60 Rear Axle . . . . .	J-20 Truck
AMC/Jeep Rear Axle . . . . .	CJ
Axle Ring Gear Diameter:	
Model 44 . . . . .	8.500-inches (21.59 cm)
Model 60 . . . . .	9.750-inches (24.38 cm)
AMC/Jeep . . . . .	8.875-inches (22.19 cm)
Rear Axle Lubricants:	
Standard Differential . . . . .	Jeep Axle Lubricant or equivalent of SAE 90 A.P.I. Grade GL-5 quality, or axle lubricant grade MIL-L-2105 B.
Trac-Lok Differential . . . . .	Jeep Trac-Lok Axle Lubricant or equivalent only.
Lubricant Capacity:	
Model 44 . . . . .	3.0 Pints (1.41 liters)
Model 60 . . . . .	6.0 Pints (2.84 liters)
AMC/Jeep . . . . .	4.75 Pints (2.25 liters)

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### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Axle Hub-To-Shaft Nut (AMC-Jeep Axle) . . . . .	250 min.	—	339 min.	—
Axle Housing Cover Bolts . . . . .	20	15-25	27	20-34
Brake Support Plate Bolts:				
Model 44 . . . . .	30	25-35	41	34-47
Model 60 . . . . .	50	45-55	68	61-75
AMC/Jeep . . . . .	32	25-40	43	34-47
Pinion Nut:				
Model 44 . . . . .	210	200-220	285	271-298
Model 60 . . . . .	260	250-270	353	339-366
AMC/Jeep . . . . .	17-25 in-lbs	—	2-3	—
Shock Absorber Lower Stud Nut . . . . .	45	35-50	61	47-68
Spring Clip U-Bolt Nut:				
9/16-18 . . . . .	100	85-105	136	115-142
1/2-20 . . . . .	55	45-65	75	61-88
Spring Shackle Bolts/Nuts:				
CJ . . . . .	24	18-30	33	24-41
Cherokee-Wagoneer-Truck . . . . .	100	80-120	136	115-163
Spring Pivot Bolts/Nuts (All) . . . . .	100	80-120	136	115-163
Styled Wheel Hub Cap . . . . .	32 in-lbs	24-40 in-lbs	4	3-5
Universal Joint U-Bolt Nuts . . . . .	15	13-18	20	18-24
Universal Joint Clamp Strap Bolts . . . . .	15	13-18	20	18-24
Universal Joint Flange Bolts/Nuts . . . . .	35	25-45	47	34-61
Wheel Retaining Nuts:				
Model 44 . . . . .	80	65-80	108	88-108
Model 60 . . . . .	120	110-150	163	149-203
AMC/Jeep . . . . .	80	65-90	108	88-108

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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# STANDARD DIFFERENTIAL

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Differential Overhaul—Axle Models 30-44-60	2F-30
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## GENERAL

CJ models use the Model 30 front axle and the AMC/Jeep rear axle which has tapered axle shafts.

Cherokee, Wagoneer, and Truck models use the Model 44F front axle and the Model 44 rear axle with flanged axle shafts. Truck models rated at 6800 GVWR (3084 kg) and up use the Model 44F front axle and the Model 60 rear axle with full-floating axle shafts.

Rear axle Models 44 and AMC/Jeep are semi-floating type axles. Only the Model 60 is a full-floating type unit.

## DIFFERENTIAL OPERATION

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

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

In operation, power flow occurs as follows: The pinion gear rotates the ring gear. The ring gear, which is bolted to the differential case, rotates the case. The differential pinion gears, which are mounted on the pinion mate shaft, which is fitted in the case, rotate the side gears. The side gears, which are splined to the axle shafts, rotate the shafts.

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (fig. 2F-29).

When turning corners, the outside wheel must travel a greater distance than the inside wheel in order to complete the turn. This difference must be compensated for in order to prevent the wheels from scuffing and sliding through the turn. To accomplish this, the differential becomes effective allowing the axle shafts to rotate at unequal speeds (fig. 2F-30). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

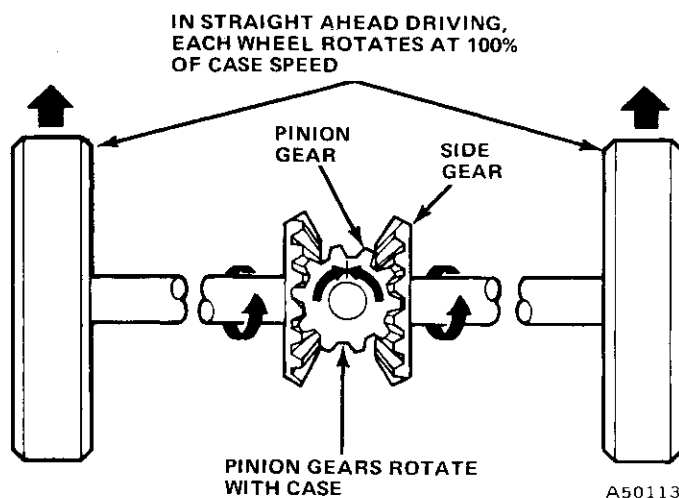


Fig. 2F-29 Differential Operation—Straight Ahead Driving

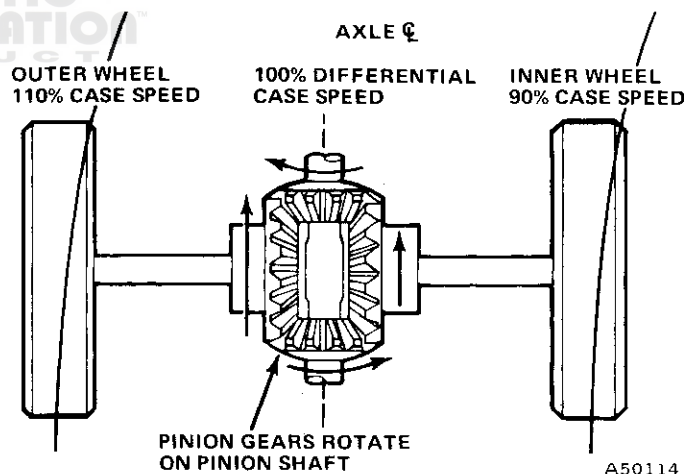


Fig. 2F-30 Differential Operation—On Turns

## DIFFERENTIAL OVERHAUL—AMC/JEEP AXLE

### Differential Disassembly

**NOTE:** It is not necessary to remove the rear axle assembly in order to overhaul the differential. All differential service operations can be performed with the axle mounted in the vehicle.

- (1) Remove axle shaft dust caps and retaining nuts.
- (2) Raise and support vehicle.
- (3) Remove axle housing cover and drain lubricant.

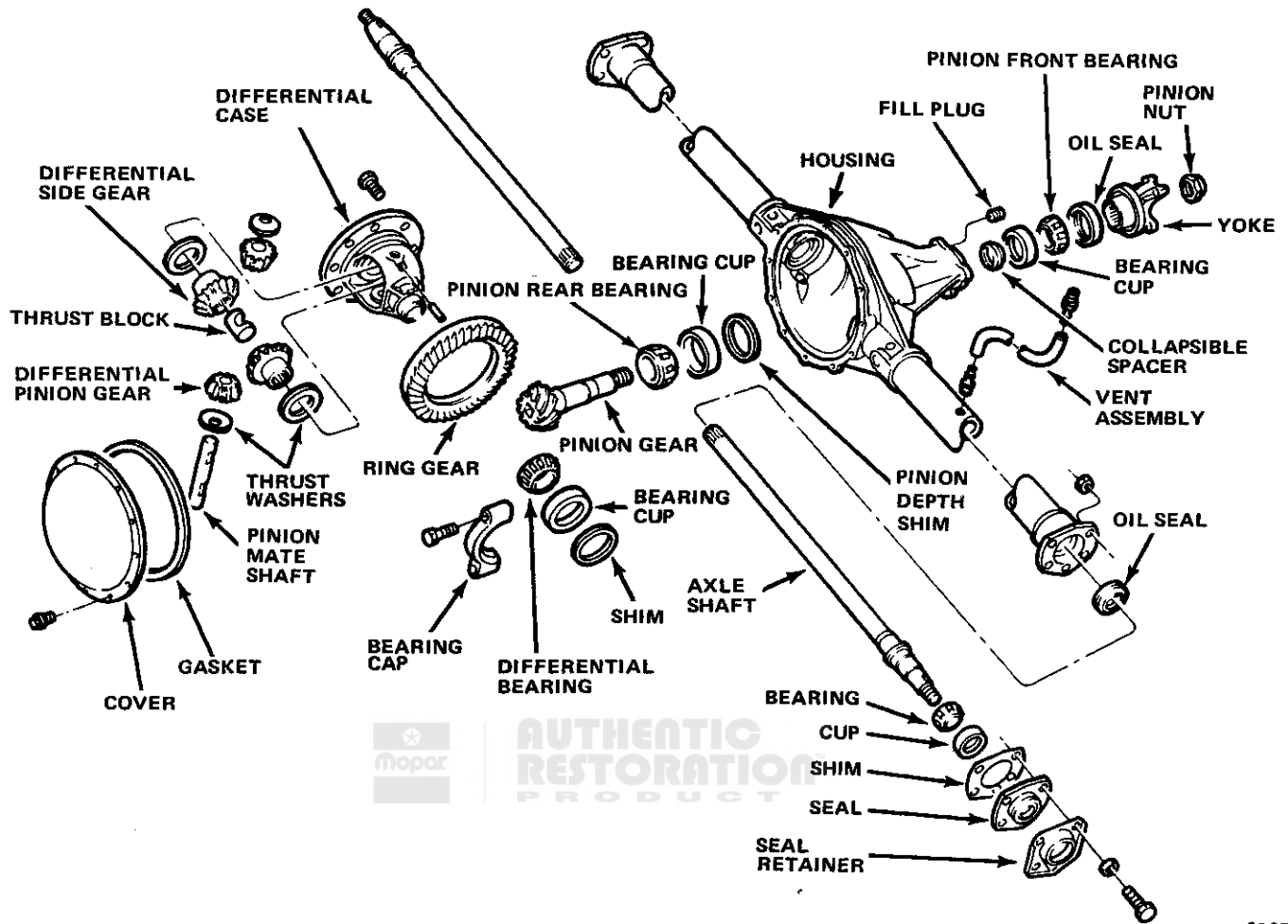


Fig. 2F-31 AMC/Jeep Rear Axle—CJ Models

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(4) Remove rear wheels, brakedrums, hubs, axle shafts, and seals. Keep left and right-side axle parts separated.

(5) Mark differential bearing caps with center punch for assembly reference.

(6) Loosen bearing cap bolts until only 2 or 3 threads are engaged, then pull bearing caps away from bearings. With caps loose but still in position, differential can not fall out and sustain damage when pried out of axle housing.

(7) Pry differential loose in axle housing using two pry bars.

(8) Remove bearing caps and remove differential.

(9) Tie differential bearing shims to their respective bearing caps and cups to prevent misplacement (fig. 2F-31).

**Differential Bearing Removal**

(1) Mount differential in vise (fig. 2F-32).

(2) Insert Button from Puller J-2497-01 in differential (fig. 2F-32).

(3) Position Puller J-2497-01 on bearing and remove bearing (fig. 2F-32). When using puller, be sure it pulls

on bearing cone in such a manner that bearing rollers are free. If puller bears on bearing roller cage, cage will be damaged.

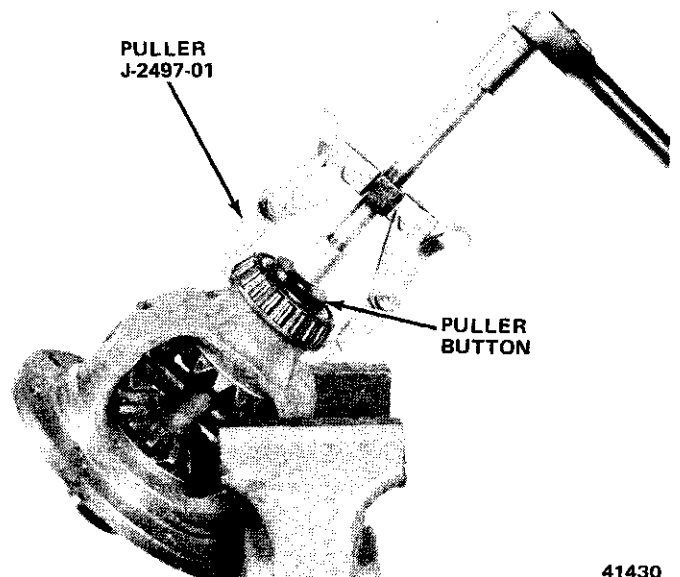


Fig. 2F-32 Differential Bearing Removal

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### Ring Gear Removal

- (1) Mount differential in vise so ring gear bolt heads face upward.
- (2) Pad vise with shop cloths to avoid damaging ring gear when removed.
- (3) Remove bolts attaching ring gear to differential case.
- (4) Remove ring gear. Tap gear from differential case using brass drift and hammer.

**CAUTION:** To avoid damaging the differential case or ring gear, do not attempt to chisel, wedge, or pry the gear off the case.

- (5) Remove case and ring gear from vise.

### Pinion Mate Shaft Removal

- (1) Remove pinion mate shaft lockpin using 3/16 (4.76 mm) diameter drift at least 3 inches (7.62 cm) long (fig. 2F-33).

- (2) Remove pinion mate shaft and remove thrust block (fig. 2F-34).

- (3) Rotate pinion gears on side gears until pinion gears are aligned with opening in case.

- (4) Remove pinion gears and thrust washers through opening in case.

- (5) Remove side gears and thrust washers through opening in case.

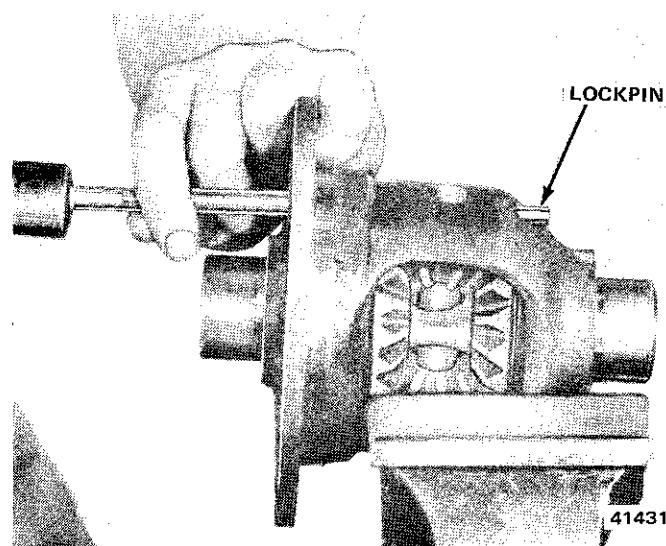


Fig. 2F-33 Pinion Mate Shaft Lockpin Removal

### Pinion Gear Removal

- (1) Remove pinion nut using tool J-8614-01 (fig. 2F-3).
- (2) Remove pinion yoke using tools J-8614-01,-02,-03 (fig. 2F-4).
- (3) Reinstall axle housing cover loosely using two bolts. This is necessary to prevent pinion from falling out of housing when driven out of bearings.

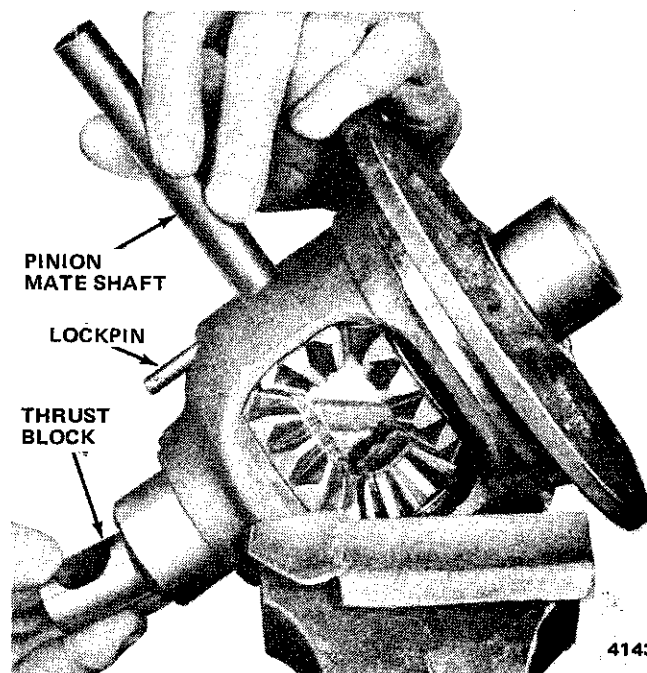


Fig. 2F-34 Pinion Mate Shaft and Thrust Block Removal

- (4) Remove pinion seal.

- (5) Tap yoke end of pinion gear with rawhide mallet until gear is driven out of front bearing.

- (6) Remove front bearing and collapsible spacer. Discard spacer.

**CAUTION:** The collapsible spacer is used to control pinion bearing preload. Discard this spacer after removal, it is not reusable.

- (7) Remove axle housing cover and remove pinion gear.

### Pinion Rear Bearing Removal

- (1) Install Bearing Remover Tool J-22912-01 on pinion gear.

- (2) Position chamfered edges of remover tool between bearing inner race and pinion head.

- (3) Tighten remover tool bolts until chamfered edges of tool are well under bearing race.

- (4) Position gear and tool in arbor press and press gear out of bearing.

### Pinion Bearing Cup Removal

- (1) Remove rear bearing cup using Driver Handle J-8092 and Cup Remover J-21786.

- (2) Remove pinion gear depth adjustment shims from cup bore in housing.

**NOTE:** The pinion gear depth adjustment shims are located under the rear bearing cup. Tag these shims for assembly reference.

- (3) Remove front bearing cup using Driver Handle J-8092 and Cup Remover J-21787.

**CAUTION:** *Keep the bearing cup tool seated squarely on the cup to prevent damaging the cup bores during removal.*

### Cleaning and Inspection

Clean all parts in solvent. Allow bearings to air dry. Dry other parts with compressed air.

Inspect the differential bearing cones, cups, and rollers for pitting, galling, flat spots, or cracks.

Inspect the differential case for an elongated or enlarged pinion mate shaft hole. The machined thrust washer surface areas and counterbores must be smooth and free of nicks, gouges, cracks, or burrs. Inspect the differential case for cracks or other visible damage which would necessitate replacement.

Inspect the pinion mate shaft for excessive wear in the contact area of the differential pinions. The shaft should be smooth and concentric and not scored or galled.

Inspect the differential side gears and pinions; they should have smooth teeth with a uniform contact pattern but not display excessive wear or broken surfaces. The side gear and pinion thrust washers should be smooth and free from any scoring or metal pickup.

Inspect the pinion mate shaft lockpin for damage or looseness in the case. Replace the pin or case as necessary.

Inspect the ring and pinion gears for worn or chipped teeth or damaged attaching bolt threads. If replacement is necessary, replace the ring gear and pinion as a matched set only.

Inspect the pinion bearing cones, cups, and rollers for pitting, galling, excessive wear, or other visible damage. Replace any part that exhibits any of these conditions.

Inspect the axle housing for cracks, porosity, bent or loose tubes, or other damage. In addition, if raised metal was created on the pinion bearing cup bore shoulders during cup removal, flatten it using a blunt punch.

Inspect the pinion gear for damaged bearing journals, damaged shim surfaces, or excessively worn splines. If pinion replacement is necessary, replace both the pinion gear and ring gear as a matched set only.

Inspect the pinion yoke for cracks, worn splines, and a pitted, rough, or corroded oil seal contact surface. Repair or replace the yoke as necessary.

Inspect the pinion gear depth adjustment shims for being broken, damaged, or distorted. Replace the shims as necessary before adjusting pinion gear depth.

### Differential Assembly

#### Pinion Gear Depth Measurement and Adjustment

Pinion gear depth is the distance (measured in inches) from the end (button) face of the pinion gear to the centerline of the axle shafts (fig. 2F-35). This dimension is controlled by shims installed between the pinion gear rear bearing cup and axle housing (fig. 2F-35).

Ring and pinion sets are factory tested to detect machining variances. Tests are started at a standard setting which is then varied to obtain the most desirable tooth contact pattern and quiet operation. When this setting is determined, the ring and pinion gear are etched with identifying numbers (fig. 2F-36).

The ring gear receives one number. The pinion gear receives two numbers which are separated by a plus (+) or minus (-) sign.

The second number on the pinion gear indicates pinion position, in relation to the centerline of the axle shafts, where tooth contact was best and gear operation was quietest. This number represents pinion depth variance and indicates the amount, in thousandths of an inch, that the gear set varied from the standard setting. The number on the ring gear and first number on the pinion gear identify the gears as a matched set. Do not attempt to use a ring and pinion set having differing numbers. This is not a matched set.

The standard setting for AMC/Jeep axles is 2.547 inches (6.46 cm). If the pinion is marked +2, the gear set varied from standard by +0.002 inches (0.05 mm) and will require 0.002 inch (0.05 mm) less shims than a gear set marked zero (0). When a gear set is marked plus (+), the distance from the pinion end face to the axle shaft centerline must be more than the standard setting. If the pinion gear is marked -3, the gear set varied from standard by 0.003 inches (0.07 mm) and will require 0.003 (0.07 mm) more shims than a set marked zero (0). When a set is marked minus (-), the distance from the pinion end face to the axle shaft centerline must be less than the standard setting. Refer to Figure 2F-35 for an illustration of the standard setting dimension.

**NOTE:** *On some factory installed gear sets, an additional 0.010 or 0.020 inches (0.25 or 0.50 mm) may have been machined off the pinion gear button face. This does not affect gear operation but does affect pinion gear marking and depth measurement. Pinion gears machined in this fashion have different identifying numbers. For example, if the pinion is marked +23, the number 2 indicates that 0.020 (0.50 mm) was removed from the pinion button face and the number 3 indicates that variance from the standard setting is +0.003 (0.07 mm). If the pinion is marked +16, the number 1 indicates that 0.010 (0.25 mm) was removed from the pinion button face and the number 6 indicates that variance from the standard setting is +0.006 (0.15 mm). Gear sets with additional amounts machined off the pinion button face are factory installed items exclusively. All service replacement gear sets will be machined to standard settings only. In addition, replacement gear sets marked + or -0.009 (0.22 mm) or more, or sets with mismatched identifying numbers must be returned to the parts distribution center. Do not attempt to install these gear sets.*

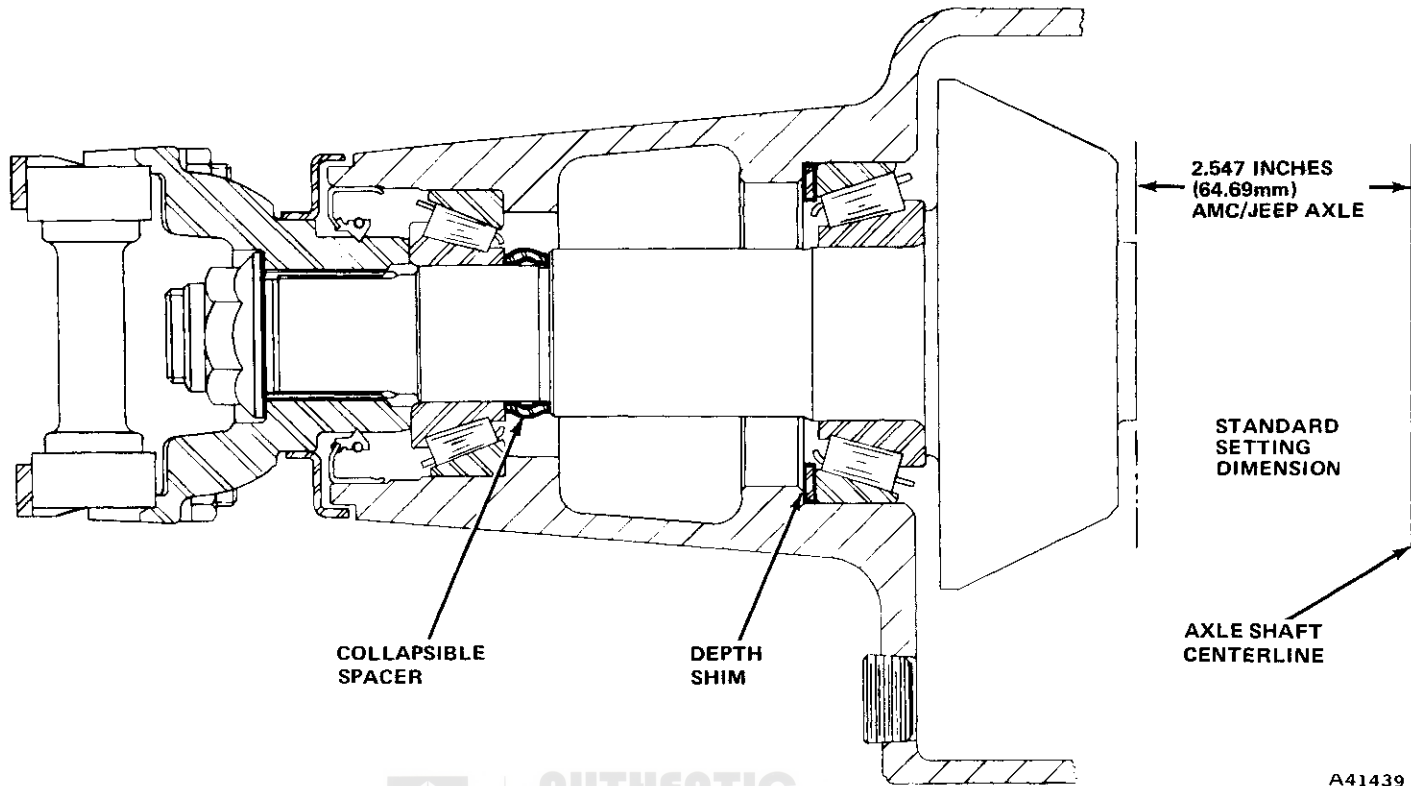


Fig. 2F-35 Standard Setting Dimension and Pinion Depth Shim Location

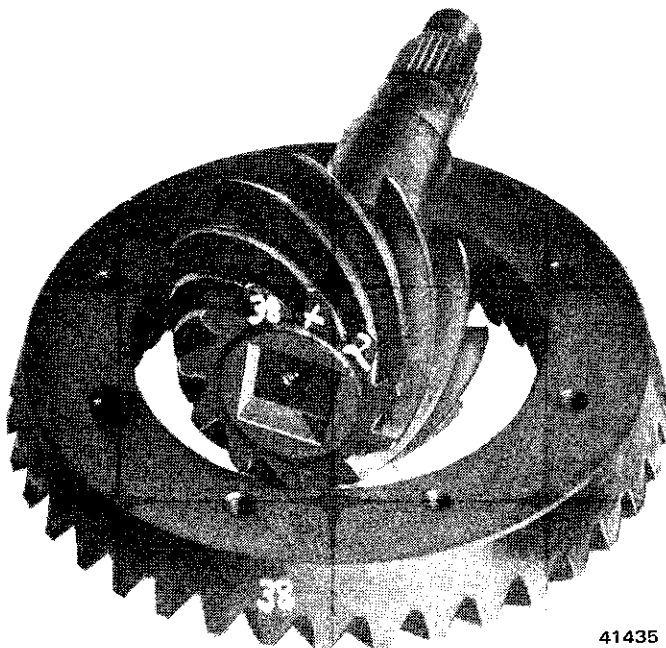
**Pinion Variance Chart**

This chart will help to determine the approximate "starter shim" thickness needed for initial pinion depth measurement. However, the chart will not provide the exact shim thickness required for final adjustment and must not be used as a substitute for an actual pinion depth measurement.

To use the chart, proceed as follows:

- (a) Measure thickness of original pinion depth shim.
- (b) Note pinion depth variance numbers marked on old and new pinion gears.
- (c) Refer to Old and New Pinion Marking columns in chart. Chart box where old and new pinion depth variances intersect will provide approximate amount of change required to achieve desired starter shim thickness.

For example, if the old pinion is marked -3 and the new pinion +2, chart procedure would be as follows: Refer to Old Pinion Marking column at left side of chart and locate -3 figure in this column. Then read to right, across chart, until under +2 figure in New Pinion Marking column. Box where two columns intersect is amount of shim thickness change required. In this case, the number in the intersecting box is -0.005 (0.12 mm) which represents the amount to be subtracted from the old shim thickness. If the box number had been a + figure, this amount would be added to the old shim thickness.



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Fig. 2F-36 Ring and Pinion Gear Markings

**Pinion Gear Installation and Depth Adjustment**

- (1) Measure thickness of pinion depth shim removed during disassembly.
- (2) Note pinion depth variance numbers marked on old and new pinion gears.
- (3) Refer to Pinion Variance Chart and determine amount to be added or subtracted from original shim for desired starter shim thickness.

Pinion Variance Chart

Old Pinion Marking	New Pinion Marking								
	-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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**CAUTION:** Do not attempt to use the starter shim thickness determined by the pinion variance chart as the final shim setting. An actual pinion depth measurement must be performed and final shim thickness adjusted as necessary.

(4) Install rear bearing on pinion gear using arbor press. Install bearing so large diameter of bearing cage faces gear end of pinion and press bearing against pinion head.

(5) Clean pinion bearing bores in axle housing thoroughly. This is important to obtaining correct pinion gear depth adjustment.

(6) Install starter pinion depth shim in housing rear bearing cup bore. Be sure shim is centered in bearing cup bore.

**NOTE:** If the shim is chamfered, be sure the chamfered side faces the bottom of the bearing cup bore.

(7) Install rear bearing cup using Driver Handle J-8092 and Cup Installer J-8608 (fig. 2F-37).

(8) Install front bearing cup using Driver Handle J-8092 and Cup Installer J-8611-01.

(9) Install pinion gear. Be sure rear bearing is seated in rear bearing cup.

(10) Install front bearing, rear universal joint yoke, and original pinion nut on pinion gear. **Tighten pinion nut only enough to remove bearing end play.**

**CAUTION:** Do not install a new pinion nut and collapsible spacer at this time as the pinion gear will be removed after depth measurement.

(11) Note pinion depth variance marked on pinion gear. If number is preceded by a plus (+) sign, add that amount (in thousands) to standard setting for axle model being overhauled. If number is preceded by a minus (-) sign, subtract that amount (in thousandths) from standard setting. Result of this addition or sub-

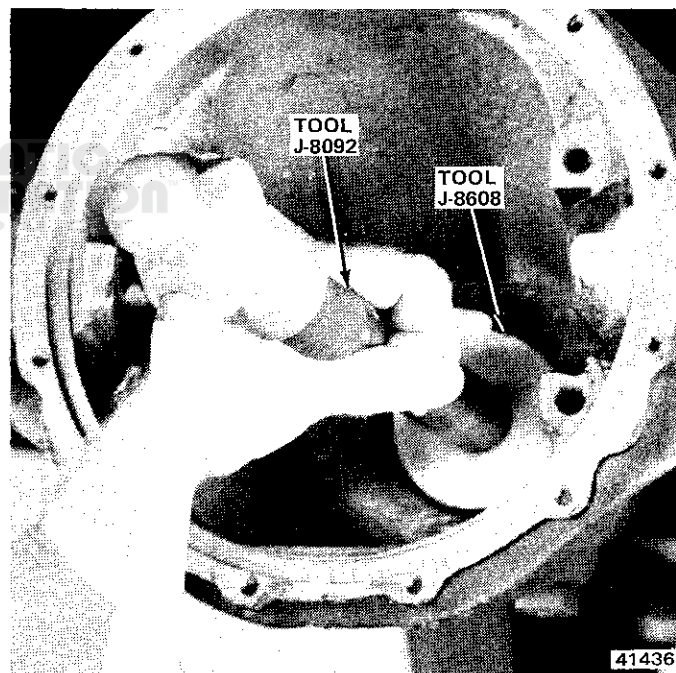


Fig. 2F-37 Pinion Rear Bearing Cup Installation

traction is **desired pinion depth**. Record this figure for future reference.

(12) Assemble Arbor Tool J-5223-4 and Discs J-5223-23 and install assembled tools in differential bearing cup bores (fig. 2F-38). Be sure discs are completely seated in bearing cup bores.

(13) Install bearing caps over discs and install bearing cap bolts (fig. 2F-38). Tighten bearing cap bolts securely, but not to specified torque.

(14) Install Gauge Block J-5223-20 (fig. 2F-38). Position block so that plunger is directly underneath gauge arbor and flat surface on opposite side of block is seated on end face of pinion.

**NOTE:** To avoid false readings, do not allow the gauge anvil to contact the pinion gear at any point.

(15) Assemble Clamp J-5223-24 and Bolt J-5223-29 and mount on axle housing (fig. 2F-38). Use one axle housing cover bolt to attach clamp to housing.

(16) Extend clamp bolt until it presses against gauge block with enough force to prevent gauge block from moving.

(17) Loosen gauge block thumbscrew to release plunger. When plunger contacts arbor tool, tighten thumbscrew to lock plunger in position. Do not disturb plunger after locking in place.

(18) Remove clamp and bolt assembly from axle housing.

(19) Remove gauge block and measure distance from end of anvil to end of plunger using 3 inch (7.62 cm) micrometer (fig. 2F-39). This dimension represents **measured pinion depth**. Record this dimension for assembly reference.

(20) Remove bearing caps and remove arbor tool and discs from housing.

(21) Remove pinion gear, rear bearing cup, and pinion depth shim from housing.

(22) Measure thickness of depth shim used in step (10). Add this dimension to measured pinion depth obtained in step (8). From this total, subtract desired pinion depth. Result represents correct shim thickness required.

**NOTE:** The desired pinion depth is the standard setting plus or minus the pinion depth variance.

(23) Following examples will illustrate procedure for determining correct shim thickness.

**Example I—Pinion Depth Variance is Plus (+)**

**Step 1—Determine desired pinion depth**

Add pinion depth variance (marked on pinion gear) to standard setting. Result is desired pinion depth.

<i>Standard Setting</i> . . . . .	2.547 (6.46 cm)
<i>Pinion Depth Variance</i> . . . . .	+0.007 (0.17 mm)
<i>Desired Pinion Depth</i> =	<u>2.554 (6.48 cm)</u>

**Step 2—Determine total measured pinion depth**

Add measured pinion depth to measured shim thickness. Result is total measured pinion depth.

<i>Measured Pinion Depth</i> . . . . .	2.550 (6.47 cm)
<i>Starter Shim Thickness</i> . . . . .	+0.098 (2.48 mm)
<i>Total Measured Pinion Depth</i> =	<u>2.648 (6.72 cm)</u>

**Step 3—Determine correct shim thickness**

Subtract desired pinion depth from total measured pinion depth. Result is correct shim thickness.

<i>Total Measured Pinion Depth</i> . . . . .	2.648 (6.72 cm)
<i>Desired Pinion Depth</i> . . . . .	-2.554 (6.48 cm)
<i>Correct Shim Thickness</i> =	<u>0.094 (2.38 mm)</u>

**Example II—Pinion Depth Variance is Minus (-)**

**Step 1—Obtain desired pinion depth**

Subtract pinion depth variance (marked on pinion gear) from standard setting. Result is desired pinion depth.

<i>Standard Setting</i> . . . . .	2.547 (6.46 cm)
<i>Pinion Depth Variance</i> . . . . .	-0.003 (0.07 mm)
<i>Desired Pinion Depth</i> =	<u>2.544 (6.46 cm)</u>

**Step 2—Determine total measured pinion depth**

Add measured pinion depth to measured shim thickness. Result equals total measured pinion depth.

<i>Measured Pinion Depth</i> . . . . .	2.542 (6.45 cm)
<i>Starter Shim Thickness</i> . . . . .	+0.096 (2.43 mm)
<i>Total Measured Pinion Depth</i> =	<u>2.638 (6.70 cm)</u>

**Step 3—Determine correct shim thickness**

Subtract desired pinion depth from total measured pinion depth. Result is correct shim thickness.

<i>Total Measured Pinion Depth</i> . . . . .	2.638 (6.70 cm)
<i>Desired Pinion Depth</i> . . . . .	-2.544 (6.46 cm)
<i>Correct Shim Thickness</i> =	<u>0.094 (2.38 mm)</u>

**Pinion Gear Bearing Preload Adjustment**

(1) Install correct thickness pinion depth shim(s) in axle housing bearing cup bore.

(2) Install rear bearing cup and pinion gear.

(3) Install replacement collapsible spacer and front bearing on pinion gear.

**CAUTION:** The collapsible spacer controls pinion bearing preload. Do not reuse the old spacer. Use a replacement spacer only.

(4) Install pinion oil seal using tool J-22661 (fig. 2F-28).

(5) Install pinion yoke and replacement pinion nut. **Tighten pinion nut finger-tight only.**

(6) Tighten pinion nut **only enough to remove end play and seat pinion bearings.** Use tool J-22575 to tighten nut and use tool J-8614-01 to hold yoke while tightening nut. Rotate pinion while tightening nut to seat bearings evenly.



(7) Remove tools J-8614-01 and J-22575.

(8) Measure torque required to turn pinion gear using inch-pound torque wrench and tool J-22575. Correct pinion bearing preload torque is 17 to 25 inch-pounds (1.9 to 2.8 N•m) torque. Continue tightening pinion nut until required preload torque is obtained.

**CAUTION:** Do not exceed the specified preload torque and do not loosen the nut to reduce preload if the specified torque is exceeded.

(9) If pinion bearing preload torque is exceeded, remove pinion gear, replace collapsible spacer and pinion nut, and adjust preload again.

**Differential Case Assembly**

(1) Install differential bearings on case using Driver Handle J-8092 and Bearing Installer J-21784 (fig. 2F-40).

(2) Install thrust washers on differential side gears and install gears in differential case.

(3) Install differential pinion gears in case. Install thrust washers behind pinion gears and align pinion gear bores.

(4) Rotate differential side and pinion gears until pinion mate shaft bores in pinion gears are aligned with shaft bores in case.

(5) Install thrust block in case. Insert block through side gear bore. Align bore in block with pinion mate shaft bores in pinion gears and case.

(6) Install pinion mate shaft. Align lockpin bore in shaft with bore in case and install shaft lockpin.

**Differential Bearing Adjustment**

(1) Place bearing cup over each differential bearing and install differential case assembly in axle housing.

(2) Install shim on each side between bearing cup and housing. Use 0.080-inch (2.03 mm) shims as starting point (fig. 2F-41).

(3) Install bearing caps and tighten bolts finger-tight. Mount dial indicator as shown in figure 2F-42.

(4) Using two screwdrivers, pry between shims and housing. Pry assembly to one side and zero indicator then pry assembly to opposite side and read indicator.

**NOTE:** Do not zero or read indicator while prying.

(5) Amount read on indicator is shim thickness that should be added to arrive at zero preload and zero end play. Repeat procedure to ensure accuracy and adjust if necessary.

(6) Shims are available in thicknesses from 0.080 to 0.110 inch (0.25 mm) in 0.002 inch (0.05 mm) increments.

(7) When sideplay is eliminated, a slight bearing drag will be noticed. Install bearing caps and tighten bearing cap bolts to 87 foot-pounds (118 N•m) torque.

(8) Attach dial indicator to axle housing and check ring gear mounting face of differential case for runout (fig. 2F-42). Runout should not exceed 0.002 inch (0.05 mm).

(9) Remove case from housing. Retain shims used to adjust sideplay.

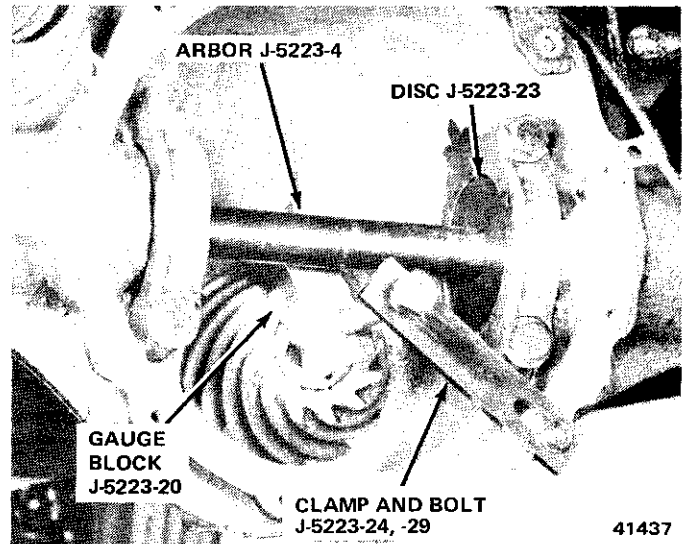


Fig. 2F-38 Installing Pinion Depth Gauge Tools

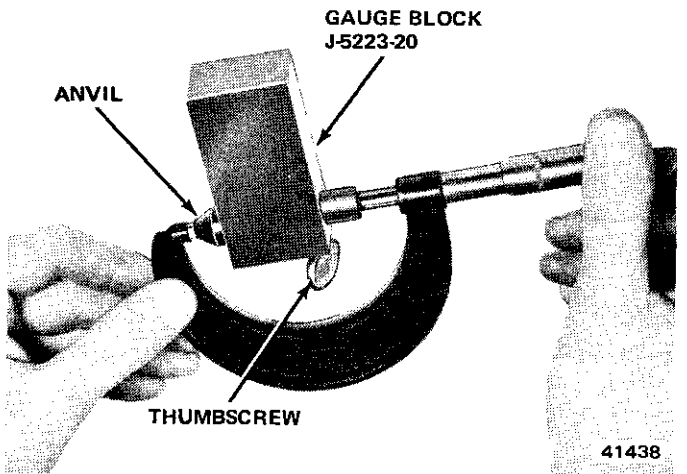


Fig. 2F-39 Measuring Gauge Block

**Ring Gear Installation**

(1) Position ring gear on differential case.

(2) Install two ring gear bolts in opposite holes and tighten bolts to pull gear into position.

(3) Install remaining ring gear attaching bolts. Tighten bolts to 105 foot-pounds (142 N•m) torque.

**Ring and Pinion Gear Backlash Adjustment**

(1) Position shims previously selected to remove differential bearing sideplay on bearing cups and install differential assembly in axle housing.

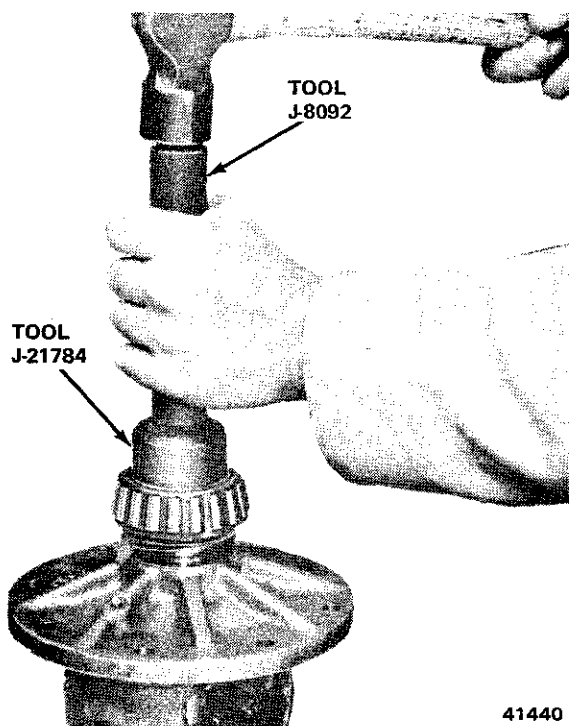


Fig. 2F-40 Differential Bearing Installation

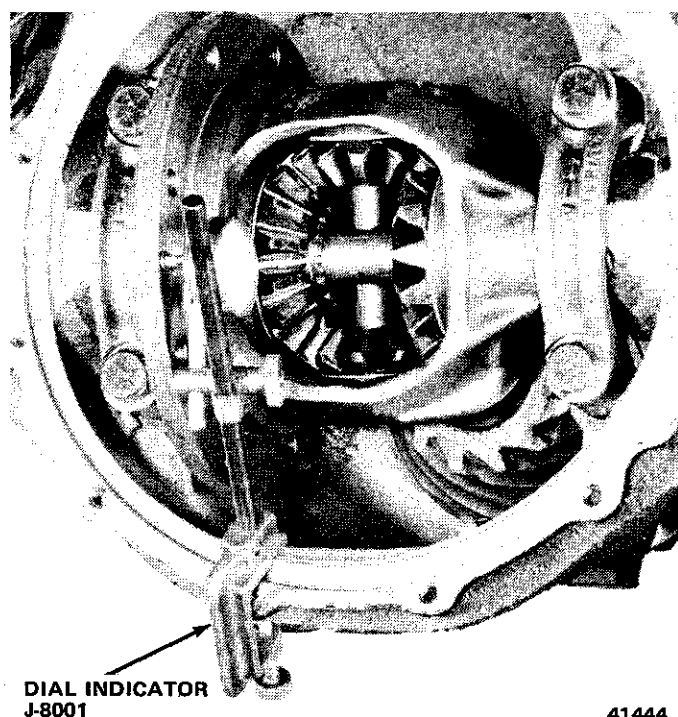


Fig. 2F-42 Checking Ring Gear Surface of Case for Runout

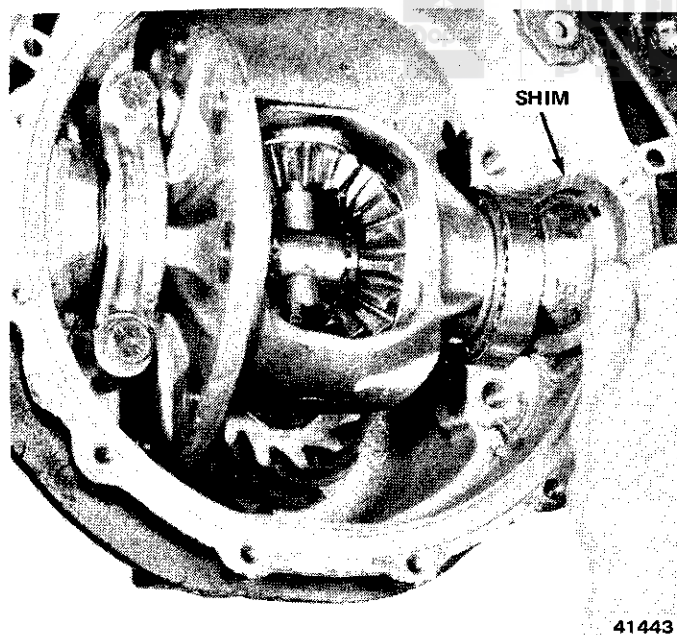


Fig. 2F-41 Adjusting Differential Bearing Sideplay

(2) Install bearing cap bolts and tighten bolts to 87 foot-pounds (118 N•m) torque.

(3) Attach dial indicator to housing. Position indicator so indicator stylus contacts drive side of a ring gear tooth and at right angle to tooth (fig. 2F-43).

(4) Move ring gear back and forth and note movement registered on dial indicator. Ring gear backlash should be 0.005 to 0.009 inch (0.12 to 0.22 mm), with 0.008 inch (0.20 mm) desired.

(5) Adjust backlash as follows: to increase backlash, install thinner shim on ring gear side and thicker shim on opposite side. To decrease backlash, reverse procedure, however, do not change total thickness of shims.

**Example:** Sideplay was removed using 0.090-inch (2.28 mm) shims on each side totaling 0.180 inch (4.57 mm). Backlash is checked and found to be 0.011 inch (0.27 mm). To correct backlash, add 0.004 inch (0.10 mm) to shim on ring gear side and subtract 0.004 inch (0.10 mm) from shim on opposite side.

This will result in 0.094-inch (2.38 mm) shim on ring gear side and 0.086-inch (2.18 mm) shim on other side. Backlash will be approximately 0.007 to 0.008 inch (0.17 to 0.20 mm). Total shim thickness remains 0.180 inch (4.57 mm).

#### Differential Bearing Preload Adjustment

**NOTE:** Differential bearings must be preloaded to compensate for heat and loads during operation. Correct preload is 0.008 inch (0.20 mm). The differential bearings are preloaded by increasing the shim pack thickness at each side of the differential by 0.004 inch (0.10 mm).

(1) Remove differential assembly from housing. Be sure to keep differential bearing shim packs together for proper assembly.

(2) Reinstall differential bearing shims in axle housing bearing bores.

(3) Install differential bearing cups on differential bearings. Cups should cover differential bearing rollers completely.

(4) Position differential assembly in housing so bearings just start into housing bearing bores (fig. 2F-44).

**NOTE:** Slightly tipping the bearing cups will ease starting them into the bores. Also keep the differential assembly square in the housing during installation and push it in as far as possible.

(5) Using plastic mallet, tap outer edge of bearing cups until differential is seated in housing.

**CAUTION:** Do not distort the shims by hammering them into the housing.

(6) Install differential bearing caps. Position caps according to alignment punch marks made at disassembly. Tighten bearing cap bolts to 87 foot-pounds (118 N•m) torque.

(7) Preloading differential bearings may change backlash setting. Check and correct backlash if necessary.

(8) Install propeller shaft, aligning index marks made at disassembly.

(9) Install axle shafts, bearings, seals, and brake support plates.

(10) Fill rear axle with Jeep Axle lubricant or Trac-Lok Lubricant, or equivalent.

(11) Check and adjust axle shaft end play if necessary. Adjust end play at left side of axle shaft only.

(12) Install hubs, drums, and wheels.

(13) Lower vehicle.

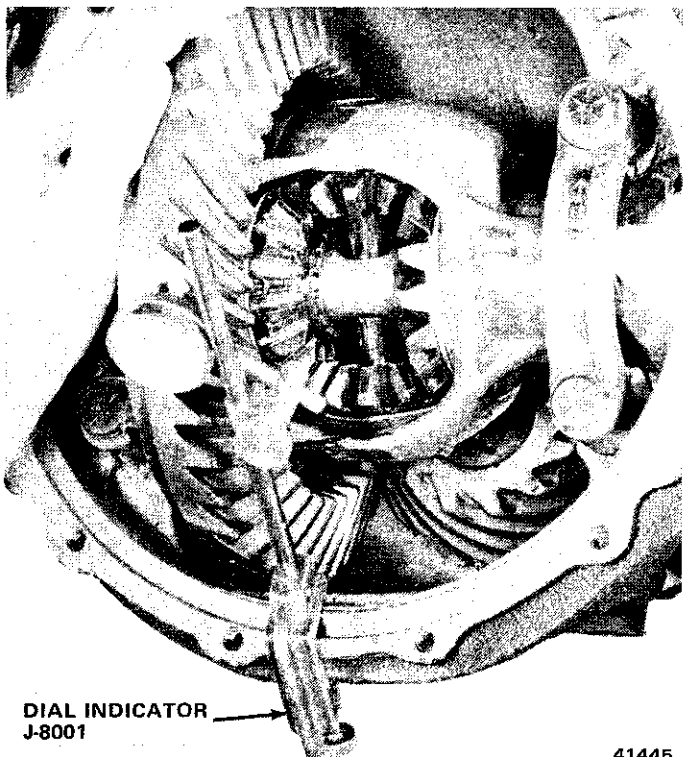


Fig. 2F-43 Checking Backlash

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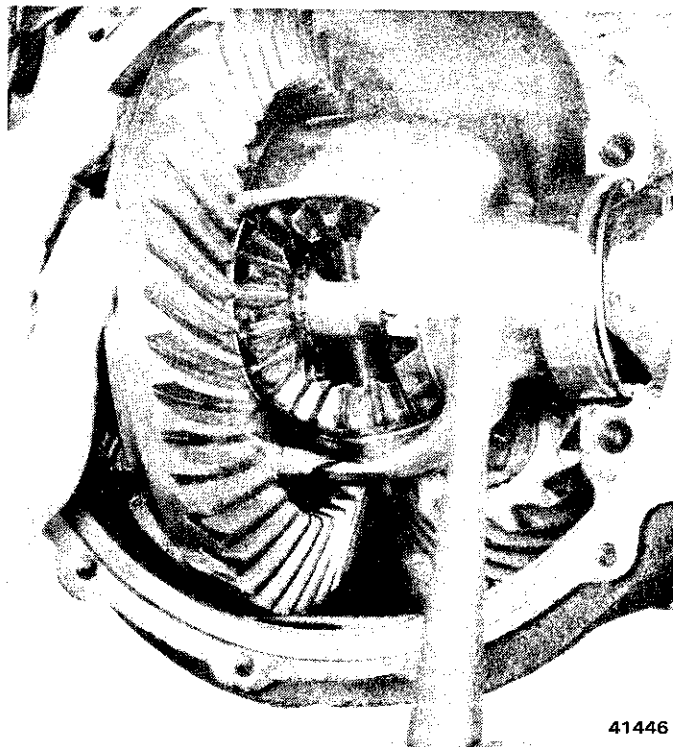


Fig. 2F-44 Differential Installation

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## DIFFERENTIAL OVERHAUL—MODEL 30-44-60 AXLE

### Differential Disassembly

**NOTE:** It is not necessary to remove the axle assembly to overhaul the differential. All differential service operations can be performed with the axle mounted in the vehicle.

- (1) Raise vehicle.
- (2) Remove wheels, brake drums, and axle shafts.
- (3) Remove axle housing cover (fig. 2F-45, 2F-46).
- (4) Mark differential bearing caps with center-punch for assembly alignment reference.
- (5) Loosen differential bearing cap bolts until only 2 or 3 threads are engaged.
- (6) Install Axle Housing Spreader Tool J-24385-01. Be sure to install holddown clamps to keep spreader tool in position (fig. 2F-47).
- (7) Mount Dial Indicator Set J-8001 on axle housing (fig. 2F-47). Zero indicator and be sure indicator stylus contacts one side of opening in housing.
- (8) Spread housing no more than 0.020 inch (0.50 mm) using spreader tool. Measure amount housing is spread with dial indicator.

**CAUTION:** Do not exceed the specified 0.020 inch (0.50 mm) when spreading the housing. If the housing is over-spread, it could be distorted or damaged necessitating replacement.

- (9) Remove dial indicator when housing has been spread 0.020 inch (0.50 mm).
- (10) Remove differential bearing caps. Tag caps for assembly reference.
- (11) Remove differential assembly using two pry bars. Position one bar under ring gear bolt head and one under differential case and pry differential upward to remove it.
- (12) Remove spreader tool immediately after removing differential. This is important in avoiding possibility of housing taking set.
- (13) Mount differential in vise.
- (14) Remove and discard ring gear attaching bolts.
- (15) Pad vise jaws with shop cloths to prevent damaging ring gear when removed from case.
- (16) Remove ring gear. Use brass drift and hammer to tap gear off case. Do not attempt to wedge or chisel gear off case as case will be damaged in process.
- (17) Remove pinion mate shaft lockpin using small pin punch (fig. 2F-48).
- (18) Remove pinion mate shaft and thrust block.
- (19) Rotate pinion gears until gears are aligned with case opening and remove pinion gears and thrust washers.
- (20) Remove side gears and thrust washers.

**Pinion Gear Removal—Model 30-44-60 Axle**

- (1) Remove pinion nut. Use tool J-8614-01 to hold yoke while removing nut.

- (2) Remove pinion yoke using tools J-8614-01, -02, and -03 (fig. 2F-4).
- (3) Remove dust cap from yoke end of pinion gear.
- (4) Remove pinion gear. Tap yoke end of gear with rawhide mallet to drive pinion out of rear bearing and housing.

**NOTE:** *The pinion bearing preload adjusting shims may remain on the pinion shaft, or stick to the bearing remaining in the housing, or they may fall out. Collect, tag, and retain these shims for assembly (fig. 2F-46).*

- (5) Remove pinion front bearing, slinger, and seal (fig. 2F-46). Use 2 X 2 inch (5.08 X 5.08 cm) piece of wood or length of pipe to drive front bearing, slinger and seal out of housing. Discard seal after removal.

**Pinion Rear Bearing Removal—Model 30-44 Axle**

- (1) Assemble and install Bearing Remover Set J-25100 on bearing and gear (fig. 2F-49).
- (2) Insert bearing remover adapters into remover base from top and position adapters 180° apart (fig. 2F-49).
- (3) Tighten remover tool forcing screw and remove bearing.

**Pinion Rear Bearing Removal—Model 60 Axle**

- (1) Install Bearing Remover Tool J-22912-01 on bearing and gear (fig. 2F-50).
- (2) Position chamfered edges of remover tool between bearing inner race and pinion head.

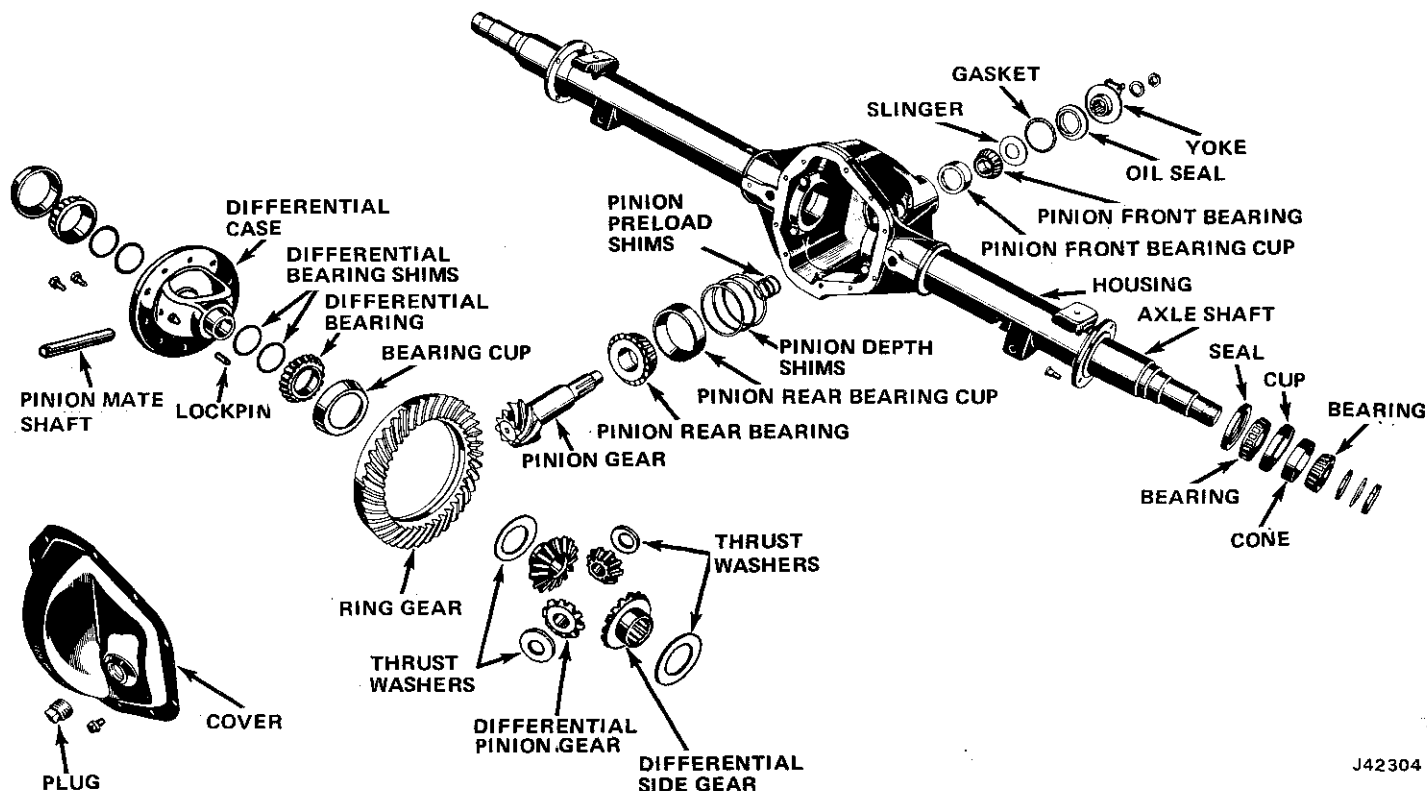
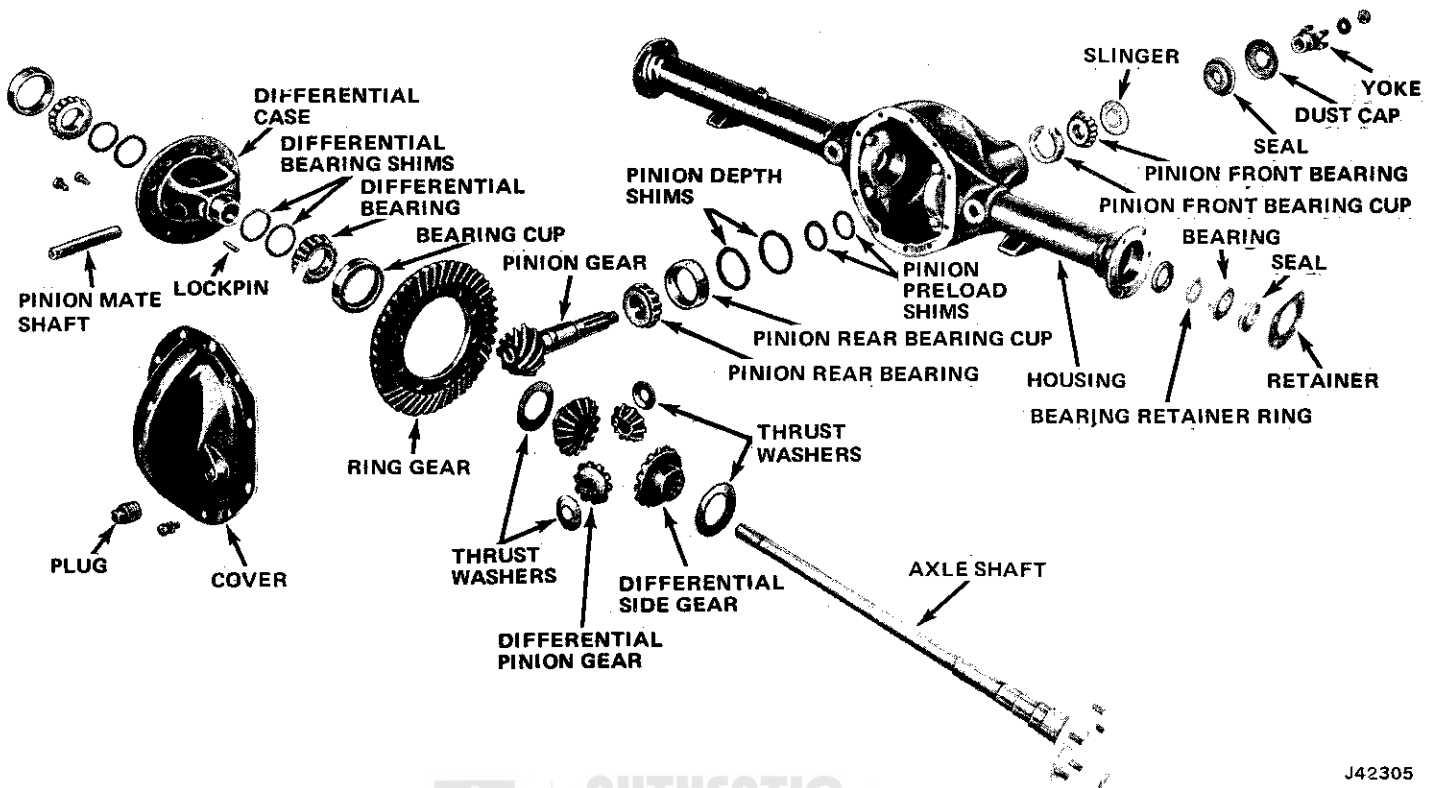
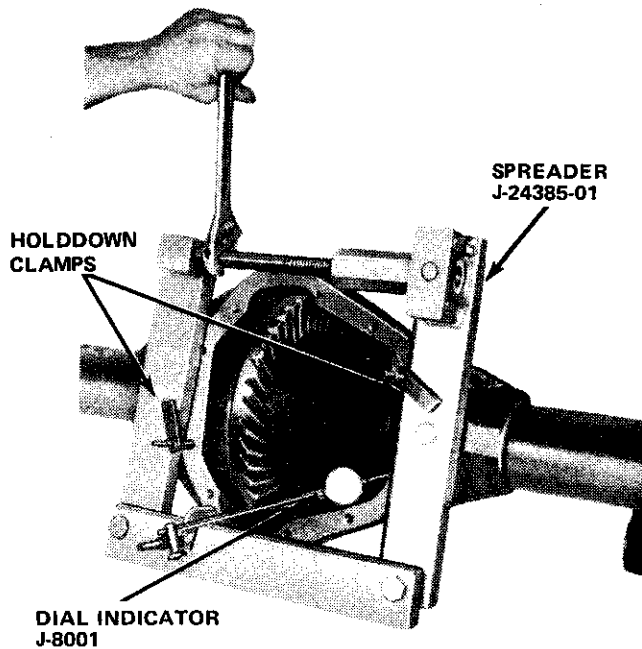


Fig. 2F-45 Model 60 Rear Axle



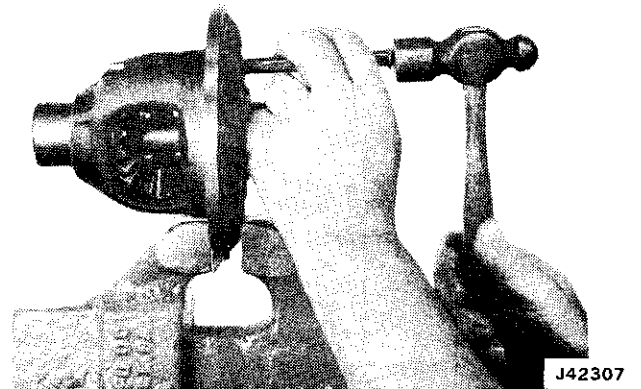
J42305

**Fig. 2F-46 Model 44 Rear Axle**



J42306

**Fig. 2F-47 Spreading Axle Housing**



J42307

**Fig. 2F-48 Pinion Mate Shaft Lockpin Removal**

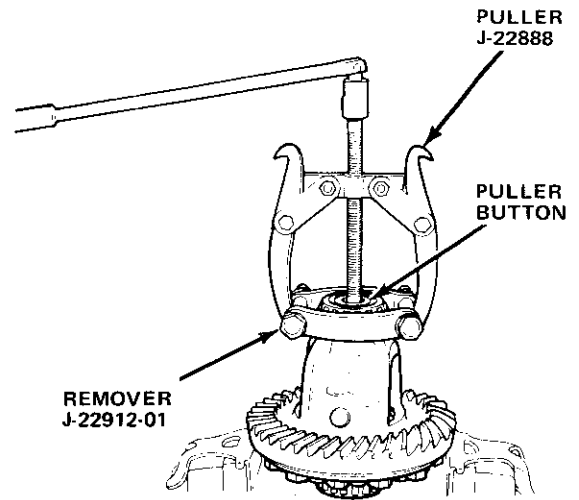
**Differential Bearing Removal—Model 30-44 Axle**

- (3) Tighten remover tool bolts until chamfered edges of tool are well under bearing race.
- (4) Position pinion gear and remover tool in arbor press and press pinion out of bearing.

- (1) Assemble and install Bearing Remover Set J-25100 on bearing and case. Remover tools are positioned in manner similar to pinion bearing removal. Refer to figure 2F-49 for tool setup.
- (2) Install two bearing adapters in remover tool base. Insert adapters into one side of tool base from top and reposition adapters 180° degrees apart (fig. 2F-49).
- (3) Install remover tool button in differential case and center remover tool forcing screw in button.
- (4) Tighten remover tool forcing screw and remove bearing.
- (5) Repeat operations to remove opposite bearing.

**Differential Bearing Removal—Model 60 Axle**

- (1) Install Bearing Remover Tool J-22912-01 on case and bearing (fig. 2F-51).
- (2) Position chamfered edges of remover tool between bearing inner race and case.
- (3) Tighten remover tool bolts until chamfered edges of tool are well under bearing race.
- (4) Install puller button in case bore.
- (5) Install Puller J-22888 on Remover Tool J-22912-01 and center puller forcing screw in puller button (fig. 2F-51).
- (6) Tighten puller forcing screw and remove bearing.
- (7) Repeat operations to remove opposite bearing.

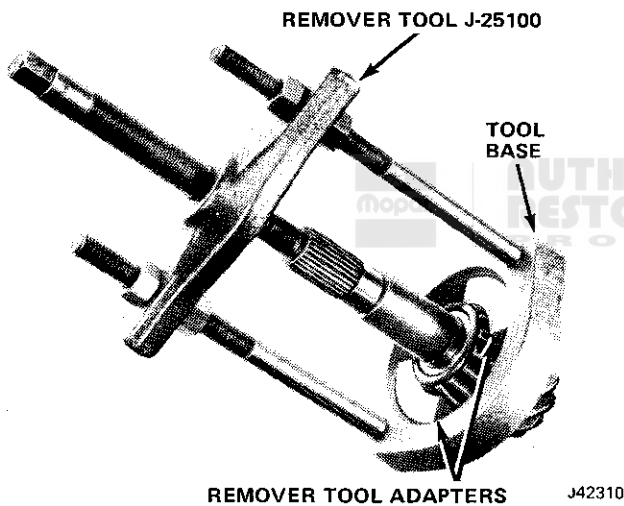


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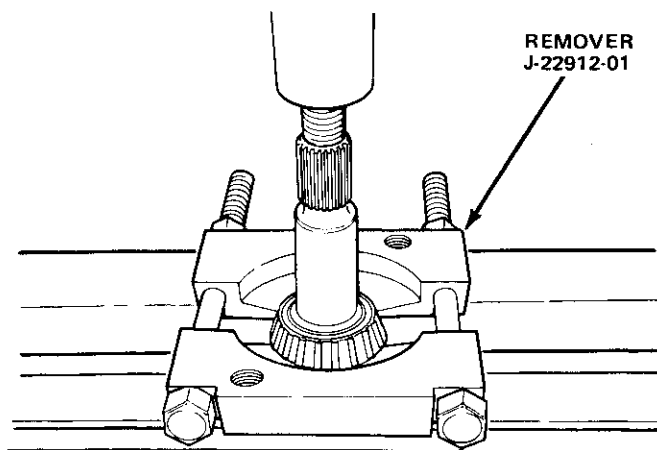
**Fig. 2F-51 Differential Bearing Removal—Model 60 Axle**

**Pinion Bearing Cup Removal—Model 30-44-60 Axle**

- (1) Remove pinion rear bearing cup. Use brass drift and hammer to tap cup out of housing.



**Fig. 2F-49 Pinion Rear Bearing Removal—Model 30/44 Axle**



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**Fig. 2F-50 Pinion Rear Bearing Removal—Model 60 Axle**

- (2) Remove pinion depth shims from rear bearing cup bore in housing. Retain shims for assembly reference even if bent or distorted.

- (3) Remove pinion front bearing cup. Use brass drift and hammer to tap cup out of housing.

**Cleaning and Inspection**

Clean all parts in solvent. Allow bearings to air dry. Dry all other parts with compressed air.

Inspect all bearings and cups for pitting, galling, flat spots, or cracks. Replace any bearing or cup that exhibits any of these conditions.

Inspect the differential case for an elongated, or enlarged pinion mate shaft bore. The machined thrust washer surface areas and counterbores must be smooth and free of nicks, gouges, cracks, or burrs. Inspect the case for cracks or other visible damage. Replace the case if it exhibits any of these conditions.

Inspect the pinion mate shaft for excessive wear, scoring, or galling. The shaft must be smooth and concentric. Replace the shaft if worn or damaged.

Inspect the side gears and pinion gears. All gear teeth must display a uniform contact pattern. Inspect the gears and gear teeth for cracks, scoring, excessive wear, or galling. Replace all the gears if any gear exhibits these conditions. Inspect the side gear and pinion gear thrust washers for wear, scoring, galling, or distortion. Replace the washers if they exhibit any of these conditions.

Inspect the pinion mate shaft lockpin for damage or for being loose in the case. Replace the pin or differential case as necessary.

Inspect the ring and pinion gears for worn or chipped teeth, cracks, damaged bearing journals, or damaged attaching bolt threads. If replacement is necessary, the gears must be replaced as matched set only.

Inspect the differential case for cracks, worn shaft and pin bores, or other damage which might necessitate replacement. If raised metal was produced on the bearing cup bore shoulders during bearing cup removal, flatten the raised portion using a blunt punch.

Inspect the pinion yoke for cracks, worn splines, and pitted, rough or corroded seal contact surfaces. Repair or replace the yoke as necessary.

Inspect the pinion differential bearing shim packs for broken, damaged, or distorted shims. Replace shims as necessary during assembly.

## Differential Assembly

### Pinion Depth Measurement and Adjustment

Pinion gear depth is the distance, measured in inches, from the end face of the pinion gear to the axle shaft centerline (fig. 2F-35). This dimension is controlled by shims installed between the pinion rear bearing and axle housing (fig. 2F-52).

Ring and pinion gear sets are factory tested to detect machining variances. Tests are started at a standard setting which is then varied to obtain the most desirable tooth contact pattern and quietest operation. When this setting is determined, identifying numbers are etched on the the ring and pinion (fig. 2F-36).

The ring gear receives one number. The pinion gear receives two numbers which are separated by a + or - sign. The ring gear number and first number on the pinion gear identify the gears as a matched set. Do not attempt to use a set with differing numbers. This is not a matched set.

The second number on the pinion indicates pinion position in relation to the centerline of the axle shafts where tooth contact was best and operation quietest. This number represents pinion depth variance and is the amount, in thousandths of an inch, that the set varied from the standard setting.

The standard settings for axle Models 30, 44, and 60 are as follows:

- Model 30—2.250 (5.71 cm)
- Model 44—2.625 (6.66 cm)
- Model 60—3.125 (7.93 cm)

If the pinion is marked +2, the gear set varied from standard by +0.002 inch (0.05 mm) and will require 0.002 inch (0.05 mm) less shims than a set marked zero (0). When a set is marked +, the distance from the pinion button face to the axle shaft centerline must be more than the standard setting. If the pinion is marked -3, the set varied from standard by -0.003 inch (0.07 mm) and will require 0.003 (0.07 mm) more shims than a set marked zero. When a set is marked zero, the distance from the pinion button face to the axle shaft centerline must be less than the standard setting. Refer to Figure 2F-35 for an illustration of the standard setting dimension.

### Pinion Variance Chart

This chart will help determine the approximate starter shim thickness needed for initial pinion depth measurement. However, the chart will not provide the exact shim thickness required for final adjustment and must not be used as a substitute for an actual pinion depth measurement.

To use the chart, proceed as follows:

- (a) Measure thickness of original pinion depth shim.
- (b) Note pinion depth variance numbers marked on old and new pinion gears.
- (c) Refer to Old and New Pinion Marking columns in chart. Chart box where old and new pinion depth columns intersect is approximate amount of change required to obtain desired starter shim thickness.

For example, if the old pinion is marked -3 and the new pinion +2, chart procedure would be as follows: Refer to Old Pinion Marking column at left side of chart and locate -3 figure in this column. Then read to right, across chart, until under +2 figure in New Pinion Marking column. Box where the two columns intersect will provide amount of shim thickness required. In this case, the number in the intersecting box is -0.005 (0.12 mm) which represents the amount to be subtracted from the original shim thickness. If the box number had been a + figure, this amount would be added to the original shim thickness.

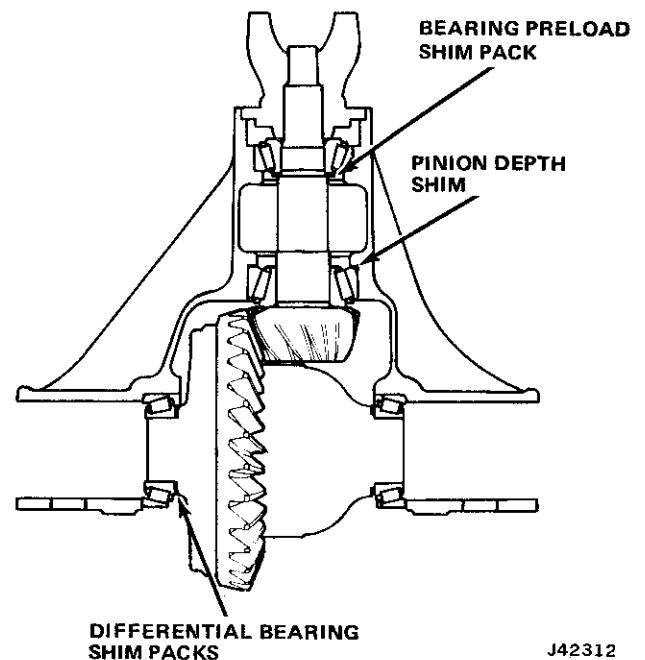


Fig. 2F-52 Differential Bearing and Pinion Gear Shim Locations

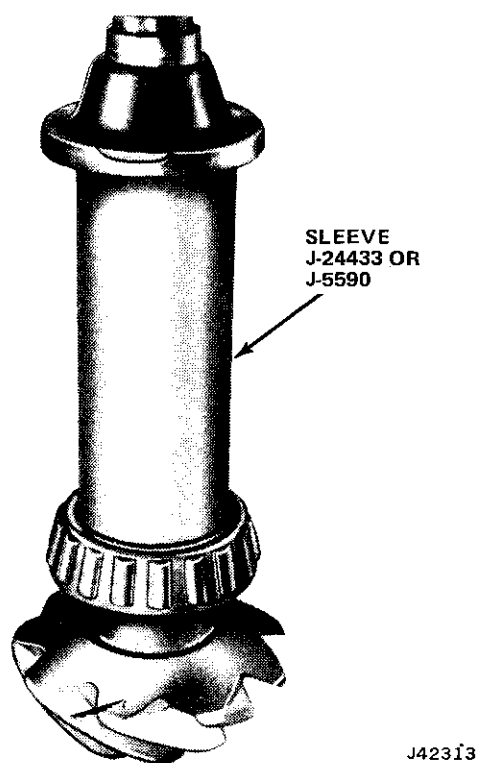


Fig. 2F-53 Pinion Bearing Installation

### Pinion Installation and Depth Adjustment

**CAUTION:** Front axle differentials use an oil slinger between the pinion rear bearing and the pinion head (fig. 2F-1). This slinger must be installed in order to measure and adjust pinion depth correctly.

(1) Measure thickness of pinion depth shim removed during disassembly.

(2) Record pinion depth variance numbers etched on old and new pinion gears.

(3) Refer to pinion variance chart and determine amount to be added to or subtracted from original shim to arrive at starter shim thickness.

**CAUTION:** Do not use or assume that the starter shim thickness will be the final shim setting. An actual pinion depth measurement must be performed and the final shim thickness adjusted as necessary.

(4) Install pinion front bearing cup in housing bore using Driver Handle J-7079-02 and Installer J-25101.

(5) Install starter shim in rear bearing bore of housing. Be sure shim is centered in cup bore. If shim is chamfered, chamfer must face toward housing bore—not toward pinion head.

(6) Install rear bearing cup in housing bore. On Model 30 axles, install cup using Driver Handle J-7079-02 and Installer J-25101. On Model 44 and 60 axles, install cup using Driver Handle J-25122 and Installer J-25157.

(7) On front axle differentials, install oil slinger on pinion gear. Be sure slinger is seated against pinion head before installing rear bearing.

(8) Install rear bearing on pinion. On Model 30 axles, install cup using Installer Sleeve J-5590 (fig. 2F-53). On Model 44 and 60 axles, install bearing using Installer Sleeve J-24433 (fig. 2F-53).

(9) Install pinion gear in axle housing.

(10) Install pinion front bearing, pinion yoke, washer, and old pinion nut on pinion gear. Tighten nut only enough to remove end play and provide 10 to 15 inch-pounds (1 to 2 N•m) of drag torque when pinion is rotated.

**NOTE:** Do not install the pinion seal, slinger, dust cap or a new pinion nut at this time. The pinion will be removed after measuring and adjusting depth.

(11) Note pinion depth variance marked on pinion gear. If number is preceded by a plus (+) sign, add that amount (in thousands or millimeters) to standard setting for axle model being overhauled. If number is preceded by a minus (-) sign, subtract that amount (in thousands or millimeters) from standard setting. Result of addition or subtraction is desired pinion depth. Record this figure for further reference.

**NOTE:** If the gear is marked 0 (zero), use the standard setting.

(12) Assemble Gauge Arbor J-5223-4 and Discs. On Model 30 axles, use Discs J-5223-26. On Model 44 and 60 axles, use Discs J-5223-25.

(13) Install assembled arbor and discs in differential bearing cup bores (fig. 2F-54). Be sure discs are firmly seated in bearing cup bores.

(14) Install differential bearing caps over discs and tighten cap bolts securely, but not to specified torque.

(15) Remove standard plunger from Gauge Block J-5223-20 and install Plunger J-5223-27.

(16) Compress plunger completely and tighten gauge block thumbscrew securely.

(17) Install Gauge Block J-5223-20. Position block so plunger is directly under Arbor J-5223-4 and flat surface on anvil side of block is seated on end face of pinion (fig. 2F-54).

**CAUTION:** To avoid false readings, do not allow the anvil to contact the pinion gear at any point.

(18) Assemble Bolt J-5223-29 and Clamp J-5223-24 and mount tools on axle housing (fig. 2F-54). Use housing cover bolt to attach clamp to housing.

(19) Extend clamp bolt until it presses against gauge block. Align gauge block plunger with center of gauge arbor and tighten clamp bolt until it presses against block with enough force to prevent block from moving.



(20) Loosen gauge block thumbscrew and release plunger. When plunger contacts arbor tool, tighten thumbscrew to lock plunger in position. Do not disturb plunger position.

(21) Remove clamp and bolt from axle housing.

(22) Remove gauge block and measure distance from end of anvil to end of plunger using 3-inch (7.62 cm) micrometer (fig. 2F-55). This dimension represents **measured pinion depth**. Record this dimension for assembly reference.

**NOTE:** *If the measured pinion depth equals the desired pinion depth, the installed shim thickness is correct and further adjustment is not required.*

(23) Remove bearing caps and remove arbor tool and discs.

(24) Remove pinion gear, rear bearing cup, and depth shim from axle housing.

(25) Measure thickness of depth shim just removed from housing and add this dimension to measured pinion depth obtained in previous step. From this total, subtract desired pinion depth. Result represents shim thickness required to adjust pinion depth.

**NOTE:** *The desired pinion depth is the standard setting plus or minus the pinion depth variance.*

The following examples illustrate the procedure for determining correct shim thickness.

**Example I—Pinion Depth Variance is Plus (+) Model 44 Axle**

Step 1—Determine desired pinion depth.

Add pinion depth variance (marked on pinion gear) to standard setting. Result is desired pinion depth.

<i>Standard Setting</i> . . . . .	2.625 (66.6 mm)
<i>Pinion Depth Variance</i> . . . . .	+0.004 (0.10 mm)
<i>Desired Pinion Depth</i> =	<u>2.629 (66.7 mm)</u>

Step 2—Determine total measured pinion depth.

Add measured pinion depth to measure shim thickness. Result is total measured pinion depth.

<i>Measured Pinion Depth</i> . . . . .	2.601 (66.0 mm)
<i>Starter Shim Thickness</i> . . . . .	+0.107 (2.71 mm)
<i>Total Measured Pinion Depth</i> =	<u>2.708 (68.7 mm)</u>

Step 3—Determine correct shim thickness.

Subtract desired pinion depth from total measured pinion depth. Result is correct shim thickness.

<i>Total Measured Pinion Depth</i> . . . . .	2.708 (68.7 mm)
<i>Desired Pinion Depth</i> . . . . .	-2.629 (66.7 mm)
<i>Correct Shim Thickness</i> =	<u>0.079 (2.00 mm)</u>

**Example II—Pinion Depth Variance is Minus (-) Model 60 Axle**

Step 1—Obtain desired pinion depth.

Subtract pinion depth variance (marked on pinion gear) from standard setting. Result is desired pinion depth.

<i>Standard Setting</i> . . . . .	3.125 (79.3 mm)
<i>Pinion Depth Variance</i> . . . . .	-0.002 (0.05 mm)
<i>Desired Pinion Depth</i> =	<u>3.123 (79.35 mm)</u>

Step 2—Determine total measured pinion depth.

Add measured pinion depth to measured shim thickness. Result equals total measured pinion depth.

<i>Measured Pinion Depth</i> . . . . .	3.120 (79.2 mm)
<i>Starter Shim Thickness</i> . . . . .	+0.100 (2.54 mm)
<i>Total Measured Pinion Depth</i> =	<u>3.220 (81.7 mm)</u>

Step 3—Determine correct shim thickness.

Subtract desired pinion depth from total measured pinion depth. Result is correct shim thickness.

<i>Total Measured Pinion Depth</i> . . . . .	3.220 (81.7 mm)
<i>Desired Pinion Depth</i> . . . . .	-3.123 (79.3 mm)
<i>Correct Shim Thickness</i> =	<u>0.097 (2.46 mm)</u>

(26) Remove pinion gear, rear bearing cup, and starter shim.

(27) Install correct thickness pinion depth shim in housing bearing cup bore and reinstall rear bearing cup.

**Pinion Bearing Preload Adjustment**

(1) Install pinion bearing preload shims on pinion.

(2) Install pinion gear, front bearing, oil slinger, if equipped, yoke, washer, and old pinion nut. Tighten nut to 260 foot-pounds (352 N•m) torque.

(3) Measure torque required to rotate pinion using 0-50 inch-pound torque wrench. Rotating torque should be 20-40 inch-pounds (2-5 N•m) with new bearings, or 10-20 inch-pounds (1-2 N•m) with original bearings. Add shims to decrease preload or subtract shims to increase preload.

(4) Remove pinion nut, washer and yoke when pinion bearing preload is adjusted.

(5) Install new pinion oil seal. On Model 30 and 44 axles, install seal using tool J-25104. On Model 60 axles, install seal using tool J-24384.

(6) Install yoke and pinion washer.

(7) Install new pinion nut. On Model 30 and 44 axles, tighten nut to 210 foot-pounds (285 N•m) torque. On Model 60 axles, tighten nut to 260 foot-pounds (352 N•m).

**Differential Side Gear Adjustment**

(1) Install thrust washers on side gears and install gears in case.

(2) Install thrust washers on differential pinion gears and install gears in case.

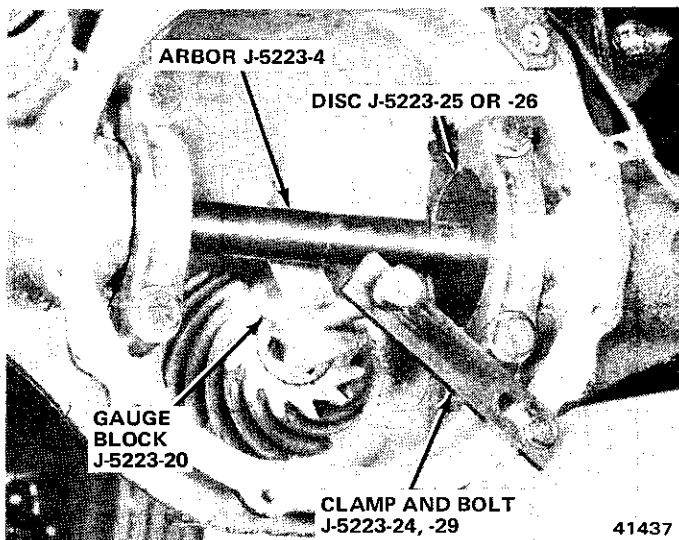


Fig. 2F-54 Installing Pinion Depth Gauge Tools

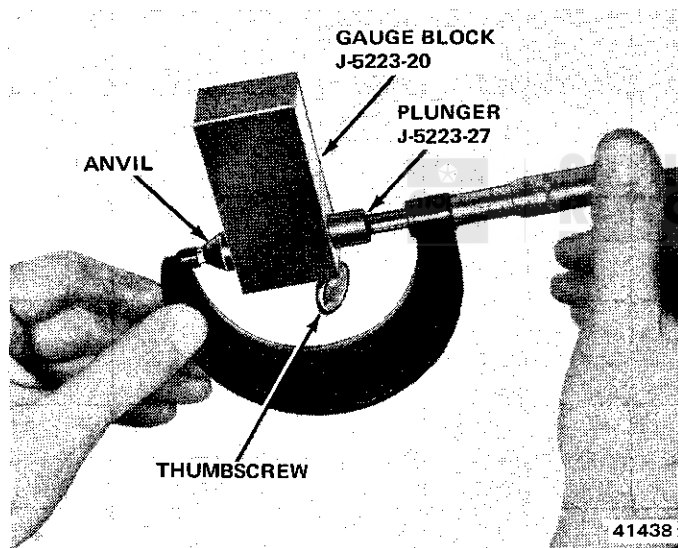


Fig. 2F-55 Measuring Gauge Block

- (3) Install thrust block and pinion mate shaft pin in case.
- (4) Position differential case on end.
- (5) Tap differential case lightly on flat surface to settle gears into position in case.
- (6) Measure clearance between case and side gears using two feeler gauges (fig. 2F-56). Clearance between gears and case must be 0.00 to 0.006 inch (0.00 to 0.15 mm).
- (7) If clearance between gears and case exceeds 0.006 inch, disassemble case and install shims between gears and case to reduce clearance.

**NOTE:** If shims are required, install at least one shim on each side and keep the shim packs as equal in thickness as possible.

- (8) If gears were shimmed, reassemble case and check side gear clearance again.

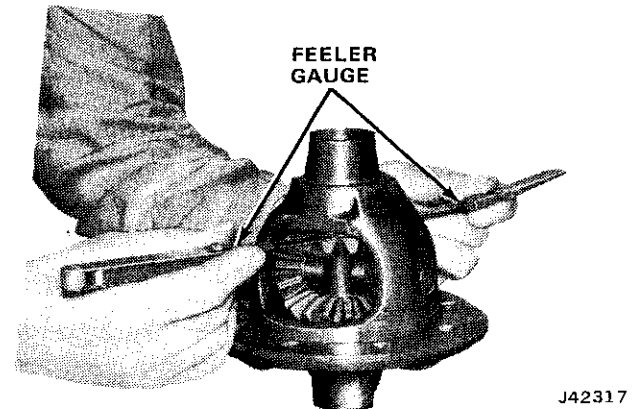


Fig. 2F-56 Checking Side Gear Clearance

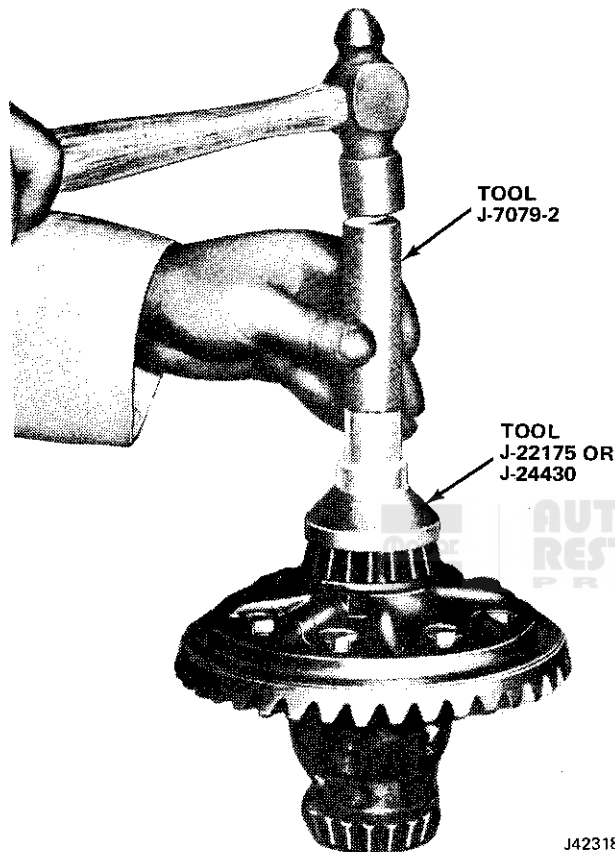
#### Differential Bearing Preload and Ring Gear Backlash Adjustment

**NOTE:** Differential bearing preload is controlled by shims located between the differential case and bearings.

- (1) Remove old differential bearing shims if not removed previously.
- (2) Install differential bearings. On Model 30 and 44 axles, install bearings using driver Handle J-7079-02 and Installer J-22175 (fig. 2F-57). On Model 60 axles, install bearings using driver handle and Installer J-24430.
- (3) Install bearing cups on differential bearings.
- (4) Install differential in axle housing.
- (5) Install bearing caps and tighten cap bolts securely but not to specified torque.
- (6) Hold ring gear in contact with pinion gear and pry differential bearing cups toward center of case using screwdriver.
- (7) Insert various thickness feeler gauges between each bearing cup and axle housing until ring gear backlash is 0.001 to 0.002 inch (0.02 to 0.05 mm) with feeler gauges installed. Feeler gauges must be installed at both sides of differential at same time to obtain accurate measurement.
- (8) Assemble shim pack that will provide desired backlash. Insert shims between bearing cups and housing and check backlash again. If OK, remove, tag and retain shims for assembly.
- (9) Remove differential case.
- (10) Add additional 0.015 inch (0.38 mm) thickness shim to shim pack to be installed on drive tooth side of ring gear.
- (11) Remove differential bearings. Refer to removal procedures outlined in Differential Disassembly.
- (12) Install shim packs on appropriate sides of differential case and reinstall differential bearings. On Model 30 and 44 axles, install bearings using Driver Handle J-7079-01 and Installer J-22175 (fig. 2F-57). On Model 60 axles, install bearings using driver handle and Installer J-24430.

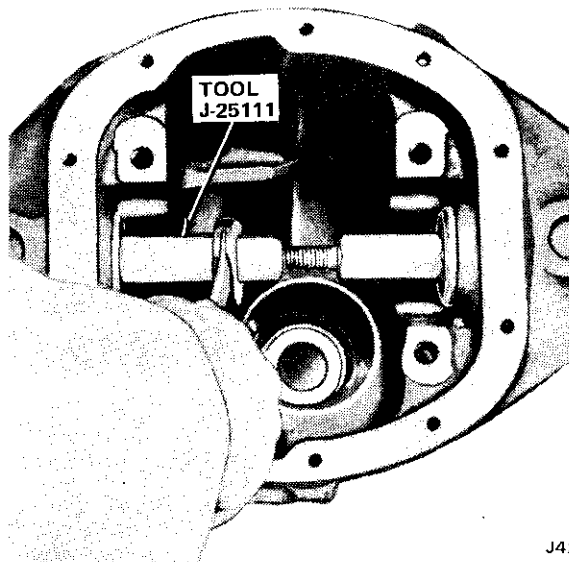
**NOTE:** When overhauling a Model 44 front axle differential, check the axle shaft inner oil seals. If seal replacement is required, pry out the old seals and install new seals using tool J-25111 (fig. 2F-58).

(13) Mount Spreader Tool J-24385-01 and Dial Indicator Set J-8001 on housing. Spread housing no more than 0.020 inch (0.50 mm) (fig. 2F-47). Do not exceed 0.020 inch (0.50 mm) to avoid damaging housing.



J42318

Fig. 2F-57 Differential Bearing Installation



J42319

Fig. 2F-58 Model 44 Front Axle Inner Oil Seal Installation

(14) Remove dial indicator when housing has been spread specified amount.

(15) Lubricate differential bearings with axle lubricant and install bearing cups on bearings.

(16) Install differential in housing. Use rawhide mallet to seat differential and bearings. Be sure ring and pinion gear teeth mesh completely.

(17) Remove spreader tool from housing.

(18) Install bearing caps on differential bearings. Be sure to position caps according to alignment marks made at disassembly.

(19) Apply sealing compound to bearing cap bolt threads and install bolts. On Model 30 axles, tighten cap bolts to 40 foot-pounds (54 N•m) torque. On Model 44 and 60 axles tighten bolts to 80 foot-pounds (108 N•m) torque.

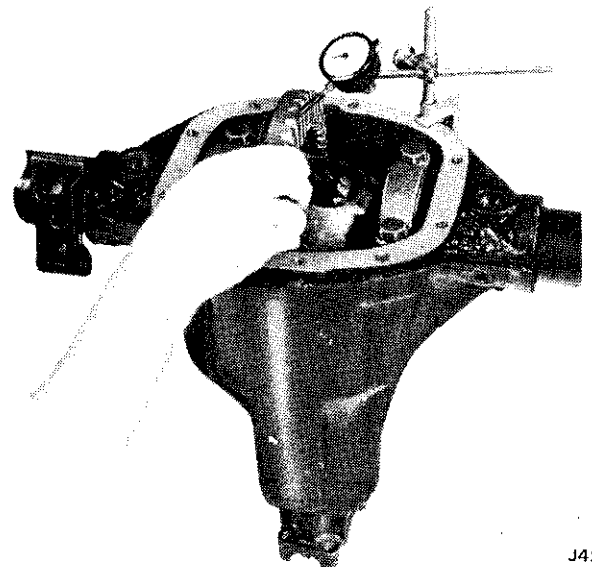
(20) Mount Dial Indicator Set J-8001 on housing and measure ring gear backlash (fig. 2F-59). Measure backlash at two points. Backlash should be 0.005 to 0.010 inch (0.12 to 0.25 mm). If backlash is incorrect, add or subtract shims from differential bearing shim packs until correct backlash is obtained.

**NOTE:** Changing the position of a 0.005 inch (0.12 mm) shim from one side to the other will change the amount of backlash approximately 0.003 inch (0.07 mm).

(21) Measure ring gear runout. If runout exceeds 0.006 inch (0.15 mm), case may be distorted, or there is dirt between case and gear, or ring gear bolts are loose. Check and correct as necessary.

(22) Install axle shafts.

(23) Clean axle housing and housing cover mating surfaces thoroughly. Apply thin bead of Jeep Gasket-In-A-Tube or equivalent silicone sealer to housing and cover and install cover. Install and tighten cover bolts to 20 foot-pounds (27 N•m) torque on all axle models.



J42320

Fig. 2F-59 Measuring Ring Gear Backlash

**SPECIFICATIONS**

**Differential Specifications**

	USA	Metric
<b>Model 30 Front Axle</b>		
Differential Bearing Preload . . . . .	.015 in	0.38 mm
Differential Side Gear-to-Case Clearance . . . . .	.000-.006 in	0.000-0.15 mm
Ring Gear . . . . .	.005-.009 in	0.12-0.22 mm
Pinion Bearing Break-Away Preload		
Original Bearings . . . . .	15-25 in-lbs.	2-3 N-m
New Bearings . . . . .	20-40 in-lbs.	2-5 N-m

**Model 44 Axle (Full-Floating and Semi-Floating Types)**

Differential Bearing Preload . . . . .	0.15 in	0.38 mm
Differential Side Gear-to-Case Clearance . . . . .	.000-.006 in	0.000-0.15 mm
Ring Gear Backlash . . . . .	.005-.010 in	0.12-0.25 mm
Pinion Bearing Break-Away Preload		
Original Bearings . . . . .	10-20 in-lbs.	1-2 N-m
New Bearings . . . . .	20-40 in-lbs.	2-5 N-m

**Model 60 Axle**

Differential Bearing Preload . . . . .	.015 in	0.38 mm
Differential Side Gear-to-Case Clearance . . . . .	.000-.006 in	0.000-0.15 mm
Drive Gear-to-Pinion Backlash . . . . .	.005-.009 in	0.12-0.15 mm
Drive Pinion Bearing Break-Away		
Original Bearings . . . . .	10-20 in-lbs.	1-2 N-m
New Bearings . . . . .	20-40 in-lbs.	2-5 N-m

**AMC/Jeep Axle (Semi-Floating Tapered Shaft)**

Axle Shaft End Play (Shims – Left Side Only) . . . . .	.004-.008 in (.006 in desired)	0.10-0.20 mm (0.15 mm desired)
Pinion Bearing Preload (Collapsible Sleeve) . . . . .	17-25 in-lbs.	2-3 N-m
Differential Bearing Preload (Shims) . . . . .	.008 in	0.20 mm
Differential Case Flange Runout (Inspection only – no adjustment) . . . . .	.002 in max.	0.05 mm max.
Ring Gear Backlash (Shims) . . . . .	.005-.009 in (.008 in desired)	0.12-0.15 mm (0.20 mm desired)
Pinion Gear Standard Setting (Shims) . . . . .	2.547 in	64-69 mm

60657B

**Torque Specifications**

**Model 30 Front Axle**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Axle Housing Cover Bolts . . . . .	20	15-25	27	20-34
Differential Bearing Cap Bolts . . . . .	40	35-50	54	47-68
Ring Gear-to-Case Bolts . . . . .	55	45-65	75	61-88
Lower Ball Stud Nut . . . . .	80 min.	—	108 min.	—
Pinion Nut . . . . .	210	200-220	271	285-298
Universal Joint U-Bolts . . . . .	15	13-18	20	18-24
Upper Ball Stud Nut . . . . .	100 min.	—	136 min.	—
Upper Ball Stud Seat . . . . .	50 min.	—	68 min.	—
Wheel-to-Hub Nuts . . . . .	80	65-90	108	88-122

## 2F-40 AXLES

### Model 44 Front/Rear Axle (Full-Floating and Semi-Floating Types)

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Axle Housing Cover Bolts . . . . .	20	15-25	27	20-34
Support Plate Bolts/Nuts . . . . .	30	25-35	41	34-47
Differential Bearing Cap Bolts . . . . .	80	70-90	108	95-122
Disc Brake Shield Bolt . . . . .	8	5-10	11	7-14
Disc Brake Shield Nuts . . . . .	35	30-40	47	41-54
Ring Gear-to-Case Bolts . . . . .	55	45-65	75	61-81
Lower Ball Stud Nut . . . . .	80 min.	—	108 min.	—
Pinion Nut . . . . .	210	200-220	271	285-298
Upper Ball Stud Nut . . . . .	100 min.	—	136 min.	—
Upper Ball Stud Seat . . . . .	50 min.	—	68 min.	—
Universal Joint Flange Bolts . . . . .	35	25-45	47	34-61
Universal Joint U-Bolts . . . . .	15	13-18	20	18-24
Wheel-to-Hub Nuts . . . . .	80	65-90	108	88-122

### Model 60 Axle

Axle Housing Cover Bolts . . . . .	20	15-25	27	20-34
Support Plate Bolts/Nuts . . . . .	50	45-55	68	61-75
Differential Bearing Cap Bolts . . . . .	80	70-90	108	95-122
Ring Gear-to-Case Bolts . . . . .	105	100-110	142	135-149
Pinion Nut . . . . .	260	250-270	352	339-366
Universal Joint Flange Bolts . . . . .	35	25-45	47	34-61
Universal Joint U-Bolts . . . . .	15	13-18	20	18-24
Wheel-to-Hub Nuts . . . . .	120	110-125	163	149-169

### AMC/Jeep Axle (Semi-Floating Tapered Shaft)

Axle Housing Cover Bolts . . . . .	170 in-lbs	150-190 in-lbs	19	17-21
Brake Tube-to-Rear Wheel Cylinder . . . . .	97 in-lbs	90-105 in-lbs	11	10-12
Differential Bearing Cap Bolts . . . . .	87	80-95	10	9-11
Ring Gear-to-Case Bolt . . . . .	105	95-115	142	135-149
Rear Brake Support Plate Bolts . . . . .	32	25-40	43	34-54
Axle Shaft-to-Hub Nuts . . . . .	250 min.	250 min.	339 min.	—
Universal Joint U-Bolts . . . . .	15	13-18	20	18-24
Clamp Strap Bolts . . . . .	13	10-18	18	14-24

All torque values given in foot-pounds and newton meters with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

60657A

# TRAC-LOK DIFFERENTIAL

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## GENERAL

The Trac-Lok limited slip differential is available as an option on Jeep vehicles equipped with Model 20 transfer case only. Trac-Lok is used in rear axles only and is not available on vehicles equipped with Quadra-Trac.

## OPERATION

In a conventional differential, torque applied to the ring gear is transmitted to the axle shafts through the differential gears. During normal operation, torque transmitted to each axle shaft is equal at all times.

However, if one wheel slips, the opposite wheel will generate only as much torque as the slipping wheel.

With Trac-Lok, part of the ring gear torque is transmitted through clutch packs located between the differential side gears and case. The clutch packs contain multiple disc clutches which have radial grooves on the plates and concentric grooves on the discs.

In operation, the Trac-Lok clutches are engaged by two concurrent forces. The first being preload force exerted through Belleville springs contained within the clutch packs and the second is from separating forces generated by the side gears as torque is applied through the ring gear.

The Trac-Lok design provides the normal differential action needed for turning corners and for the transmittal of equal torque to both wheels when driving straight ahead. However, when one wheel loses traction and spins, the clutch packs transfer additional torque to the wheel having the most traction. Trac-Lok differentials resist wheel spin on bumpy roads and provide more pulling power when one wheel loses traction. Pulling power is provided continuously until both wheels lose traction. If both wheels slip due to unequal traction, Trac-Lok operation is normal. In extreme cases of differences in traction, the wheel with the least traction may spin after the Trac-Lok has transferred as much torque as possible to the nonslipping wheel.

## LUBRICATION

The Trac-Lok differential requires a special lubricant. Ordinary multipurpose gear lubricants **must not** be used. Use Jeep Trac-Lok Lubricant or equivalent only. In addition, the only acceptable method for cleaning the Trac-Lok differential is by disassembling the unit and wiping it clean with shop towels.

**NOTE:** *Trac-Lok differentials are serviced at the same time intervals as standard differentials.*

### Trac-Lok Lubricant Change

(1) Warm axle lubricant. Operate vehicle in gear, on hoist, with wheels off floor for minimum of 5 minutes at 30 mph.

**WARNING:** *Never attempt to operate a Trac-Lok equipped vehicle in gear with only one wheel raised. The vehicle could propel itself off the jack and cause damage or personal injury.*

- (2) Stop engine and raise vehicle on hoist.
- (3) Remove axle housing cover drain plug or cover and drain lubricant while warm (only).
- (4) Remove any residual lubricant from axle housing using shop cloths.

(5) Install drain plug. If axle housing cover was removed, clean cover and housing mating surfaces and apply Jeep Gasket-In-A-Tube or equivalent silicone sealer to cover and housing mating surfaces. Install cover and cover bolts. Tighten cover bolts to 20 foot-pounds (27 N•m) torque.

(6) Refill axle housing with Trac-Lok lubricant or equivalent only. Refer to Specifications for lubricant capacities of various axle models.

(7) Operate vehicle on road for approximately ten miles (16 km). Make at least ten figure-eight turns to flush old lubricant out of clutch packs.

(8) Return vehicle to shop and raise vehicle on hoist.

(9) Drain and replace axle lubricant again. If axle housing cover is removed, be sure to clean cover and housing mating surfaces and reapply Jeep Gasket-In-A-Tube or equivalent silicone sealer to mating surfaces before reinstalling cover.

(10) Lower vehicle.

(11) Road test vehicle and verify proper Trac-Lok operation.

**NOTE:** *If a slight chatter occurs after flushing and refilling the Trac-Lok differential, drive the vehicle an additional ten to twenty miles (16 to 32 km) or until chatter stops. If the chatter persists after twenty (32 km) or more miles of driving, an overhaul may be necessary.*

## DIAGNOSIS

If noisy or rough operation such as chatter occurs when turning corners, the most probable cause is incorrect or contaminated lubricant. Before removing the Trac-Lok unit for repair, drain, flush, and refill the axle with the specified lubricant. Refer to the lubricant change procedure under Lubrication. A complete lubricant drain and refill with the specified lubricant will usually correct chatter.

### Trac-Lok Operational Test

Trac-Lok operation can be checked quickly using the following test.

(1) Position one wheel on solid, dry pavement and opposite wheel on ice, mud, grease, or similiar low traction surface.

(2) Increase engine rpm gradually to obtain maximum traction prior to breakaway. Ability to move vehicle effectively will demonstrate proper performance.

**NOTE:** *If the test is performed on extremely slick surfaces such as ice or grease coated surfaces, some question may exist as to proper performance. In these extreme cases, a properly performing Trac-Lok will provide greater pulling power by lightly applying the parking brake.*

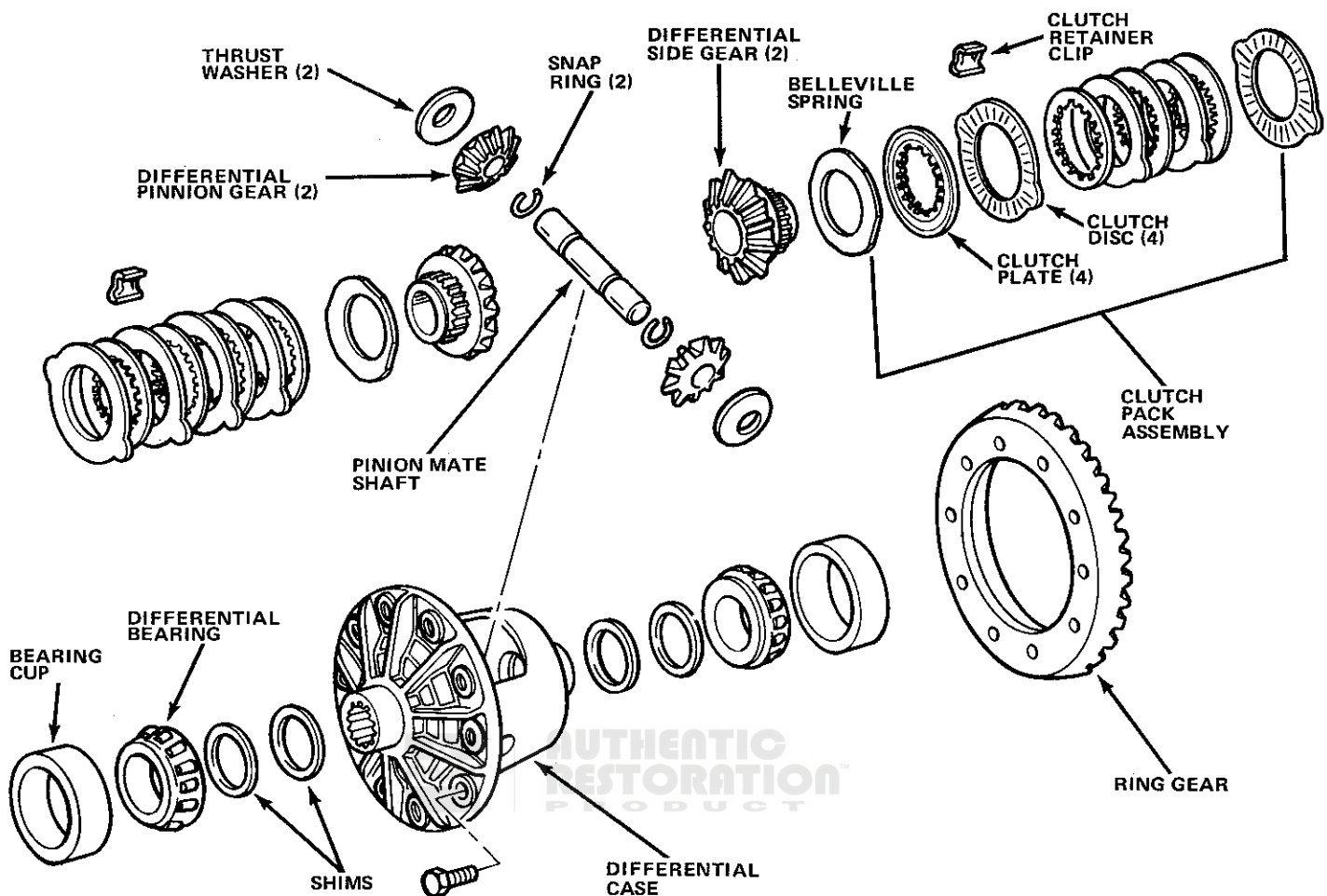


Fig. 2F-60 Trac-Lok Differential

60654

## OVERHAUL

### Disassembly

(1) Remove Trac-Lok differential from axle housing. Removal procedures are same as outlined for standard differential. Refer to Figure 2F-60 for parts nomenclature.

(2) Install one axle shaft in vise with spline end facing upward and tighten vise. Do not allow more than 2-3/4 inch (6.98 cm) of shaft to extend above top of vise (fig. 2F-61). This prevents shaft from fully entering side gear, causing interference with step plate tool used to remove differential gears.

(3) Mount differential case on axle shaft with ring gear bolt heads facing upward (fig. 2F-62).

(4) Remove and discard ring gear bolts.

(5) Place shop towels under ring gear to protect gear when it is removed from case (fig. 2F-62).

(6) Remove ring gear from case using rawhide hammer.

(7) Remove differential case from axle shaft and remove ring gear.

(8) Remount differential case on axle shaft.

(9) Remove snap rings from pinion mate shaft (fig. 2F-63). Use two screwdrivers to disengage snap rings. Place shop towel on opposite opening of case to prevent snap rings from flying out of case.

**NOTE:** On Model 60 Trac-Lok, the pinion mate shaft is retained in the case by a roll pin. Use a 3/16 inch (4.76 mm) diameter punch to remove the pin.

(10) Remove pinion mate shaft using hammer and brass drift.

**NOTE:** Gear Rotating Tool J-23781 is required to perform the following steps. The tool consists of three parts: gear rotating tool, forcing screw, and step plate.

(11) Install step plate in lower differential side gear (fig. 2F-64).

(12) Position pawl end of gear rotating tool on step plate (fig. 2F-65).

(13) Insert forcing screw through top of case and thread into gear rotating tool.

**NOTE:** Before using the forcing screw tool, apply chassis grease to the step plate centering hole and oil the forcing screw threads.

(14) Center forcing screw in step plate and tighten screw to move differential side gears away from differential pinion gears.

(15) Remove differential pinion gear thrust washers using feeler gauge or shim stock of 0.030 inch thickness (0.76 mm). Insert shim stock or gauge between washer and case and withdraw shim stock and thrust washer (fig. 2F-66).

(16) Tighten forcing screw until a slight movement of differential pinion gears is observed.

(17) Insert pawl end of gear rotating tool between teeth of one differential side gear. Pull handle of tool to rotate side gears and pinion gears. Remove pinion gears as they appear in case opening (fig. 2F-67).

**NOTE:** It may be necessary to adjust the tension applied to the Belleville springs by the forcing screw before the gears can be rotated in the case.

(18) Retain upper side gear and clutch pack in case by holding hand on bottom of rotating tool while removing forcing screw. Remove rotating tool, upper side gear, and clutch pack.

(19) Remove differential case from axle shaft. Invert case with flange or ring gear side up and remove step plate tool, lower side gear, and clutch pack from case. Remove retainer clips from both clutch packs to allow separation of plates and discs (fig. 2F-68).

### Inspection

#### Clutch Plates and Disc

If any one member of either clutch pack shows evidence of excessive wear or scoring, the complete clutch pack must be replaced on both sides.

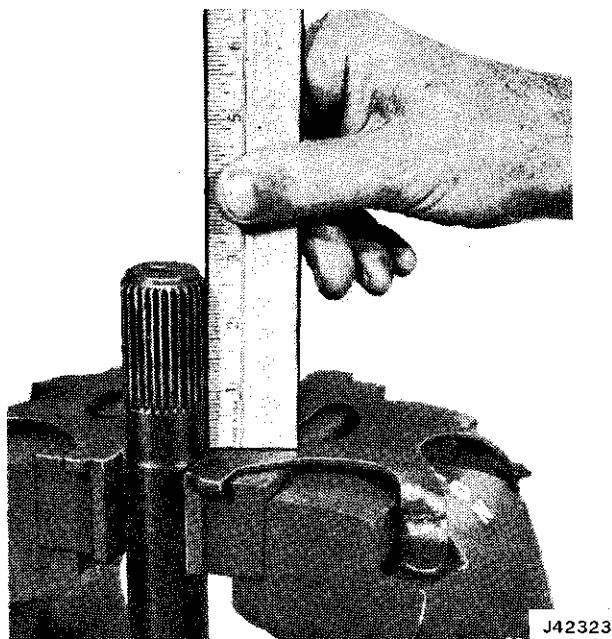


Fig. 2F-61 Axle Shaft Positioned in Vise



Fig. 2F-62 Differential Mounted on Axle Shaft

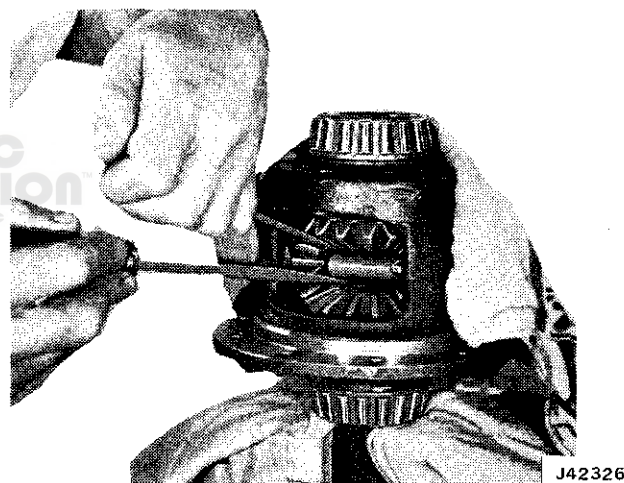


Fig. 2F-63 Pinion Mate Shaft Snap Ring Removal

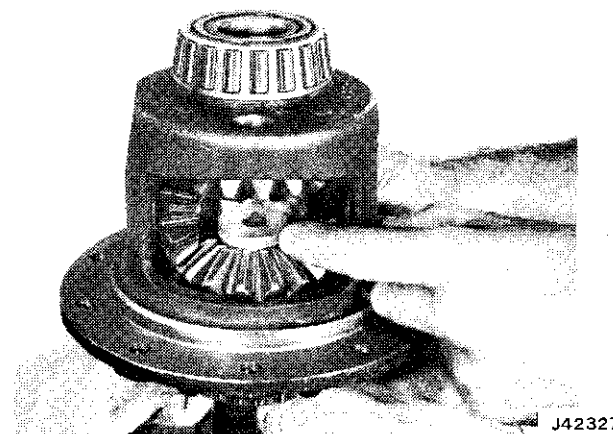


Fig. 2F-64 Step Plate Installation



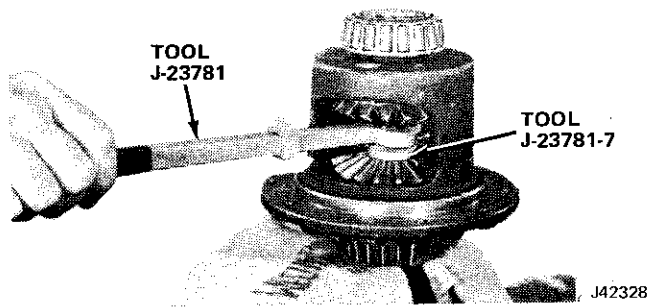


Fig. 2F-65 Gear Rotating Tool Installation

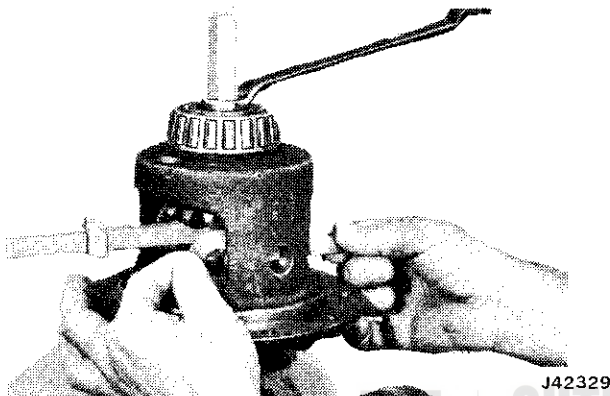


Fig. 2F-66 Pinion Thrust Washer Removal

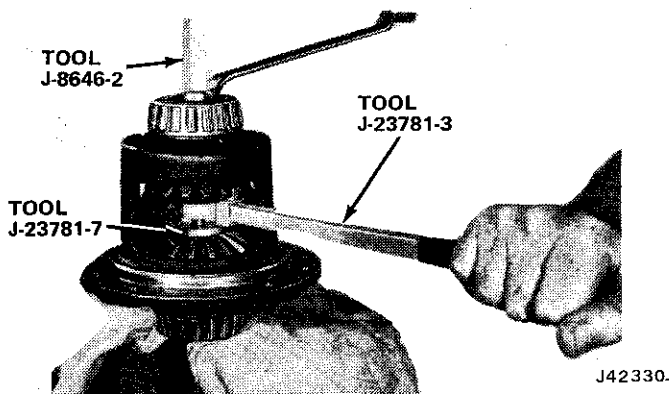


Fig. 2F-67 Pinion Gear Removal



Fig. 2F-68 Side Gear and Clutch Pack Removal

### Differential Side and Pinion Gears

The gear teeth should be checked for extreme wear or possible cracks. The external teeth of the side gear which holds the clutch pack also should be checked for wear or cracks. If replacement of one gear is required due to wear, both side gears, pinion gears, and thrust washers must be replaced.

### Pinion Mate Shaft

If excessive wear is evident on any one of the retainer clips, all clips should be replaced.

### Differential Case

If scoring, wear, or metal pickup is evident on the machined surfaces, then replacement of the case is necessary.

Examples of radial groove clutch plate (A) and the concentric groove disc (B) are shown in figure 2F-69.

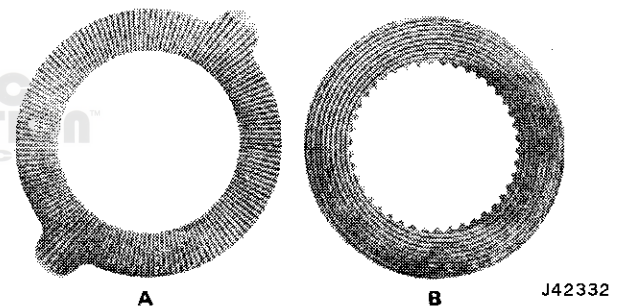


Fig. 2F-69 Clutch Plate and Disc Identification

## DIFFERENTIAL ASSEMBLY

(1) Lubricate differential gear teeth, thrust faces and splines and lubricate clutch discs and plates with Trac-Lok lubricant or equivalent only.

(2) Assemble clutch packs. Install plates and discs in same position as when removed regardless of whether they are replacement or original parts.

(3) Install clutch retainer clips on ears of clutch plates. Be sure clutch packs are completely assembled and seated on ears of plates.

(4) Install clutch packs on differential side gears and install assembly in case.

**NOTE:** Be sure clutch pack stays assembled on side gear splines and that retainer clips are completely seated in case pockets. To prevent pack from falling out of case, it will be necessary to hold them in place by hand while mounting case on axle shaft (fig. 2F-70).

(5) Mount case assembly on axle shaft (fig. 2F-71).

**CAUTION:** When installing differential case on axle shaft, be sure that splines of side gears are aligned with those of axle shaft. Be sure clutch pack is still properly assembled in case after installing case on axle shaft.

(6) Install step plate tool in side gear. Apply small daub of grease in centering hole of step plate.

(7) Install remaining clutch pack and side gear. Be sure clutch pack stays assembled on side gear splines and that retainer clips are completely seated in pockets of case (fig. 2F-71).

(8) Position gear rotating tool in upper side gear.

(9) Keep side gear and rotating tool in position by holding with hand. Insert forcing screw through top of case and thread into rotating tool (fig. 2F-72).

(10) Install both differential pinion gears in case. Be sure bores of gears are aligned. Hold gears in place by hand (fig. 2F-72).

(11) Tighten forcing screw to compress Belleville springs and provide clearance between teeth of pinion gears and side gears.

(12) Position pinion gears in case and insert rotating tool pawl between side gear teeth. Rotate side gears by pulling on tool handle and install pinion gears (fig. 2F-73).

**NOTE:** If the side gears will not rotate, Belleville spring load will have to be adjusted. If adjustment is necessary, loosen or tighten the forcing screw slightly until the gears will rotate.

(13) Continue rotating side gears using rotating tool handle until shaft bores in both pinion gears are aligned with case bores.

(14) Lubricate both sides of pinion gear thrust washers with Trac-Lok lubricant or equivalent.

(15) Tighten or loosen forcing screw to permit thrust washer installation.

(16) Install thrust washers. Use small screwdriver to guide washers into position (fig. 2F-74).

**CAUTION:** Be sure the shaft bores in the washers and gears are aligned with the case bores.

(17) Remove forcing screw, rotating tool, and step plate.

(18) Lubricate pinion mate shaft with Trac-Lok lubricant or equivalent and tap shaft into position with rawhide mallet (fig. 2F-75). Be sure snap ring grooves of shaft are exposed enough to allow snap ring installation.

(19) Install pinion mate shaft snap rings.

**NOTE:** On Model 60 Trac-Lok, align the shaft and shaft retaining pin bore and case pin bore. Drive the shaft into position and install the retaining pin. If the case is mounted in a vise and the machined side of the ring gear flange is facing upward, use a 5/16-inch (7.93 mm) diameter punch to install the retaining pin. Seat the pin until the punch bottoms in the case bore. If the case is mounted in a vise with the machined side of

the ring gear flange facing downward, wrap a length of tape around a 3/16-inch (4.76 mm) diameter punch approximately 1-3/4 inch (4.44 cm) from the end of the punch. Install the retaining pin until the edge of the tape is flush with the pin bore.

(20) Remove case from axle shaft.

(21) Install ring gear on case.

**NOTE:** Use replacement ring gear bolts only. Do not reuse the original bolts.

(22) Align ring gear and case bolt holes and install ring gear bolts finger-tight only.

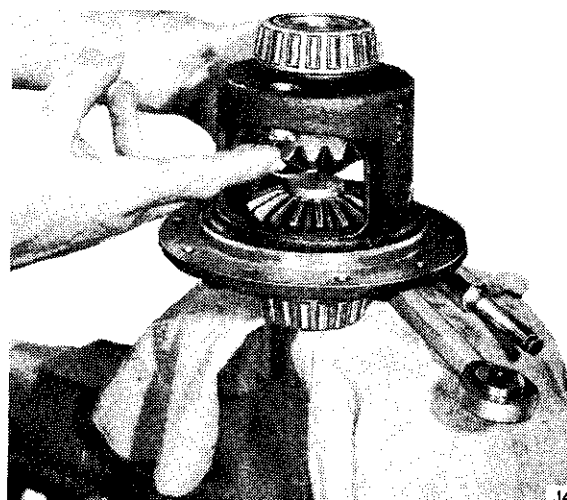
(23) Remount case on axle shaft and tighten bolts evenly. On Model 30 and 44 axles, tighten bolts to 55 foot-pounds (75 N•m) torque. On Model 60 axles, tighten bolts to 105 foot-pounds (142 N•m) torque.

(24) Install differential in axle housing. Follow service procedures previously outlined for conventional axles to complete differential and axle assembly servicing.



J42334

Fig. 2F-70 Remounting Differential Case on Axle Shaft



J42335

Fig. 2F-71 Clutch Pack and Side Gear Installation

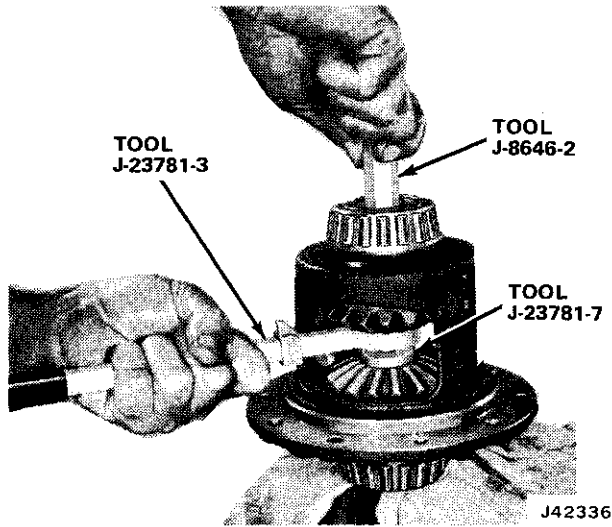


Fig. 2F-72 Threading Forcing Screw into Rotating Tool

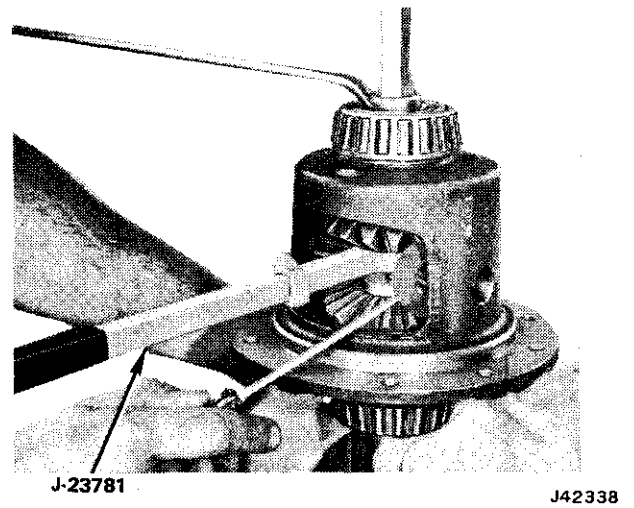


Fig. 2F-74 Pinion Gear Thrust Washer Installation

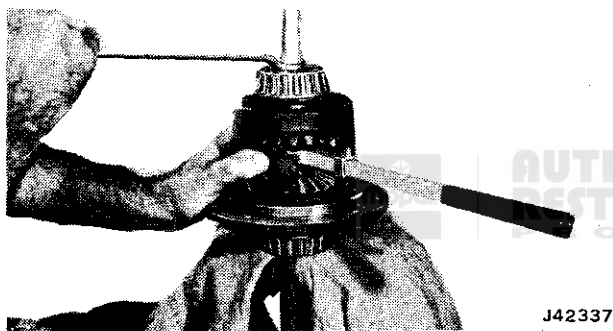


Fig. 2F-73 Pinion Gear Installation

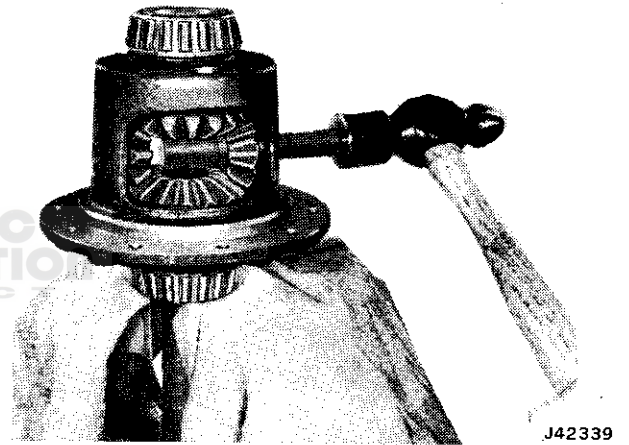


Fig. 2F-75 Pinion Mate Shaft Installation

**SERVICE REPLACEMENT**

If the Trac-Lok unit must be replaced as an assembly, replace the unit as follows:

- (1) Remove differential bearings and shims. Mark or tag each bearing and shim pack for assembly reference.
- (2) Remove ring gear from case.
- (3) Install original ring gear on replacement differential assembly. Be sure gear flange on replacement case is free of nicks or burrs.
- (4) Inspect shims and bearings which were removed. If shims and bearings are worn or damaged,

replace them. Be sure shims and bearings are used on same sides of replacement case as on old case.

- (5) Install shims and differential bearings. Use step plate on bottom bearing to protect bearing from damage during installation of upper bearing. Seat bearings, using bearing driver tool.

- (6) Lubricate differential bearings with Trac-Lok lubricant or equivalent and install differential in axle housing.

- (7) Follow service procedures previously outlined for conventional axles to complete differential and axle assembly servicing.

**SPECIFICATIONS**

**Axle Specifications**

**Model 30 Front Axle**

	USA	Metric
Differential Bearing Preload . . . . .	.015 in	0.38 mm
Differential Side Gear-to-Case Clearance . . . . .	.000-.006 in	0.000-0.15 mm
Ring Gear . . . . .	.005-.009 in	0.12-0.22 mm
Pinion Bearing Break-Away Preload		
Original Bearings . . . . .	15-25 in-lbs.	2-3 N-m
New Bearings . . . . .	20-40 in-lbs.	2-5 N-m

	USA	Metric
<b>Model 44 Axle (Full-Floating and Semi-Floating Types)</b>		
Differential Bearing Preload . . . . .	0.15 in	0.38 mm
Differential Side Gear-to-Case Clearance . . . . .	.000-.006 in	0.000-0.15 mm
Ring Gear Backlash . . . . .	.005-.010 in	0.12-0.25 mm
Pinion Bearing Break-Away Preload		
Original Bearings . . . . .	10-20 in-lbs.	1-2 N·m
New Bearings . . . . .	20-40 in-lbs.	2-5 N·m

<b>Model 60 Axle</b>		
Differential Bearing Preload . . . . .	.015 in	0.38 mm
Differential Side Gear-to-Case Clearance . . . . .	.000-.006 in	0.000-0.15 mm
Drive Gear-to-Pinion Backlash . . . . .	.005-.009 in	0.12-0.15 mm
Drive Pinion Bearing Break-Away		
Original Bearings . . . . .	10-20 in-lbs.	1-2 N·m
New Bearings . . . . .	20-40 in-lbs.	2-5 N·m

<b>AMC/Jeep Axle (Semi-Floating Tapered Shaft)</b>		
Axle Shaft End Play (Shims — Left Side Only) . . . . .	.004-.008 in (.006 in desired)	0.10-0.20 mm (0.15 mm desired)
Pinion Bearing Preload (Collapsible Sleeve) . . . . .	17-25 in-lbs.	2-3 N·m
Differential Bearing Preload (Shims) . . . . .	.008 in	0.20 mm
Differential Case Flange Runout (Inspection only — no adjustment) . . . . .	.002 in max.	0.05 mm max.
Ring Gear Backlash (Shims) . . . . .	.005-.009 in (.008 in desired)	0.12-0.15 mm (0.20 mm desired)
Pinion Gear Standard Setting (Shims) . . . . .	2.547 in	64-69 mm

60657B



**Authentic  
Restoration  
Product**  
**Torque Specifications**  
**Model 30 Front Axle**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Axle Housing Cover Bolts . . . . .	20	15-25	27	20-34
Differential Bearing Cap Bolts . . . . .	40	35-50	54	47-68
Ring Gear-to-Case Bolts . . . . .	55	45-65	75	61-88
Lower Ball Stud Nut . . . . .	80 min.	—	108 min.	—
Pinion Nut . . . . .	210	200-220	271	285-298
Universal Joint U-Bolts . . . . .	15	13-18	20	18-24
Upper Ball Stud Nut . . . . .	100 min.	—	136 min.	—
Upper Ball Stud Seat . . . . .	50 min.	—	68 min.	—
Wheel-to-Hub Nuts . . . . .	80	65-90	108	88-122

**Model 44 Front/Rear Axle  
(Full-Floating and Semi-Floating Types)**

Axle Housing Cover Bolts . . . . .	20	15-25	27	20-34
Support Plate Bolts/Nuts . . . . .	30	25-35	41	34-47
Differential Bearing Cap Bolts . . . . .	80	70-90	108	95-122
Disc Brake Shield Bolt . . . . .	8	5-10	11	7-14
Disc Brake Shield Nuts . . . . .	35	30-40	47	41-54
Ring Gear-to-Case Bolts . . . . .	55	45-65	75	61-81
Lower Ball Stud Nut . . . . .	80 min.	—	108 min.	—
Pinion Nut . . . . .	210	200-220	271	285-298
Upper Ball Stud Nut . . . . .	100 min.	—	136 min.	—
Upper Ball Stud Seat . . . . .	50 min.	—	68 min.	—
Universal Joint Flange Bolts . . . . .	35	25-45	47	34-61
Universal Joint U-Bolts . . . . .	15	13-18	20	18-24
Wheel-to-Hub Nuts . . . . .	80	65-90	108	88-122

# 2F-48 AXLES

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
<b>Model 60 Axle</b>				
Axle Housing Cover Bolts . . . . .	20	15-25	27	20-34
Support Plate Bolts/Nuts . . . . .	50	45-55	68	61-75
Differential Bearing Cap Bolts . . . . .	80	70-90	108	95-122
Ring Gear-to-Case Bolts . . . . .	105	100-110	142	135-149
Pinion Nut . . . . .	260	250-270	352	339-366
Universal Joint Flange Bolts . . . . .	35	25-45	47	34-61
Universal Joint U-Bolts . . . . .	15	13-18	20	18-24
Wheel-to-Hub Nuts . . . . .	120	110-125	163	149-169

## AMC/Jeep Axle (Semi-Floating Tapered Shaft)

Axle Housing Cover Bolts . . . . .	170 in-lbs	150-190 in-lbs	19	17-21
Brake Tube-to-Rear Wheel Cylinder . . . . .	97 in-lbs	90-105 in-lbs	11	10-12
Differential Bearing Cap Bolts . . . . .	87	80-95	10	9-11
Ring Gear-to-Case Bolt . . . . .	105	95-115	142	135-149
Rear Brake Support Plate Bolts . . . . .	32	25-40	43	34-54
Axle Shaft-to-Hub Nuts . . . . .	250 min.	250 min.	339 min.	—
Universal Joint U-Bolts . . . . .	15	13-18	20	18-24
Clamp Strap Bolts . . . . .	13	10-18	18	14-24

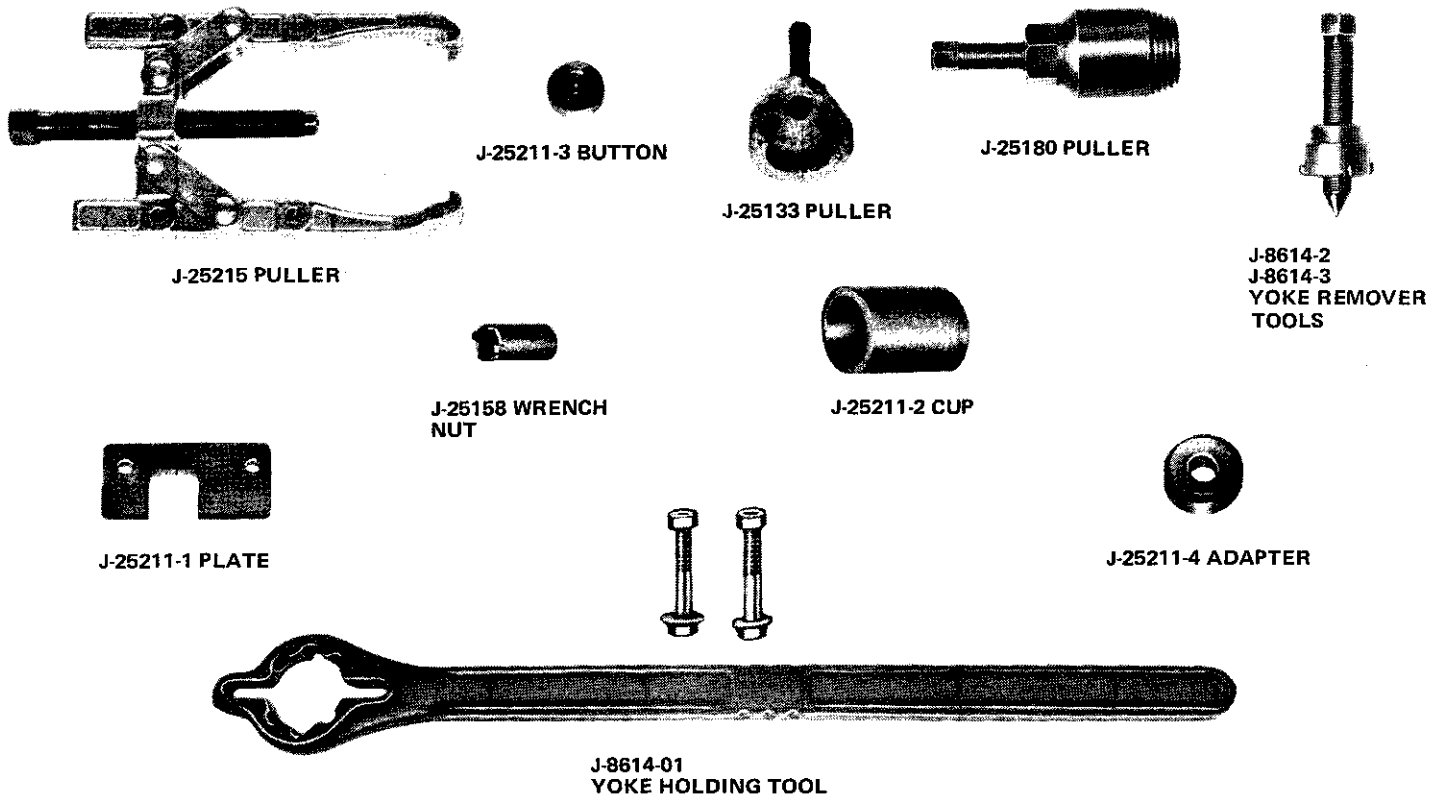
All torque values given in foot-pounds and newton meters with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.



60657A

### Tools



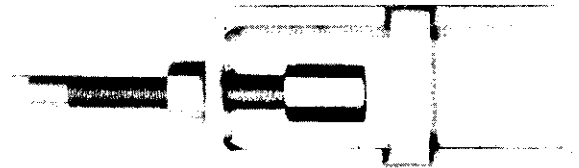
Tools (Continued)



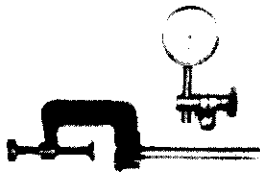
J-22575  
PINION NUT SOCKET



J-22661 REAR PINION  
OIL SEAL INSTALLER



J-2498  
AXLE SHAFT REMOVER



J-8001  
DIAL INDICATOR SET



J-21788  
AXLE SHAFT OIL  
SEAL INSTALLER



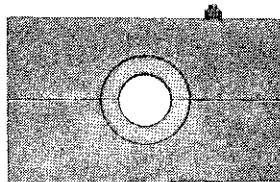
J-8614-2  
J-8614-3  
YOKE REMOVER  
TOOLS



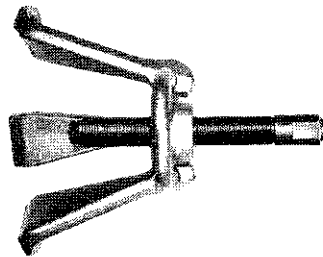
J-2092 AXLE END  
PLAY CHECKING TOOL



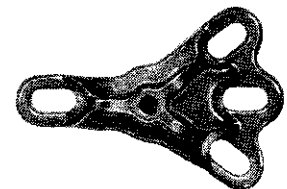
J-9233  
PINION OIL SEAL REMOVER



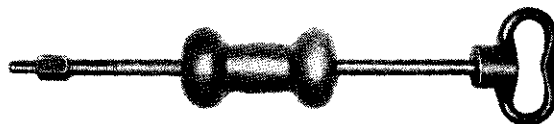
J-23674  
AXLE SHAFT BEARING  
REMOVER-INSTALLER



J-25109-01  
AXLE HUB PULLER



J-21679  
AXLE SHAFT PULLER



J-2619-01 SLIDE HAMMER



J-25135-01

Tools (Continued)



J-21787  
PINION FRONT  
BEARING CUP  
REMOVER



J-21786  
PINION REAR  
BEARING REMOVER



J-8608  
PINION REAR BEARING  
CUP INSTALLER



J-8611-01  
PINION FRONT  
BEARING CUP  
INSTALLER



J-5223-24  
CLAMP



J-5223-29  
BOLT



J-5223-20  
GAUGE BLOCK  
AND PLUNGER



J-5223-25 OR -26  
DISCS



J-24433  
PINION BEARING  
INSTALLER SLEEVE



J-21784  
DIFFERENTIAL  
BEARING INSTALLER

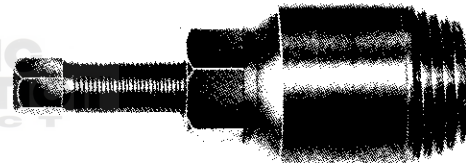


J-5223-4  
ARBOR

J-5223-03  
PINION DEPTH SETTING GAUGE SET



J-22697 PINION REAR  
BEARING INSTALLER

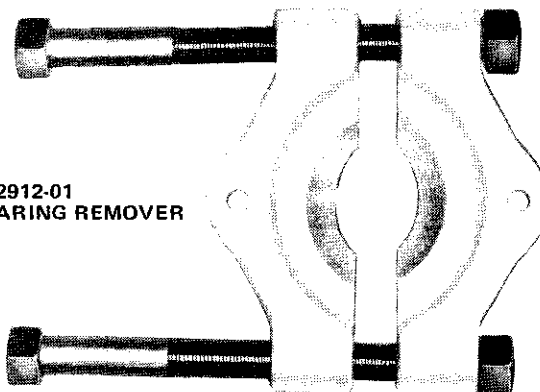


J-9233  
PINION SEAL REMOVER



J-2497-01  
DIFFERENTIAL BEARING  
PULLER SET

J-22912-01  
BEARING REMOVER



J-22661  
PINION SEAL  
INSTALLER



J-5590  
PINION BEARING  
INSTALLER SLEEVE



J-25111  
FRONT AXLE INNER  
SEAL INSTALLER



J-25157 INSTALLER  
J-25122 DRIVER HANDLE

Tools (continued)



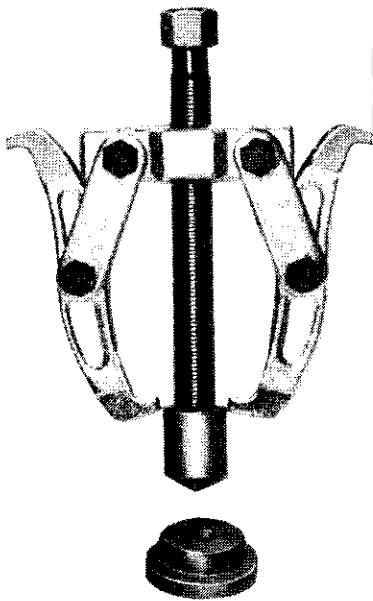
J-24385-01  
AXLE HOUSING SPREADER



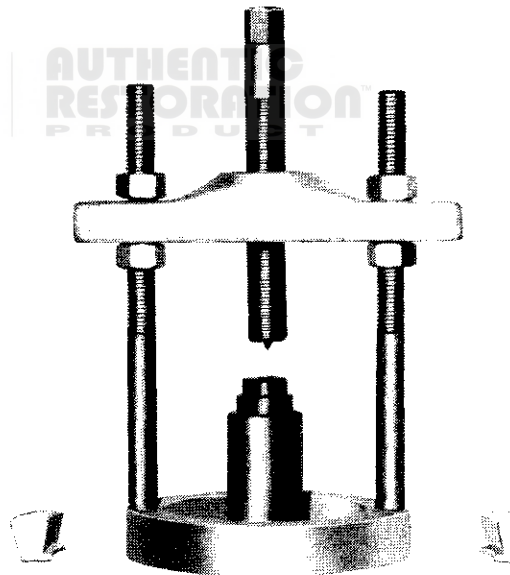
J-7079-2  
DRIVER HANDLE (NON-THREADED)



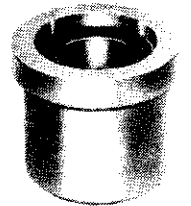
J-8092  
DRIVER HANDLE (THREADED)



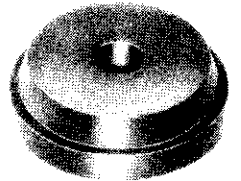
J-22888  
BEARING PULLER SET



J-25100  
BEARING REMOVER TOOL SET



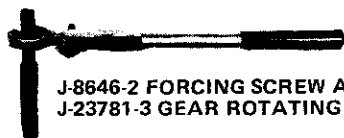
J-25104  
BEARING INSTALLER



J-25101  
BEARING CUP INSTALLER



J-24430  
BEARING INSTALLER



J-8646-2 FORCING SCREW AND  
J-23781-3 GEAR ROTATING TOOL



J-23781-7  
STEP PLATE



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# NOTES



**AUTHENTIC  
RESTORATION™**  
PRODUCT

# BRAKES 2G

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## GENERAL INFORMATION

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Brake Lining Inspection	2G-17	Parking Brake Cables	2G-16
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Brake Warning Lamp	2G-14	Specifications	2G-19

### GENERAL

Jeep vehicles are equipped with single piston, floating caliper front disc brakes and self energizing rear drum brakes.

Two different disc brake calipers are used. The caliper used on CJ models slides on abutment surfaces machined into the caliper and caliper support bracket. The caliper used on Cherokee, Wagoneer and Truck models slides on pivot bolts installed in the support shield and bracket assembly. Refer to the Brake Size and Application Chart for size and application details.

Two different drum brake units are used. They are similar in construction and operation but differ in method of automatic adjustment. Rear drum brakes on CJ models have cable operated automatic adjusters while rear drum brakes on Cherokee, Wagoneer and Truck models have linkage operated adjusters.

A dual reservoir master cylinder that provides separate hydraulic systems for the front and rear brake units is used on all models.

A three-function combination valve is used on all Jeep models. The valve consists of a one-piece housing containing a front brake metering valve, pressure differential warning valve, and rear brake proportioning valve.

Three power brake units are used. CJ models with optional power assist brakes use an 8 inch (20.3 cm)

single diaphragm power unit. Cherokee, Wagoneer and J-10 Truck models use a 9-1/2 inch (24.1 cm) single diaphragm power unit. J-20 Truck models use a 9-1/2 inch (24.1 cm) tandem diaphragm power unit.

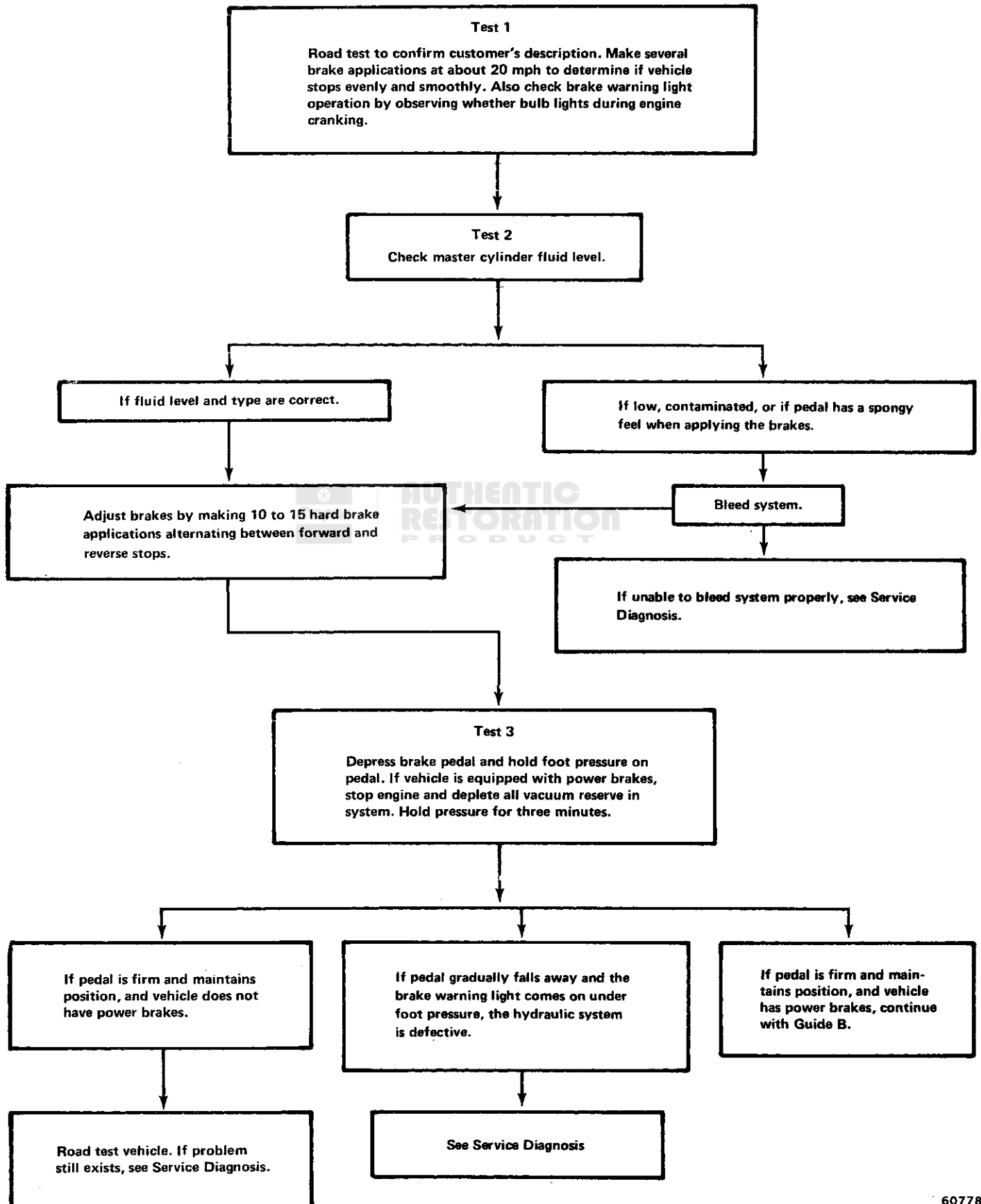
### BRAKE DIAGNOSIS

Brake system preliminary diagnosis procedures are outlined in Brake Diagnosis Guides A and B. Guide A applies to all vehicles and Guide B applies to vehicles equipped with power brakes only. Do not use Guide B until all of the steps outlined in Guide A have been completed.

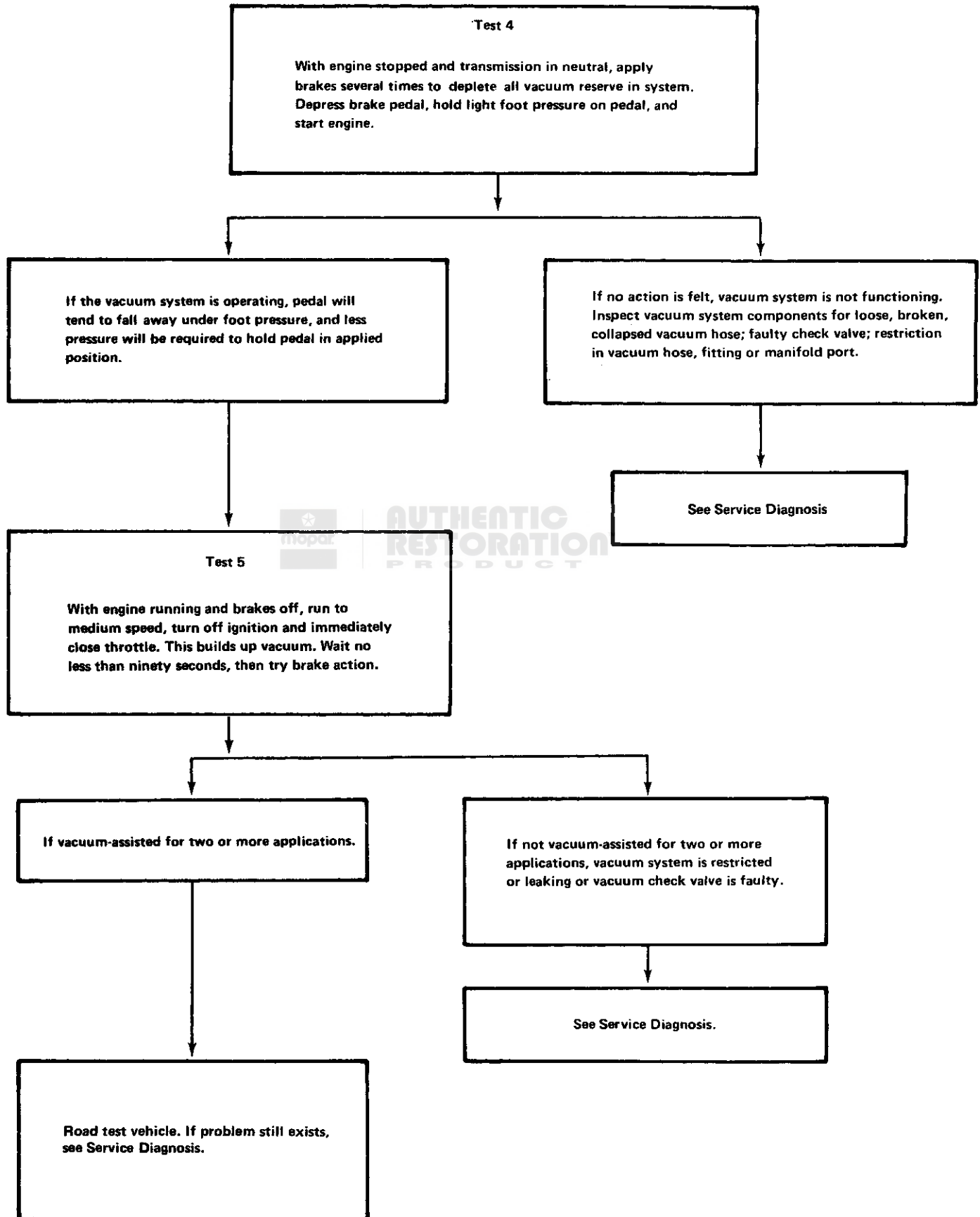
The procedures outlined in the Brake Diagnosis Guides are provided as a method for determining the general problem area. After the general problem area has been defined, refer to the Power Unit, Disc Brake, and Drum Brake Service Diagnosis Charts to determine the specific cause of a brake problem.

In most cases, an owner will describe a brake problem as one or more of the conditions listed in the Service Diagnosis Charts. However, to ensure an accurate diagnosis and avoid ineffective repair, road test the vehicle (if possible), perform the procedures outlined in the Diagnosis Guides, and then consult the Service Diagnosis Charts before attempting problem correction.

**Brake Diagnosis Guide A**



**Brake Diagnosis Guide B**



**Service Diagnosis-Power Unit**

Condition	Possible Cause	Correction
HARD PEDAL (NO POWER ASSIST)	(1) Refer to EXCESSIVE PEDAL EFFORT.	(1) Refer to EXCESSIVE PEDAL EFFORT in Service Diagnosis Charts.
	(2) Loss of vacuum to power unit.	(2) Check for loose hose or check valve seal. Check for collapsed or damaged hose. Inspect vacuum check valve for damage or leak. Replace parts as required.
	(3) Internal malfunction in power unit.	(3) Replace power unit.
SLOW RETURN OF BRAKE PEDAL	(1) Power unit bellcrank pivot pins binding (CJ only) or, pedal binding. See PULLS and GRABBING BRAKES in Brake Service Diagnosis Charts.	(1) Lube all pedal pivot points. Remove, clean, lube and install pivot pins.
	(2) Internal malfunction in power unit.	(2) Replace power unit.
GRABBING OR DRAGGING BRAKES	(1) Bellcrank pivot pins binding (CJ only).	(1) Remove, clean, lubricate, and install pivot pins.
	(2) Refer to PULLS and GRABBING BRAKES in Brake Service Diagnosis Charts.	(2) See PULLS and GRABBING BRAKES in Service Diagnosis Charts
	(3) Push rod (in power unit) binding due to corrosion or burrs on push rod.	(3) Check and correct as required. Do not lube push rod. Clean push rod with brake fluid and clean cloth only.
	(4) Internal malfunction in power unit.	(4) Replace power unit.

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**Service Diagnosis-Drum Brakes**

Condition	Possible Cause	Correction
LOW PEDAL OR PEDAL GOES TO TOE BOARD	(1) Low fluid level.	(1) Fill reservoir with approved brake fluid.
	(2) Excessive clearance between lining and drums.	(2) Adjust brakes.
	(3) Automatic adjusters not working.	(3) Make forward and reverse stops; if pedal stays low, repair faulty adjusters.
	(4) Leaking brake lines.	(4) Repair or replace faulty parts.

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**Service Diagnosis-Drum Brakes (Continued)**

Condition	Possible Cause	Correction
<p><b>LOW PEDAL OR PEDAL GOES TO TOE BOARD</b> (Continued)</p>	<p>(5) Leaking wheel cylinders. (6) Internal leak in master cylinder. (7) Air in system. (8) Improper brake fluid.</p>	<p>(5) Overhaul wheel cylinder. (6) Overhaul master cylinder. (7) Bleed system. (8) Flush system and refill with approved fluid.</p>
<p><b>SPRINGY, SPONGY PEDAL</b></p>	<p>(1) Air trapped in hydraulic system. (2) Improper brake fluid. (3) Improper lining thickness or location. (4) Drums worn too thin, (beyond 0.060 (1.52 mm) oversize specification) (5) Master cylinder filler vent clogged (6) Hoses-lines collapsed, kinked, leaking. (7) Master cylinder compensator port blocked.</p>	<p>(1) Remove air by bleeding. (2) Flush and bleed system; use approved brake fluid. (3) Install new lining or replace shoe and lining. (4) Replace drum(s) as required. (5) Clean vent or replace cap; bleed brakes. (6) Replace as required. (7) Disassemble master cylinder. Repair as required.</p>
<p><b>EXCESSIVE PEDAL PRESSURE REQUIRED TO STOP VEHICLE</b></p>	<p>(1) Brake adjustment not correct. (2) Incorrect lining. (3) Grease or fluid-soaked lining. (4) Improper fluid. (5) Frozen master or wheel cylinder pistons. (6) Brake pedal binding on shaft. (7) Linings watersoaked. (8) Glazed linings. (9) Bell-mouthed, barrel-shaped, or scored drums.</p>	<p>(1) Adjust brakes. (2) Install new linings. (3) Repair grease seal or wheel cylinder. Install new linings. (4) Flush system; use approved brake fluid. (5) Overhaul master or wheel cylinders. (6) Lubricate pivot points. (7) Drive with brakes lightly applied to dry linings. (8) Replace linings. (9) Replace or resurface drums in left and right hand pairs.</p>

## Service Diagnosis-Drum Brakes (Continued)

Condition	Possible Cause	Correction
LIGHT PEDAL PRESSURE-BRAKES TOO SEVERE	(1) Brake adjustment not correct.	(1) Adjust brakes.
	(2) Loose support plates.	(2) Tighten support plates.
	(3) A small amount of grease or fluid on linings.	(3) Replace the linings.
	(4) Pedal linkage binding, or power unit bellcrank pivot pins binding (CJ only).	(4) Lube linkage and bellcrank pivot pins.
	(5) Internal bind in power unit.	(5) Replace power unit.
	(6) Incorrect lining.	(6) Install new linings.
	(7) Lining loose on shoe.	(7) Replace lining or shoe and lining.
	(8) Bell-mouthed, barrel-shaped, or scored drums.	(8) Turn drums in pairs or replace.
PULSATING BRAKE PEDAL	(9) Combination valve faulty.	(9) Replace combination valve.
	(1) Drums out-of-round.	(1) Refinish or replace drums.
	(2) Loose brake drum on hub.	(2) Tighten.
	(3) Worn or loose wheel bearings.	(3) Replace or adjust.
	(4) Bent shoes or linings.	(4) Replace shoe-lining assembly as required.
	(5) Bent rear axle shaft.	(5) Replace axle shaft.
	(6) Loose or bent support plate.	(6) Tighten or replace support plate.
	BRAKE FADE	(1) Incorrect lining.
(2) Air in lines or improper brake fluid.		(2) Bleed system. Drain and flush if fluid is improper type.
(3) Master cylinder primary piston worn, or bore scored, corroded.		(3) Disassemble master cylinder. Repair as required.
ALL BRAKES DRAG (ADJUSTMENT IS KNOWN TO BE CORRECT)	(1) Power unit bellcrank pivot pins binding (CJ only).	(1) Lubricate pedal pivot or bellcrank pivot pins.
	(2) Improper fluid.	(2) Replace fluid and rubber parts.
	(3) On power brakes (CJ only) push rod height is incorrect.	(3) Adjust push rod height.

**Service Diagnosis-Drum Brakes (Continued)**

Condition	Possible Cause	Correction
<b>ALL BRAKES DRAG</b> (ADJUSTMENT IS KNOWN TO BE CORRECT) (Continued)	(4) Compensating or bypass port of master cylinder closed. (5) Use of inferior hydraulic fluid or rubber parts. (Swollen cups, corroded wheel or master cylinder bores.	(4) Open with compressed air. (5) Overhaul wheel and/or master cylinder.
<b>BRAKE PEDAL TRAVEL DECREASING</b>	(1) Master cylinder compensating port plugged. (2) Power unit bellcrank pivot pins binding (CJ only) or pedal pivot binding on manual brakes. (3) Swollen cup in master cylinder. (4) Master cylinder piston not returning. (5) Wheel cylinder pistons sticking.	(1) Use compressed air to unplug. (2) Lube pedal pivot or pivot pins. (3) Replace rubber parts. Flush system. (4) Overhaul master cylinder. (5) Overhaul wheel cylinder.
<b>ONE WHEEL DRAGS</b>	(1) Weak or broken brake shoe retracting springs. (2) Power unit bellcrank pivot pins binding (CJ only) or pedal pivot binding. (3) Insufficient brake shoe-to-drum clearance. (4) Loose wheel bearings. (5) Wheel cylinder piston cups swollen and distorted. (6) Pistons sticking in wheel cylinder. (7) Restriction in brake line. (8) Loose anchor pin. (9) Parking brake components seized or incorrectly adjusted.	(1) Replace the defective brake shoe springs and lubricate the brake shoe ledges. (2) Lube pedal pivot or pivot pins. (3) Adjust brakes. Repair automatic adjusters if necessary. (4) Adjust wheel bearings. (5) Overhaul wheel cylinders. (6) Clean or replace pistons; clean cylinder bore. (7) Clean out or replace. (8) Adjust and tighten lock nut. (9) Repair or replace parts as necessary.
<b>ONE WHEEL LOCKS</b>	(1) Contaminated linings. (2) Worn tire treads.	(1) Replace the linings. (2) Replace tire or, match up tire treads from side to side.



Service Diagnosis-Drum Brakes (Continued)

Condition	Possible Cause	Correction
BRAKES GRAB OR WON'T HOLD IN WET WEATHER	(1) Linings water-soaked. (2) Dirt, water in drums. (3) Bent support plate allowing excessive water to enter drum. (4) Scored drums.	(1) Dry out linings by driving with brakes lightly applied. (2) Clean drums. (3) Replace support plate. (4) Replace or resurface in pairs.
BRAKES SQUEAK	(1) Support plate bent or shoes twisted. (2) Metallic particles or dust imbedded in lining. (3) Lining rivets loose or lining not held tightly against the shoe at the ends. (4) Drums distorted. (5) Shoes scraping on support plate ledges. (6) Weak or broken hold-down springs. (7) Loose wheel bearings. (8) Charred lining. (9) Loose support plate, anchor, drum, or wheel cylinder. (10) Linings located wrong on shoes.	(1) Replace damaged parts. (2) Sand the surfaces of the linings and drums. Remove all particles of metal that may be found in the surface of the linings. (3) Replace rivets. Replace shoe lining assemblies if damaged. (4) Turn or replace drums. (5) Lubricate. (6) Replace defective parts. (7) Adjust bearings. (8) Replace lining. (9) Tighten. (10) Install linings correctly.
REAR BRAKES DRAG	(1) Adjustment not correct. (2) Parking brake cables frozen. (3) Dirty lining. (4) Wheel cylinder cups swollen or piston sticking. (5) Weak retracting springs. (6) Shoes binding on support plate.	(1) Adjust brake shoes and parking brake mechanism. (2) Lubricate or replace as required. (3) Replace lining. (4) Overhaul cylinders. (5) Replace springs. (6) Lubricate support plate ledges.

## Service Diagnosis-Drum Brakes (Continued)

Condition	Possible Cause	Correction
VEHICLE PULLS TO ONE SIDE	(1) Grease or fluid-soaked lining.	(1) Locate and correct leakage; replace linings.
	(2) Adjustment not correct.	(2) Adjust the brakes.
	(3) Loose wheel bearings, loose support plate(s) or loose spring bolts.	(3) Adjust wheel bearing; tighten support plate(s) and tighten spring bolts.
	(4) Linings not of specified kind or primary and secondary shoes reversed.	(4) Install new linings.
	(5) Power unit bellcrank pivot pins binding (CJ only).	(5) Lube pivot pins.
	(6) Tires not properly inflated or unequal wear of tread. Different tread design side to side.	(6) Inflate the tires to recommended pressures. Rotate tires so that tread surfaces of similar design and equal wear will be installed on the front wheels.
	(7) Water, mud, or foreign matter in brakes.	(7) Remove foreign material from brake parts and inside of the drums. Lubricate the shoe ledges and the rear brake cable ramps.
	(8) Wheel cylinder sticking.	(8) Overhaul or replace wheel cylinder.
	(9) Weak or broken retracting springs.	(9) Check springs. Replace bent, distorted or cracked springs.
	(10) Out-of-round drums.	(10) Resurface or replace drums in left and right hand pairs (both front and both rear).
	(11) Brake dragging.	(11) Check for loose lining. Repair or replace as required.
	(12) Broken spring or loose U-bolts.	(12) Replace spring or tighten U-bolts.
	(13) Loose steering components.	(13) Tighten or repair and adjust as required.
	(14) Unequal camber.	(14) Replace axle housing.
	(15) Clogged or crimped brake line.	(15) Repair or replace line.
	(16) Wheel cylinder incorrect size.	(16) Replace with correct cylinders.
	(17) Worn steering knuckle bearings.	(17) Replace.

**Service Diagnosis-Drum Brakes (Continued)**

Condition	Possible Cause	Correction
BRAKES CHATTER	(1) Incorrect lining-to-drum clearance. (2) Loose brake support plate. (3) Grease, fluid, road dust on lining. (4) Weak or broken retractor spring. (5) Loose wheel bearings. (6) Drums out-of-round. (7) Cocked or distorted shoes. (8) Tapered or barrel-shaped drums.	(1) Adjust to recommended clearances. (2) Tighten support plate. (3) Clean out dust; replace grease and fluid-soaked lining. (4) Replace. (5) Adjust. (6) Turn or replace drums in pairs. (7) Straighten or replace. (8) Turn or replace drums in pairs.
SHOE CLICK	(1) Shoes lift off support plate and snap back. (2) Holddown springs weak. (3) Shoe bent. (4) Grooves in support plate ledges.	(1) Change drums side to side or turn drums (in pairs). (2) Replace springs. (3) Replace shoes on both sides. (4) Replace support plate.

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**Service Diagnosis-Disc Brakes**

Condition	Possible Cause	Correction
BRAKE CHATTER OR ROUGHNESS. BRAKE PEDAL PULSATES	(1) Excessive rotor lateral runout. (2) Excessive rotor thickness variation. (3) Loose or worn wheel bearings. (4) Rear drums out-of-round.	(1) Check rotor runout. Refinish if not to specs (refer to Rotor Measurements). Replace if unable to refinish. (2) Check rotor thickness variation. Refinish if out of spec. Replace if unable to refinish. (3) Adjust to specs. Replace if worn or damaged. (4) Check runout. If not to specs turn drum. Do not remove more than .060 inch (1.52 mm)

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## Service Diagnosis-Disc Brakes (Continued)

Condition	Possible Cause	Correction
BRAKE CHATTER OR ROUGHNESS. BRAKE PEDAL PULSATES (Continued)	(5) Disc brake shoes reversed (steel side of shoe riding on rotor).  (6) Shoes bent or linings worn.	(5) Replace rotor and shoes.  (6) Replace shoes.
EXCESSIVE PEDAL EFFORT REQUIRED	(1) Malfunction in power brake unit.  (2) Malfunction in front or rear brake system (dual master cylinder) such as: wheel cylinder leaks, defective brake lines, caliper piston seal leak, master cylinder piston cups not holding pressure.  (3) Lining worn.	(1) Check operation. Refer to Power Brake Units.  (2) Check both brake systems and correct as required. Check for failed brake warning light if brake failure occurred and light did not operate.  (3) Check and replace linings as required.
EXCESSIVE PEDAL TRAVEL	(4) Caliper piston sticking.  (5) Brake fade caused by incorrect or non-recommended linings.  (6) Incorrect master cylinder.	(4) Rebuild caliper.  (5) Replace with correct or recommended lining.  (6) Check and replace if required.
EXCESSIVE PEDAL TRAVEL	(1) Low fluid level.  (2) Leak in system.  (3) Air in system.  (4) Rear brakes not adjusting properly.  (5) Worn lining.	(1) Add fluid as required.  (2) Inspect and correct as required.  (3) Bleed brakes.  (4) Adjust rear brakes and repair automatic adjusters.  (5) Replace linings. If wear is excessive or premature, check for incorrect lining, sticking caliper pistons, binding park brake cables, shoe drag on support plate, weak return springs on drum brakes, improper rear brake adjustment.
EXCESSIVE PEDAL TRAVEL	(6) Bent or broken shoe.  (7) Master cylinder mounting bolts loose.  (8) Rotor thickness or drum diameter below specification.	(6) Replace as required.  (7) Check and retighten.  (8) Inspect, measure and replace as required.
DRAGGING BRAKES	(1) Master cylinder pistons not returning properly.	(1) Remove cover, check for spurt of fluid at compensator holes as brake pedal is depressed. Rebuild master cylinder if fluid spurt is not observed. Inspect compensator ports for blockage, use compressed air to clear passages.

NOTE: A very light drag occurring after releasing the brake pedal is a characteristic of disc brakes.

Service Diagnosis-Disc Brakes (Continued)

Condition	Possible Cause	Correction
	<ul style="list-style-type: none"> <li>(2) Restrictions in brake lines or hoses.</li> <li>(3) Incorrect parking brake adjustment.</li> <li>(4) Rear shoes not returning to normal position.</li> <li>(5) Caliper pistons not releasing. Pistons stuck due to piston scoring or corrosion or piston cocking in bore.</li> <li>(6) Lines to combination valve installed incorrectly.</li> <li>(7) Bind in brake pedal or power unit bellcrank pivot pins (CJ only)</li> <li>(8) Check valve installed in master cylinder outlet port.</li> </ul>	<ul style="list-style-type: none"> <li>(2) Check for kinks or dents in steel lines . Check rubber hoses for swelling or restrictions inside hose.</li> <li>(3) Check and readjust to specification. Inspect cables for bind or frayed conditions.</li> <li>(4) Return springs weak. Shoes dragging on support plate due to lack of lube or ridges on support plate ledges. Wheel cylinder cups swollen or pistons sticking. Repair or replace faulty parts as required.</li> <li>(5) Repair or replace pistons or caliper as required.</li> <li>(6) Check and correct as required. Port marked inlet goes to master cylinder; port marked outlet goes to calipers.</li> <li>(7) Lube pedal pivot or pivot pins.</li> <li>(8) Check outlet. Remove valve if present. Bleed brakes.</li> </ul>
GRABBING BRAKES	<ul style="list-style-type: none"> <li>(1) Refer to all conditions listed under PULLS WHEN BRAKES ARE APPLIED.</li> <li>(2) Power brake unit malfunction or bellcrank pivot pins binding (CJ only).</li> <li>(3) Combination valve malfunction.</li> <li>(4) Incorrect power unit.</li> </ul>	<ul style="list-style-type: none"> <li>(1) See PULLS WHEN BRAKES ARE APPLIED.</li> <li>(2) Check operation and replace or repair as required. Refer to POWER UNIT SERVICE DIAGNOSIS Chart.</li> <li>(3) Replace valve and bleed system.</li> <li>(4) Check and replace as required.</li> </ul>
PULLS WHEN BRAKES ARE APPLIED	<ul style="list-style-type: none"> <li>(1) Incorrect tire pressures.</li> <li>(2) Mismatched tires on same axle.</li> <li>(3) Wheel bearings misadjusted or worn.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Inflate to spec.</li> <li>(2) Install equal size, type tires.</li> <li>(3) Adjust or replace as required.</li> </ul>

## Service Diagnosis-Disc Brakes (Continued)

Condition	Possible Cause	Correction
	<p>(4) Malfunction in caliper.</p> <p>(5) Damaged or contaminated shoe and lining (grease on lining or bent shoe).</p> <p>(6) Rear brake problem: automatic adjusters inoperable, contaminated lining, defective wheel cylinders, seized or improperly adjusted park brake cables, shoes binding on support plate, linings worn, linings charred or cracked, bent support plate, weak retracting springs, drums out-of-round.</p> <p>(7) Loose calipers.</p> <p>(8) Loose suspension parts.</p> <p>(9) Front end out of alignment.</p> <p>(10) Lining soaked with water after operation in heavy rains, or flooding conditions.</p> <p>(11) Disc brake rotor out of tolerance.</p>	<p>(4) Check for stuck piston.</p> <p>(5) Replace shoe and lining on both sides. Replace axle seals, wheel cylinder cups, or caliper piston seals, if leaking.</p> <p>(6) Inspect and repair or replace malfunctioning parts. Check for equal size wheel cylinders on rear brakes.</p> <p>(7) Check mounting bolt torque, inspect threads on bolts for galling or stripped threads, check support plate for broken welds.</p> <p>(8) Inspect and correct as required.</p> <p>(9) Check and correct as required.</p> <p>(10) Allow lining to air dry, or while driving, keep brakes lightly applied to warm up lining and evaporate water.</p> <p>(11) Check and refinish or replace as required.</p>
REAR DRUM BRAKES SKID PREMATURELY ON HARD BRAKE APPLICATION	<p>(1) Combination valve proportioner section malfunctioning.</p> <p>(2) Check items listed under PULLS and GRABBING.</p>	<p>(1) Replace valve and bleed brakes.</p> <p>(2) See PULLS and GRABBING.</p>
SPONGY PEDAL	<p>(1) Air in system.</p> <p>(2) Rear drums thin or cracked.</p> <p>(3) Calipers loose.</p> <p>(4) Loose master cylinder or brake booster attaching parts.</p>	<p>(1) Bleed brakes. Inspect for broken lines, loose fittings, leaking caliper pistons, or wheel cylinders; check rubber seal on master cylinder cover. Check cover itself for distortion or cracks, check all bleed valves for proper torque.</p> <p>(2) Inspect and correct as required.</p> <p>(3) Check mounting bolt torque.</p> <p>(4) Check and correct as required.</p>

Service Diagnosis-Disc Brakes (Continued)

Condition	Possible Cause	Correction
SPONGY PEDAL (Continued)	(5) Compensator port blocked in master cylinder.  (6) Improper (low quality) brake fluid in system. Fluid boils and becomes aerated.	(5) Check and correct as required.  (6) Drain and flush system.

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**BRAKE PEDAL**

A suspended brake pedal is used on all models. The pedal is attached to the pedal support bracket by a pivot bolt (fig. 2G-1 and 2G-2). The pivot bolt serves as both attaching part and pivoting member for the pedal.

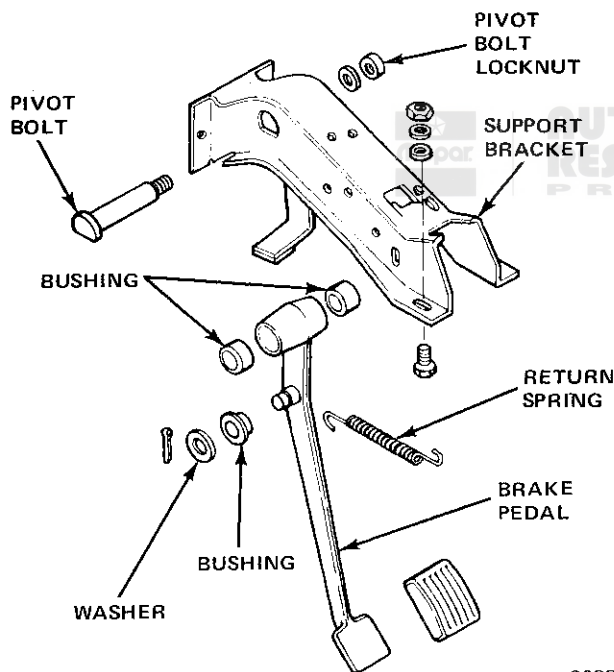


Fig. 2G-1 Brake Pedal—CJ Models

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The pedal linkage should be lubricated and inspected regularly for binding, looseness, or excessive play. Binding can cause improper pedal release which may result in brake drag and rapid lining wear. In addition, worn pedal linkage may cause a low pedal condition or frequent need for brake adjustment.

Pedal free play should be 1/16 to 1/4 inch (1.58 to 6.35 mm). Inadequate free play can result in brake drag or grab while excessive free play can produce a low pedal condition. Free play on models with nonpower brakes is governed by pedal push rod length which is preset at manufacture. The push rod is not adjustable on these

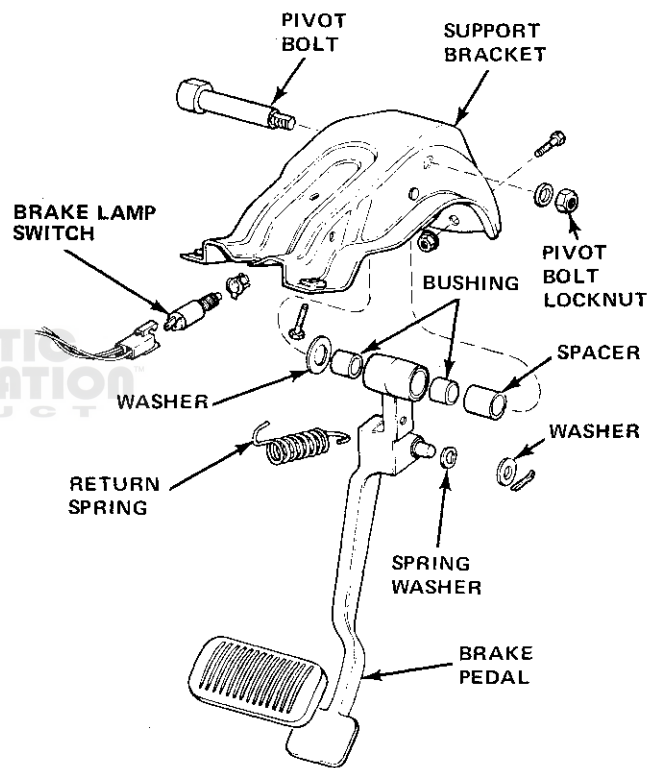


Fig. 2G-2 Brake Pedal—Cherokee-Wagoneer-Truck Models

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models and under normal circumstances should not require further attention. Power brake equipped vehicles utilize a single push rod in the power unit which is also preset at manufacture and is not adjustable. When replacing a power unit, use the push rod supplied with the replacement power unit as it has been properly gauged for use with the replacement unit. Pedal free play for power brake equipped vehicles is the same as for vehicles with nonpower brakes.

**BRAKE WARNING LAMP**

A dual purpose warning lamp is located in the instrument cluster on all Jeep vehicles. The primary function of this lamp is to alert the driver if a pressure

differential between front and rear brake hydraulic systems should ever occur.

On vehicles with a parking brake warning system, the lamp also functions as a signal device to alert the driver when the parking brakes are applied.

In the parking brake signal mode, the lamp is activated by a mechanically operated switch mounted on the parking brake lever assembly. In the brake hydraulic pressure differential warning mode, the lamp is activated by a plunger-type switch located in the combination valve.

If a pressure loss should occur in either the front or rear brake hydraulic systems, a pressure differential of 70 to 300 psi (483 to 2 068 kPa) will cause a piston in the pressure differential section of the combination valve to shuttle toward the low pressure side of the valve. As the piston moves toward this side of the valve, ramps on the piston contact the differential switch plunger forcing it upward and closing the switch internal contacts. This completes the electrical circuit between switch and warning lamp causing the lamp to light. Unless the ignition lock cylinder is turned to the OFF position, the lamp will remain illuminated until the cause of the

pressure differential is corrected.

In normal operation, with the ignition lock cylinder turned to the Start Position, the warning lamp will illuminate and remain so until the engine is started and the lock cylinder is returned to the On position, or when the parking brakes are released. This feature is provided as a means of checking warning lamp bulb and circuit operation.

### PARKING BRAKE ADJUSTMENT

**NOTE:** *The service brakes must be adjusted before adjusting the parking brakes.*

- (1) Release parking brakes.
- (2) Loosen equalizer locknuts to release tension on cables (fig. 2G-3 and 2G-4).
- (3) Inspect all cables for binds, kinks, or frayed condition. Replace damaged cables.
- (4) Tighten equalizer locknut until slight drag is produced at wheels.
- (5) Loosen equalizer locknut until wheels rotate freely and brake drag is eliminated.

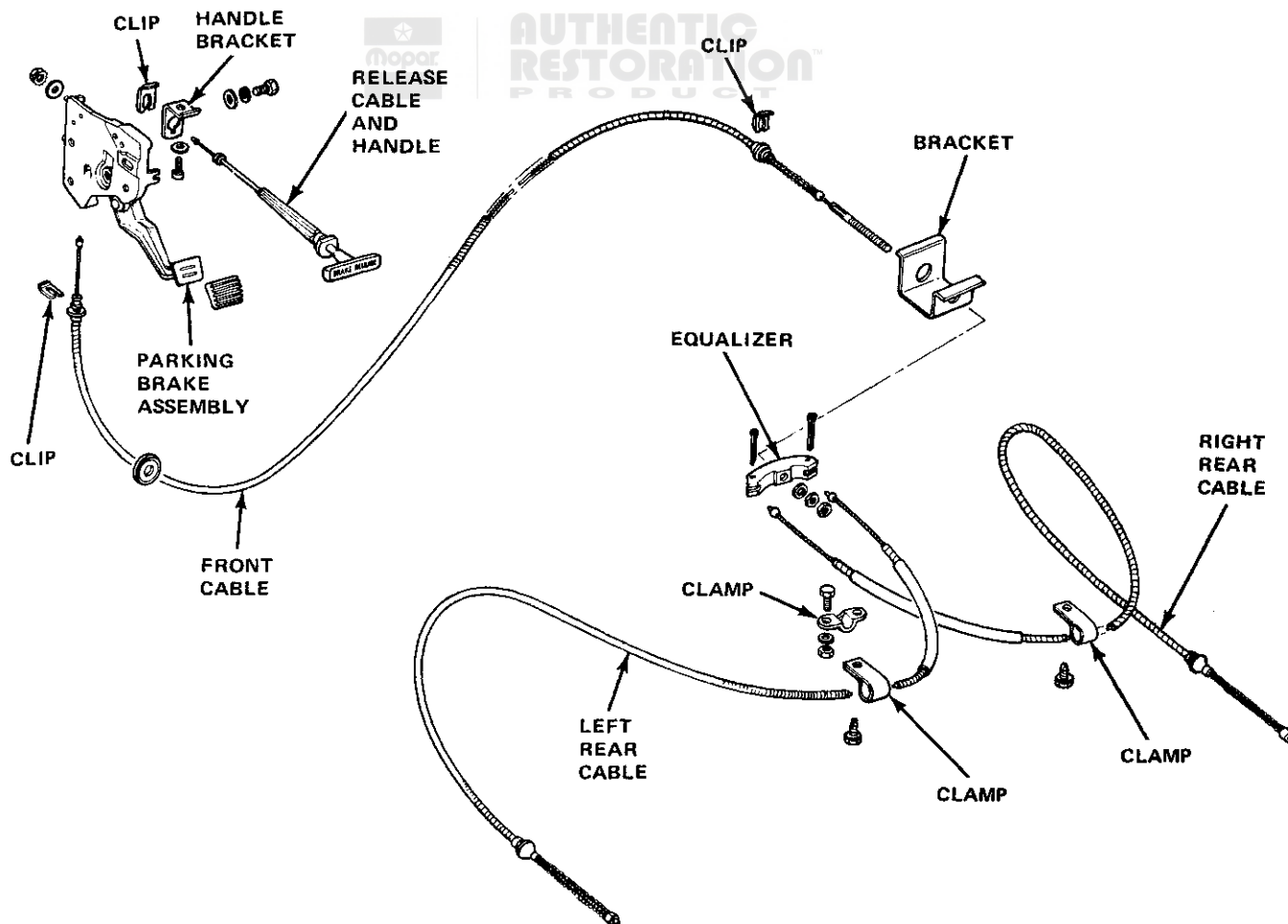
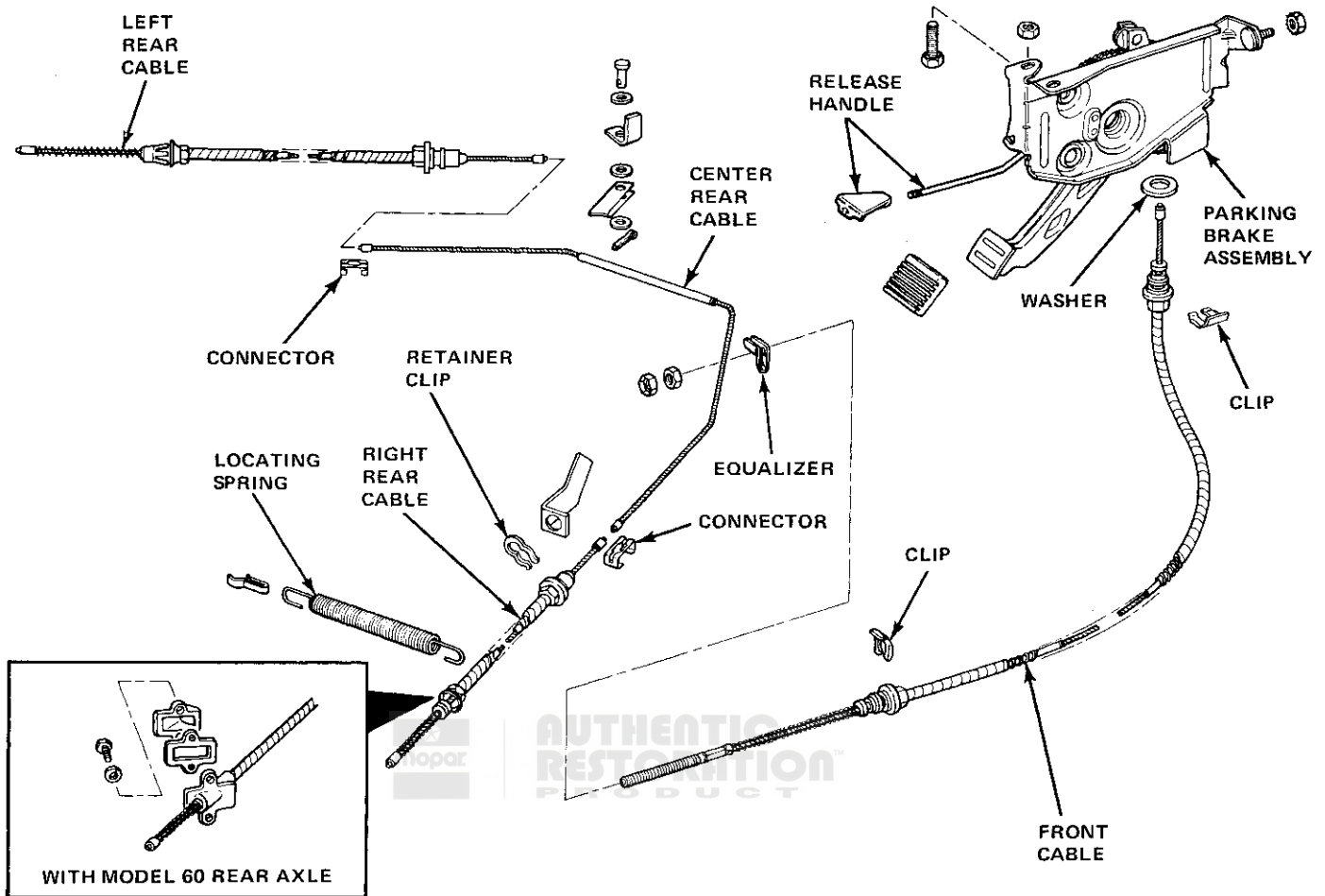


Fig. 2G-3 Parking Brake Assembly—CJ Models





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Fig. 2G-4 Parking Brake Assembly—Cherokee-Wagoneer-Truck Models

- (6) Tighten equalizer locknuts securely.
- (7) Check parking brake operation.

**PARKING BRAKE CABLES**

**Removal—Rear Cable**

- (1) Raise vehicle.
- (2) Loosen cable adjuster locknuts at equalizer (fig. 2G-2 and 2G-3).
- (3) On CJ models, remove necessary cable locating clamps, remove cotter pin retaining cable in equalizer, and remove cable end from equalizer (fig. 2G-3).
- (4) On Cherokee, Wagoneer and Truck models, disengage cable from connector attached to center cable.
- (5) On Cherokee, Wagoneer and Truck models, if left cable is being removed, remove fuel tank skid plate.
- (6) Remove clip retaining cable in frame bracket and unhook locating spring from cable (fig. 2G-4).
- (7) Disassemble necessary rear drum brake unit as outlined in this chapter.
- (8) On all vehicles except those with Model 60 rear axle, compress cable lock tabs at brake support plate

using small hose clamp and remove cable. On vehicles with Model 60 rear axle, remove bolts attaching cable mounting bracket to support plate and remove cable.

**Installation—Rear Cable**

- (1) On all vehicles except those with Model 60 rear axle, insert cable in support plate and pull cable through plate until cable lock tabs engage in support plate.
- (2) On vehicles with Model 60 rear axle, insert cable end through support plate, position cable mounting bracket on support plate, and install mounting bracket attaching bolts.
- (3) Reassemble rear drumbrake unit as outlined in this chapter.
- (4) On CJ models, engage cable end in equalizer, install cable retaining cotter pin, and install necessary cable locating clamps.
- (5) On Cherokee, Wagoneer and Truck models, engage cable end in center cable connector.
- (6) Insert cable in frame bracket, install cable-to-bracket retainer clip in cable ferrule, and engage cable end in center cable connector.

(7) On Cherokee, Wagoneer and Truck models, install fuel tank skid plate if removed.

(8) Tighten cable adjuster locknuts and adjust parking brakes as outlined in this chapter.

(9) Lower vehicle.

### Removal—Front Cable

(1) Raise vehicle.

(2) Remove equalizer from front cable.

(3) On CJ models, remove clip retaining cable to frame bracket.

(4) On Cherokee, Wagoneer and Truck models, remove clip retaining cable to rear crossmember.

(5) Lower vehicle.

(6) Disconnect front cable return spring at parking brake lever assembly if equipped.

(7) Roll carpet back and remove front cable ferrule-to-parking brake lever assembly retaining clip.

(8) Disengage cable end from parking brake lever assembly.

(9) Remove cable.

(10) If cable is to be replaced, remove insulator or grommet from lever end of cable.

### Installation—Front Cable

(1) Install front cable through floorpan and install cable grommet or insulator in floorpan.

(2) Install cable ferrule-to-parking brake lever assembly retaining clip and reposition carpet.

(3) Engage cable end in parking brake lever assembly and install cable return spring if equipped.

(4) On CJ models, install clip retaining cable to frame bracket.

(5) On Cherokee, Wagoneer and Truck models, install clip retaining cable to rear crossmember.

(6) Raise vehicle.

(7) Install cable equalizer and locknuts. On CJ models, be sure cable is properly positioned in frame bracket as well as equalizer (fig. 2G-3).

(8) Adjust parking brakes as outlined in this section.

(9) Lower vehicle.

### BRAKELAMP SWITCH

The brakelamp switch is mounted on a flange attached to the brake pedal support bracket (fig. 2G-2). A spring-loaded plunger in the switch opens and closes the stoplamp circuit.

When the brake pedal is in the released position, the pedal arm contacts the switch plunger, holding it in the off position. When the brake pedal is pressed, the spring loaded plunger extends with brake pedal movement until the switch is in the On position.

### Brakelamp Switch Adjustment

(1) On CJ models with air conditioning, remove screws attaching evaporator housing to instrument panel and move housing away from panel.

(2) Press and hold brake pedal in applied position.

(3) Push brakelamp switch through mounting bracket until it stops against brake pedal bracket.

(4) Release brake pedal to set switch in proper position.

(5) Check switch position. Switch plunger should be in On position and activate brakelamps after  $\frac{3}{8}$  to  $\frac{5}{8}$  inch (9.52 to 15.87 mm) brake pedal travel. Measure pedal travel from center of brake pedal pad.

(6) On CJ models with air conditioning, reposition evaporator housing on panel and install housing attaching screws.

### SERVICE BRAKE ADJUSTMENT

The rear drum brakes are the only adjustable service brakes on Jeep vehicles. If the rear brakes are disassembled for any reason, an initial adjustment must be performed before installing the drum. In addition, if diagnosis indicates the need, the rear brakes can be adjusted manually as follows:

(1) To perform initial adjustment with drums removed, use Brakeshoe-to-Drum Clearance Gauge J-21107-01 to preset brake lining adjustment (fig. 2G-5). Drums should fit over brake lining with slight drag.

(2) To manually adjust rear brakes with drums in place, proceed to next step.

(3) Remove access slot covers from brake support plates.

(4) Rotate adjusting screw in clockwise direction using brake adjusting tool until brakes are locked.

(5) Rotate adjuster screw in counterclockwise direction until wheel rotates freely (fig. 2G-6).

**CAUTION:** *The automatic adjuster lever must be disengaged from the adjuster screw before the screw can be rotated. Use a thin blade screwdriver or section of 1/8 welding rod to unseat the adjuster lever (fig. 2G-6).*

(6) Install access slot cover in brake support plate.

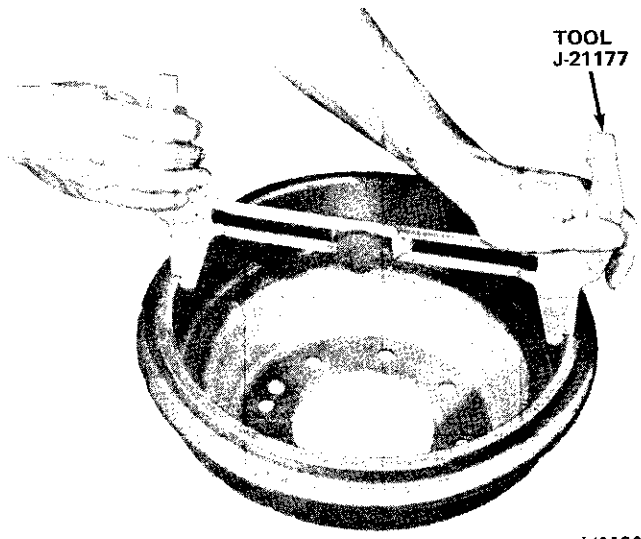
(7) Check brake operation before moving vehicle.

(8) Complete rear brake and pedal travel adjustment by driving vehicle in reverse and making 10 to 15 firm brake applications. Make one forward brake application between each reverse application to equalize adjustment.

### BRAKELINING INSPECTION

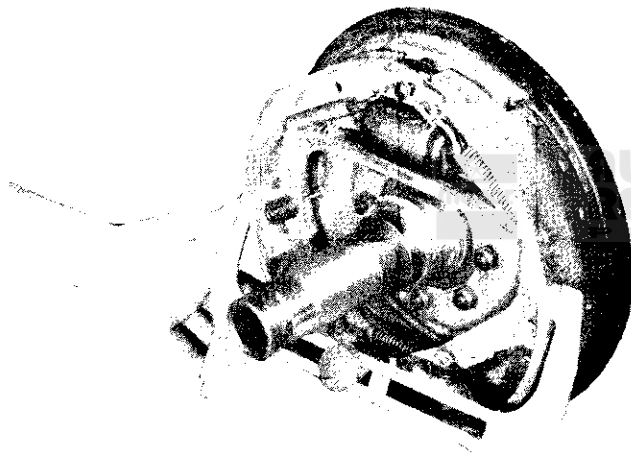
#### Disc Brakes

The brakelining should be inspected whenever the wheels are removed for tire rotation or at the intervals specified in the Maintenance Schedule.



VIEW A

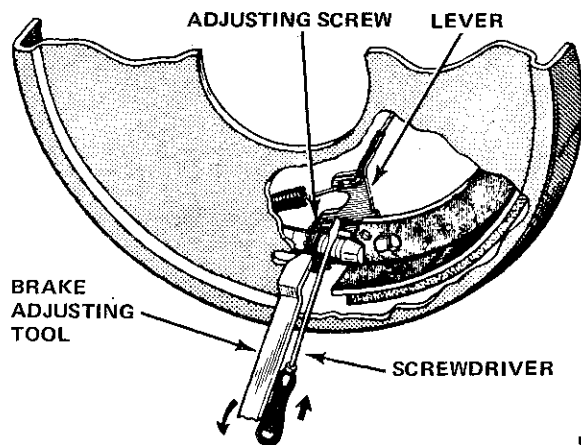
J41138



VIEW B

J41139

Fig. 2G-5 Presetting Brakeshoe-To-Drum Clearance



J42292

Fig. 2G-6 Adjusting Drum Brakes Manually

It is not necessary to remove the front calipers for brakelining inspection. The outboard lining can be viewed from either end of the caliper and the inboard lining can be viewed through the inspection port in the caliper body (fig. 2G-7). The lining should be replaced when it has worn to the approximate thickness of the metal brakeshoe.

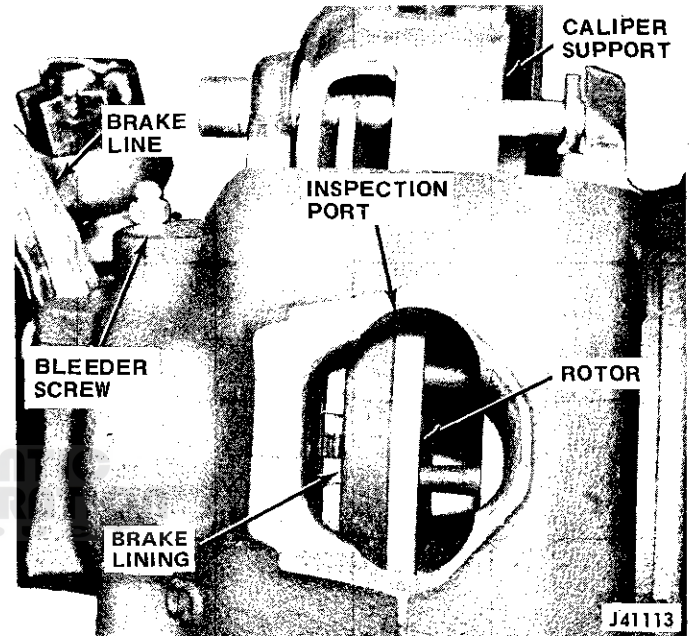


Fig. 2G-7 Caliper Inspection Port

**NOTE:** The disc brakeshoes used on Cherokee, Wagoneer and Truck models have a wear sensor attached to the inboard brakeshoe. When the lining wears sufficiently, the sensor contacts the rotor making a high pitched noise to warn the driver that replacement is necessary.

### Drum Brakes

Inspect the rear drum brakelining whenever the rear wheels and drums are removed or at the intervals specified in the Mechanical Maintenance Schedule. Bonded linings should be replaced whenever the lining has worn to a thickness of 1/16 inch (1.58 mm) or less. Riveted linings should be replaced whenever the lining has worn to within 1/32 inch (0.79 mm) of the rivet heads.

**SPECIFICATIONS**

**Brake Size and Application Chart**

Model	Master Cylinder Bore Diameter	Front Brakes		Rear Brakes		Power Brake Unit Type
		Brake Size And Type	Caliper Piston Diameter	Brake Size And Type	Wheel Cyl. Diameter	
CJ	1.00 (25.4 mm)	11.7 Disc. (29.7 cm)	2.6 Single Piston (6.60 cm)	10 x 1.75 Drum (25.4 x 4.44 cm)	.875 (22.2 mm)	8.00 Single Diaphragm (20.3 cm)
Cherokee Wagoneer	1.125 (28.5 mm)	12.0 Disc. (30.48 cm)	2.937 Single Piston (7.45 cm)	11 x 2 Drum (27.94 x 5.08 cm)	.937 (23.79 mm)	9 1/2 Single Diaphragm (24.13 cm)
J-10 Truck	1.125 (28.5 mm)	12.0 Disc. (30.48 cm)	2.937 Single Piston (7.45 cm)	11 x 2 Drum (27.94 x 5.08 cm)	.937 (23.79 mm)	9 1/2 Single Diaphragm (24.13 cm)
J-20 Truck 6800 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)
J-20 Truck 7600 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)
J-20 Truck 8400 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)

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**Torque Specifications**

	USA (ft.-lbs.)		Metric (N-m)	
	Service Set - to Torque	In - Use Recheck Torque	Service Set - to Torque	In - Use Recheck Torque
Brakeline-to-Caliper Fitting Bolt (Cke, Wag, Trk) . . . . .	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Bleeder Screw (1/4 - 28) . . . . .	45 in-lbs.	40 - 50 in-lbs.	5	5 - 6
Bleeder Screw (3/8 - 24) . . . . .	90 in-lbs.	40 - 140 in-lbs.	10	5 - 16
Brake Support Plate Mounting Bolts/Nuts (J-20 Trk) . . . . .	50	45 - 55	68	61 - 75
Brake Support Plate Mounting Bolts/Nuts (Cke, Wag, J10 Trk) . . . . .	45	35 - 55	61	47 - 75
Brake Support Plate Mounting Bolts/Nuts (CJ) . . . . .	33	30 - 35	45	41 - 47
Caliper Anchor Bracket to Steering Knuckle (CJ) . . . . .	85	75 - 95	115	102 - 129
Master Cylinder Mounting Bolts/Nuts . . . . .	30	25 - 35	41	34 - 47
Master Cylinder-to-Power Unit Mounting Nuts . . . . .	25	20 - 30	34	27 - 41
Power Brake Unit-to-Dash Mounting Bolts/Nuts . . . . .	22	18 - 25	30	24 - 34
Brake Line-to-Caliper Fitting Bolt (CJ) . . . . .	25	20 - 30	34	27 - 41
Brake Line-to-Wheel Cylinder Fitting . . . . .	160 in-lbs.	120 - 200 in-lbs.	.18	14 - 23
Parking Brake Cable Clamp-to-Support Plate Bolts (5/16 - 18) . . . . .	10	8 - 12	14	11 - 16
Wheel Nuts (CJ) . . . . .	75	65 - 90	102	88 - 122
Wheel Nuts (Cke, Wag, Trk) . . . . .	75	65 - 80	102	88 - 108
Wheel Nuts (8400 GVW Trk) . . . . .	130	110 - 150	176	149 - 203
Brake Pedal-to-Power Unit Push Rod Bolt/Nut . . . . .	35	25 - 40	47	34 - 54
Caliper Mounting Bolts (Cke, Wag, Trk) . . . . .	35	30 - 40	47	41 - 54
Caliper Support Key Retaining Screw (CJ) . . . . .	15	15 - 18	20	20 - 24
Disc. Brake Shield Bolts (Cke, Wag, Trk) . . . . .	8	5 - 10	11	7 - 14
Disc. Brake Shield Nuts (Cke, Wag, Trk) . . . . .	35	30 - 40	47	41 - 54
Wheel Bearing Outer Locknut (All) . . . . .	50(min.)		68 (min.)	
Wheel Bearing Inner Locknut (Bearing Adjuster):				
CJ . . . . .	Tighten to 50 ft.-lbs. (68 N-m) and back off 1/3 turn while rotating wheel.			
Cke, Wag, Trk . . . . .	Tighten to 50 ft.-lbs. (68 N-m), loosen and retighten to 35 ft.-lbs. (47 N-m), then back off 1/3 turn - all while rotating wheel.			

# BRAKE HYDRAULIC SYSTEM

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Brake Fluid	2G-20
Brake Fluid Level	2G-21
Combination Valve	2G-24
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## GENERAL

The brake hydraulic system consists of the dual reservoir master cylinder, combination valve, front disc brake calipers, rear drum brake wheel cylinders, and the connecting brake lines, hoses, and fittings (fig. 2G-8).

The hydraulic system is a closed system and must remain free of contaminants in order to function properly. When servicing the system, prevent the entry of contaminants by capping all lines and ports, and by avoiding the use of cleaning solvents that have a mineral oil base.

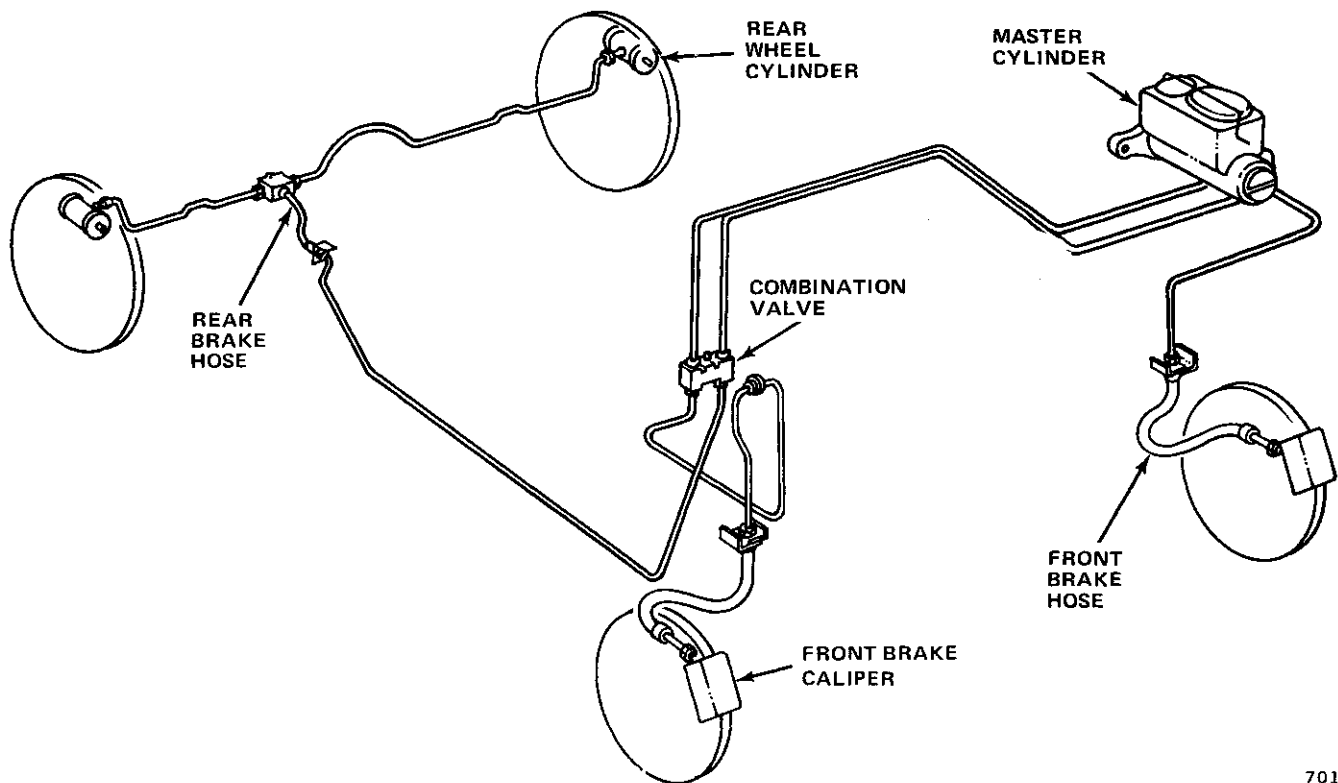
**CAUTION:** *Never use gasoline, kerosene, carbon tetrachloride, paint thinner, alcohol, or any similar fluid containing mineral oil, to clean or lubricate hydraulic*

*system components. These materials will cause swelling, deterioration, and premature aging of rubber parts. Use brake fluid or brake cleaning solvent only.*

To determine if dirt, moisture, or mineral oil base fluids have contaminated the hydraulic fluid, drain off a sample and check for suspended particles, discoloration, or separation of the fluid into distinct layers. Layering indicates the presence of water or mineral oil. If system contamination should occur, drain and flush the entire brake hydraulic system with an approved brake fluid only.

## BRAKE FLUID

When refilling or adding brake fluid to the hydraulic



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Fig. 2G-8 Brake Hydraulic System (Typical)

system, use Jeep Brake Fluid or equivalent grade marked SAE J1703 or DOT 3 only. Do not use any brake fluid that does not have these grade markings. The use of nonapproved fluids can result in low fluid levels, spongy pedal, fluid aeration, brake fade, and deterioration of brake system components.

**CAUTION:** *Never refill or add used or reclaimed brake fluid to the hydraulic system.*

## BRAKE FLUID LEVEL

The master cylinder fluid level should be checked at least four times a year or every 5,000 miles (8 046 km). Refer to the Maintenance Schedule for details.

When refilling or adding fluid to the system, fill the master cylinder fluid reservoirs to within 1/4 inch (6.35 mm) of each reservoir rim. This is the proper fluid level for all Jeep vehicles.

When checking the fluid level, also inspect the rubber diaphragm seal on the cylinder cover for cracks, cuts, distortion, or any other condition that might allow air or foreign material to enter the master cylinder reservoirs. In addition, when the cover is removed for any reason, do not allow the seal to contact dirt, grease, or other foreign material which could be transferred to the fluid reservoirs.

## HYDRAULIC SYSTEM INSPECTION

- (1) Clean master cylinder and cylinder cover thoroughly before checking fluid level.
- (2) Check master cylinder cover retaining spring for proper tension and fit. Spring should provide enough tension on cover to maintain airtight seal.
- (3) Remove cylinder cover and inspect cover and rubber diaphragm seal for cracks and distortion.
- (4) Check master cylinder fill level.
- (5) Check for dirt and foreign material in reservoirs. If fluid contamination is suspected, drain fluid sample into clean glass container and test for contamination as evidenced by fluid layering.
- (6) Inspect all fittings and brake lines for leakage, kinks, or other damage.
- (7) Inspect condition of front brake hoses. Replace hoses if cut, cracked, swollen, or leaking.
- (8) Check for evidence of fluid leakage at rear wheel cylinders and front calipers. Repair as necessary.

## MASTER CYLINDER

A dual reservoir master cylinder is used on all Jeep vehicles. The hydraulic system for the front brakes is completely separate from the rear brakes. In the event of hydraulic brake failure in the front system, the rear hydraulic brakes will still operate. If a failure occurs in the rear brakes, the front brakes will still operate.

The dual master cylinder has two outlet ports, two fluid reservoirs, and two hydraulic pistons which are operated in tandem by a single push rod.

When the master cylinder fluid reservoirs are filled and the front and rear brake systems purged of air, there is a solid column of fluid on the forward side of both the primary and secondary pistons.

During brake application, fluid is displaced by the master cylinder pistons into the front caliper and rear wheel cylinders to activate the brakes. At brake release, fluid returns from the calipers and wheel cylinders to the master cylinder reservoirs.

## Master Cylinder Service—All Models

### Removal

- (1) Disconnect brake lines at master cylinder. Cap or tape outlet ports in master cylinder and open ends of brake lines to prevent entry of dirt.
- (2) On models with nonpower brakes, disconnect master cylinder push rod at brake pedal.
- (3) Remove bolts or nuts attaching master cylinder to dash panel or power unit and remove master cylinder.

### Disassembly

- (1) Remove cover and diaphragm seal and drain fluid from master cylinder. Mount master cylinder in vise.
- (2) On models with power brakes, push primary piston inward using wooden dowel and remove piston snap ring (fig. 2G-9 and 2G-10).
- (3) On CJ models with nonpower brakes, slide boot to rear of push rod. Push primary piston inward (with push rod) and unseat piston snap ring. Remove push rod, boot, snap ring, washer, and push rod retainer as assembly (fig. 2G-9).
- (4) Remove and discard primary piston assembly. It is not necessary to disassemble primary piston. It is supplied as complete assembly in overhaul kit.
- (5) Remove secondary piston assembly. To ease piston removal, apply compressed air through compensator port in front reservoir.
- (6) Remove and discard piston seal and piston cups from secondary piston.
- (7) Clean and inspect master cylinder. Replace unit

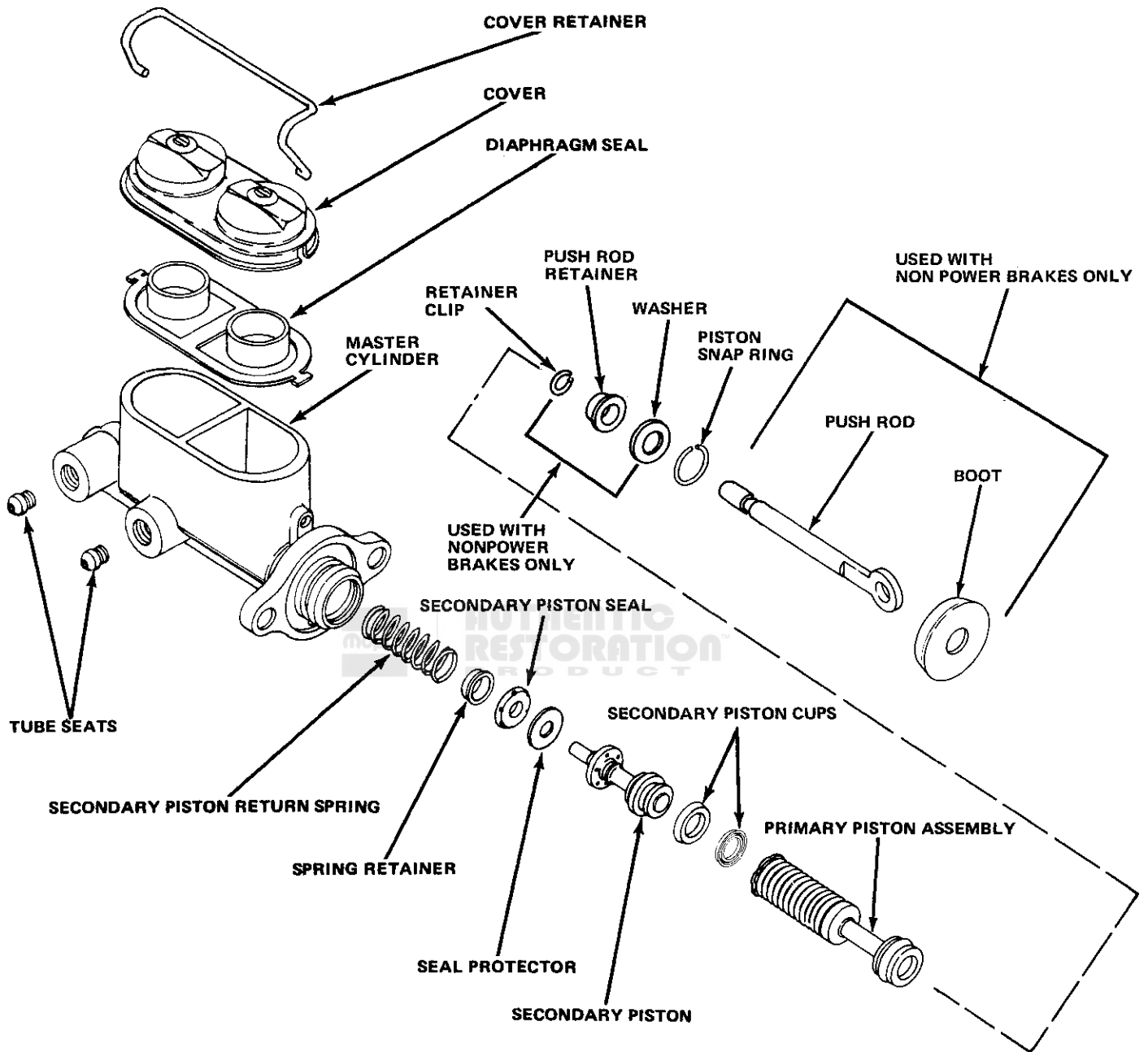


Fig. 2G-9 Master Cylinder—CJ Models

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if bore is severely scored, corroded, or pitted, or if body is cracked, porous, or has sustained other damage. Check compensator and bypass ports in reservoirs. If plugged or dirty, open them using brake cleaning solvent and air pressure only. Never use wire to open ports as wire may raise burr in port and push burr into cylinder bore.

**CAUTION:** Clean the master cylinder with brake fluid or an approved brake cleaning solvent only. Never use solvents containing mineral oil such as gasoline, kerosene, alcohol, or carbon tetrachloride. Mineral oil is very harmful to the rubber piston cups and seals.

(8) Inspect tube seats in outlet ports. Replace seats only if cracked, scored, cocked in bore, or loose. If replacement is necessary, remove seats as follows:

(a) On Cherokee, Wagoneer, and Truck models, thread 6-32 x 5/8 self-tapping screw into tube seat. Pry upward on screw using two screwdrivers to remove seat. Remove chips using brake cleaning solvent.

(b) On CJ models, enlarge hole in tube seats using 13/64 drill. Place flat washer on each outlet port and thread 1/4-20 x 3/4 screw into seat. Tighten screw until seat is loosened. Remove seat, screw, and washer. Remove chips using brake cleaning solvent and compressed air.

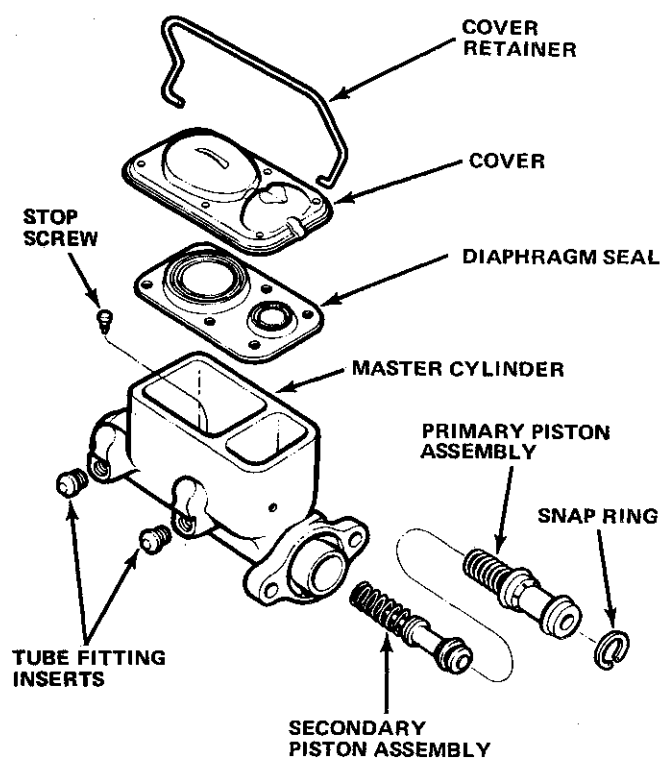


Fig. 2G-10 Master Cylinder  
Cherokee-Wagoneer-Truck Models

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### Assembly

(1) Install replacement tube seats (if removed) using spare tube fitting nuts to press seats into place. Do not allow seats to become cocked during installation. Be sure seats are bottomed. Remove tube fitting nuts and check for burrs or chips. Remove burrs or chips. Rinse master cylinder in brake cleaning solvent and blow out all passages with compressed air.

(2) Install piston cups on secondary piston. Piston cup installed in groove at end of piston should have lip facing away from piston. Install next cup so lip faces piston (fig. 2G-9 and 2G-10).

(3) Install seal protector, piston seal, spring retainer, and return spring on secondary piston (fig. 2G-9 and 2G-10). Install piston seal so lip faces interior of master cylinder bore when assembly is installed. Be sure return spring seats against retainer and that retainer is located inside lip of piston seal.

(4) Lubricate master cylinder bore and secondary piston seal and cups with clean brake fluid and install secondary piston assembly in cylinder bore.

(5) Lubricate seals on new primary piston assembly with clean brake fluid and install assembly in master cylinder bore.

(6) On models with power brakes, press primary piston inward using wooden dowel and install piston snap ring in groove of master cylinder bore.

(7) On CJ models with nonpower brakes, press

primary piston inward (using push rod) and install piston snap ring in groove of master cylinder bore.

(8) On CJ models with nonpower brakes, install boot if removed.

(9) Install replacement diaphragm seal on master cylinder cover.

### Installation

(1) Position master cylinder on dash panel or power unit and install attaching nuts and washers. Tighten nuts to 30 foot-pounds (41 N•m) torque.

(2) Connect brake lines to master cylinder.

(3) Fill master cylinder reservoirs to within 1/4 inch (6.35 mm) of rim with Jeep Brake Fluid or equivalent grade marked SAE J-1703 or DOT 3.

(4) Install cover and diaphragm seal.

(5) On models with nonpower brakes, connect push rod to brake pedal.

(6) Bleed entire brake system as outlined under Brake Bleeding.

### WHEEL CYLINDER

The rear drum brake wheel cylinder consists of a cast iron housing with a piston bore machined in it. Two opposed pistons, rubber piston cups, and a compression spring with integral cup expanders are contained within the piston bore (fig. 2G-11). Rubber dust boots are installed at each end of the cylinder to prevent entry of dirt and water. Each cylinder is equipped with a bleeder screw to facilitate brake bleeding.

The compression spring is used to hold the piston cups tightly against the pistons and the integral cup expanders hold the piston cups tightly against the walls of the piston bore. The expanders prevent air from being drawn past the cups and into the hydraulic system when the brakes are released.

### Removal

(1) Remove wheels, brakedrums, and brakeshoes. Refer to Drum Brake Section for procedure.

(2) Disconnect brake line at wheel cylinder. Do not bend line away from cylinder. When cylinder is removed, line will separate from cylinder easily.

(3) Remove cylinder-to-support plate bolts and remove cylinder.

### Overhaul

(1) Remove brakeshoe links and dust boots.

(2) Push pistons, piston cups, and compression spring and expanders out of piston bore. Discard piston cups, they are not reusable.

(3) Clean all cylinder components using brake cleaning solvent or brake fluid only.



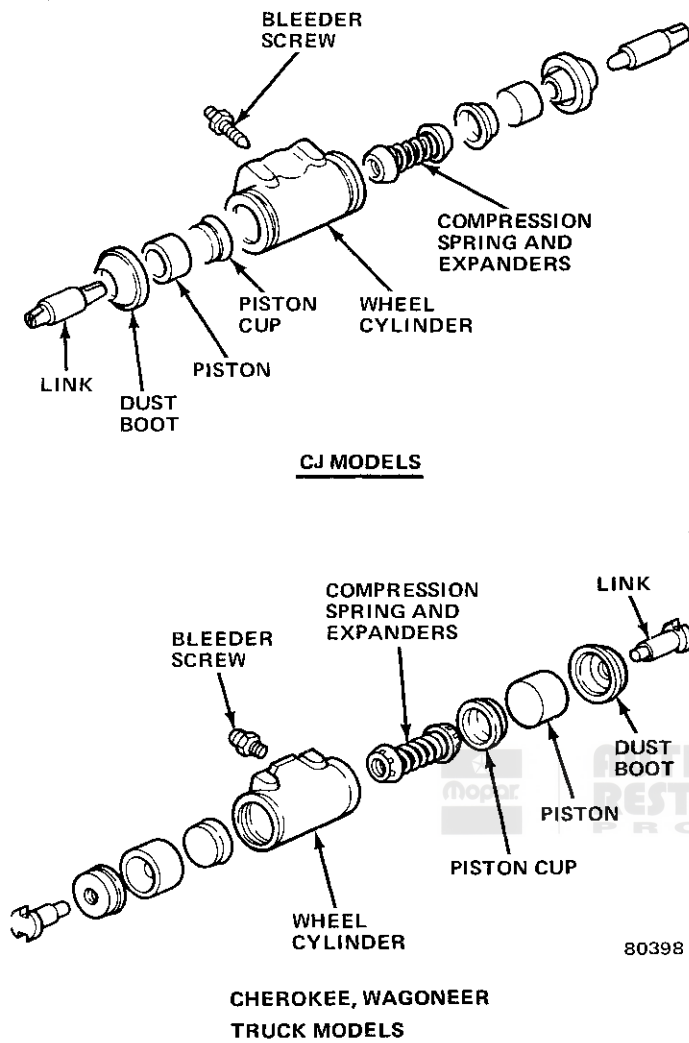


Fig. 2G-11 Wheel Cylinder

**CAUTION:** Do not clean brake parts with solvents containing mineral oil such as gasoline, carbon tetrachloride, kerosene, alcohol, paint thinner or similar fluids. Mineral oil causes swelling, deterioration, and premature aging of all rubber parts in the hydraulic system. Use clean brake fluid or an approved brake cleaning solvent only.

(4) Inspect wheel cylinder and pistons. Replace cylinder if bore or pistons are scored, corroded, rusted, pitted, worn, or cracked. If bore or pistons are only discolored, or stained, polish bore or pistons lightly using crocus cloth only. Do not polish cylinder bore in lengthwise direction, polish by rotating cylinder around crocus cloth supported on fingers.

**CAUTION:** Do not hone the wheel cylinders at any time or for any reason.

(5) Inspect bleeder screw and screw threads in cylinder. Screw must turn freely. Replace screw if damaged or replace cylinder if cylinder threads are damaged.

(6) Inspect compression spring and integral expanders. Replace spring if broken, distorted, lacks tension, or if expanders are damaged in any way.

(7) Inspect rubber dust boots. Replace boots if cut, torn, cracked, distorted.

(8) If cylinder bore or pistons were polished, clean them using brake fluid or brake cleaning solvent and dry using compressed air.

(9) Lubricate cylinder bore and all cylinder internal components with new brake fluid. Do not lubricate dust boots. Install them dry only.

(10) Position replacement piston cups on compression expanders and install assembled parts in cylinder bore. Be sure expanders are seated in piston cups and that cups are installed with lips facing one another and toward interior of cylinder bore.

(11) Install pistons in cylinder bore. Be sure pistons are installed with flat sides facing interior of bore.

(12) Install dust boots.

**Installation**

(1) Clean wheel cylinder mounting surface of support plate.

(2) Clean brake line fitting and threads.

(3) Start brake line fitting into cylinder. Do not tighten fitting completely.

(4) Position cylinder on support plate and install cylinder mounting bolts. Tighten bolts to 18 foot-pounds (24 N•m) torque.

(5) Insert brakeshoe connecting links through dust boots and into into pistons.

(6) Install Wheel Cylinder Clamp Tool J-8002 over cylinder to retain internal components in cylinder.

(7) Tighten wheel cylinder brake line fitting.

**COMBINATION VALVE**

A three-function combination valve is used on all Jeep models. The valve consists of a one-piece housing containing a front brake metering valve, a pressure differential warning valve, and a rear brake proportioning valve. The combination valve also serves as the junction block for the front brakes.

Two different combination valves are used. Some models may be equipped with the type-W valve (fig. 2G-12), while other models may be equipped with the type-D valve (fig. 2G-13). Although the two valve types differ in external appearance and in internal component design, valve function and operation is the same for both.

Combination valve location is the same for all models. The valve is mounted on the inner side of the left frame rail adjacent to the transmission (fig. 2G-14).

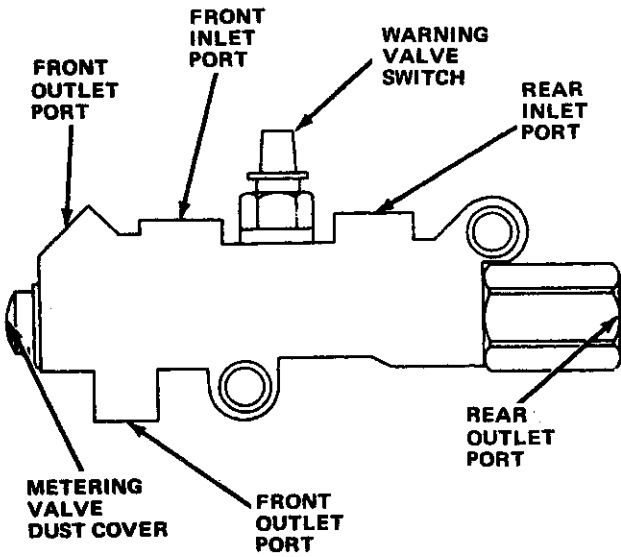


Fig. 2G-12 Type-W Combination Valve

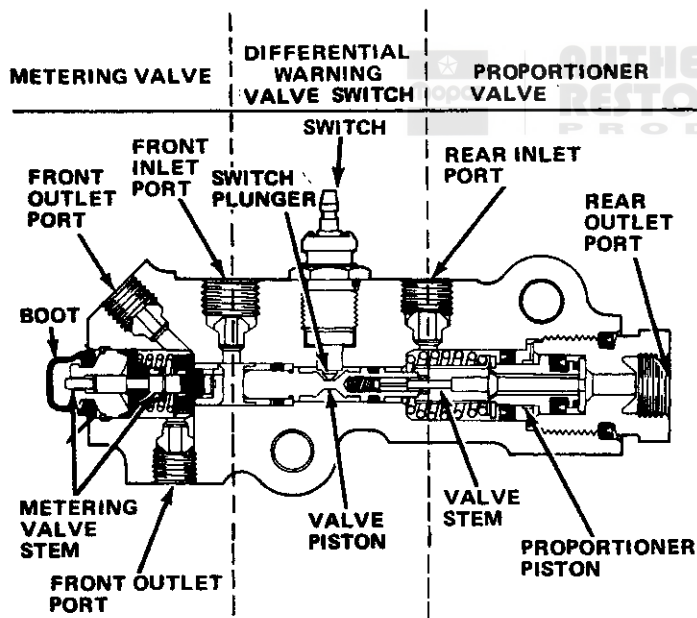


Fig. 2G-13 Type-D Combination Valve

**Combination Valve Operation**

The front brake metering valve assists in providing balanced front-to-rear braking. To accomplish this, the metering valve holds off (delays) full hydraulic fluid pressure to the front disc brakes until the rear drum brakes overcome return spring tension and the linings contact the drums.

When the brakes are not applied, the metering valve permits the free flow of brake fluid. This feature allows the fluid to expand and contract with changes in temperature.

When bleeding the front disc brakes, the metering valve stem must be held out using tool J-26869 on type-W valves or tool J-23709 on type-D valves. Refer to Brake Bleeding for specific details regarding tool use.

The pressure differential warning valve activates the brake warning lamp if a pressure loss in the front or rear hydraulic system should ever occur. This feature is provided as a method for alerting the driver if such a system malfunction ever occurs.

The valve consists of a valve piston, and plunger-type switch. If a pressure loss in either system occurs, a

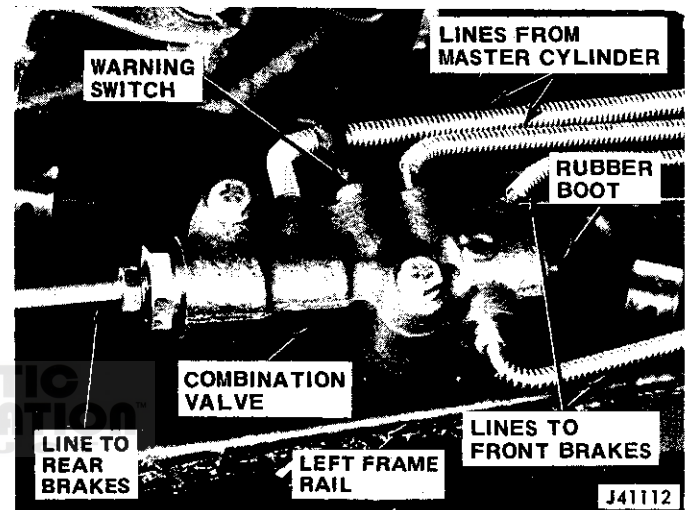


Fig. 2G-14 Combination Valve Location (Type-D Valve Shown)

pressure differential of 70 to 300 psi (483 to 2 068 kPa) will cause the piston to shuttle toward the low pressure side of the valve. As the piston moves, ramps on the piston force the switch contact plunger upward closing the switch contacts. This action completes the electrical circuit between the switch and brake warning lamp causing the light to illuminate. Unless the lock cylinder is turned to the Off position, the warning light will remain illuminated until the cause of the malfunction is corrected and the valve recentered.

**NOTE:** The type D and W combination valves are hydraulic self-reset types which do not require manual recentering.

The rear brake proportioning valve provides balanced front-to-rear braking action during high pedal pressure stops. During light pedal pressure application, the proportioner does not operate. Brake fluid normally flows through the proportioner valve and into the rear brake wheel cylinders. Spring pressure on the valve piston holds it against the piston stop plate for normal brake pressures.

**Combination Valve Service**

The combination valve is not repairable. If any section of the valve is found defective, the entire valve assembly must be replaced.

**BRAKE BLEEDING**

**General**

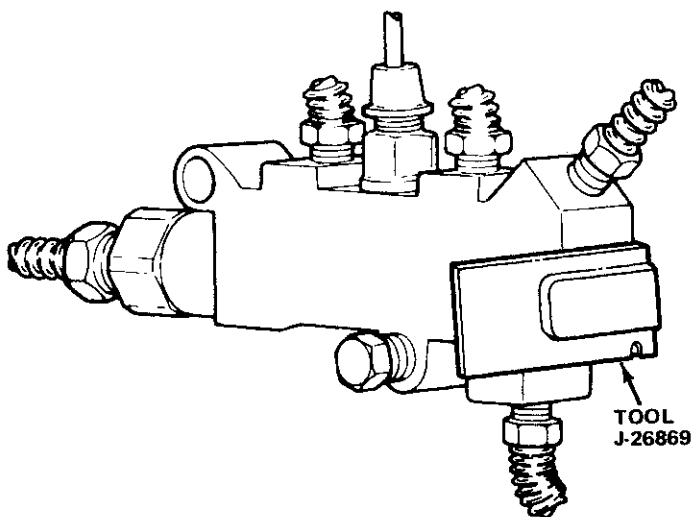
The brake hydraulic system must be purged of air whenever a line has been disconnected or if air has entered the system.

In most cases, it will be necessary to bleed only that portion of the hydraulic system (front or rear) being serviced. However, if a firm brake pedal cannot be obtained, or if diagnosis indicates the need, the entire system must be bled.

Brake bleeding can be performed manually or with pressure equipment. Bleeder screws are provided at the calipers and wheel cylinders to simplify the bleeding procedure.

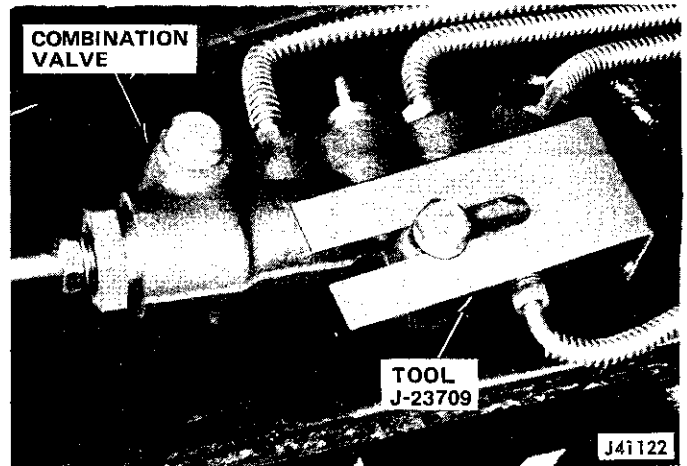
**Manual Bleeding Procedure**

- (1) Remove all accumulated dirt from master cylinder and cover.
- (2) Remove master cylinder cover.
- (3) Fill master cylinder if required and install cover.
- (4) On vehicles equipped with type-W combination valve, remove dust cover from metering valve stem and install tool J-26869 on stem to hold valve open (fig. 2G-15).



**Fig. 2G-15 Metering Valve Tool Installation  
Type-W Combination Valve**

- (5) On vehicles equipped with type-D combination valve, loosen valve front mounting bolt and insert slotted end of tool J-23709 under bolt. Push metering valve stem inward (using tool) to hold valve open and tighten mounting bolt to secure tool (fig. 2G-16).



**Fig. 2G-16 Metering Valve Tool Installation  
Type-D Combination Valve**

- (6) Bleed brake system in following sequence:
  - (a) right rear wheel
  - (b) left rear wheel
  - (c) right front wheel
  - (d) left front wheel
  - (e) master cylinder brake line connections

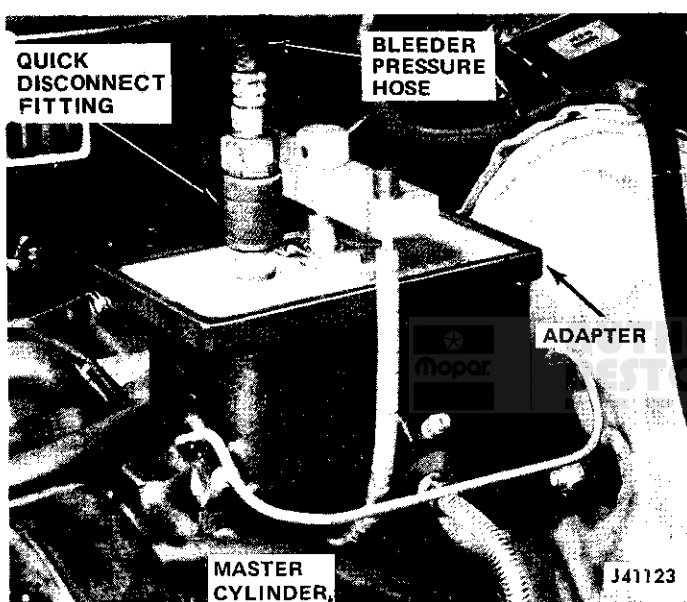
**NOTE:** Correct bleeding procedure is as follows: Place wrench on bleeder screw. Install rubber hose on screw with free end of hose **submerged** in a transparent container partially filled with clean brake fluid. Open bleeder screw 3/4 turn. Have helper depress brake pedal. Close bleeder screw before pedal reaches end of travel. Have helper pump up pedal each time bleeder screw is closed to ensure a good surge of fluid when the screw is reopened. Repeat bleeding process until fluid comes out in a solid stream without the presence of air bubbles.

**CAUTION:** Do not allow the supply of fluid in the master cylinder to become exhausted. Check the fluid level frequently while bleeding and refill as required. Do not bleed two wheels at a time and do not bleed the system with the front calipers or rear drums not in place.

- (7) Remove master cylinder cover and refill as required. Fill reservoir to within 1/4 inch (6.35 mm) of reservoir rim. Install cover. Make sure cover retainer is in place.
- (8) Remove metering valve tool.
- (9) Test brake operation before moving vehicle.

**Pressure Bleeding Procedure**

- (1) Remove all accumulated dirt from master cylinder and cover.
- (2) Remove cover and rubber diaphragm seal. Place cover on work bench or on lint-free cloth. Do not allow diaphragm seal to contact dirt or foreign material.
- (3) Fill master cylinder if required.
- (4) Install brake bleeder adapter cover on master cylinder (fig. 2G-17).



**Fig. 2G-17 Pressure Bleeder Adapter Installation (Typical)**

- (5) Connect hose from pressure bleeder to fitting on adapter and open pressure bleeder release valve.

- (6) On vehicles with type-W combination valve, remove dust cover from metering valve stem and install tool J-26869 on stem to hold valve open (fig. 2G-15).

- (7) On vehicles equipped with type-D combination valve, loosen valve front mounting bolt and insert slotted end of tool J-23709 under bolt. Push metering valve stem inward (using tool) to hold valve open and tighten mounting bolt to secure tool (fig. 2G-16).

- (8) Bleed brake system in following sequence:
  - (a) right rear wheel
  - (b) left rear wheel
  - (c) right front wheel
  - (d) left front wheel
  - (e) master cylinder brake line connections

**NOTE:** When using pressure equipment, the bleeding procedure is the same as outlined in the Manual Bleeding Procedure except that a helper is not required to apply the brake pedal. The pressure bleeder develops enough system pressure to permit bleeding without the use of the brake pedal.

- (9) When system has been purged of all air, turn off pressure bleeder and close bleeder fluid release valve.

- (10) Disconnect pressure bleeder hose at adapter fitting and remove master cylinder cover adapter.

- (11) Refill master cylinder reservoirs to within 1/4 inch (6.35 mm) of reservoir rims.

- (12) Install cover and rubber diaphragm seal. Make sure cover retainer is in place.

- (13) On vehicles equipped with type-W combination valve, remove tool J-26869 from metering valve stem and install dust cover. On vehicles equipped with type-D combination valve, loosen valve front mounting bolt, remove tool J-23709, and retighten mounting bolt.

- (14) Test brake operation before moving vehicle.

**SPECIFICATIONS**

**Fluid Specifications**

Brake Fluid .....	Use Jeep brake fluid or equivalent marked DOT 3 or SAE J-1703 only.
Brake Fluid Level .....	Fill master cylinder reservoirs to within 1/4 inch (6.35 mm) of reservoir rims.

# 2G-28 BRAKES

## Brake Size and Application Chart

Model	Master Cylinder Bore Diameter	Front Brakes		Rear Brakes		Power Brake Unit Type
		Brake Size And Type	Caliper Piston Diameter	Brake Size And Type	Wheel Cyl. Diameter	
CJ	1.00 (25.4 mm)	11.7 Disc. (29.7 cm)	2.6 Single Piston (6.60 cm)	10 x 1.75 Drum (25.4 x 4.44 cm)	.875 (22.2 mm)	8.00 Single Diaphragm (20.3 cm)
Cherokee Wagoneer	1.125 (28.5 mm)	12.0 Disc. (30.48 cm)	2.937 Single Piston (7.45 cm)	11 x 2 Drum (27.94 x 5.08 cm)	.937 (23.79 mm)	9 1/2 Single Diaphragm (24.13 cm)
J-10 Truck	1.125 (28.5 mm)	12.0 Disc. (30.48 cm)	2.937 Single Piston (7.45 cm)	11 x 2 Drum (27.94 x 5.08 cm)	.937 (23.79 mm)	9 1/2 Single Diaphragm (24.13 cm)
J-20 Truck 6800 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)
J-20 Truck 7600 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)
J-20 Truck 8400 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)

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## Torque Specifications

	USA (ft.-lbs.)		Metric (N-m)	
	Service Set - to Torque	In - Use Recheck Torque	Service Set - to Torque	In - Use Recheck Torque
Brakeline-to-Caliper Fitting Bolt (Cke, Wag, Trk)	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Bleeder Screw (1/4 - 28)	45 in-lbs.	40 - 50 in-lbs.	5	5 - 6
Bleeder Screw (3/8 - 24)	90 in-lbs.	40 - 140 in-lbs.	10	5 - 16
Brake Support Plate Mounting Bolts/Nuts (J-20 Trk)	50	45 - 55	68	61 - 75
Brake Support Plate Mounting Bolts/Nuts (Cke, Wag, J10 Trk)	45	35 - 55	61	47 - 75
Brake Support Plate Mounting Bolts/Nuts (CJ)	33	30 - 35	45	41 - 47
Caliper Anchor Bracket to Steering Knuckle (CJ)	85	75 - 95	115	102 - 129
Master Cylinder Mounting Bolts/Nuts	30	25 - 35	41	34 - 47
Master Cylinder-to-Power Unit Mounting Nuts	25	20 - 30	34	27 - 41
Power Brake Unit-to-Dash Mounting Bolts/Nuts	22	18 - 25	30	24 - 34
Brake Line-to-Caliper Fitting Bolt (CJ)	25	20 - 30	34	27 - 41
Brake Line-to-Wheel Cylinder Fitting	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Parking Brake Cable Clamp-to-Support Plate Bolts (5/16 - 18)	10	8 - 12	14	11 - 16
Wheel Nuts (CJ)	75	65 - 90	102	88 - 122
Wheel Nuts (Cke, Wag, Trk)	75	65 - 80	102	88 - 108
Wheel Nuts (8400 GVW Trk)	130	110 - 150	176	149 - 203
Brake Pedal-to-Power Unit Push Rod Bolt/Nut	35	25 - 40	47	34 - 54
Caliper Mounting Bolts (Cke, Wag, Trk)	35	30 - 40	47	41 - 54
Caliper Support Key Retaining Screw (CJ)	15	15 - 18	20	20 - 24
Disc. Brake Shield Bolts (Cke, Wag, Trk)	8	5 - 10	11	7 - 14
Disc. Brake Shield Nuts (Cke, Wag, Trk)	35	30 - 40	47	41 - 54
Wheel Bearing Outer Locknut (All)	50(min.)		68 (min.)	
Wheel Bearing Inner Locknut (Bearing Adjuster):				
CJ	Tighten to 50 ft-lbs. (68 N-m) and back off 1/3 turn while rotating wheel.			
Cke, Wag, Trk	Tighten to 50 ft-lbs. (68 N-m), loosen and retighten to 35 ft-lbs. (47 N-m), then back off 1/3 turn - all while rotating wheel.			

# POWER BRAKE UNITS

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Power Unit Service	2G-31
Specifications	2G-31

## GENERAL

Three power units are used on Jeep vehicles. An 8-inch single diaphragm unit is used on CJ models (fig. 2G-18). A 9-1/2 single diaphragm unit is used on Cherokee, Wagoneer and J-10 Truck models (fig. 2G-19) and a 9-1/2 tandem diaphragm unit is used on J-20 Truck models.

The power units consist of a two-piece outer shell containing the single or dual diaphragms, air inlet valve, air filter, control valve, power piston, reaction plate and master cylinder push rod, and vacuum check valve (fig 2G-20 and 2G-21).

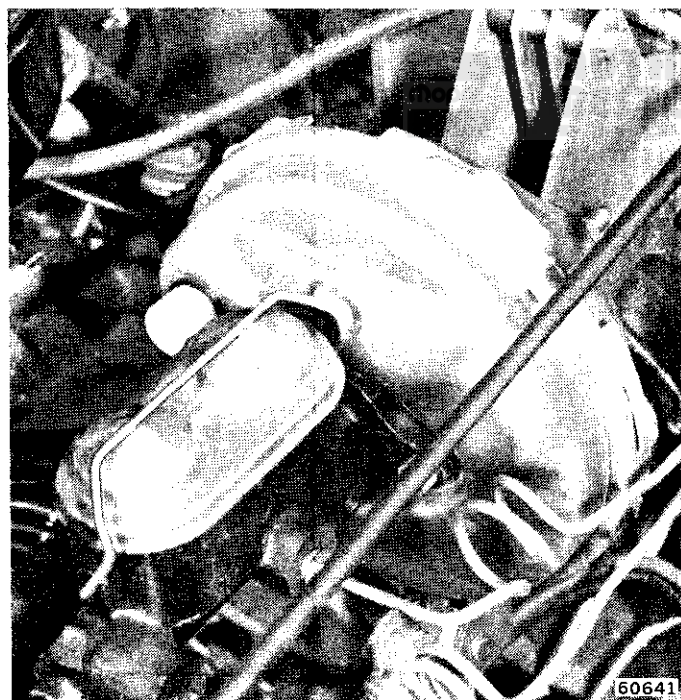


Fig. 2G-18 Power Brake Unit and Bellcrank—CJ Models

## Power Unit Operation

The power unit utilizes a combination of engine vacuum and atmospheric pressure to increase brake apply force without increasing brake pedal efforts.

In the neutral (non-applied) position, a vacuum is present within the chamber formed by the two halves of the outer shell and on both sides of the power piston and diaphragm.

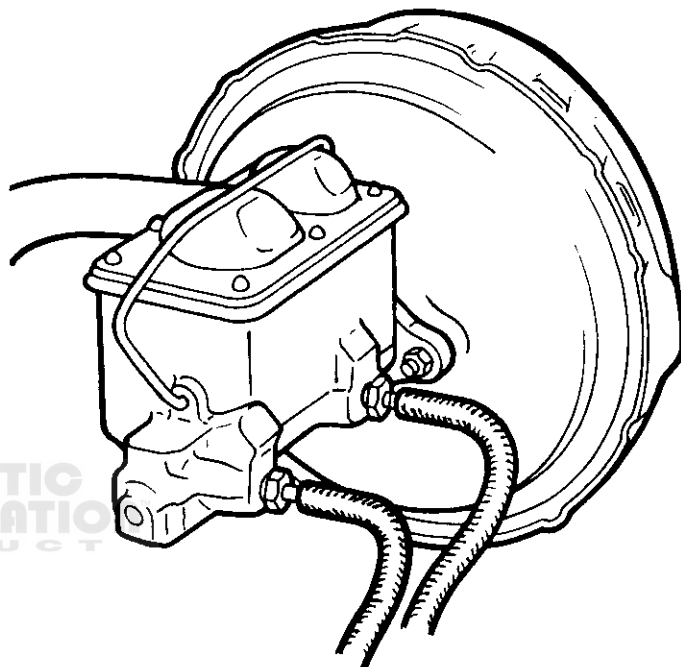


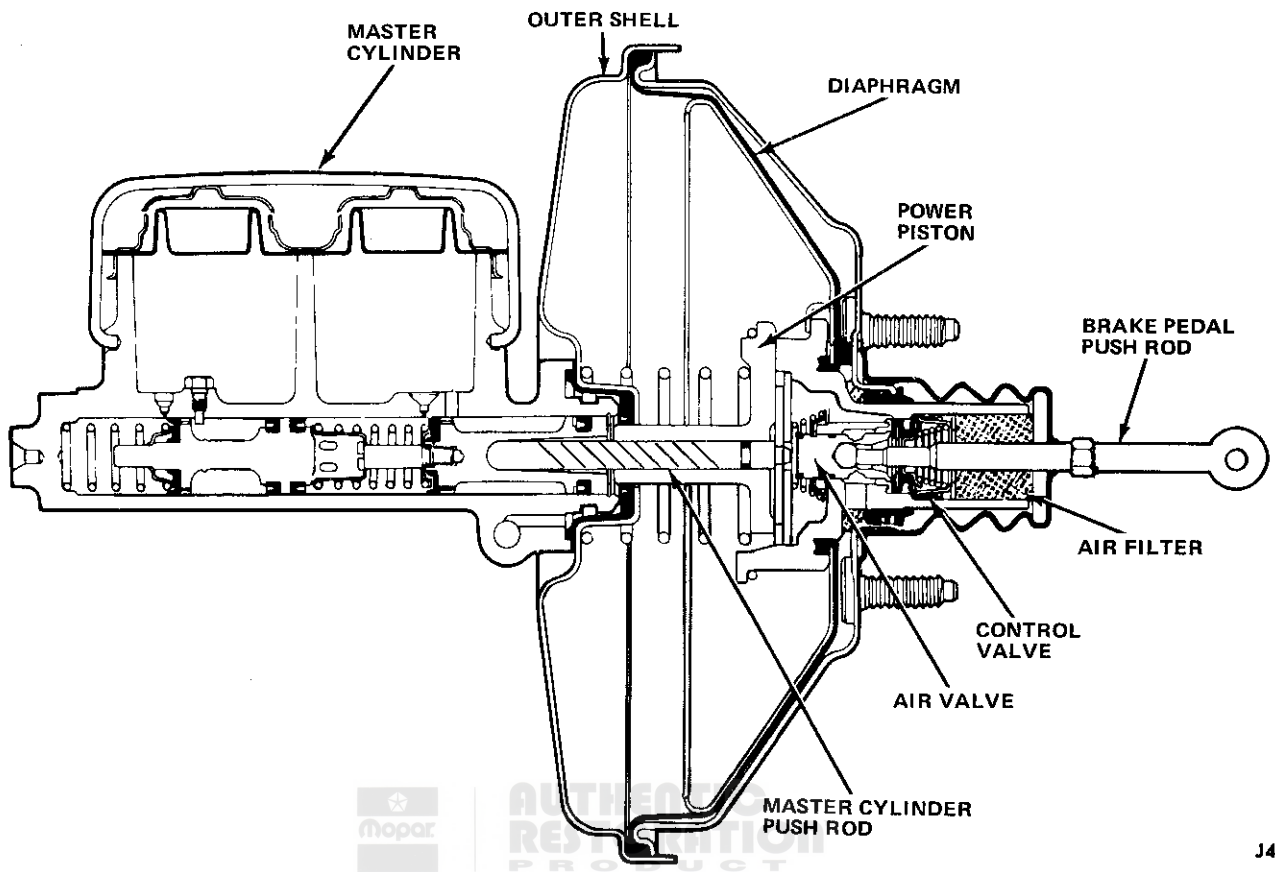
Fig. 2G-19 Power Brake Unit  
Cherokee-Wagoneer-Truck Models

As the brake pedal is pressed, the brake pedal push rod moves the air inlet valve away from the control valve (fig. 2G-20 and 2G-21). The control valve then follows the air inlet valve until the control valve contacts the raised seat on the power piston. When contact occurs, vacuum to the chamber space at the right-side of the power piston is shut off.

At vacuum shut off, air under an atmospheric pressure of 14.7 psi (101.3 kPa), then flows into the right side of the chamber through the air filter. Since a vacuum still exists in the left side of the chamber, the force of air at atmospheric pressure on the right side of the power piston forces the piston and master cylinder push rod to the left applying the brakes.

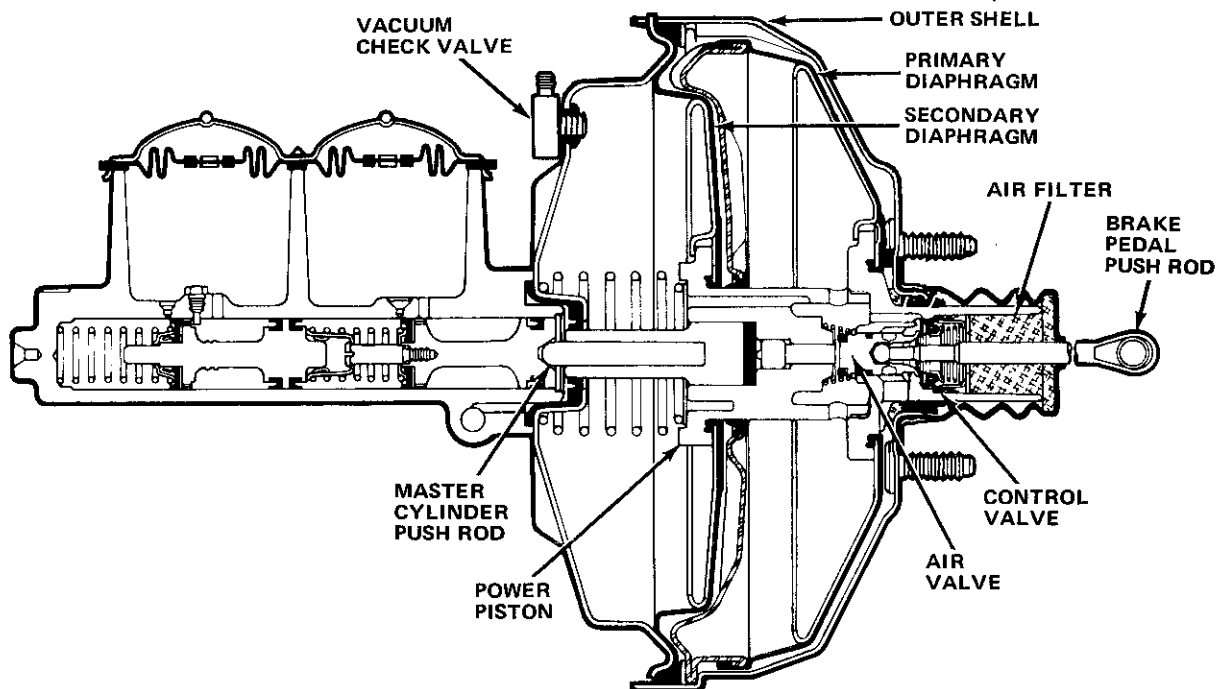
When the brake pedal is released, the control valve returns to its seat against the air inlet valve shutting off the supply of air under atmospheric pressure. At this point, engine vacuum coming through the vacuum check valve again enters the right-side of the chamber past the power piston.

In operation, the single and tandem diaphragm units function in exactly the same manner with one exception. The tandem unit utilizes two chambers on the right-side



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Fig. 2G-20 Single Diaphragm Power Unit (Typical)



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Fig. 2G-21 Tandem Diaphragm Power Unit (Typical)

of the power piston to develop atmospheric air pressure on the power piston.

**POWER UNIT SERVICE**

All power units are serviced as assemblies only. If diagnosis indicates that an internal malfunction has occurred within a power unit, replace the unit as an assembly. Do not attempt to repair the unit.

All power units have a single master cylinder push rod of a preset, nonadjustable length. When replacing a power unit, use the push rod supplied with the replacement power unit only. This push rod has been correctly gauged to the replacement unit.

**POWER UNIT DIAGNOSIS**

Power unit malfunction should be diagnosed using Brake Diagnosis Guide B and the Power Unit and Service Diagnosis Charts. When diagnosing suspected power unit malfunctions, always perform the preliminary diagnosis procedures outlined in Brake Diagnosis Guide A first. This is an important step in avoiding inaccurate diagnosis and ineffective repair.

**POWER UNIT REMOVAL**

- (1) Disconnect power unit push rod at brake pedal. Discard bolt and nut attaching rod to pedal.
- (2) Disconnect vacuum at power unit check valve.
- (3) Remove nuts and washers attaching master cylinder to power unit and move master cylinder aside. Do

not disconnect brake lines at master cylinder.

(4) On CJ models, remove nuts and bolts attaching power unit bellcrank to dash panel and remove power unit and bellcrank as assembly.

(5) On Cherokee, Wagoneer, and Truck models, remove nuts and washers attaching power unit to dash panel and remove power unit.

**NOTE:** *If the power unit is to be replaced on CJ models, remove the bellcrank from the original power unit, lubricate the bellcrank pivot pins with chassis lubricant, and transfer the bellcrank to the replacement unit.*

**POWER UNIT INSTALLATION**

(1) On Cherokee, Wagoneer and Truck models, mount power unit on dash panel and install attaching washers and nuts. Tighten nuts to 35 foot-pounds (47 N•m) torque.

(2) On CJ models, mount assembled power unit and bellcrank on dash panel. Install bellcrank-to-dash panel attaching bolts and nuts. Tighten bolts to 35 foot-pounds (47 N•m) torque.

(3) Connect vacuum hose to power unit check valve.

(4) Position master cylinder on power unit and install cylinder attaching washers and nuts. Tighten nuts to 30 foot-pounds (41 N•m) torque.

(5) Align power unit push rod and brake pedal and install replacement pedal attaching bolt and nut. Tighten bolt and nut to 35 foot-pounds (47 N•m) torque.

**SPECIFICATIONS**

**Brake Size and Application Chart**

Model	Master Cylinder Bore Diameter	Front Brakes		Rear Brakes		Power Brake Unit Type
		Brake Size And Type	Caliper Piston Diameter	Brake Size And Type	Wheel Cyl. Diameter	
CJ	1.00 (25.4 mm)	11.7 Disc. (29.7 cm)	2.6 Single Piston (6.60 cm)	10 x 1.75 Drum (25.4 x 4.44 cm)	.875 (22.2 mm)	8.00 Single Diaphragm (20.3 cm)
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**Torque Specifications**

	USA (ft.-lbs.)		Metric (N-m)	
	Service Set - to Torque	In - Use Recheck Torque	Service Set - to Torque	In - Use Recheck Torque
Brakeline-to-Caliper Fitting Bolt (Cke, Wag, Trk) . . . . .	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Bleeder Screw (1/4 - 28) . . . . .	45 in-lbs.	40 - 50 in-lbs.	5	5 - 6
Bleeder Screw (3/8 - 24) . . . . .	90 in-lbs.	40 - 140 in-lbs.	10	5 - 16
Brake Support Plate Mounting Bolts/Nuts (J-20 Trk) . . . . .	50	45 - 55	68	61 - 75
Brake Support Plate Mounting Bolts/Nuts (Cke, Wag, J10 Trk) . . . . .	45	35 - 55	61	47 - 75
Brake Support Plate Mounting Bolts/Nuts (CJ) . . . . .	33	30 - 35	45	41 - 47
Caliper Anchor Bracket to Steering Knuckle (CJ) . . . . .	85	75 - 95	115	102 - 129
Master Cylinder Mounting Bolts/Nuts . . . . .	30	25 - 35	41	34 - 47
Master Cylinder-to-Power Unit Mounting Nuts . . . . .	25	20 - 30	34	27 - 41
Power Brake Unit-to-Dash Mounting Bolts/Nuts . . . . .	22	18 - 25	30	24 - 34
Brake Line-to-Caliper Fitting Bolt (CJ) . . . . .	25	20 - 30	34	27 - 41
Brake Line-to-Wheel Cylinder Fitting . . . . .	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Parking Brake Cable Clamp-to-Support Plate Bolts (5/16 - 18) . . . . .	10	8 - 12	14	11 - 16
Wheel Nuts (CJ) . . . . .	75	65 - 90	102	88 - 122
Wheel Nuts (Cke, Wag, Trk) . . . . .	75	65 - 80	102	88 - 108
Wheel Nuts (8400 GVW Trk) . . . . .	130	110 - 150	176	149 - 203
Brake Pedal-to-Power Unit Push Rod Bolt/Nut . . . . .	35	25 - 40	47	34 - 54
Caliper Mounting Bolts (Cke, Wag, Trk) . . . . .	35	30 - 40	47	41 - 54
Caliper Support Key Retaining Screw (CJ) . . . . .	15	15 - 18	20	20 - 24
Disc. Brake Shield Bolts (Cke, Wag, Trk) . . . . .	8	5 - 10	11	7 - 14
Disc. Brake Shield Nuts (Cke, Wag, Trk) . . . . .	35	30 - 40	47	41 - 54
Wheel Bearing Outer Locknut (All) . . . . .	50(min.)		68 (min.)	
Wheel Bearing Inner Locknut (Bearing Adjuster):				
CJ . . . . .		Tighten to 50 ft.-lbs. (68 N-m) and back off 1/3 turn while rotating wheel.		
Cke, Wag, Trk . . . . .		Tighten to 50 ft.-lbs. (68 N-m), loosen and retighten to 35 ft.-lbs. (47 N-m), then back off 1/3 turn - all while rotating wheel.		

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**DRUM BRAKES**

	Page		Page
Brake Service—CJ Models	2G-34	Operation and Wear Compensation	2G-32
Brake Service—Cherokee-Wagoneer-Truck Models	2G-36	Specifications	2G-38
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**GENERAL**

Two different drum brake units are used on Jeep vehicles. The brakes used on CJ models have a cable operated automatic adjuster mechanism, while the brakes used on Cherokee, Wagoneer, and Truck models have a linkage operated automatic adjuster mechanism. Although the units differ slightly in construction, operation and service procedures for both units are similar.

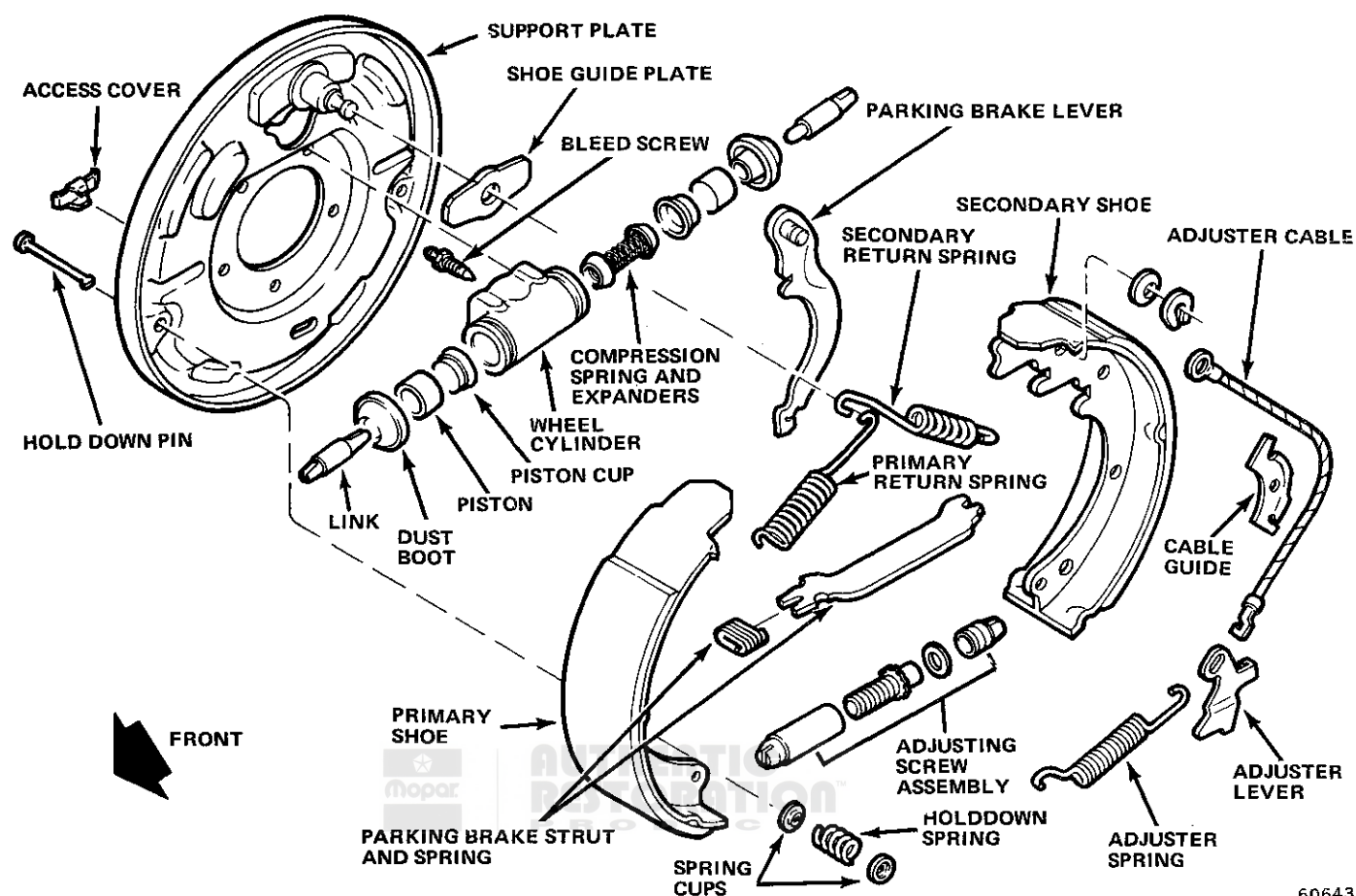
Each drum brake unit consists of a support plate, a primary and a secondary brakeshoe, two brakeshoe return springs, an adjusting screw assembly, two hold-down springs, automatic adjuster components, and a wheel cylinder assembly (figs. 2G-22 and 2G-23).

**OPERATION AND WEAR COMPENSATION**

**Operation**

When the brakes are applied, fluid pressure developed in the master cylinder is transmitted to the wheel cylinders forcing the cylinder pistons outward. This motion is transferred to the upper ends of the brakeshoes through links which interconnect the brakeshoes and wheel cylinder pistons.

As the brakeshoes are expanded and contact the drum, they tend to rotate with the drum. This action causes the primary brakeshoe to pivot downward and away from the support plate anchor pin and the secondary brakeshoe to pivot upward and against the anchor pin.



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Fig. 2G-22 Drum Brake Assembly—CJ Models

As the primary brakeshoe pivots downward, it exerts a rearward force on the adjuster screw assembly. Since the adjuster screw interconnects the lower ends of the brakeshoes, this additional force is transmitted directly to the secondary brakeshoe increasing its braking action. The additional force applied to the secondary brakeshoe accounts for the fact that the secondary brakeshoe linings are generally thicker and have more contact area.

When the brakes are released, the return springs overcome the diminishing fluid pressure and return the brakeshoes and wheel cylinder pistons to the neutral position.

During a reverse stop, the drum brakes operate in the same mode as for a forward stop. However, because the drum is rotating in the opposite direction, the secondary brakeshoe now operates, in effect, as the primary brakeshoe.

#### Parking Brake Operation

The parking brake lever is mounted on the back of the brakeshoe and is connected to it by a pivot pin installed in the upper end of the lever. The pin is re-

tained in the brakeshoe by a washer and U-clip. The parking brake cable is attached to the lower end of the lever. A strut, located just below the pivot pin, connects the lever to the primary brakeshoe. The strut is notched at each end and fits into matching notches in the brakeshoe and lever. The strut is positioned in the brakeshoe by an oval shaped spring.

When the parking brakes are applied, the cable pulls the lower end of the lever forward causing the connecting strut to push the primary brakeshoe forward also. At the same time, the upper end of the lever pushes the secondary brakeshoe rearward. The combined action of lever and strut expands the brakeshoes forcing them against the drum to develop braking action.

#### Wear Compensation

The automatic adjuster mechanism continuously maintains correct lining-to-drum operating clearance by adjusting the brakes in small increments in direct proportion to lining wear. This continuous adjustment prevents a gradual increase in brake pedal travel as the linings wear. The adjuster mechanism also adds the safety feature of maintaining adequate pedal reserve during the service life of the lining.

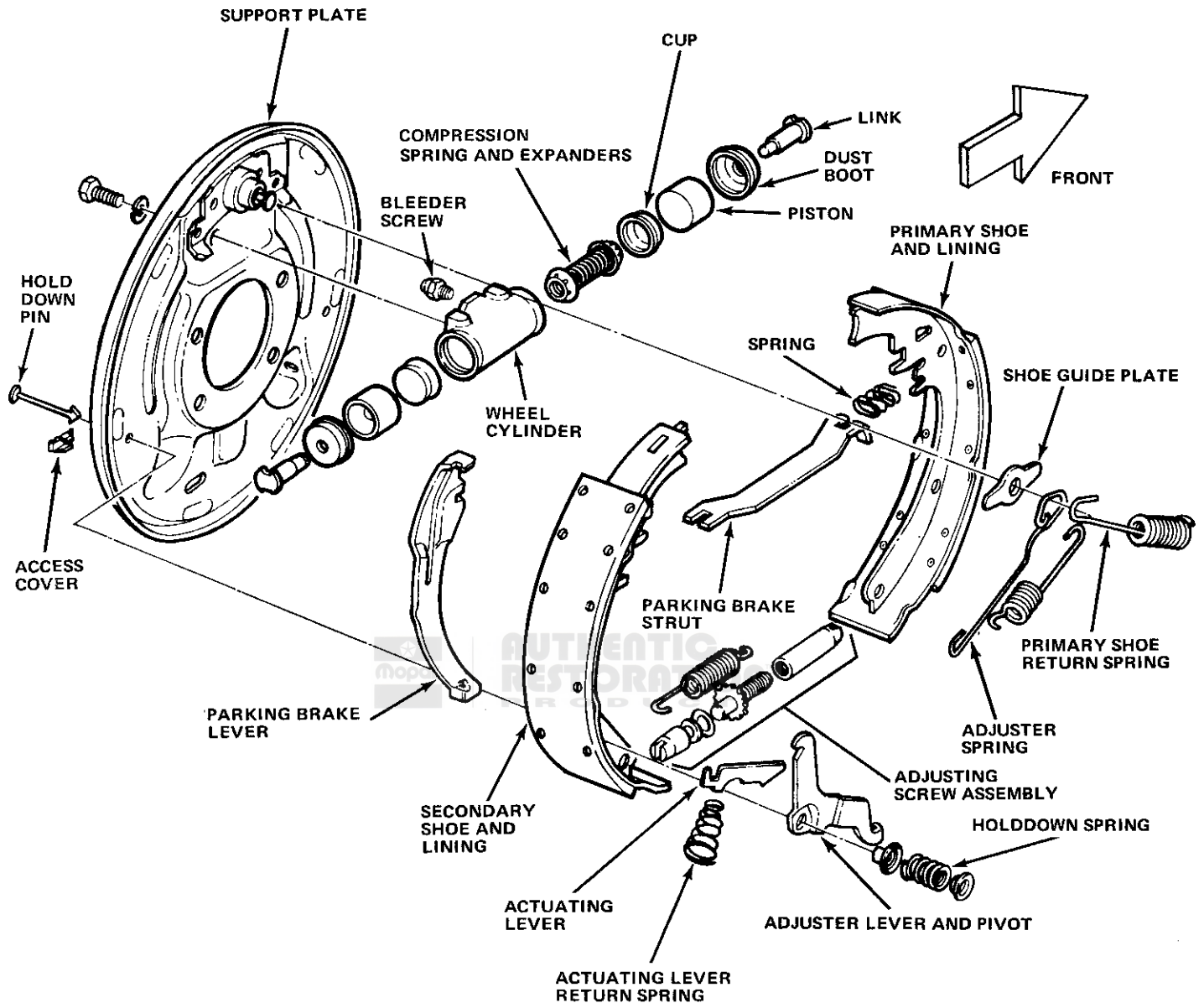


Fig. 2G-23 Drum Brake Assembly—Cherokee-Wagoneer-Truck Models

When the lining wears enough to require adjustment, the adjusting cable (CJ) or actuating lever (Cherokee-Wagoneer-Truck) lifts the lever into engagement with the next tooth of the adjusting screw during reverse brake applications. When the brakes are released, the brakeshoes return to the anchor pin.

The adjuster mechanism utilizes movement of the secondary shoes during reverse brake applications to actuate the adjuster mechanism.

This action will repeat on subsequent brake applications until the drum-to-lining clearance is reduced to a point where shoe movement is no longer sufficient to cause the adjuster mechanism to lift the lever to the next adjuster screw tooth.

## BRAKE SERVICE—CJ MODELS

### Disassembly

**WARNING:** When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel brake parts with a dry brush or with compressed air. Use water dampened cloths only to remove dirt from brake parts prior to disassembly. Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily injury.

- (1) Raise vehicle.
- (2) Remove wheels and drums.
- (3) Grasp adjusting lever with pliers and remove lever tang from hole in secondary shoe.
- (4) Place Brake Cylinder Clamps J-8002 over wheel cylinders to hold pistons in place while shoes are removed.
- (5) Remove return springs using Brake Spring Remover Tool J-8057.
- (6) Remove secondary return spring, adjuster cable, primary return spring, cable guide, adjuster lever, and adjuster springs.
- (7) Remove holddown springs and brakeshoes.
- (8) Disengage parking brake cable from parking brake lever.

### Cleaning and Inspection

Clean all parts, except the brakeshoes and brake drums, with brake cleaning solvent only. Clean brake drums with a soap and water solution only and replace brakeshoes that are contaminated with grease or brake fluid. Remove dirt and dust from the support plate using water dampened shop cloths only.

Pull the wheel cylinder dust boots aside and check for evidence of leakage. If leakage is observed, overhaul the wheel cylinders.

Polish the brake support plate ledges with fine sandpaper or emery cloth. If grooves, which may restrict shoe movement, still exist after polishing, replace the support plate. Do not attempt to remove grooves by grinding the ledges smooth as this could result in improper shoe-to-drum contact.

Inspect the lining wear pattern. If the wear across the width of the lining is uneven, check the drums for a bell-mouthed condition, inspect the drums for correct positioning, and inspect the support plate for distortion. Inspect all springs for evidence of overheating (discoloration), fractures, or distortion.

On CJ models, inspect the adjuster cable for kinks, fraying, or for an elongated (worn) eyelet. On all other models, inspect the adjuster levers for wear, cracks, or distortion.

Inspect the adjusting screw for freedom of rotation and the adjuster lever for wear and distortion.

Inspect the brake lines for evidence of leakage, swelling, distortion, kinks, or cracks.

Clean the support plates using compressed air or dry cloths and polish the anchor pins with crocus cloth. Also check the pins for being loose, worn, or damaged. Inspect the support plates for distortion or cracks and check the support plate-to-axle flange bolt torques.

Clean the brake drums with a soap and water solution only. Inspect the drums for excessive wear, scoring, runout, cracks, heat checks, hard spots, or distortion. Mount the drums on a brake lathe and check runout using a dial indicator. Radial runout must not exceed

0.005 inch. If runout exceeds this figure, replace or turn the drum. If the drums are machined, do not remove more than 0.030 inch (0.76 mm) total. Maximum allowable oversize for any drum is 0.060 inch (1.52 mm) over the original diameter. In addition, do not attempt to refinish drums with hard spots. Replace drums with this condition.

### Assembly and Adjustment

**NOTE:** When it is necessary to replace the brakeshoes on one wheel, the brakeshoes must also be replaced on the opposite wheel to maintain braking balance.

(1) Lubricate support plate ledges, anchor pin, self-adjuster cable guide, adjuster screw threads and pivot, and parking brake cable lever and pivot with molydisulphide grease or chassis lubricant.

(2) Install parking brake lever on secondary brake shoe and install washer and replacement lever retaining U-clip. Crimp ends of clip using pliers to retain it on pivot.

(3) Position brakeshoes on brake support plate and install holddown springs (figs. 2G-22 and 2G-23).

(4) Install parking brake cable in lever and install parking brake strut and positioning spring.

(5) Place adjuster cable eyelet on anchor pin.

(6) Install primary return spring (fig. 2G-24).

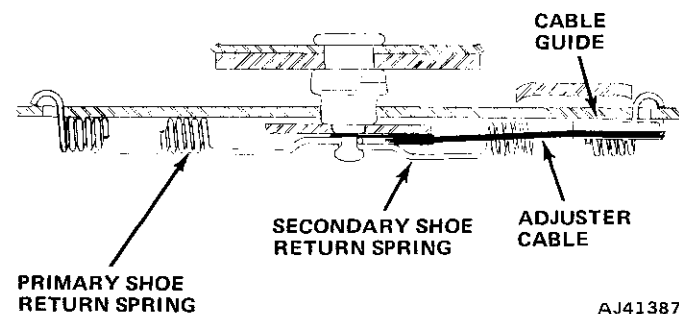
(7) Install cable guide on secondary brakeshoe.

(8) Install secondary return spring (fig. 2G-24).

(9) Install adjusting screw and spring on brakeshoes. Insert small hooked end of spring in large hole in primary brakeshoe and large hooked end of spring in adjuster lever.

(10) Position adjuster cable in cable guide groove insert hooked end of cable in adjuster lever.

(11) Grip adjuster lever with pliers and hook lever tang in large hole at bottom of secondary brakeshoe.



**Fig. 2G-24 Return Spring Installation**

(12) Perform initial brake adjustment using clearance gauge or manual adjustment procedure. Refer to Service Brake Adjustment.

(13) Install brakedrums.

(14) If any brake lines were disconnected, bleed brakes. Refer to Brake Bleeding.

- (15) Install rear wheels and tires.
- (16) Lower vehicle.
- (17) Check brake operation before moving vehicle.
- (18) Drive vehicle in reverse and make 10 to 15 firm brake applications to complete brake adjustment. Make one forward brake application after each reverse application to equalize adjustment.

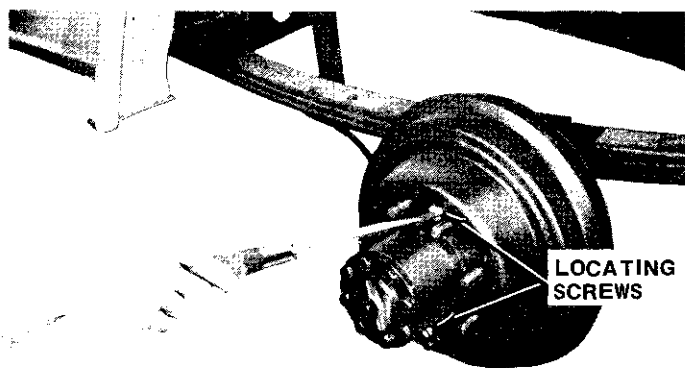
**NOTE:** *If the vehicle has an automatic transmission, do not use the forward range to halt vehicle movement in reverse. This procedure will prevent the automatic adjuster mechanism from operating properly resulting in unsatisfactory pedal heights. All stops must be completed.*

**BRAKE SERVICE—CHEROKEE-WAGONEER-TRUCK MODELS**

**WARNING:** *When servicing wheel brake units, do not create dust by grinding or sanding brakelinings or by cleaning wheel brake parts with a dry brush or with compressed air. Use water dampened cloths only to remove dirt and dust from brake parts prior to disassembly. Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing operations. Breathing dust containing asbestos fibers may cause serious bodily harm.*

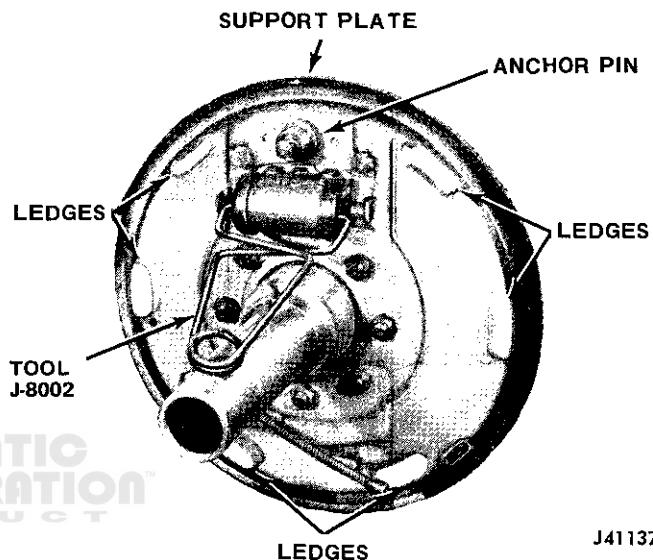
**Disassembly**

- (1) Raise vehicle.
- (2) Remove rear wheels and drums.
- (3) Release parking brake and loosen locknuts at parking brake equalizer to relieve cable tension before removing rear drums.
- (4) On Truck models with Model 60 full-floating rear axle, remove two screws that locate rear drums on hubs (fig. 2G-25).
- (5) Remove primary brakeshoe return spring (fig. 2G-23).



**Fig. 2G-25 Brake Drum Locating Screw Removal—Model 60 Axle**

- (6) Remove automatic adjuster actuating spring and secondary brakeshoe return spring using Spring Remover Tool J-8057.
- (7) Remove holddown springs and remove brakeshoes.
- (8) Disengage parking brake cable from parking brake lever on secondary brakeshoe.
- (9) Place Wheel Cylinder Clamps J-8002 over wheel cylinders to retain pistons (fig. 2G-26).



**Fig. 2G-26 Wheel Cylinder Clamps Installed**

**Cleaning and Inspection**

Inspect brakelining wear. Replace riveted lining if it is worn to within 1/32 inch (0.79 mm) of the rivet heads. Replace bonded lining if it is worn to a total thickness of approximately 1/16 inch (1.58 mm) or less.

Inspect the lining wear pattern. If wear is uneven across the width of the lining, replace the lining and check the drum for distortion and runout. Inspect the lining for cracks, charred surface, or broken rivets. Replace the lining if contaminated with brake fluid, axle lubricant, or similar contaminants or if the lining exhibits any of the conditions described previously.

Inspect the adjusting screw spring, return springs, holddown springs, actuating lever return spring, and automatic adjuster spring. Replace any springs that are distorted, broken, discolored (overheated), or lack tension.

Inspect the parking brake lever, automatic adjuster lever and pivot, and actuating lever for wear and defects. Replace levers if bent, broken, or excessively worn.

Inspect the adjusting screw pivot and screw threads. The screw must rotate freely. Inspect the screw serrations for excessive wear which could effect automatic adjustment.

Inspect the parking brake cables for being frayed, worn, kinked, or siezed. Also check for missing or loose cable end retainer buttons. Inspect the parking brake lever for distortion, worn pivot pin, and for proper cable retention.

Inspect the wheel cylinders for evidence of leakage. Pull back the dust boots and check for signs of leakage past the piston cups. If necessary, overhaul the cylinder as described in this chapter. Inspect the bleeder screw and hydraulic line connection for evidence of leakage or damaged threads. Replace the wheel cylinder if the internal threads are damaged. Check the brake lines for swelling, distortion, kinks, or cracks. Replace any line exhibiting these conditions.

Clean the support plates using shop cloths or compressed air. Polish the anchor pins with crocus cloth and polish the support plate ledges with emery cloth. If the ledges have deep grooves or ridges which might restrict shoe movement, the support plate should be replaced. Do not attempt to reduce deep ridges or grooves by grinding. This can result in improper shoe-to-drum contact. Inspect the support plates for distortion or cracks and check the support plate-to-axle flange bolt torques. Inspect the anchor pins for wear or for being loose. Replace the support plate if it exhibits any of the conditions described previously.

Clean the brakedrums using a soap and water solution only.

**CAUTION:** Do not use brake fluid, gasoline, kerosene, or similar solvents to clean the drums. Use a soap and water solution only to clean the drums.

Inspect the drums for scoring, cracks, heat checking, hard spots, and distortion and check the drums for excessive runout. Mount the drums on a brake lathe and check runout using a dial indicator. Drum runout must not exceed 0.005 inch (0.12 mm). If drum runout is excessive, replace or remachine the drum.

**CAUTION:** When machining drums, do not remove more than 0.030 inch (0.76 mm). Maximum allowable oversize for any drum is 0.060 inch (1.52 mm) over original diameter. In addition, do not attempt to machine drums with hard spots. Replace drums with this condition.

### Assembly and Adjustment

**NOTE:** When it is necessary to replace the brake lining on one wheel, the lining must also be replaced on the opposite wheel to maintain braking balance.

(1) Apply thin film of molydisulphide grease, or chassis lubricant to support plate ledges, anchor pin, adjusting screw threads and pivot, adjuster lever-to-secondary brakeshoe contact surface, parking brake lever pivot and portion of lever that contacts secondary brakeshoe.

(2) Connect parking brake cable to parking brake lever on secondary brakeshoe.

**NOTE:** When installing the parking brake lever on replacement brakeshoes, pinch the U-clip to retain the lever on the shoe.

(3) Install secondary brakeshoe, automatic adjuster lever, and lever pivot as assembly and install brakeshoe holddown spring.

(4) Install actuating lever and adjusting lever. Install return spring on actuating lever tang. Large end of tapered spring should rest on brakeshoe.

(5) Install primary shoe and holddown spring.

(6) Install guide plate on anchor pin.

(7) Install parking brake strut and spring on brakeshoes.

(8) Install adjusting screw and spring. Short hooked end of spring goes on primary brakeshoe. Long hooked end goes on secondary brakeshoe (fig. 2G-23).

(9) Install return springs and adjuster spring in following sequence (fig. 2G-23):

(a) install adjuster spring.

(b) install secondary brakeshoe return spring on brakeshoe and adjuster spring.

(c) install primary shoe return spring.

**CAUTION:** Be sure the brakeshoes are seated against the anchor pin after installing the springs.

(10) Perform initial brake adjustment. Refer to Service Brake Adjustment.

(11) Install brake drums.

(12) If brake lines were disconnected, bleed brakes. Refer to Brake Bleeding.

(13) Install wheels and tires.

(14) Lower vehicle.

(15) Test brake operation before moving vehicle.

(16) Perform final brake adjustment by making 10 to 15 forward and reverse stops to equalize adjustment and until satisfactory brake pedal height is obtained.

**NOTE:** If the vehicle has an automatic transmission, do not use the forward range to halt reverse movement of the vehicle. This procedure will prevent the automatic adjusters from operating properly resulting in unsatisfactory pedal heights. All stops must be completed.

**SPECIFICATIONS**

**General Specifications**

Brake Drum Radial Runout Limit . . . . . 0.005 inches (0.12 mm)  
 Brake Drum Internal Diameter Limit:  
     CJ Models . . . . . 10.060 inches (25.5 cm)  
     Cherokee—Wagoneer—J-10 Truck . . . . . 11.060 inches (28.09 cm)  
     J-20 Truck . . . . . 12.060 inches (30.6 cm)  
 Brake Lining Wear Limits:  
     Riveted Lining . . . . . Replace when worn to within  
         1/32 inch (0.79mm) of rivet heads.  
     Bonded Lining . . . . . Replace when worn to thickness of  
         approximately 1/16 inch (1.58 mm) or less.

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**Torque Specifications**

	USA (ft.-lbs.)		Metric (N-m)	
	Service Set - to Torque	In - Use Recheck Torque	Service Set - to Torque	In - Use Recheck Torque
Brakeline-to-Caliper Fitting Bolt (Cke, Wag, Trk) . . . . .	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Bleeder Screw (1/4 - 28) . . . . .	45 in-lbs.	40 - 50 in-lbs.	5	5 - 6
Bleeder Screw (3/8 - 24) . . . . .	90 in-lbs.	40 - 140 in-lbs.	10	5 - 16
Brake Support Plate Mounting Bolts/Nuts (J-20 Trk) . . . . .	50	45 - 55	68	61 - 75
Brake Support Plate Mounting Bolts/Nuts (Cke, Wag, J10 Trk) . . . . .	45	35 - 55	61	47 - 75
Brake Support Plate Mounting Bolts/Nuts (CJ) . . . . .	33	30 - 35	45	41 - 47
Caliper Anchor Bracket to Steering Knuckle (CJ) . . . . .	85	75 - 95	115	102 - 129
Master Cylinder Mounting Bolts/Nuts . . . . .	30	25 - 35	41	34 - 47
Master Cylinder-to-Power Unit Mounting Nuts . . . . .	25	20 - 30	34	27 - 41
Power Brake Unit-to-Dash Mounting Bolts/Nuts . . . . .	22	18 - 25	30	24 - 34
Brake Line-to-Caliper Fitting Bolt (CJ) . . . . .	25	20 - 30	34	27 - 41
Brake Line-to-Wheel Cylinder Fitting . . . . .	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Parking Brake Cable Clamp-to-Support Plate Bolts (5/16 - 18) . . . . .	10	8 - 12	14	11 - 16
Wheel Nuts (CJ) . . . . .	75	65 - 90	102	88 - 122
Wheel Nuts (Cke, Wag, Trk) . . . . .	75	65 - 80	102	88 - 108
Wheel Nuts (8400 GVW Trk) . . . . .	130	110 - 150	176	149 - 203
Brake Pedal-to-Power Unit Push Rod Bolt/Nut . . . . .	35	25 - 40	47	34 - 54
Caliper Mounting Bolts (Cke, Wag, Trk) . . . . .	35	30 - 40	47	41 - 54
Caliper Support Key Retaining Screw (CJ) . . . . .	15	15 - 18	20	20 - 24
Disc. Brake Shield Bolts (Cke, Wag, Trk) . . . . .	8	5 - 10	11	7 - 14
Disc. Brake Shield Nuts (Cke, Wag, Trk) . . . . .	35	30 - 40	47	41 - 54
Wheel Bearing Outer Locknut (All) . . . . .	50(min.)		68 (min.)	
Wheel Bearing Inner Locknut (Bearing Adjuster):				
CJ . . . . .	Tighten to 50 ft-lbs. (68 N-m) and back off 1/3 turn while rotating wheel.			
Cke, Wag, Trk . . . . .	Tighten to 50 ft-lbs. (68 N-m), loosen and retighten to 35 ft-lbs. (47 N-m), then back off 1/3 turn - all while rotating wheel.			

# DISC BRAKES

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Brakeshoe Replacement—Cherokee-Wagoneer-Truck Models	2G-42	Rotor Service	2G-50
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General	2G-39		

## GENERAL

Jeep vehicles are equipped with single piston, floating caliper front disc brakes. Two different calipers are used. On CJ models, the caliper is positioned on abutment surfaces machined into the leading and trailing edges of the caliper anchor bracket (fig. 2G-27). On Cherokee, Wagoneer, and Truck models, the caliper is positioned on mounting bolts located in the caliper support bracket (fig. 2G-28). Although the two caliper designs differ in construction, caliper operation and service procedures are similar.

All models are equipped with an integral-type hub and rotor. CJ models use an 11.7 inch (29.71 cm) rotor. Cherokee, Wagoneer and J-10 Truck models use a 12.0 inch (30.48 cm) rotor. J-20 Truck models use a 12.5 inch (31.75 cm) rotor.

Both caliper types consist of a one-piece casting containing a piston, piston bore, bleeder screw and fluid inlet ports. The piston and piston seal are contained within the piston bore. The piston seal is located in a groove machined in the bore wall. An all-rubber dust boot is used on CJ models while a combination rubber boot with integral metal retainer is used on Cherokee,

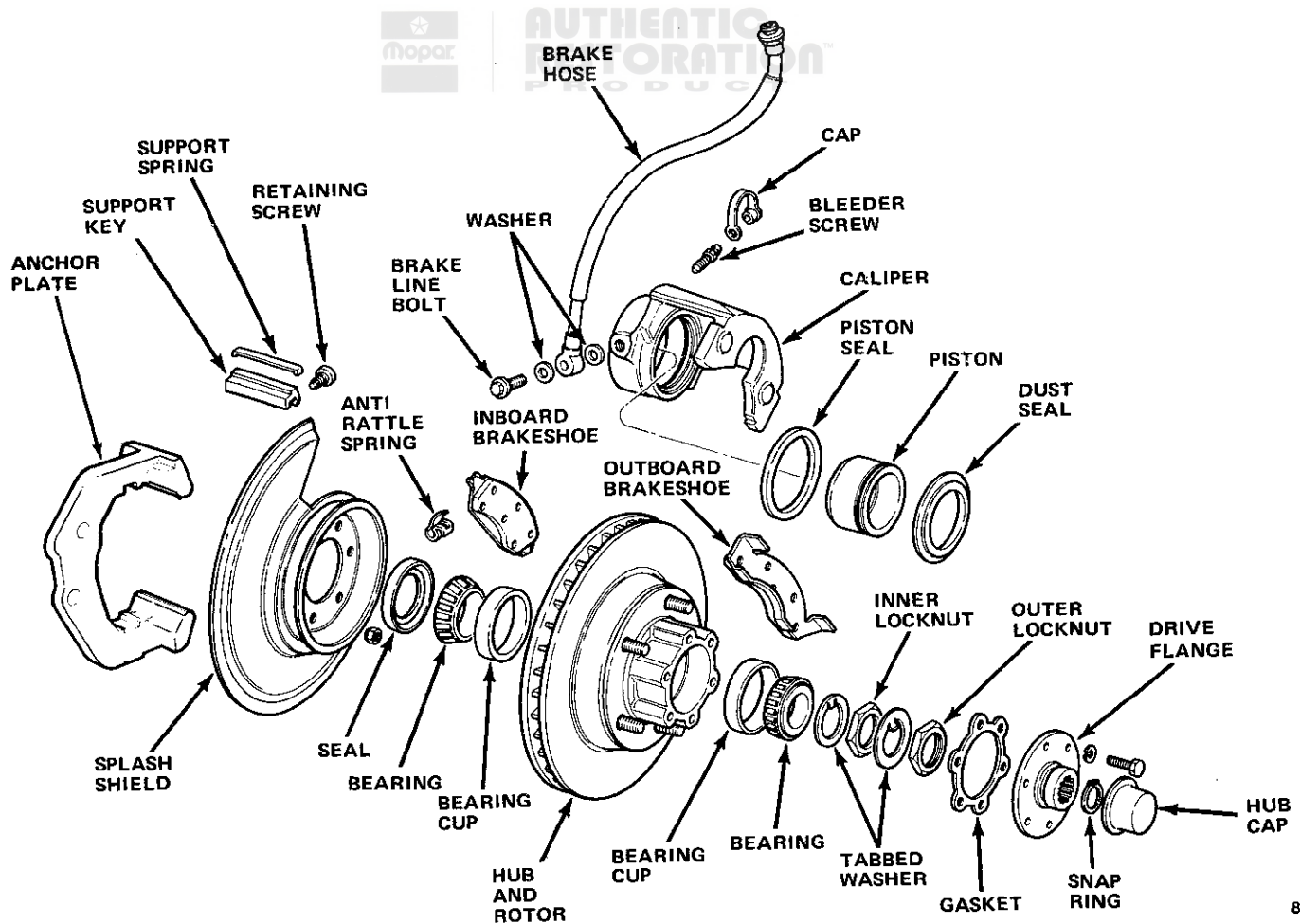
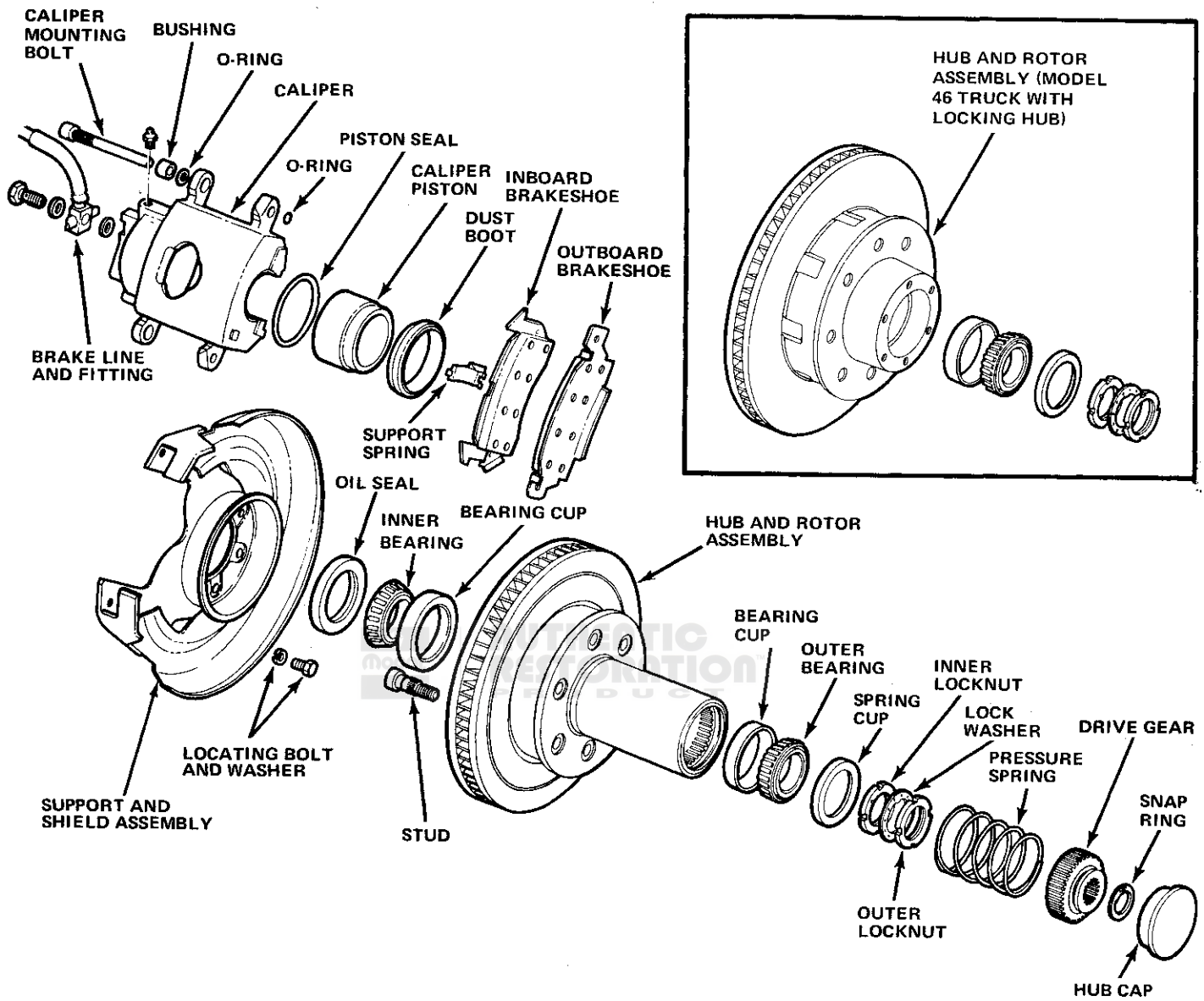


Fig. 2G-27 Disc Brake Assembly—CJ Models





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Fig. 2G-28 Disc Brake Assembly—Cherokee-Wagoneer-Truck Models

Wagoneer, and Truck models. The boot is located in a counterbore or groove machined in the upper edge of the piston bore and in a groove machined in the exterior surface of the piston.

All caliper pistons are precision ground and plated to provide a hard, durable surface. A return spring is not used in the piston bore in either caliper. Lining wear is compensated for by the lateral sliding movement of the caliper and by increased piston extension (fig. 2G-29).

A brakelining wear sensor, which consists of a strip of flanged metal, is attached to the inboard brakeshoe on Cherokee, Wagoneer and Truck models (a sensor is not used on CJ model lining). When the brakelining wears to the point of replacement, the sensor contacts the rotor

surface making a high-pitched noise to alert the driver (fig. 2G-30).

## DISC BRAKE OPERATION

### Operation

The significant feature of disc brake operation is that the caliper is free to slide laterally on the mounting bolts or anchor plate abutment surfaces.

When the brakes are applied, fluid pressure is exerted equally against the piston and piston bore surfaces. Pressure applied to the piston is transmitted to the

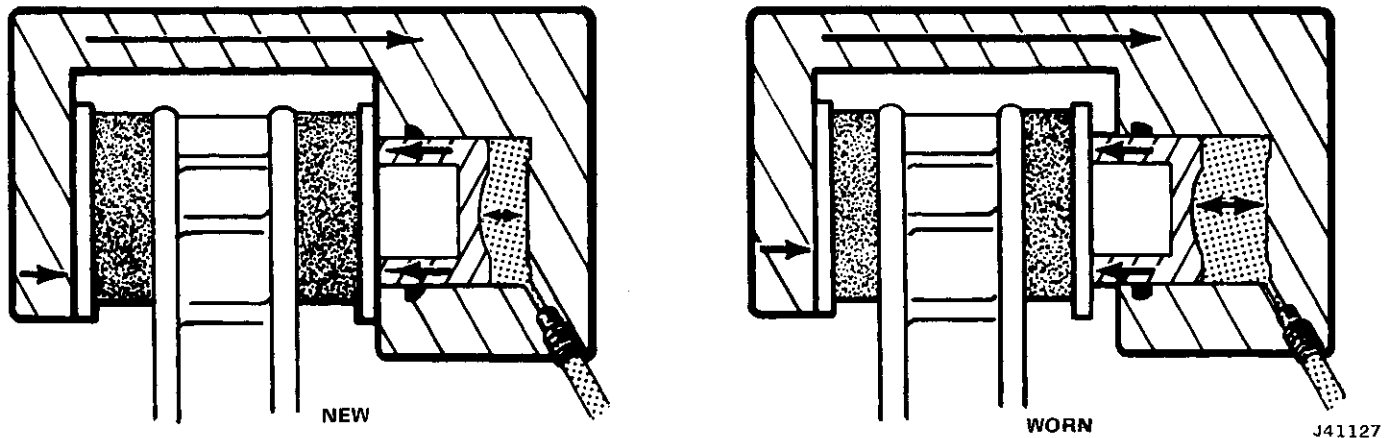


Fig. 2G-29 Piston Extension—New and Worn Linings

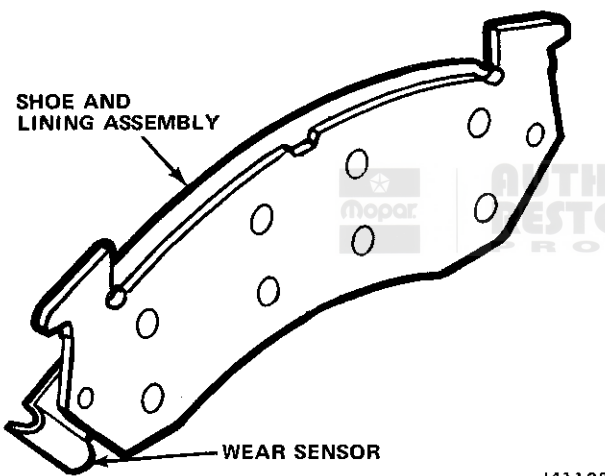


Fig. 2G-30 Brake Lining Wear Sensor Location  
Cherokee-Wagoneer-Truck Models

tends, additional brake fluid flows into the bore to compensate for the increase in bore volume caused by piston extension (fig. 2G-29).

### Wear Compensation

The piston seal maintains operating clearance between the rotor and lining and adjusts for wear during each brake application. When the brakes are applied, the seal is deflected by hydraulic pressure and by friction between the piston and seal. When hydraulic pressure is released, the seal reverts to its original shape and retracts the piston just enough to provide the necessary operating clearance.

As the linings wear, piston travel begins to exceed the seal deflection limit. The piston then moves outward through the seal just far enough to compensate for lining wear and reestablish normal seal deflection (fig. 2G-31).

inboard shoe and lining pressing the lining against the rotor inboard surface. At the same time, pressure applied to the piston bore forces the caliper to slide inboard. This movement causes the outboard portion of the caliper to press the outboard shoe and lining assembly against the rotor outboard surface.

Any application or release of brake apply pressure produces very slight piston and caliper movement. At release, the piston and caliper return to a neutral position. In this position, the brake lining does not retract any appreciable distance from the rotor. This provides rapid brake response and reduced pedal travel. Because the brakeshoes operate at approximately a zero clearance, they continually wipe the rotor free of foreign matter.

As the linings wear, the piston extends farther out of the caliper bore causing the caliper to reposition itself to maintain lining-to-rotor clearance. When the piston ex-

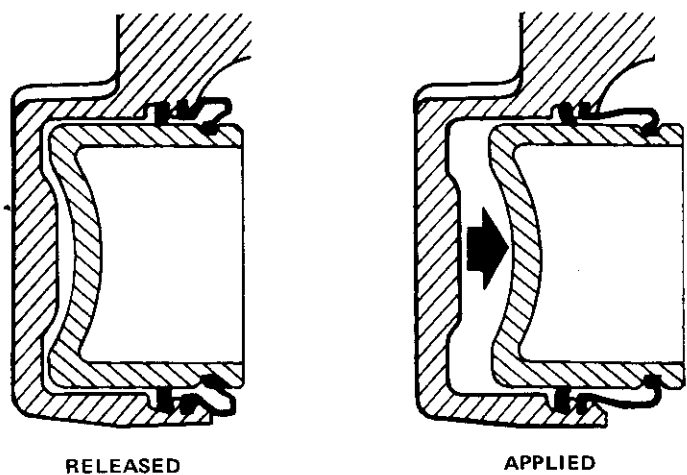
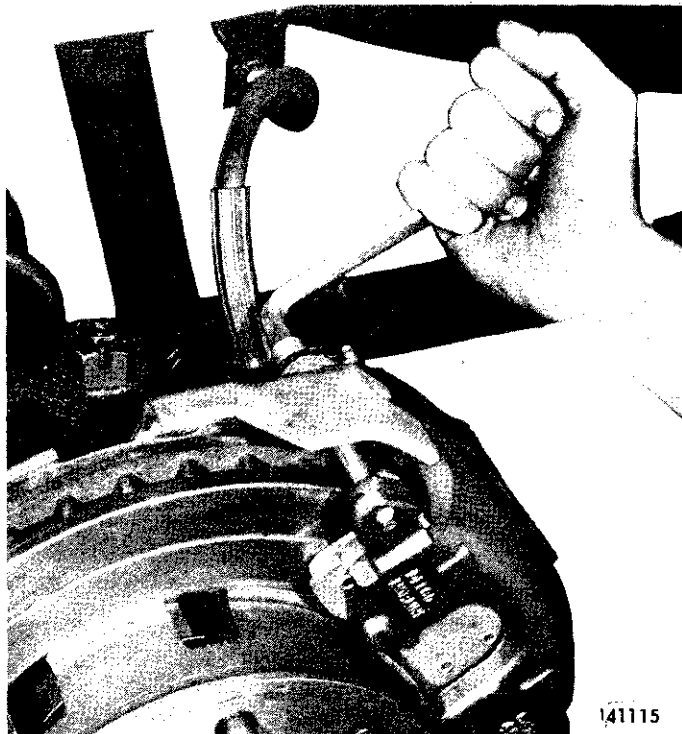


Fig. 2G-31 Piston and Seal Movement

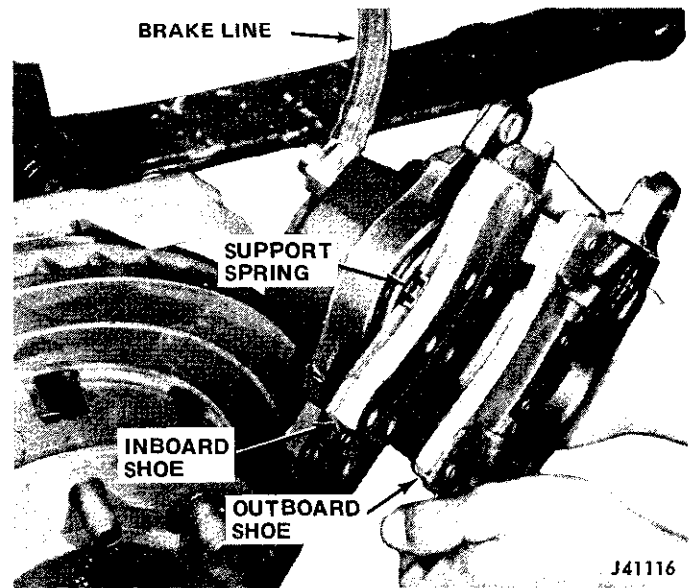
**BRAKESHOE REPLACEMENT — CHEROKEE-WAGONEER-TRUCK MODELS**

**WARNING:** When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel brake parts with a dry brush or with compressed air. Use water dampened shop cloths only to remove dirt and dust from brake parts prior to disassembly. Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing operations. Breathing dust containing asbestos fibers may cause serious bodily harm.

- (1) Remove two-thirds of brake fluid from master cylinder front reservoir.
- (2) Raise vehicle.
- (3) Remove front wheel and tire.
- (4) Bottom caliper piston in bore. Insert screwdriver between piston and inboard shoe and press piston into bore. If piston is difficult to move using screwdriver, use large C-clamp.
- (5) Remove caliper mounting bolts using hex wrench (fig. 2G-32).
- (6) Remove caliper by lifting it upward and out of shield and support (fig. 2G-33). Place caliper on front spring or other suitable support. Do not allow brake hose to support weight of caliper.
- (7) Remove brakeshoes from caliper.
- (8) Remove support spring from inboard shoe. Note spring position for assembly reference (fig. 2G-33).



**Fig. 2G-32 Caliper Mounting Bolt Removal**



**Fig. 2G-33 Caliper Removal**

- (9) Remove sleeves and rubber bushings from mounting bolt bores in caliper mounting ears (fig. 2G-27).
- (10) Clean mounting bolts, bolt bores, and bushing grooves in caliper mounting ears with brake cleaning solvent. Replace mounting bolts if corroded or if threads are damaged.

**NOTE:** Do not use abrasives to clean or polish the mounting bolts. Abrasives will destroy the protective plating on the bolts.

- (11) Clean caliper interior and dust boot using shop cloths only. Inspect dust boot for cuts, cracks, and for proper seating in piston bore. If evidence of fluid leakage is noted during inspection, overhaul caliper.

**CAUTION:** Do not use compressed air to clean the caliper interior or dust boot. The force of compressed air will unseat the boot. Use shop cloths only.

- (12) Lubricate replacement bushings, sleeves, bushing grooves, and small ends of mounting bolts with silicone lubricant.

- (13) Install rubber bushings in caliper mounting ears.

**CAUTION:** Do not use the original old bushings or sleeves. Use replacement parts only.

- (14) Install sleeves in inboard mounting ears of caliper. Position sleeves with sleeve end facing shoe and lining flush with machined surface of mounting ear.
- (15) Install support spring on inboard shoe. Place single tang end of spring over notch in shoe (fig. 2G-34).
- (16) Install inboard shoe in caliper (fig. 2G-35). Be sure shoe is flush against piston and that support spring is fully seated in piston (fig. 2G-35).

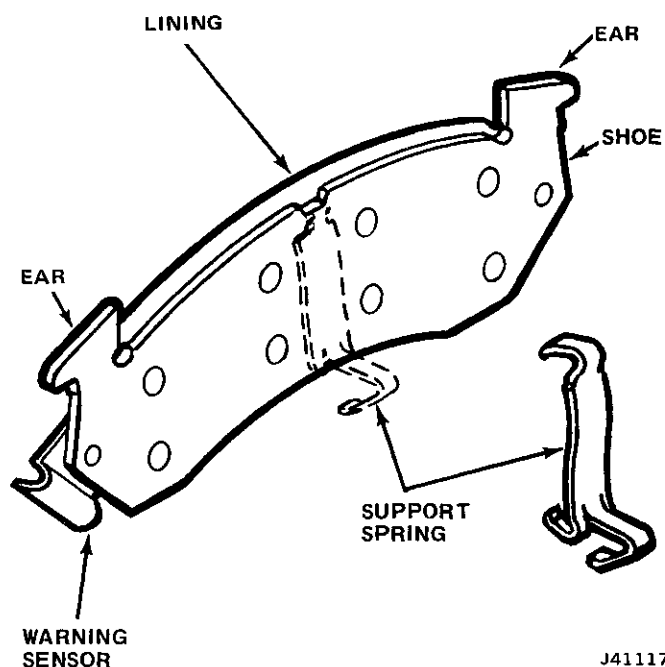


Fig. 2G-34 Support Spring Installation

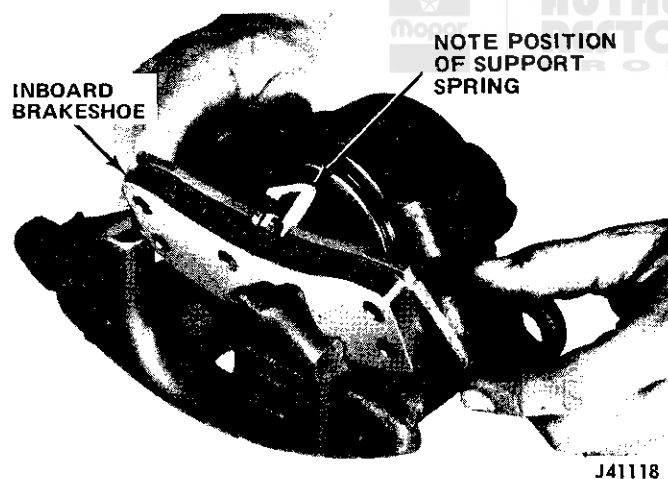


Fig. 2G-35 Inboard Brakeshoe Installation

(17) Install outboard shoe. Shoe ears should rest on upper surface of caliper mounting ears and lower shoe tab should fit into cutout in caliper. Be sure shoe is fully seated.

(18) Position caliper over rotor and in support shield and bracket. Align mounting holes in caliper and bracket.

(19) Install caliper mounting bolts. Be sure bolts pass under inboard shoe retaining ears and insert bolts until they enter bores in outboard shoe and caliper mounting ears. Thread bolts into support bracket and tighten to 35 foot-pounds (47 N•m) torque.

(20) Fill master cylinder with brake fluid and pump brake pedal to seat shoes.

(21) Clinch upper ears of outboard shoe until radial clearance between shoe and caliper is eliminated.

**NOTE:** Outboard shoes with formed ears are designed for original installation only and are fitted to the caliper. These shoes should never be relined or reconditioned for future installation.

(22) Install wheel and tire.

(23) Lower vehicle.

(24) Check master cylinder fluid level. Add fluid as required to within 1/4 inch (6.35 mm) of reservoir rim.

(25) Apply brakes several times to seat brakeshoes.

(26) Check and correct master cylinder fluid level as necessary.

(27) Test brake operation before moving vehicle.

## CALIPER OVERHAUL — CHEROKEE-WAGONEER-TRUCK MODELS

### Removal

(1) Remove two-thirds of brake fluid from master cylinder front reservoir.

(2) Raise vehicle.

(3) Remove wheel and tire.

(4) Bottom caliper piston using screwdriver or large C-clamp.

(5) Clean brake line hose connection thoroughly using shop cloth.

(6) Disconnect brake line at caliper. Remove brake line bolt and copper gaskets. Discard copper gaskets.

(7) Cap or tape open end of brake hose to prevent dirt entry.

(8) Remove caliper and remove brakeshoes from caliper.

**NOTE:** Work on one caliper at a time only. If shoes are to be reused, mark their location for assembly reference.

### Disassembly

(1) Clean caliper exterior with brake cleaning solvent.

(2) Drain remaining fluid from caliper and place caliper on clean work surface.

(3) Pad caliper interior with clean shop cloths (fig. 2G-36).

(4) Insert air nozzle into caliper fluid inlet hole and slowly apply just enough air pressure to ease piston out of bore (fig. 2G-36).

**WARNING:** Do not, under any circumstances, place fingers in front of the piston in an attempt to catch or protect it. In addition, use only enough air pressure to ease the piston out of the bore. Excessive air pressure can eject the piston with enough force to cause damage or injury.

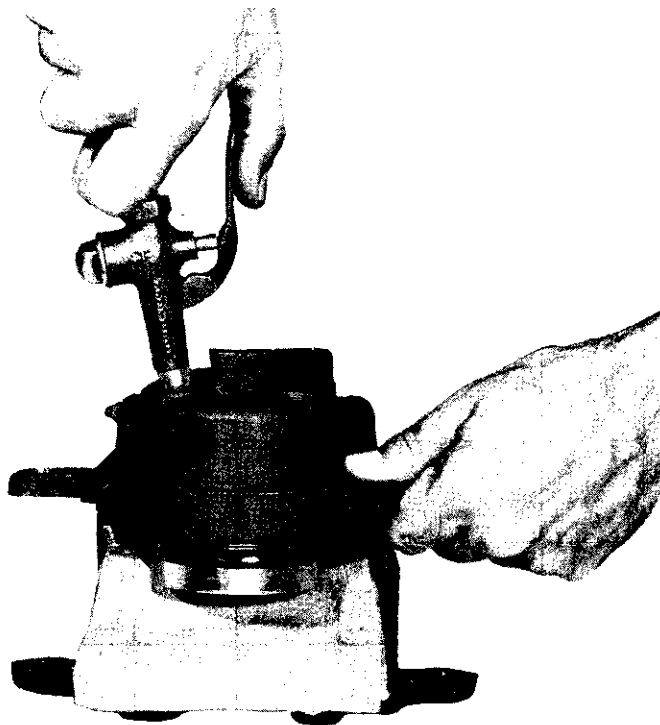


Fig. 2G-36 Piston Removal

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(5) Remove and discard dust boot. Use screwdriver to pry boot from bore (fig. 2G-37). Do not scratch piston bore during boot removal.

(6) Remove and discard piston seal. Use pencil or similar wood implement to remove seal (fig. 2G-38).

**CAUTION:** Remove the seal using a pencil, wooden stick, piece of plastic, or similar tool only. Do not use a metal tool or similar object to remove the seal as the bore could be scored.

(7) Remove bleeder screw.

(8) Remove and discard sleeves and rubber bushings from caliper mounting ears.

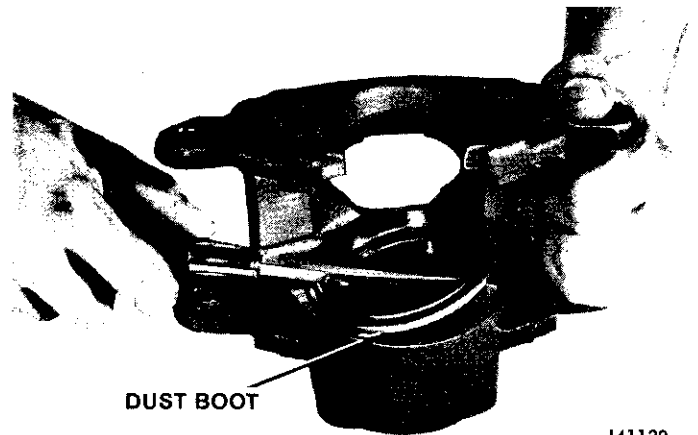
### Cleaning and Inspection

Clean all parts in brake cleaning solvent or clean brake fluid only. Blow out all caliper passages using filtered compressed air only.

Replace the mounting bolts if corroded or if the threads are damaged. Do not attempt to clean or polish the mounting bolts with abrasives as the protective plating will be removed.

Inspect the caliper piston. Replace the piston if nicked, scratched, corroded, or if the protective plating has worn off.

**CAUTION:** Do not attempt to refinish the piston in any way. The outside diameter is the sealing surface and is manufactured to very close tolerances. Removal of the nickel-chrome protective plating will lead to pitting, rusting, and eventual piston seizure.



DUST BOOT

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Fig. 2G-37 Dust Boot Removal

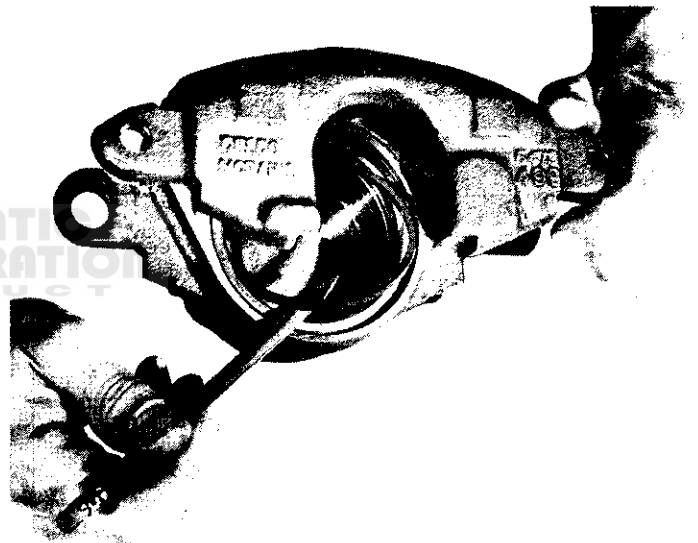


Fig. 2G-38 Piston Seal Removal

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Inspect the piston bore. Replace the caliper if the bore is nicked, scratched, worn, cracked, or badly corroded. However, minor stains or corrosion can be removed using crocus cloth.

**CAUTION:** Do not use emery cloth or similar abrasives on the piston bore. If the bore does not clean up with crocus cloth, replace the caliper. Clean the caliper thoroughly with brake fluid or brake cleaning solvent if the bore was polished.

### Assembly

(1) Lubricate piston bore and replacement seal with brake fluid.

(2) Install seal in bore groove. Work seal into groove using fingers only.

(3) Lubricate piston with brake fluid.

(4) Install replacement dust boot on piston. Slide metal retainer portion of boot over open end of piston and pull boot rearward until rubber boot lip seats in piston groove (fig. 2G-39).

(5) Push metal retainer portion of boot forward until retainer is flush with rim at open end of piston and boot fold snaps into place (fig. 2G-40).

(6) Insert piston into bore and into piston seal. Do not unseat seal.

(7) Press piston to bottom of bore using hammer handle. Approximately 50 to 100 pounds (23 to 45 kg) of force is required to bottom piston in bore.

(8) Seat metal retainer portion of dust boot in counterbore at upper end of piston bore using tool J-22904 (fig. 2G-41).

**CAUTION:** *The metal portion of the dust boot must be seated evenly and below the face of the caliper.*

(9) Install bleeder screw. Tighten screw securely but not to required torque until brakes have been bled.

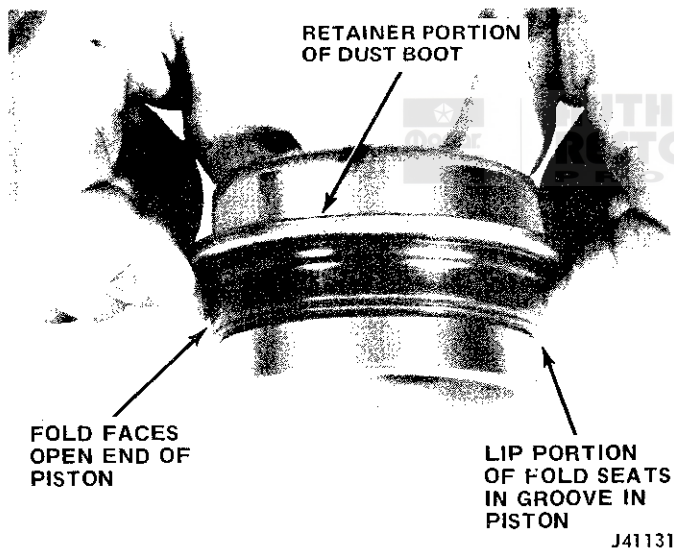


Fig. 2G-39 Installing Dust Boot on Piston

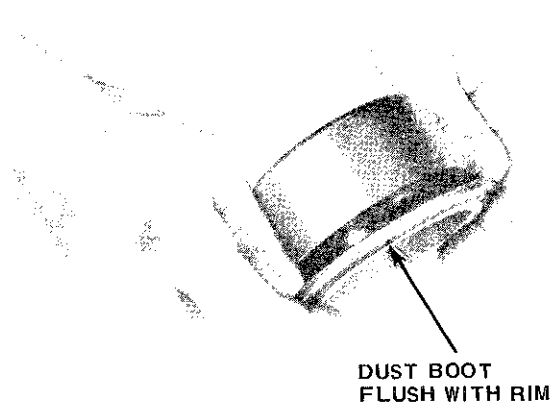


Fig. 2G-40 Snapping Dust Boot Fold In Place

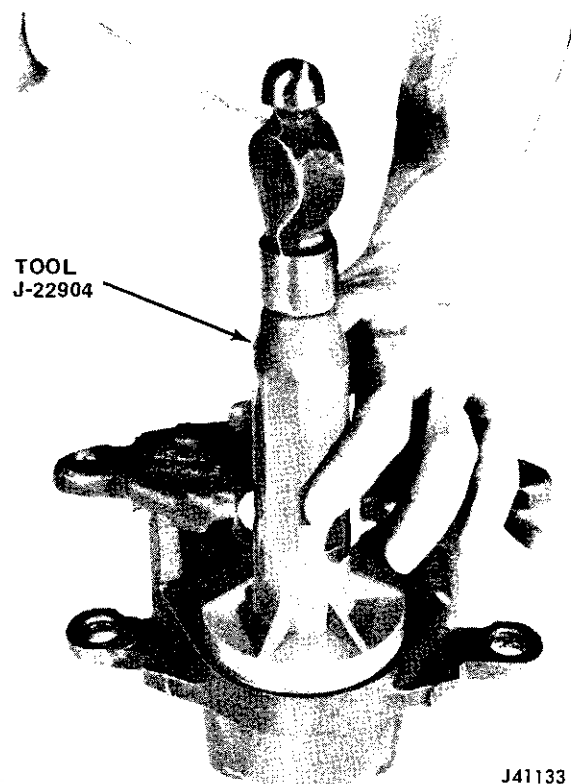


Fig. 2G-41 Seating Dust Boot In Counterbore

### Installation

- (1) Install replacement copper gaskets on brake line and connect line to caliper. Tighten brake line bolt to 160 inch-pounds (18 N•m) torque.
- (2) Install brakeshoes, and replacement sleeves and bushings as outlined in Brakeshoe Replacement.
- (3) Position caliper on rotor and support bracket and install caliper mounting bolts. Tighten bolts to 35 foot-pounds (47 N•m) torque.
- (4) Bleed brakes as outlined in Brake Bleeding.
- (5) Install wheel and tire.
- (6) Lower vehicle.
- (7) Check brake operation before moving vehicle.

### BRAKESHOE REPLACEMENT—CJ MODELS

**WARNING:** *When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning brake parts with a dry brush or with compressed air. Use a water dampened cloth only to remove dirt and dust from brake parts prior to disassembly. Many brake parts contain asbestos fibers which can become airborne if dust is created during service operations. Breathing dust containing asbestos fibers may cause serious bodily harm.*

- (1) Remove and discard two thirds of fluid from largest master cylinder reservoir.
- (2) Remove hub cap and loosen wheel retaining nuts.

## 2G-46 BRAKES

- (3) Raise vehicle.
- (4) Remove front wheels.

**NOTE:** *Work on one caliper at a time only.*

(5) Press caliper piston to bottom of bore using screwdriver (fig. 2G-42). If piston is difficult to move, use large C-clamp.

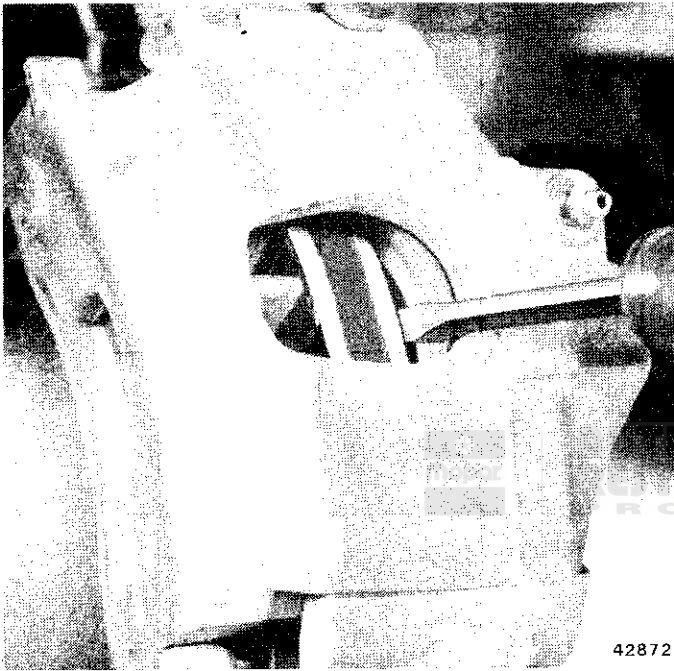
(6) Remove caliper support key retaining screw using 1/4 hex wrench (fig. 2G-43).

(7) Remove caliper support key and spring using punch and hammer (fig. 2G-44).

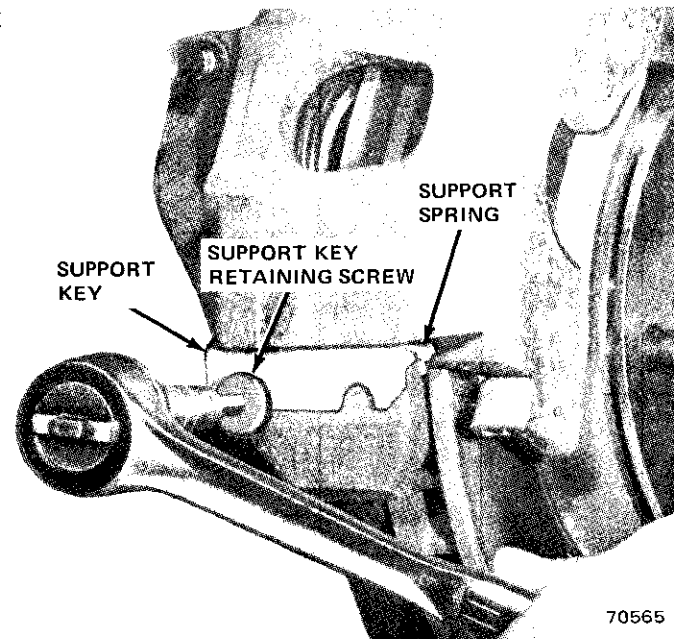
(8) Lift caliper upward and out of anchor plate and off of rotor (fig. 2G-45).

(9) Place caliper on front suspension spring. Do not let brake hose support weight of caliper.

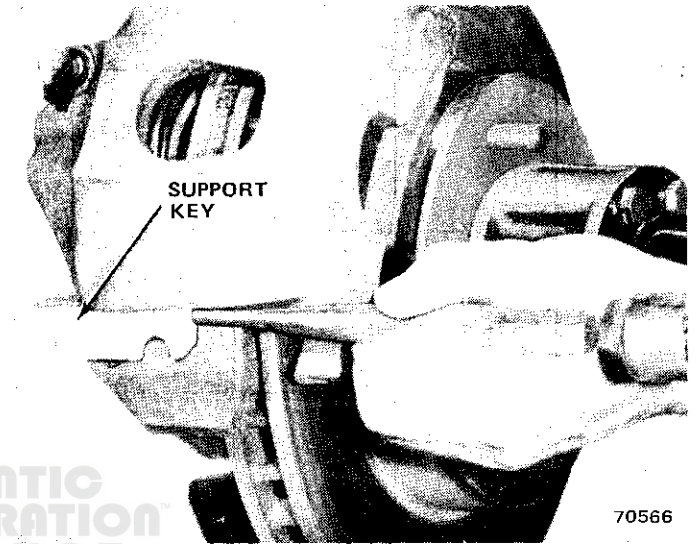
(10) Remove inboard brakeshoe from anchor plate (fig. 2G-46).



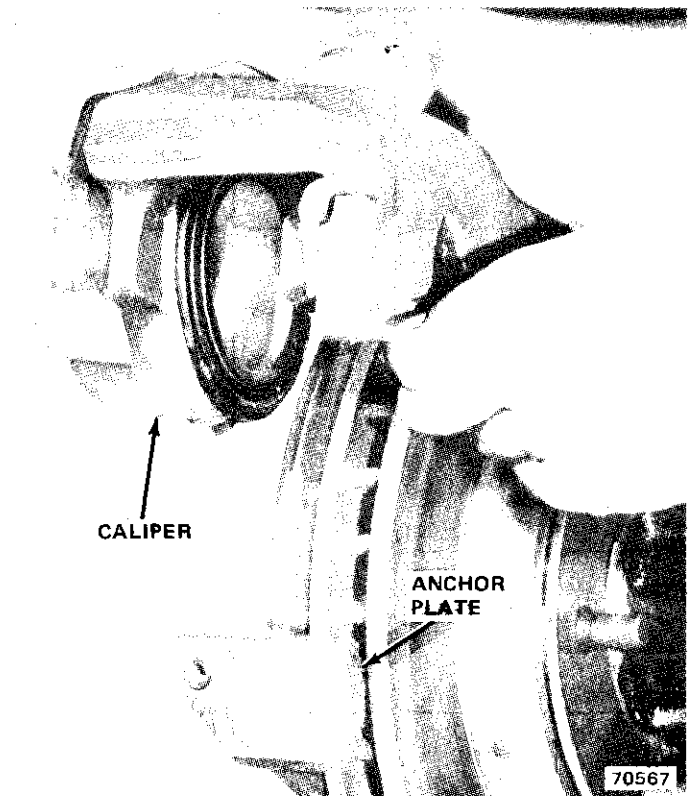
**Fig. 2G-42** Bottoming Caliper Piston



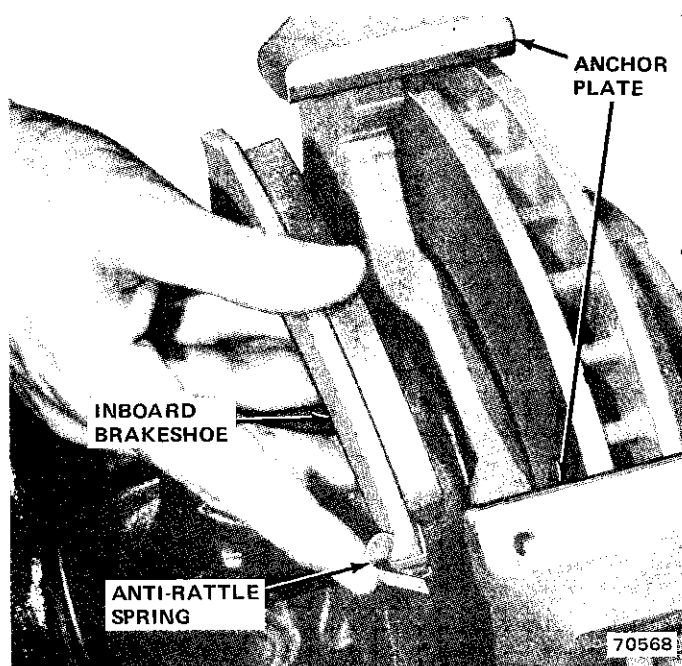
**Fig. 2G-43** Support Key Retaining Screw Removal



**Fig. 2G-44** Support Key and Spring Removal



**Fig. 2G-45** Caliper Removal/Installation



**Fig. 2G-46 Inboard Brakeshoe and Anti-Rattle Spring Removal**

(11) Remove anti-rattle spring from inboard brakeshoe (fig. 2G-46). Note spring position for assembly reference.

(12) Remove outboard brakeshoe from caliper.

(13) Clean caliper interior using shop cloths only.

**CAUTION:** Do not use compressed air to clean the caliper interior. The force of compressed air is enough to dislodge or damage the dust boot.

(14) Inspect caliper for evidence of leakage from piston bore. If leakage is evident, overhaul caliper. Refer to Caliper Overhaul—CJ Models.

(15) Inspect abutment (sliding) surfaces of caliper and anchor plate for rust or corrosion (fig. 2G-47). Clean these surfaces using stiff wire brush and fine grit sandpaper and lubricate them with molydisulphide grease.

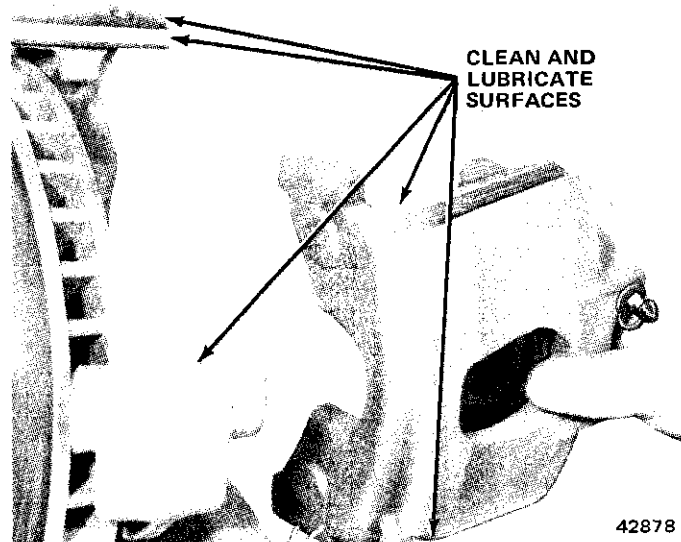
**CAUTION:** It is important that the abutment surfaces be clean, smooth, and lubricated with molydisulphide grease. Rust, corrosion, or foreign material on these surfaces will impair the sliding action of the caliper in the anchor plate.

(16) Install inboard brakeshoe anti-rattle spring on rear flange of inboard brakeshoe. Be sure looped section of spring faces away from rotor (fig. 2G-47).

(17) Install assembled inboard brakeshoe and anti-rattle spring in caliper anchor plate (fig. 2G-46). Do not dislodge anti-rattle spring during shoe installation.

(18) Install outboard brakeshoe in caliper (fig. 2G-48).

(19) Install caliper over rotor and in anchor plate (fig. 2G-45).



**Fig. 2G-47 Abutment Surfaces**



**Fig. 2G-48 Installing Anti-Rattle Spring On Inboard Brakeshoe**

**CAUTION:** Be very careful to avoid tearing or dislodging the dust boot when installing the caliper. A damaged or displaced boot will expose the caliper piston to road splash resulting in corrosion and eventual piston seizure.

(20) Align caliper and anchor plate and insert support key and spring between abutment surfaces at trailing end of caliper (fig. 2G-43).



(21) Complete installation of support key and spring using hammer and punch.

(22) Install support key retaining screw and tighten screw to 15 foot-pounds (20 N•m) torque. Be sure screw is properly seated in support key notch before tightening.

(23) Fill master cylinder reservoir to within 1/4 inch (6.35 mm) of reservoir rim.

(24) Press firmly on brake pedal several times to seat shoes.

(25) Install wheels and tires.

(26) Lower vehicle.

(27) Recheck master cylinder fluid level and correct if necessary.

**CAUTION:** Check for a firm brake pedal before moving the vehicle.

### CALIPER OVERHAUL—CJ MODELS

#### Removal

(1) Remove two-thirds of brake fluid from master cylinder front reservoir.

(2) Remove hub cap and loosen wheel retaining nuts.

(3) Raise and support vehicle.

(4) Remove front wheels.

**NOTE:** Work on one caliper at a time only.

(5) Clean caliper brake line fitting thoroughly.

(6) Disconnect brake line at caliper. Remove brake line bolt and washers. Discard washers. Cover open end of brake line with cloth or tape.

(7) Remove caliper and brakeshoes as outlined in Brakeshoe Replacement—CJ Models.

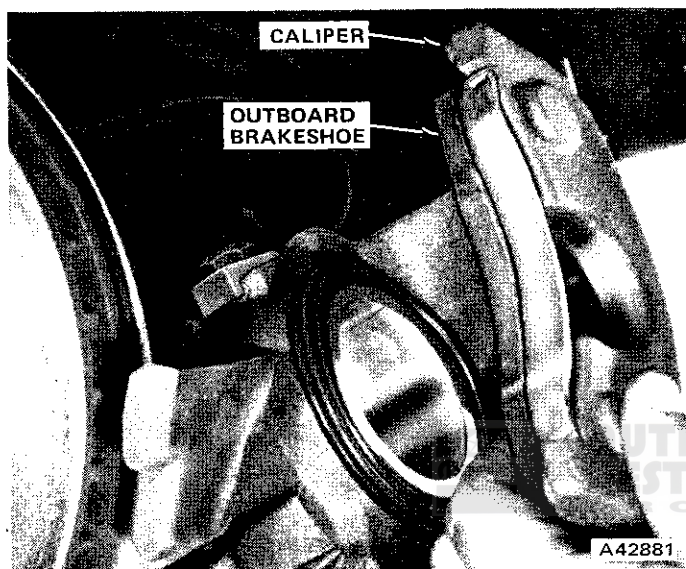
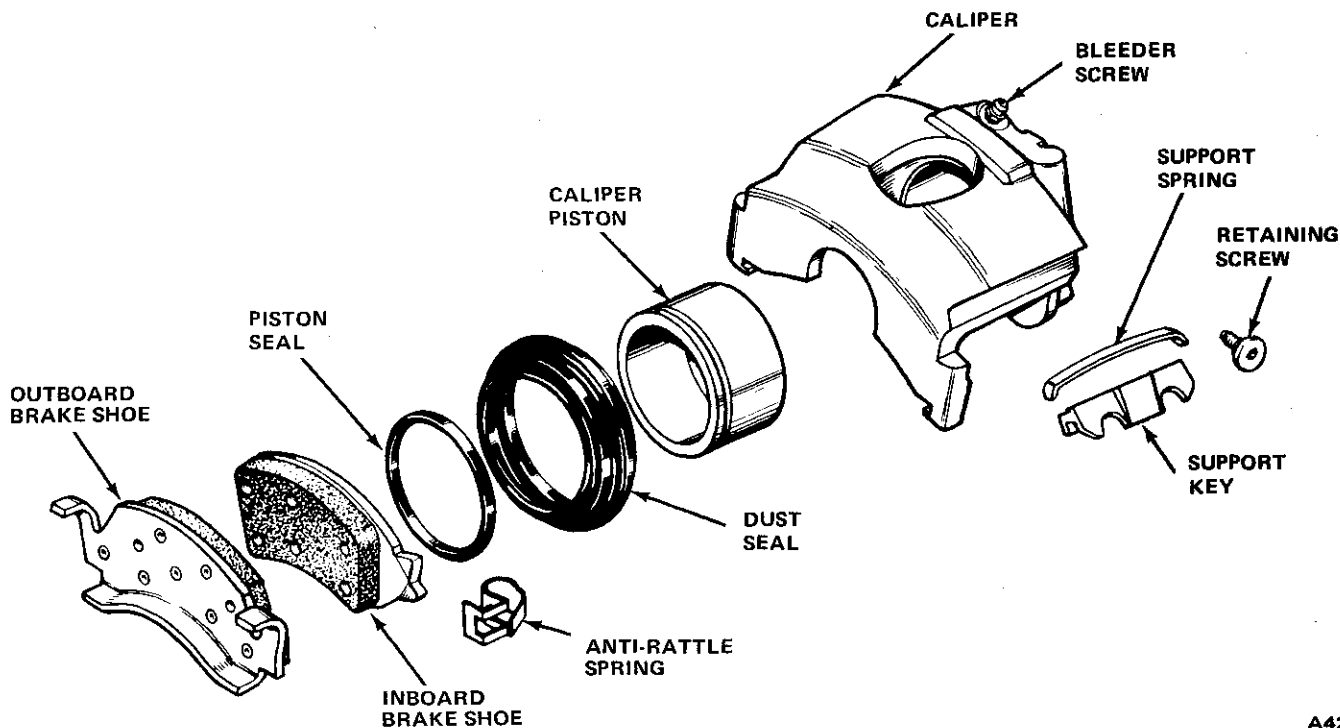


Fig. 2G-49 Outboard Brakeshoe Installation



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Fig. 2G-50 Caliper Assembly—CJ Models

## Disassembly

- (1) Drain remaining fluid from caliper and place caliper on clean work surface.
- (2) Pad caliper interior with shop cloths (fig. 2G-51).
- (3) Insert air nozzle in caliper fluid inlet port and slowly apply just enough air pressure to ease piston out of bore.

**WARNING:** Do not, under any circumstances, place fingers in front of the piston in an attempt to catch or protect it. In addition, use only enough air pressure to ease the piston out of the bore. Excessive air pressure can eject the piston with enough force to cause damage or personal injury.

- (4) Remove and discard dust boot.
- (5) Remove piston seal from bore using plastic or wood tool only. Discard piston seal.

**CAUTION:** Do not use metal tools to remove the piston seal. Metal tools may damage the piston bore.

- (6) Remove bleeder screw protective cap and bleeder screw.

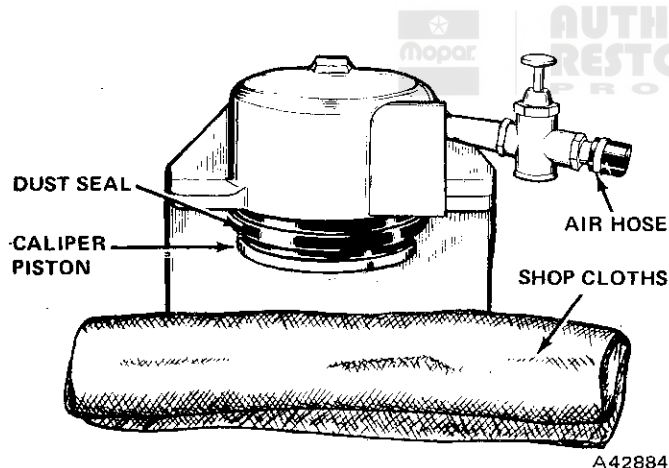


Fig. 2G-51 Caliper Piston Removal

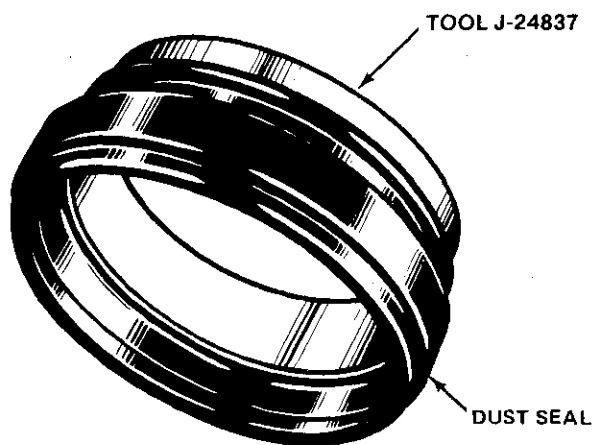


Fig. 2G-52 Positioning Dust Seal On Installer Tool

## Cleaning and Inspection

Remove rust and corrosion from the caliper and anchor plate abutment surfaces using a wire brush and fine grit sandpaper and lubricate these surfaces with molydisulphide grease (fig. 2G-47).

Clean the caliper and piston with brake cleaning solvent and dry both parts using filtered compressed air. Be sure to blow out all passages in the caliper.

Inspect the caliper piston for damage. Replace the piston if worn, scored, pitted, or corroded.

Inspect the caliper for damage. Replace the caliper if the bore or seal grooves are worn, nicked, pitted, or badly corroded. Minor corrosion in the bore can be removed using a fiber brush only.

Inspect the anti-rattle spring, support key, support key spring, and support key retaining screw. Replace any parts that are damaged or worn. Replace the support spring and anti-rattle springs if they are flattened, distorted, or lack tension.

PRESS SEAL LIP  
FIRMLY INTO GROOVE

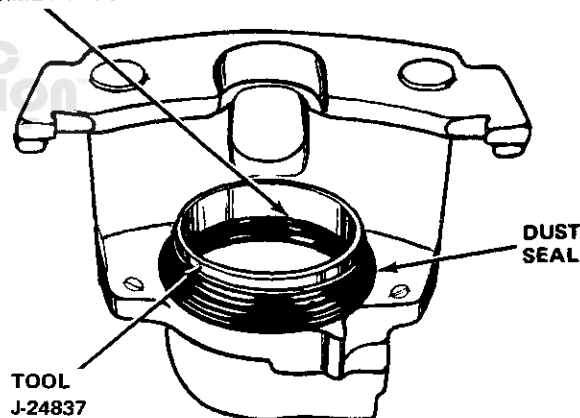


Fig. 2G-53 Dust Seal Installation

## Assembly

- (1) Lubricate piston bore and replacement piston seal with brake fluid.
- (2) Install piston seal in bore. Work seal into groove using fingers only.
- (3) Install bleeder screw and protective cap.
- (4) Install caliper piston and replacement dust boot using Installer Tool J-24837. Refer to Piston and Boot Replacement with Installer Tool J-24837.

**NOTE:** If a boot installer tool is not available, refer to Piston and Boot Installation without Installer Tool.

### Piston and Boot Installation with Installer Tool J-24837

- (1) Lubricate piston and replacement dust boot with brake fluid.

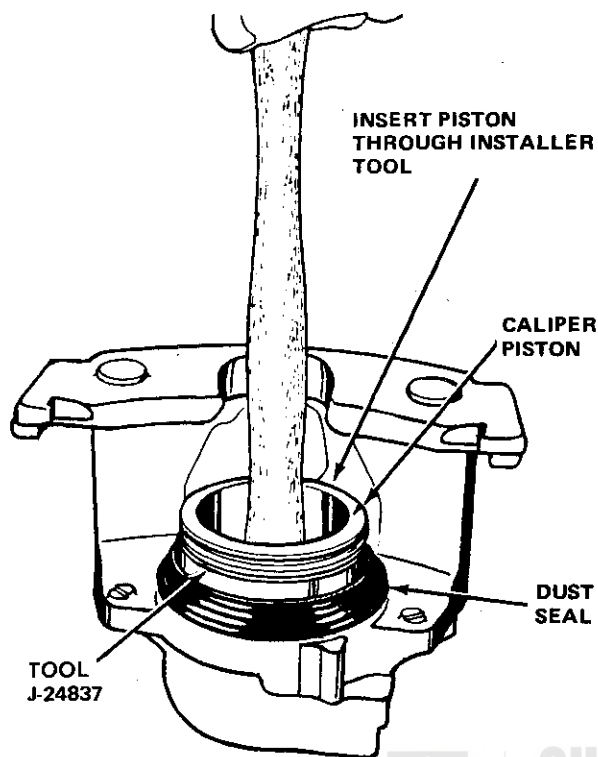


Fig. 2G-54 Caliper Piston Installation

(2) Mount dust boot on Installer Tool J-24837 (fig. 2G-52). Allow approximately 1/4 inch (6.35 mm) of tool to extend beyond small lip of dust boot.

(3) Position assembled boot and installer tool over piston bore. Reach through installer tool and work large lip of boot into boot groove in upper edge of piston bore (fig. 2G-53). Be sure boot is completely seated in groove.

(4) Lubricate caliper piston with brake fluid.

(5) Insert piston through installer tool and center piston in bore.

(6) Press piston half-way into bore. Use hammer handle and steady pressure to install piston (fig. 2G-54). Do not strike hammer handle or piston to install. Piston must be pressed into bore only.

(7) Remove boot installer tool.

(8) Seat rubber lip of dust boot in piston groove.

(9) Press piston to bottom of bore using hammer handle.

(10) Inspect rotor and install caliper and brakeshoes. Refer to Installation.

#### Piston and Boot Installation without Installer Tool

(1) Lubricate piston bore with brake fluid.

(2) Position dust boot on piston bore. Do not lubricate boot.

(3) Reach through top of boot and work large lip of boot into boot groove at upper edge of bore. Be sure boot is completely seated in groove.

(4) Lubricate piston and small lip of dust boot with brake fluid.

(5) Position piston over small lip of boot.

(6) Hold piston in position over boot lip and direct reduced air pressure of approximately 15 psi (112 kPa) compressed air into caliper fluid inlet port.

**NOTE:** Reduce air pressure to a maximum of 15 psi (112 kPa) by closing air supply valve completely; then opening it approximately 1/4 to 1/2 turn.

(7) As air pressure expands boot, carefully work piston into boot until boot lip seats in piston groove. When boot lip is seated in piston groove, release air pressure.

(8) Press piston to bottom of bore using hammer handle.

(9) Inspect rotor and install caliper and brakeshoes. Refer to Installation.

#### Installation

(1) Check rotor lateral runout and thickness variation. Inspect rotor for scoring, cracks, and broken ventilating ribs. Refer to Rotor Service for procedures.

(2) Install brakeshoes and caliper. Refer to Brake Shoe Replacement—CJ Models.

(3) Install replacement washers on brake line connector or fitting and connect brake line to caliper. Tighten brake line bolt to 160 inch-pounds (18 N•m) torque. Or, if equipped with brake line fitting, tighten fitting to 25 foot-pounds (34 N•m) torque.

(4) Fill master cylinder to within 1/4 inch (6.35 mm) of reservoir rims.

(5) Press brake pedal firmly several times to seat brakeshoes.

(6) Refill master cylinder if necessary and bleed brakes. Refer to Brake Bleeding.

(7) Install wheels.

(8) Lower vehicle.

(9) Check brake operation before moving vehicle.

#### ROTOR SERVICE

The hub and rotor are cast as a single unit. The hub contains the wheel bearings and wheel mounting studs. The hollow-cast rotor section has integral ventilating fins and provides the contact surfaces that the brakeshoes are pressed against.

The hub and rotor are serviced as an assembly only. If either section is damaged, replace the complete assembly.

Rotor service is extremely important because rotor tolerances must be accurate to ensure proper brake operation. Rotor service involves inspection, measurement, and refinishing or replacement where indicated.

#### Inspection

(1) Raise vehicle and remove wheels.

(2) If rotor braking surfaces are heavily rusted or scaled, clean the surfaces as follows before attempting further inspection or measurement:

(a) Remove rotor and mount it in brake lathe.  
 (b) Clean surfaces using flat sanding discs while rotor is turning in lathe.

(c) Reinstall rotor when surfaces are clean.

(3) Check braking surfaces for cracks, nicks, wear, hard spots, broken ventilating fins, and deep scoring. Some scoring may occur during normal use. However, scoring that is 0.009 inch (0.22 mm) deep (CJ models) or 0.015 inch (0.38 mm) deep (all other models) is not detrimental to brake operation.

(4) If vehicle had developed unexplained vibration or slight front end shimmy, check for missing rotor balance weight. Weight consists of small section of formed metal that is pressed into space between two ventilating fins.

**CAUTION:** Do not remove the rotor balance weight for any reason.

(5) Replace rotor if cracked or broken.

(6) If rotor condition is acceptable, proceed to Measurement.

### Measurement

(1) Tighten wheel bearing adjusting nuts enough to remove all end play from front wheel bearings.

(2) Measure rotor lateral (face) runout:

(a) Mount dial indicator on support stand or wheel spindle so indicator stylus contacts rotor outboard surface approximately one inch from outer edge (fig. 2G-55).

(b) Turn rotor 360 degrees and note indicator reading.

(c) Lateral runout must not exceed 0.005 inch (0.12 mm). Lateral runout will cause rotor wobble resulting in chatter, vibration, pedal pulsation, and excessive pedal travel (wobbling rotor will contact brakeshoes and knock caliper pistons back into bore).

(d) If lateral runout exceeds tolerances, replace or refinish rotor.

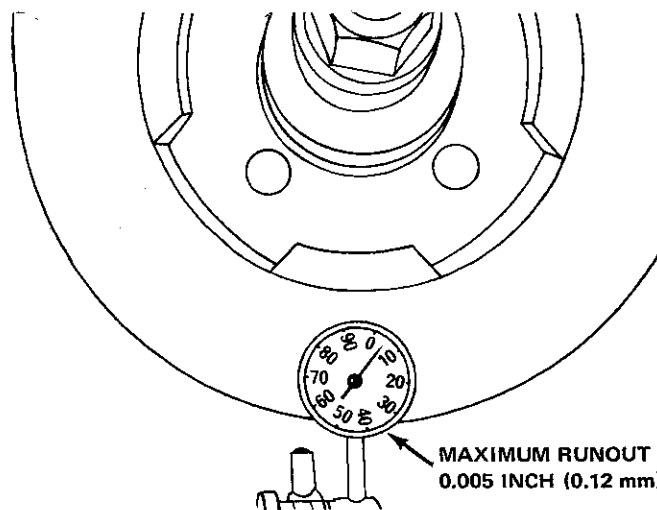
(3) Measure rotor thickness variation:

(a) Using micrometer or two dial indicators, measure rotor thickness at four equally spaced points around rotor circumference (fig. 2G-56). Take measurements approximately one inch (2.54 cm) in from outer edge of rotor.

(b) Thickness variation must not exceed 0.001 inch (0.02 mm) on any model. Thickness variations can cause pedal pulsation and vibration during brake applications.

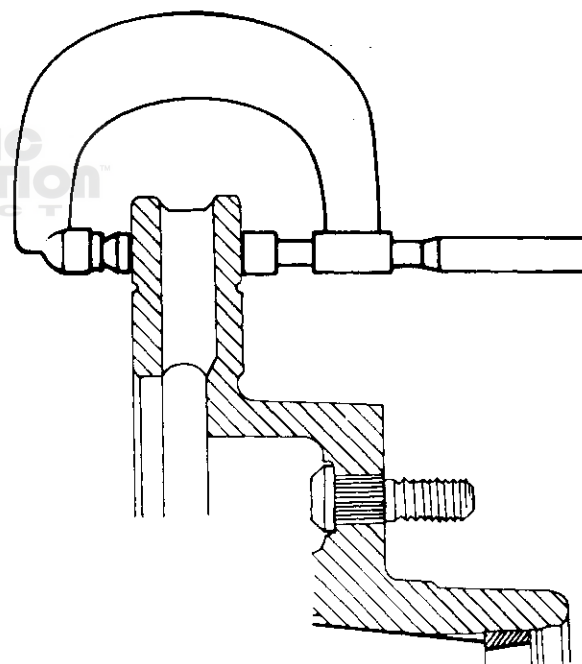
(c) If thickness variation exceeds tolerance, replace or refinish rotor.

(4) Measure hub-to-bore runout. Wheel mounting surface of hub must be square with centerline of bearing cup bore to within 0.010 inch (0.25 mm) on all models (fig. 2G-57).



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Fig. 2G-55 Checking Lateral Runout



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Fig. 2G-56 Checking Thickness Variation

(a) Mount dial indicator on spindle so indicator stylus contacts wheel mounting surface of hub.

(b) Rotate hub and note indicator reading.

(c) Replace hub and rotor if runout exceeds tolerance.

**NOTE:** Although hub-to-bore runout does not affect brake operation or action, it can cause a mechanical-type vibration at higher speeds. Measure hub-to-bore runout only if the vehicle has an unexplained high speed vibration, or if there is excessive front wheel lateral runout.

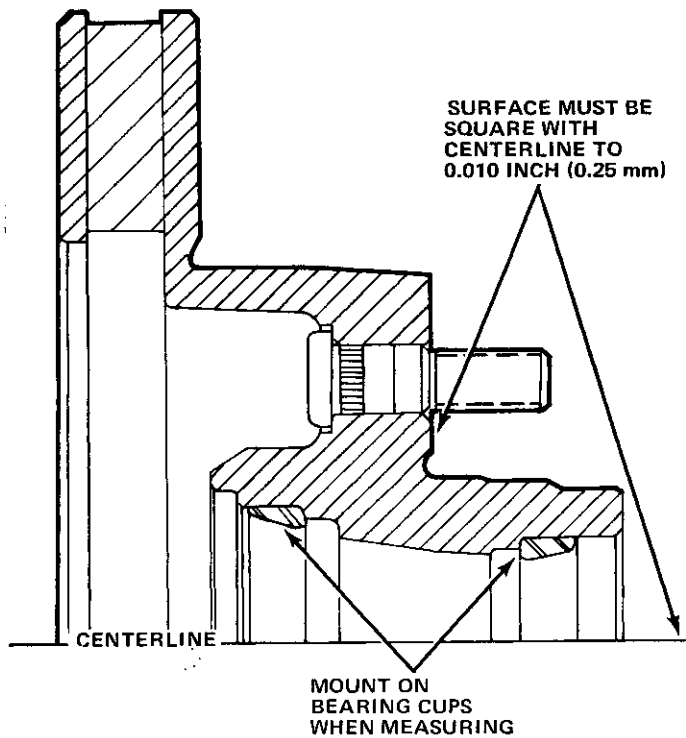


Fig. 2G-57 Checking Hub-To-Bore Runout

(5) If rotor surfaces are not scored or otherwise damaged and measurements are within tolerance, rotor can be reused without further servicing.

(6) If rotor surfaces are rusted or scaled, or only lightly scored and rotor meets all measurement tolerances, resurface rotor. Refer to Rotor Refinishing.

### Rotor Refinishing

If the rotor surfaces are within specified tolerances and are only lightly scored or rusty and scaled, a brake lathe and flat sanding discs are all that is needed to restore the surface finish.

If the rotor surfaces are heavily scored or not within tolerance, the rotor will have to be turned in a brake lathe to restore the surface finish and meet required tolerances. When machining a rotor, be sure to follow the lathe manufacturers operating instructions explicitly.

The correct rotor surface finish is 15 to 80 micro inches for CJ models and 20 to 60 micro inches for all other models. The finished rotor surface must form a nondirectional crosshatch pattern. A directional type of pattern is not desirable. After machining a rotor, use flat sanding discs to generate the desired microfinish and crosshatch pattern (fig. 2G-58).

When rotor resurfacing or refinishing operations are completed, recheck lateral runout, thickness variation, and overall thickness to be sure the rotor meets all specified tolerances.

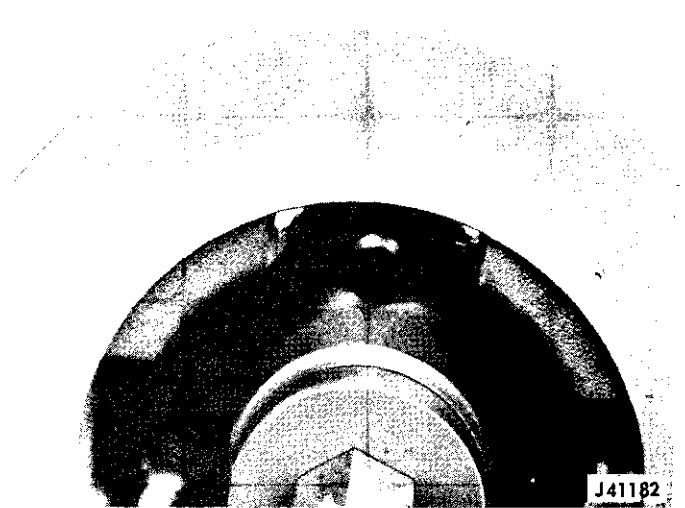


Fig. 2G-58 Correct Rotor Finish (Nondirectional Crosshatch Pattern)

### Rotor Replacement Thickness

Replace the rotor if refinishing will cause the rotor to fall below the minimum thickness specification of 0.815 inches (20.7 mm) on CJ models or 1.215 inches (30.8 mm) on Cherokee, Wagoneer and Truck models. Do not attempt to use a rotor that does not meet this specification.

### Rotor Replacement—CJ Models

#### Removal

- (1) Raise and support vehicle.
- (2) Remove caliper. Refer to Brakeshoe Replacement—CJ Models.
- (3) Remove hub cap.
- (4) Remove hub cover attaching bolts and remove cover and gasket.
- (5) Remove drive flange snap ring and remove drive flange.
- (6) Straighten lip of outer locknut retaining washer.
- (7) Remove outer locknut and retaining washer, and inner locknut and retaining washer.
- (8) Remove rotor.
- (9) Remove wheel bearings from rotor.

#### Installation

- (1) Lubricate wheel bearings with EP-type, water proof wheel bearing lubricant.
- (2) Install wheel bearings and replacement grease seal in rotor.
- (3) Install rotor.
- (4) Install tabbed inner washer and inner locknut.
- (5) Install wheel but do not tighten wheel nuts completely.
- (6) Tighten inner locknut to 50 foot-pounds (68

N•m) torque using tool J-25103. Rotate wheel while tightening locknut to seat bearings uniformly.

(7) Back off inner locknut 1/3 turn.

(8) Install outer tabbed washer and outer locknut. Tighten locknut to minimum of 50 foot-pounds (68 N•m) torque and bend lip of tabbed washer over locknut.

(9) Install drive flange and retaining snap ring.

(10) Install gasket, hub cover, cover attaching bolts, and hub cap.

(11) Install caliper. Refer to Brakeshoe Replacement—CJ Models.

(12) Lower vehicle.

## Rotor Replacement—Cherokee-Wagoneer-Truck Models

### Removal

(1) Remove wheel cover, if equipped, and loosen wheel retaining nuts.

(2) Raise vehicle.

(3) Remove wheels.

(4) Remove caliper. Refer to Brakeshoe Replacement—Cherokee-Wagoneer-Truck Models.

(5) Remove rotor hub cap.

(6) Remove drive gear snap ring and remove drive gear, pressure spring, and spring cup.

(7) Straighten lip of outer locknut retaining washer.

(8) Remove wheel bearing outer and inner locknuts and retaining washers using tool J-6893.

(9) Remove rotor.

(10) Remove wheel bearings from rotor.

### Installation

(1) Lubricate wheel bearings with EP-type, waterproof wheel bearing lubricant.

(2) Install wheel bearings and replacement grease seal in rotor.

(3) Install rotor.

(4) Install inner locknut using tool J-6893.

**NOTE:** The bearing adjuster inner locknut has a locating peg on one side. When installed, this peg must face away from the bearing.

(5) Install wheel on rotor but do not tighten wheel nuts completely at this time.

(6) Tighten inner locknut to 50 foot-pounds (68 N•m) torque using tool J-6893. Rotate wheel while tightening locknut to seat bearings uniformly.

(7) Loosen and retighten inner locknut to 35 foot-pounds (47 N•m) torque. Rotate wheel while tightening locknut to maintain bearing seating.

(8) Back off inner locknut 1/3 turn while rotating wheel.

(9) Install retaining washer and outer locknut.

**NOTE:** Be sure the inner locknut locating peg is engaged in one of the retaining washer holes before installing the outer locknut.

(10) Tighten outer locknut to minimum of 50 foot-pounds torque (68 N•m) using tool J-6893.

(11) Install pressure spring cup.

**CAUTION:** The spring cup must be installed so the recessed side of the cup faces the outboard bearing and the flat side of the cup faces the pressure spring.

(12) Install pressure spring, drive gear and snap ring.

(13) Coat rim of chrome hub cap with Permatex Form-A-Gasket number 3 (or equivalent) and install cap in rotor hub.

(14) Remove wheel and install caliper. Refer to Brakeshoe Replacement—Cherokee-Wagoneer-Truck models.

(15) Reinstall wheel but do not tighten wheel nuts completely.

(16) Lower vehicle.

(17) Tighten wheel nuts to 75 foot-pounds (102 N•m) torque on Cherokee, Wagoneer and Truck. On 8400 GVW J-20 Truck, tighten nuts to 130 foot-pounds (176 N•m) torque.

(18) Install wheel cover if equipped.

## SPECIFICATIONS

### General Specifications

#### Caliper Piston Diameter:

CJ Models . . . . . 2.6 inches (6.60 cm)

Cherokee-Wagoneer-Truck . . . . . 2.94 inches (7.45 cm)

#### Minimum Rotor Thickness:

CJ Models . . . . . .815 inches (20.7 mm)

Cherokee-Wagoneer-Truck . . . . . 1.215 inches (30.86 mm)

#### Rotor Diameter:

CJ Models . . . . . 11.7 inches (29.7 cm)

Cherokee-Wagoneer-J10 Truck . . . . . 12.0 inches (30.48 cm)

J-20 Truck . . . . . 12.5 inches (31.75 cm)

#### Rotor Hub-To-Bore Runout Limit . . . . . 0.010 inches (0.25 mm)

Rotor Lateral Runout Limit . . . . . 0.005 inches (0.12 mm)

Rotor Thickness Variation . . . . . 0.001 inches (0.02 mm)

**Torque Specifications**

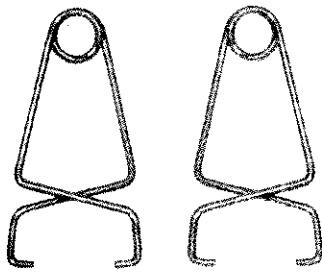
Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Caliper Mounting Bolts (Cke-Wag-Trk) . . . . .	35	30-40	47	41-54
Caliper Support Key Retaining Screw (CJ) . . . . .	15	15-18	20	20-24
Caliper Brake Line Fitting . . . . .	160 in-lbs.	150-170 in-lbs.	18	17-19
Disc Brake Shield Bolts (Cke-Wag-Trk) . . . . .	8	5-10	11	7-14
Disc Brake Shield Nuts (Cke-Wag-Trk) . . . . .	35	30-40	47	41-54
Front Wheel Bearing Adjusting Locknuts . . . . .	50	50-55	68	68-75
Wheel Retaining Lugnuts:				
CJ Models . . . . .	75	65-80	102	88-108
Cherokee—Wagoneer—J-10 Truck . . . . .	75	65-80	102	88-108
J-20 Truck (8400 GVW) . . . . .	130	110-150	176	149-203

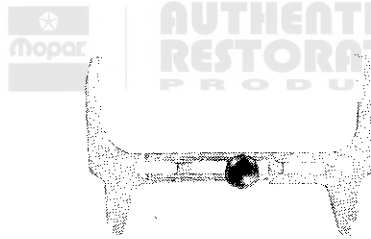
All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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**Tools**



**J-8002  
WHEEL CYLINDER CLAMPS**



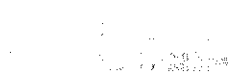
**J-21177  
DRUM BRAKE  
CLEARANCE GAUGE**



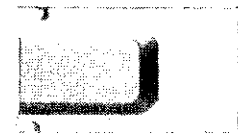
**J-8057  
BRAKE SPRING TOOL**



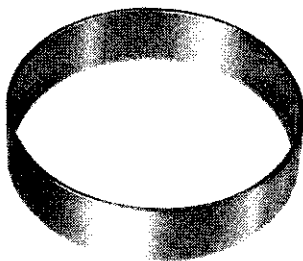
**J-22904  
DUST BOOT INSTALLER**



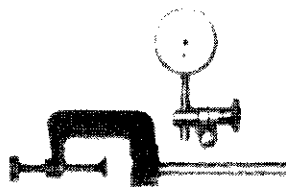
**J-23709  
METERING VALVE TOOL  
(TYPE-D VALVE)**



**J-26869  
METERING VALVE TOOL  
(TYPE-W VALVE)**



**J-24837  
CALIPER PISTON  
INSTALLER**



**J-8001  
DIAL INDICATOR SET**



**J-25133  
FRONT HUB  
FLANGE PULLER**

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# WHEELS AND TIRES

# 2H

## SECTION INDEX

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Tire Repair	2H-4	Wheel Maintenance and Condition	2H-5

### GENERAL

Jeep vehicles are equipped with American and Metric size, tubeless-type, pneumatic tires available in load ranges SL, B, C, and D. Standard equipment tires are of bias-ply or bias-belted construction. Radial-ply tires are available as an option on most models.

Standard equipment wheels are safety rim, drop center-types constructed entirely of steel. Optional wheels, which are available on most models, consist of forged aluminum wheels, wide rim spoke-type sport wheels, and chrome plated styled steel wheels.

Original equipment wheels and tires are tested and selected to provide the best all around performance for normal operation. To obtain optimum wheel/tire performance, tire inflation pressures must be maintained at recommended levels and wheel/tire condition should be checked regularly. This is especially important on vehicles equipped with the Quadra-Trac full-time four wheel drive transfer case.

### TIRE CONSTRUCTION

Three types of tire construction are currently in use. They are referred to as bias-ply, bias-belted, and radial-ply construction. The description for each construction-type is derived from the method used to position the tire cord plies in relation to the tread centerline.

#### Bias-Ply Construction

Bias-ply tires are constructed with the body cord plies extending from bead-to-bead and at an angle to the

tread centerline (fig. 2H-1). Alternate plies overlap one another at opposing angles.

#### Bias-Belted Construction

Bias-belted tires are constructed basically the same as bias-ply tires. However, in addition to the angled body cord plies, they also have belts that encircle the tire. These belts are located under the tire tread and extend from tread shoulder-to-tread shoulder (fig. 2H-1).

#### Radial-Ply Construction

Radial-ply tires, like bias-belted tires, also have belts under the tread which encircle the tire and extend from tread shoulder-to-tread shoulder. However, these tires are constructed with the body cord plies at right angles to the tread centerline. The plies cross the tread centerline at an angle of approximately 90 degrees (fig. 2H-1). Because the body cord plies radiate from the tread centerline, this type of construction is designated radial-ply.

#### Identifying Tire-Types

Radial tires are identified by the code letter R which appears in the size description imprinted on the tire sidewall. Bias-ply and bias-belted tires do not have such a code letter. For example, P225/75R-15 or HR78-15 for radial tires as compared to H78-15 for similar size bias-ply or bias-belted tires.

**NOTE:** As a result of their unique construction, radial tires have a highly flexible sidewall. This flexibility is



## 2H-2 WHEELS AND TIRES

responsible for the characteristic sidewall "bulge" which makes the tire appear to be underinflated. This is a normal condition for radial tires. Do not attempt to reduce this bulge by overinflating the tire. The only way to be sure a tire is properly inflated is to use an accurate and reliable tire pressure gauge. Check and adjust inflation pressures in accordance with the information provided in the Tire Inflation Pressure Chart at the end of this chapter.

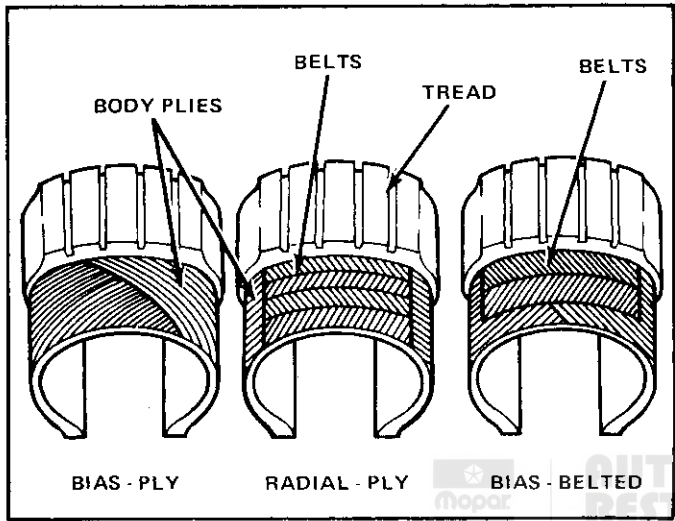


Fig. 2H-1 Types of Tire Construction

### TIRE SIZE AND LOAD RATING

American and metric tire sizes and tire load range ratings are indicated in the combination of letters and numbers imprinted on the tire sidewall such as: P225/75R-15 load range SL, H78-15 load range B, G78-15 load range D and 9.50-16.5 load range D. The load range rating replaces the ply rating system formerly used to denote tire load capacity. Original equipment tires used on Jeep vehicles are available in load range ratings SL, B, C, and D.

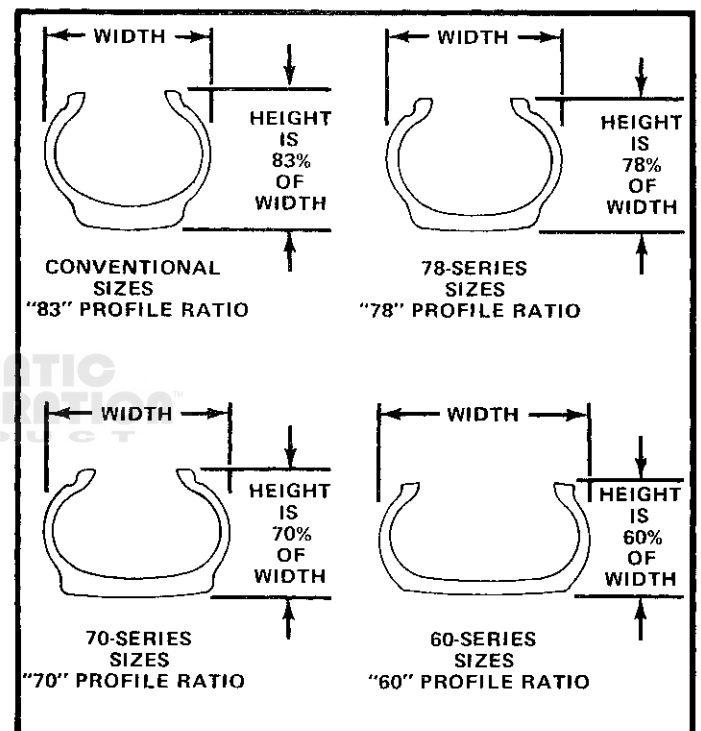
**NOTE:** The SL load range rating applied to the P225/75R-15 metric tire is equivalent to the current load range B rating.

Conventional size American tires are identified with numbers only such as 9.50-16.5. These numbers indicate approximate tire width and rim diameter in inches. For example, 9.50 represents tire sidewall-to-side-wall width and 16.5 the nominal wheel rim diameter required.

The newer American tire sizes are based on tire profile ratio and use letter-number combinations such as H78-15. In this case, letter H represents tire industry specifications for the load and inflation schedule for tires in this letter classification. The number 78 indicates tire section height as determined by the ratio of section height to sidewall-to-side-wall width. Or, height divided by width equals size or profile ratio. In this case,

the height of an H78 tire is equal to 78 percent of the width. This formula applies to all profile series tires (fig. 2H-2). The number 15 denotes the wheel rim diameter required.

Metric size tires also use letter-number combinations to indicate size and type. For example, with the P225/75R-15 tire, letter P indicates tire use is for passenger vehicle applications, 225 is the sidewall-to-side-wall width in millimeters, 75 is the profile ratio (height equals 75% of width), R indicates radial-ply construction and 15 the wheel rim diameter required stated in inches.



70223

Fig. 2H-2 Tire Size and Profile Ratio

### TIRE INFLATION PRESSURE AND CAPACITY

Original equipment tires used on Jeep vehicles are selected and tested to meet operating requirements within tire capacity. The recommended load capacities and inflation pressures for full or reduced load operation are listed in the Tire Inflation Pressure Chart at the end of this chapter. This information is also provided in the owners manual and on a label attached to the interior surface of the glove box door.

Tire inflation pressures are selected to be compatible with the load capacity, ride, and handling characteristics of a specific vehicle. In cases where a slightly softer ride is preferred, the driver may use reduced load pressures but must not exceed 55 mph (88 km/h) or reduced load vehicle capacity.

When sustained high speed operation is anticipated, tires may be inflated to recommended full load inflation pressures plus an additional 2 psi (14 kPa). However, inflation pressures must not exceed maximum recommended pressures.

Tire pressures should be checked and adjusted to recommended levels on a weekly basis. This is especially important when extreme changes of 20 degrees or more in average seasonal temperatures occur and is especially important on vehicles with Quadra-Trac.

**Adjusting Inflation Pressures**

Check and adjust inflation pressures only when the tires are cold, or driven for less than two miles at speeds below 40 mph (64 km/h), or after the vehicle has been parked for three hours or more.

Do not reduce inflation pressures if the tires are hot, or driven over two miles at speeds above 40 mph (64 km/h). At this stage, tire pressures may increase as much as 6 psi over cold inflation pressures due to air expansion caused by heat buildup in the tire.

When checking and adjusting inflation pressures, always use a reliable and accurate gauge to ensure proper inflation levels.

**ABNORMAL TIRE WEAR**

Abnormal tire wear may be caused by incorrect inflation pressures, tire-wheel unbalance, worn suspension components, improper brake operation, bent wheels, front wheel alignment, and excessive speed on turns.

In most cases, inspection of tire wear patterns will reveal the cause of abnormal wear. The various types of wear patterns and necessary corrective action are illustrated in Figure 2H-3.

Rapid wear of the tread shoulders is usually caused by underinflation or lack of rotation or a combination of

both. If this type of wear occurs and the tires are serviceable, rotate the tires and inflate them to recommended levels when they are cool.

Rapid wear at the tread center is usually caused by overinflation or lack of rotation or a combination of both. If this type of wear occurs and the tires are still serviceable, rotate the tires and inflate them to recommended levels when they are cool.

Cracked treads are usually caused by underinflation or excessive high speed operation or a combination of both. Tires with cracked treads should be replaced and the replacement tires properly maintained to avoid a recurrence.

Excessive wear of one tread shoulder may be caused by excessive speed on turns or by incorrect camber. Incorrect negative camber will wear the inboard tire shoulder while incorrect positive will wear the outboard shoulder. If this type of wear occurs, check camber. If camber is incorrect, the front axle housing may need to be replaced. If camber is within specified limits, caution the owner about excessive speed on turns. If the tires are serviceable, rotate them and adjust inflation pressures to recommended levels.

Incorrect toe-in will cause the tire tread surface to develop a feathered edge. One side of the tread will be rounded while the opposite side develops a feathered edge. This type of wear indicates that the tire is side slipping and scuffing as it moves over the road surface.

A feathered edge that faces toward the vehicle indicates excessive toe-in. A feathered edge that faces away from the vehicle indicates excessive toe-out. The direction in which a feathered edge has developed can be determined by passing a hand over the tire tread surface. Bent steering knuckle arms can also cause this type of wear.

If a feathered edge develops, check and correct toe-in as necessary and rotate the tires if they are serviceable.

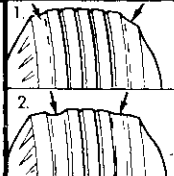
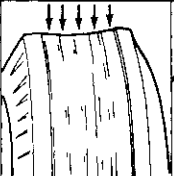

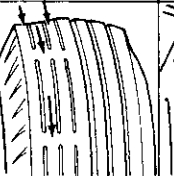
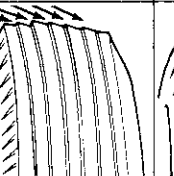
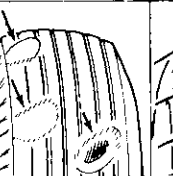
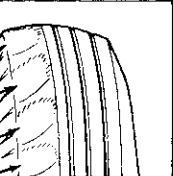
	RAPID WEAR AT SHOULDERS	RAPID WEAR AT CENTER	CRACKED TREADS	WEAR ON ONE SIDE	FEATHERED EDGE	BALD SPOTS	SCALLOPED WEAR
CONDITION							
CAUSE	UNDERINFLATION OR LACK OF ROTATION	OVERINFLATION OR LACK OF ROTATION	UNDERINFLATION OR EXCESSIVE SPEED	EXCESSIVE CAMBER	INCORRECT TOE	UNBALANCED WHEEL OR TIRE DEFECT	LACK OF ROTATION OR WORN OR OUT-OF-ALIGNMENT SUSPENSION.
CORRECTION	ADJUST PRESSURE TO SPECIFICATIONS WHEN TIRES ARE COOL ROTATE TIRES		REPLACE TIRES	REPLACE FRONT AXLE HOUSING IF NECESSARY	ADJUST TOE-IN TO SPECIFICATIONS	DYNAMIC OR STATIC BALANCE WHEELS	ROTATE TIRES AND INSPECT SUSPENSION

Fig. 2H-3 Tire Wear Patterns

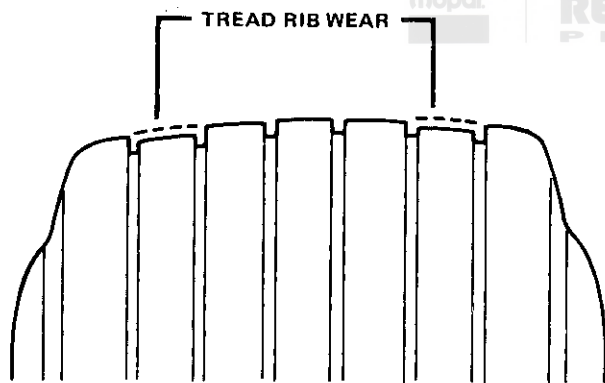
## 2H-4 WHEELS AND TIRES

### Wide Tread Bias-Belted Tire Wear

Bias-belted wide tread tires have an initial wear characteristic that is unique to this type of tire. It occurs as a fairly rapid but even wear of the second and sixth tread ribs (fig. 2H-4). Wear may occur at only one of the ribs or at both ribs simultaneously. In some cases, a slight cupping of these ribs may also develop in addition to wear. Although wear develops rapidly, the degree of wear is relatively light.

This wear characteristic is a normal condition with wide tread bias-belted tires and is related to the tread deflection properties of these tires. When the tread is pressed against the road surface, all tread ribs do not support equal portions of weight. The outer and center ribs support the most weight while the second and sixth ribs support the least. Because of the lighter load on the second and sixth ribs, they are able to deflect more and tend to slip and scrub slightly as the tire rotates. This action causes more wear on these ribs.

Wear on the second and sixth ribs cannot be reduced by over or underinflating the tires. Maximum benefit in minimizing wear is obtained only by adhering to the specifications recommended for tire inflation pressures, tire rotation, and front wheel alignment.



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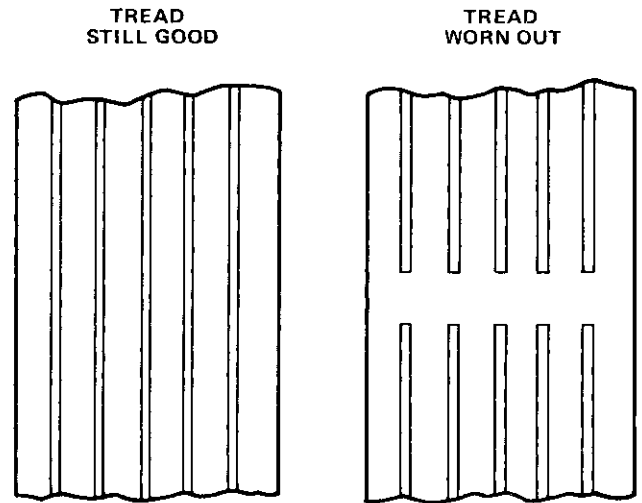
Fig. 2H-4 Wide Tread Bias-Belted Tire Wear

### TIRE MAINTENANCE AND CONDITION

To maximize tire performance, inspect tires frequently for signs of incorrect inflation and uneven wear which may indicate a need for balancing, rotation, or alignment. Tires should also be inspected frequently for cuts, abrasions, stone bruises, blisters, or for objects imbedded in the tire. Weekly inspection intervals are recommended as a minimum. More frequent inspections are recommended when extreme temperature changes occur or where road surfaces are rough or occasionally littered with debris.

As a further check of tire condition, tread wear indicators are molded into the bottom of the tread grooves.

These indicators appear in the form of 1/2 inch (13 mm) wide bands across the tread when it has worn to a thickness of 1/16 inch (1.58 mm) or less (fig. 2H-5). The tire should be replaced when these bands become visible.



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Fig. 2H-5 Tread Wear Indicators

A number of states have statutes concerning minimum permissible tread depths and use these indicators as the tire wear limit.

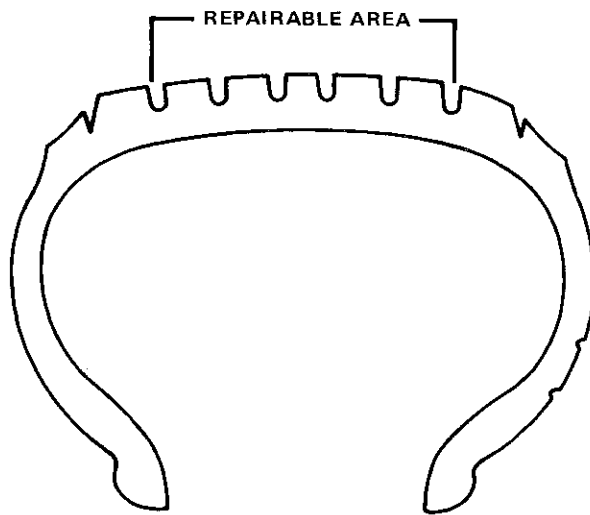
Clean tires using a mild soap and water solution only and rinse thoroughly with water. Do not use caustic solutions or abrasive materials. To clean white sidewalls and raised letters and numbers, use an approved white-wall cleaner only. Do not use steel wool, wire brushes, or materials having a mineral oil base such as gasoline, paint thinner, or turpentine. These materials are harmful to the tires and will also discolor the white sidewalls and raised figures.

### TIRE REPAIR

Punctured tires should be removed from the wheel and permanently repaired from the inside using a combination repair plug and vulcanized patch. When repairing punctures, always follow the manufacturers instructions for repair kit installation.

Punctures in the tread area only are repairable (fig. 2H-6). Never attempt to repair punctures in the tire shoulders or sidewalls. In addition, never attempt to repair any tire that has sustained the following damage:

- Bulges or blisters
- Ply separations
- Broken, cut, or cracked beads
- Fabric cracks or cuts
- Tires worn to the fabric or if wear indicators are visible
- Punctures larger than 1/4 inch (6.35 mm) in diameter



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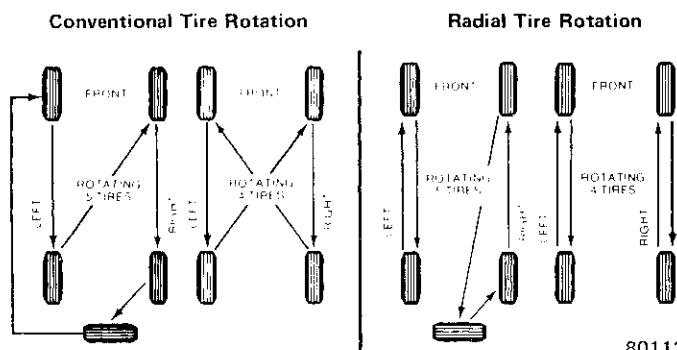
Fig. 2H-6 Tire Repair Area

Externally applied repair plugs, blowout patches, and aerosol sealants should be considered as emergency-type repairs only. Tires repaired in this fashion should not be driven at speeds over 40 mph (64 km/h) or for more than 75 miles (121 kilometers) before permanent repair is made.

### TIRE ROTATION

To equalize wear, tires should be rotated at the intervals specified in the Mechanical Maintenance Schedule. The first rotation is the most important in setting the stage for even tread wear. After rotation, adjust tire inflation pressures to the levels recommended in the Tire Inflation Pressure Chart.

Radial tires are not rotated in the same manner as conventional tires. Conventional tires are rotated in a crossing pattern. Radial tires are rotated on the same side, front-to-rear (fig. 2H-7).



80112

Fig. 2H-7 Tire Rotation

### RADIAL, WIDE TREAD AND SNOW TIRE APPLICATIONS

Radial, wide tread, mud and snow, or conventional tires must be installed in **complete sets** only. This is especially important on vehicles with Quadra-Trac. Different tire types must not be intermixed at any time.

**CAUTION:** *Tires installed on Jeep four-wheel drive vehicles must all be of equal circumference to maintain satisfactory operation. They must also be the same size, tread pattern, make, construction, and inflation pressure. Inter-mixing tires of different size or construction will cause unusual handling, noisy operation, and accelerated wear of driveline components.*

Wide tread tires must be installed in complete sets and only when there is adequate clearance for the tire in the wheel well. Refer to the Tire Inflation Pressure Chart for tire sizes allowable on each model.

Radial tires must never be intermixed with bias-ply or bias-belted tires on any vehicle. Inter-mixing these tires will produce an adverse effect on vehicle handling and cornering stability. In an emergency situation, tires may be intermixed but only for the duration of the emergency and only if vehicle speed is kept below 40 mp/h (64 km/h).

Mud and snow tires must not be intermixed with conventional tread tires on any vehicle. These tires must also be of the same size, tread pattern, make, construction, and inflation pressure. In addition, never mix bias-ply or bias-belted snow tires with radial-ply mud or snow tires.

### WHEELS

The standard equipment wheels used on Jeep vehicles are safety rim, drop center, J-type wheels of all-steel construction. Optional wheels include chrome-plated styled steel wheels, wide rim spoke-type steel wheels, and forged aluminum wheels.

Steel wheels are of two-piece construction consisting of a rim and center section (spider). The two sections are welded together to form a seamless, air-tight assembly.

### WHEEL MAINTENANCE AND CONDITION

Wheel condition should be checked frequently. Replace any wheel that is cracked, bent, severely dented, has excessive runout, or has broken welds. The tire inflation valve should also be inspected frequently for wear, leaks, cuts, or looseness and should be replaced if damaged or worn.

Clean all 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 as 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 lustre.

**WHEEL BALANCING**

Wheel balancing may be performed using on or off-vehicle equipment. However, when using on-vehicle balancing equipment, observe the following precautions:

- On vehicles with a Trac-Lok rear axle, do not use on-vehicle equipment to balance the rear wheels. Instead, remove the wheels and balance them off the vehicle using a two-plane, dynamic balancer.
- Before balancing wheels on a vehicle equipped with a Model 20 transfer case, shift the transmission and transfer case into neutral.
- Before balancing wheels on a vehicle equipped with a Quadra-Trac transfer case, disconnect the front or rear propeller shafts as required.

Because of their unique construction, radial tires are sometimes less responsive to certain balancing techniques. In some cases, dynamic two-plane, off-vehicle type balancing equipment will provide the most satisfactory results with radial tires.

When balancing aluminum or chrome plated wheels, take care to avoid damaging the wheel surface when installing balance weights. Use self-adhering type weights on aluminum wheels only and install them on the back side of the wheel whenever possible.

**WHEEL BEARING ADJUSTMENT**

Wheel bearing adjustment is very important because it establishes the operating clearance of the wheel bearings. A tight adjustment preloads the bearings excessively causing them to overheat. A loose adjustment allows the hub to shift position as bearing load varies during acceleration, braking, and cornering. A loose bearing adjustment can produce shimmy, vibration, and low brake pedal heights as a result of disc brakeshoe knock back caused by rotor wobble.

**Front Wheel Bearing Adjustment—CJ Models**

- (1) Raise vehicle.
- (2) Remove wheel cover, if equipped, and remove hubcap.
- (3) Remove drive flange snap ring.
- (4) Remove drive flange attaching bolts and remove flange and gasket (fig. 2H-8).
- (5) Straighten lip of outer locknut tabbed washer and remove locknut and washer.
- (6) Loosen, then tighten inner locknut to 50 foot-pounds (68 N•m) torque using tool J-25103. Rotate wheel while tightening nut to seat bearing properly.
- (7) Back off inner locknut 1/3 turn while rotating wheel. Wheel must rotate freely and not display any lateral movement.
- (8) Install outer locknut tabbed washer and locknut.
- (9) Tighten outer locknut to 50 foot-pounds (68 N•m) torque using tool J-25103 and bend lip of tabbed washer over locknut.
- (10) Recheck bearing adjustment. Wheel must rotate freely and not display any lateral movement.
- (11) Install drive flange gasket and drive flange.
- (12) Coat drive flange attaching bolts with Lock-tite 271 or equivalent. Install bolts and tighten to 24 foot-pounds (33 N•m) torque.
- (13) Install hub cap.
- (14) Lower vehicle.

**Front Wheel Bearing Adjustment—Cherokee-Wagoneer-Truck**

- (1) Raise vehicle.
- (2) Remove wheel cover (if equipped) and hubcap.
- (3) Remove drive gear snap ring (fig. 2H-9).
- (4) Remove drive gear, pressure spring, and spring cup (fig. 2H-9).

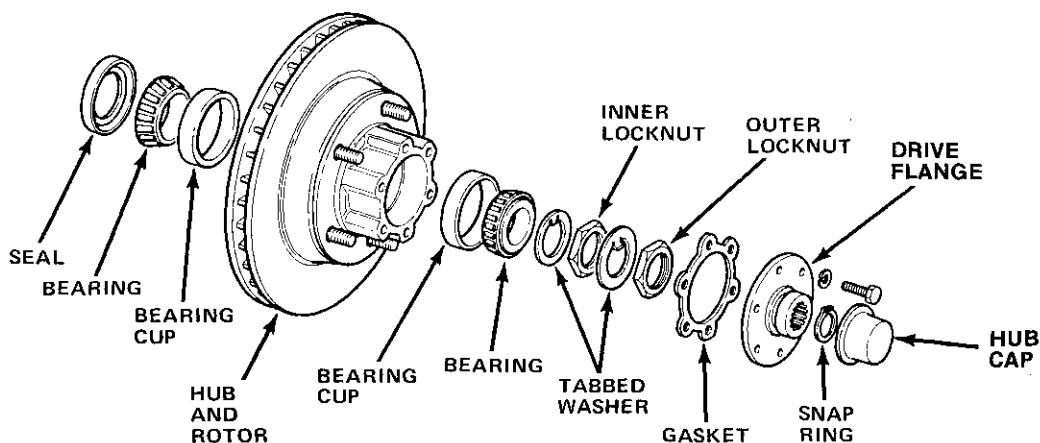


Fig. 2H-8 Rotor and Wheel Bearings—CJ Models

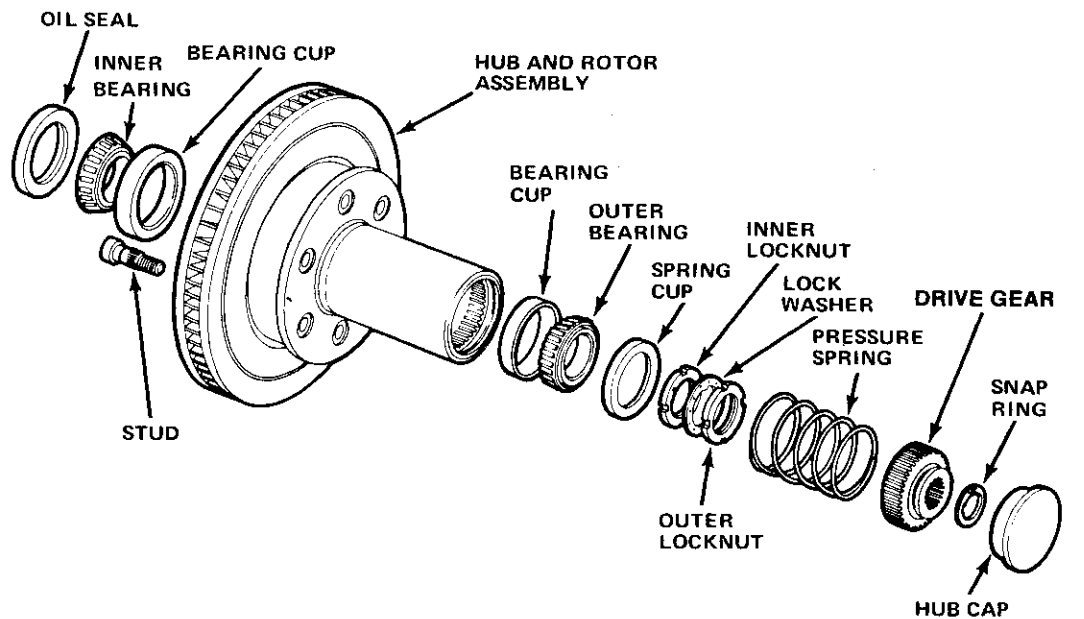


Fig. 2H-9 Rotor and Wheel Bearings—Cherokee-Wagoneer-Truck

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(5) Remove outer locknut and lockwasher (fig. 2H-9).

(6) Seat bearings by tightening inner locknut to 50 foot-pounds (68 N•m) torque using tool J-6893. Rotate wheel while tightening locknut to seat bearings uniformly.

(7) Loosen and retighten inner locknut to 35 foot-pounds (47 N•m) while rotating wheel.

(8) Back off inner locknut 1/3 turn while rotating wheel.

(9) Install lockwasher. Align one of lockwasher holes with peg on inner locknut and install washer on nut.

(10) Install outer locknut and tighten to minimum of 50 foot-pounds (68 N•m) torque using tool J-6893.

(11) Recheck bearing adjustment. Wheel must rotate freely and not display any lateral movement.

(12) Install spring cup and pressure spring.

**CAUTION:** The spring cup must be installed so the recessed side faces the bearing and the flat side faces the pressure spring. The pressure spring should contact the flat side of the cup only.

(13) Install drive gear and drive gear snap ring.

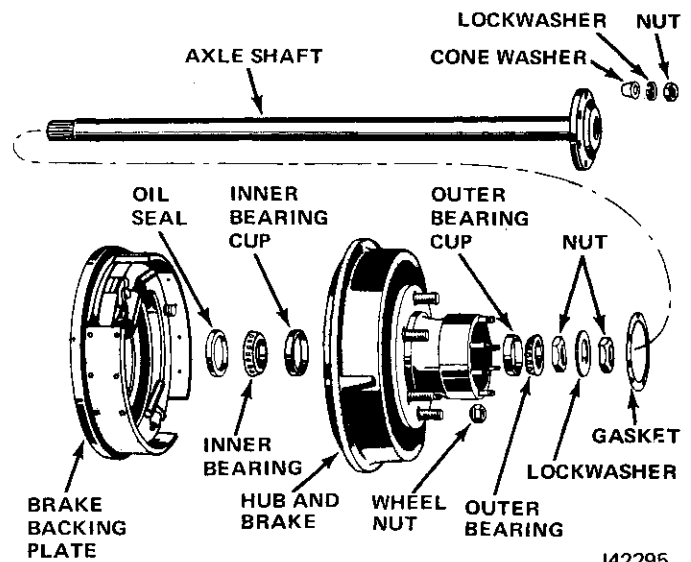
(14) Coat hub cap rim with Permatex Form-A-Gasket number 3 or equivalent and install hub cap.

(15) Lower vehicle.

(CJ) do not require adjustment. The shafts used in these axle models are equipped with tapered roller bearings which are capable of accepting lateral thrust in either direction. However, the tapered axle shafts used in CJ models (AMC/Jeep axle) do require correct axle shaft end play to maintain proper bearing operating clearances. Refer to Chapter 2F—Axles for end play measurement and adjustment procedures.

**Model 60 Full-Floating Rear Axle**

(1) Remove axle shaft attaching bolts, lockwashers, and cone washers (fig. 2H-10).



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**Rear Wheel Bearing Adjustment**

**Model 44 and AMC/Jeep Rear Axle**

The wheel bearings used in Model 44 rear axles (Cherokee, Wagoneer, J-10 Truck) or AMC/Jeep rear axles

Fig. 2H-10 Model 60 Rear Axle Hub and Bearings

## 2H-8 WHEELS AND TIRES

- (2) Remove axle shaft and shaft gasket. Discard gasket.
- (3) Straighten lip of lockwasher and remove locknut and lockwasher.
- (4) Raise vehicle.
- (5) Rotate wheel and tighten adjusting nut to 50 foot-pounds (68 N•m) torque using tool J-25106.
- (6) Back off adjusting nut about 1/6-turn or until wheel rotates freely without lateral movement.
- (7) Install and tighten locknut to 50 foot-pounds (68 N•m) torque and bend lockwasher lip over locknut.
- (8) Check adjustment and correct if necessary.
- (9) Install replacement axle shaft gasket and axle shaft. Install cone washers, lockwashers, and bolts.
- (10) Lower vehicle.

### TIRE ROUGHNESS

Roughness, vibration, tramp, shimmy, and thump are usually caused by excessive wheel or tire runout, cupped tires, or wheel/tire unbalance. These problem conditions may also be caused by operation over rough or undulating road surfaces. Driving the vehicle on different road surfaces will usually help determine if the road surfaces or tires are causing the problem.

Always road test the vehicle to determine the exact nature of the problem. Drive the vehicle for at least seven miles (11 km) to warm the tires and remove temporary flat spots that may have formed while the vehicle was parked. Note tire condition and wear and check and adjust inflation pressures to recommended levels before road testing.

#### Radial Tire Performance Characteristics

As a result of their unique construction, radial tires produce ride, handling, and appearance characteristics that are noticeably different from conventional tires.

The low speed ride quality or feel of radial tires may seem harsh when compared to conventional tires. This is a normal characteristic and is due to the stiff belts used in radial tire construction. Harshness often leads to the assumption that the tires are overinflated. Do not underinflate radial tires in an attempt to correct this condition. Inflate radial tires to recommended levels only.

Because radial tire body plies are positioned at a 90 degree angle to the tread centerline, they have highly flexible sidewalls. It is this flexibility which produces a characteristic sidewall bulge making the tire appear underinflated. This is a normal condition. Do not attempt to reduce this bulge by overinflating the tire. Check inflation pressure using an accurate gauge and inflate radial tires to recommended levels only.

At speeds of 15 mph (24 km/h) or less, radial tires may generate a side-to-side or waddle motion. This motion is a normal radial tire characteristic and is due to the highly flexible sidewall. An objectionable waddle condition can be reduced only by rotating the tires.

Wheel balancing will not alleviate this condition.

Proper mounting of radial tires is very important. Incomplete seating of the tire bead can produce a high frequency vibration at speeds above 45 mph (72 km/h). Improper bead seating can be checked by visually inspecting the tire. Correction involves removing and re-seating the tire on the wheel.

Because of their construction, radial tires are sometimes less responsive to certain methods of wheel balancing. Radial tire balancing is best accomplished using dynamic, two-plane, off-vehicle balance equipment.

### Tire Thump

Thump noise is caused by the tire moving over irregularities in the road or by irregularities in the tire itself. The sound coincides with each wheel revolution.

To determine which tire is causing thump, inflate all tires to 45 psi (310 kPa) temporarily and drive over the same roads. If thump stops, reduce the pressure in one tire at a time and repeat the road test. Perform this procedure until all tires have been tested and each test is made with three tires at high pressure and one tire at recommended pressure. When thump develops again, the tire just reduced to normal inflation pressure is the problem tire.

**NOTE:** *Although the procedure for diagnosing thump is quite effective with conventional tires, it is considerably less effective with radial tires.*

### Tire Tramp

Tramp is caused by wheel/tire static unbalance or by excessive lateral runout of the tire or wheel.

The most effective method for checking static balance is by using off-vehicle balancing equipment.

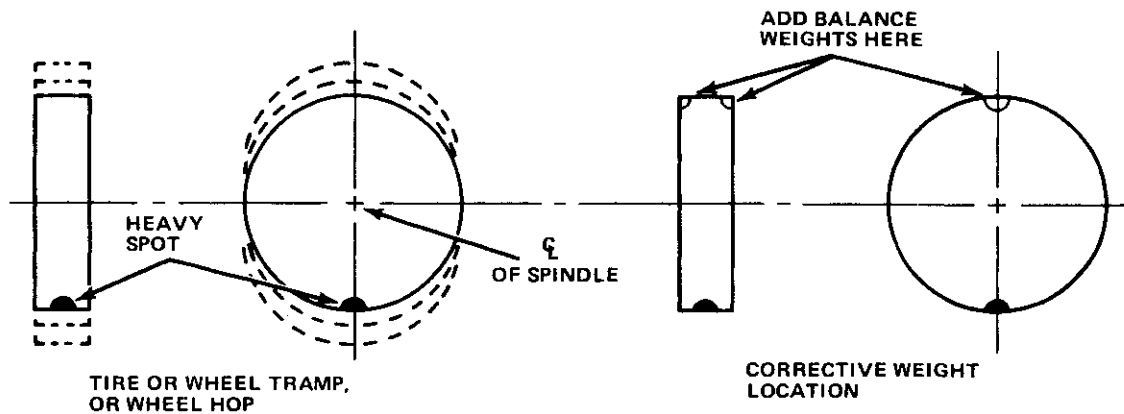
Static balance is the result of an equal distribution of wheel and tire weight about the circumference of the tire. In this case, weight is distributed about the spindle in such a manner that the assembly lacks the tendency to rotate by itself when mounted on the arbor of a balancing machine.

Static unbalance occurs when an unequal portion of weight is concentrated at one point on the tire and wheel (fig. 2H-11). It causes a vibratory-type pounding action which is referred to as tramp or hop.

Dynamic balance is the result of an equal distribution of wheel/tire weight around the plane of rotation (fig. 2H-12). This causes the wheel to rotate smoothly about the axis that bisects the wheel and tire centerline.

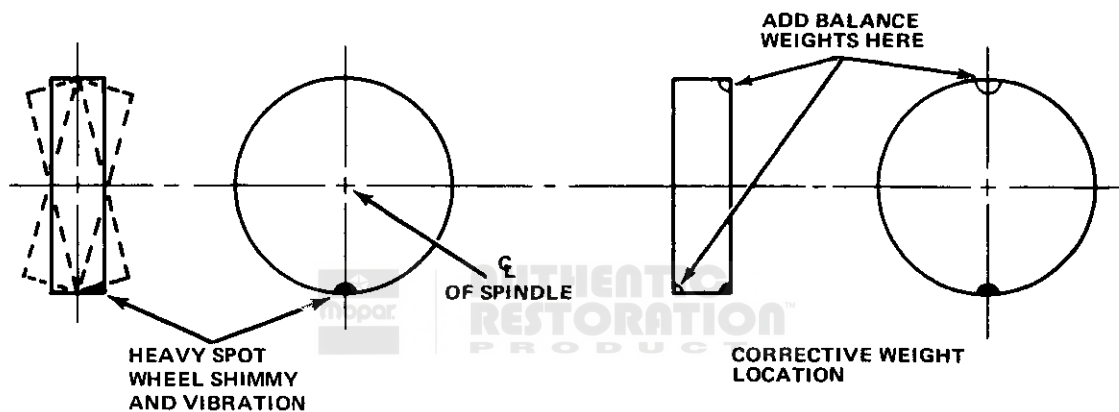
Dynamic unbalance occurs when unequal forces are concentrated at opposing points on the tire circumference. It will cause shimmy and vibration at medium and high speeds (fig. 2H-12).

The most effective method for balancing wheels and tires is by using equipment that will correct both static and dynamic balance. Dynamic, two-plane balancing equipment is preferable.



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Fig. 2H-11 Static Unbalance



70226

Fig. 2H-12 Dynamic Unbalance

Since procedures vary with different machines, follow the equipment manufacturers operating instructions explicitly to obtain satisfactory results.

**WARNING:** *On-vehicle type wheel balancers may be used on the rear wheels of vehicles equipped with a Trac-Lok differential, but only after raising the rear end and removing the wheel opposite the one being balanced. In addition, do not exceed 35 mph (56 km/h) on the speedometer when spinning wheels. As a result of differential action, actual wheel speed is double the speed indicated on the vehicle speedometer. The centrifugal force generated by a tire spinning at high speed could cause damage and personal injury.*

### Wheel and Tire Runout

Excessive radial or lateral runout of a wheel or tire can cause roughness, vibration, tramp, tire wear, and steering wheel tremor.

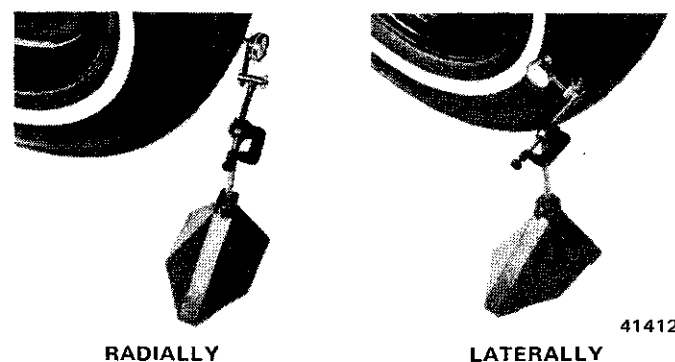
Before checking runout, drive the vehicle for at least seven miles to remove temporary flat spots that may have formed in the tires. Flat spots must be removed to avoid false readings when measuring runout.

Measure runout using a dial indicator. All measure-

ments should be made on the vehicle with the tires inflated to recommended levels and with the wheel bearings adjusted to specifications.

Measure radial runout at the center and outside ribs of the tread face (fig. 2H-13). Measure lateral runout at the tire sidewall just above the buffing rib on the sidewall (fig. 2H-13).

On conventional tires, radial runout should not exceed 0.105 inch (2.66 mm) and lateral runout should not exceed 0.080 inch (2.03 mm). Mark the high points of lat-



41412

Fig. 2H-13 Measuring Tire Runout



## 2H-10 WHEELS AND TIRES

eral or radial runout for reference.

On radial tires, radial runout should not exceed 0.080 inch (2.03 mm) and lateral runout should not exceed 0.100 inch (2.54 mm).

If the tire radial or lateral runout exceeds specified limits, it will be necessary to check wheel runout to determine whether the wheel or tire is at fault.

Wheel radial runout is measured at the wheel rim just inside of the wheel cover retaining nibs (fig. 2H-14). Wheel lateral runout is measured at the wheel rim bead flange just inside the curved lip of the flange (fig. 2H-14). Mark the high points of radial or lateral runout for reference.

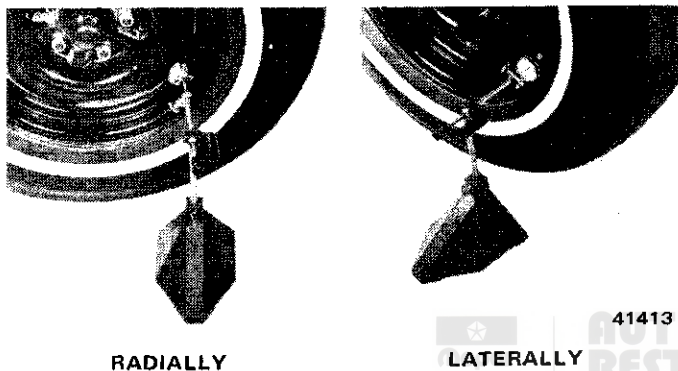


Fig. 2H-14 Measuring Wheel Runout

Wheel radial runout should not exceed 0.035 inch (0.88 mm). Wheel lateral runout should not exceed 0.045 inch (1.14 mm).

If tire runout exceeds specified limits but wheel runout is within limits, runout may be reduced to an acceptable level by changing tire position on the wheel so that the previously marked high points are 180 degrees apart.

**NOTE:** On vehicles with disc brakes, excessive wheel lateral runout may be caused by excessive rotor hub-to-bore runout. Refer to the Rotor Inspection procedure in Chapter 2G.

### VIBRATION

Vibration may be caused by tire and wheel unbalance or runout, incorrect wheel bearing adjustment, loose or worn suspension or steering components, worn or defective tires, certain tire tread patterns, incorrect universal joint angles, worn universal joints, excessive propeller shaft runout or yoke runout, rotor or brakedrum runout, loose engine or transmission supports, or by engine operated accessories.

#### Vibration Types

There are two types of vibration which are referred to as mechanical and audible.

Mechanical vibrations are felt through the seats, floorpan, or steering wheel and usually produce some visible motion in the rear view mirror, fenders, dash panel, or steering wheel.

Audible vibrations are heard or sensed above normal background noise and may or may not be accompanied by a mechanical vibration. In some cases, they occur as a droning or drumming noise while in other cases they produce a buffeting sensation that is felt or sensed by the driver rather than heard.

#### Vibration Sensitivity

Mechanical and audible vibrations are sensitive to changes in engine torque, vehicle speed, or engine speed. They usually occur within one, or sometimes two well-defined ranges in terms of vehicle speed, engine rpm, and torque application.

##### Torque Sensitive

This means the means the condition can be improved or worsened by accelerating, decelerating, coasting, or maintaining a steady vehicle speed and application of engine torque.

##### Vehicle Speed Sensitive

This means that the vibration occurs at the same speed and is not affected by engine torque, engine rpm, or transmission gear selected.

##### Engine Speed Sensitive

This means that the vibration occurs at varying vehicle speeds when a different transmission gear is selected. It can sometimes be isolated by increasing or decreasing engine speed with the transmission in neutral.

#### Vibration Diagnosis

A proper vibration diagnosis should always begin with a road test. corrective measures should not be attempted until the vibration type, magnitude, and speed range have been established by a road test.

##### Road Test

During the road test, drive the vehicle on a road that is smooth and free of undulations. If vibration is apparent, note and record the following:

- The speed range in which vibration occurs
- The type of vibration—mechanical or audible
- If the vibration is affected by changes in Vehicle speed, engine rpm, or engine torque
- Determine the vibration sensitivity—torque sensitive, engine speed sensitive, or vehicle speed sensitive

**Diagnosis Procedure**

When the vibration type, sensitivity, and range has been determined, refer to the Vibration Diagnosis Chart for probable causes.

Consider for correction only those items coded on the charts that are related to the problem condition.

Refer to the following correction codes for a description of the various corrective procedures.

**Vibration Diagnosis Chart Codes**

**TRR**—Tire and Wheel Radial Runout. Vehicle speed sensitive mechanical vibration. Not a cause of vibration below 20 mph. Speed required to cause vibration increases as runout decreases.

**WH**—Wheel Hop. Vehicle speed sensitive mechanical vibration. Not a cause of vibration below 20 mph (32 km/h). Generates rapid up-down movement in steering wheel and dash panel. Most noticeable in 20-40 mph (32-64 km/h) speed range. Caused by tires having radial runout of more than 0.045 inch (1.14 mm). Balancing ineffective, faulty tire should be replaced.

**TB**—Tire Balance. Vehicle speed sensitive mechanical vibration. Static unbalance not a cause of vibration below 30 mph (46 km/h). Dynamic unbalance not a cause of vibration below 40 mph (64 km/h).

**TLR**—Tire and Wheel Lateral Runout. Vehicle speed sensitive mechanical vibration. Not a cause of vibration below 50-55 mph (80-88 km/h) unless runout is extreme. Generates front end shimmy if extreme.

**TW**—Tire Wear. Vehicle speed sensitive mechanical vibration. Abnormal wear causes vibration in 30-55 mph (50-88 km/h) range and may generate whine noise at high speed changing to growl noise at low speed.

**W**—Radial Tire Waddle. Normal condition with radial tires. Construction causes side-to-side motion at speeds up to 15 mph. Rotate tires to reduce condition. Replace tires if condition is extremely severe.

**UJA**—Universal Joint Angles. Incorrect angles cause mechanical vibration below 20 mph (32 km/h) changing to mechanical and/or audible vibration at 35 to 55 mph (56 to 88 km/h). Torque sensitive vibration.

**UJ**—Universal Joints. If needle bearings, bearing cups,

or bearing ends of spiders are worn, damaged, over-tightened, or loose, they will cause mechanical vibration at almost any speed. Torque and vehicle speed sensitive vibration.

**PSY**—Propeller Shaft and Yokes. Not a cause of vibration below 35 mph (56 km/h). Excessive runout, unbalance, missing balance weights, undercoating on shaft tube, dents or bends in tube will cause mechanical vibration at 35 mph (56 km/h) and above. Torque and vehicle speed sensitive vibration.

**WB**—Wheel Bearings. Loose bearings cause shimmy-like vehicle speed sensitive mechanical vibration at 35 mph (56 km/h) and above. Rough or damaged bearings will also generate growl noise at low speed or whine noise at high speed.

**AN**—Axle Noise. Axle not a cause of vibration unless axle shaft is bent or front axle shaft U-Joint is damaged. Worn or damaged axle gears or bearings will cause noise in varying speed ranges in relation to amount of engine torque applied.

**SSC**—Suspension and Steering Components. Worn, damaged, or loose suspension components (steering damper, steering knuckles, pitman arm, springs, spring U-bolts or center bolts, shocks, tie rod ends, etc.) can cause mechanical or audible vibrations at many speeds. Can be torque and vehicle speed sensitive.

**EA**—Engine Driven Accessories. Loose or broken AC compressor, power steering pump, water pump, air pump, alternator, etc. can cause engine speed sensitive mechanical vibration. Usually apparent when transmission is shifted into neutral and engine rpm increased.

**ADB**—Accessory Drive Belts. Loose, worn belts can cause engine speed sensitive audible vibration that sounds like droning, fluttering, or rumbling noise.

**DEM**—Damaged Engine or Transmission Mounts. If loose, worn, or broken can allow engine, transmission, or engine accessories to contact body causing noise and vibration.

**ES**—Exhaust System. Loose or broken components may contact body causing noise. In addition, mispositioned components (e.g., muffler, converter, pipes, hangers) may also contact body or driveline components causing noise.

**2H-12 WHEELS AND TIRES**

**SPECIFICATIONS**

**Vibration Diagnosis Chart**

Vibration Sensitivity	Correction Codes For Mechanical Vibrations Within Specific MPH (km/h) Ranges									
	10 (16 km)	20 (32 km)	30 (48 km)	40 (64 km)	50 (80 km)	60 (96 km)	70 (112 km)	80 (128 km)	90 (144 km)	
Vehicle Speed Sensitive		← W →		← WH →		← TRR and SSC →		← TB →		
							← PSY →	← TLR →		
				← UJ and AN →		← WB →				
Torque Sensitive	← UJA →			← UJ and AN →				← UJA →		
Engine Speed Sensitive		← EA →			← ES →					
	← DEM →									

Vibration Sensitivity	Correction Codes For Audible Vibrations Within Specific MPH (km/h) Ranges									
	10 (16 km)	20 (32 km)	30 (48 km)	40 (64 km)	50 (80 km)	60 (96 km)	70 (112 km)	80 (128 km)	90 (144 km)	
Vehicle Speed Sensitive			← UJA →		← JU and WH →		← PSY →			
							← TW →			
							← WB →			
Torque Sensitive					← AN →					
					← UJ and TED →					
Engine Speed Sensitive						← EA and ES →				
	← DEM →	← ADB →								

Tire Inflation Pressure Chart (P.S.I.)

Model	GVW Rating		Tire Size	Load Range	Normal Load <sup>1</sup>				Maximum Load <sup>2</sup>				Wheel Size	
					Sustained Driving Over 65 mph (105 km/h) <sup>4</sup>		Under 65 mph (105 km/h)		Sustained Driving Over 65 mph (105 km/h) <sup>4</sup>		Under 65 mph (105 km/h)			
	lbs	kg			Front	Rear	Front	Rear	Front	Rear	Front	Rear		
CJ-5 & CJ-7	3750 & 4150	1700 & 1882	9-15 H78-15 L78-15	B B & D B	30 24 24	30 24 24	20 20 20	20 20 20	35 28 24	35 28 24	25 24 20	25 24 20	15 x 8 15 x 5.50 15 x 8	
Cherokee & Wagoneer	6200	2812	G78-15	D	30	30	26	26	40*	40*	38	38	15 x 6	Aluminum Wheel is 15 x 7
			H78-15	B	26	26	22	22	32*	32*	32	32	15 x 6	
			H78-15	D	26	26	22	22	36	36	32	32	15 x 6	
			HR78-15	B	26	26	22	22	32*	32*	32	32	15 x 6	
			HR78-15	C	26	26	22	22	36	36	32	32	15 x 6	
			L78-15	B	24	24	20	20	32	32	28	28	15 x 8	
P225/75R-15 10-15	SL <sup>3</sup>	26	26	22	22	35*	35*	32	32	15 x 6				
B	B	30	30	20	20	40*	40*	30	30	15 x 8				
J-10 Truck	6200	2812	G78-15	D	32	32	28	28	40*	40*	38	38	15 x 6	Aluminum Wheel is 15 x 7
			H78-15	B	28	28	24	24	32*	32*	32	32	15 x 6	
			H78-15	D	28	28	24	24	36	36	32	32	15 x 6	
			HR78-15	B	26	26	22	22	32*	32*	32	32	15 x 6	
			HR78-15	C	26	26	22	22	36	36	32	32	15 x 6	
			P225/75R-15 10-15	SL <sup>3</sup>	26	26	22	22	35*	35*	32	32	15 x 6	
B	B	30	30	20	20	40*	40*	30	30	15 x 8				
J-20 Truck	6800	3084	8.75-16.5	C	40	40	30	30	50*	55*	40	45	16.5 x 6	16.5 x 6.75
	7600	3447	9.50-16.5	D	45	45	35	35	55*	70*	45	60	16.5 x 6.75	
	8400	3810	9.50-16.5	D	45	45	35	35	55*	70*	45	60	16.5 x 6.75	
Cherokee & Wagoneer with Snow Plow Package	6200	2812	H78-15	D	26	26	22	22	40*	40*	38	38	15 x 6	Aluminum Wheel is 15 x 7
J-10 Truck with Snow Plow Package	6200	2812	H78-15	D	28	28	24	24	40*	40*	38	38	15 x 6	

NOTE: Inflate tires while cold, before running. Do not reduce pressure if tires are warm.

\*Speed limited to 74 mph (119 km/h).

(1) Normal Load: Frequently selected accessories plus driver and two passengers. For CJ models, driver and one passenger.

(2) Maximum Load: Gross Vehicle Weight Rating (GVWR).

(3) SL is approximate metric tire equivalent of load range B.

(4) Sustained driving over 74 mph (119 km/h) for Cherokee and Wagoneer except where indicated by asterisk (\*).

## 2H-14 WHEELS AND TIRES

### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Caliper Mounting Bolt (Cke-Wag-Trk)	35	30-40	47	41-54
Caliper Support Key Retaining Screw (CJ)	15	15-18	20	20-24
Wheel Retaining Nuts:				
CJ	75	65-80	102	88-108
Cke-Wag-J-10 Trk.	75	65-90	102	88-122
J-20 Trk (8400 GVW)	130	110-150	176	149-203
Wheel Bearing Adjustment (CJ):				
Outer Locknut	50	50 min.	68	68 min.
Inner Locknut (Adjusting Nut)			Tighten to 50 foot-pounds (68 N·m) torque and back locknut off 1/3 turn while rotating wheel.	
Wheel Bearing Adjustment (Cke-Wag-Trk):				
Outer Locknut	50	50 min.	68	68 min.
Inner Locknut			Tighten to 50 foot-pounds (68 N·m), then loosen and retighten locknut to 35 foot-pounds (47 N·m) and back off nut 1/3 turn while rotating wheel.	
Tire Radial Runout:				
Conventional Tire	0.105 inch		2.66 mm	
Radial Tire	0.080 inch		2.03 mm	
Tire Lateral Runout (All)	0.100 inch		2.54 mm	
Wheel Radial Runout (All)	0.045 inch		1.14 mm	
Wheel Lateral Runout (All)	0.045 inch		1.14 mm	

All Torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

# STEERING COLUMNS

# 2J

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## GENERAL

Three different steering column designs are used on Jeep vehicles. Models with automatic transmission use a non-tilt column with column mounted gearshift mechanism. Models with manual transmission use a non-tilt column with ignition key release lever. A six position tilt column is available as an option on all models.

All steering columns used on Jeep vehicles have anti-theft and energy absorbing features. Each column is designed to compress under impact.

The ignition lock cylinder, ignition switch, and neutral safety switch are mounted on the column. When the lock cylinder is turned to LOCK position, the ignition switch and steering shaft cannot be operated. On models with

automatic transmission, the lock mechanism also prevents operation of the column mounted gearshift mechanism.

A center slip-type (telescoping) intermediate shaft is used on all models. It is attached to the steering gear with a flexible coupling and to the steering column with a universal joint.

## SERVICE DIAGNOSIS

When diagnosing steering column malfunctions, refer to the Service Diagnosis Charts for the probable cause and correction procedures. To simplify chart use, they are divided into the various sub-systems within the column and include: ignition system, lock mechanism, turn signal switch, electrical, tilt column, and steering column.

## 2J-2 STEERING COLUMNS

### Lock System

Condition	Possible Cause	Correction
WILL NOT LOCK	(1) Lockbolt spring broken or defective.	(1) Replace lock bolt spring.
HIGH EFFORT (HIGH EFFORT REQUIRED TO TURN IGNITION KEY AND LOCK CYLINDER)	(1) Lock cylinder defective. (2) Ignition switch defective. (3) Rack preload spring broken or deformed. (4) Burr on lock sector, lock rack, housing, support or remote rod coupling. (5) Bent sector shaft. (6) Defective lock rack. (7) Remote rod bent, deformed. (8) Ignition switch mounting bracket bent. (9) Distorted coupling slot in lock rack (tilt column).	(1) Replace lock cylinder. (2) Replace ignition switch. (3) Replace preload spring. (4) Remove burr. (5) Replace shaft. (6) Replace lock rack. (7) Replace rod. (8) Straighten or replace. (9) Replace lock rack.
WILL STICK IN "START"	(1) Remote rod deformed. (2) Ignition switch mounting bracket bent.	(1) Straighten or replace. (2) Straighten or replace.
KEY CANNOT BE REMOVED IN "OFF-LOCK"	(1) Ignition switch is not adjusted correctly. (2) Defective lock cylinder.	(1) Adjust switch. (2) Replace lock cylinder.
LOCK CYLINDER CAN BE REMOVED WITHOUT DEPRESSING RETAINER	(1) Lock cylinder with defective retainer. (2) Burr over retainer slot in housing cover or on cylinder retainer.	(1) Replace lock cylinder. (2) Remove burr.
HIGH EFFORT ON LOCK CYLINDER BETWEEN "OFF" AND "OFF-LOCK"	(1) Distorted lock rack. (2) Burr on tang of shift gate (automatic column). (3) Gearshift linkage not adjusted.	(1) Replace lock rack. (2) Remove burr. (3) Adjust linkage.

Steering Column		
Condition	Possible Cause	Correction
NOISE IN COLUMN	(1) One click when in "off-lock" position and the steering wheel is moved (all except automatic column).	(1) Normal—lock bolt is seating.
	(2) Coupling bolts not tightened.	(2) Tighten pinch bolts.
	(3) Lack of grease on bearings or bearing surfaces.	(3) Lubricate with chassis grease.
	(4) Upper shaft bearing worn or broken.	(4) Replace bearing assembly.
	(5) Lower shaft bearing worn or broken.	(5) Replace bearing. Check shaft and replace if scored.
	(6) Column not correctly aligned.	(6) Align column.
	(7) Coupling pulled apart.	(7) Replace coupling.
	(8) Broken coupling lower joint.	(8) Repair or replace joint and align column.
	(9) Steering shaft snap ring not seated.	(9) Replace snap ring. Check for proper seating in groove.
	(10) Shroud loose on shift bowl. Housing loose on jacket—will be noticed with ignition in "off-lock" and when torque is applied to steering wheel.	(10) Position shroud over lugs on shift bowl. Tighten mounting screws.
HIGH STEERING SHAFT EFFORT	(1) Column misaligned.	(1) Align column.
	(2) Defective upper or lower bearing.	(2) Replace as required.
	(3) Tight steering shaft universal joint.	(3) Repair or replace.
	(4) Flash on I.D. of shift tube at plastic joint (tilt column only).	(4) Replace shift tube.
	(5) Upper or lower bearings siezed.	(5) Replace bearings.



## 2J-4 STEERING COLUMNS

### Steering Column (Continued)

Condition	Possible Cause	Correction
<b>LASH IN MOUNTED COLUMN ASSEMBLY</b>	<ol style="list-style-type: none"> <li>(1) Column mounting bracket bolts loose.</li> <li>(2) Broken weld nuts on column jacket.</li> <li>(3) Column capsule bracket sheared.</li> <li>(4) Column bracket to column jacket mounting bolts loose.</li> <li>(5) Loose lock shoes in housing (tilt column only).</li> <li>(6) Loose pivot pins (tilt column only).</li> <li>(7) Loose lock shoe pin (tilt column only).</li> <li>(8) Loose support screws (tilt column only).</li> </ol>	<ol style="list-style-type: none"> <li>(1) <b>Tighten bolts.</b></li> <li>(2) <b>Replace column jacket.</b></li> <li>(3) <b>Replace bracket assembly.</b></li> <li>(4) <b>Tighten to 20 ft.-lbs. torque.</b></li> <li>(5) <b>Replace shoes.</b></li> <li>(6) <b>Replace pivot pins and support.</b></li> <li>(7) <b>Replace pin and housing.</b></li> <li>(8) <b>Tighten screws.</b></li> </ol>
<b>HOUSING LOOSE (TILT COLUMN ONLY)</b>	<ol style="list-style-type: none"> <li>(1) Excessive clearance between holes in support or housing and pivot pin diameters.</li> <li>(2) Housing support-screws loose.</li> </ol>	<ol style="list-style-type: none"> <li>(1) <b>Replace pivot pins and support.</b></li> <li>(2) <b>Tighten screws.</b></li> </ol>
<b>STEERING WHEEL LOOSE—EVERY OTHER TILT POSITION (TILT COLUMN ONLY)</b>	<ol style="list-style-type: none"> <li>(1) Loose fit between lock shoe and lock shoe pivot pin.</li> </ol>	<ol style="list-style-type: none"> <li>(1) <b>Replace lock shoes and pivot pin.</b></li> </ol>
<b>STEERING COLUMN NOT LOCKING IN ANY TILT POSITION (TILT COLUMN ONLY)</b>	<ol style="list-style-type: none"> <li>(1) Lock shoe seized on pivot pin.</li> <li>(2) Lock shoe grooves have burrs or are filled with foreign material.</li> <li>(3) Lock shoe springs weak or broken.</li> </ol>	<ol style="list-style-type: none"> <li>(1) <b>Replace lock shoes and pin.</b></li> <li>(2) <b>Clean or replace lock shoes.</b></li> <li>(3) <b>Replace springs.</b></li> </ol>
<b>NOISE WHEN TILTING COLUMN (TILT COLUMN ONLY)</b>	<ol style="list-style-type: none"> <li>(1) Upper tilt bumpers worn.</li> <li>(2) Tilt spring rubbing in housing.</li> </ol>	<ol style="list-style-type: none"> <li>(1) <b>Replace tilt bumper.</b></li> <li>(2) <b>Lubricate with chassis grease.</b></li> </ol>

**Steering Column (Continued)**

Condition	Possible Cause	Correction
<p><b>ONE CLICK WHEN IN "OFF-LOCK" POSITION AND THE STEERING WHEEL IS MOVED</b></p>	<p>(1) Seating of lock bolt.</p>	<p>(1) None. Click is normal characteristic sound produced by lock bolt as it seats.</p>
<p><b>HIGH SHIFT EFFORT (AUTOMATIC AND TILT COLUMN ONLY)</b></p>	<p>(1) Column not correctly aligned.                      (2) Lower bearing not aligned correctly.                      (3) Lack of grease on seal or lower bearing areas.</p>	<p>(1) Align column.                      (2) Assemble correctly.                      (3) Lubricate with chassis grease.</p>
<p><b>IMPROPER TRANSMISSION SHIFTING (AFTER ANY NECESSARY CORRECTIONS, THE NEUTRAL SAFETY SWITCH SHOULD BE CHECKED AND ADJUSTED AS REQUIRED) (AUTOMATIC AND TILT COLUMN ONLY)</b></p>	<p>(1) Sheared shift tube joint.                      (2) Improper transmission gearshift linkage adjustment.                      (3) Loose lower shift lever.</p>	<p>(1) Replace shift tube.                      (2) Adjust linkage.                      (3) Replace shift tube.</p>

## 2J-6 STEERING COLUMNS

### Ignition System

Condition	Possible Cause	Correction
IGNITION SWITCH ELECTRICALLY INOPERATIVE	<ol style="list-style-type: none"> <li>(1) Loose or defective switch connector.</li> <li>(2) Feed wire open (fusible link).</li> <li>(3) Defective ignition switch.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Tighten or replace connector.</li> <li>(2) Repair or replace.</li> <li>(3) Replace ignition switch.</li> </ol>
ENGINE WILL NOT CRANK	<ol style="list-style-type: none"> <li>(1) Ignition switch not adjusted properly.</li> <li>(2) Neutral safety switch defective or not adjusted.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Adjust switch.</li> <li>(2) Adjust or replace switch.</li> </ol>
IGNITION SWITCH WILL NOT ACTUATE MECHANICALLY	<ol style="list-style-type: none"> <li>(1) Defective ignition switch.</li> <li>(2) Defective lock sector.</li> <li>(3) Defective remote rod.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Replace switch.</li> <li>(2) Replace lock sector.</li> <li>(3) Replace remote rod.</li> </ol>
IGNITION SWITCH CANNOT BE ADJUSTED CORRECTLY	<ol style="list-style-type: none"> <li>(1) Remote rod deformed.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Repair, straighten or replace.</li> </ol>

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### Turn Signal

Condition	Possible Cause	Correction
TURN SIGNAL WILL NOT CANCEL	<ol style="list-style-type: none"> <li>(1) Loose switch mounting screws.</li> <li>(2) Switch or anchor bosses broken.</li> <li>(3) Broken, missing or out of position detent, or cancelling spring.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Tighten screws.</li> <li>(2) Replace switch.</li> <li>(3) Reposition springs or replace switch as required.</li> </ol>

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## Turn Signal (Continued)

Condition	Possible Cause	Correction
TURN SIGNAL DIFFICULT TO OPERATE	(1) Turn signal lever loose. (2) Switch yoke broken or distorted. (3) Loose or misplaced springs. (4) Foreign parts and/or materials in switch. (5) Switch mounted loosely.	(1) Tighten mounting screw. (2) Replace switch. (3) Reposition springs or replace switch. (4) Remove foreign parts and/or material. (5) Tighten mounting screws.
TURN SIGNAL WILL NOT INDICATE LANE CHANGE	(1) Broken lane change pressure pad or spring hanger. (2) Broken, missing or misplaced lane change spring. (3) Jammed wires.	(1) Replace switch. (2) Replace or reposition as required. (3) Loosen mounting screws, reposition wires and retighten screws.
TURN SIGNAL WILL NOT STAY IN TURN POSITION	(1) Foreign material or loose parts impeding movement of switch yoke. (2) Defective switch.	(1) Remove material and/or parts. (2) Replace switch.
HAZARD SWITCH CANNOT BE PULLED OUT	(1) Foreign material between hazard support cancelling leg and yoke.	(1) Remove foreign material. (a) No foreign material impeding function of hazard switch—replace turn signal switch.
NO TURN SIGNAL LIGHTS	(1) Inoperative turn signal flasher. (2) Defective or blown fuse. (3) Loose chassis to column harness connector. (4) Disconnect column to chassis connector. Connect new switch to chassis and operate switch by hand. If vehicle lights now operate normally, signal switch is inoperative. (5) If vehicle lights do not operate check chassis wiring for opens, grounds, etc.	(1) Replace turn signal flasher. (2) Replace fuse. (3) Connect securely. (4) Replace signal switch. (5) Repair chassis wiring as required.

## 2J-8 STEERING COLUMNS

### Turn Signal (Continued)

Condition	Possible Cause	Correction
<b>INSTRUMENT PANEL TURN INDICATOR LIGHTS ON BUT NOT FLASHING</b>	<ol style="list-style-type: none"> <li>(1) Burned out or damaged front or rear turn signal bulb.</li> <li>(2) If vehicle lights do not operate, check light sockets for high resistance connections, the chassis wiring for opens, grounds, etc.</li> <li>(3) Inoperative flasher.</li> <li>(4) Loose chassis to column harness connection.</li> <li>(5) Inoperative turn signal switch.</li> <li>(6) To determine if turn signal switch is defective, substitute new switch into circuit and operate switch by hand. If the vehicle's lights operate normally, signal switch is inoperative.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Replace bulb.</li> <li>(2) Repair chassis wiring as required.</li> <li>(3) Replace flasher.</li> <li>(4) Connect securely.</li> <li>(5) Replace turn signal switch.</li> <li>(6) Replace turn signal switch.</li> </ol>
<b>STOP LIGHT NOT ON WHEN TURN INDICATED</b>	<ol style="list-style-type: none"> <li>(1) Loose column to chassis connection.</li> <li>(2) Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If brake lights work with switch in the turn position, signal switch is defective.</li> <li>(3) If brake lights do not work check connector to stop light sockets for grounds, opens, etc.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Connect securely.</li> <li>(2) Replace signal switch.</li> <li>(3) Repair connector to stop light circuits using service manual as guide.</li> </ol>
<b>TURN INDICATOR PANEL LIGHTS NOT FLASHING</b>	<ol style="list-style-type: none"> <li>(1) Burned out bulbs.</li> <li>(2) High resistance to ground at bulb socket.</li> <li>(3) Opens, grounds in wiring harness from front turn signal bulb socket to indicator lights.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Replace bulbs.</li> <li>(2) Replace socket.</li> <li>(3) Locate and repair as required.</li> </ol>

## Turn Signal (Continued)

Condition	Possible Cause	Correction
<b>TURN SIGNAL LIGHTS FLASH VERY SLOWLY</b>	<ol style="list-style-type: none"> <li>(1) High resistance ground at light sockets.</li> <li>(2) Incorrect capacity turn signal flasher.</li> <li>(3) If flashing rate is still extremely slow, check chassis wiring harness from the connector to light sockets for grounds, high resistance points, etc.</li> <li>(4) Loose chassis to column harness connection.</li> <li>(5) Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If flashing occurs at normal rate, the signal switch is defective.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Repair high resistance grounds at light sockets.</li> <li>(2) Replace turn signal flasher.</li> <li>(3) Locate and repair as required.</li> <li>(4) Connect securely.</li> <li>(5) Replace turn signal switch.</li> </ol>
<b>HAZARD SIGNAL LIGHTS WILL NOT FLASH—TURN SIGNAL FUNCTIONS NORMALLY</b>	<ol style="list-style-type: none"> <li>(1) Blown fuse.</li> <li>(2) Inoperative hazard warning flasher.</li> <li>(3) Loose chassis-to-column harness connection.</li> <li>(4) Disconnect column to chassis connector. Connect new switch into system without removing old. Depress the hazard warning lights. If they now work normally, turn signal switch is defective.</li> <li>(5) If lights do not flash, check wiring harness "K" lead for open between hazard flasher and connector. If open, fuse block is defective.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Replace fuse.</li> <li>(2) Replace hazard warning flasher in fuse panel.</li> <li>(3) Connect securely.</li> <li>(4) Replace turn signal switch.</li> <li>(5) Repair or replace brown wire or connector as required.</li> </ol>

## 2J-10 STEERING COLUMNS

### STEERING COLUMN ALIGNMENT

- (1) Loosen all toe plate screws.
- (2) Remove instrument panel lower trim.
- (3) Loosen column mounting bracket-to-instrument-panel attaching bolts.
- (4) Pull steering column upward. Maintain upward pressure and tighten instrument panel-to-column mounting bracket bolts to 20 foot-pounds (27 N•m) torque.
- (5) Install lower clamp bracket and tighten bolts to 20 foot-pounds (27 N•m) torque.
- (6) Tighten toe plate screws to 10 foot-pounds (14 N•m) torque.
- (7) Install instrument panel lower trim.
- (8) On vehicles with automatic transmission, check gearshift manual linkage for proper operation. Refer to Chapter 2C—Automatic Transmission.

### STEERING WHEEL REMOVAL

#### CJ Models

- (1) Disconnect battery negative cable.
- (2) Place front wheels in straight ahead position.
- (3) Remove horn button. On models with standard steering wheel, rotate button until button lock tabs align with horn button receiver notches and pull button upward to remove. On models with sport steering wheel, pull button straight up to remove.
- (4) Remove steering wheel nut and washer.
- (5) Remove receiver bushing attaching screws and remove bushing.
- (6) On models with sport steering wheel, remove horn button receiver and contact plate. On models with standard steering wheel, remove boot from receiver and remove receiver and contact plate.
- (7) Paint or scribe alignment marks on steering wheel and steering shaft for assembly reference.
- (8) Remove steering wheel using Puller J-21232 (fig. 2J-1).

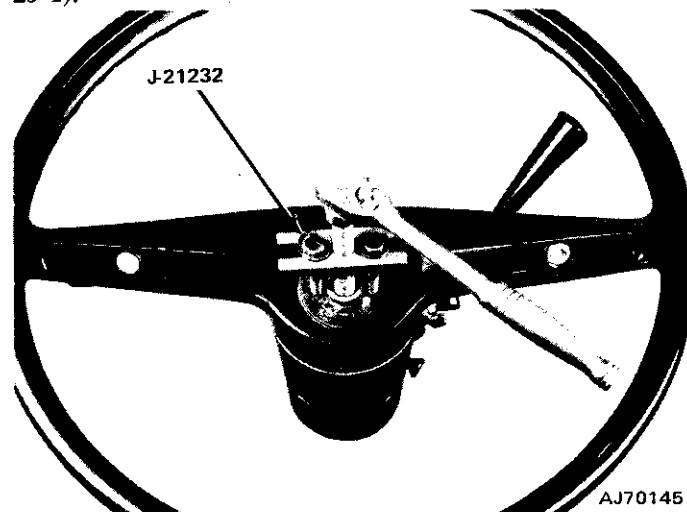


Fig. 2J-1 Steering Wheel Removal

#### Cherokee-Wagoneer-Truck Models

- (1) Disconnect battery negative cable.
- (2) Place front wheels in straight ahead position.
- (3) On models with standard steering wheel, remove horn cover attaching screws from underside of wheel and remove cover. On models with sport steering wheel, remove horn button by pulling button upward.
- (4) On models with standard steering wheel, remove horn wire. Disconnect wire at steering wheel switch. Unseat retainer that holds horn wire and spring in cancelling cam yoke and remove wire, retainer, and spring as assembly.
- (5) Remove steering wheel nut and washer.
- (6) On models with sport steering wheel, remove receiver bushing attaching screws and remove bushing, horn button receiver, and contact plate.
- (7) Paint or scribe alignment marks on steering wheel and steering shaft for assembly reference.
- (8) Remove steering wheel using Puller J-21232 (fig. 2J-1).

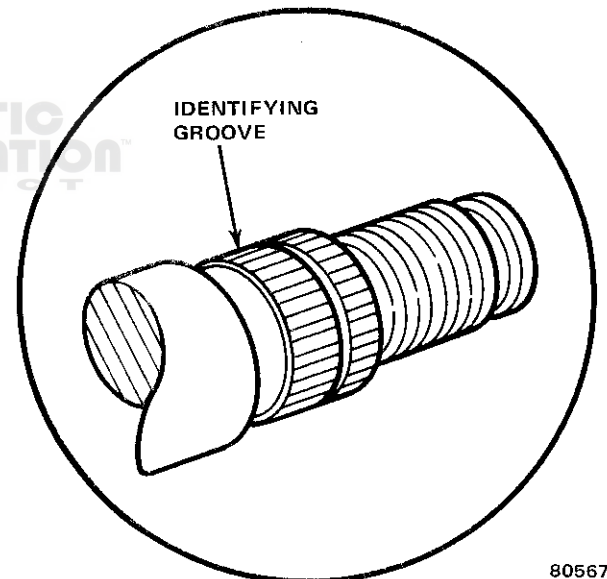


Fig. 2J-2 Metric Steering Shaft Identification

### STEERING WHEEL INSTALLATION

**CAUTION:** Some steering shafts have metric steering wheel nut threads. Inspect and identify the shaft thread-type before installing a replacement nut. Metric shafts have an identifying groove in the steering wheel splines (fig. 2J-2). American thread shafts do not have this groove.

#### CJ Models

- (1) Align reference marks on steering shaft and steering wheel and install wheel.
- (2) Install contact plate and horn button receiver. On models with sport steering wheel, install receiver so horn button locating notch is at 12 o'clock position.

- (3) Install receiver bushing and bushing attaching screws.
- (4) Install steering wheel washer and nut. Tighten nut to 30 foot-pounds (41 N•m) torque.
- (5) On models with standard steering wheel, position boot in receiver and install horn button. On models with sport steering wheel, install horn button.
- (6) Connect battery negative cable.
- (7) Reset clock if equipped.

**Cherokee-Wagoneer-Truck Models**

- (1) Align reference marks on steering shaft and steering wheel and install wheel.
- (2) On models with sport steering wheel, install contact plate, horn button receiver, and receiver bushing. Be sure to install receiver so horn button locating notch is at 12 o'clock position.
- (3) Install steering wheel washer and nut. Tighten nut to 30 foot-pounds (41 N•m) torque.
- (4) On models with standard steering wheel, insert spring and horn wire in cancelling cam yoke. Seat horn wire retainer in cam yoke and connect opposite end of wire to steering wheel switch.
- (5) Install horn button.
- (6) Connect battery negative cable.
- (7) Reset clock if equipped.

- (6) Remove steering wheel using tool J-21232 (fig. 2J-1).
- (7) Remove receiver insulator attaching screws and remove insulator and skirt (fig. 2J-3).
- (8) Color coat replacement skirt. Refer to Chapter 3B—Metal Repair and Painting for color coat procedure.
- (9) Align and install replacement skirt and receiver insulator on steering wheel and install insulator attaching screws.
- (10) Align reference marks on steering shaft and wheel and install wheel.
- (11) Install contact plate and horn button receiver. Install receiver so horn button locating notch is at 12 o'clock position.
- (12) Install receiver bushing and bushing attaching screws.
- (13) Install steering wheel washer and nut. Tighten nut to 30 foot-pounds (41 N•m) torque.
- (14) Install horn button. Align button tab with receiver notch and press button downward until seated.
- (15) Connect battery negative cable.
- (16) Reset clock if equipped.

**STEERING COLUMN REMOVAL**

**CAUTION:** Handle the steering column with special care after it is removed from the vehicle. Sharp blows on the end of the steering shaft or shift lever, leaning on the column assembly, or dropping the assembly could shear or loosen the plastic fasteners that maintain column rigidity.

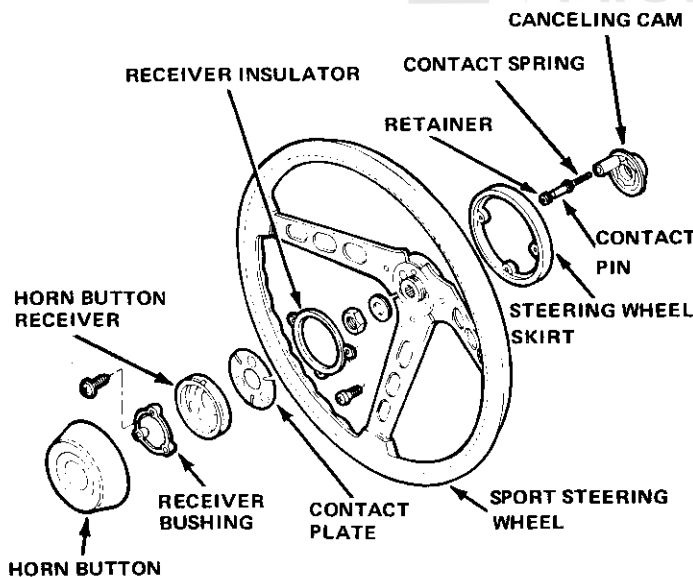
- (1) Disconnect battery negative cable.
- (2) On vehicles with automatic transmission, disconnect transmission shift rod at steering column shift lever.

**NOTE:** On Cherokee and Wagoneer models with automatic transmission and power brakes, the gearshift lever must be moved to the "1" range position to gain access to the shift rod-to-shift lever retaining clip.

- (3) Remove steering column-to-intermediate shaft U-joint pinch bolt.

**CAUTION:** Do not attempt to separate the intermediate shaft and steering column at this time. If separated, the plastic connector injected into the intermediate shaft could be damaged.

- (4) On Cherokee and Wagoneer models with air conditioning, remove left air duct extension.
- (5) Remove steering column-to-instrument panel bezel. On Cherokee, Wagoneer, and Truck models, screws attaching two halves of bezel are located behind lower bezel half.
- (6) Remove bolts attaching steering column mounting bracket to instrument panel.
- (7) Remove bolts attaching steering column mounting bracket to steering column and remove bracket.



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Fig. 2J-3 Sport Steering Wheel Assembly

**SPORT STEERING WHEEL SKIRT REPLACEMENT**

- (1) Disconnect battery negative cable.
- (2) Place wheels in straight-ahead position.
- (3) Remove horn button. Pull straight up on button to remove.
- (4) Remove steering wheel nut and washer.
- (5) Remove receiver bushing attaching screws and remove bushing, horn button receiver, and contact plate (fig. 2J-3).



## 2J-12 STEERING COLUMNS

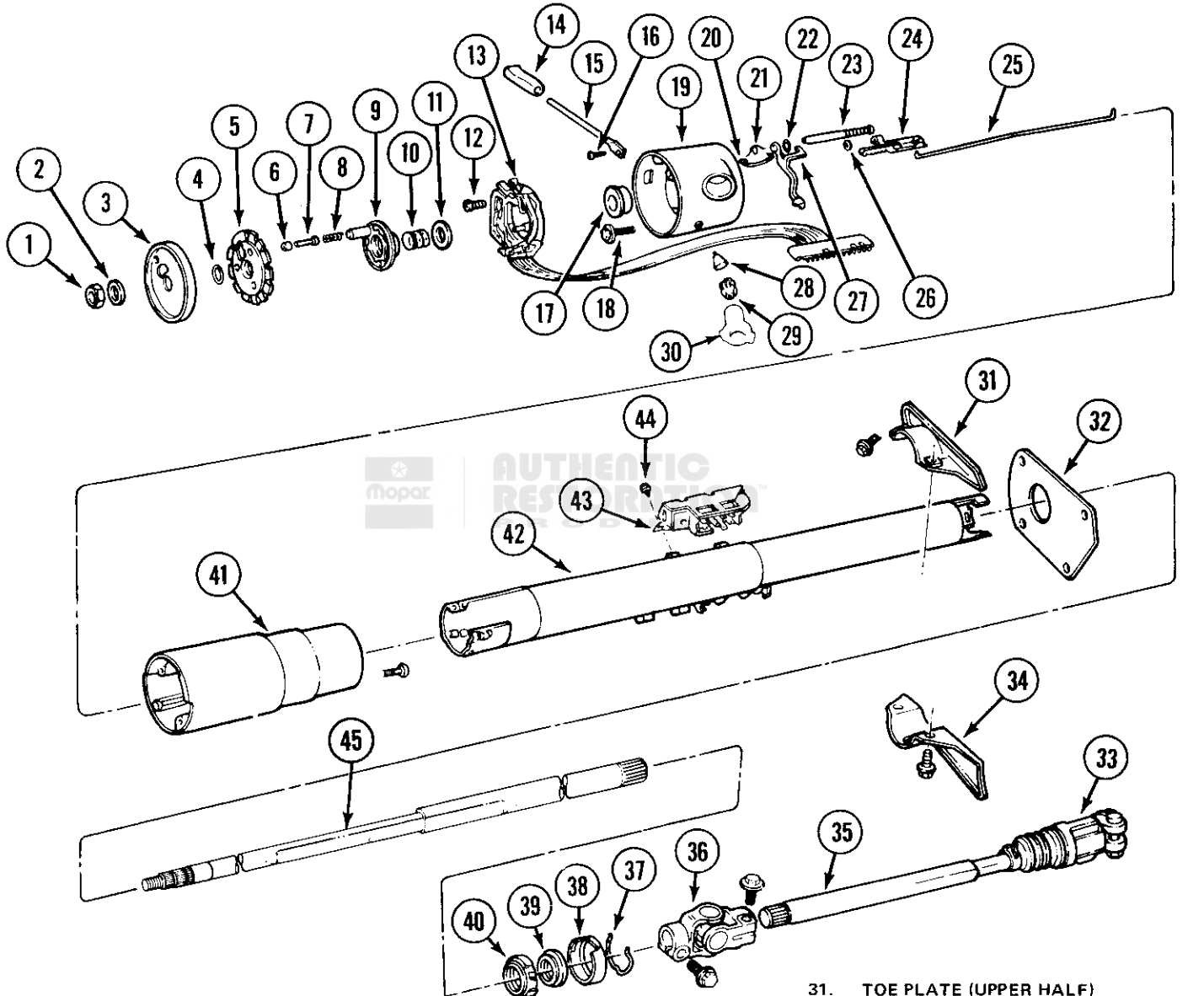
**CAUTION:** To avoid damaging the mounting bracket breakaway capsules, store the bracket in a safe place until service operations are completed.

- (8) Remove top and bottom toe plates.
- (9) Disconnect wiring harness at ignition switch.
- (10) Disconnect Cruise Command wiring harness

connector if equipped.

(11) On vehicles with automatic transmission, disconnect wiring harness connector at neutral safety switch.

(12) Separate steering column from intermediate shaft and remove steering column.



1. STEERING WHEEL NUT
2. WASHER
3. LOCK PLATE COVER
4. STEERING SHAFT SNAP RING
5. LOCKPLATE
6. RETAINER
7. HORN CONTACT PIN
8. SPRING
9. CANCELING CAM
10. UPPER BEARING PRELOAD SPRING
11. THRUST WASHER
12. TURN SIGNAL SWITCH SCREW (3)
13. TURN SIGNAL SWITCH
14. TURN SIGNAL LEVER KNOB
15. TURN SIGNAL LEVER

16. TURN SIGNAL LEVER SCREW
17. UPPER BEARING
18. HOUSING RETAINING SCREW (4)
19. HOUSING
20. RACK PRELOAD SPRING
21. KEY RELEASE LEVER SPRING
22. WAVE WASHER
23. LOCK BOLT
24. LOCK RACK
25. REMOTE ROD
26. SPRING WASHER
27. KEY RELEASE LEVER
28. HAZARD WARNING SWITCH KNOB
29. LOCK SECTOR
30. LOCK CYLINDER

31. TOE PLATE (UPPER HALF)
32. SEAL
33. INTERMEDIATE SHAFT COUPLING
34. TOE PLATE (LOWER HALF)
35. INTERMEDIATE SHAFT
36. INTERMEDIATE SHAFT-TO-STEERING SHAFT U-JOINT
37. SNAP RING
38. RETAINER
39. LOWER BEARING
40. LOWER BEARING ADAPTER
41. SHROUD
42. JACKET
43. IGNITION SWITCH
44. IGNITION SWITCH SCREW (2)
45. STEERING SHAFT

Fig. 2J-4 Steering Column—Manual Transmission

## STEERING COLUMN INSTALLATION

**CAUTION:** Use only the specified screws, bolts, and nuts when servicing the column. Do not use any substitute fasteners. Tighten all fasteners to the specified torque only to maintain the energy-absorbing (compression) action of the column. Bolts and screws longer than specified must not be used as they may prevent the column from compressing under impact. The bolts or nuts securing the column mounting bracket to the instrument panel must be tightened to the proper torque so that the bracket will break away under impact.

- (1) Install steering column in vehicle and connect column to intermediate shaft.
- (2) Install intermediate shaft-to-column U-joint pinch bolt. Tighten bolt to 45 foot-pounds (61 N•m) torque.
- (3) Connect Cruise Command wire harness connector, if equipped.
- (4) Connect wiring harness connectors to ignition switch. Install white connector first—black connector last.
- (5) On vehicles with automatic transmission, connect wiring harness connector to neutral safety switch.
- (6) Install top and bottom toe plates but do not tighten attaching bolts completely.
- (7) Install mounting bracket on steering column and tighten bracket attaching bolts to 20 foot-pounds (27 N•m) torque.
- (8) Align steering column mounting bracket and instrument panel and loosely install mounting bracket-to-instrument panel bolts.
- (9) Pull steering column upward and tighten column mounting bracket-to-instrument panel bolts to 20 foot-pounds (27 N•m) torque. Be sure to maintain upward pressure on column when tightening bolts.
- (10) Tighten toe plate bolts to 10 foot-pounds (14 N•m) torque.
- (11) Install both halves of steering column-to-instrument panel bezel.
- (12) On Cherokee, Wagoneer and Truck models with air conditioning, install left air duct extension.
- (13) Connect transmission shift rod to steering column shift lever.
- (14) On vehicles with automatic transmission, check operation of gearshift manual linkage and adjust linkage if necessary. Refer to Chapter 2C—Automatic Transmission.
- (15) Connect all electrical components and check for proper operation.
- (16) Install instrument panel trim and left side air conditioning duct if equipped.
- (17) Connect battery negative cable.
- (18) Reset clock if equipped.

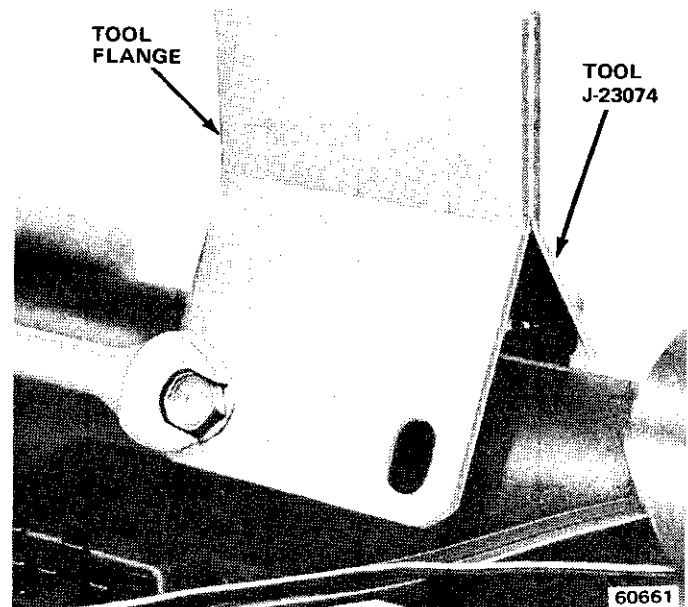


Fig. 2J-5 Steering Column Support Fixture Installation

## STANDARD COLUMN OVERHAUL—MANUAL TRANSMISSION

### Column Disassembly

**NOTE:** Steering column removal is not necessary if only the lock plate cover, lock plate, steering shaft snap ring, canceling cam, turn signal switch, upper bearing preload spring, or lock cylinder are to be serviced (fig. 2J-3). However, the column must be removed in order to service any of the remaining components. If the column is removed, remove the column-to-instrument panel mounting bracket and install Support Fixture J-23074 (fig. 2J-5). Mount the column in a vise by clamping the support fixture flange in the vise.

- (1) Place front wheels in straight-ahead position.
- (2) Disconnect battery negative cable.
- (3) Cover painted areas of column.
- (4) Remove steering wheel.
- (5) Remove lock plate cover. Use two screwdrivers to pry cover off lock plate and out of column.
- (6) Compress lock plate and unseat steering shaft snap ring as follows:
  - (a) Inspect and identify steering shaft nut thread type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.
  - (b) If shaft has American threads, use tool J-23653 as is to compress lockplate and unseat snap ring (fig. 2J-6).
  - (c) If shaft has metric threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing tool on steering shaft.

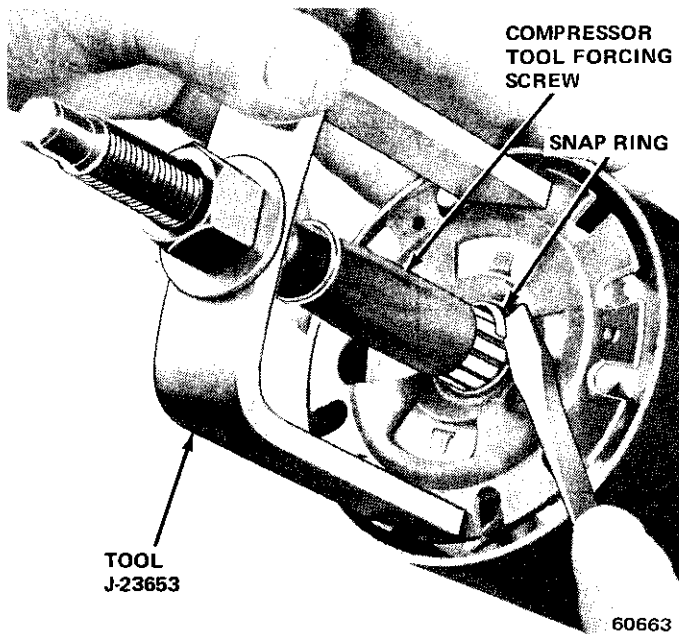


Fig. 2J-6 Steering Shaft Snap Ring Removal

**WARNING:** The lock plate is under strong spring tension. Do not attempt to remove the steering shaft snap ring without using the compressor tool.

(7) Remove lock plate compressor tool and snap ring. Discard snap ring.

**CAUTION:** When the steering shaft snap ring is removed, the shaft is free in the column. During bench overhaul, remove the shaft by pulling it out from the lower end of column. Do not allow the shaft to fall out whenever the column is removed from the vehicle.

(8) Remove lock plate, canceling cam, upper bearing preload spring, and thrust washer from shaft.

(9) Remove hazard warning switch knob. Press knob inward and unthread knob from column.

(10) On vehicles without Cruise Command, remove turn signal lever attaching screw and remove lever.

(11) On vehicles with Cruise Command, disconnect two of four wires at switch connector. Fold wires back along harness. Tape wires to harness and tape length of string to harness to aid removal.

(12) Unhook turn signal switch wire harness connector from bracket at lower end of steering column.

(13) Disconnect instrument panel harness connector from turn signal switch harness connector by lifting plastic lock tab on connector and separating connectors, (fig. 2J-7).

(14) Wrap tape around turn signal switch harness connector to prevent snagging during removal.

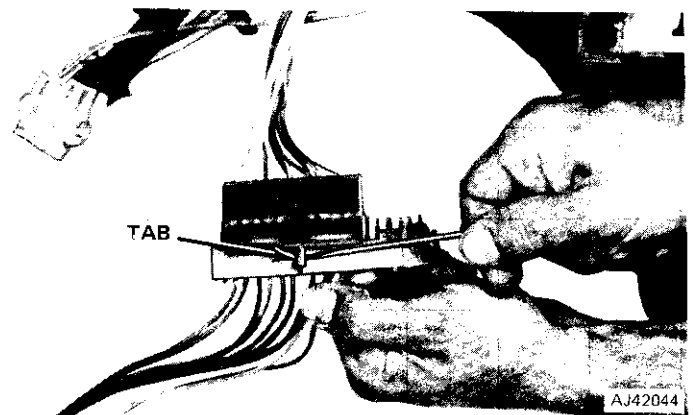


Fig. 2J-7 Disconnecting Turn Signal Switch Harness

(15) Remove turn signal switch attaching screws and remove switch. Pull switch and harness straight up and out of housing (fig. 2J-8).

(16) On vehicles with Cruise Command, remove turn signal lever and switch and remove switch harness using string previously taped in place.

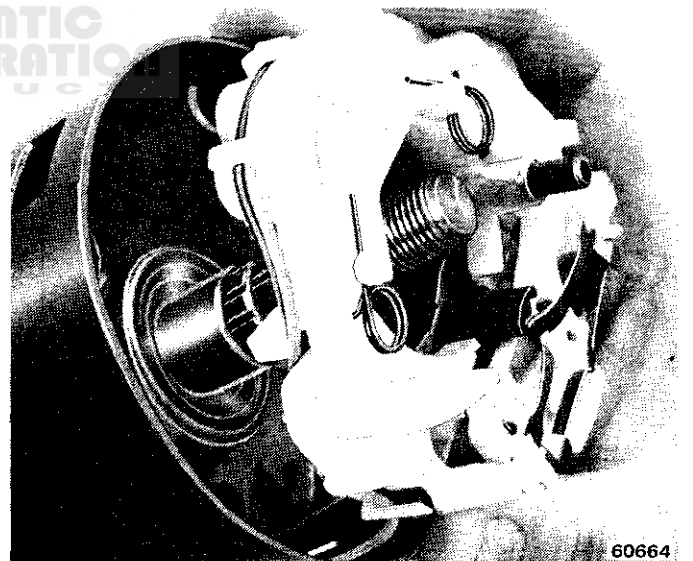


Fig. 2J-8 Turn Signal Switch Removal/Installation

(17) Turn ignition lock cylinder (clockwise) two detent positions beyond Off-LOCK position.

(18) Compress lock cylinder retaining tab using thin-bladed screwdriver and remove lock cylinder from column.

**NOTE:** The lock cylinder retaining tab is accessible through the slot adjacent to the turn signal switch mounting boss (fig. 2J-9). If the retaining tab is not visible through the slot, scrape or knock any casting flash out of the slot to provide access.

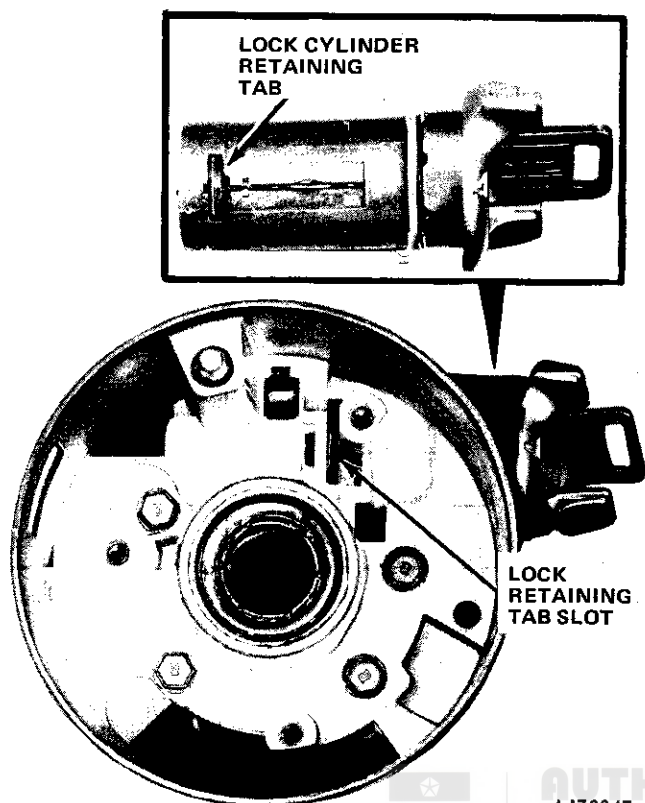


Fig. 2J-9 Lock Cylinder Retaining Tab Location

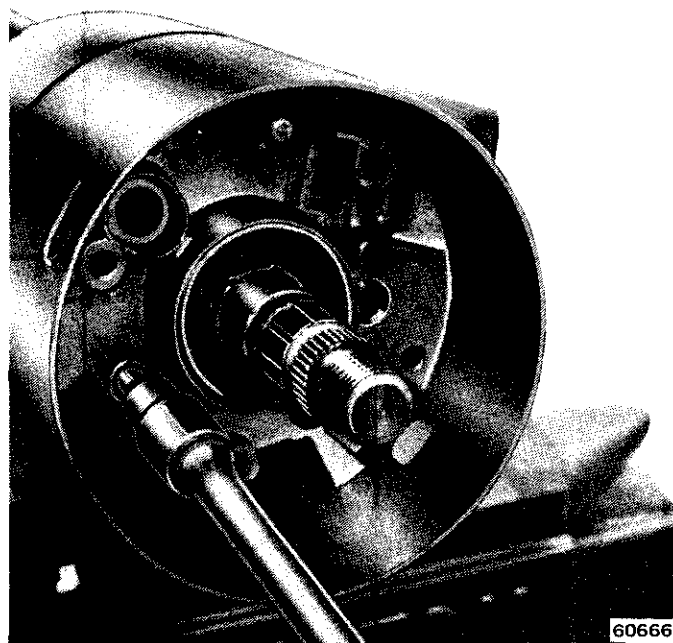


Fig. 2J-11 Housing and Shroud Removal/Installation

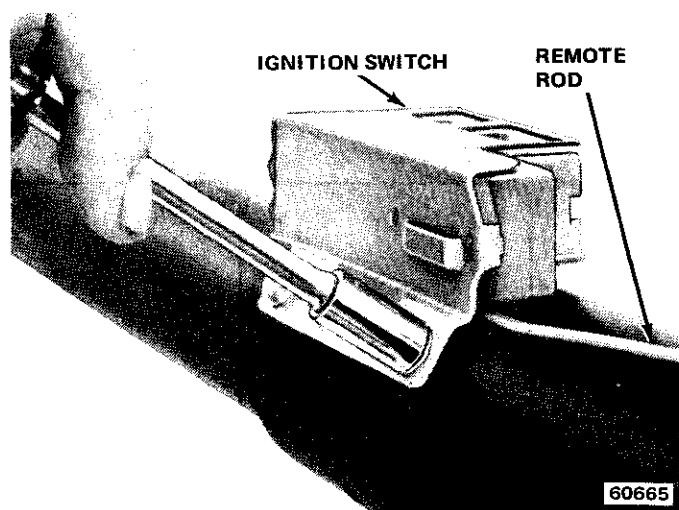


Fig. 2J-10 Ignition Switch Removal/Installation

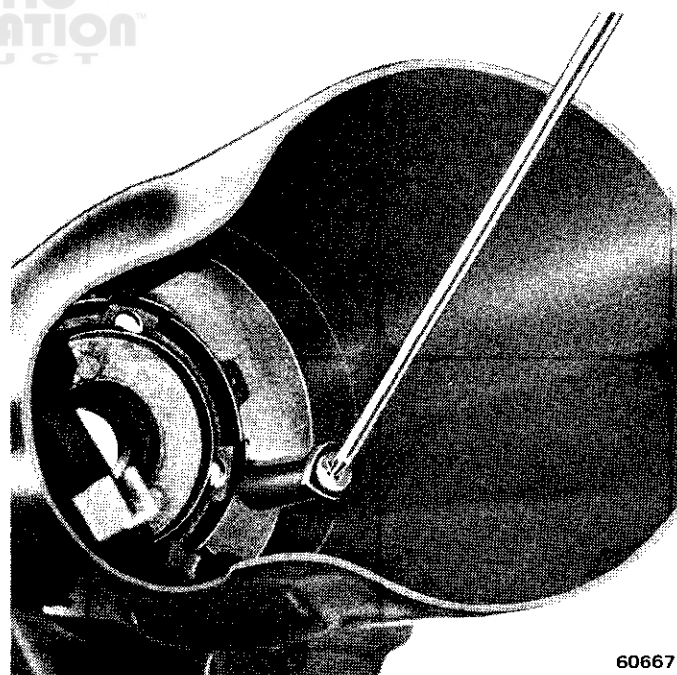


Fig. 2J-12 Removing Shroud From Housing

(19) Remove ignition switch from lower end of column (fig. 2J-10).

(20) Remove screws attaching housing and shroud to column jacket (fig. 2J-11) and remove housing and shroud.

(21) Disengage remote rod from lock rack.

(22) Remove screws attaching shroud to housing (fig. 2H-12) and remove housing from shroud.

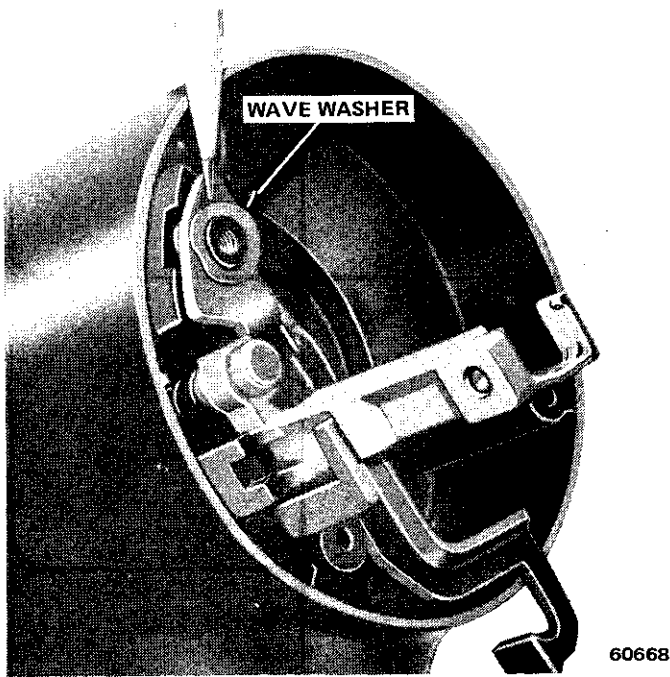


Fig. 2J-13 Wave Washer Position

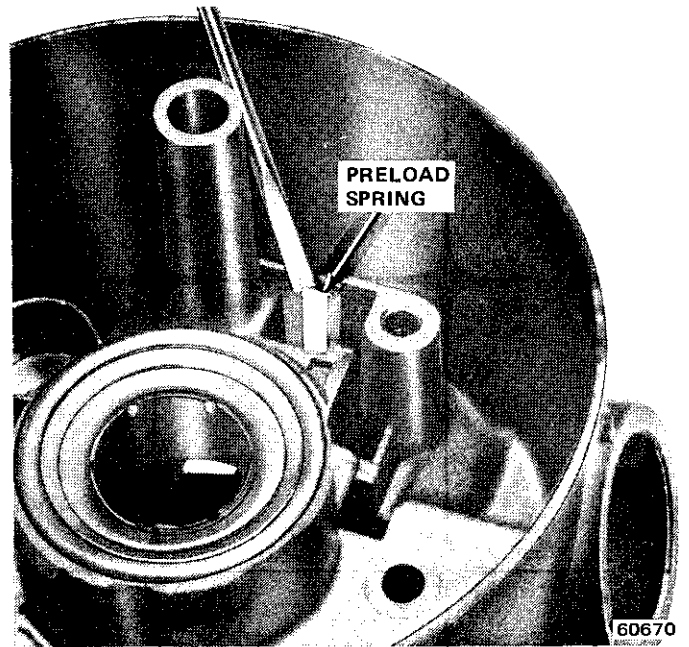


Fig. 2J-15 Rack Preload Spring Removal/Installation

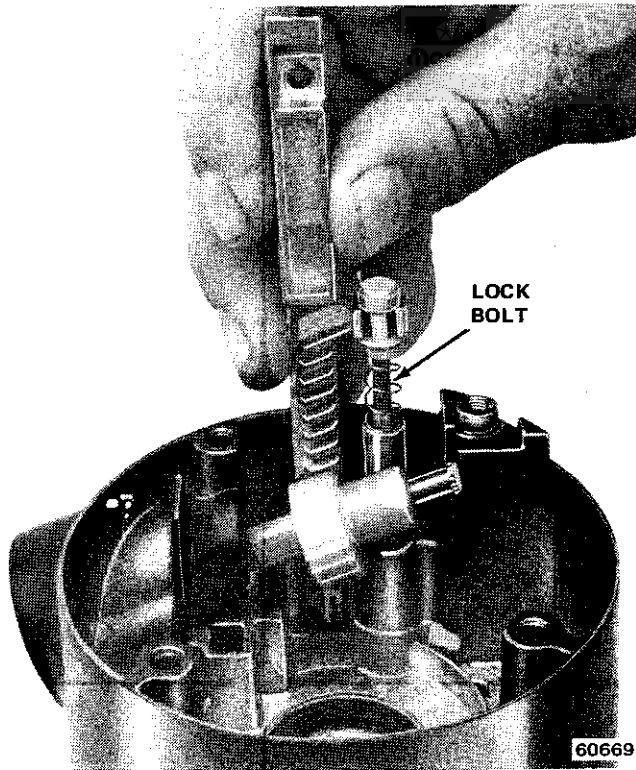


Fig. 2J-14 Lock Rack and Lock Bolt Removal

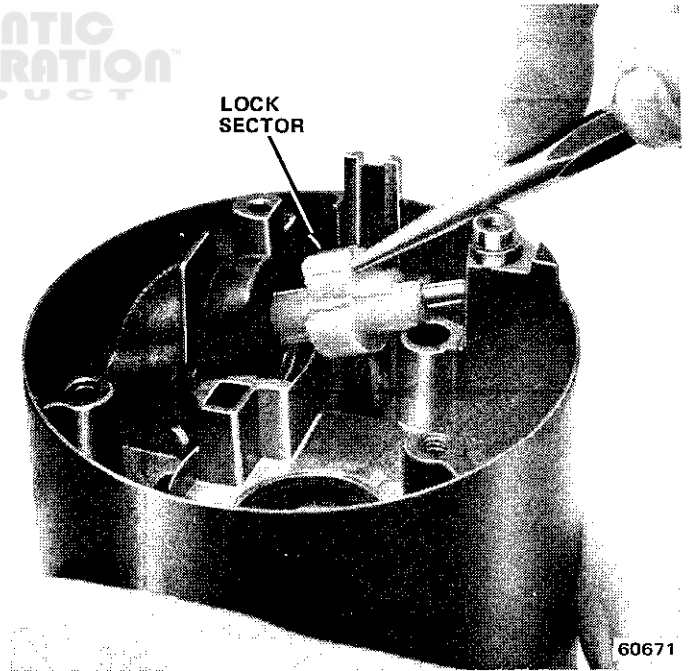


Fig. 2J-16 Lock Sector Removal

(23) Remove wave washer from key release lever pivot and remove key release lever and spring (fig. 2J-13).

(24) Remove lock rack and lock bolt assembly (fig. 2J-14).

(25) Remove rack preload spring (fig. 2J-15).

(26) Remove lock sector through lock cylinder hole in housing. Push on block tooth of sector with blunt punch to remove (fig. 2J-16).

**NOTE:** Although the preceding steps can be performed with the column mounted in the vehicle, the following steps can be performed only after the column has been removed.

(27) Remove column from vehicle, if necessary, and mount column in vise using Support Fixture Tool J-23074 (fig. 2J-5).

(28) Remove steering shaft if not removed previously.

(29) Remove spring clip from lower bearing retainer and remove retainer, bearing, and adapter.

### Column Assembly

**CAUTION:** Use only the specified screws, bolts, and nuts when servicing the column and tighten all fasteners to recommended torque values only to maintain the energy-absorbing (compressing) action of the column. Incorrect length screws or bolts can prevent the column from compressing under impact. The bolts and nuts that attach the column mounting bracket to the column and instrument panel must also be tightened to the proper torque so that the bracket will break away under impact.

(1) Coat all friction and bearing surfaces with chassis grease before assembly.

(2) Install lock sector on sector shaft. Install sector through lock cylinder hole in housing (fig. 2J-17). Use blunt tool to press sector onto shaft. Be sure sector turns freely after installation.



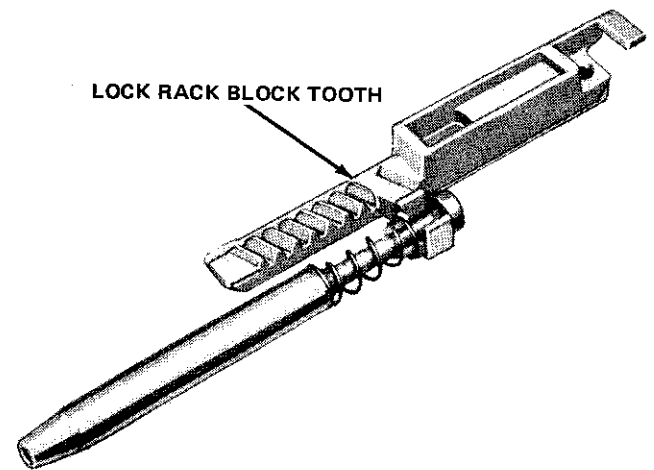
Fig. 2J-17 Sector Installation

(3) Install rack preload spring (fig. 2J-15). Bowed side of spring must bear against lock rack when rack is installed.

(4) Assemble lock bolt and lock rack (fig. 2J-18).

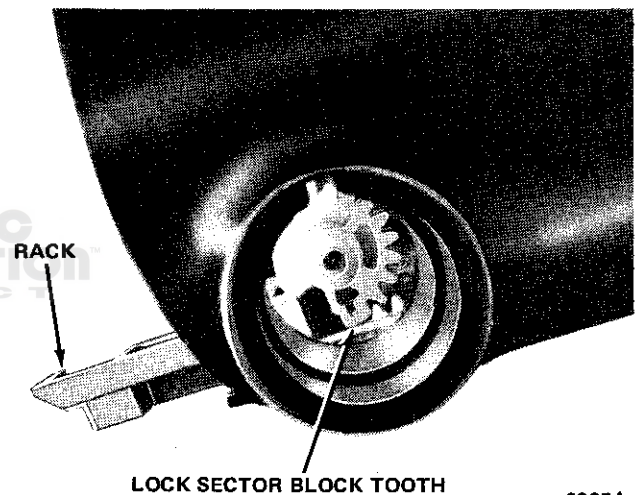
(5) Install assembled lock bolt and lock rack in housing. Mate block tooth of lock rack with block tooth of sector (fig. 2J-19).

(6) Install key-release lever return spring over post in housing (fig. 2J-20). Insert release lever finger in lock



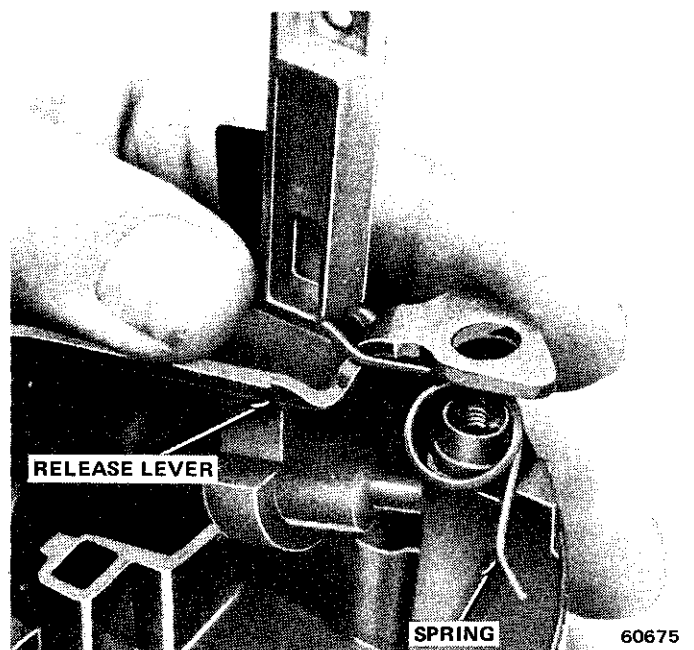
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Fig. 2J-18 Assembling Lock Bolt and Lock Rack



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Fig. 2J-19 Lock Bolt and Lock Rack Installation



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Fig. 2J-20 Key Release Lever and Spring Installation

## 2J-18 STEERING COLUMNS

rack slot and position hole in lever over threaded hole in housing post (fig. 2J-21). Be sure inner end of spring contacts release lever.

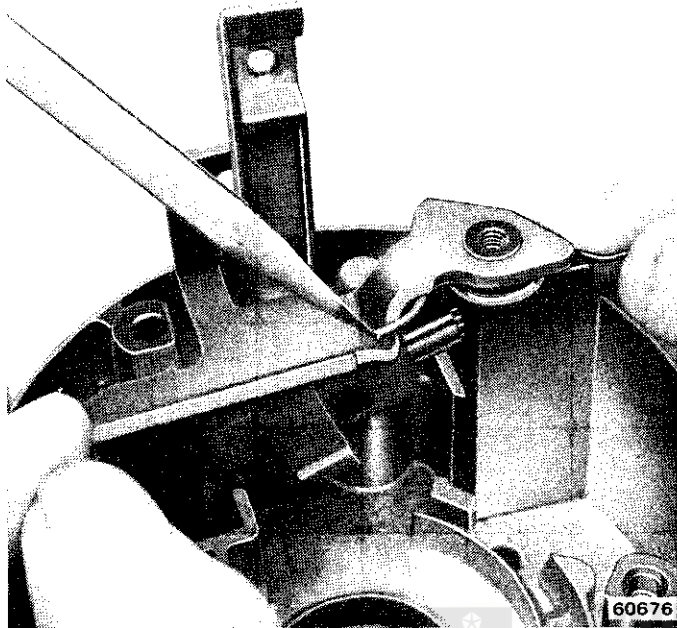


Fig. 2J-21 Positioning Key Release Lever Spring

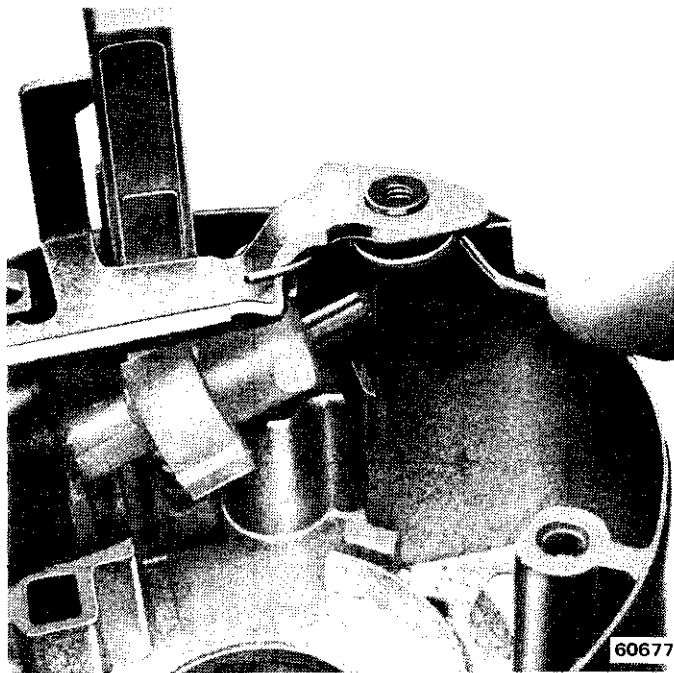


Fig. 2J-22 Securing Key Release Lever Spring

(7) Raise key-release lever slightly and install end of release lever spring between lever and housing boss (fig. 2J-22).

(8) Coat wave washer with chassis grease and install washer on post and over release lever (fig. 2J-13).

(9) Position shroud on housing and install attaching screws. Tighten screws to 18 inch-pounds (2 N•m) torque. Do not displace release lever wave washer when assembling shroud and housing.

(10) Install remote rod on lock rack. Insert short hooked end of rod in lock rack.

(11) Install assembled shroud and housing on column and install attaching screws (fig. 2J-11). Tighten screws to 60 inch-pounds (7 N•m) torque.

(12) Install lock cylinder in housing. Insert key in lock, hold cylinder sleeve, and rotate key clockwise until key stops (this retracts actuator).

(13) Insert lock cylinder in housing bore with cylinder tab aligned with keyway in housing. Push cylinder inward until it bottoms. Rotate key counterclockwise until drive section of cylinder mates with sector. Push cylinder in fully until tab engages in housing groove.

(14) Turn lock cylinder clockwise to stop, then counterclockwise to Off-Unlock position.

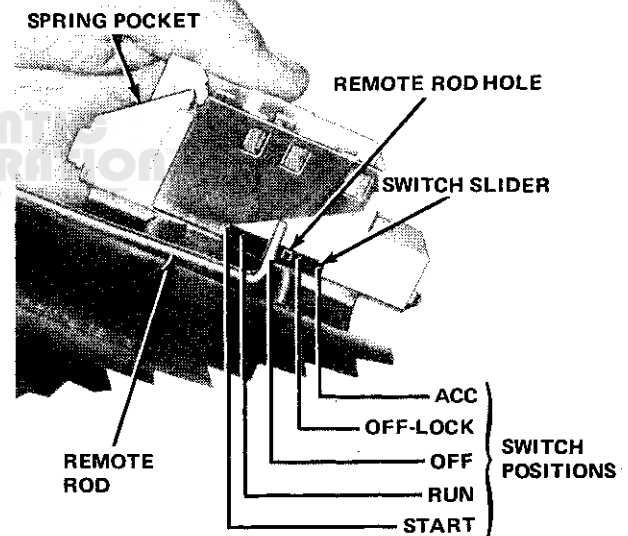


Fig. 2J-23 Positioning Ignition Switch

(15) Install ignition switch as follows:

(a) Position switch on column jacket (fig. 2J-23).

(b) Move switch slider to extreme left to Accessory position.

(c) Move slider two positions to right from Accessory position to Off-Unlock position.

(d) Insert remote rod into hole in switch slider.

(e) Position switch on column and install attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

(16) Install lower bearing, bearing adapter, retainer, and snap ring in lower end of column.

(17) Install steering shaft through lower end of column and into upper bearing in housing.

(18) Install turn signal switch and wire harness. Bend wires against connector and feed connector through housing and shroud.

(19) Align turn signal switch in housing and install switch attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

(20) On vehicles without Cruise Command, install turn signal lever. Tighten lever attaching screw to 35 inch-pounds (4 N•m) torque.

(21) On vehicles with Cruise Command, install lever and switch assembly. Use string previously taped in place to guide wires into housing. Remove string and tape. Connect wires to switch terminal and install lever attaching screw. Tighten screw to 35 inch-pounds (4 N•m) torque.

(22) Install thrust washer, upper bearing preload spring, and canceling cam on steering shaft. Position canceling cam as shown in figure 2J-24.

(23) Place turn signal switch in neutral position and install hazard warning switch knob.

(24) Position lock plate on steering shaft.

(25) Install replacement steering shaft snap ring on sleeve of Compressor Tool J-23653 and install tool on steering shaft (fig. 2J-25).

(26) Compress lock plate and install snap ring in steering shaft groove (fig. 2J-25).

(27) Remove compressor tool. Be sure snap ring is fully seated before removing tool.

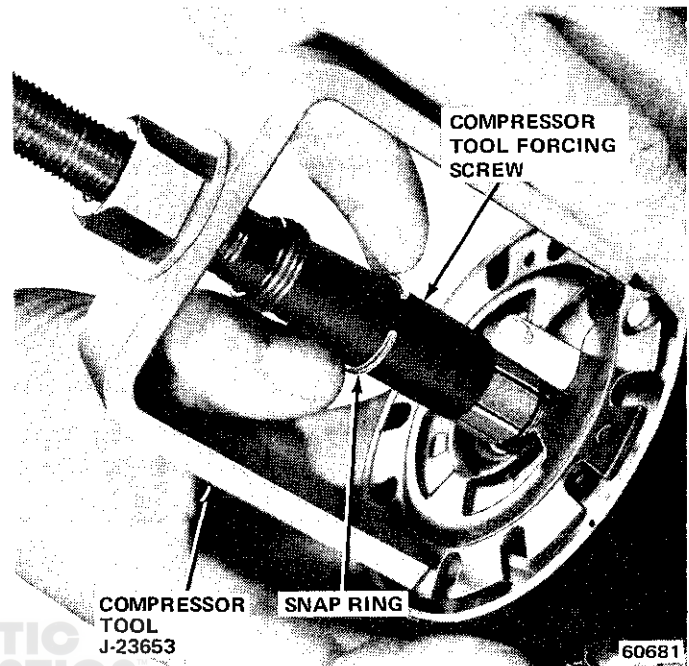


Fig. 2J-25 Steering Shaft Snap Ring Installation

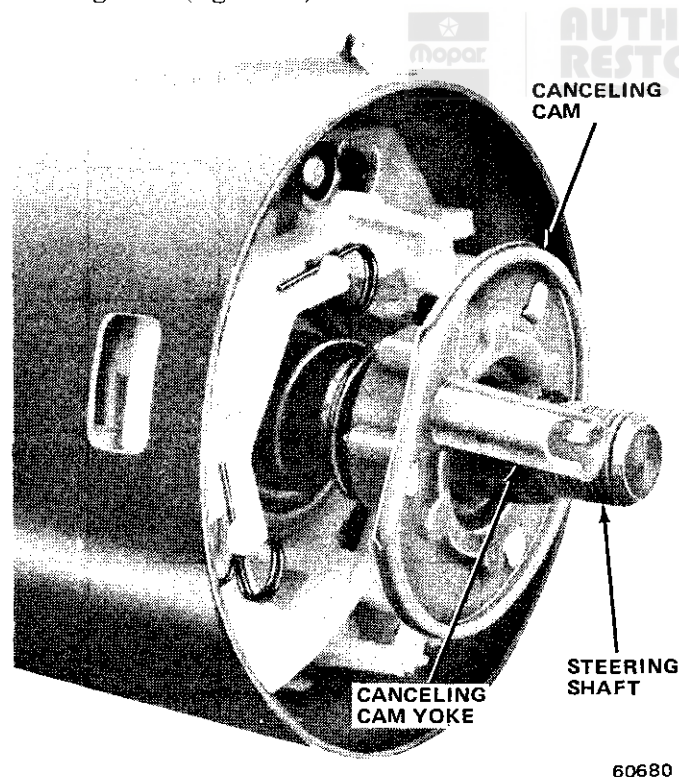


Fig. 2J-24 Positioning Cancelling Cam

**CAUTION:** Identify the steering shaft nut thread type before using the compressor tool. If the shaft has American threads, use the compressor tool as is. However, if the shaft has metric threads (fig. 2J-2), replace the compressor tool forcing screw with Metric Forcing Screw J-23653-4 before using the tool.

(28) Install lock plate cover.

(29) Remove Support Fixture Tool J-23074 if installed.

(30) Install column mounting bracket. Tighten bracket attaching bolts to 20 foot-pounds (27 N•m) torque.

(31) Connect column wiring harness connectors and install harness protector.

(32) Install steering wheel.

(33) Install and tighten steering wheel nut to 30 foot-pounds (41 N•m) torque.

**CAUTION:** Some steering shafts have metric size steering wheel nut threads. If a replacement nut is being installed, identify the shaft thread-type before installation. Metric shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

(34) Install column bezel.

(35) Install and tighten column bracket-to-instrument panel bolts to 20 foot-pounds (27 N•m) torque.

(36) Tighten toe plate bolts to 10 foot-pounds (14 N•m) torque.

(37) Remove protective covering from column painted areas.

(38) Connect battery negative cable.



**STANDARD COLUMN OVERHAUL—AUTOMATIC TRANSMISSION**

**Column Disassembly**

**NOTE:** Steering column removal is not necessary if only the lock plate cover, lock plate, steering shaft snap ring, upper bearing preload spring, canceling cam, turn signal switch, or lock cylinder are to be serviced. However, the column must be removed in order to service any of the remaining components. If the column must be removed, remove the column mounting bracket and install Support Fixture J-23074 (fig. 2J-5). Mount the column in a vise by clamping the support fixture flange in the vise.

- (1) Disconnect battery negative cable.
- (2) Place front wheels in straight-ahead position.
- (3) Remove column-to-instrument panel bezel and left air conditioning duct if equipped.
- (4) Cover painted areas of column.
- (5) Remove steering wheel (fig. 2J-1).
- (6) Remove lock plate cover. Use two screwdrivers to pry cover off lock plate and out of housing.
- (7) Compress lock plate and unseat steering shaft snap ring as follows:

(a) Inspect and identify steering shaft nut thread type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

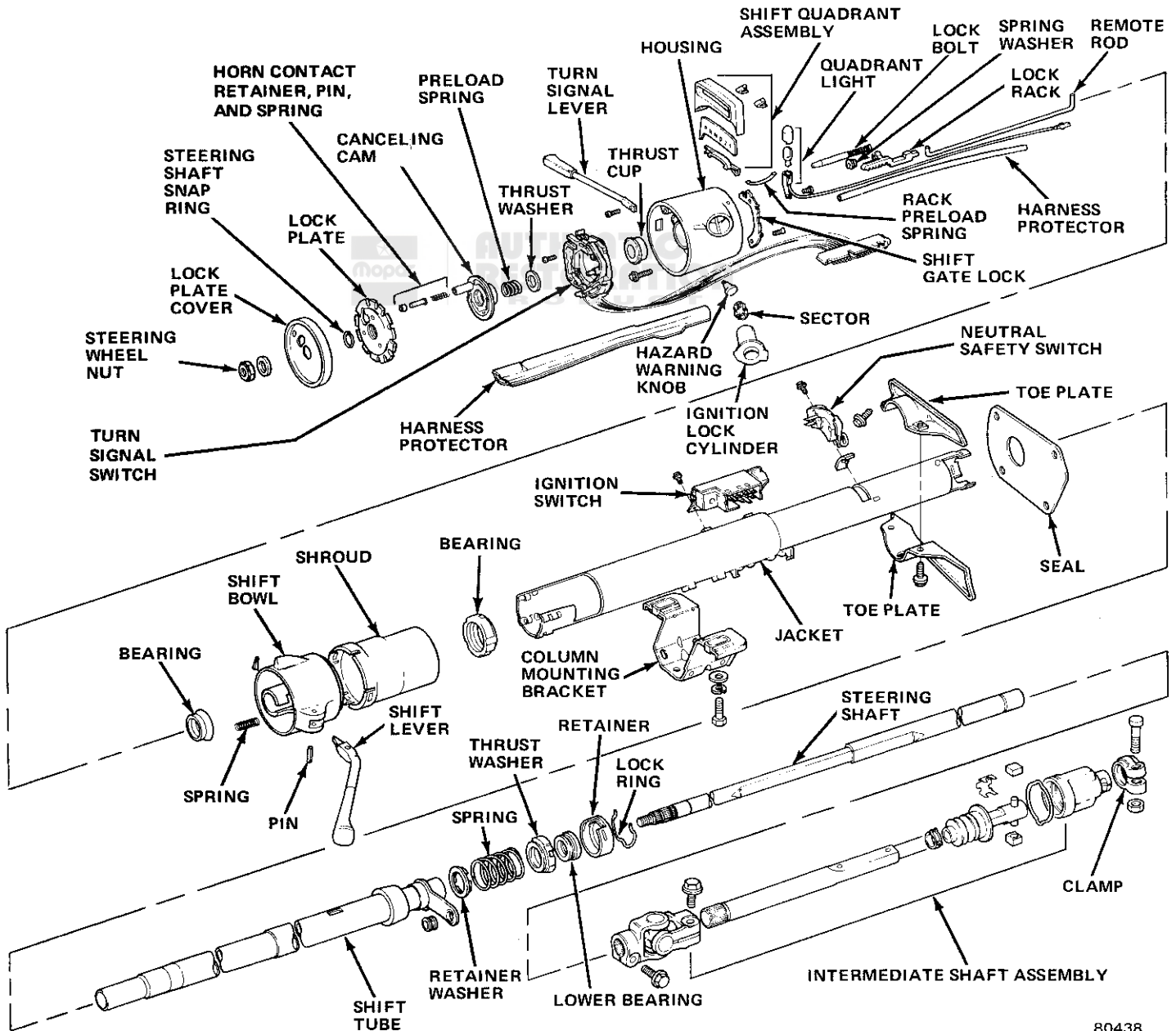


Fig. 2J-26 Steering Column—Automatic Transmission

(b) If shaft has American threads, use Compressor Tool J-23653, as is, to compress lock plate and unseat snap ring (fig. 2J-6).

(c) If shaft has metric nut threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing tool on steering shaft.

**WARNING:** *The lock plate is under strong spring tension. Do not attempt to remove the snap ring without using the compressor tool.*

(8) Remove lock plate compressor tool and remove steering shaft snap ring. Discard snap ring.

**CAUTION:** *When the snap ring is removed, the steering shaft is free in the column. If the column is removed for bench overhaul, do not let the shaft fall out when the column is moved.*

(9) Remove lock plate, canceling cam, upper bearing preload spring, and thrust washer (fig. 2J-26).

(10) On vehicles without Cruise Command, remove turn signal lever attaching screw and remove lever.

(11) On vehicles with Cruise Command, remove wires from switch terminal. Fold two of four wires back along harness. Tape wires in place and tape length of string to harness to aid removal.

(12) Push inward on hazard warning switch knob and unthread knob in counterclockwise direction.

(13) Place gearshift lever in Park position. Remove lever retaining pin using punch and remove lever.

(14) Unhook turn signal switch wire harness connector from column.

(15) Disconnect turn signal switch harness connector from instrument panel harness connector (fig. 2J-7). Lift connector lock tab to separate connectors.

(16) Using stiff wire or paper clip, compress lock tab retaining shift quadrant light wire in connector block and disconnect wire.

(17) Remove column lower bracket and plastic harness protector.

(18) Remove column-to-instrument panel mounting bracket if turn signal switch is to be removed with column mounted in vehicle.

(19) Wrap tape around turn signal switch harness connector to prevent snagging (fig. 2J-27).

(20) Remove turn signal switch attaching screws and remove switch and harness. Pull switch straight up and out of column.

(21) On vehicles with Cruise Command, remove turn signal lever attaching screw and remove lever and switch as assembly. Guide switch harness out of column using string previously taped to harness.

(22) Place lock cylinder in LOCK position. Compress lock cylinder retaining tab and remove lock cylinder (fig. 2J-9).

**NOTE:** *The retaining tab is accessible through the tab slot in the housing (fig. 2J-9). If the tab is not visible through the slot, scrape or knock all casting flash from the slot.*

(23) Remove ignition switch from lower end of column.

(24) Remove upper housing attaching screws and remove upper housing.

**NOTE:** *The remote rod and shift quadrant light wire, if equipped will be removed as an assembly along with the upper housing.*

(25) Remove thrust cup from upper housing (fig. 2J-28).

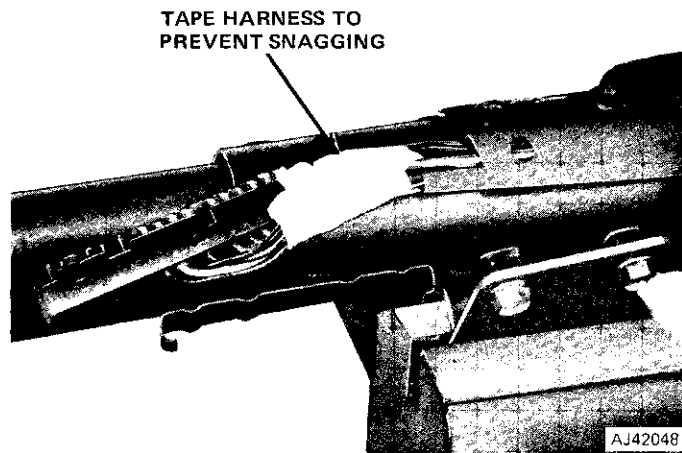


Fig. 2J-27 Turn Signal Switch Harness Removal

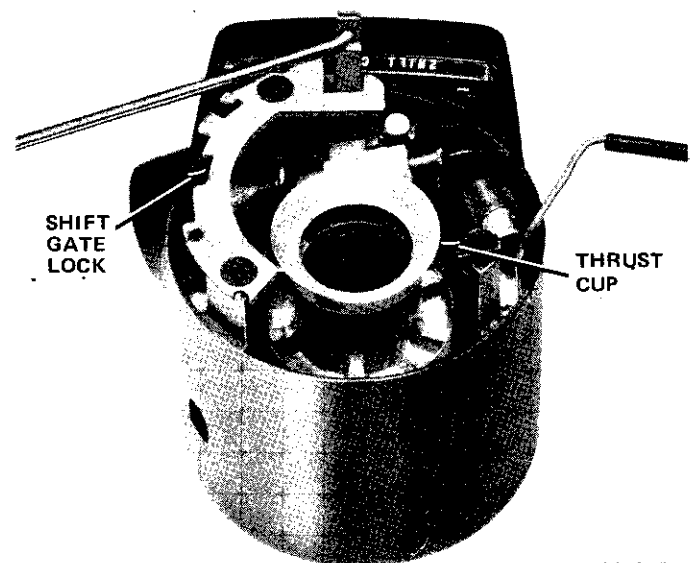


Fig. 2J-28 Thrust Cup Position

## 2J-22 STEERING COLUMNS

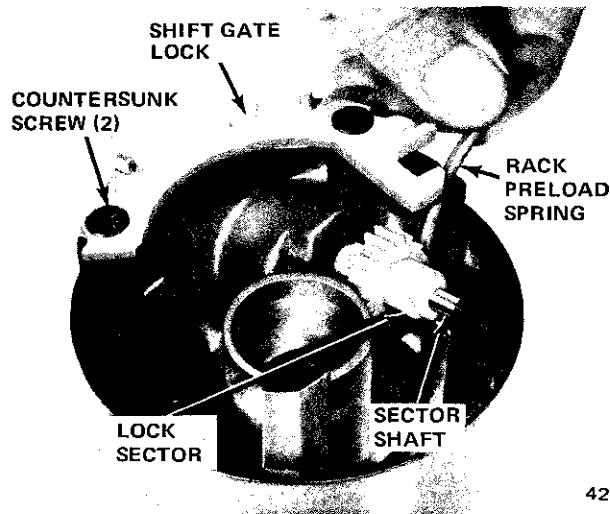


Fig. 2J-29 Housing Components

(26) Remove lock bolt and lock rack and remove rack preload spring (fig. 2J-29).

(27) Remove lock sector from sector shaft using blunt punch (fig. 2J-19). Note lock sector position for assembly reference and remove sector through lock cylinder hole in housing.

(28) Remove shift gate lock from upper housing. Examine shift gate lock detents for wear. Replace lock if excessively worn.

(29) Remove shift quadrant. Quadrant is retained by two clips which must be pried out with small punch (fig. 2J-30).

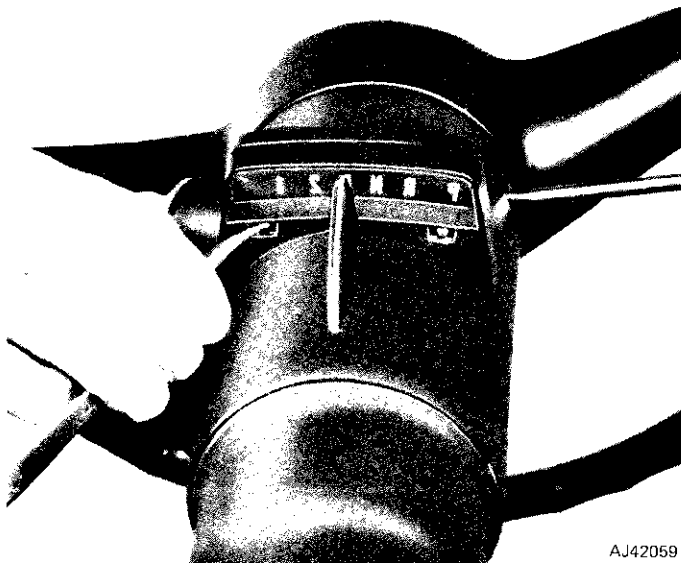


Fig. 2J-30 Shift Quadrant Retainer Clip Removal

(30) Remove shift quadrant light cover. Remove screw retaining socket assembly and remove assembly.

(31) Remove shift bowl from column jacket.

(32) Remove nylon lower bowl bearing from upper end of column tube (fig. 2J-31).

**NOTE:** Although the preceding steps are performed with the column mounted in the car, the following steps can be performed only after the column has been removed.

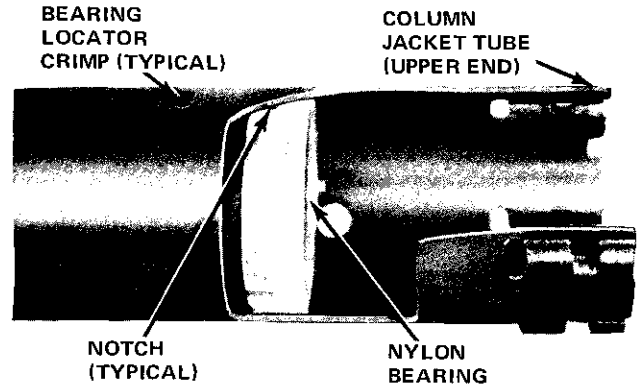
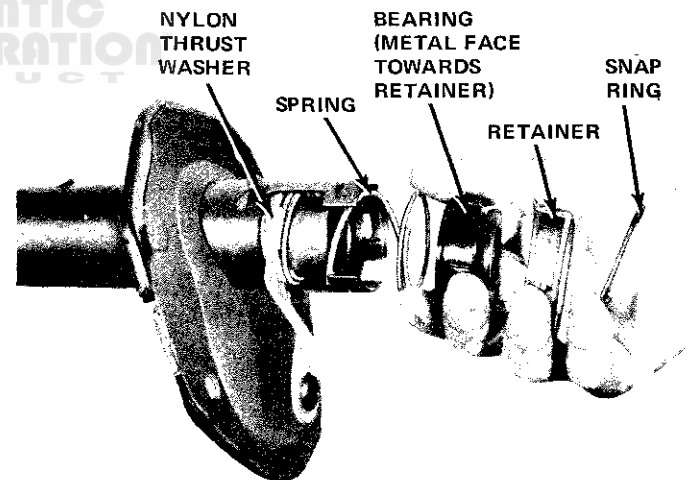


Fig. 2J-31 Shift Bowl Lower Bearing Position



**NOTE:** FLOOR SHIFT STEERING COLUMNS HAVE NO THRUST WASHER OR SPRING

Fig. 2J-32 Lower Bearing Assembly

(33) Remove column from vehicle. Refer to Steering Column Removal.

(34) Remove steering shaft from lower end of column.

(35) Remove lower bearing retainer, retainer ring, lower bearing preload spring, and nylon washer (fig. 2J-32).

(36) Remove neutral safety switch from base of column.

(37) Remove shift tube.

(38) Remove nylon shift tube bearing from tube.

### Column Assembly

- (1) Apply chassis grease to all friction and bearing surfaces.
- (2) Install shift tube.
- (3) Install nylon washer in lower end of shift tube with flat side of washer facing upper end of tube (fig. 2J-32).
- (4) Install preload spring, lower bearing (with metal face toward retainer), bearing retainer, and retainer ring.
- (5) Install nylon lower bowl bearing in upper end of jacket.

**NOTE:** The bearing must be installed with the smaller inside diameter facing the lower end of the jacket, and with the bearing notches engaged in the three locator crimps in the column (fig. 2J-31).

- (6) Align shift bowl with shift tube spline and install bowl.
- (7) Install rack preload spring in upper housing (fig. 2J-29).
- (8) Position large end of sector on sector shaft and press sector in place using blunt punch (fig. 2J-17).
- (9) Install shift gate lock and install two countersunk attaching screws (fig. 2J-28). Tighten screws to 45 inch-pounds (5 N•m) torque.
- (10) Install shift quadrant lamp and install lamp cover.
- (11) Install shift quadrant indicator and press retainer clips into place with flat side toward bowl.
- (12) Assemble lock bolt and lock rack (fig. 2J-18).
- (13) Install assembled lock bolt and lock rack in shift bowl (fig. 2J-33).

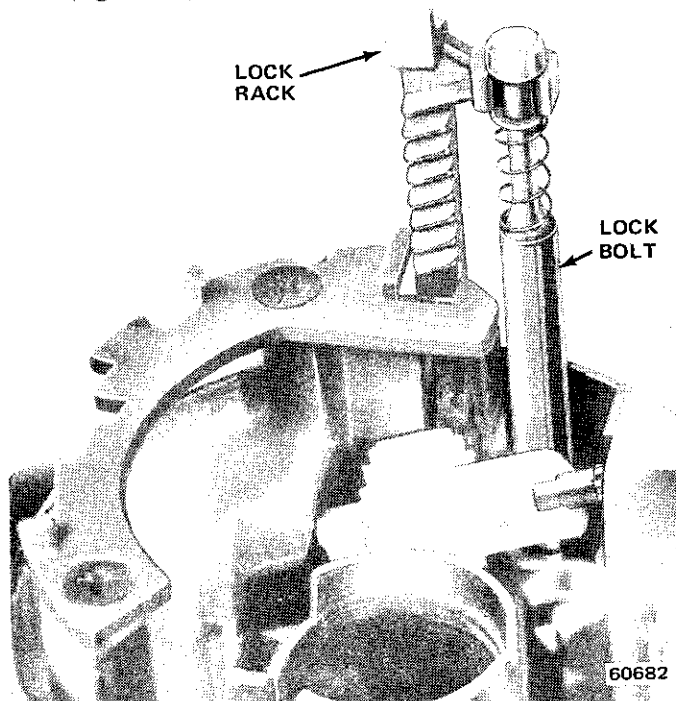


Fig. 2J-33 Lock Rack and Lock Bolt Installation

**NOTE:** Block tooth of lock rack must engage block tooth of sector (fig. 2J-19).

- (14) Install nylon thrust cup in upper housing with flared end of cup facing outward (fig. 2J-28).
  - (15) Rotate shift bowl counterclockwise to stop and install upper housing. Tighten housing attaching screws to 60 inch-pounds (7 N•m) torque.
- NOTE:** The shift bowl must be in the Park position and the rack pulled downward before the upper housing can be installed.
- (16) Guide shift quadrant lamp wire and remote lock rod into position between shift bowl and column jacket.
  - (17) Install turn signal switch and harness assembly in column.

- (18) Remove tape from turn signal switch wire harness connector and position harness in protector and protector-to-column jacket.
- (19) Install turn signal switch retaining screws. Be sure switch actuating lever pivot is correctly aligned and seated in upper housing pivot boss before installing screws.
- (20) On vehicles without Cruise Command, install turn signal lever and lever attaching screw. Tighten screw to 35 inch-pounds (4 N•m) torque.
- (21) On vehicles with Cruise Command, install turn signal lever and switch assembly. Guide wires into housing using string previously taped in place. Remove string and tape. Connect wires to switch terminals. Install lever attaching screw and tighten screw to 35 inch-pounds (4 N•m) torque.
- (22) Install steering shaft if removed. Install shaft through lower end of column and into upper bearing.
- (23) Install thrust washer, upper bearing preload spring, and canceling cam on upper end of steering shaft.
- (24) Align lock plate splines with steering shaft splines and install lock plate. Be sure canceling cam shaft protrudes through opening in lock plate (fig. 2J-34).

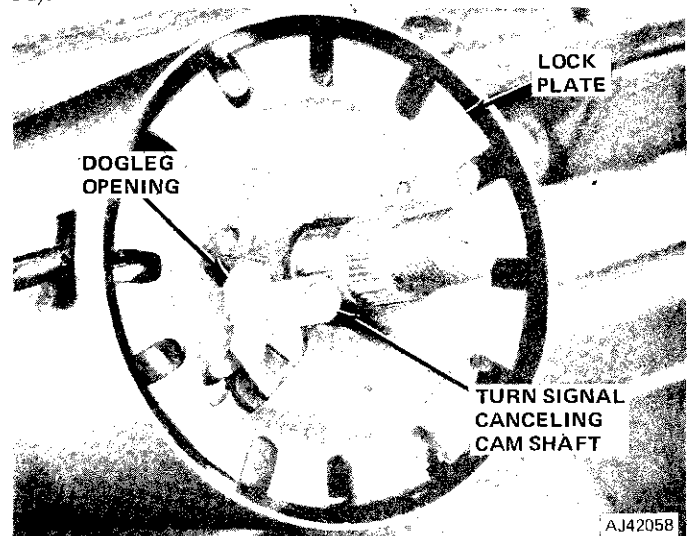


Fig. 2J-34 Canceling Cam and Lock Plate Position

(25) Install replacement steering shaft snap ring on sleeve of Lock Plate Compressor Tool J-23653 and install tool on steering shaft (fig. 2J-25).

**CAUTION:** *Inspect and identify the steering shaft nut thread type before installing the compressor tool. If the shaft has metric threads (fig. 2J-2), be sure to replace the compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing the tool on the shaft.*

(26) Compress lock plate and seat snap ring in steering shaft groove.

(27) Remove compressor tool.

(28) Install lock plate cover.

(29) Align canceling cam and index marks on steering shaft and steering wheel and install steering wheel. Tighten steering wheel nut to 30 foot-pounds (41 N•m) torque.

**CAUTION:** *Some steering shafts have metric steering wheel nut threads. Be sure to obtain and install the proper thread-type nut. Metric thread shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2).*

(30) Install hazard warning light switch knob and steering wheel trim cover.

(31) Install gearshift lever.

(32) Install lock cylinder in housing.

(33) Place shift bowl in any position except Park and rotate bowl counterclockwise until lock rack bottoms against lower surface of bowl.

(34) Install ignition switch on column:

(a) Move switch slider toward left to Accessory position.

(b) Move slider two positions toward right to Off-Unlock position (fig. 2J-35).

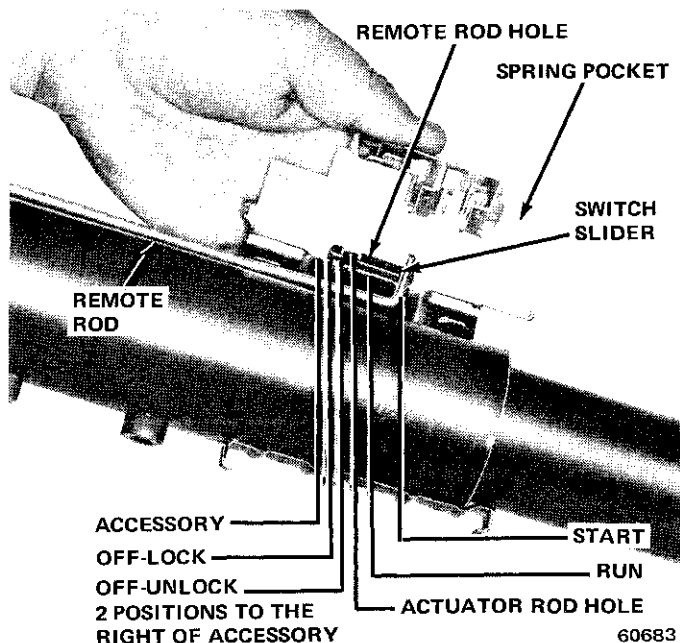


Fig. 2J-35 Positioning Ignition Switch

(c) Insert remote rod into slider hole and attach ignition switch to column. Tighten switch attaching screws to 35 inch-pounds (4 N•m) torque.

(35) Install neutral safety switch on column.

(36) Install column if removed. Refer to Steering Column Installation.

(37) Install lower finish panel, air conditioning duct if equipped, and column-to-instrument panel bezel.

(38) Remove protective covering from painted areas of column.

(39) Connect battery negative cable.

## TILT COLUMN OVERHAUL—CHEROKEE-WAGONEER-TRUCK MODELS

### Column Disassembly

**NOTE:** *Although it is possible to disassemble the tilt steering column down to the housing with the column in the vehicle, the column must be removed if more extensive disassembly is necessary. If the column is removed, use Steering Column Support Fixture J-23074 to mount the column assembly in a vise (fig. 2J-6).*

(1) Place front wheels in straight-ahead position.

(2) Disconnect battery negative cable.

(3) Cover painted areas of column.

(4) Remove steering wheel.

(5) Remove gearshift lever retaining pin and remove gearshift lever.

(6) Remove lock plate cover. Use two screwdrivers to pry cover off lock plate and out of housing.

(7) Compress lock plate and unseat steering shaft snap ring as follows:

(a) Inspect and identify steering shaft nut thread type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

(b) If shaft has American threads, use Compressor Tool J-23653 as is to compress lock plate and unseat snap ring (fig. 2J-6).

(c) If shaft has metric threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing tool on steering shaft.

**WARNING:** *The lock plate is under strong spring pressure. Do not attempt to remove the lock plate without using the compressor tool.*

(8) Remove compressor tool and steering shaft snap ring. Discard snap ring.

(9) Remove lock plate, canceling cam, upper bearing preload spring, spring seat, and bearing race.

(10) On vehicles without Cruise Command, remove turn signal lever attaching screw and remove lever.

(11) On vehicles with Cruise Command, remove wires from switch terminal in lever. Fold two of four switch wires back, along harness and tape wires in place. Tape length of string to harness to aid removal.

(12) Press hazard warning light switch knob inward and remove knob by turning counterclockwise.

(13) Unhook turn signal switch wire harness connector from mounting bracket on lower right side of column jacket.

(14) Loosen toe plate bolts.

(15) Remove bolts attaching column mounting bracket to steering column.

(16) Remove bolts attaching mounting bracket to instrument panel and remove mounting bracket.

(17) Remove wire harness plastic protector from column jacket.

(18) Wrap tape around harness connector to prevent snagging (fig. 2J-27).

(19) Remove turn signal switch retaining screws and remove switch and wire harness. Pull switch straight up and out of column.

(20) On vehicles with Cruise Command, remove turn signal lever attaching screw and remove lever and switch. Guide switch wire harness out of column using string previously taped to harness.

(21) Insert ignition key in lock cylinder and turn cylinder to LOCK position.

(22) Compress lock cylinder retaining tab and remove lock cylinder (fig. 2J-9).

**NOTE:** The retaining tab is accessible through the tab slot in the housing (fig. 2J-9). If the tab is not visible through the slot, remove all casting flash from the slot.

(23) Remove spring clips retaining shift quadrant using punch or long needlenose pliers and remove quadrant (fig. 2J-30).

(24) Remove shift quadrant mounting bracket and light socket.

(25) Remove tilt lever.

(26) Remove cover retaining screws and remove cover from column.

(27) Remove lock sector tension spring retaining screw. Unhook spring from lock sector shaft and remove spring.

(28) Remove snap ring from lock sector shaft and remove lock sector, sector shaft, and retaining ring.

(29) Install tilt lever and place upper housing in full upward tilt position.

(30) Insert screwdriver in tilt spring retainer slot and compress retainer approximately 3/16 inch (4.7 mm). Rotate retainer 1/8-turn counterclockwise and remove retainer and spring.

**WARNING:** The tilt spring is under strong spring tension.

(31) Place housing in center (non-tilt) position.

(32) Remove housing pivot pins using tool J-21854-1 (fig. 2J-36).

(33) Lift tilt lever to disengage lock shoes and remove housing. Remove both ball bearing assemblies from housing if bearings are to be replaced.

(34) Remove tilt lever.

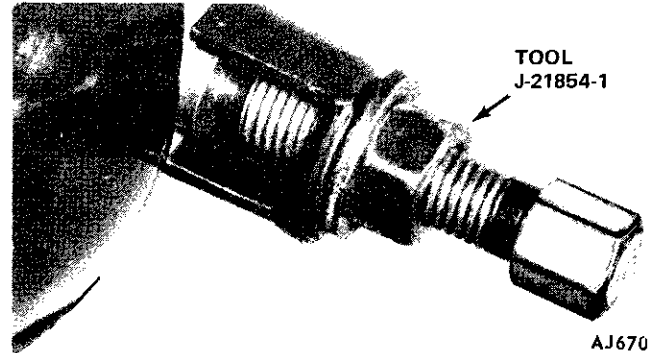


Fig. 2J-36 Pivot Pin Removal

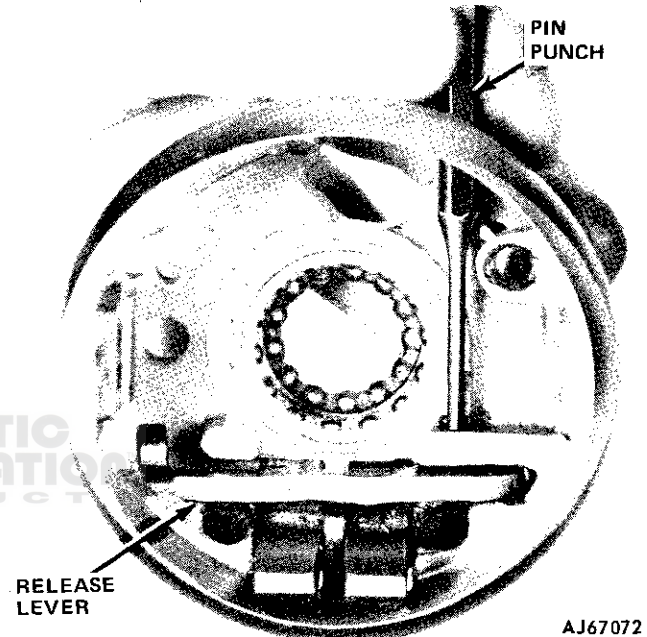


Fig. 2J-37 Release Lever Pin Removal

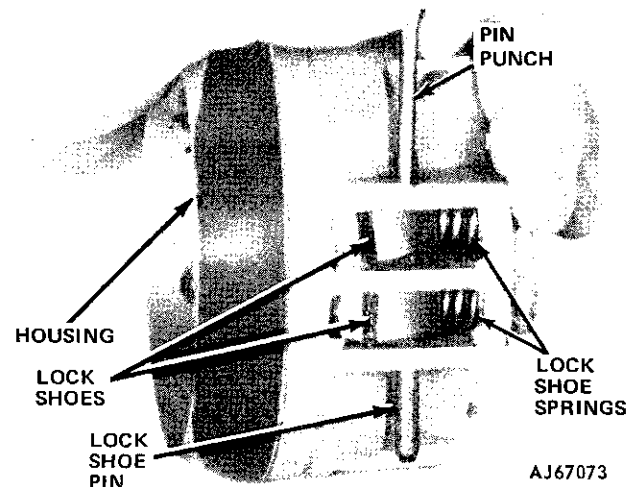


Fig. 2J-38 Lock Shoe Pin Removal

(35) Remove release lever pin from housing using pin punch or tool J-22635 (fig. 2J-37).

**NOTE:** When removing the release lever pin, compress the lock shoe springs to relieve spring tension on the pin.

(36) Remove lock shoe pin from housing using pin punch or tool J-22635 (fig. 2J-38).

## 2J-26 STEERING COLUMNS

**NOTE:** When removing the lock shoe pin, compress the lock shoe springs to relieve spring tension on the pin (fig. 2J-38).

(37) Remove lock shoes and lock shoe springs.

(38) Disconnect steering shaft at intermediate shaft coupling. Remove steering shaft through upper end of column.

(39) Disassemble steering shaft by folding shaft at 90° and separating upper and lower halves of shaft at flexible joint (fig. 2J-39).

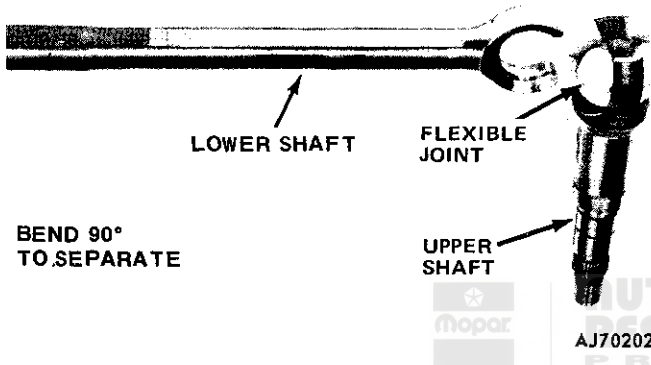


Fig. 2J-39 Steering Shaft Assembly

(40) Remove ignition switch.

(41) Remove neutral safety switch from base of column.

(42) Remove lock rack and remote rod.

(43) Remove lower bearing retainer snap ring and remove retainer, bearing, and adapter.

(44) Remove screws attaching support to shift bowl and remove support. Use 1/4-inch, 12-point deep socket to remove screws.

(45) Remove shift gate screws and remove shift gate from support.

(46) Remove shift tube retaining ring and thrust washer.

(47) Remove shift tube from column jacket using Shift Tube Remover Tool J-23072 (fig. 2J-40).

(48) Remove retainer plate by rotating shift bowl clockwise, sliding plate out of jacket notches, tipping it down toward shift bowl hub at 12 o'clock position and removing plate-bottom side first (fig. 2J-41).

(49) Remove wave washer and shift tube spring.

(50) Remove shift bowl from column jacket.

(51) Remove lower bearing retainer spring clip (fig. 2J-42).

(52) Remove lower bearing retainer and remove lower bearing, and bearing adaptor assembly.

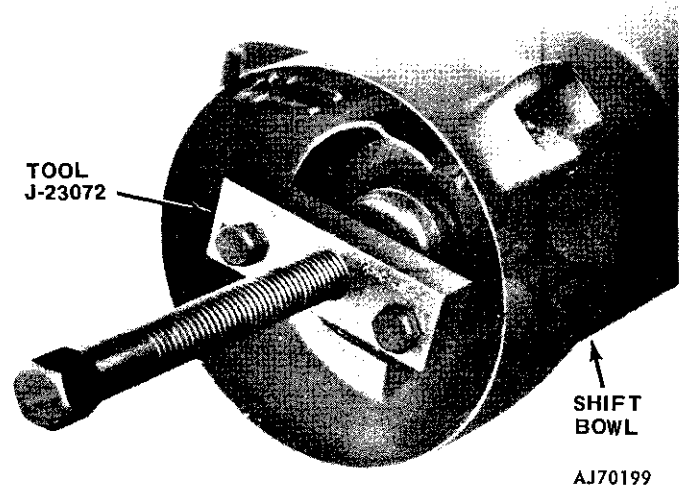


Fig. 2J-40 Shift Tube Removal

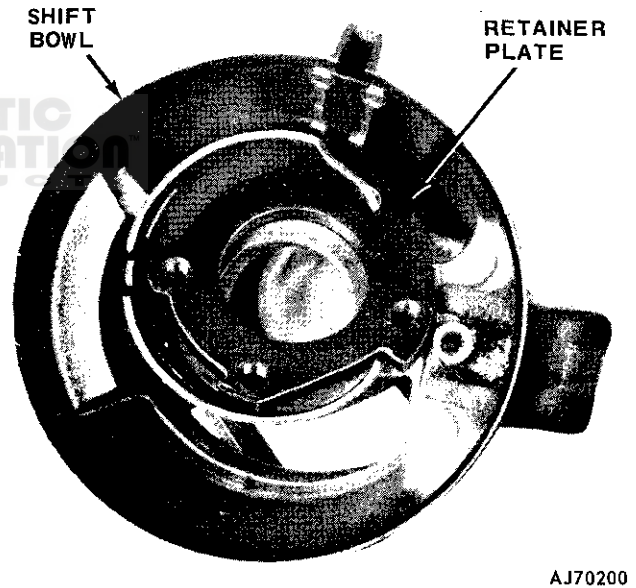


Fig. 2J-41 Retainer Plate Removal

### Column Assembly

(1) Coat all bearing and friction surfaces with chassis grease.

(2) Mount shift bowl on column jacket.

(3) Install shift tube spring, wave washer, and retainer plate in shift bowl.

(4) Install shift tube through lower end of column jacket and align tube spline with shift bowl keyway.

(5) Insert Installer Tools J-23073-2 and -4 in shift tube (fig. 2J-43). Spring-loaded lower foot of tool must engage shift tube inner shoulder and tool guide must be seated in shift tube.

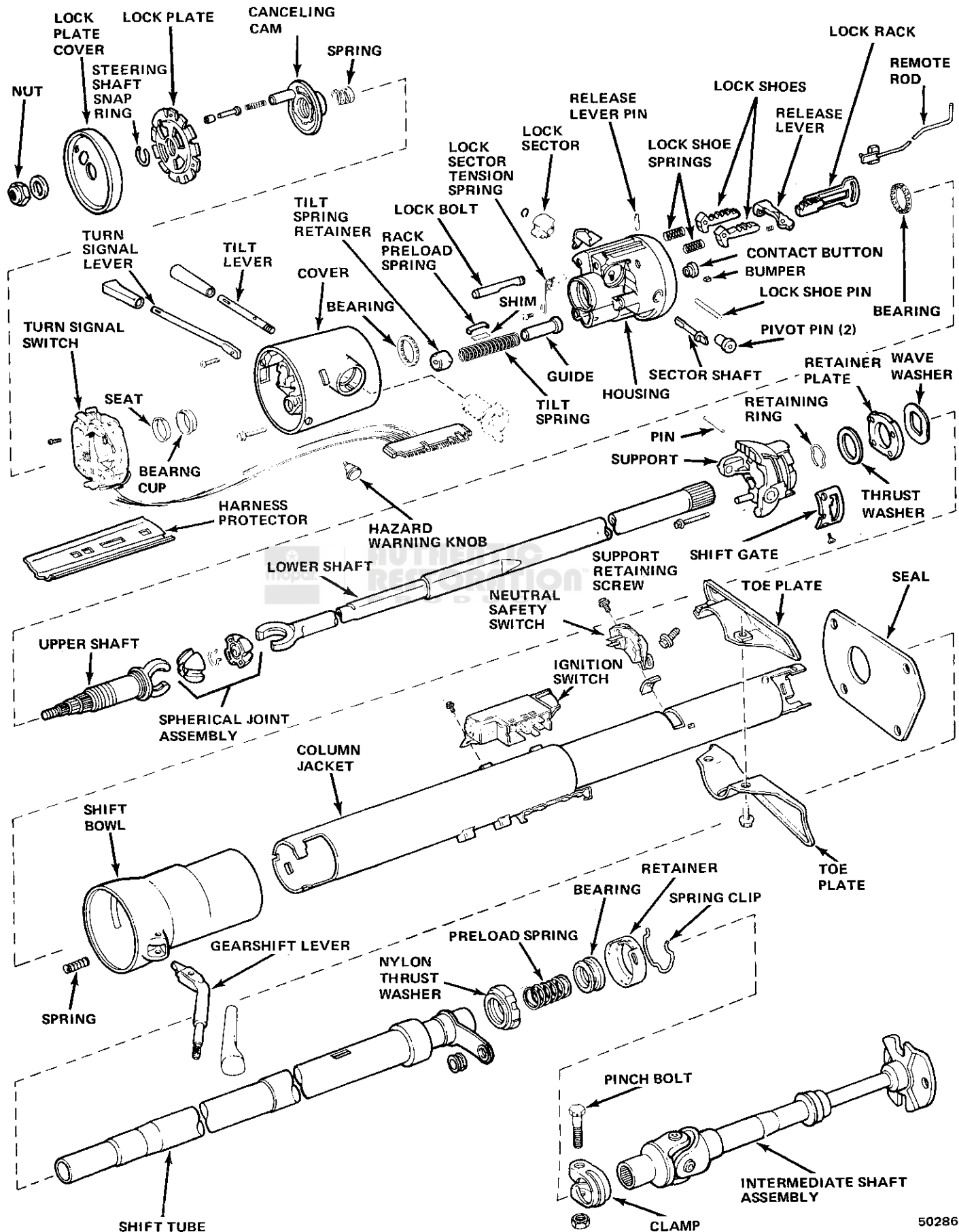


Fig. 2J-42 Tilt Steering Column—Cherokee-Wagoner-Truck Models



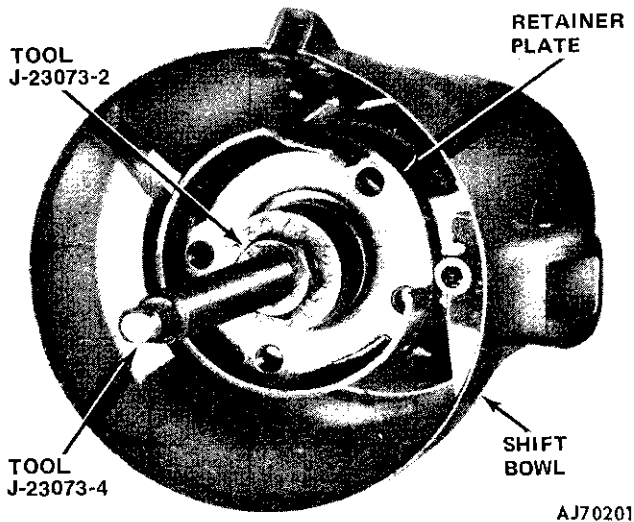


Fig. 2J-43 Positioning Shift Tube Installer Tools

- (6) Tighten tool spring tension nut to snug fit.
- (7) Place Receiver Tools J-23073-3 and -4 over puller stud and tighten Tool Nut J-23073-2 to pull tube into shift bowl (fig. 2J-44).

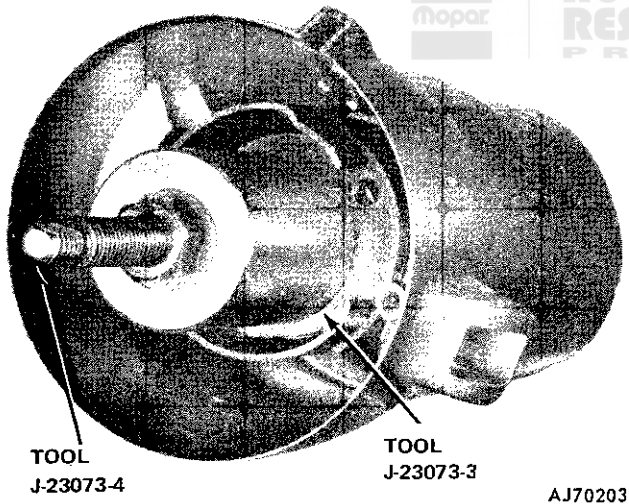


Fig. 2J-44 Pulling Shift Tube into Shift Bowl

- (8) Remove shift tube installer tools.
- (9) Install shift tube thrust washer and retainer plate snap ring.
- (10) Install lower bearing adaptor with notched end of adaptor facing lower end of column.
- (11) Install lower bearing in column with metal face of bearing toward lower end of column.
- (12) Install lower bearing retainer and retainer spring clip (fig. 2J-42).
- (13) Install shift gate in support and install shift gate attaching screws.

- (14) Install support in shift bowl. Align V-notch in support with notch in column jacket (located at 9 o'clock position).
- (15) Install support attaching screws.
- (16) Assemble steering shaft.
- (17) Install steering shaft through upper end of column.
- (18) Install replacement ball bearings in housing if removed. Be sure there are 14 balls in each bearing.
- (19) Install tilt handle.
- (20) Insert ignition switch remote rod between shift bowl and column jacket, and into guide channel in left side of support.
- (21) Engage lock rack in remote rod (fig. 2J-45).

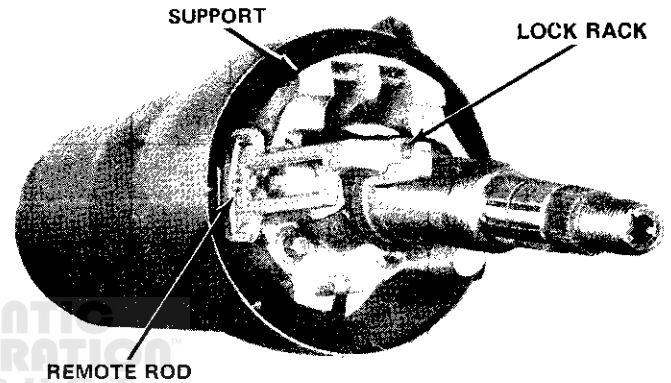


Fig. 2J-45 Lock Rack and Remote Rod Position

- (22) Guide housing over steering shaft and lock rack and align lock shoes with teeth in support.
- (23) Align housing and support pivot pin holes and install pivot pins using fiber mallet or brass drift.
- (24) Install lock shoes, lock shoe springs, tilt bumpers, and lockpin in housing.
- (25) Install sector shaft in housing and install lock sector on shaft. Large block tooth on sector must engage large slot in lock rack.
- (26) Install lock sector retaining snap ring.
- (27) Hook lock sector tension spring on lock bolt, engage spring in sector, and install spring retaining screw (fig. 2J-46).
- (28) Place housing in full upward tilt position and install tilt spring and guide in housing.
- (29) Install tilt spring retainer over spring and into housing. Press retainer downward approximately 3/16 inch (4.7 mm) and rotate approximately 1/8-turn clockwise to secure retainer tabs in housing lugs.
- (30) Place housing in neutral (non-tilt) position and remove tilt handle.
- (31) Install cover on housing and install cover attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

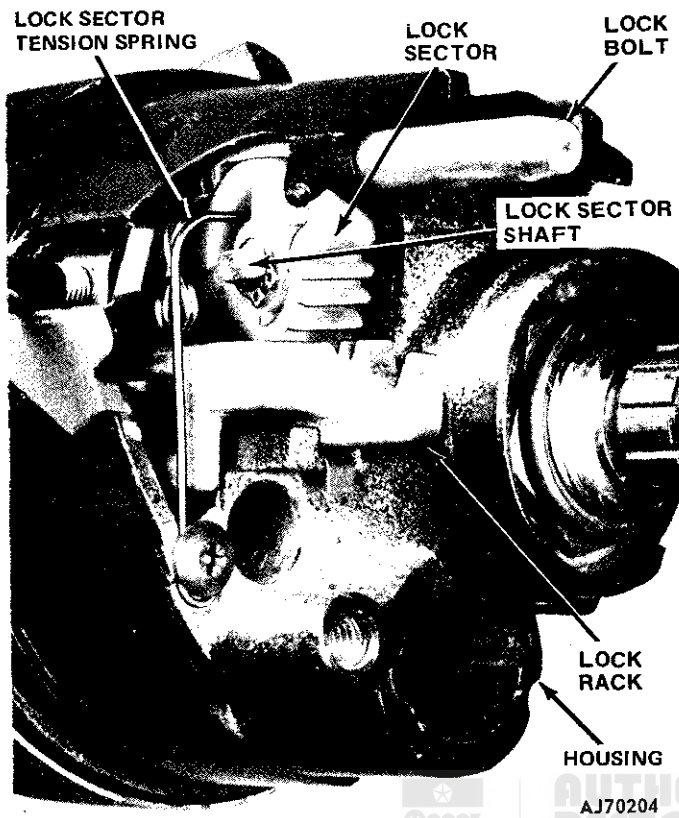


Fig. 2J-46 Lock Sector and Tension Spring Position

- (32) Guide shift quadrant light wire through housing and between shift bowl and column jacket.
- (33) Install shift quadrant mounting bracket and attach light socket.
- (34) Hook base of shift quadrant over tabs on left side of retainer and place in position.
- (35) Install shift quadrant pointer in shift bowl and engage pointer in quadrant.
- (36) Install quadrant retainer clips so flat side of clips face downward.
- (37) Reinstall tilt handle.
- (38) Install turn signal switch and switch harness in column. Guide switch wire harness between cover and column jacket.
- (39) On vehicles without Cruise Command, install turn signal lever and lever attaching screw. Tighten screw to 35 inch-pounds (4 N•m) torque.
- (40) On vehicles with Cruise Command, install turn signal lever and switch assembly. Guide switch wire harness into cover using string previously taped to harness. Remove tape from harness and connect wires to switch terminal. Install lever attaching screw and tighten screw to 35 inch-pounds (4 N•m) torque.
- (41) Remove tape from turn signal switch harness connector and position wires in column harness protector.
- (42) Align turn signal switch in cover and install switch attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

**NOTE:** Be sure the switch actuating lever pivot is correctly aligned and seated in the housing pivot boss before installing the switch attaching screws.

- (43) Install mounting bracket on column. Tighten bracket-to-column bolts to 20 foot-pounds (27 N•m) torque.
- (44) Position column mounting bracket on instrument panel and install bracket-to-instrument panel attaching bolts. Tighten bolts to 20 foot-pounds (27 N•m) torque.
- (45) Tighten toe plate bolts to 10 foot-pounds (14 N•m) torque.
- (46) Install upper bearing race, bearing seat, preload spring, and canceling cam on steering shaft.
- (47) Align lock plate splines with steering shaft splines and install lock plate. Canceling cam shaft must protrude through opening in lock plate (fig. 2J-34).
- (48) Install replacement steering shaft snap ring on sleeve of Compressor Tool J-23653 and install tool on steering shaft (fig. 2J-25).

**CAUTION:** Identify the steering shaft nut thread type before installing the compressor tool on the shaft. If the shaft has American threads, use the compressor tool as is. However, if the shaft has metric threads (fig. 2J-2), replace the compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before using the tool.

- (49) Compress lock plate and seat snap ring in steering shaft groove (fig. 2J-25).
- (50) Connect steering shaft to intermediate shaft coupling.
- (51) Install gearshift lever in shift bowl. Guide lever-over lock sector tension spring and into bowl. Align lever retaining pin holes with pin punch and install retaining pin using fiber mallet or brass drift.
- (52) Install lock cylinder as follows:
- Insert ignition key in lock cylinder.
  - Hold lock cylinder and turn key clockwise until it stops.
  - Align cylinder retainer tab with keyway in cover and insert cylinder in cover.
  - Push lock cylinder against lock sector. Rotate cylinder counterclockwise until cylinder engages in sector and push cylinder inward until cylinder retainer tab snaps into place.
- (53) Install neutral safety switch at base of column.
- (54) Install steering wheel. Tighten steering wheel nut to 30 foot-pounds (41 N•m) torque.

**CAUTION:** Some steering shafts have metric size steering wheel nut threads. Be sure to install the proper thread-type nut. Metric shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2). Shafts with American threads do not have this groove.

- (55) Install column if removed. Refer to Steering Column Installation. However, if column was serviced in vehicle, proceed to following steps.

## 2J-30 STEERING COLUMNS

(56) Install and tighten column mounting bracket bolts to 20 foot-pounds (27 N•m) torque.

(57) Position column mounting bracket on instrument panel and install panel-to-bracket nuts. Tighten nuts to 20 foot-pounds (27 N•m) torque.

(58) Install column bezel.

(59) Tighten toe plate screws to 10 foot-pounds (14 N•m) torque.

(60) Remove protective covering from column painted areas.

(61) Connect battery negative cable.

## TILT COLUMN OVERHAUL—CJ MODELS

**NOTE:** Although the tilt column can be disassembled down to the housing with the column mounted in the vehicle, the column must be removed if disassembly is to be more extensive. If the column is removed, use Support Fixture J-23074 to mount the column in a vise for service operations (fig. 2J-5).

### Column Disassembly

- (1) Place front wheels in straight-ahead position.
- (2) Disconnect battery negative cable.

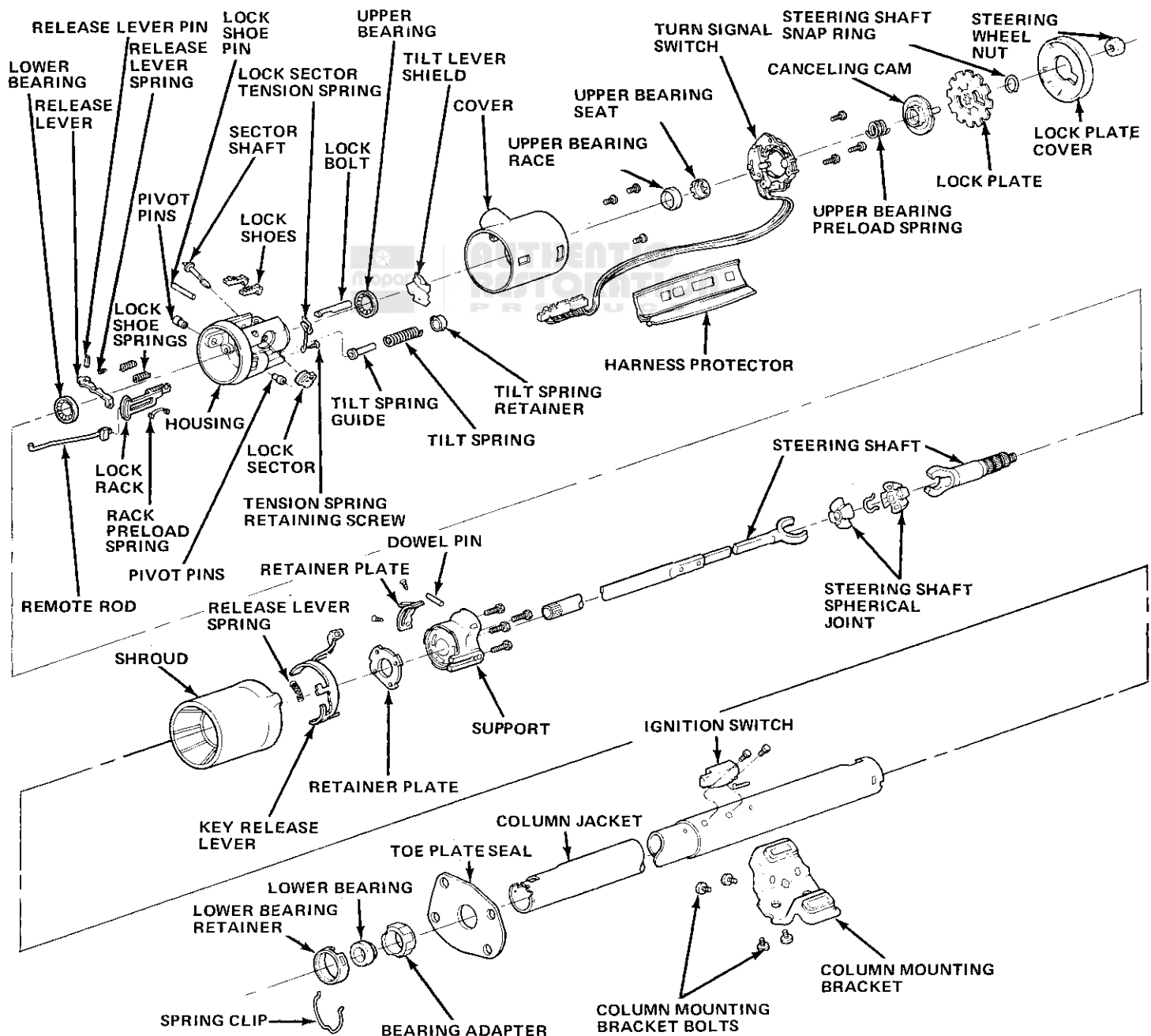


Fig. 2J-47 Tilt Steering Column—CJ Models

- (3) Cover painted areas of column.
- (4) Remove steering wheel.
- (5) Remove gearshift lever retaining pin and remove lever, if equipped.
- (6) Remove lock plate cover. Use two screwdrivers to pry cover off plate and out of column.
- (7) Remove tilt and turn signal levers.
- (8) Remove hazard warning knob. Press knob inward and turn in counterclockwise direction to remove.
- (9) Compress lockplate and unseat steering shaft snap ring as follows:
  - (a) Inspect and identify steering shaft nut thread type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.
  - (b) If shaft has American threads, use tool J-23653, as is, to compress lockplate and unseat steering shaft snap ring (fig. 2J-6).
  - (c) If shaft has metric threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before using compressor tool.

**WARNING:** The lock plate is under strong spring pressure. Do not attempt to remove the snap ring without using the compressor tool.

- (10) Remove compressor tool and snap ring. Discard snap ring.
- (11) Remove lock plate, canceling cam, and upper bearing preload spring (fig. 2J-47).
- (12) Disconnect turn signal switch harness at lower right-side of column jacket.
- (13) Loosen all toe plate screws.
- (14) Remove bolts attaching column mounting bracket to column jacket.
- (15) Remove nuts attaching column mounting bracket to instrument panel bolts and remove mounting bracket.
- (16) Remove wire harness protector from column jacket (fig. 2J-48).
- (17) Wrap tape around harness connector to prevent snagging connector when removed (fig 2J-49).

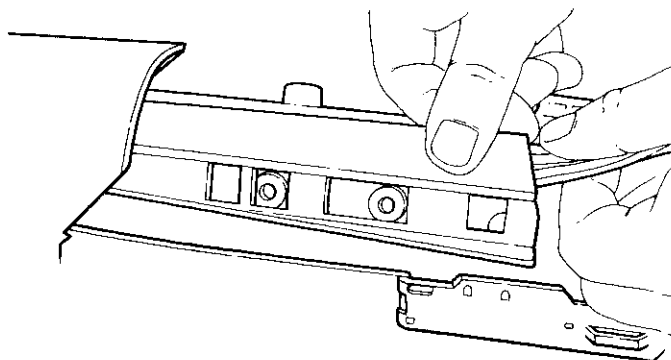


Fig. 2J-48 Harness Protector Removal

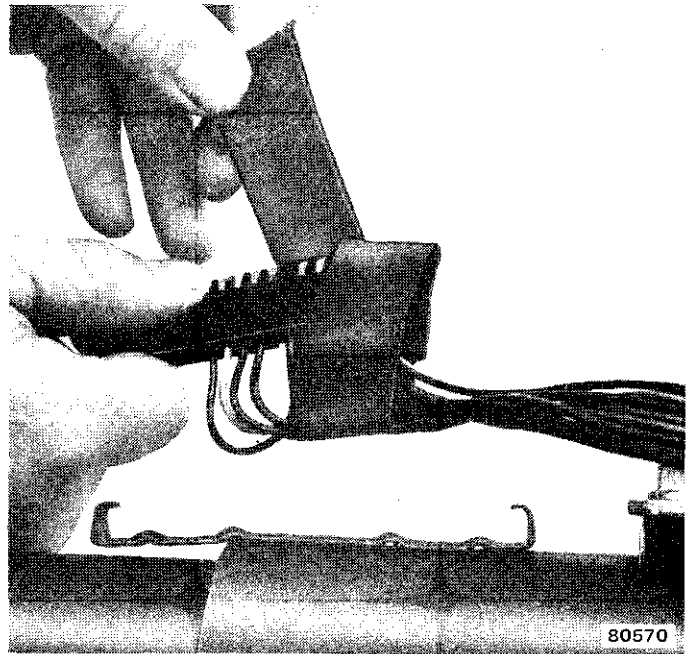


Fig. 2J-49 Taping Harness Connector

- (18) Remove turn signal switch attaching screws and remove switch and harness. Pull switch straight up and out of column.
  - (19) Insert ignition key in ignition lock cylinder and turn cylinder to On position.
  - (20) Compress ignition lock cylinder retaining tab using thin bladed screwdriver and remove cylinder from column.
- NOTE:** The retaining tab is accessible through the slot adjacent to the turn signal switch mounting boss (fig. 2J-9). If the tab is not visible through the slot, scrape or knock any casting flash out of the slot to provide access.
- (21) Remove cover retaining screws and remove cover from column (fig. 2J-50).

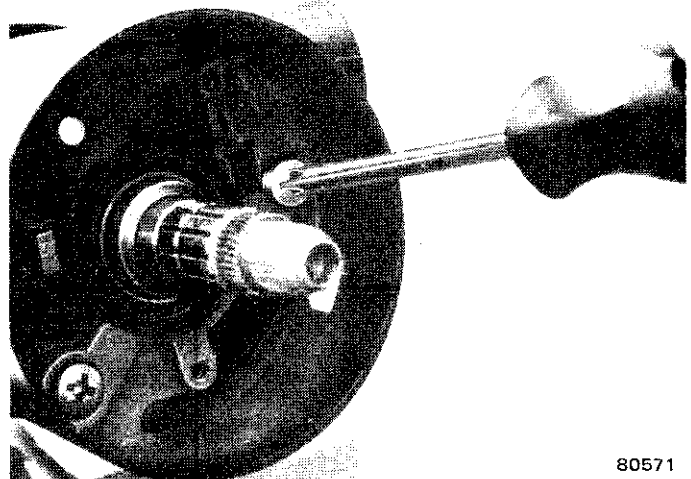


Fig. 2J-50 Cover Removal

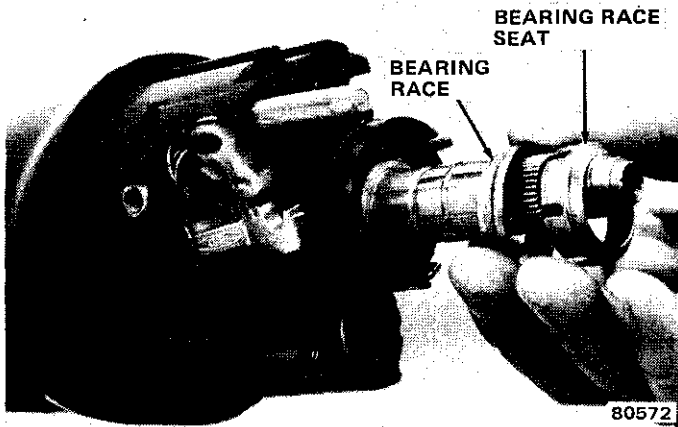


Fig. 2J-51 Upper Bearing Race and Seat Removal/Installation

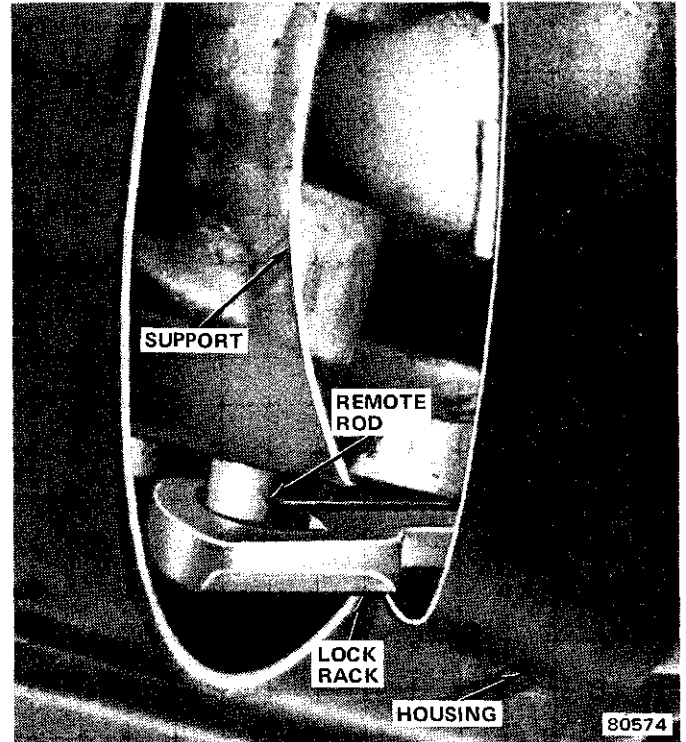


Fig. 2J-53 Housing Removal

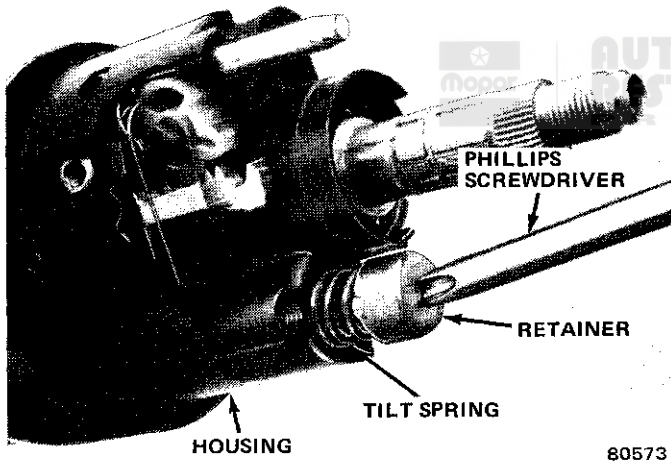


Fig. 2J-52 Tilt Spring and Guide Removal

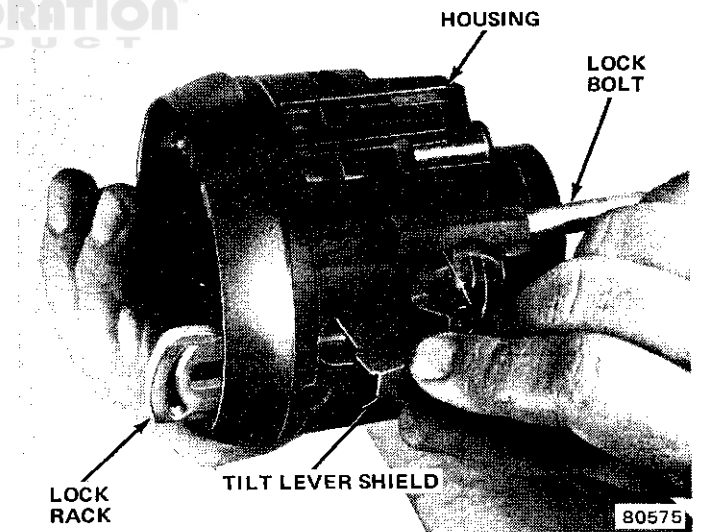


Fig. 2J-54 Tilt Lever Shield Removal

(22) Remove upper bearing race and bearing seat from steering shaft (fig. 2J-51).

(23) Reinstall tilt lever and place column in full upward tilt position.

(24) Remove tilt spring, guide, and retainer using screwdriver (fig. 2J-52). Press retainer inward and turn it counterclockwise until retainer tabs align with housing lugs. Be sure screwdriver blade just fits into retainer slot.

**WARNING:** The tilt spring guide is under strong spring pressure.

(25) Place housing in center (non-tilt) position.  
 (26) Remove housing pivot pins using tool J-21854-1 (fig. 2J-36).

(27) Raise tilt lever to disengage lock shoes and remove housing (fig. 2J-53). Pull housing upward to disengage shoes and turn housing to one side to separate lock rack from remote rod.

(28) Remove tilt lever from housing.

(29) Remove tilt lever shield from housing (fig. 2J-54).

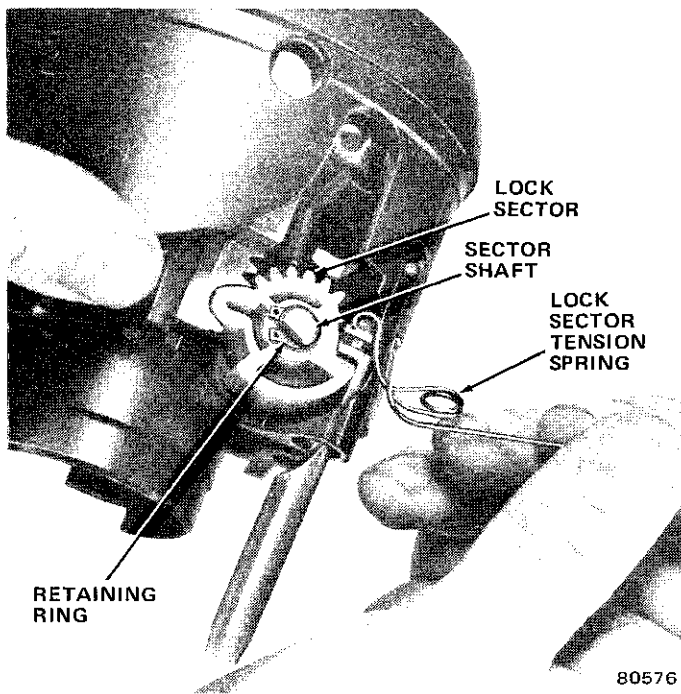


Fig. 2J-55 Lock Sector Tension Spring Removal/Installation

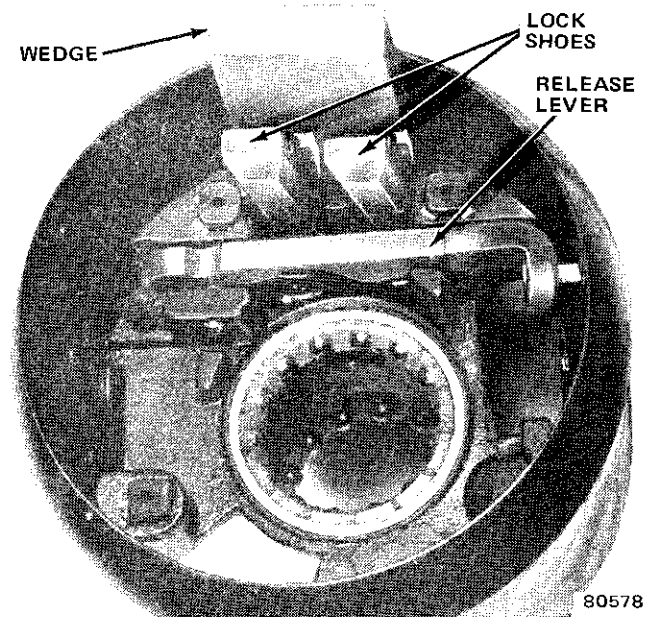


Fig. 2J-57 Relieving Lock Shoe Spring Tension

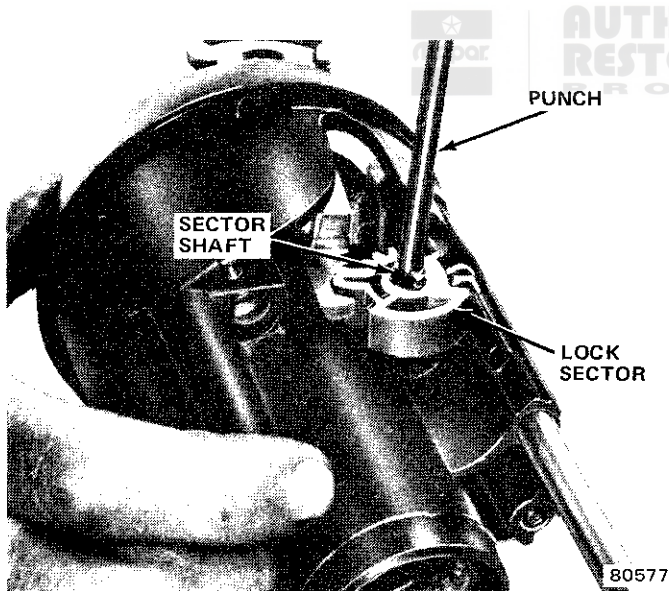


Fig. 2J-56 Lock Sector and Sector Shaft Removal

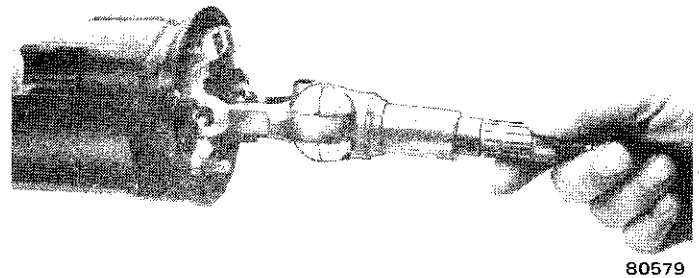


Fig. 2J-58 Steering Shaft Removal/Installation

(30) Remove lock sector spring retaining screw and remove spring (fig. 2J-55). Rotate spring in clockwise direction to remove it from bolt.

(31) Remove lock sector retaining ring (fig. 2J-55).

(32) Remove lock sector and sector shaft. Tap shaft through sector and out of housing using hammer and punch (fig. 2J-56).

(33) Remove lock bolt, lock rack, rack preload spring, spring shim if equipped, and remote rod from housing.

(34) Insert wedge between lock shoes and housing to relieve spring tension on tilt and lock shoe pins (fig. 2J-57).

(35) Remove tilt lever pin from housing using tool J-22635 or pin punch (fig. 2J-37).

(36) Remove lock shoe pin from housing using tool J-22635 or pin punch (fig. 2J-38) and remove lock shoes, springs, and wedge.

(37) Remove housing upper and lower bearings and races only if damaged or worn. If bearings and races must be replaced, remove bearings and races using hammer and punch.

**NOTE:** Discard the housing bearings and races if removed. They are not reusable.

(38) Disconnect steering shaft at intermediate shaft coupling.

(39) Remove steering shaft through upper end of column (fig. 2J-58).

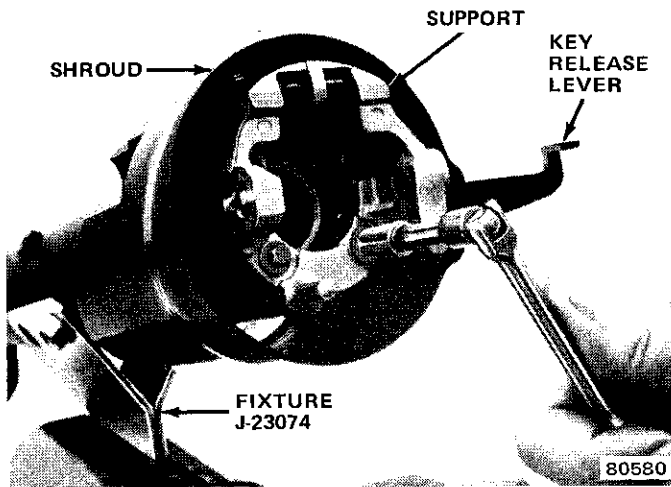


Fig. 2J-59 Support Removal/Installation

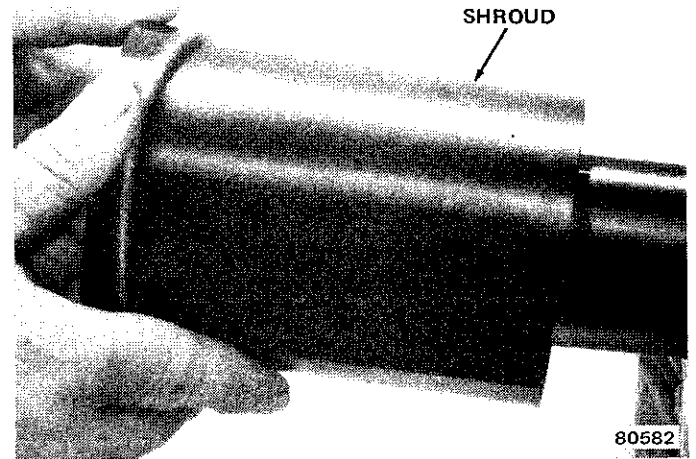


Fig. 2J-61 Shroud Removal/Installation

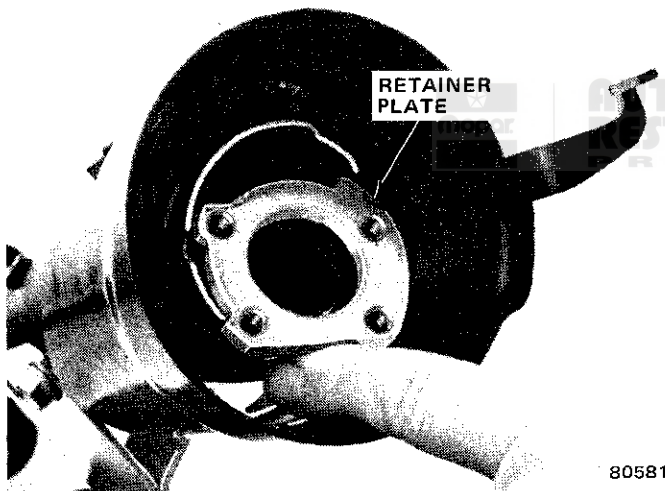


Fig. 2J-60 Retainer Plate Removal/Installation

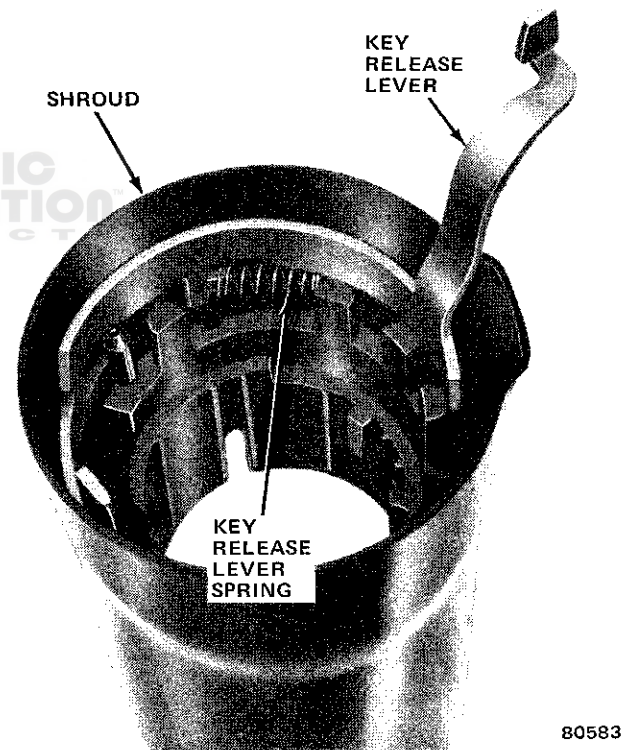


Fig. 2J-62 Key Release Lever and Spring Removal/Installation

(40) Remove support attaching bolts and remove support (fig 2J-59). Use 1/4-inch, 12-point deep socket to remove bolts.

(41) Remove retainer plate (fig. 2J-60). Tip upper end of plate rearward and turn plate counterclockwise to remove.

(42) Remove shroud using twisting-pulling motion (fig. 2J-61).

(43) Remove key release lever and lever spring from shroud (fig. 2J-62). Tip lever forward and lift upward to remove.

(44) Disconnect ignition switch and neutral safety switch wire harness connectors and remove both switches from lower end of column.

(45) Remove snap ring, retainer, and bearing assembly from lower end of column.

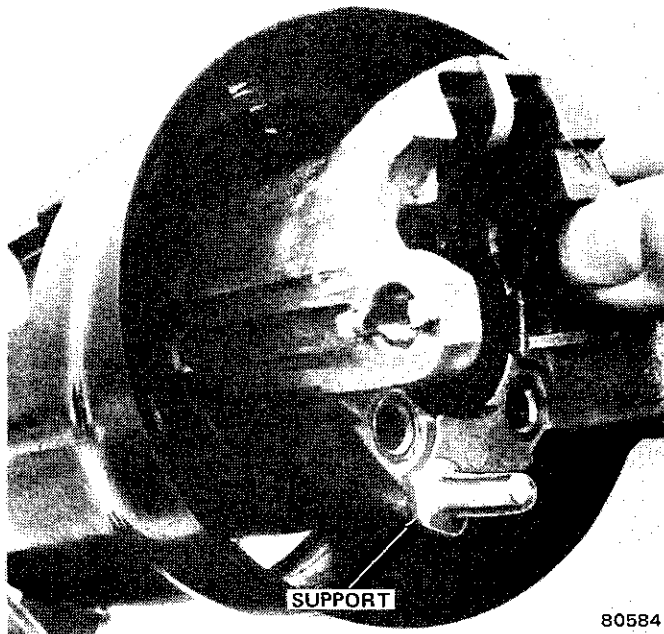
### Column Assembly

(1) Lubricate all bearing, friction, and thrust surfaces with chassis grease.

(2) Install bearing assembly, bearing retainer, and snap ring in lower end of column (fig. 2J-47).

(3) Install key release lever spring on lever and install assembled lever and spring in shroud (fig. 2J-62).

(4) Align and install shroud on column jacket (fig. 2J-61).



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**Fig. 2J-63 Support Installation**

(5) Install retainer plate (fig. 2J-60). Tip plate toward 12 o'clock position, slide it under jacket opening, and seat it in column jacket notches.

(6) Align column jacket "V" notch with corresponding "V" on support and install support in column (fig. 2J-63). Press key release lever downward while pressing support into place to seat support fully.

(7) Install all support attaching screws finger tight; Then tighten screws alternately and evenly to 60 inch-pounds (81 N•m) torque (fig. 2J-59).

(8) Install remote rod in support. Guide rod through upper end of shroud and insert it into rod slot in support.

(9) Install steering shaft in column (fig. 2J-58).

(10) Install replacement bearings in housing, if removed. Be sure to lubricate bearings with chassis grease before installation.

(11) Install lock shoes, lock shoe springs, and lock shoe pin in housing. Use 0.180 inch (4.5 mm) diameter rod to align lock shoes and pin during installation.

(12) Install release lever, lever spring, and lever pin in housing. Insert wedges between housing and lever to relieve spring tension and ease pin installation (fig. 2J-57).

(13) Install sector shaft in housing. Lightly tap shaft into housing using punch.

(14) Install lock sector on shaft. Lightly tap sector onto shaft until shaft snap ring groove is exposed and install sector retaining snap ring.

(15) Install lock bolt in housing and engage bolt in lock sector cam surface (fig. 2L-56).

(16) Install lock rack, rack preload spring, and replacement shim (if used) in housing. Square block tooth of rack must engage square block tooth of sector (fig. 2J-56).

(17) Install lock spring and spring retaining screw (fig. 2J-55). Tighten screw to 35-inch pounds (4 N•m) torque.

(18) Align and install assembled housing on support (fig. 2J-53). Hold lock shoes in disengaged position to ease housing installation.

(19) Align pivot pin holes in housing and support and install pivot pins. Press housing downward when first installing pins to prevent damaging pin holes in support. When pins are started in both housing and support, seat pins fully using hammer and punch.

(20) Insert tilt lever in housing and place housing in full upward tilt position.

(21) Lubricate tilt guide and spring liberally with chassis grease and install tilt spring on guide.

(22) Insert assembled tilt spring and guide in housing and install guide retainer on spring (fig. 2J-52). Engage retainer lock tabs with housing lugs by pressing retainer downward and turning clockwise using screwdriver.

(23) Install tilt lever shield in housing.

(24) Remove tilt lever.

(25) Install cover on housing. Align and install cover attaching screws. Tighten screws to 60 inch-pounds (7 N•m) torque.

(26) Install turn signal switch. Guide switch harness and connector through column and position switch in housing. Do not install switch screws at this time.

(27) Insert hazard warning knob in signal switch, press knob inward, and align and install signal switch attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque. Be sure signal switch is properly seated before tightening screws.

(28) Thread hazard warning knob into signal switch and pull knob outward.

(29) Install upper bearing race and seat in housing (fig. 2J-51).

(30) Install upper bearing preload spring, cancelling cam, and lock plate (fig. 2J-47).

(31) Install replacement steering shaft snap ring on sleeve of Compressor Tool J-23653 and install tool on steering shaft (fig. 2J-25).

**CAUTION:** Identify the steering shaft nut thread type before installing the compressor tool. If the shaft has American threads, use the compressor tool as is. However, if the shaft has metric threads (fig. 2J-2), replace the compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing the tool.

(32) Compress lock plate and seat snap ring in steering shaft groove (fig. 2J-25).

(33) Remove compressor tool. Be sure snap ring is completely seated before removing tool.

(34) Install tilt and turn signal levers. Tighten turn signal lever attaching screw to 15 inch-pounds (2 N•m) torque.

(35) Install shift lever and lever retaining pin, if equipped.



## 2J-36 STEERING COLUMNS

(36) Install ignition lock cylinder. Hold cylinder sleeve, turn knob clockwise against stop, align cylinder tab with housing keyway and insert cylinder in housing. Turn cylinder knob counterclockwise until cylinder mates with lock sector and push cylinder inward until retainer snaps into place.

(37) Insert key in lock cylinder and turn cylinder to Off-Unlock position.

(38) Install ignition switch as follows:

(a) Move switch slider to Accessory position then back two clicks to Off-Unlock position. Remote rod hole in slider should be almost at center (fig. 2J-64).

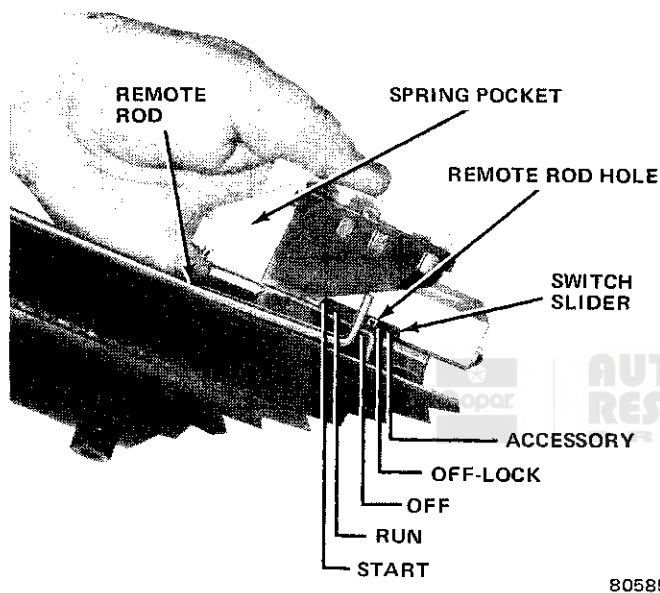


Fig. 2J-64 Ignition Switch Installation

(b) Insert remote rod into slider hole and install switch on column jacket.

(c) Move switch downward to eliminate switch-to-remote rod lash and tighten switch attaching screws to 35 inch-pounds (4 N•m) torque.

(39) Install neutral safety switch at base of column if equipped.

(40) Position switch harness protectors, if equipped, over harness and snap protectors into place on column.

(41) Install lock plate cover.

(42) Install steering wheel. Tighten steering wheel nut to 30 foot-pounds (41 N•m) torque.

**CAUTION:** Some steering shafts have metric size steering wheel nut threads. Identify the shaft nut thread type before installing a replacement nut. Metric shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

(43) Remove column support fixture and install column mounting bracket. Tighten bracket attaching bolts to 20 foot-pounds (27 N•m) torque.

(44) Install column if removed. Refer to Steering Column Installation.

## TURN SIGNAL AND CRUISE COMMAND SWITCH

### Removal

- (1) Disconnect battery negative cable.
- (2) Cover painted areas of column.
- (3) Remove column-to-instrument panel bezel.
- (4) Loosen toe plate screws.
- (5) On vehicles with tilt column, place column in neutral (non-tilt) position.
- (6) Remove steering wheel.
- (7) Remove lock plate cover.
- (8) Compress lock plate and unseat steering shaft snap ring as follows:

(a) Inspect and identify steering shaft nut thread type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

(b) If shaft has American threads, use Compressor Tool J-23653 as is to compress lock plate and unseat snap ring.

(c) If shaft has metric threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing tool on shaft.

(9) Remove compressor tool and snap ring. Discard snap ring.

(10) Remove lock plate, canceling cam, and upper bearing preload spring.

(11) Place turn signal lever in right turn position and remove lever.

(12) Remove hazard warning knob. Press knob inward and turn counterclockwise to remove.

(13) Remove column wiring harness protectors, if equipped.

(14) Disconnect column wiring harness connectors at base of column.

(15) If Cruise Command switch is to be serviced, remove switch and harness by removing turn signal lever attaching screw and removing lever, switch, and switch harness as assembly.

(16) If turn signal switch is to be serviced, remove hazard warning knob and turn signal lever. Remove switch attaching screws and remove switch from column.

### Installation

(1) If turn signal switch was serviced, install switch in housing and install attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque. Install hazard warning knob and install turn signal lever. Tighten lever attaching screw to 15 inch-pounds (2 N•m) torque.

(2) If Cruise Command switch was serviced, install signal lever and switch assembly and install attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

(3) Install upper bearing preload spring, canceling cam, and lock plate on steering shaft.

(4) Install replacement steering shaft snap ring on sleeve of Compressor Tool J-23653 and install tool on steering shaft.

**CAUTION:** *Identify the steering shaft nut thread type before installing the compressor tool. If shaft has American threads, use tool J-23653 as is. However, if the shaft has metric threads (fig. 2J-2), replace the compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before using the tool.*

(5) Compress lock plate and seat steering shaft snap ring in shaft groove. Remove compressor tool after snap ring installation.

(6) Install lock plate cover.

(7) Install steering wheel and install replacement steering wheel nut. Tighten nut to 30 foot-pounds (41 N•m) torque.

**CAUTION:** *Some steering shafts have metric size steering wheel nut threads. Be sure to install the proper thread-type nut. Metric shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2).*

(8) Connect signal switch or Cruise Command switch harness connectors at base of column and install harness protector.

(9) Install and tighten column-to-mounting bracket bolts to 20 foot-pounds (27 N•m) torque.

(10) Install and tighten column mounting bracket-to-instrument panel bolts to 20 foot-pounds (27 N•m) torque.

(11) Install column bezel.

(12) Tighten toe plate bolts to 10 foot-pounds (14 N•m) torque.

(13) Remove protective covering from painted areas of column.

(14) Connect battery negative cable.

## NEUTRAL SAFETY SWITCH

A neutral safety switch is used only on Jeep models with automatic transmission. The switch is located at the base of the steering column just below the ignition switch (fig. 2J-26).

The switch has two functions. The first is to allow the engine to be started in Park and Neutral positions only and the second is to operate the backup lights when the transmission is shifted into Reverse.

The switch must be readjusted whenever it is removed during service operations or when diagnosis indicates adjustment is necessary. Adjustment consists of repositioning the switch on the column jacket. Refer to the following adjustment procedure.

### Adjustment

(1) Adjust transmission manual linkage if necessary.

(2) Check switch operation by starting engine in Park and Neutral positions. Engine should start in these positions only.

(3) If engine fails to start in one or both positions, proceed to following step.

(4) Loosen switch attaching screws slightly. Move switch clockwise or counterclockwise on column until engine starts in Park and Neutral. Tighten switch attaching screws to 35 inch-pounds (4 N•m) torque.

(5) Check switch operation in all gearshift lever positions. Engine must start in Park and Neutral only.

(6) If engine starts in Drive or Reverse positions, switch is defective or short exists in switch or switch wires. Check switch and wire continuity and replace switch, wiring harness, or both as necessary.

## Removal

(1) Disconnect battery negative cable.

(2) Disconnect switch harness connector at switch.

(3) Remove switch attaching screws and remove switch from column.

## Installation

(1) Position switch on column and install attaching screws finger-tight only.

(2) Connect harness connector to switch terminals.

(3) Adjust switch. Refer to Adjustment.

(4) Tighten switch attaching screws to 35 inch-pounds (4 N•m) torque.

(5) Connect battery negative cable.

## IGNITION SWITCH

### Removal

(1) Insert key in lock cylinder and turn cylinder to Off-Unlock position.

(2) Disconnect battery negative cable.

(3) Disconnect harness connectors at switch.

(4) Remove switch attaching screws.

(5) Disengage remote rod from switch slider and remove switch from column.

### Installation

(1) Move switch slider to Accessory position (fig. 2J-64).

(2) Move switch slider back two clicks to Off-Unlock position (fig. 2J-64).

(3) Engage remote rod in switch slider and position switch on column. Do not move slider when positioning switch on column jacket.

(4) Install and tighten switch attaching screws to 35 inch-pounds (4 N•m) torque.

(5) Connect harness connectors to switch.

(6) Connect battery negative cable.

## IGNITION LOCK CYLINDER

The key-operated lock cylinder is located at the upper end of the steering column and is mounted in the column housing or cover. The lock cylinder is a two-piece assembly and can be removed, disassembled, and repaired or recoded if necessary.

### Conditions Requiring Service

#### Key Lost—Key Code Number Known

The key code may be converted to a five-digit number that determines key bitting. This number may be obtained from the catalogues furnished by manufacturers of key cutting machines or by calling the Jeep zone office.

#### Defective Ignition Lock—Ignition Key Available—No Key Code Number

New lock cylinders are available from service parts warehouses only as uncoded cylinders without tumblers. Tumblers are ordered under five different part numbers, one for each depth of cut available. Refer to Key Coding.

#### Key Lost—Key Code Lost Or Not Known

Contact the servicing dealer and provide the dealer with the vehicle identification number. The dealer may have a record of the key codes involved. If not, the key code numbers assigned to the vehicle may be obtained from the Jeep zone office.

### Lock Cylinder Removal

- (1) Disconnect battery negative cable.
- (2) Apply protective material to painted areas of column.
- (3) Remove steering wheel.
- (4) Remove lock plate cover. Use two screwdrivers to pry cover out of column.
- (5) Compress lock plate and unseat steering shaft snap ring as follows:
  - (a) Inspect and identify steering shaft nut thread-type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.
  - (b) If shaft has American threads, use Compressor Tool J-23653, as is, to compress lock plate and unseat snap ring (fig. 2J-6).
  - (c) If shaft has metric threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing tool on steering shaft.

**WARNING:** The lock plate is under strong spring pressure. Do not attempt to remove the steering shaft snap ring without using the compressor tool.

- (6) Remove compressor tool and snap ring. Discard snap ring.

- (7) Remove lock plate, canceling cam, and upper bearing preload spring.

- (8) Remove turn signal lever attaching screw and remove lever.

- (9) Press hazard warning knob inward and turn knob counterclockwise to remove it.

- (10) Disconnect turn signal and Cruise Command wire harness connectors at base of column.

- (11) Remove turn signal switch attaching screws and move switch aside to provide working clearance. It is not necessary to remove switch and harness completely.

- (12) Insert key in lock cylinder. On manual transmission columns, place cylinder in On position. On automatic transmission columns, place cylinder in Off-Lock position.

- (13) Compress lock cylinder retaining tab using thin blade screwdriver and remove lock cylinder from column.

**NOTE:** The lock cylinder retaining tab is accessible through the slot adjacent to the turn signal switch mounting boss (fig. 2J-9). If the tab is not visible through the slot, scrape or knock any casting flash out of the slot to provide access.

### Lock Cylinder Installation

- (1) Install lock cylinder as follows:
  - (a) Insert key in lock cylinder.
  - (b) Hold cylinder sleeve and turn key clockwise until key stops.
  - (c) Align lock cylinder retaining tab with keyway in housing and insert cylinder into column.
  - (d) Push cylinder inward until it contacts lock sector. Rotate cylinder to engage it with lock sector, and push cylinder inward until cylinder retaining tab engages in housing groove.
- (2) Align and install turn signal switch in column.
- (3) Install and tighten switch attaching screws to 35 inch-pounds (4 N•m) torque.
- (4) Install hazard warning knob. Tighten knob to 5 inch-pounds (0.56 N•m) torque.
- (5) Install turn signal lever. Tighten lever attaching screw to 15 inch-pounds (2 N•m) torque.
- (6) Install upper bearing preload spring, canceling cam, and lock plate on steering shaft.
- (7) Install replacement steering shaft snap ring on sleeve of Compressor Tool J-23653 and install tool on steering shaft (fig. 2J-6).

**CAUTION:** Identify the steering shaft nut thread-type before installing the compressor tool. If the shaft has American threads, use the tool as is. However, if the shaft has metric threads (fig. 2J-2), replace the compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing the tool on the shaft.

- (8) Compress lock plate with compressor tool and seat snap ring in steering shaft groove (fig. 2J-6).

- (9) Remove compressor tool.
- (10) Install lock plate cover.
- (11) Install steering wheel and tighten steering wheel nut to 30 foot-pounds (41 N•m) torque.

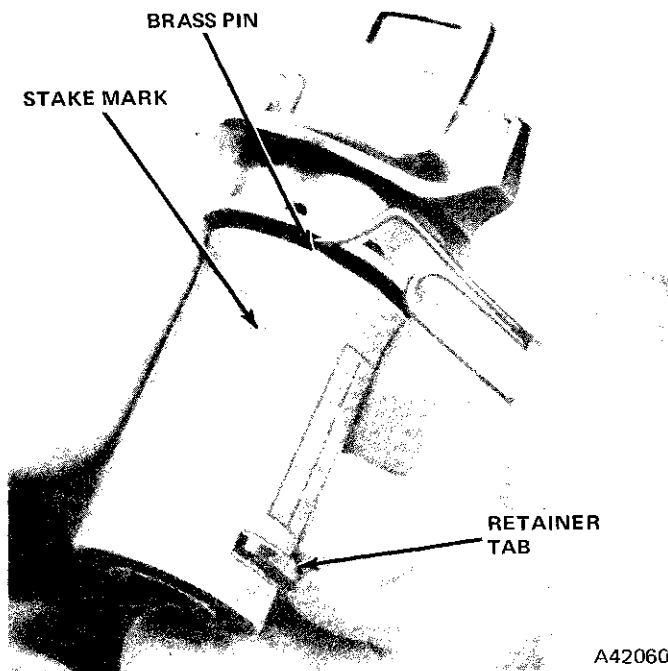
**CAUTION:** Some steering shafts have metric steering wheel nut threads. Identify the shaft nut thread-type before installing a replacement nut. Metric shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2).

- (12) Connect column wiring harness connectors at base of column.
- (13) Remove protective covering from column painted areas.
- (14) Connect battery negative cable.
- (15) Reset clock if equipped.

**Lock Cylinder Disassembly**

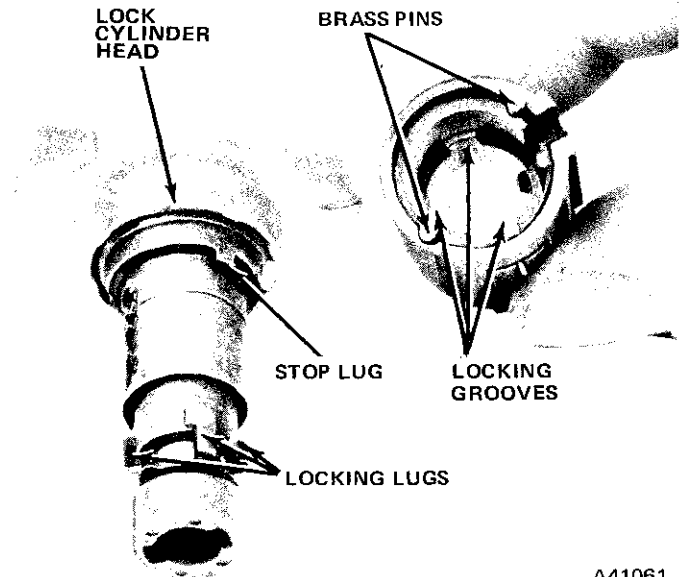
In the following procedures, all references to turning the key clockwise or counterclockwise are made as if the cylinder is being viewed from the key-end.

- (1) Insert key in lock cylinder.
- (2) Hold lock sleeve and turn cylinder to Lock position.
- (3) Fabricate plunger pin compressor tool from paper clip. Make 90° bend in one end of clip about 1/4 inch (6.35 mm) from end (fig. 2J-65).

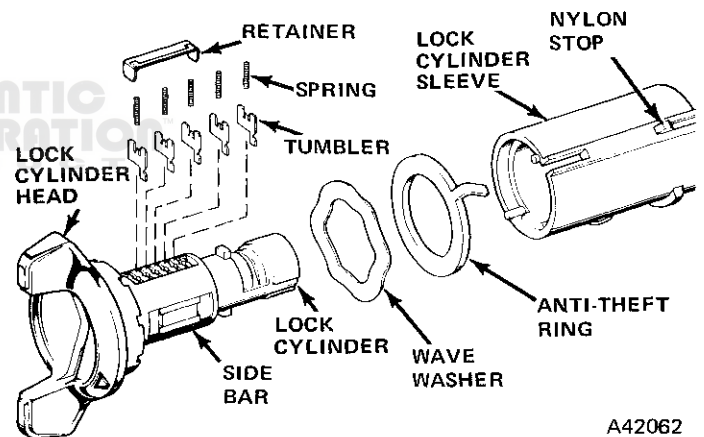


**Fig. 2J-65 Compressing Lock Cylinder Plunger Pin**

- (4) Turn lock cylinder to Accessory position. Brass plunger pins in lock sleeve should now bear against lock cylinder stop lug (fig. 2J-66).
- (5) Compress plunger pin using paper clip compressor tool (fig. 2J-66).



**Fig. 2J-66 Lock Cylinder and Sleeve Disassembled**



**Fig. 2J-67 Ignition Lock Cylinder Assembly**

**NOTE:** There are two brass pins and two staking marks on the lock sleeve. The brass pin that must be compressed in order to separate the cylinder and sleeve is located just above the stake mark that is positioned above and to the left of the retaining tab (fig. 2J-65).

- (6) Hold brass plunger pin in compressed position and turn lock cylinder clockwise using paper clip.
- (7) Stop turning cylinder when it springs upward slightly. Cylinder locking lugs are now aligned with sleeve locking grooves.
- (8) Remove ignition key.
- (9) Turn sleeve and cylinder upside down.
- (10) Fabricate wire hook from additional paper clip.
- (11) Lift nylon stop on lock sleeve using wire hook and separate cylinder from sleeve (fig. 2J-67).

## 2J-40 STEERING COLUMNS

**NOTE:** If the cylinder does not separate from the sleeve easily, tap the assembly lightly on the workbench to free the sleeve from the cylinder.

(12) Pry tumbler retainer from cylinder and remove tumbler springs (fig. 2J-67).

(13) Pull side bar outward slightly and remove tumblers from cylinder (fig. 2J-67).

### Key Coding

To determine the tumblers needed when the key code is not available, use the code diagram as follows (fig. 2J-68):

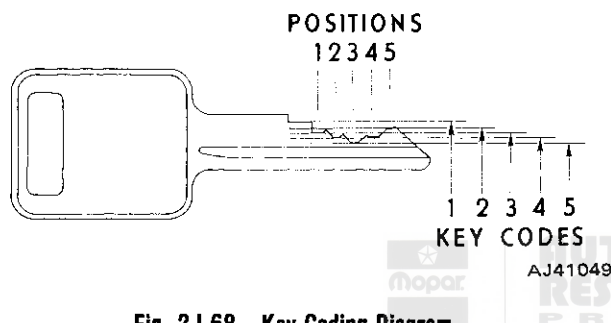


Fig. 2J-68 Key Coding Diagram

(1) Place key over coding diagram with uncut side of key aligned exactly with diagram. Each of five positions will align with key notches.

(2) Starting at head of key blade, determine and record lowest level tumbler number that is visible in each position (1 through 5).

(3) After tumbler number sequence is determined, lock cylinder is ready for assembly.

(4) Starting at key end of lock cylinder, insert tumblers in proper slots and in order required by key code. Pull side bar outward slightly to allow tumblers to drop completely into place.

(5) Install a spring on each tumbler.

(6) Insert tumbler retainer so two end prongs slide into slots in cylinder.

(7) Press retainer downward until it is seated.

(8) Insert key in lock cylinder and check tumbler operation. If tumblers are properly installed, side bar will drop downward when key is inserted. If side bar does not move, disassemble cylinder and check for incorrect assembly or coding of key and tumblers.

(9) If cylinder is correctly assembled and operates properly, stake each end of spring retainer in place using punch (fig. 2J-69).

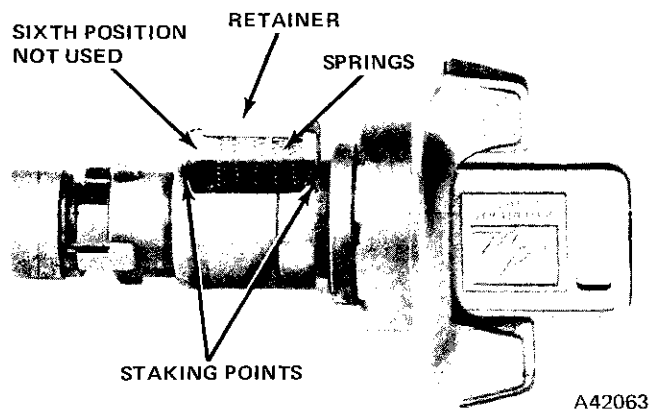


Fig. 2J-69 Tumbler and Spring Installation

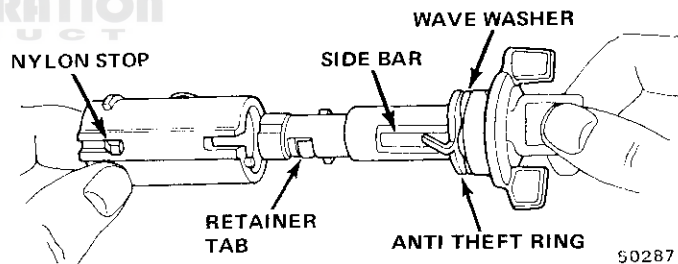


Fig. 2J-70 Assembling Lock Cylinder and Sleeve

### Assembly

(1) Insert key completely into lock cylinder then pull key out two notches.

(2) Install wave washer and anti-theft ring on lock cylinder (fig. 2J-70).

(3) Grasp lock sleeve with left thumb and forefinger and hold nylon stop in lock sleeve upward with forefinger (fig. 2J-70).

(4) Grasp lock cylinder with right thumb and forefinger, align anti-theft ring tang and lock cylinder side bar with slot in wall of lock sleeve, and insert cylinder into sleeve (fig. 2J-70).

(5) Push key completely into cylinder and turn key clockwise to lock cylinder in sleeve.

**SPECIFICATIONS**  
**Torque Specifications**

Service Set-To Torques should be used when assembling components.

Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N•m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Clamp Bolt, Flexible Coupling .....	30	25-35	41	34-47
Clamp Bolt, Intermediate Shaft .....	45	40-55	61	54-75
Clamp Bolt, Steering Shaft U-Joint .....	45	40-55	61	54-75
Column Mounting Bracket Bolt .....	20	15-25	27	20-34
Column Mounting Bracket-to-Instrument Panel Bolts .....	20	15-25	27	20-34
Cover Screws (Auto. Col.) .....	60 in-lbs.	50-65 in-lbs.	7	5-7
Cover Screws (Tilt Col.) .....	100 in-lbs.	95-105 in-lbs.	11	10-12
Hazard Warning Knob .....	5 in-lbs.	3-7 in-lbs.	0.56	0.34-0.79
Housing Screws (Std. Col.) .....	60 in-lbs.	55-65 in-lbs.	7	5-7
Housing Screws (Tilt Col.) .....	100 in-lbs.	95-105 in-lbs.	11	10-12
Ignition Switch Mounting Screws .....	35 in-lbs.	30-40 in-lbs.	4	3-5
Lock Sector Tension Spring Screw .....	35 in-lbs.	30-40 in-lbs.	4	3-5
Shroud Screws (Man. Trans. Col.) .....	18 in-lbs.	14-22 in-lbs.	2	2-3
Steering Wheel Nut .....	30	25-35	41	34-47
Support Screws (Tilt Col.) .....	60 in-lbs.	50-65 in-lbs.	7	5-7
Tilt Lever Screw .....	35 in-lbs.	30-40 in-lbs.	4	3-5
Toe Plate Screws .....	10	10-18	14	14-24
Turn Signal Lever Screw .....	15 in-lbs.	12-20 in-lbs.	2	1-3
Turn Signal Switch Screws .....	35 in-lbs.	28-40 in-lbs.	4	3-5

All Torque values given in foot-pounds with dry fits unless otherwise specified.

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**Tools**



**J-23072**  
**SHIFT TUBE REMOVER**



**J-22635**  
**PIN REMOVER AND**  
**INSTALLER**



**J-23653**  
**LOCK PLATE**  
**COMPRESSOR**



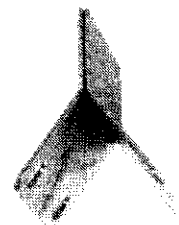
**J-23073**  
**SHIFT TUBE**  
**INSTALLER**



**J-22569**  
**STEERING SHAFT SNAP RING**  
**REMOVER AND INSTALLER**



**J-21232**  
**STEERING WHEEL**  
**PULLER**



**J-23074**  
**STEERING COLUMN**  
**HOLDING FIXTURE**



**J-21854-1 PIVOT**  
**PIN PULLER**



# MANUAL STEERING GEAR 2K

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Steering Gear—Left Hand Drive Vehicles	2K-3	Tools	2K-14

## GENERAL INFORMATION

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Service Diagnosis	2K-2		

### GENERAL

Two different manual steering gear units are used in Jeep vehicles. Left hand drive models use a recirculating ball-type gear (fig. 2K-1). Right hand drive models use a worm and roller-type gear (fig. 2K-2).

In the recirculating ball gear, the wormshaft and ball nut are in line with the steering shaft in the column. The ball nut is mounted on the wormshaft and is driven through steel ball bearings which circulate in spiral grooves machined in the wormshaft and ball nut. The bearings act as a rolling thread between the wormshaft and ball nut. The ball nut is directly engaged by the pitman shaft teeth.

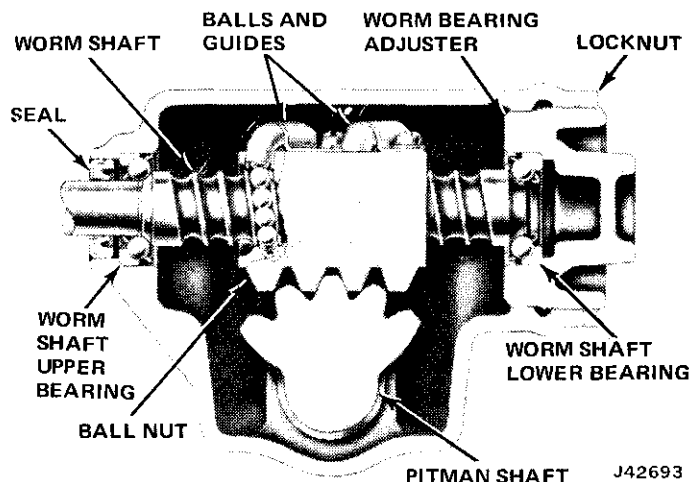


Fig. 2K-1 Recirculating Ball Gear—Left Hand Drive Vehicles

In the worm and roller gear, only the wormshaft is in line with the steering shaft. The roller gear and shaft assembly are mounted in a fixed position in the steering gear. The three tooth roller gear is attached to the roller shaft by a steel pin. The steering arm is attached directly to the splined end of the roller shaft.

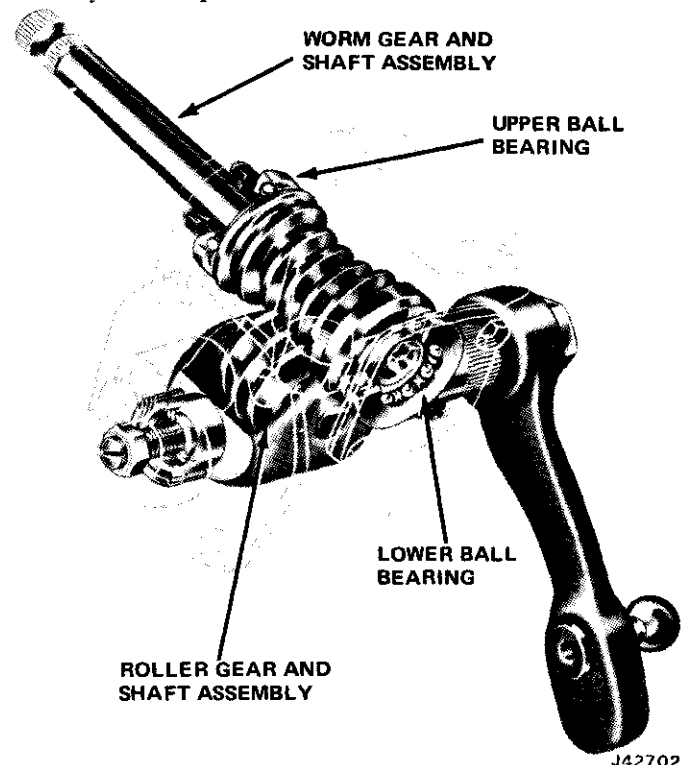


Fig. 2K-2 Worm and Roller Gear—Right Hand Drive Vehicles



## 2K-2 MANUAL STEERING GEAR

### Service Diagnosis

Condition	Possible Cause	Correction
HARD STEERING	<ul style="list-style-type: none"> <li>(1) Incorrect tire pressure.</li> <li>(2) Lack of lubrication.</li> <li>(3) Tie rod ends worn.</li> <li>(4) Steering knuckle ball studs tight.</li> <li>(5) Steering gear parts worn.</li> <li>(6) Frozen steering column bearings.</li> <li>(7) Lower coupling flange rubbing against steering shaft.</li> <li>(8) Steering gear adjusted incorrectly.</li> <li>(9) Front spring sag.</li> <li>(10) Frame bent or broken.</li> <li>(11) Steering knuckle bent.</li> <li>(12) Ball stud galled or too tight.</li> <li>(13) Steering knuckle ball studs binding.</li> <li>(14) Steering gear or connections binding.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Adjust.</li> <li>(2) Lubricate steering linkage.</li> <li>(3) Replace.</li> <li>(4) Adjust or replace.</li> <li>(5) Replace.</li> <li>(6) Replace bearings.</li> <li>(7) Loosen bolt and assemble properly.</li> <li>(8) Check adjustment. Disconnect pitman arm from gear or disconnect linkage from pitman arm and adjust gear if necessary.</li> <li>(9) Check front end jounce height. It should be approximately the same at both wheels. Replace front springs if sagged.</li> <li>(10) Repair frame as necessary.</li> <li>(11) Install new knuckle.</li> <li>(12) Replace ball stud.</li> <li>(13) Reseat or replace studs.</li> <li>(14) Test steering system with wheels off floor. Adjust and lubricate.</li> </ul>
LOOSE STEERING	<ul style="list-style-type: none"> <li>(1) Tie rod ends worn.</li> <li>(2) Steering knuckle ball studs worn.</li> <li>(3) Steering gear parts worn.</li> <li>(4) Steering gear improperly adjusted.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Replace.</li> <li>(2) Replace.</li> <li>(3) Replace.</li> <li>(4) Adjust.</li> </ul>
EXCESSIVE ROAD SHOCK	<ul style="list-style-type: none"> <li>(1) U-bolts loose.</li> <li>(2) Wheel bearings loose.</li> <li>(3) Shock absorbers worn.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Repair as necessary.</li> <li>(2) Repair as necessary.</li> <li>(3) Replace.</li> </ul>

**Service Diagnosis (Continued)**

Condition	Possible Cause	Correction
TURNING RADIUS SHORT ONE SIDE	(1) Center bolt in spring sheared off.	(1) Repair as necessary.
	(2) Axle shifted.	(2) Repair as necessary.
	(3) Steering arm bent.	(3) Replace.

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**SPECIFICATIONS**

**Steering Gear Specifications**

**Left Hand Drive Vehicles:**

Gear-Type	Recirculating Ball
Ratio	24:1
<b>Bearings</b>	
Upper	Ball
Lower	Ball
<b>Adjustments:</b>	
Worm Bearing Preload	8 in-lbs. (0.90 N·m)
Pitman Shaft Overcenter Drag Torque	4-10 in-lbs. (0.45-1.13 N·m) in addition to 8 in-lbs. (0.90 N·m) worm bearing preload for a total of 18 in-lbs. (2.03 N·m) maximum
Adjuster Screw End Play	0.002 in. (0.05 mm)

**Right Hand Drive Vehicles:**

Gear-Type	Worm and Roller
Ratio	24:1
<b>Bearings</b>	
Upper	Ball
Lower	Ball
Lever Shaft	Roller and Bushing
<b>Adjustments:</b>	
Worm Bearing Preload	2-5 in-lbs. (0.23-0.56 N·m)
Worm and Roller Gear Clearance	7-12 in-lbs. (0.79-1.36 N·m)
<b>Worm Gear Shaft</b>	
Shaft Bearing Clearance (Maximum)	0.010 in. (0.25 mm)

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# STEERING GEAR – LEFT HAND DRIVE VEHICLES

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<b>Disassembly</b>	<b>2K-4</b>
<b>Installation</b>	<b>2K-4</b>

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<b>Removal</b>	<b>2K-3</b>
<b>Specifications</b>	<b>2K-10</b>
<b>Subassembly Overhaul</b>	<b>2K-6</b>

**REMOVAL**

- (1) Remove intermediate shaft-to-wormshaft coupling clamp bolt and disconnect intermediate shaft.
- (2) Remove pitman arm nut and lockwasher.
- (3) Remove pitman arm from steering gear pitman shaft using Puller J-6632 (fig. 2K-3).
- (4) On Cherokee, Wagoneer and Truck models, remove bolts attaching steering gear to frame and remove gear.
- (5) On CJ models:
  - (a) Raise left side of vehicle slightly to relieve tension on left front spring and place support stand under frame.

- (b) Remove bolts attaching steering gear lower bracket to frame (fig. 2K-4).
- (c) Remove bolts attaching steering gear upper bracket to frame rail and remove gear.
- (d) Remove Torx Head upper bracket bolt using 9 inch (22.86 cm) extension and Torx Bit External Socket Tool J-25359-21 (fig. 2K-4).
- (e) Remove remaining bolts attaching upper bracket to tie plate and lower bracket to steering gear and remove brackets from gear.

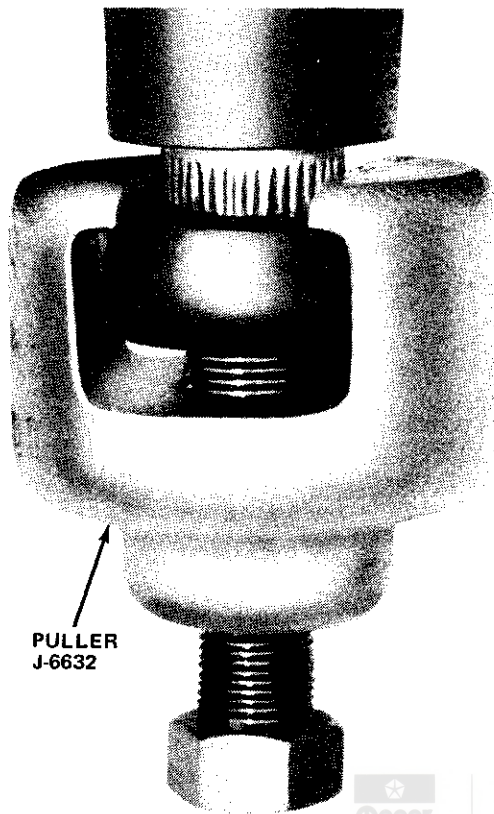


Fig. 2K-3 Pitman Arm Removal

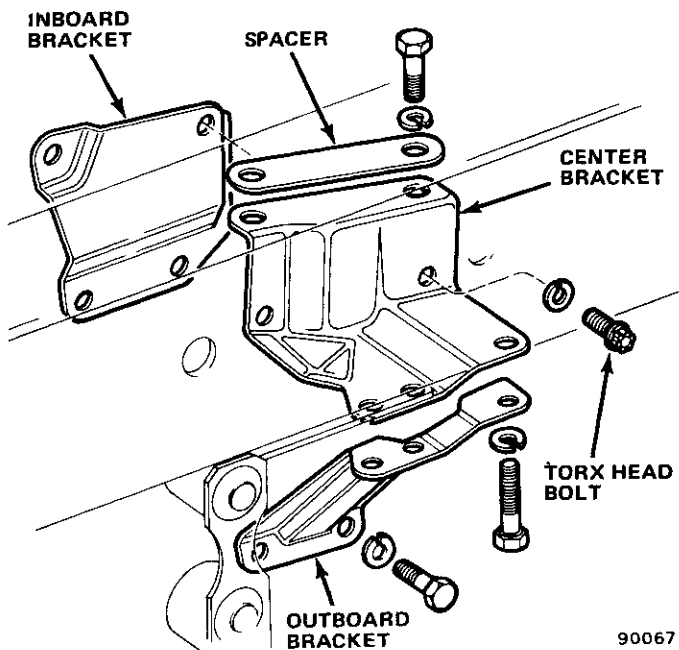


Fig. 2K-4 Steering Gear Mounting Brackets—CJ Models

**INSTALLATION**

**NOTE:** Proper retention of the steering gear is important. Some of the following steps in gear installation require the application of Loctite or similar material to

attaching bolt threads. Wherever indicated, use Loctite 271 Adhesive/Sealant or equivalent. Before applying this material, first clean all bolt threads thoroughly to remove dirt and grease and apply the material to the bolt threads no more than five minutes before installation.

- (1) On Cherokee, Wagoneer and Truck models:
  - (a) Apply Loctite or equivalent to steering gear-to-frame mounting bolts.
  - (b) Align and engage intermediate shaft coupling with splines on steering gear wormshaft.
  - (c) Position gear on frame and install gear attaching bolts. Tighten bolts to 70 foot-pounds (95 N•m) torque.
  - (d) Install intermediate shaft coupling pinch bolt and nut. Tighten nut to 45 foot-pounds (61 N•m) torque.
- (2) On CJ models:
  - (a) Apply Loctite or equivalent to all steering gear mounting bracket attaching bolts.
  - (b) Position tie plate and upper and lower mounting brackets on steering gear and install mounting bracket-to-gear attaching bolts. Tighten hex head bolts to 70 foot-pounds (95 N•m) torque. Tighten torx head bolt to 55 foot-pounds (75 N•m) torque using Torx Head External Socket Tool J-25359-21.
  - (c) Apply Loctite or equivalent to all steering gear-to-frame and crossmember mounting bolts.
  - (d) Align and engage intermediate shaft coupling with steering gear wormshaft splines.
  - (e) Position steering gear on frame and install remaining gear mounting bolts. Tighten bolts to 55 foot-pounds (75 N•m) torque.
- (3) Install intermediate shaft coupling clamp bolt and nut. Tighten nut to 45 foot-pounds (61 N•m) torque.
- (4) Install pitman arm on pitman shaft and install lockwasher and pitman arm nut. Tighten nut to 185 foot-pounds (251 N•m) torque.
- (5) On CJ models, remove support stand and hydraulic jack.

**NOTE:** After the steering gear is installed, it may produce a slightly rough feel. To eliminate this roughness, turn the gear full left and right for 10 to 15 complete cycles.

**DISASSEMBLY**

- (1) Mount steering gear in vise. Clamp vise jaws on gear mounting bosses only.
- (2) Place ball nut and pitman shaft in centered position. Rotate wormshaft stop-to-stop and count total number of turns. Turn wormshaft back 1/2 total number of turns to center shaft and nut.
- (3) Remove pitman shaft adjuster screw locknut (fig. 2K-5).
- (4) Remove side cover attaching bolts (fig. 2K-5).

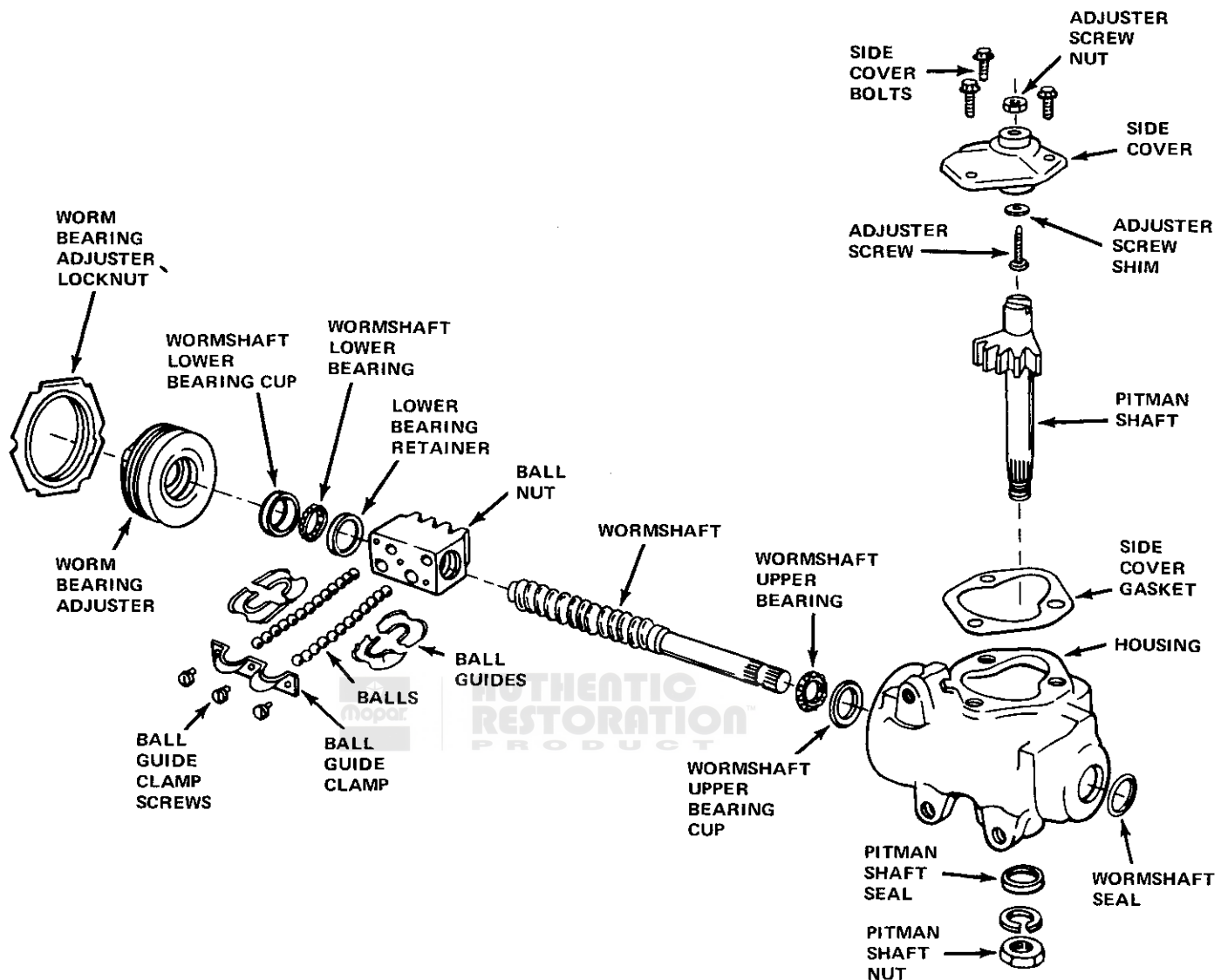


Fig. 2K-5 Steering Gear—Left Hand Drive Vehicles

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(5) Turn pitman shaft adjuster screw clockwise to unthread side cover from screw and remove side cover and gasket.

(6) Slide adjuster screw and shim out of T-slot in pitman shaft (fig. 2K-5). Retain shim and screw for end play measurement at assembly.

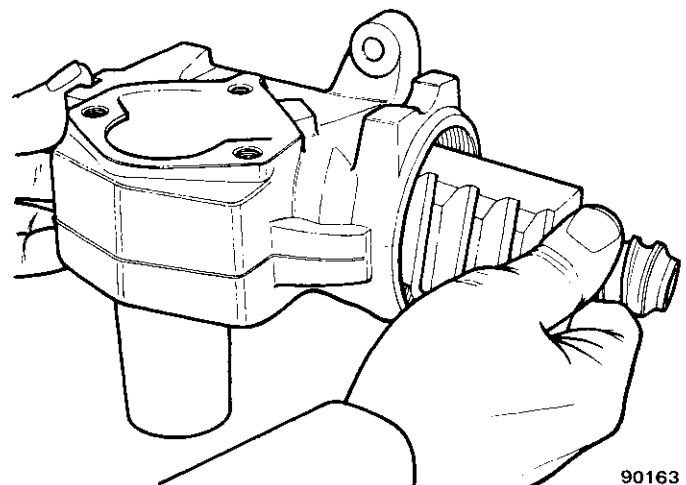
(7) Remove pitman shaft. If necessary, tap shaft lightly with plastic mallet to remove it.

(8) Remove worm bearing adjuster locknut.

(9) Remove worm bearing adjuster.

(10) Remove wormshaft and ball nut (fig. 2K-6).

**CAUTION:** During service operations, do not allow the ball nut to rotate freely and bottom at either end of the wormshaft. This can damage the tangs at the ends of the ball guides.



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Fig. 2K-6 Wormshaft and Ball Nut Removal/Installation

### SUBASSEMBLY OVERHAUL

#### Wormshaft and Ball Nut

##### Disassembly

- (1) Place clean shop cloths on workbench and position wormshaft and ball nut on cloths.
- (2) Remove upper bearing from wormshaft.
- (3) Remove ball guide clamp attaching screws and remove clamp.
- (4) Remove ball guides. Separate guide halves and retain ball bearings that stayed in guides during removal.
- (5) Remove remaining ball bearings from ball nut circuits. Position ball nut over shop cloths and rotate wormshaft back and forth until bearings drop out onto cloth.

**NOTE:** There are a total of 50 ball bearings in the ball nut with 25 in each circuit.

- (6) Remove wormshaft from ball nut.

##### Cleaning and Inspection

Wash all parts in solvent and dry using clean cloths or compressed air. Inspect all components for wear, scoring, cracks, nicks, or surface pitting and also check the upper bearing and ball bearings for flat spots. If the upper bearing is damaged, the upper bearing cup must also be replaced.

##### Assembly

- (1) Position ball nut on workbench with ball guide holes facing upward and deep side of ball nut teeth facing edge of workbench (fig. 2K-7).

- (2) Install wormshaft in ball nut from left side. Thread shaft into nut until equal number of shaft threads are visible at each end of nut (fig. 2K-7).

**CAUTION:** The ball nut teeth are machined to a greater width and depth on one side. When assembling the wormshaft and ball nut, position the ball nut so the wider-deeper side of the teeth will face the housing side cover opening after installation (fig. 2K-7).

- (3) Install one ball bearing in each ball guide hole.
- (4) Move wormshaft up/down and side-to-side until bearings roll into ball nut threads under wormshaft and support wormshaft.
- (5) Assemble and install ball guides in ball nut.
- (6) Divide remaining 48 ball bearings in half and install 24 bearings in each ball nut circuit. Insert bearings into ball nut circuits through holes in ball guides (fig. 2K-8).

**NOTE:** To ease ball bearing installation, rotate the wormshaft back and forth slightly while inserting the bearings.

- (7) Position ball guide clamp on ball nut and install clamp attaching screws. Tighten screws to 4 foot-pounds (6 N•m) torque.

- (8) Lubricate wormshaft threads with chassis grease and thread shaft in and out of ball nut to circulate grease.

**CAUTION:** To avoid damaging the tangs on the ball guide ends, do not allow the wormshaft to bottom in either direction.

- (9) Lubricate wormshaft upper bearing with chassis grease and install bearing on wormshaft.

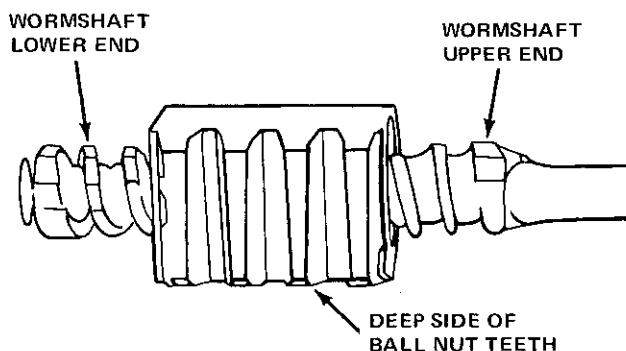


Fig. 2K-7 Positioning Wormshaft in Ball Nut

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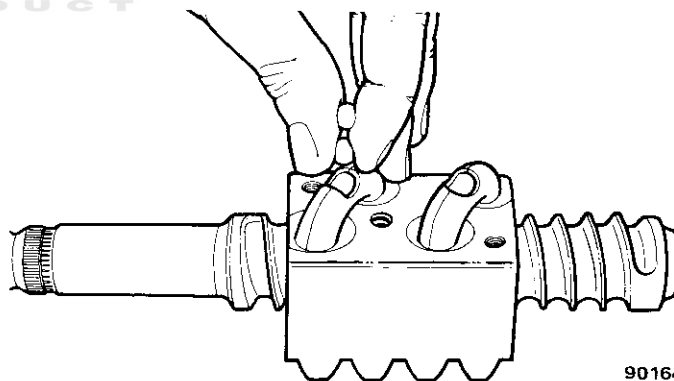


Fig. 2K-8 Installing Bearings in Ball Nut Circuits

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#### Worm Bearing Adjuster

##### Disassembly

- (1) Remove wormshaft lower bearing retainer from worm bearing adjuster. Use screwdriver to pry retainer out of adjuster (fig. 2K-9).
- (2) Remove wormshaft lower bearing from adjuster.

##### Cleaning and Inspection

Clean parts in solvent and dry using clean cloths only. Inspect all components for wear or damage and also inspect the bearing for flat spots or scoring. If either the lower bearing or bearing cup is damaged, both parts must be replaced.

**Assembly**

(1) If lower bearing cup is to be replaced, remove old cup and install replacement as follows:

(a) Install spare locknut on worm bearing adjuster and clamp adjuster in vise. Clamp vise jaws on locknut only.

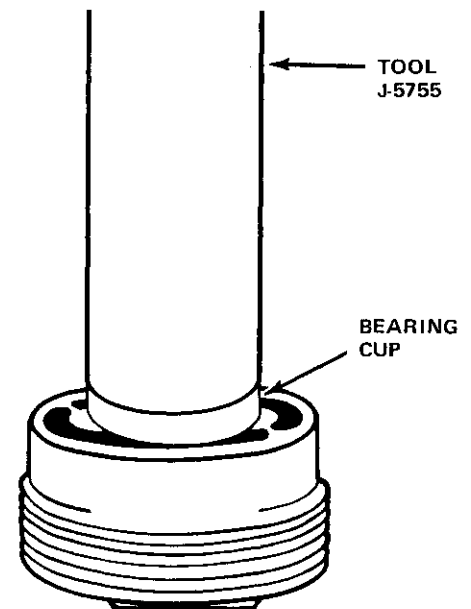
(b) Assemble Puller J-5822 and Slide Hammer J-2619-01 (fig. 2K-10). Position puller legs under bearing cup and tighten puller screw to expand and hold legs in position. Bump outward with slide hammer weight to remove bearing cup.

(c) Remove adjuster from vise and remove spare locknut from adjuster.

(d) Install replacement bearing cup in adjuster using tool J-5755 (fig. 2K-11).

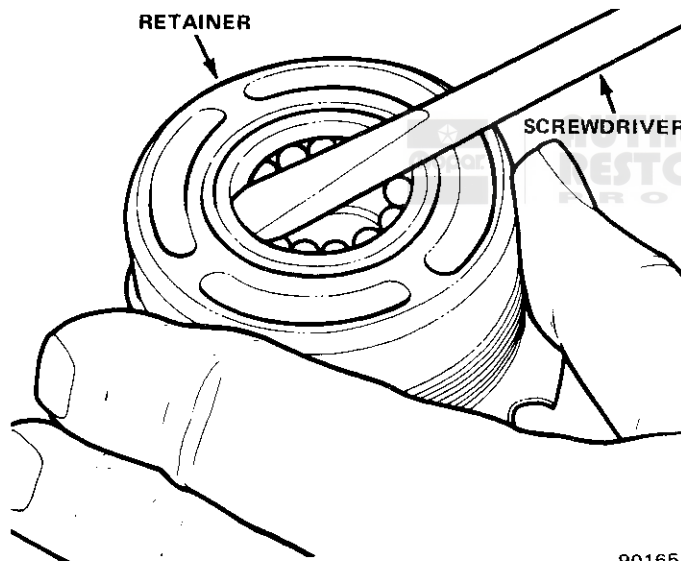
(2) Lubricate lower bearing with chassis grease and install bearing in adjuster.

(3) Install lower bearing retainer in adjuster. If necessary, tap retainer lightly with plastic mallet to seat it.



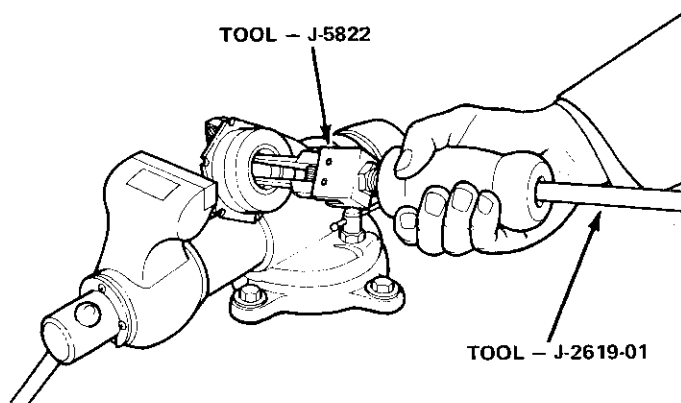
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**Fig. 2K-11 Installing Wormshaft Lower Bearing Cup**



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**Fig. 2K-9 Removing Wormshaft Lower Bearing Retainer**



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**Fig. 2K-10 Removing Wormshaft Lower Bearing Cup**

**Steering Gear Housing and Pitman Shaft**

**Disassembly**

(1) Remove pitman shaft and wormshaft seals from housing. Use screwdriver to pry seals out (fig. 2K-12).

(2) Remove adjuster screw and shim from pitman shaft T-slot (if not removed previously). Retain screw and shim for end play check.

**Cleaning and Inspection**

Clean the housing and pitman shaft with solvent and dry using clean cloths or compressed air. Inspect the housing for cracks, porosity, damaged threads and gasket surface scoring or distortion. Inspect the pitman shaft bore contact surface and sector teeth for wear, pitting, or other damage.

Insert the pitman shaft in the housing bore and check for shaft or housing bore wear. The shaft should exhibit a smooth, bind free fit and not display any visible side play when installed in the bore. If the shaft appears loose and is not visibly worn, trial fit a new shaft in the housing bore. If the new shaft is also loose, replace the housing. However, if the new shaft fits properly, replace the pitman shaft.

Measure adjuster screw fit and end play in the pitman shaft T-slot. When installed, the screw must rotate freely and not bind in any position. Measure end play by inserting a feeler gauge between the screw head and T-slot surface (fig. 2K-14). End play must not exceed 0.002 inches (0.05 mm). If end play exceeds specified limit, select and install a replacement shim that will provide the specified clearance. Shims are furnished in four

## 2K-8 MANUAL STEERING GEAR

thicknesses; 0.063, 0.065, 0.067 and 0.069 inch (1.60, 1.65, 1.70 and 1.75 mm) and are available in kit form.

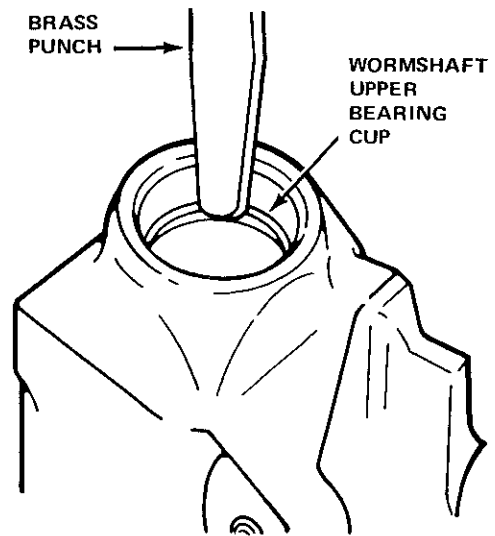
Inspect the wormshaft upper bearing and bearing cup for wear, looseness, flat spots, pitting, cracks, or other damage. If either the bearing or bearing cup is damaged, both parts must be replaced. If the cup is loose in the housing, trial fit a new cup. If the new cup is also loose, replace the housing. If the new cup fits properly, replace only the bearing cup.

### Assembly

(1) If wormshaft upper bearing cup is to be replaced, remove old cup using hammer and brass punch (fig. 2K-14).

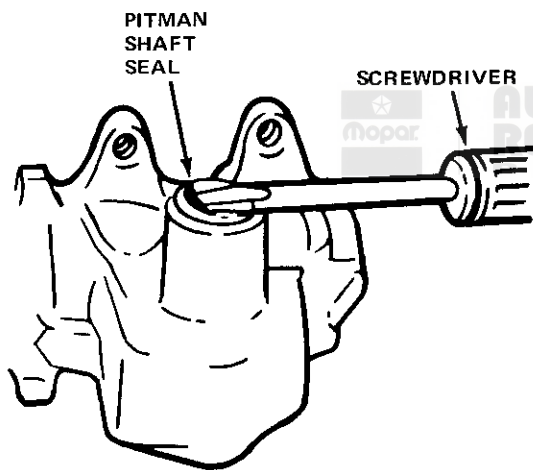
(2) Install replacement bearing cup using Installer J-5755 (fig. 2K-15).

**NOTE:** Do not install the wormshaft or pitman shaft seals at this time. Refer to Assembly and Adjustment.



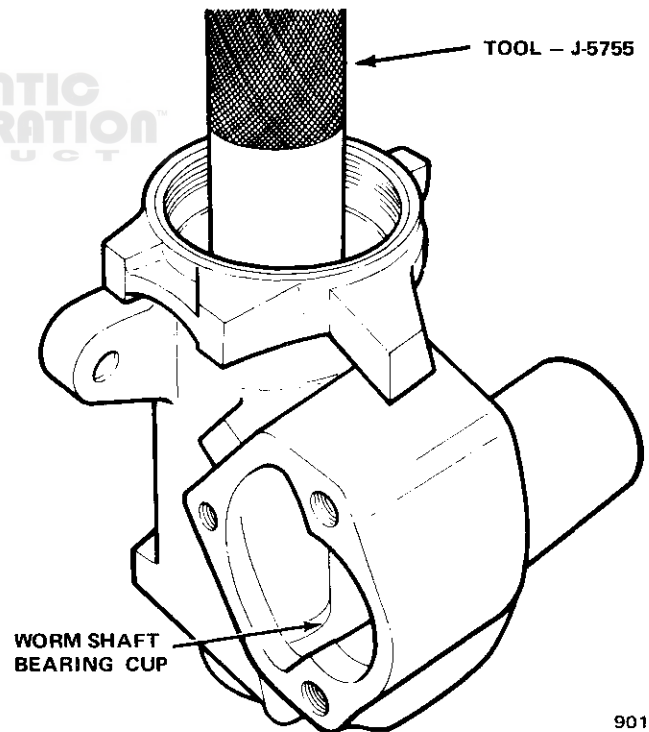
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Fig. 2K-14 Removing Wormshaft Upper Bearing Cup



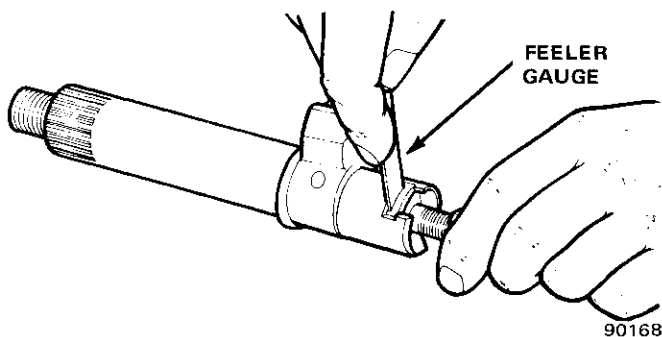
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Fig. 2K-12 Removing Pitman Shaft and Wormshaft Seal



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Fig. 2K-15 Installing Wormshaft Upper Bearing Cup



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Fig. 2K-13 Measuring Adjuster Screw End Play

### ASSEMBLY AND ADJUSTMENT

- (1) Lubricate all components with chassis grease if not lubricated previously.
- (2) Place gear housing in vise. Clamp vise jaws on housing mounting bosses only.
- (3) Install wormshaft and ball nut in housing.

**CAUTION:** Be sure the ball nut is installed with the deep side of the ball nut teeth facing the side cover opening.

- (4) Install worm bearing adjuster in housing and tighten adjuster only enough to remove wormshaft end play.
- (5) Install locknut on worm bearing adjuster but do not tighten locknut at this time.
- (6) Pack steering gear housing with as much chassis grease as possible.

**NOTE:** In order to pack the maximum amount of grease 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 ball nut travel ceases. Pack the unobstructed housing end full of grease; then rotate the shaft in the opposite direction and repeat the packing procedure.

- (7) Place ball nut in centered position. Rotate wormshaft from stop to stop and count total number of turns. Turn wormshaft back 1/2 number of turns to center ball nut.

- (8) Lubricate pitman shaft with chassis grease and install shaft in housing. Engage center tooth of shaft in center groove of ball nut (fig. 2K-16).

- (9) Coat replacement side cover gasket with chassis grease and position gasket on housing side cover opening.

- (10) Install end play shim on adjuster screw and thread screw into side cover to depth of 2-3 threads.

- (11) Slide adjuster screw into pitman shaft T-slot and turn screw counterclockwise to thread it into cover. Stop turning screw when side cover almost contacts gasket.

- (12) Align gear housing and side cover bolt holes and install cover attaching bolts finger tight only (do not attempt to seat cover on housing by tightening bolts).

- (13) Tighten adjuster screw until it bottoms and back off screw 1/2 turn.

- (14) Tighten side cover bolts to 30 foot-pounds (41 N•m) torque.

- (15) Install pitman shaft and wormshaft seals as follows:

- (a) Wrap 0.005 inch (0.1 mm) thick shim stock (or single layer of thinnest tape available) around shaft splines and threads. Shim stock (or tape) will serve as seal protector when seals are installed.

- (b) Lubricate seals with chassis grease. Slide each seal over protective material and down shaft until seal contacts housing.

- (c) Start seals into housing seal seats by hand. Complete seal installation by tapping seals into place using plastic mallet. Be sure each seal is fully seated in housing.

**CAUTION:** Some type of protective wrap must be used during seal installation. If the seals are installed over exposed shaft splines or threads, the seal lips could be cut or distorted resulting in leakage after assembly.

- (16) Check gear operation. With adjuster screw backed off, wormshaft should rotate freely and without bind in either direction. Also check for grease leaks past seals. If gear binds, repair as necessary and recheck operation. If seals leak, replace them and recheck operation.

- (17) Adjust steering gear worm bearing preload and overcenter drag torque. Refer to following adjustment procedure.

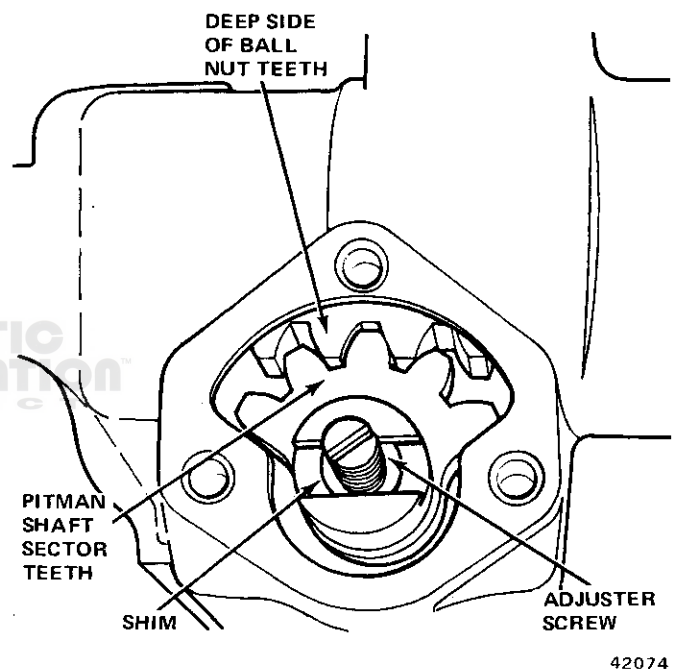


Fig. 2K-16 Pitman Shaft and Ball Nut In Centered Position

### Adjustment

The recirculating ball gear requires two adjustments which are, worm bearing preload and pitman shaft overcenter drag torque.

Worm bearing preload is controlled by the amount of compression force exerted on the wormshaft bearings by the worm bearing adjuster.

Pitman shaft overcenter drag torque is controlled by the pitman shaft adjuster screw which determines the clearance between the ball nut and pitman shaft sector teeth.

**CAUTION:** The following adjustment procedures must be performed exactly as described and in the sequence outlined. Failure to do so can result in damage to the gear internal components and improper steering response. Always adjust worm bearing preload first and pitman shaft overcenter drag torque last.



## 2K-10 MANUAL STEERING GEAR

### Worm Bearing Preload Adjustment

- (1) Tighten worm bearing adjuster until it bottoms, then back off adjuster 1/4 turn.
- (2) Install socket and Torque Wrench J-7754 on splined end of wormshaft.
- (3) Rotate wormshaft clockwise to stop; then back off shaft 1/2 turn.
- (4) Tighten worm bearing adjuster until torque required to rotate wormshaft is 5 to 8 inch-pounds (0.60 to 0.90 N•m).

**CAUTION:** The preload adjustment must be made with the wormshaft turned back no more than 1/2 turn from either the right or left turn stop positions.

- (5) Tighten worm bearing adjuster locknut to 90 foot-pounds (122 N•m) torque. Recheck wormshaft rotating torque and readjust if necessary.
- (6) Record worm bearing preload torque reading.

### Pitman Shaft Overcenter Drag Torque Adjustment

- (1) Rotate wormshaft from stop-to-stop and count total number of turns.
- (2) Turn wormshaft back 1/2 total number of turns to place ball nut and pitman shaft in centered position..
- (3) Install socket and Torque Wrench J-7754 on pitman shaft splines (fig. 2K-18).
- (4) Tighten pitman shaft adjuster screw (while rotating shaft back and forth over center) until torque required to rotate shaft over center equals worm bearing preload setting.
- (5) Rotate shaft over center and continue tightening adjuster screw until drag torque is increased by additional 4 to 10 inch-pounds (0.45 to 1.13 N•m) but do not exceed total of 16 inch-pounds (1.81 N•m).

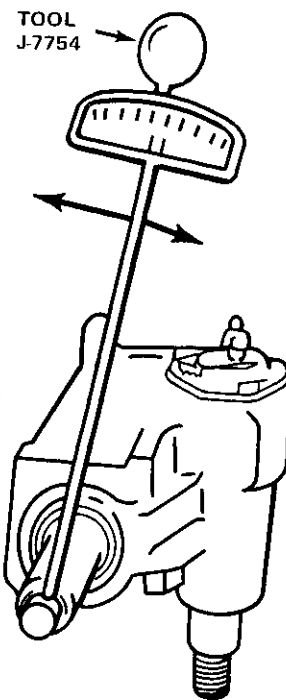
**CAUTION:** The total amount of over center drag torque (worm bearing preload setting plus additional 4-

10 inch-pounds) must not exceed combined total of 16 inch-pounds (1.81 N•m).

- (6) Hold adjuster screw in position using screwdriver and tighten adjuster screw locknut to 23 foot-pounds (31 N•m) torque. Do not allow screw to turn when tightening locknut.

**NOTE:** If the adjuster screw is allowed to turn when the locknut is tightened, the entire drag torque adjustment procedure will have to be performed once again.

- (7) Recheck overcenter drag torque and readjust if necessary.



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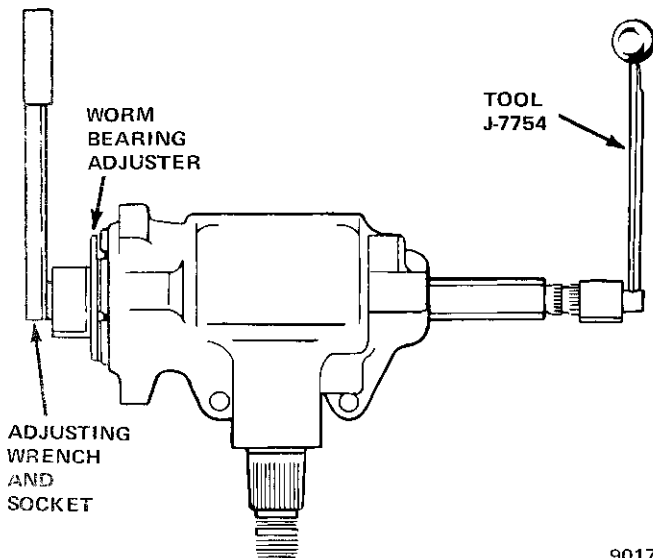
Fig. 2K-18 Adjusting Pitman Shaft Overcenter Drag Torque

### SPECIFICATIONS

#### Steering Gear Specifications— Left Hand Drive Vehicles

##### Left Hand Drive Vehicles:

Gear-Type .....	Recirculating Ball
Ratio .....	24:1
Bearings	
Upper .....	Ball
Lower .....	Ball
Adjustments:	
Worm Bearing Preload .....	8 in-lbs. (0.90 N•m)
Pitman Shaft Overcenter Drag Torque .....	4-10 in-lbs. (0.45-1.13 N•m) in addition to 8 in-lbs. (0.90 N•m) worm bearing preload for a total of 16 in-lbs. (1.8 N•m) maximum
Adjuster Screw End Play .....	.0002 in. (0.05 mm)



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Fig. 2K-17 Adjusting Worm Bearing Preload Torque

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## Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Intermediate Shaft Coupling Clamp Bolt . . . . .	45	40-50	61	54-68
Pitman Arm Nut . . . . .	185	160-210	251	217-285
Steering Gear Mounting Bracket-to-Gear Bolts (CJ) . . . . .	70	60-80	95	81-108
Steering Gear Mounting Bracket-to-Tie Plate Bolt (CJ) . . . . .	55	50-60	75	68-81
Steering Gear Mounting Bolts (Cke., Wag., Trk.,) . . . . .	70	60-80	95	81-108
Side Cover Bolts (Recirc. Ball Gear) . . . . .	30	25-35	41	34-47
Side Cover Bolts (Worm and Roller Gear) . . . . .	20	18-25	27	24-41
Adjuster Screw Locknut (Recirc. Ball Gear) . . . . .	23	18-27	31	24-37
Adjuster Screw Locknut (Worm and Roller Gear) . . . . .	18	16-20	24	22-27
Worm Bearing Adjuster Locknut (Recirc. Ball Gear) . . . . .	90	70-110	122	95-149
End Cover Bolts (Worm and Roller Gear) . . . . .	20	18-25	27	24-34

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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# STEERING GEAR – RIGHT HAND DRIVE VEHICLES

	Page		Page
Assembly and Adjustment	2K-12	Installation	2K-11
Cleaning and Inspection	2K-12	Removal	2K-11
Disassembly	2K-11	Specifications	2K-13

## REMOVAL

- (1) Remove gear-to-column flexible coupling allen-head clamping screw.
- (2) Disconnect steering connecting rod at steering arm.
- (3) Remove bolts attaching steering gear to frame.
- (4) Remove gear by sliding gear slightly forward and to right and lifting gear out of engine compartment.

## INSTALLATION

- (1) Position gear on frame and install gear mounting bolts.
- (2) Attach steering connecting rod to steering arm.
- (3) Align and engage steering gear wormshaft with steering column and install flexible coupling clamp bolt.

## DISASSEMBLY

- (1) Clean exterior of steering gear with solvent.
- (2) Remove fill plug from housing (fig. 2K-19) and drain lubricant from gear.
- (3) Paint assembly alignment reference marks on steering arm and roller gear and shaft assembly.
- (4) Remove nut and lockwasher from roller gear shaft (fig. 2K-19).

- (5) Remove steering arm from roller gear shaft using pitman arm puller.

**CAUTION:** Do not use a hammer or wedge to remove the steering arm from the roller gear shaft. This will damage the gear and shaft assembly.

- (6) Remove nicks or burrs from exposed portions of roller gear and shaft assembly and from worm gear and shaft assembly using fine-tooth file or emery cloth.
- (7) Remove side cover attaching bolts.
- (8) Remove side cover, cover gasket, and roller gear and shaft from housing as an assembly.
- (9) Remove locknut from roller shaft adjustment screw.
- (10) Turn roller shaft adjustment screw clockwise until screw is completely unthreaded from side cover and separate roller gear and shaft assembly from cover.
- (11) Remove end cover attaching bolts and remove end cover and shims from housing.
- (12) Remove worm gear and shaft assembly.
- (13) Remove upper and lower bearing cups and bearings from worm gear and shaft.
- (14) Remove worm gear shaft and roller gear shaft oil seals from housing. Discard both seals.

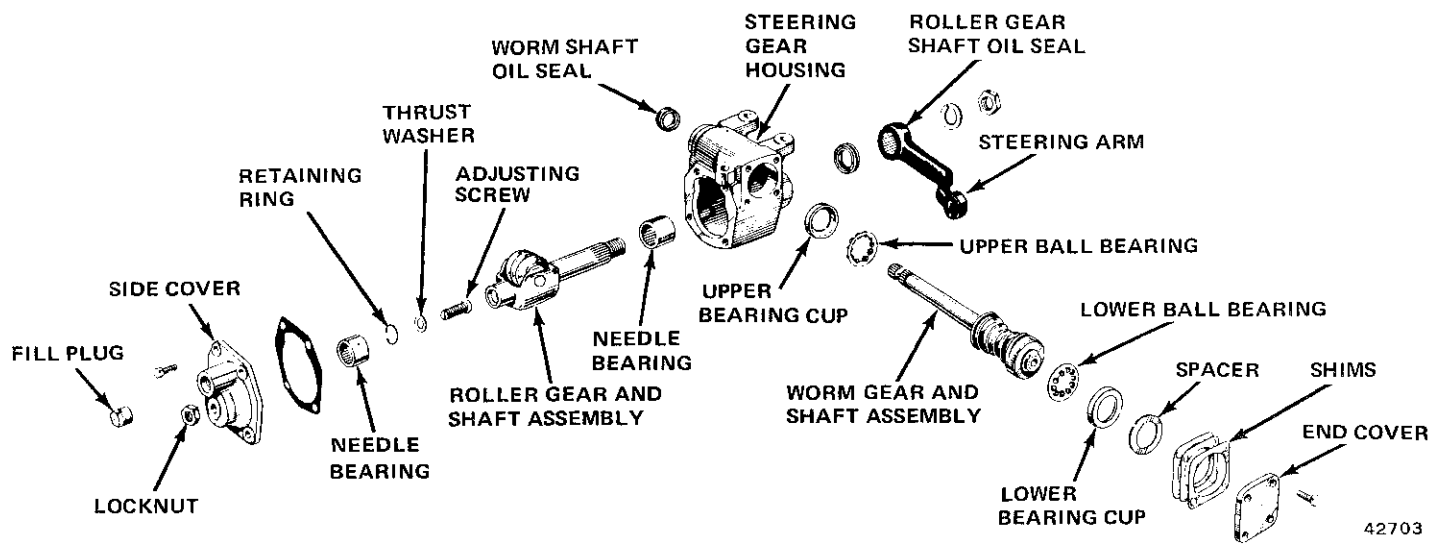


Fig. 2K-19 Steering Gear—Right-Hand Drive Vehicles

## CLEANING AND INSPECTION

Clean all parts with solvent and wipe them dry.

Inspect the steering gear housing for cracks, porosity, or other damage. Replace the housing if damaged.

Inspect the roller gear and shaft assembly for wear, scoring, or pitting. Remove slight burrs or scratches using fine emery cloth. Be sure the roller gear moves freely on its shaft and does not have excessive end play. Replace the gear and shaft assembly if worn or damaged.

Measure the roller gear shaft adjustment screw end play. End play must not exceed 0.015 inch (0.38 mm). If end play is excessive, replace the retaining ring, thrust washer, and adjustment screw.

Inspect the roller gear and shaft assembly needle bearings. Replace the bearings if worn or damaged. Insert the roller gear shaft through each bearing and check the shaft-to-bearing clearance. If clearance exceeds 0.010 inch (0.25 mm), replace the bearings. Remove and install the bearings using universal-type bearing driver tool set. Press the bearings into the side cover and gear housing until the face of each bearing is flush with the bearing boss of the cover or housing.

Inspect the worm gear and shaft assembly for wear, scoring, or pitting. Remove light corrosion or scratches using a fine abrasive cloth. Replace the assembly if it is excessively worn or damaged.

Inspect the upper and lower worm shaft bearings and bearing cups for wear and damage. Replace the bearings and cups as assemblies if worn or damaged.

**NOTE:** The bearing balls must be replaced as a full set in each bearing.

## ASSEMBLY AND ADJUSTMENT

(1) Position replacement worm and roller shaft oil seals on seal bores in gear housing. Longest lip of each seal must face into housing.

(2) Press each seal into housing seal bore using suitable diameter tool that will contact seal bore of housing around entire perimeter of bore.

(3) Lubricate worm gear and shaft assembly and upper bearing and bearing cup with Gear Lubricant MIL-L2105B, Grade SAE 80 or equivalent.

(4) Install upper bearing and bearing cup on worm gear shaft.

(5) Install worm gear and shaft assembly in gear housing. Do not damage oil seal when installing shaft.

(6) Lubricate lower end of worm gear and shaft assembly and lower bearing and bearing cup with Gear Lubricant MIL-L-2105B, Grade SAE 80 or equivalent.

(7) Install lower bearing, bearing cup, and spacer on lower end of worm gear shaft.

(8) Install shims and end cover on steering gear housing and install cover attaching bolts. Do not tighten bolts completely at this time.

(9) Position side cover on roller gear shaft adjustment screw.

(10) Thread screw counterclockwise into cover until end of roller gear shaft just touches inner face of cover.

(11) Install locknut on adjustment screw finger-tight only.

(12) Install gasket on side cover.

(13) Lubricate roller gear and shaft assembly with Gear Lubricant MIL-L-2105B, Grade SAE 80 or equivalent.

(14) Install roller gear and shaft assembly in housing. Do not damage roller gear shaft oil seal when installing assembly.

(15) Mesh roller gear and worm gear.

(16) Install side cover attaching bolts. Tighten bolts to 20 foot-pounds (27 N•m) torque.

(17) Clamp exposed portion of roller gear and shaft assembly in vise equipped with protective jaws.

(18) Align assembly reference marks on roller gear shaft and steering arm and install steering arm on splined end of shaft.

- (19) Install lockwasher and nut on roller gear shaft and tighten nut to pull arm onto splined end of shaft.
- (20) Fill steering gear housing with Gear Lubricant MIL-L-2105B, Grade SAE 80 or equivalent.
- (21) Adjust gear as outlined under Adjustment.

**Adjustment**

**Worm Bearing Preload**

This adjustment controls the preload applied to the upper and lower worm bearings. Adjustment is accomplished by adding or subtracting shims from between the steering gear housing and end cover (fig. 2K-11).

- (1) Loosen end cover attaching bolts if necessary.
- (2) Tighten bolts alternately, and only a few turns at a time, while rotating worm gear shaft.
- (3) Tighten bolts to 20 foot-pounds (27 N•m) torque.
- (4) Install socket and inch-pound torque wrench on splined end of worm gear shaft.
- (5) Turn worm gear shaft using torque wrench and record torque required to rotate shaft. Rotating torque must be 2 to 5 inch-pounds (0.23 to 0.56 N•m).
- (6) If adjustment is necessary, remove end cover and add or subtract shims to obtain correct preload torque.

**NOTE:** Adding shims will decrease preload torque. Subtracting shims will increase preload torque.

- (7) Recheck preload and adjust if necessary.

**Worm and Roller Gear Clearance**

This adjustment controls the clearance between the worm and roller gears. Adjustment is accomplished by turning the roller gear shaft adjusting screw inward or outward to control worm-to-roller clearance.

- (1) Loosen adjuster screw locknut and turn adjuster screw counterclockwise until worm gear shaft turns freely when rotated to full right and left-turn positions.

- (2) Count total number of turns required to rotate worm gear shaft through entire range of travel.
- (3) Center gear by turning shaft back one-half total number of turns.
- (4) Rotate worm gear shaft back and forth through center of travel and tighten adjustment screw until slight bind occurs at center of shaft travel.
- (5) Loosen or tighten adjusting screw until rolling torque of 7 to 12 inch-pounds (0.79 to 1.36 N•m) is obtained.
- (6) Hold adjustment screw in position and tighten adjustment screw locknut to 18 foot-pounds torque (24 N•m).
- (7) Recheck torque required to rotate worm gear shaft through center of travel and adjust if necessary.

**SPECIFICATIONS**

**Steering Gear Specifications—  
Right Hand Drive Vehicles**

**Right Hand Drive Vehicles:**

Gear-Type	Worm and Roller
Ratio	24:1
Bearings	
Upper	Ball
Lower	Ball
Lever Shaft	Roller and Bushing
<b>Adjustments:</b>	
Worm Bearing Preload	2-5 in-lbs. (0.23-0.56 N•m)
Worm and Roller Gear Clearance	7-12 in-lbs. (0.79-1.36 N•m)
Worm Gear Shaft	
Shaft Bearing Clearance (Maximum)	0.010 in. (0.25 mm)

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**Torque Specifications**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N•m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Intermediate Shaft Coupling Clamp Bolt	45	40-50	61	54-68
Pitman Arm Nut	185	160-210	251	217-285
Steering Gear Mounting Bracket-to-Gear Bolts (CJ)	70	60-80	95	81-108
Steering Gear Mounting Bracket-to-Tie Plate Bolt (CJ)	55	50-60	75	68-81
Steering Gear Mounting Bolts (Cke., Wag., Trk.)	70	60-80	95	81-108
Side Cover Bolts (Recirc. Ball Gear)	30	25-35	41	34-47
Side Cover Bolts (Worm and Roller Gear)	20	18-25	27	24-41
Adjuster Screw Locknut (Recirc. Ball Gear)	23	18-27	31	24-37
Adjuster Screw Locknut (Worm and Roller Gear)	18	16-20	24	22-27
Worm Bearing Adjuster Locknut (Recirc. Ball Gear)	90	70-110	122	95-149
End Cover Bolts (Worm and Roller Gear)	20	18-25	27	24-34

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

## 2K-14 MANUAL STEERING GEAR

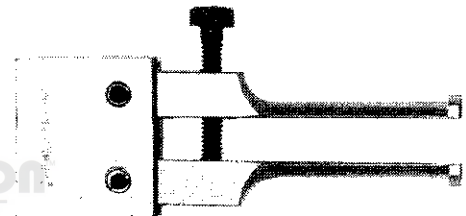
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### Tools



BEARING CUP  
INSTALLER  
J-5755

AUTHENTIC  
RESTORATION  
PRODUCT



BEARING CUP  
PULLER  
J-5822



TORQUE WRENCH  
J-7754



SLIDE HAMMER  
J-2619-01



J-8632  
PITMAN ARM  
PULLER

# POWER STEERING GEAR AND PUMP



## SECTION INDEX

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## GENERAL INFORMATION

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General	2L-1	Service Diagnosis	2L-6
Hydraulic Pressure Test	2L-16	Specifications	2L-18
Leak Diagnosis	2L-10		

### GENERAL

The power steering system consists of a power steering gear, hydraulic pump, and interconnecting hoses. The system fluid supply is contained in a reservoir mounted on the pump. Fluid from the pump is supplied to the gear through the interconnecting pressure and return hoses. The pump is operated by a drive belt mounted on pulleys attached to the pump shaft and engine crankshaft.

Two different ratio steering gear units are used. CJ models use a constant ratio gear with a 17.5:1 steering ratio. Cherokee, Wagoneer and Truck models use a variable ratio gear with a 16:1 ratio on center and 13:1 ratio at full lock.

Although the steering ratios of the two units differ, exterior appearance and service procedures for both units are the same. However, the internal components of the two gears are not interchangeable.

A vane-type power steering pump with a combination flow control/relief valve is used on all models. Two valve calibrations are used. On CJ models, the valve is calibrated to open at 1100 psi (7 584 kPa). On Cherokee, Wagoneer, and Truck models, the valve is calibrated to open at 1500 psi (10 342 kPa).

The power steering gear is designed to operate manually if a system malfunction should ever occur. This feature provides the driver with continued steering control of the vehicle. In this condition, the gear operates like a manual steering gear; hydraulic fluid is bypassed through the gear valve body to allow manual operation.

**NOTE:** The power steering gear and pump form a closed system. Contaminants or foreign material must not be allowed to enter the system at any point. If either the gear or pump become contaminated, or incur damage extensive enough to produce debris, both components must be disassembled, cleaned, and serviced.

### DESCRIPTION AND OPERATION

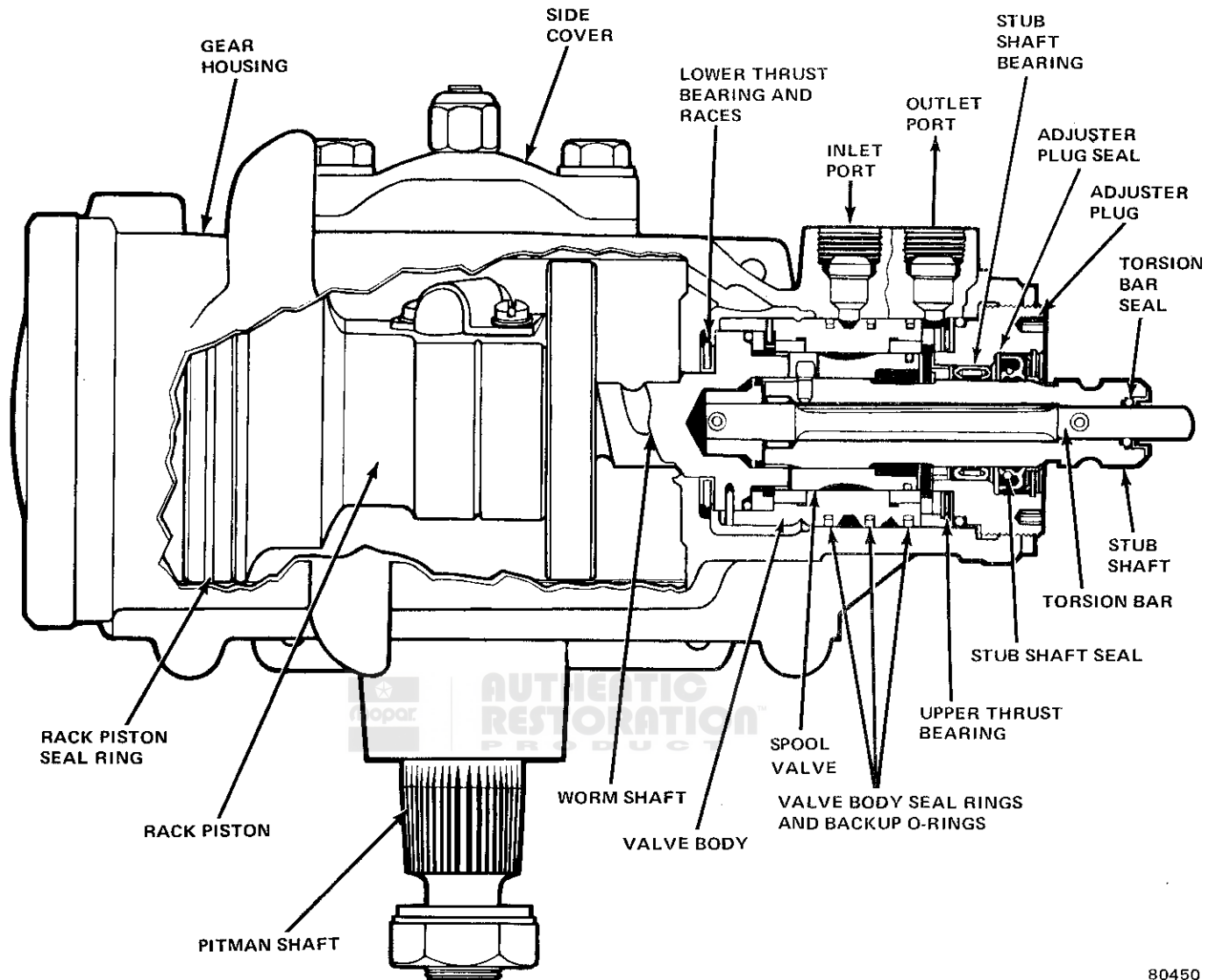
#### Steering Gear

The power steering gear is a recirculating ball-type unit (fig. 2L-1). Steel ball bearings act as a rolling thread between the steering gear wormshaft and rack piston.

Two different ratio gears are used. CJ models use a constant ratio gear with 17.5:1 steering ratio. Cherokee, Wagoneer and Truck models use a variable ratio gear with 16:1 steering ratio on center and 13:1 at full lock. Although the two gears have different steering ratios, exterior appearance, diagnosis, and service procedures are the same for both.

Steering gear wormshaft fore and aft thrust is controlled by a bearing and two races at the lower end, and a bearing assembly in the adjuster plug at the upper end. The lower bearing races are conical in shape. This design maintains constant preload on the wormshaft to prevent loss of thrust bearing preload. The adjuster plug provides initial worm bearing preload and service adjustment.

## 2L-2 POWER STEERING GEAR AND PUMP



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Fig. 2L-1 Power Steering Gear

In a right-turn position, the rack piston moves upward within the gear. In a left-turn position, the rack piston moves downward within the gear. The rack piston teeth mesh with the pitman shaft sector teeth. The sector is forged as an integral part of the pitman shaft. Turning the wormshaft also turns the pitman shaft which, through mechanical linkage, turns the wheels.

### Power Steering Pump

A vane-type, constant displacement hydraulic pump is used to develop system fluid pressure (fig. 2L-2). The pump has an integral reservoir that contains the system fluid supply.

The reservoir cap is vented to maintain atmospheric pressure within the reservoir and allow air trapped in the system to escape. A dipstick mounted in the reservoir cap is used to check system fluid level.

System operating pressures are maintained by a combination flow control/relief valve located in the pump (fig. 2L-2). The relief section of the valve prevents excessive system pressure buildup.

### Hydraulic Assist

An open center, three position, rotary-type valve body is used to control fluid flow within the gear (fig. 2L-1). Pump supplied fluid enters the valve body through a pressure port in the gear housing. The valve then directs fluid to the rack piston through passages in the housing.

The valve body, spool valve, torsion bar, and stub shaft (which is pinned to the torsion bar) are connected to the front wheels through mechanical linkage.

Because of the pressure exerted on the front wheels by vehicle weight, the wheels and valve body tend to resist

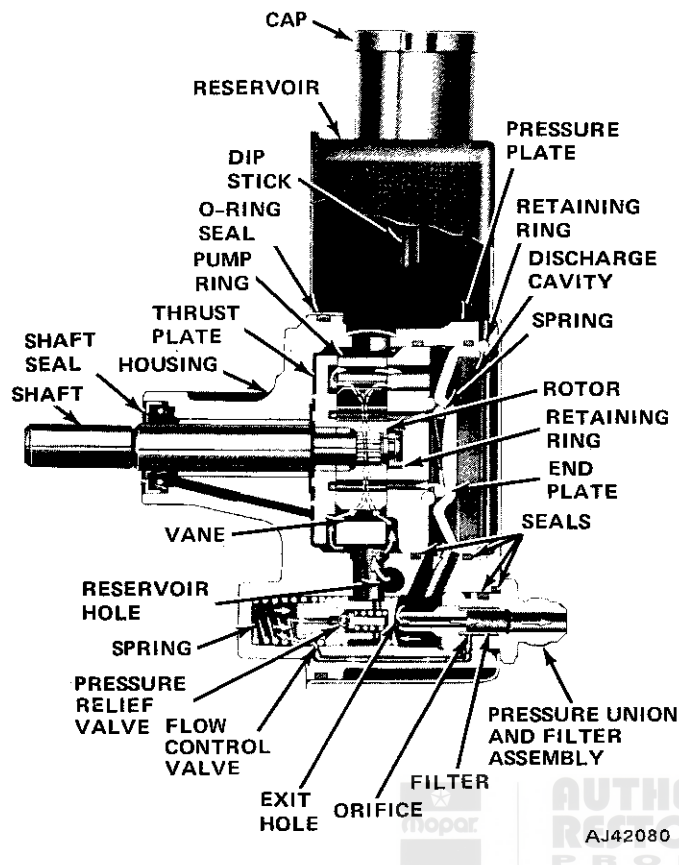


Fig. 2L-2 Power Steering Pump

any turning effort applied at the steering wheel. As front wheel resistance to turning effort increases, the torsion bar (which is pinned to the stub shaft) deflects. Since the spool valve is connected to the stub shaft by a locating pin, torsion bar deflection causes the spool valve to rotate within the valve body. As the spool valve rotates, fluid directional passages in the valve are brought into alignment with matching passages in the valve body. When these passages are aligned, high pressure fluid from the pump is directed through the passages and against either side of the rack piston to provide hydraulic assist.

Torsion bar deflection provides the required amount of steering gear "road feel." If the bar should ever break, road feel would be lost but the steering system would still function due to auxiliary locking tabs on the stub shaft. In this situation, the gear would operate as a manual-type recirculating ball steering gear.

#### Neutral (Straight-Ahead) Position

In this position, fluid does not enter the rack piston chamber. Fluid from the pump flows through the open-center valve body and back to the pump reservoir.

The valve body remains in the open center position at all times, except when turning, to reduce fluid and pump friction losses. In addition, the gear is always filled with fluid to lubricate internal components and absorb road shock.

#### Right Turn Position

The valve body is held in position by the resistance to movement of the front wheels. When the steering wheel is turned to the right, torsion bar deflection causes the spool valve to rotate within the valve body.

As the spool valve rotates, the spool valve fluid return grooves are closed off while the right turn grooves are aligned with high pressure fluid grooves in the valve body (fig. 2L-3). The spool valve left turn grooves are closed off from pump pressure and are aligned with the valve body fluid return grooves. In this position, the valve body directs high pressure fluid into the lower end of the rack piston chamber to force the rack piston upward and apply additional turning effort to the pitman shaft (fig. 2L-3).

As the valve body directs fluid against the lower end of the rack piston, fluid in the upper end of the gear simultaneously flows back to the reservoir through valve body return grooves. When front wheel resistance to turning effort increases, torsion bar deflection causes additional spool valve rotation. This exposes more of the spool valve right turn grooves to the valve body pressure grooves increasing fluid pressure exerted on the rack piston.

When the driver stops applying turning effort at the steering wheel, the torsion bar unwinds returning the spool valve to the neutral (straight ahead) position. At this point, fluid pressure on each end of the rack piston is equalized once again and steering geometry causes the front wheels to resume a straight ahead position.

#### Left Turn Position

In the left turn position, the torsion bar, spool valve, and valve body operate the same as in a right turn except that valve rotation is now reversed (fig. 2L-4). This causes the valve body to channel high pressure fluid into the upper end of the rack piston chamber forcing the rack piston downward (fig. 2L-4). Fluid in the lower end of the gear flows back to the pump reservoir through the valve body and steering gear return port.

When the driver stops applying turning effort at the steering wheel, the torsion bar unwinds returning the spool valve to the neutral (straight ahead) position. As in the right turn position, fluid pressure on each end of the rack piston is equalized again and steering geometry causes the front wheels to resume a straight ahead position.



2L-4 POWER STEERING GEAR AND PUMP

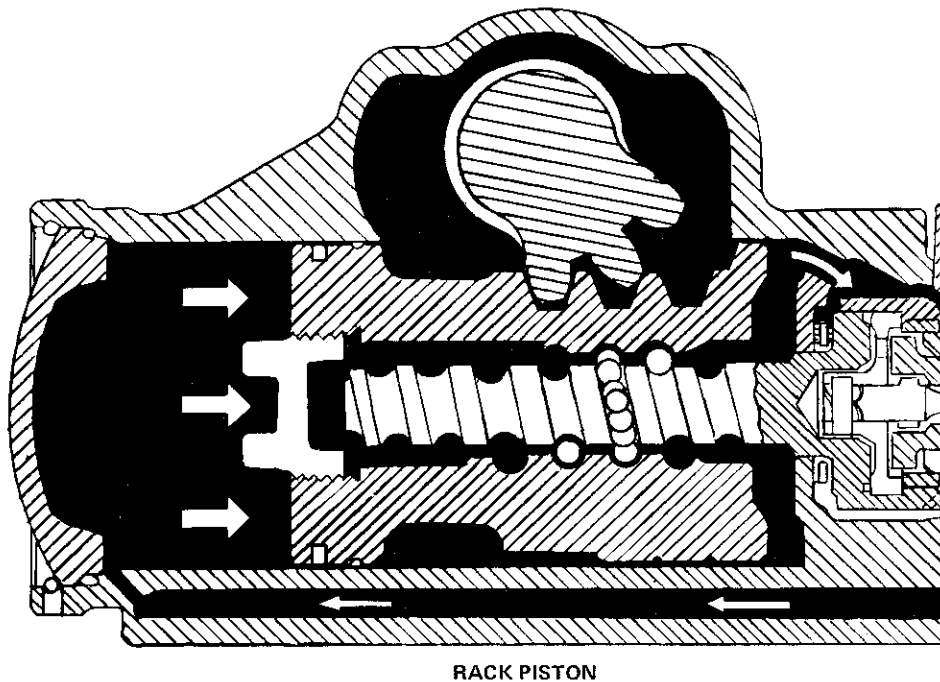
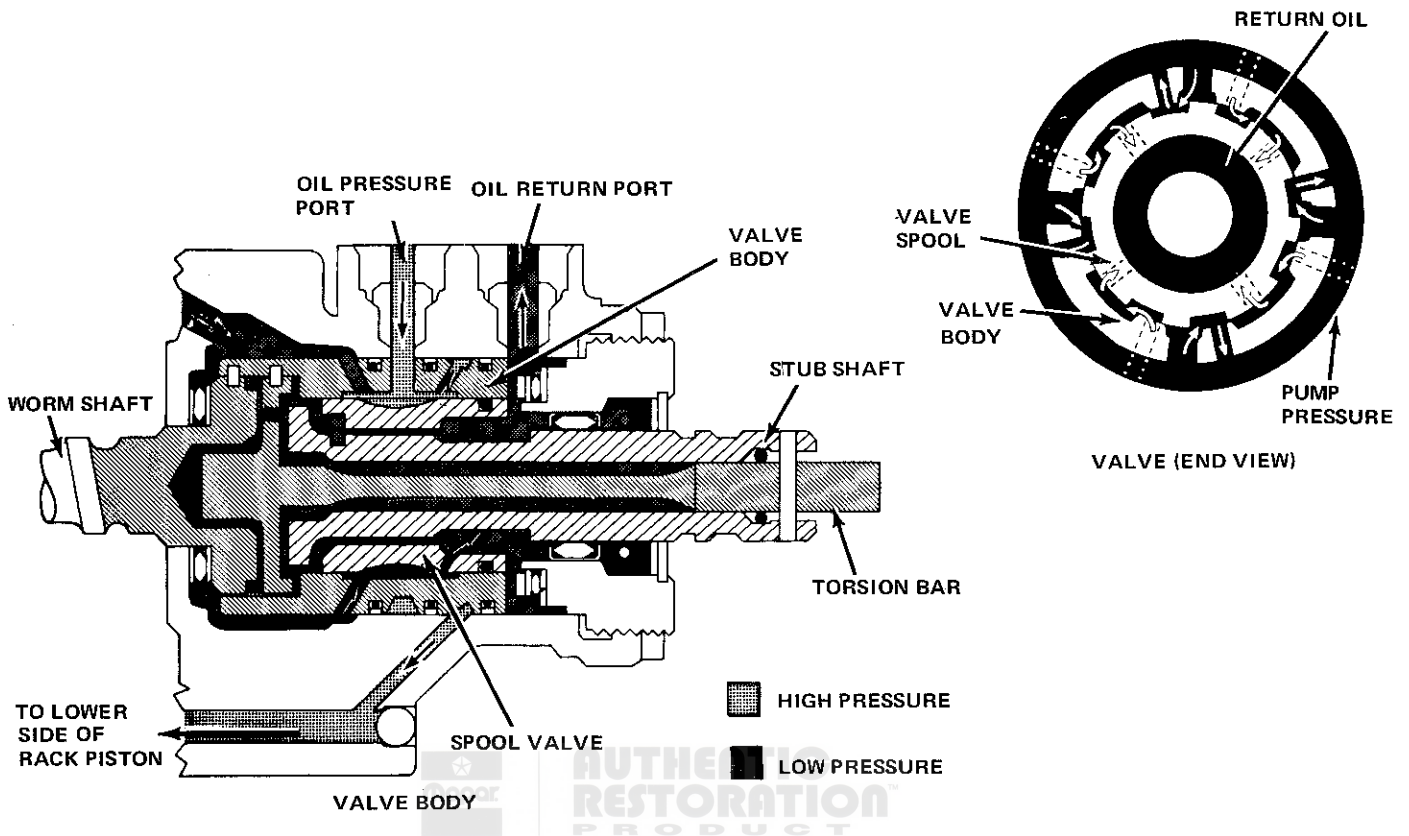


Fig. 2L-3 Fluid Flow—Right Turn Position

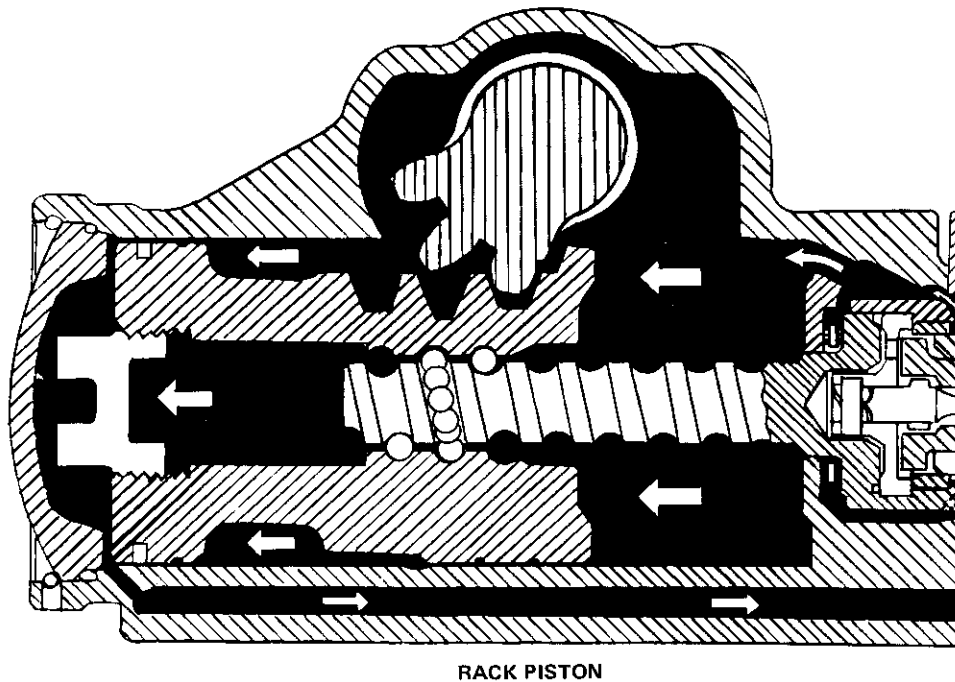
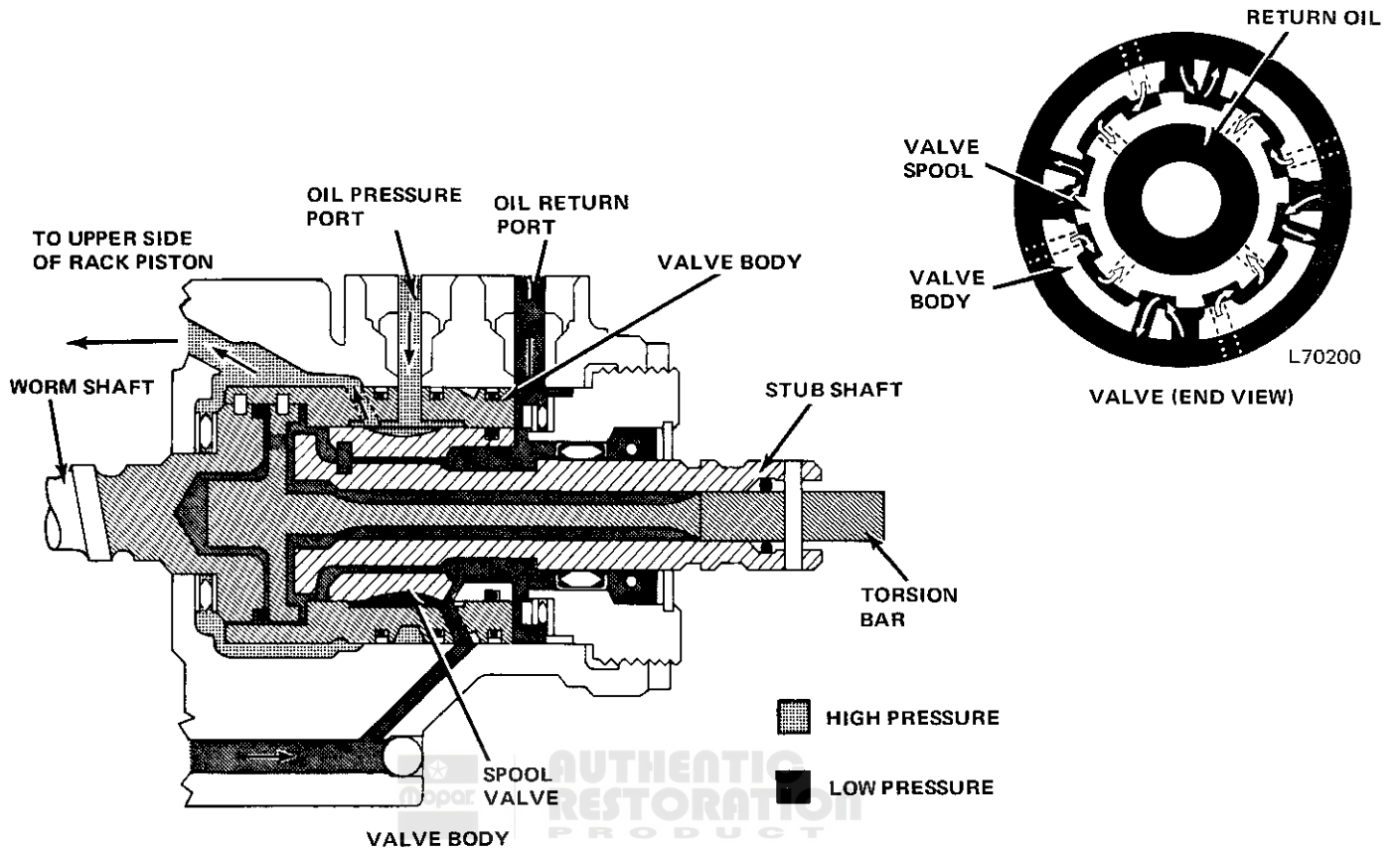


Fig. 2L-4 Fluid Flow—Left Turn Position

## 2L-6 POWER STEERING GEAR AND PUMP

### Variable Ratio Power Steering

A variable ratio power steering gear is used on Cherokee, Wagoneer and Truck models. CJ models are equipped with a constant ratio steering gear.

The ratio of a steering gear is the relationship of steering wheel movement to that of the front wheels. It is described in terms of the number of degrees of steering wheel rotation required to turn the front wheels one degree.

Variable ratio steering is accomplished by using a pitman shaft sector that has one long center tooth flanked by two short sector teeth. This is opposed to a constant ratio gear where all sector teeth are of equal length (fig. 2L-5). Because the variable ratio gear has unequal length sector teeth, companion changes are also made in the rack piston teeth (fig. 2L-5).

Since the sector is basically a series of levers, any movement of the rack piston causes the sector to swing the pitman arm in the same ratio. In other words, it turns the pitman arm the same number of degrees with each sector tooth.

To increase or decrease steering ratio, it is only necessary to change the length of the sector teeth. A low numerical ratio (smaller radius sector with shorter teeth) produces greater pitman arm movement than would a high ratio sector with longer teeth and greater leverage.

On this basis, the variable ratio sector is in reality one long, high ratio lever at the center, flanked by two lower ratio levers for left and right turns.

In the straight ahead position, only the tip of the long center tooth is in contact with the rack piston. As a result, initial movement of the rack piston in either direction produces a relatively small response of the sector and pitman arm. This is due to the high ratio produced by a long lever relationship.

Because of this relationship, the steering ratio remains a nearly constant 16:1 for the first 40 degrees of steering wheel movement in either direction from center.

Turning the steering wheel further reduces the length of the lever. This moves the point of contact down the side of the center tooth decreasing the radius and providing a steering ratio of 13:1 at full lock.

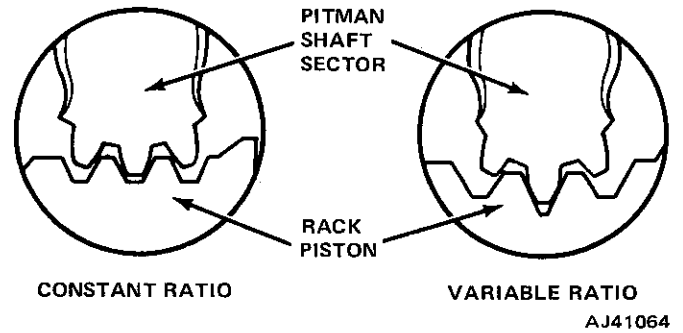


Fig. 2L-5 Rack and Sector Comparison

### SERVICE DIAGNOSIS

When diagnosing suspected power steering system malfunctions, refer to the Service Diagnosis Charts in this section for probable causes and indicated repair procedures.

To avoid ineffective or unnecessary repair, do not attempt to correct a malfunction until an accurate diagnosis has been made. Utilize the diagnosis charts, hydraulic pressure test and leak diagnosis procedures before servicing the gear or pump.

#### Service Diagnosis—Steering Gear and Pump

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 does not affect steering.
RATTLE OR CHUCKLE NOISE IN STEERING GEAR	(1) Gear loose on frame.	(1) Tighten gear-to-frame mounting bolts.

Service Diagnosis—Steering Gear and Pump (Continued)

Condition	Possible Cause	Correction
<p>RATTLE OR CHUCKLE NOISE IN STEERING GEAR (CONTINUED)</p>	<p>(2) Steering linkage looseness.</p> <p>(3) Pressure hose touching other parts of vehicle.</p> <p>(4) Insufficient pitman shaft over center drag torque.</p> <p><b>NOTE:</b> 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.</p> <p>(5) Loose pitman arm.</p>	<p>(2) Check linkage pivot points for wear. Replace if necessary.</p> <p>(3) Adjust hose position. Do not bend tubing by hand.</p> <p>(4) Adjust to specifications.</p> <p>(5) Tighten pitman arm nut to specifications, or replace nut.</p>
<p>SQUAWK NOISE IN STEERING GEAR WHEN TURNING OR RECOVERING FROM A TURN</p>	<p>(1) Damper O-ring on spool valve cut.</p>	<p>(1) Replace damper O-ring.</p>
<p>CHIRP NOISE IN STEERING PUMP</p>	<p>(1) Loose or damaged belt.</p>	<p>(1) Adjust belt tension or replace belt.</p>
<p>BELT SQUEAL (PARTICULARLY NOTICEABLE AT FULL WHEEL TRAVEL AND STAND STILL PARKING)</p>	<p>(1) Loose or damaged belt.</p>	<p>(1) Adjust belt tension or replace belt.</p>
<p>GROWL NOISE IN STEERING PUMP</p>	<p>(1) Excessive back pressure in hoses or steering gear caused by restriction.</p>	<p>(1) Locate restriction and correct. Replace part if necessary.</p>
<p>GROWL NOISE IN STEERING PUMP (PARTICULARLY NOTICEABLE AT STAND STILL PARKING)</p>	<p>(1) Scored pressure plates, thrust plate or rotor.</p> <p>(2) Extreme wear of cam ring.</p>	<p>(1) Replace parts and flush system.</p> <p>(2) Replace parts.</p>
<p>GROAN NOISE IN STEERING PUMP</p>	<p>(1) Low oil level.</p> <p>(2) Air in the oil or loose pressure hose connection.</p>	<p>(1) Fill reservoir to proper level.</p> <p>(2) Tighten connector to specified torque. Bleed system by operating steering from right to left-full turn.</p>
<p>RATTLE NOISE IN STEERING PUMP</p>	<p>(1) Vanes not installed properly.</p> <p>(2) Vanes sticking in rotor slots.</p>	<p>(1) Install properly.</p> <p>(2) Free up by removing burrs, varnish, or dirt.</p>

## 2L-8 POWER STEERING GEAR AND PUMP

### Service Diagnosis—Steering Gear and Pump (Continued)

Condition	Possible Cause	Correction
WHINE NOISE IN STEERING PUMP	(1) Pump shaft bearing scored.	(1) Replace housing and shaft. Flush system.
POOR RETURN OF STEERING WHEEL TO CENTER	(1) Tires not properly inflated. (2) Lack of lubrication in linkage and ball studs. (3) Lower coupling flange rubbing against steering gear adjuster plug. (4) Improper front wheel alignment	(1) Inflate to specified pressure. (2) Lube linkage and ball studs. (3) Loosen pinch bolt and assemble properly. (4) Check and adjust as necessary.  With front wheels still on alignment pads of front-end machine, disconnect pitman arm from pitman shaft. Turn front wheels by hand. If wheels will not turn or turn with considerable effort, determine if linkage or ball studs are binding.
	(5) Steering linkage binding.	(5) Replace rod ends.
	(6) Ball studs binding.	(6) Replace ball studs.
	(7) Tight or frozen steering shaft bearings.	(7) Replace bearings.
	(8) Sticky or plugged spool valve.	(8) Remove and clean or replace valve.
	(9) Steering gear adjustments over specifications.	(9) Check adjustment with gear out of vehicle. Adjust as required.
	(10) Steering gear poppet valve installed incorrectly.	(10) Inspect and install valve correctly.
CAR LEADS TO ONE SIDE OR THE OTHER (KEEP IN MIND ROAD CONDITION AND WIND. TEST CAR IN BOTH DIRECTIONS ON FLAT ROAD)	(1) Incorrect tire pressure. (2) Front end misaligned. (3) Unbalanced steering gear valve.	(1) Check and adjust. (2) Adjust to specifications. (3) Replace valve.
MOMENTARY INCREASE IN EFFORT WHEN TURNING WHEEL FAST TO RIGHT OR LEFT	(1) Low oil level in pump. (2) Pump belt slipping. (3) High internal leakage.	(1) Add power steering fluid as required. (2) Tighten or replace belt. (3) Check pump pressure. (See pressure test)

Service Diagnosis—Steering Gear and Pump (Continued)

Condition	Possible Cause	Correction
<p>STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING ESPECIALLY DURING PARKING</p>	<p>(1) Low oil level.                      (2) Loose pump belt.                      (3) Insufficient pump pressure.                      (4) Flow control valve sticking.</p>	<p>(1) Fill as required.                      (2) Adjust tension to specification.                      (3) Check pump pressure. (See pressure test). Replace relief valve if defective.                      (4) Inspect for varnish or damage, replace if necessary.</p>
<p>LOOSE STEERING</p>	<p>(1) Steering gear loose on frame.                      (2) Steering gear flexible coupling loose on shaft or rubber disc mounting screws loose.                      (3) Steering linkage rod ends worn.                      (4) Worn poppet valve (Gear).                      (5) Insufficient wormshaft bearing preload.                      (6) Insufficient overcenter drag torque.</p>	<p>(1) Tighten attaching bolts to specified torque.                      (2) Tighten flange pinch bolts. If serrations are not damaged, tighten upper flange to coupling nuts to specified torque.                      (3) Replace rod ends.                      (4) Replace poppet valve.                      (5) Adjust to specification with gear out of vehicle.                      (6) Adjust to specification with gear out of vehicle.</p>
<p>HARD STEERING OR LACK OF ASSIST</p>	<p>(1) Loose pump belt.                      (2) Low oil level in pump reservoir.  <b>NOTE:</b> Low oil level will also result in excessive pump noise.                      (3) Tires not properly inflated.                      (4) Sticky flow control valve.                      (5) Pump pressure low.                      (6) Pump internal leakage.                      (7) Gear internal leakage.</p>	<p>(1) Adjust belt tension to specification.                      (2) Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage. Tighten loose connectors.                      (3) Inflate to recommended pressure.                      In order to diagnose conditions such as listed in (4), (5), (6), (7) a test of the entire power steering system using gauge tool J-21567 is required.</p>

**NOTE:** If checks (1) through (3) do not reveal cause of hard steering, refer to pressure test.

**Service Diagnosis—Steering Gear and Pump (Continued)**

Condition	Possible Cause	Correction
<p><b>FOAMING AERATED POWER STEERING FLUID, LOW FLUID LEVEL AND POSSIBLE LOW PRESSURE</b></p>	<p>(1) Air in fluid, and loss of fluid due to pump internal leakage causing overflow.</p>	<p>(1) Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeration 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.</p>
<p><b>LOW PRESSURE DUE TO STEERING PUMP</b></p>	<p>(1) Flow control valve stuck or inoperative.</p> <p>(2) Pressure plate not flat against cam ring.</p> <p>(3) Extreme wear of cam ring.</p> <p>(4) Scored pressure plate, thrust plate, or rotor.</p> <p>(5) Vanes not installed properly.</p> <p>(6) Vanes sticking in rotor slots.</p> <p>(7) Cracked or broken thrust or pressure plate.</p>	<p>(1) Remove burrs or dirt or replace. Flush system.</p> <p>(2) Correct.</p> <p>(3) Replace parts. Flush system.</p> <p>(4) Replace parts. Flush system.</p> <p>(5) Install properly.</p> <p>(6) Freeup by removing burrs, varnish, or dirt.</p> <p>(7) Replace part.</p>
<p><b>LOW PRESSURE DUE TO STEERING GEAR</b></p>	<p>(1) Pressure loss in cylinder due to worn piston ring or badly worn housing bore.</p> <p>(2) Leakage at valve rings, valve body-to-worm seal.</p>	<p>(1) Remove gear for disassembly and inspection of ring and housing bore.</p> <p>(2) Remove gear for disassembly and replace seals.</p>

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**LEAK DIAGNOSIS**

The actual source of power steering system fluid leaks should always be determined before attempting repair. Because innaccurate diagnosis can lead to ineffective repair, proper inspection procedures are necessary. The most common fluid leak sources are shown in figures 2L-6, 2L-7, and 2L-8.

**Inspection Procedure**

- (1) Raise front of vehicle.
- (2) Clean exterior surfaces of steering gear, pump, hoses, and fittings thoroughly.

(3) Check pump fluid level. Add or remove fluid as necessary.

(4) Check for aerated fluid (orange in color and full of bubbles) which can cause overflow from reservoir and be mistaken for leak.

(5) Check and tighten all hose connections at gear and pump. Do not exceed 30 foot-pounds (41 N•m) torque at any fitting.

(6) Start engine. Have helper turn steering wheel left and right several times while locating source of leak. Contact steering stops momentarily in each direction when turning wheel.

(7) Stop engine when leak source is identified.

**Leak Diagnosis and Correction—Steering Gear**

**NOTE:** Refer to figures 2L-6 and 2L-7 for an illustration of steering gear leak sources.

- (1) If leak occurs from hose or hose fittings, replace hose. If leak continues to occur at gear housing pressure or return port and hose has been replaced, replace hose connector seats in gear housing.
- (2) If leak occurs between adjuster plug and housing, replace adjuster plug O-ring.
- (3) If leak occurs between stub shaft and stub shaft seal in adjuster plug, replace seal.
- (4) If leak occurs from steering gear housing ball plug, reset plug in housing and stake housing around ball. If leak persists after staking ball, replace housing.
- (5) If leak occurs between torsion bar and torsion bar seal, replace entire valve body assembly.
- (6) If leak occurs at side cover gasket or locknut, replace gasket or locknut as necessary.
- (7) If leak occurs between pitman shaft and shaft seal, replace seal and check shaft for nicks, scores, burrs, or pitting. Remove minor surface imperfections using crocus cloth. Replace shaft if severely damaged.

(8) If leak occurs between end plug and housing, replace end plug O-ring seal.

(9) If leak is from crack or porous spot in gear housing, replace housing.

**Leak Diagnosis and Correction—Pump**

**NOTE:** Refer to figure 2L-8 for an illustration of the various pump leak sources.

- (1) If leak occurred between pump union fitting and hose fitting, replace union and hose.
- (2) If leak occurred between pump union fitting and pump body, replace pump union fitting O-rings.
- (3) If leak occurred between reservoir and pump body, replace reservoir O-ring seal.
- (4) If leak occurred between pump shaft and pump shaft seal, replace seal and check pump shaft for nicks, scores, burrs, or pitting.
- (5) If leak is result of overfill condition, drain fluid from reservoir to correct level.
- (6) If fluid is aerated, check for overfill condition, or air entering fluid through loose hose connection or reservoir O-ring seal, or perform hydraulic pressure test to check for sticking flow control valve.
- (7) If leak occurs from cracked or porous pump body or reservoir, replace pump as assembly.

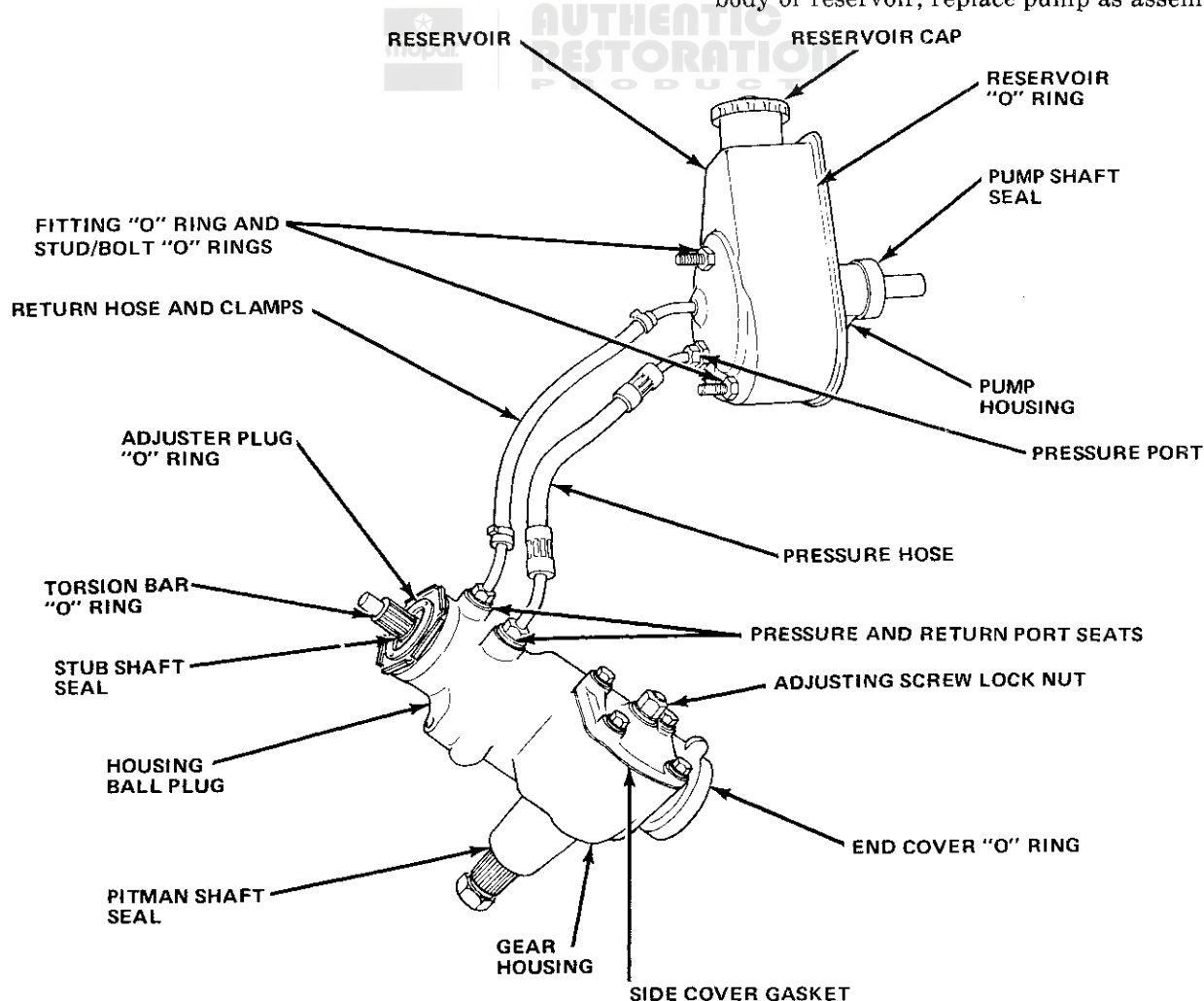
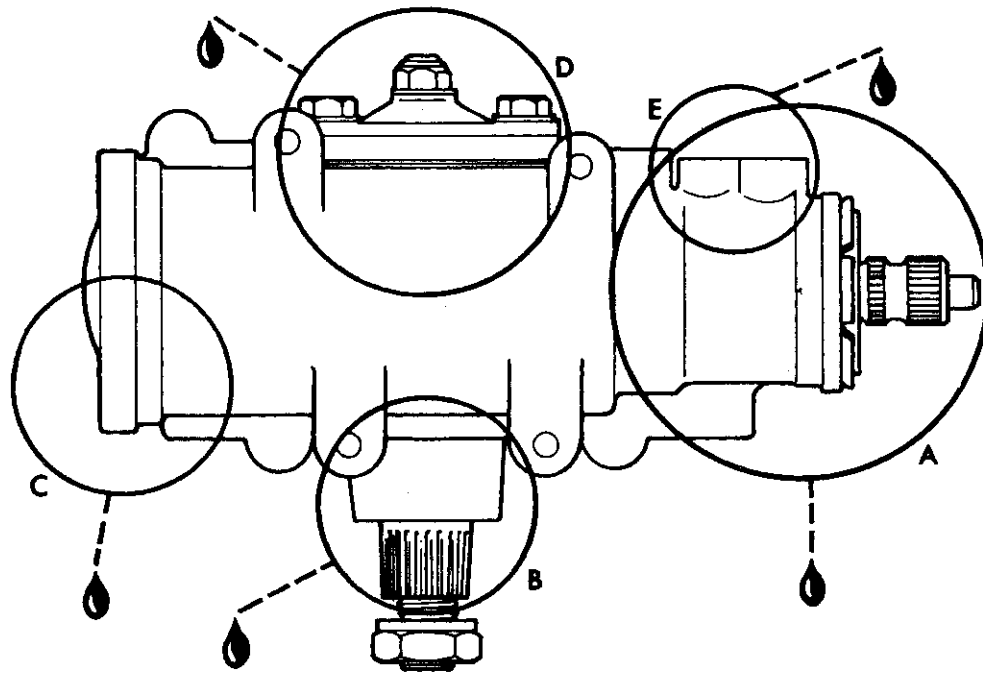


Fig. 2L-6 Power Steering System Leak Points



## 2L-12 POWER STEERING GEAR AND PUMP

### Gear Leak Points and Corrective Action



### Leak Points

Pay particular attention to the exact source of leakage. Due to the proximity of the various seals, an incorrect diagnosis will result in ineffective repair.

### Corrective Action

Replace adjuster plug O-ring seal.

Replace Dust and stub shaft seals.

If seepage is observed between the torsion bar and stub shaft, do not attempt repair. The rotary valve assembly must be replaced.

Seat housing ball with punch and restake. If seepage persists, replace housing.

Replace both pitman shaft seals.

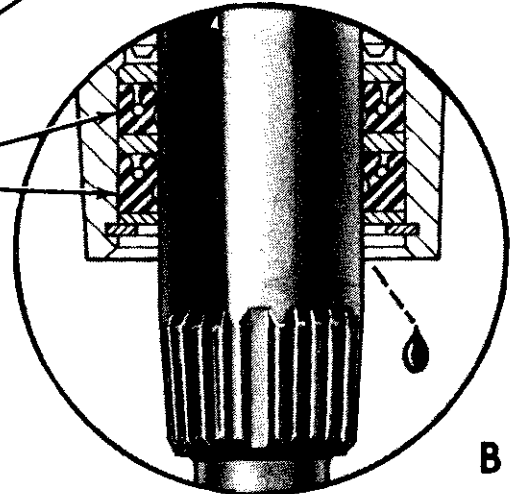
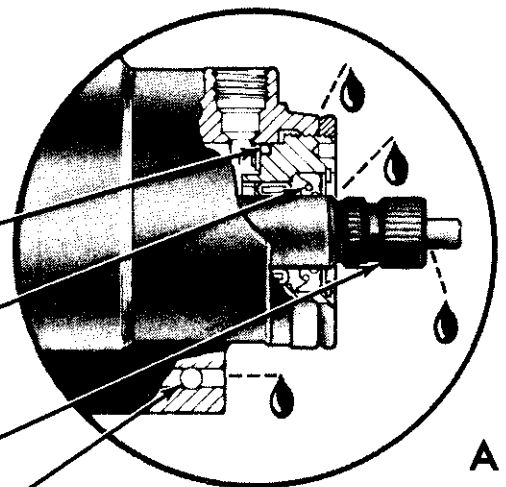
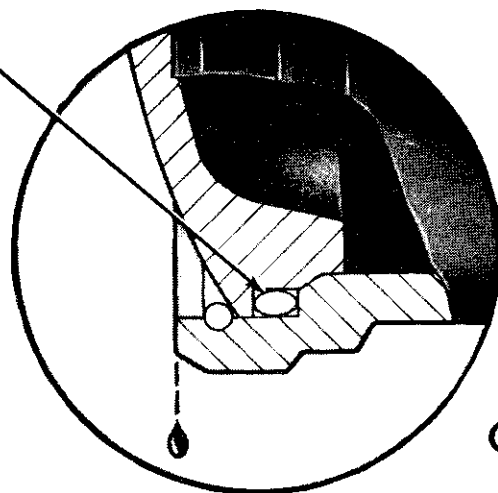


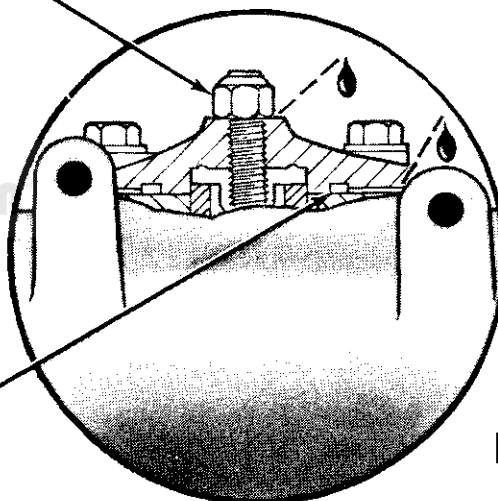
Fig. 2L-7 Steering Gear Leak Diagnosis and Corrective Action (View A)

**Corrective Action (cont.)**

Replace end plug O-ring seal.



Tighten nut to 35 foot-pounds (47 N·m) torque. Replace nut if leak persists.



Tighten side cover bolts to 50 foot-pounds (68 N·m) maximum. Replace side cover seal if leak persists. If side cover seal replacement is required, discard bolts and install replacement. Whenever the side cover is removed, install bolts supplied in overhaul kit.

If leak continues after tightening fitting nut to specified torque:

- a. Loosen nut and rotate tubing to reseal. Tighten nut again and recheck. If leak persists, replace connector seats.
- b. Remove hose and check sealing face for cracks. If flare is cracked, replace connector seats.
- c. Replace brass connector seats and reface hose flare. Check threads in housing and on fitting nut. If nut threads are damaged, replace nut. If housing threads are damaged, replace both housing and nut.

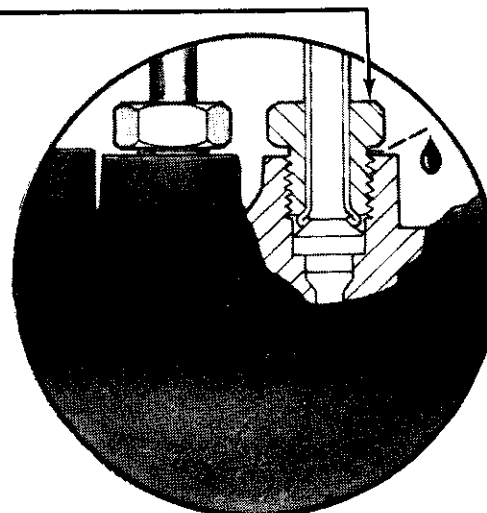
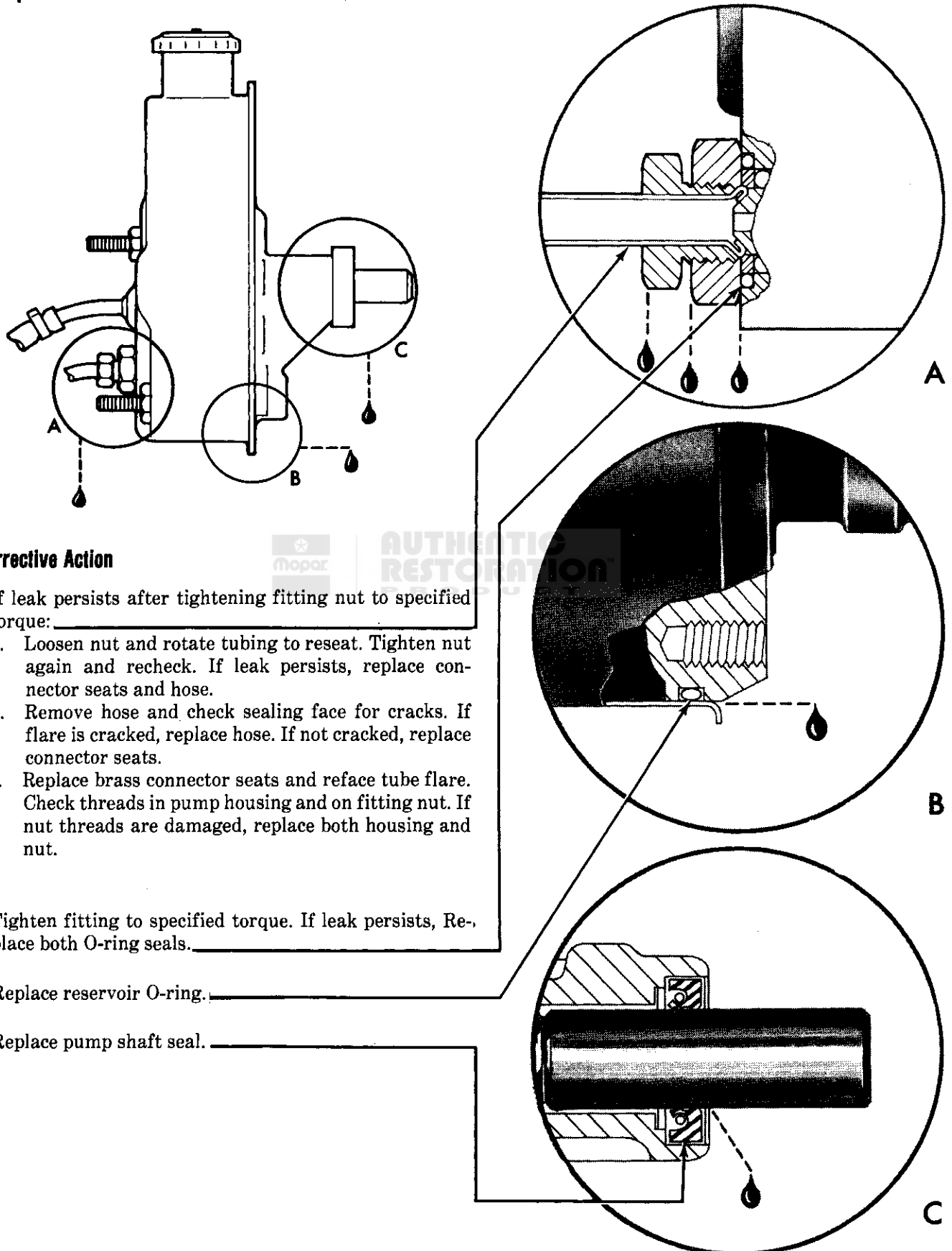


Fig. 2L-7 Steering Gear Leak Diagnosis and Corrective Action (View B)

## 2L-14 POWER STEERING GEAR AND PUMP

### Pump Leak Points and Corrective Action



#### Corrective Action

If leak persists after tightening fitting nut to specified torque:

- Loosen nut and rotate tubing to reseal. Tighten nut again and recheck. If leak persists, replace connector seats and hose.
- Remove hose and check sealing face for cracks. If flare is cracked, replace hose. If not cracked, replace connector seats.
- Replace brass connector seats and reface tube flare. Check threads in pump housing and on fitting nut. If nut threads are damaged, replace both housing and nut.

Tighten fitting to specified torque. If leak persists, Replace both O-ring seals.

Replace reservoir O-ring.

Replace pump shaft seal.

Fig. 2L-8 Power Steering Pump Leak Diagnosis and Corrective Action

## HYDRAULIC PRESSURE TEST

The hydraulic pressure test is performed using Test Gauge J-21567. The fittings on the test gauge and gauge valve have 1/4 pipe threads. Any combination of fittings is acceptable for gauge installation and connection can be made at the pump or gear as desired. However, the gauge must be connected in the pressure line circuit between pump and test gauge valve at all times.

### Test Procedure

(1) Check condition of power steering fluid. Drain and replace fluid if it contains small amount of dirt or contaminant. If fluid is exceptionally dirty, contaminated, or full of debris or foreign material, gear and pump should be disassembled and serviced.

(2) If fluid is full of bubbles, bleed power steering system. Refer to Fluid Level and Initial Operation in Power Steering Pump section.

(3) Check and adjust pump drive belt tension if necessary.

(4) Position drip pan under pump.

(5) Disconnect pressure hose at pump. Keep hose end raised to avoid excessive fluid loss.

(6) Connect pressure hose to Test Gauge J-21567. Refer to Pump Diagnosis Charts.

(7) Connect test gauge hose to pump. Refer to Hydraulic Pressure Test Procedure.

(8) Open test gauge valve completely. Turn valve counterclockwise to open.

(9) Fill pump reservoir with power steering fluid.

(10) Shift transmission into neutral, apply parking brakes, start engine, and operate engine until power steering fluid reaches normal operating temperature.

(11) Record pump initial output pressure registered on test gauge. Pressure should be 80-125 psi (552-862 kPa) with gauge valve open completely.

**NOTE:** If the initial output pressure exceeds 200 psi (1 379 kPa), stop the engine and check the test gauge and pressure hoses for restrictions.

(12) Check pump maximum output pressure as follows: Close gauge valve completely for 2-3 seconds; then open valve completely. Perform this procedure three times in succession and record highest pressure developed each time valve is closed.

**CAUTION:** Do not hold the gauge valve closed for more than five seconds at a time as pump damage could occur.

(13) On CJ models, maximum pump output pressures should be in 1000-1100 psi (6 895-7 584 kPa) range and not vary by more than 50 psi (345 kPa). On all other models, pressures should be in 1400-1500 psi (9 653-10 342 kPa) range and also not vary by more than 50 psi (345 kPa).

For example if recorded pressures on CJ models were 1050-1060-1070 (7 240-7 309-7 378 kPa), or 1450-1480-1470 (9 998-10 205-10 136 kPa) on Cherokee, Wagoneer and Truck models, maximum pressures are within allowable variance and pump operation is within limits.

(14) If maximum pressures were within specified high ranges but varied by more than 50 psi (345 kPa), flow control valve is sticking. Remove and clean valve and remove any surface imperfections with crocus cloth.

(15) If pump flow control valve was serviced, repeat pressure test to check valve operation before proceeding.

(16) Turn steering wheel right and left. Contact steering stops in both directions and record highest pressure developed when each stop is contacted. If pressures are 1000-1100 psi (6 895-7 584 kPa) on CJ models, or 1400-1500 psi (9 653-10 342 kPa) on all other models, pump is operating properly.

**CAUTION:** Do not hold the steering wheel against the steering stops for more than 5 seconds at a time as pump damage could occur.

(17) If pump maximum output pressure cannot be duplicated at each steering stop, steering gear is leaking internally and must be disassembled and serviced.

(18) If pump output pressures were duplicated at each steering stop, proceed to next step.

(19) Stop engine and remove test gauge.

(20) Connect pressure hose to pump. Tighten hose fitting to 30 foot-pounds (41 N•m) torque.

(21) Check and adjust power steering fluid level as necessary.

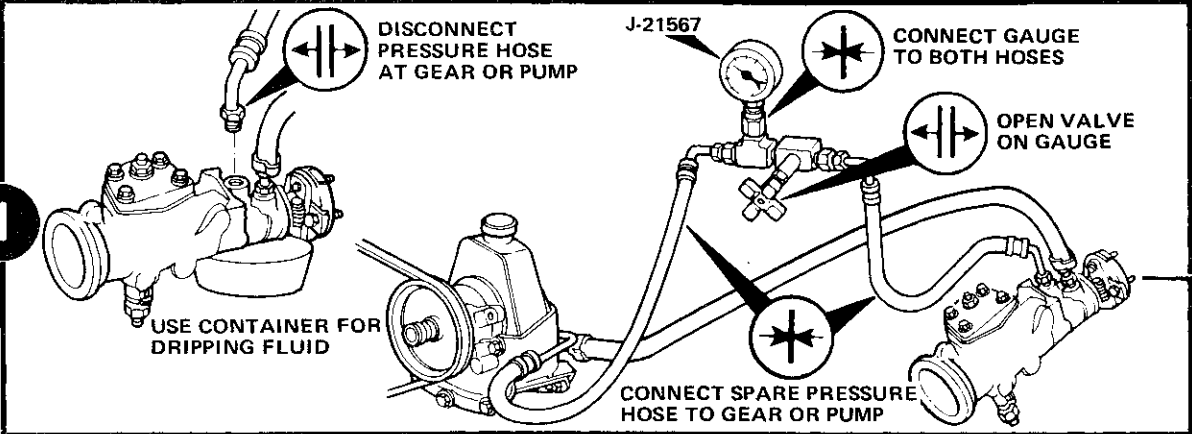

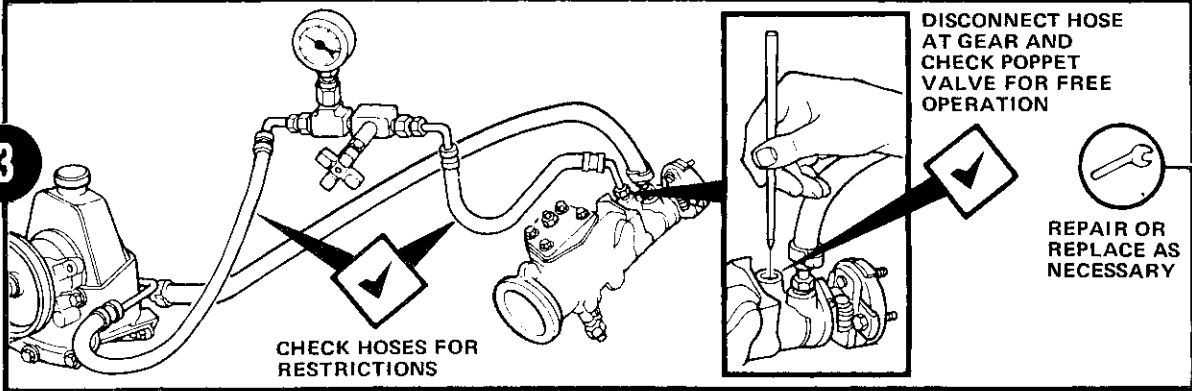
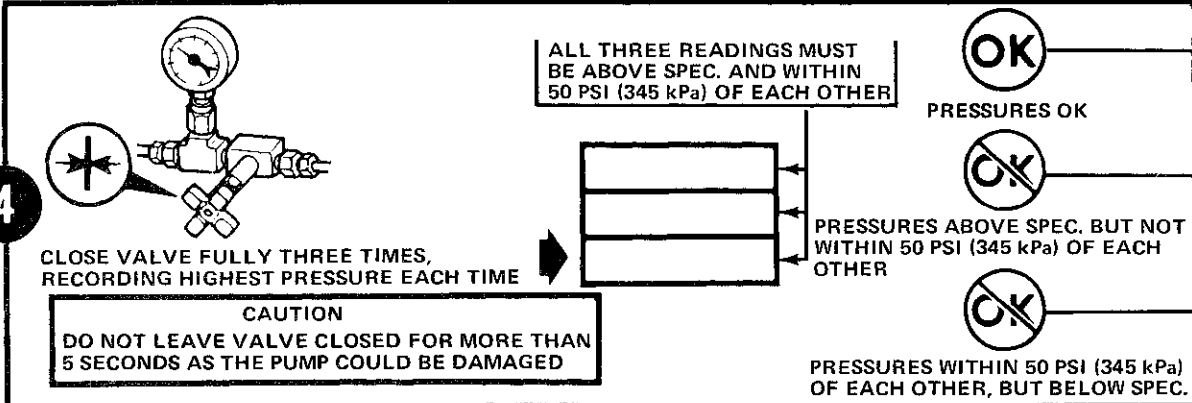
(22) Remove drain pan.

## PERIODIC MAINTENANCE

Power steering fluid level and condition should be checked periodically as outlined in the Maintenance Schedule. A dipstick attached to the pump reservoir cap is used to check fluid level.

Fluid level can be checked when cold or at operating temperature. At operating temperature, the fluid level should be at the FULL HOT mark on the dipstick. When cold it should be at the FULL COLD mark. If the fluid level is low, add fluid as necessary and check for leaks. If the reservoir is overfilled, drain fluid to correct level.

# POWER STEERING SYSTEM HYDRAULIC PRESSURE TEST PROCEDURE

STEP	SEQUENCE	RESULT
1	 <p>DISCONNECT PRESSURE HOSE AT GEAR OR PUMP</p> <p>J-2157</p> <p>CONNECT GAUGE TO BOTH HOSES</p> <p>OPEN VALVE ON GAUGE</p> <p>USE CONTAINER FOR DRIPPING FLUID</p> <p>CONNECT SPARE PRESSURE HOSE TO GEAR OR PUMP</p>	2
2	 <p>START ENGINE AND LET IDLE</p> <p>CHECK FLUID LEVEL, ADD FLUID IF NECESSARY</p> <p>GAUGE SHOULD READ BELOW 150 PSI (1034 kPa)</p> <p>OK</p> <p>GAUGE READS OK</p> <p>OK</p> <p>GAUGE READS OVER 150 PSI (1034 kPa)</p>	4 3
3	 <p>CHECK HOSES FOR RESTRICTIONS</p> <p>DISCONNECT HOSE AT GEAR AND CHECK POPPET VALVE FOR FREE OPERATION</p> <p>OK</p> <p>REPAIR OR REPLACE AS NECESSARY</p>	4
4	 <p>CLOSE VALVE FULLY THREE TIMES, RECORDING HIGHEST PRESSURE EACH TIME</p> <p>CAUTION DO NOT LEAVE VALVE CLOSED FOR MORE THAN 5 SECONDS AS THE PUMP COULD BE DAMAGED</p> <p>ALL THREE READINGS MUST BE ABOVE SPEC. AND WITHIN 50 PSI (345 kPa) OF EACH OTHER</p> <p>OK</p> <p>PRESSURES OK</p> <p>OK</p> <p>PRESSURES ABOVE SPEC. BUT NOT WITHIN 50 PSI (345 kPa) OF EACH OTHER</p> <p>OK</p> <p>PRESSURES WITHIN 50 PSI (345 kPa) OF EACH OTHER, BUT BELOW SPEC.</p>	7 5 6

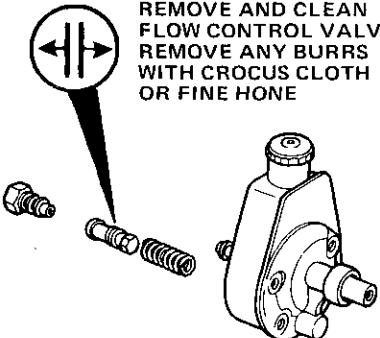
STEP

SEQUENCE

RESULT

**5**

REMOVE AND CLEAN FLOW CONTROL VALVE  
REMOVE ANY BURRS WITH CROCUS CLOTH OR FINE HONE



CHECK FLUID CONDITION

OK  
FLUID CLEAN

OK  
FLUID DIRTY

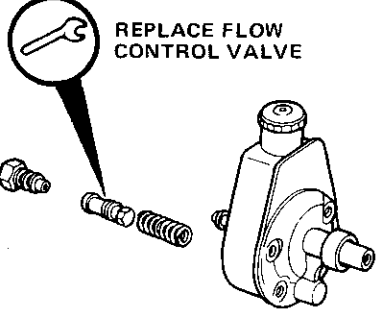
DISASSEMBLE PUMP AND GEAR AND CLEAN. REASSEMBLE

**7**

**7**

**6**

REPLACE FLOW CONTROL VALVE

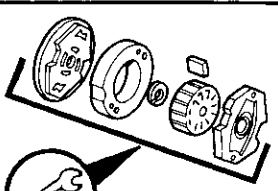


RECHECK PRESSURES (SEE STEP 4)

OK  
PRESSURES OK

OK  
PRESSURES LOW

REPLACE ROTATING GROUP

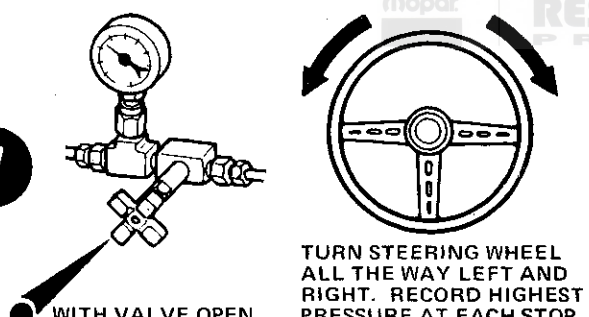


**7**

**7**

**7**

WITH VALVE OPEN



TURN STEERING WHEEL ALL THE WAY LEFT AND RIGHT. RECORD HIGHEST PRESSURE AT EACH STOP

COPY HIGHEST PRESSURE FROM STEP 4

LEFT	
RIGHT	

COMPARE PRESSURES LEFT AND RIGHT. PRESSURE READING MUST BE SAME AS HIGH PRESSURE STEP 4

OK  
PRESSURE OK

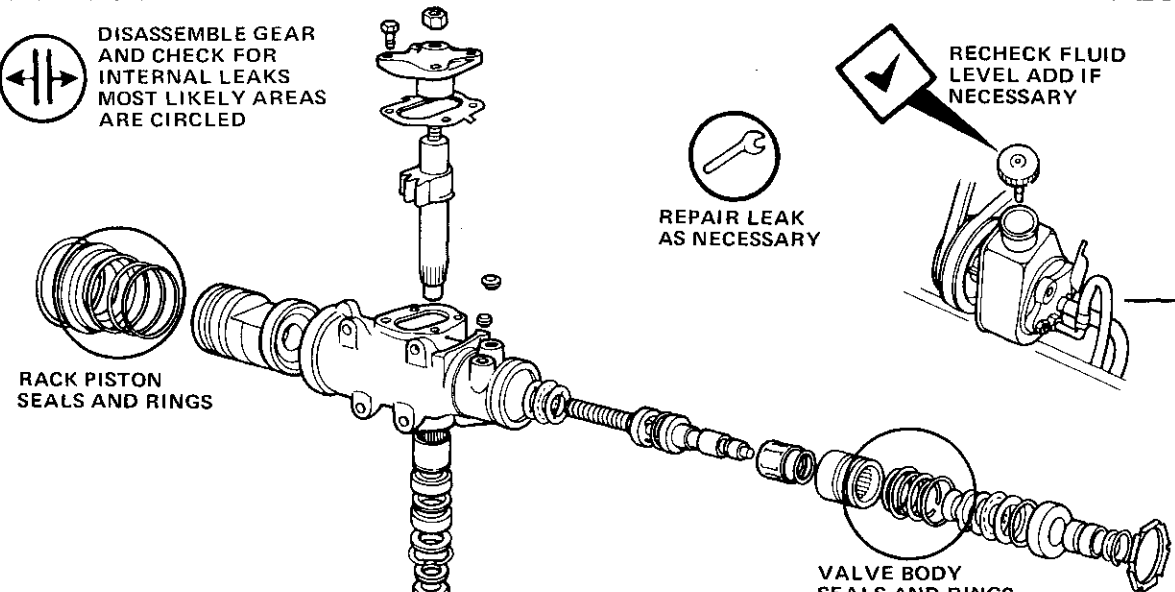
OK  
PRESSURE NOT OK

**STOP**

**8**

**8**

DISASSEMBLE GEAR AND CHECK FOR INTERNAL LEAKS MOST LIKELY AREAS ARE CIRCLED



RACK PISTON SEALS AND RINGS

REPAIR LEAK AS NECESSARY

RECHECK FLUID LEVEL ADD IF NECESSARY

**STOP**

VALVE BODY SEALS AND RINGS

## 2L-18 POWER STEERING GEAR AND PUMP

When adding fluid to or refilling the reservoir after service operations, use Jeep Power Steering Fluid or equivalent only. Use power steering fluid or fluid designated for use in power steering systems only. Do not use transmission fluid, motor oil, or similar fluids.

The pump drive belt tension and condition should be also be checked periodically. Use Tension Gauge J-23600 to measure belt tension. When checking tension with this gauge, position the gauge at the center of the longest belt span to take readings. When checking tension of notched drive belts, be sure the gauge finger is firmly seated in a belt notch before taking readings.

### SPECIFICATIONS

#### Power Steering Gear Specifications

Type	Recirculating Ball, worm and nut.
Bearings	
Wormshaft Upper	Needle Roller
Lower	Needle Roller
Pitman Shaft	Needle Roller
Fluids	Use Jeep Power Steering Fluid or equivalent only. Do not use transmission fluid.
Power Steering System Fluid Capacity	1-1/4 pints (0.59 liters)
Steering Gear Adjustment:	
Worm Bearing Preload	4 to 10 inch-pounds (0.45 to 1.13 N-m) rotating torque. Refer to Steering Gear Adjustment.
Pitman Shaft Overcenter Drag Torque	
(New gear with less than 400 miles service)	.4 to 8 inch-pounds (0.45 to 0.90 N-m) in addition to worm bearing preload but not to exceed total of 14 inch-pounds (1.58 N-m)
(Used gear with over 400 miles service)	.4 to 5 inch-pounds (0.45 to 0.56 N-m) in addition to worm bearing preload but not to exceed total of 18 inch-pounds (2.03 N-m)
Steering Ratio	
CJ	17.5:1 constant ratio
Cke-Wag-Trk	13/16:1 variable ratio
Value Body	Three-way, open center, rotary-type.

80499

#### Power Steering Pump Specifications

Pump Type	Vane-type, constant displacement, belt-driven hydraulic pump.
Capacity at 465 RPM	1.25 GPM
Flow Range	1.25 to 2.15 GPM
Relief Valve Setting (Maximum Pressure):	
CJ	1100-1200 psi (7584-8274 kPa)
Cke-Wag-Trk	1400-1500 psi (9653-10342 kPa)
Pressure Test Specifications:	
Initial pressure (engine at idle speed)	80-125 psi (552-862 kPa)
Test pressures (gauge valve closed)	Pressures must be within maximum pressure specifications and not vary by more than 50 psi (345 kPa)
Turning	400 psi (2758 kPa)
Fluids	Use Jeep Power Steering Fluid or equivalent only. Do not use transmission fluid. Use fluids designed for power steering system use only.

80502

#### Drive Belt Tension Specifications

	USA (pounds)		Metric (N)	
	New Belt*	Used Belt	New Belt*	Used Belt
Air Conditioner, Six-Cylinder	125-155	90-115	556-689	400-512
Air Conditioner, Eight-Cylinder	125-155	90-115	556-689	400-512
Air Pump (All except Six-Cylinder w/AC)	125-155	90-115	556-689	400-512
Air Pump Six-Cylinder w/AC (3/8 inch belt)	65-75	60-70	291-334	267-311
Fan	125-155	90-115	556-689	400-512
Idler Pulley	125-155	90-115	556-689	400-512
Power Steering Pump	125-155	90-115	556-689	400-512

\*New belt specifications apply only to replacement belts. Once a belt has been tensioned and run, it is considered a used belt and should be adjusted to used belt specifications.

80503

# POWER STEERING GEAR

	Page		Page
Fluid Level and Initial Operation	2L-39	Steering Gear Installation	2L-21
General	2L-19	Steering Gear Removal	2L-20
In-Vehicle Service	2L-19	Steering Gear Subassembly Overhaul	2L-24
Steering Gear Assembly and Adjustment	2L-32	Specifications	2L-36
Steering Gear Disassembly	2L-22		

## GENERAL

Although service and adjustment procedures for constant and variable ratio steering gears are the same, do not attempt to interchange gear internal components.

When servicing a gear, perform all repair operations on a clean work surface only. Small amounts of foreign material or contaminants can cause a malfunction after assembly. Clean all parts in clean-filtered solvent only and dry all parts, except bearings, using filtered compressed air. Use lint-free paper towels or cloths only to dry bearings.

During assembly operations, use the recommended torque values and adjustment specifications only. Failure to adhere to these specifications can result in accelerated wear and unsatisfactory gear operation.

## IN-VEHICLE SERVICE

### Steering Gear Adjustment

Because of the complexity involved in adjusting worm bearing preload and pitman shaft overcenter drag torque plus the friction effect of hydraulic fluid, the steering gear must be adjusted off the vehicle only. Refer to Worm Bearing Preload and Pitman Shaft Overcenter Drag Torque Adjustment under Steering Gear Assembly and Adjustment.

**CAUTION:** Do not attempt on-vehicle adjustment of the power steering gear. Incorrect adjustment could result in accelerated wear of gear internal components and undesirable steering response.

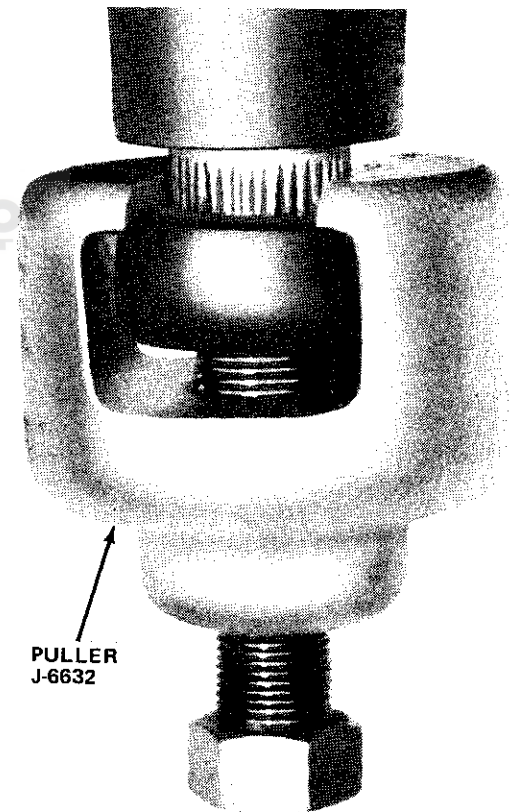
Conditions such as shimmy and hard or loose steering may be caused by wheels and tires or worn or damaged front suspension components. These items should be checked before attempting power steering gear repairs.

Before performing any service operations, check and correct fluid level and condition, belt adjustment, and pump pressures.

**CAUTION:** Use power steering fluid only in the system.

## Pitman Shaft Seal Replacement

- (1) Raise vehicle.
- (2) Disconnect pitman arm using tool J-6632 (fig. 2L-9).
- (3) Position drain pan under gear.



42065

Fig. 2L-9 Pitman Arm Removal

- (4) Remove seal retaining ring using tool J-4245 and remove outer seal backup washer.

(5) Start engine and momentarily hold steering wheel in full left turn position to actuate spool valve. This builds pressure on upper end of piston and in pitman shaft chamber to force seals and backup washers out of gear.



## 2L-20 POWER STEERING GEAR AND PUMP

**CAUTION:** To avoid excessive fluid loss and possible pump damage, do not hold the gear in the full left turn position for more than one or two seconds at a time.

(6) Stop engine and remove seals and backup washers from pitman shaft.

(7) Inspect outer diameter of seals for damage. If scored or cut, inspect housing bore for burrs and nicks. Remove any burrs or nicks, before installing replacement seals, using crocus cloth.

(8) Inspect pitman shaft surface for roughness, pitting, scoring, rust, or nicks. Clean dirt, rust corrosion from shaft seal surfaces using crocus cloth. Replace shaft if pitted or severely corroded.

(9) Lubricate replacement seals and shaft surfaces with power steering fluid.

(10) Apply single layer of thin tape to pitman shaft splines to avoid cutting seals.

(11) Insert single lip seal in bore first; then insert backup washer (fig. 2L-10).

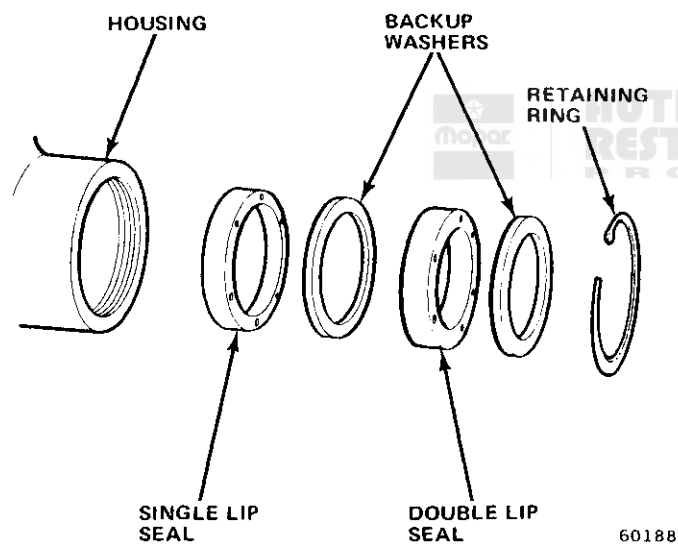


Fig. 2L-10 Pitman Shaft Seals and Backup Washers

(12) Seat single lip seal and washer using Snap Ring Tool J-21553. Install seal and washer only far enough to provide clearance for remaining seal, backup washer, retaining ring, and for clearance between seals. Do not allow seal to bottom in housing bore.

**CAUTION:** To ensure proper seal action, be sure to allow enough space for clearance between the two seals.

(13) Install double lip seal and backup washer in housing bore using tool J-21553. Install seal only far enough into bore to allow clearance for retaining ring.

(14) Install retaining ring using Snap Ring Tool J-4245. Be sure ring is fully seated.

(15) Install pitman arm on shaft and install replacement pitman arm nut and lockwasher. Tighten nut to 185 foot-pounds (251 N•m) torque. Stake nut in two places to retain it.

(16) Lower vehicle.

(17) Fill power steering pump reservoir to correct level with power steering fluid.

(18) Start and idle engine for at least three minutes. Do not turn steering wheel during this time.

(19) Turn steering wheel left and right and check for leaks. Add additional fluid as necessary.

### End Plug O-Ring Seal Replacement

#### CJ Models

(1) Raise vehicle.

(2) Rotate end plug retaining ring (fig. 2L-11) until one end of ring is positioned over hole in side of housing.

(3) Remove retaining ring by inserting punch through hole in housing and unseating ring.

(4) Remove end plug by turning steering wheel slowly to left until rack piston forces end plug out of housing.

(5) Turn steering wheel back to center position.

**CAUTION:** Do not turn the steering wheel any farther than necessary or the ball bearings in the rack piston may fall out of the rack piston bearing circuit and drop into the piston chamber.

(6) Remove and discard end plug O-ring seal.

(7) Lubricate replacement seal with power steering fluid and install seal on end plug.

(8) Install assembled end plug and seal in housing.

(9) Install retaining ring.

(10) Lower vehicle.

(11) Check and correct power steering fluid level as necessary.

#### Cherokee-Wagoneer-Truck Models

On Cherokee, Wagoneer and Truck models, the position of the steering gear prevents on-vehicle replacement of the end plug O-ring seal (fig. 2L-11).

### STEERING GEAR REMOVAL

(1) Disconnect pressure and return hoses at gear. Keep hoses raised to avoid excessive fluid loss and cap hoses to prevent dirt entry.

(2) On Cherokee, Wagoneer, and Truck models, remove clamp bolt and nut attaching flexible coupling to steering gear stub shaft and disengage coupling from stub shaft.



## 2L-22 POWER STEERING GEAR AND PUMP

(a) Apply Loctite or equivalent material to all steering gear mounting bracket attaching bolts.

(b) Position upper and lower mounting brackets on steering gear and install bracket attaching bolts. Tighten bolts to 70 foot-pounds (95 N•m) torque.

(c) Apply Loctite or equivalent material to steering gear mounting bracket-to-frame and cross-member attaching bolts.

(d) Align and connect intermediate shaft coupling to steering gear stub shaft.

(e) Position assembled steering gear and mounting brackets on frame and crossmember and install attaching bolts. Tighten all attaching bolts to 55 foot-pounds (75 N•m) torque.

(f) Remove support stands and lower vehicle.

(g) Install intermediate shaft coupling-to-steering gear stub shaft clamp bolt and nut. Tighten nut to 45 foot-pounds (61 N•m) torque.

(3) On all models, align and install pitman arm on pitman shaft using reference marks made during removal.

(4) Install replacement pitman shaft lockwasher and nut. Tighten nut to 185 foot-pounds (251 N•m) torque and stake nut in two places to retain it.

(5) Connect pressure and return hoses to steering gear. Tighten hose fittings to 25 foot-pounds (34 N•m) torque.

(6) Check and adjust fluid level as necessary. Refer to Fluid Level and Initial Operation.

### STEERING GEAR DISASSEMBLY

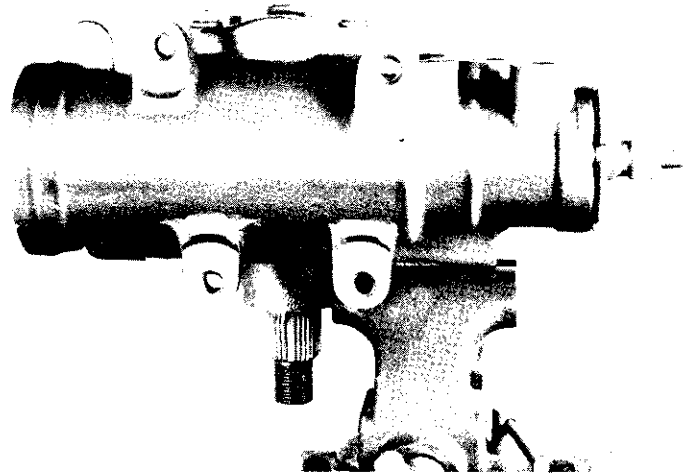
**NOTE:** In most cases, complete disassembly of the power steering gear will not be necessary. Only those subassemblies that have malfunctioned should be disassembled. In addition, steering gear repair operations must always be performed on a clean work bench. Cleanliness is very important. The work bench, tools, and steering gear component parts must be kept clean at all times to avoid a problem recurring after assembly. Thoroughly clean the gear exterior with solvent before disassembly. Refer to Figure 2L-11 for parts nomenclature and disassembly/assembly sequence during service operations.

(1) Drain fluid from gear.

(2) Cap all openings in gear and clean gear exterior thoroughly.

(3) Mount steering gear in vise so pitman shaft points downward. Clamp unmachined housing boss portion of gear in vise only (fig. 2L-12).

(4) Rotate end plug retaining ring until one end of ring is aligned with hole in side of housing. Unseat ring using punch inserted through hole in housing and remove ring using screwdriver (fig. 2L-13).



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Fig. 2L-12 Mounting Steering Gear In Vise



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Fig. 2L-13 End Plug Retaining Ring Removal

(5) Remove end plug. Install 12-point deep socket and ratchet handle on stub shaft and slowly rotate shaft counterclockwise until rack piston forces end plug out of housing.

**CAUTION:** Do not rotate the stub shaft any farther than necessary or the ball bearings will drop out of the rack piston circuits. This causes the rack piston and pitman shaft sector teeth to disengage preventing removal. If disengagement should occur, remove the side cover and pitman shaft and reengage the teeth.

- (6) Remove and discard O-ring seal from housing end plug.
- (7) Turn stub shaft 1/2 turn clockwise.
- (8) Unseat rack piston end plug by striking it with plastic mallet.
- (9) Remove rack piston end plug.

**CAUTION:** Do not attempt to remove the rack piston end plug until it has been unseated as the plug could break.

- (10) Remove and discard pitman shaft adjuster screw locknut. Use Allen wrench to prevent adjuster screw from turning when removing locknut (fig. 2L-14).

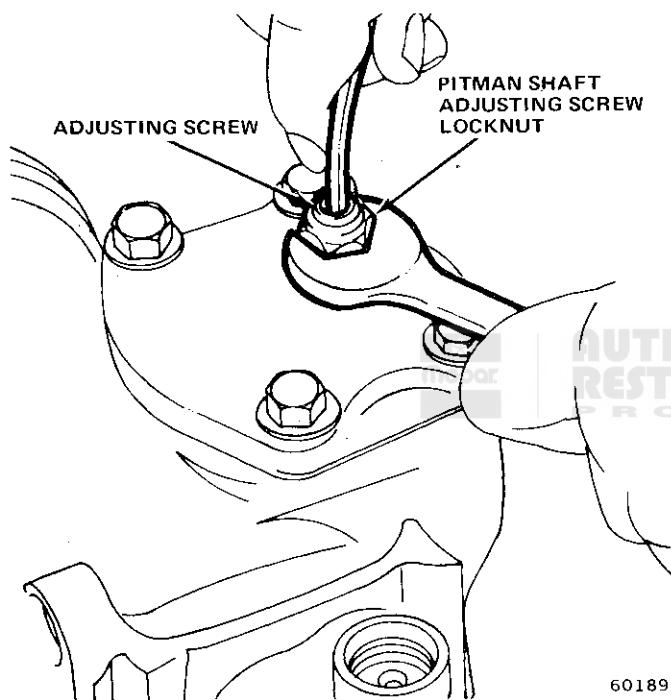


Fig. 2L-14 Adjuster Screw Locknut Removal/Installation

- (11) Remove side cover bolts and lockwashers.
- (12) Remove side cover. Unthread cover from adjuster screw by turning screw clockwise.
- (13) Rotate stub shaft until pitman shaft sector teeth are centered in housing.
- (14) Remove pitman shaft from housing by tapping threaded end of shaft with plastic mallet.

**NOTE:** Do not remove or disassemble any of the pitman shaft component parts. The shaft and component parts are serviced as an assembly only.

- (15) Remove rack piston from housing as follows:
  - (a) Insert Arbor Tool J-7539-01 or J-21552 into rack piston until tool contacts end of wormshaft.
  - (b) Hold arbor tool tightly against wormshaft and turn stub shaft counterclockwise to force rack piston onto arbor tool.

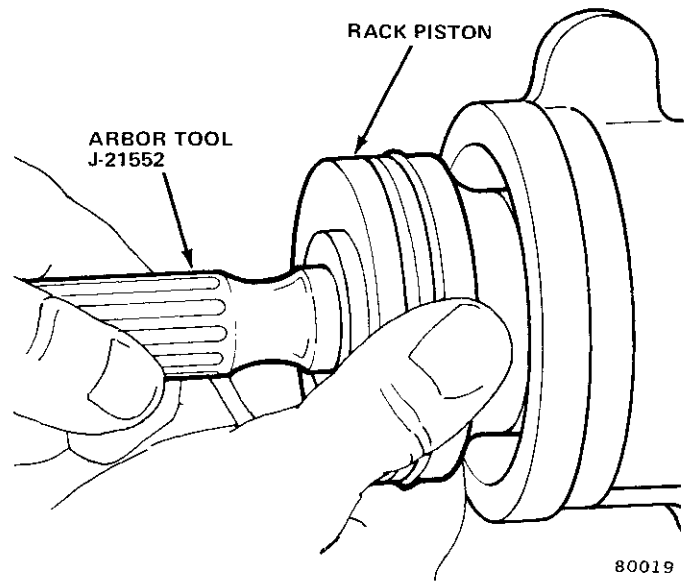


Fig. 2L-15 Rack Piston Removal/Installation

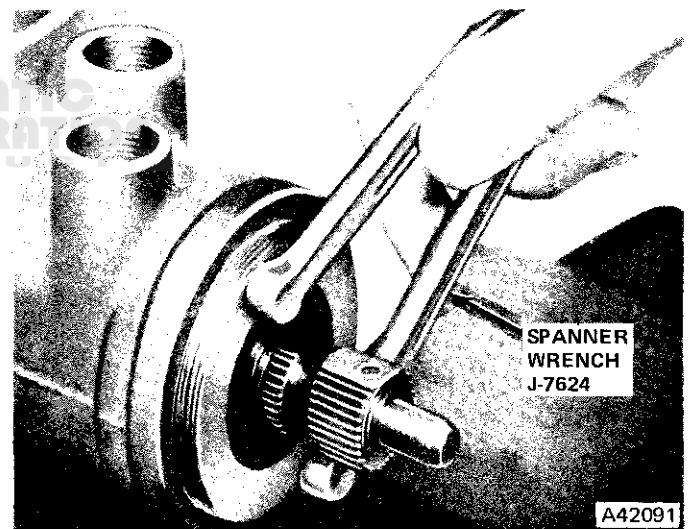


Fig. 2L-16 Adjuster Plug Removal

- (c) Remove rack piston and arbor tool as assembly (fig. 2L-15).
- (16) Remove adjuster plug locknut using brass drift and hammer.
- (17) Remove adjuster plug using Spanner Tool J-7624 (fig. 2L-16).
- (18) Remove valve body from housing. Grasp stub shaft and pull outward to remove.
- (19) Remove wormshaft lower thrust bearing and bearing races from housing if not removed previously.

### STEERING GEAR SUBASSEMBLY OVERHAUL

#### Gear Housing

##### Disassembly

(1) Remove pitman shaft seal retaining ring using Snap Ring Pliers J-4245.

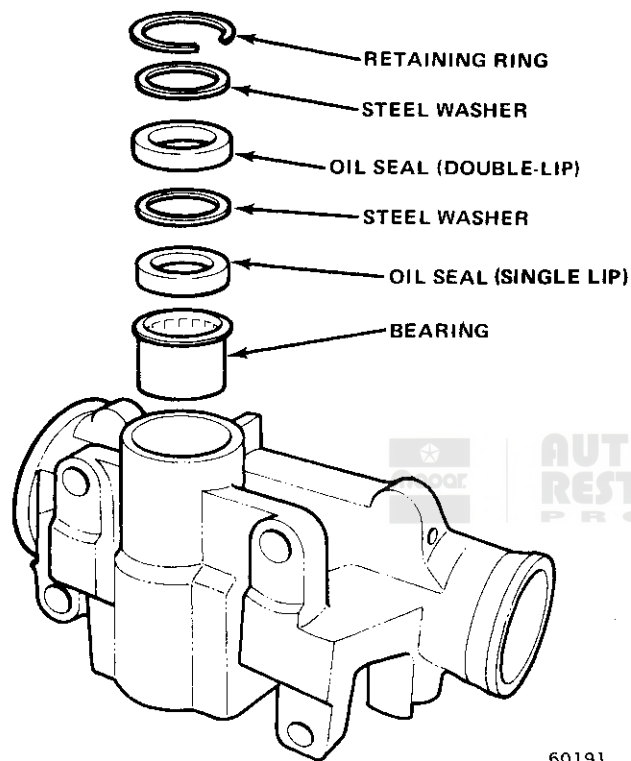


Fig. 2L-17 Pitman Shaft Bearing and Seals

- (2) Remove steel washer (fig. 2L-17).
- (3) Remove backup washer and double lip seal (fig. 2L-17). Use screwdriver to pry seal out of bore. Discard seal.
- (4) Remove backup washer and single lip seal (fig. 2L-17). Use screwdriver to pry seal out of bore. Discard seal. Do not damage seal bore when removing washers and seals.
- (5) Remove and discard pitman shaft needle bearing using tools J-8092 and J-21551 (fig. 2L-18).

**NOTE:** When removing the bearing, drive the bearing out the end of the pitman shaft bore. Do not attempt to drive the bearing out through the housing.

##### Cleaning and Inspection

Clean all components thoroughly with solvent and dry using compressed air or lint free paper towels or shop cloths.

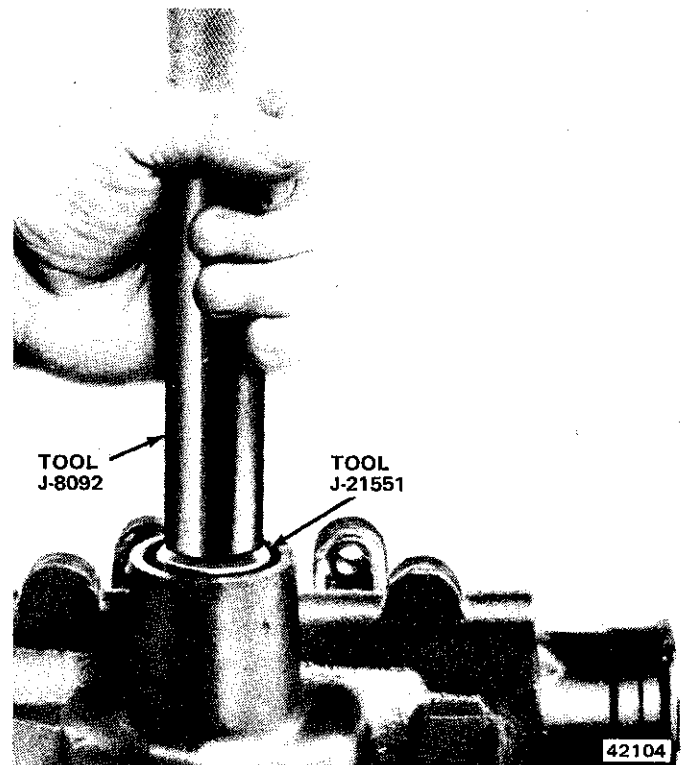


Fig. 2L-18 Pitman Shaft Bearing Removal/Installation

Inspect the housing bore. Replace the housing if severely worn, scored, or pitted. However, slight scratches or minor corrosion can be removed using crocus cloth.

Inspect the pressure and return port hose connector seats and check the poppet check valve in the pressure port. Replace the seats if cracked, loose, cocked, worn, or scored. Replace the check valve if scored, chipped, cracked, or distorted. If seat or valve replacement is necessary, refer to Hose Connector Seat and Check Valve Replacement.

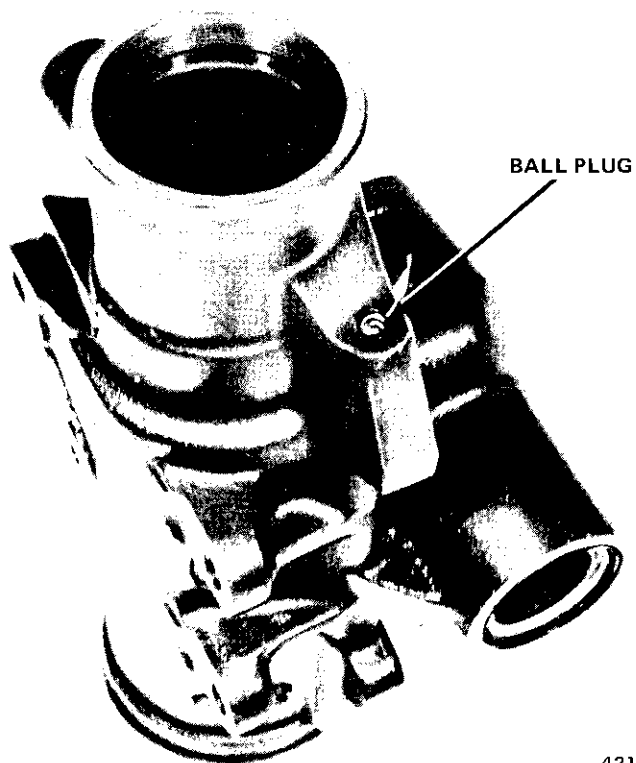
Inspect the housing ball plug (fig. 2L-19). Reseat the ball if fluid leaked past the ball before disassembly or if it has risen above the housing surface. If necessary, drive the ball into the housing until it is flush with, or 1/16 inch (1.58 mm) below the housing surface. Secure the ball by staking the housing around it. Replace the housing if the ball is loose or cannot be resealed.

Inspect all retaining ring, bearing, and seal surfaces in the housing. Replace the housing if any surface is worn or damaged.

##### Hose Connector Seat and Check Valve Replacement

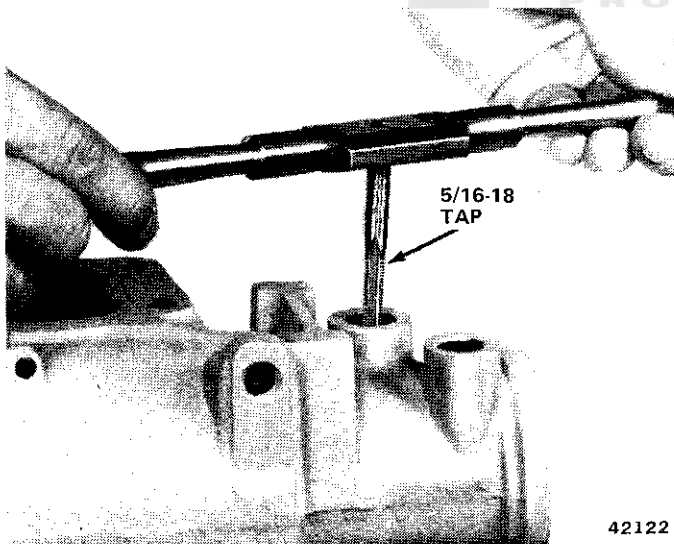
**CAUTION:** Do not attempt connector seat or check valve replacement unless the gear has been removed and disassembled. Connector seat replacement will generate metal chips and shavings which can enter the gear and cause a malfunction after assembly.

- (1) Pack seats and pressure ports with petroleum jelly to prevent chips from lodging in ports.



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Fig. 2L-19 Housing Ball Plug Location



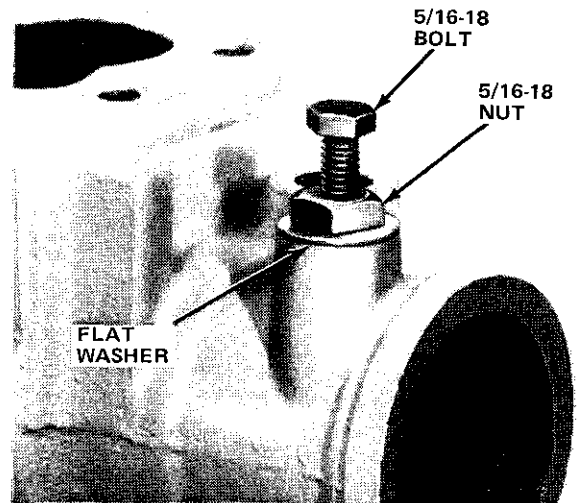
42122

Fig. 2L-20 Threading Hose Connector Seats

(2) Thread connector seats to depth of 2-3 threads (only) using 5/16-18 tap (fig. 2L-20).

**CAUTION:** Do not thread the pressure port seat any more than 2-3 threads deep or the tap may contact the check valve and damage it.

(3) Assemble 5/16-18 bolt and nut and thread bolt into connector seat (fig. 2L-21).



42123

Fig. 2L-21 Hose Connector Seat Removal

(4) Place wrench on bolt to prevent it from turning and tighten nut against housing to remove seat.

(5) Remove check valve and spring from pressure port and discard both parts, they are not reusable.

(6) Clean housing thoroughly to remove metal chips and shavings, dirt, and petroleum jelly.

(7) Install replacement check valve spring in pressure port. Be sure spring is seated in pressure port counterbore and large end of spring faces downward.

(8) Install replacement check valve over spring so valve tangs face downward. Be sure valve is centered on small end of spring.

(9) Coat replacement pressure port connector seat with petroleum jelly and position seat on top of check valve.

(10) Insert replacement return port connector seat in port.

(11) Install both seats using tool J-6217 (fig. 2L-22).

(12) Inspect check valve operation by lightly pressing valve downward with pencil. Valve should reseat itself when pencil pressure is released.

(13) Clean housing with solvent to remove any remaining chips and petroleum jelly.

### Assembly

(1) Lubricate housing bores and all replacement bearings and seals with power steering fluid.

(2) Install pitman shaft needle bearing using tools J-8092 and J-21553 (fig. 2L-18). Install bearing until approximately 1/32 inch (0.79 mm) below shoulder in housing bore.

(3) Install single lip seal and backup washer (fig. 2L-17). Seat washer and seal using tool J-21553. Install seal and washer only far enough to provide clearance for next seal and washer, steel washer and retaining ring, and to provide small clearance between seals.

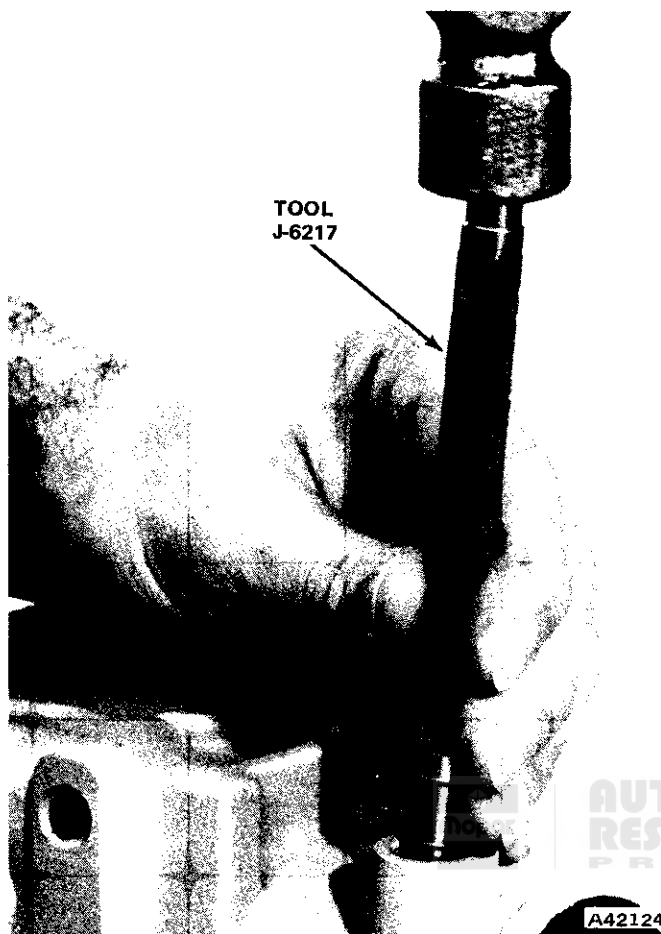


Fig. 2L-22 Hose Connector Seat Installation

**CAUTION:** Do not bottom the seal against the housing counterbore.

(4) Install double lip seal and backup washer using tool J-21553. Install seal and washer only far enough to allow clearance for steel washer and retaining ring.

**CAUTION:** To ensure proper seal action, do not allow the seals to contact one another. Be sure there is clearance between them.

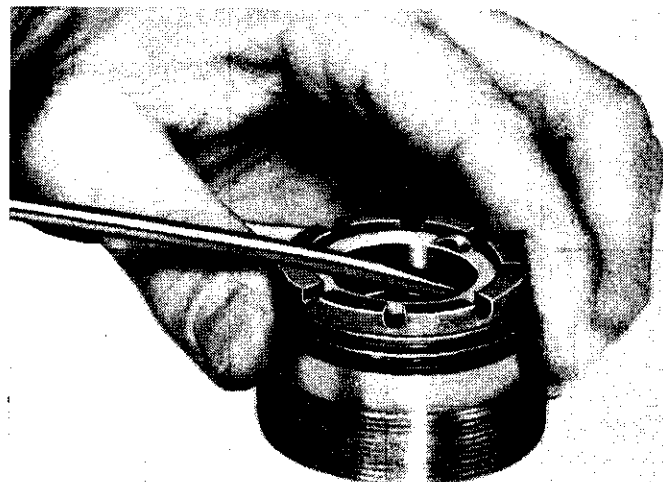
(5) Install steel washer.

(6) Install retaining ring using Snap Ring Pliers J-4245. Be sure ring is seated completely in housing ring groove.

### Adjuster Plug

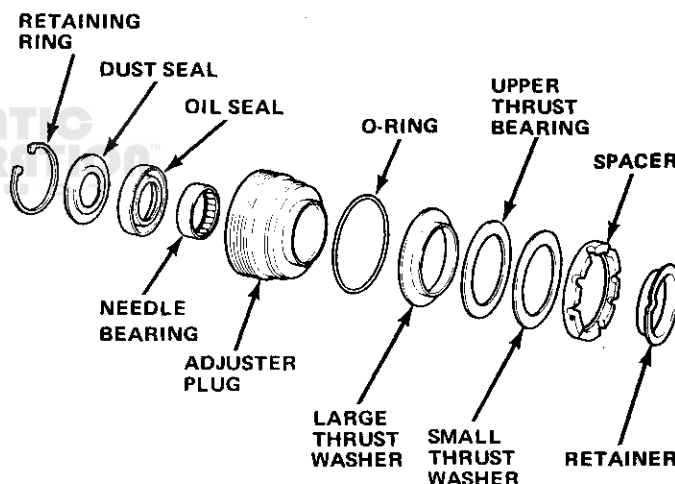
#### Disassembly

(1) Remove thrust bearing retainer using screwdriver (fig. 2L-23). Discard retainer. Do not damage needle bearing bore when removing retainer.



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Fig. 2L-23 Thrust Bearing Retainer Removal



60192

Fig. 2L-24 Adjuster Plug Components

(2) Remove thrust bearing spacer, thrust bearing, and thrust bearing races (fig. 2L-24).

(3) Remove and discard adjuster plug O-ring seal.

(4) Remove stub shaft seal retainer ring and remove and discard stub shaft dust seal. Use screwdriver to pry retainer and seal out of adjuster plug.

(5) Remove needle bearings using tool J-6221 (fig. 2L-25). Discard bearings after removal.

#### Cleaning and Inspection

Clean the adjuster components with solvent and dry them using compressed air.

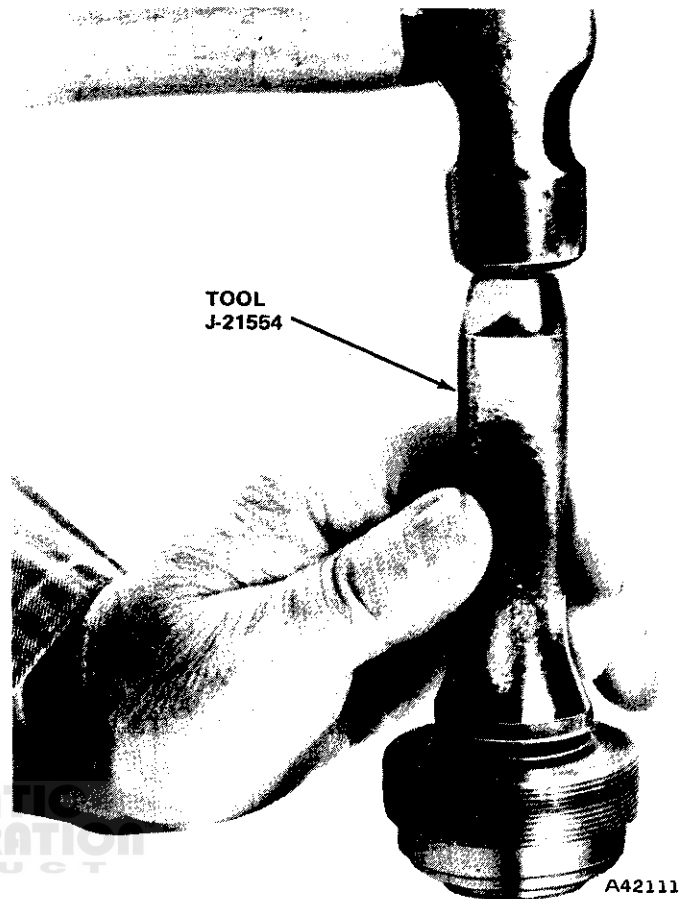


**Fig. 2L-25 Adjuster Plug Needle Bearing Removal/Installation**

Inspect the adjuster plug bearing and seal surfaces for pitting, nicks, or scoring and inspect the plug threads for damage. Inspect the washers, spacer, and retainer for distortion, and wear. Replace any component that exhibits any of these conditions.

#### Assembly

- (1) Lubricate dust seal and O-ring with petroleum jelly. Lubricate all other components with power steering fluid.
- (2) Position needle bearing on tool J-6221 so bearing manufacturer's identification number is facing tool.



**Fig. 2L-26 Stub Shaft Seal Installation**

(3) Install bearing in adjuster plug until bearing is flush with bottom surface of stub shaft seal counterbore (fig. 2L-25).

(4) Install stub shaft seal in adjuster plug using tool J-21554 (fig. 2L-26). Install seal deep enough to provide clearance for dust seal and retaining ring.

(5) Install dust seal in adjuster plug. Rubber face of seal must face away from plug (outward).

(6) Install retaining ring using Snap Ring Pliers J-4245.

(7) Install O-ring in adjuster plug ring groove.

(8) Install large thrust washer, upper thrust bearing, small thrust washer, and spacer in adjuster plug.

(9) Install retainer. Use brass drift to press retainer into plug.

**NOTE:** The radial location of the spacer notches are not important. However, do not damage the notches during retainer installation.



**Valve Body**

**CAUTION:** The valve body assembly is a precision unit with select fit components that are hydraulically matched and balanced during manufacture. Service repairs to the valve are uncommon with the possible exception of the spool valve damper O-ring. Do not disassemble the valve body unless absolutely necessary as improper disassembly could result in damage. If the spool valve damper O-ring requires replacement, remove the valve, replace the O-ring, and reinstall the valve immediately. If either the spool valve or valve body require replacement, replace the entire valve body as an assembly only. Do not attempt to interchange parts. If valve body disassembly is absolutely necessary, proceed as outlined in the following steps.

**Disassembly**

- (1) Remove and discard stub shaft cap O-ring (fig. 2L-27).
- (2) Hold valve body assembly in both hands with stub shaft pointing downward. Tap end of stub shaft lightly against wood block until shaft cap is free of valve body (fig. 2L-28).

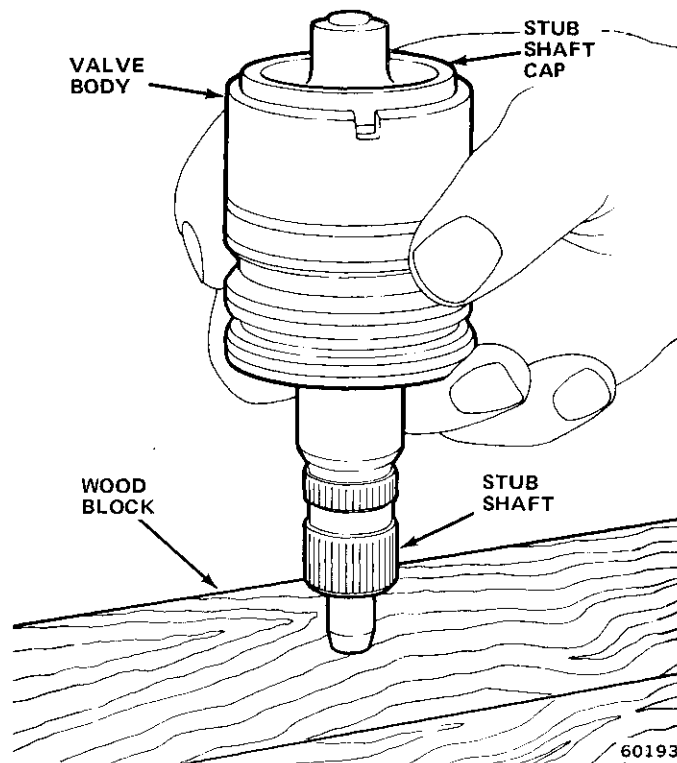
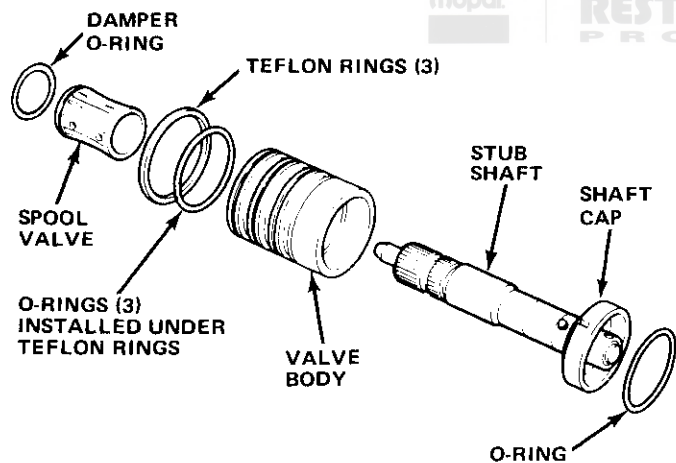


Fig. 2L-28 Separating Stub Shaft and Valve Body



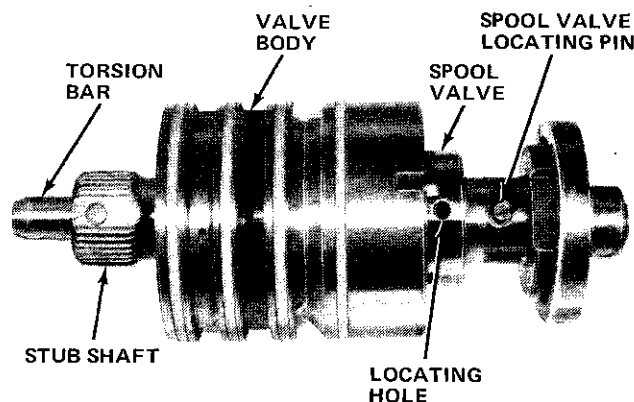
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Fig. 2L-27 Valve Body Components

- (3) Pull stub shaft outward until shaft cap clears valve body by approximately 1/4 inch (6.35 mm).

**CAUTION:** Do not pull the stub shaft out of the valve body any farther than 1/4 inch (6.35 mm) or the spool valve may become cocked in the valve body.

- (4) Press spool valve locating pin inward and carefully remove stub shaft from valve body and spool valve (fig. 2L-30).

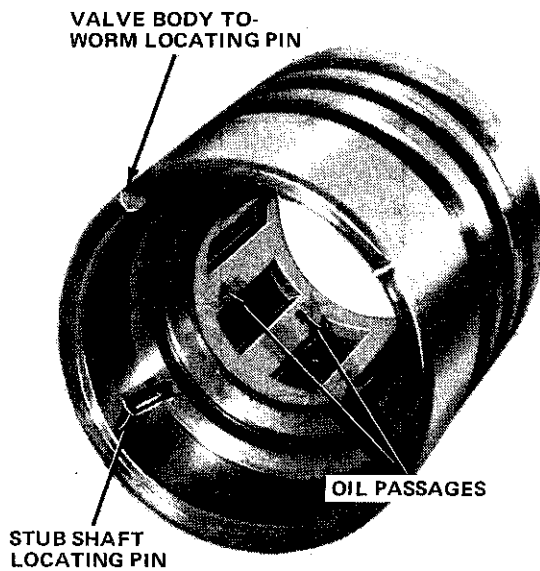


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Fig. 2L-29 Valve Body and Spool Valve Disassembly

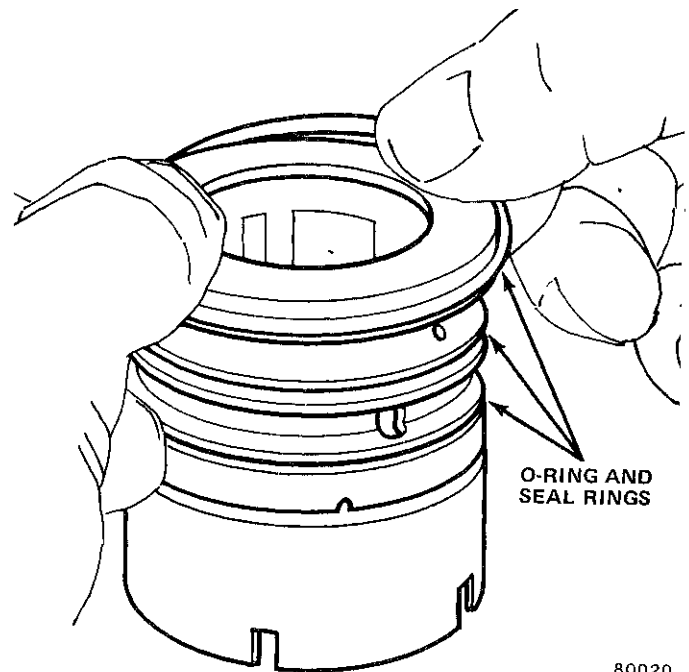
- (5) Remove spool valve from valve body using a push and turn motion. If spool valve becomes cocked, carefully realign valve and try removal again. Do not force spool valve out.

- (6) Remove and discard spool valve damper O-ring.
- (7) Cut and remove valve body seal rings and backup O-rings (fig. 2L-27). Discard all rings.



42115

Fig. 2L-30 Valve Body



80020

Fig. 2L-31 Valve Body Seal Ring Installation

### Cleaning and Inspection

Wash the valve body components in clean solvent and blow out all fluid passages using filtered, compressed air.

If the torsion bar is broken or loose, or if the torsion seal leaked prior to disassembly, replace the entire valve body as an assembly.

If the spool valve locating pin is broken or the valve body is cracked, worn, or broken, replace the entire valve body as an assembly.

**NOTE:** *Tiny flat spots on either side of the spool valve locating pin are normal.*

A slightly polished appearance is normal for all valve body assembly surfaces. However, if there are scores, nicks, or burrs on the valve body and stub shaft surfaces that cannot be cleaned up with crocus cloth, replace the entire valve body as an assembly.

Inspect the valve body-to-wormshaft locating notch in the valve body skirt (fig. 2L-30). Replace the entire valve body as an assembly if this notch is damaged or excessively worn.

Inspect the spool valve-to-valve body fit. Lubricate the spool valve with power steering fluid and insert it into the valve body. Replace the entire valve body as an assembly if the spool valve is a loose fit, binds or sticks, or does not rotate freely within the valve body.

### Assembly

(1) Lubricate all valve body components with power steering fluid.

(2) Install replacement backup O-rings in seal ring grooves.

(3) Install replacement seal rings over backup O-rings (fig. 2L-31). Take care to avoid damaging seal rings during installation.

**NOTE:** *The teflon seal rings may appear to be distorted after installation. However, the heat generated by power steering fluid during normal operation will straighten them.*

(4) Lubricate replacement spool valve damper O-ring with petroleum jelly and install O-ring on spool valve.

(5) Insert spool valve in valve body. Do not attempt to force spool valve into place.

(6) Push spool valve through valve body until spool valve locating pin hole is visible at opposite end of valve body and spool valve is flush with notched end of valve body.

(7) Install stub shaft in spool valve and valve body. Be sure stub shaft locating pin is aligned with spool valve locating hole (fig. 2L-29).

(8) Align notch in stub shaft cap with stub shaft locating pin in valve body and press stub shaft and spool valve into valve body (fig. 2L-32).

**CAUTION:** *Before installing the assembled valve body in the gear housing, be sure the valve body stub shaft locating pin is fully engaged in the stub shaft cap notch.*

(9) Lubricate stub shaft cap O-ring with power steering fluid and install O-ring in valve body.

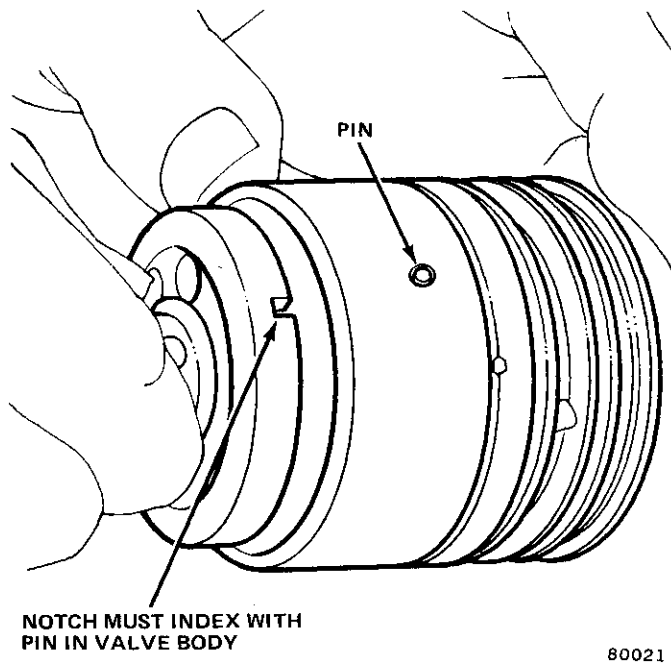


Fig. 2L-32 Stub Shaft Installation

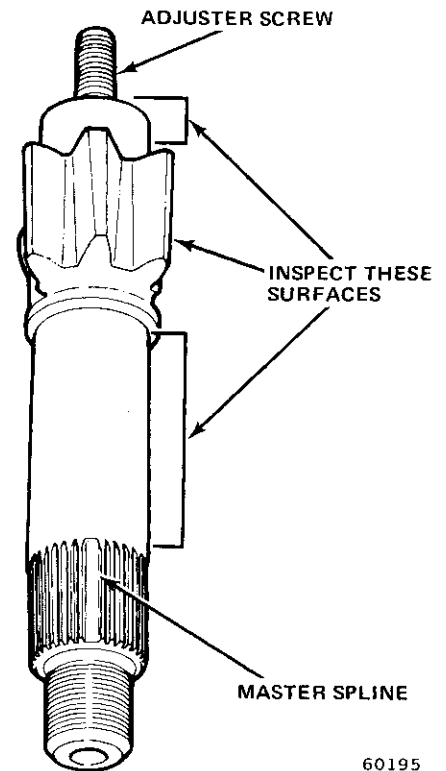


Fig. 2L-33 Pitman Shaft Inspection

**CAUTION:** Do not allow the stub shaft to disengage from the valve body pin. If disengagement occurs, the spool valve will extend too far into the valve body, allow the damper O-ring to expand into the valve body grooves and prevent valve withdrawal. If disengagement occurs, attempt to remove the valve using a pull and turn motion. If this fails, proceed as follows: First be sure the spool valve is free to rotate, then place the valve body on a flat surface with the notched end of the valve body facing upward. Tap the spool valve with a wood or plastic rod until the damper O-ring is cut and remove the valve. Replace the damper O-ring and reassemble the valve body. Be sure all pieces of the cut O-ring are removed before assembly.

### Pitman Shaft and Side Cover

#### Cleaning and Inspection

Clean the shaft and cover with solvent and wipe them dry with lint free cloths.

Inspect the side cover bearing and mating surfaces for wear, distortion, scoring, or distortion. Replace the cover if it exhibits any of these conditions.

Inspect the pitman shaft bearing and seal surfaces and sector teeth for cracks, wear, pitting, or scoring (fig. 2L-33). Inspect the adjuster screw for looseness, damaged threads, or distortion. Replace the pitman shaft if any of these conditions are noted. However, light scoring, corrosion, or scratches on the shaft surfaces may be removed using crocus cloth.

Inspect the pitman shaft nut threads and master spline for damage (fig. 2L-33). If either of these surfaces are damaged, replace the shaft.

### Rack Piston and Wormshaft

#### Disassembly

- (1) Remove wormshaft, lower thrust bearing, and bearing races from rack piston.
- (2) Cut and remove seal ring and backup O-ring from rack piston. Discard seal ring and O-ring.
- (3) Remove ball return guide clamp attaching screws and remove return guide clamp.
- (4) Place rack piston on clean cloth and remove two-piece ball return guide, arbor tool, and ball bearings.

#### Cleaning and Inspection

Clean all components with solvent and dry them using filtered compressed air.

Inspect the wormshaft for wear, scoring, pitting, distortion, nicked threads, or cracks. Replace the wormshaft if it exhibits any of these conditions. Inspect the rack piston for scored, pitted, or nicked ball bearing grooves. Replace the wormshaft and rack piston as an assembly if either part is damaged.

Inspect the exterior surface of the rack piston for wear or scoring and be sure the seal ring seat is clean and free from burrs.

Inspect the rack piston teeth for chips, cracks, dents, or scoring. If either the wormshaft or rack piston are damaged, replace both parts as a matched set only.

Inspect each of the ball bearings for dents, nicks, excessive wear, flaking, or flat spots and replace as necessary. Inspect the ball return guides. Be sure the guide ends, where the bearings enter and leave the guides, are free of burrs or distortion.

Inspect the lower thrust bearing and bearing races for wear or scoring. Replace any parts that are damaged or worn.

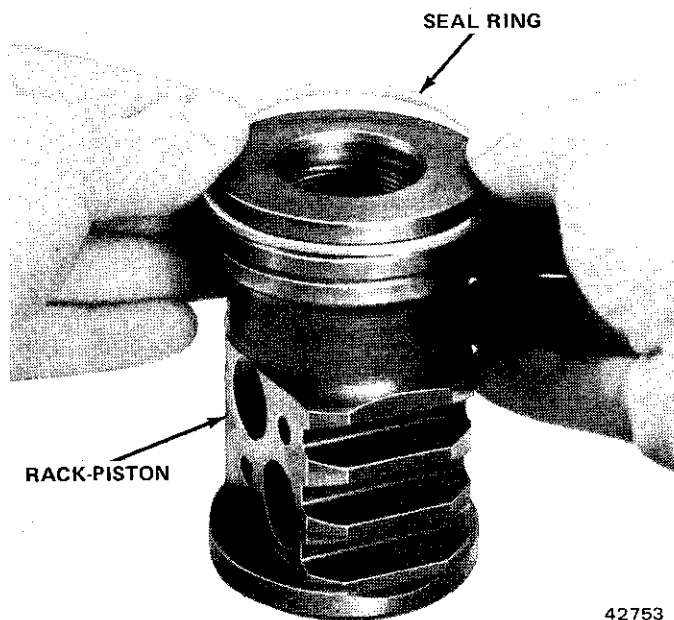
**Assembly**

(1) Lubricate all components with power steering fluid.

(2) Install backup O-ring in rack piston seal ring groove.

(3) Install seal ring over backup O-ring (fig. 2L-34).

**NOTE:** The seal ring may appear slightly loose after installation, however, this is normal. The seal ring will tighten when exposed to system fluid at operating temperature.



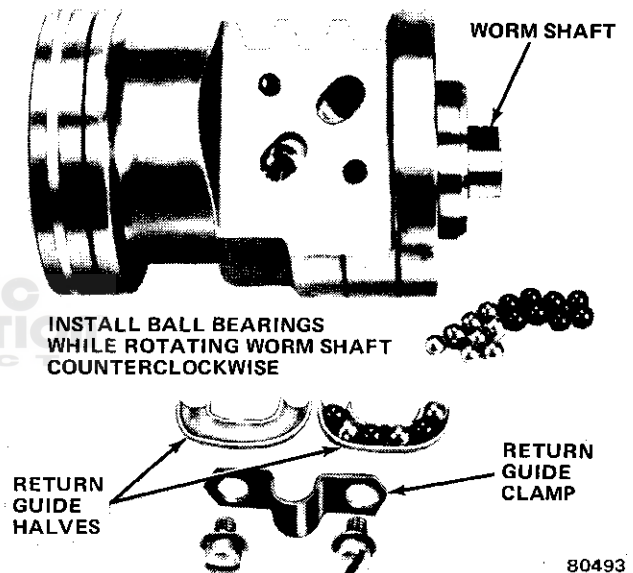
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Fig. 2L-34 Rack Piston Seal Ring Installation

(4) Install wormshaft in rack piston.  
 (5) Align ball return guide holes with wormshaft grooves.

(6) Alternately install 18 ball bearings in rack piston bearing circuit hole adjacent to seal ring (fig. 2L-35). Install silver ball bearing followed by black ball bearing until 18 bearings have been installed. Rotate wormshaft slowly in counterclockwise direction when installing bearings and press each bearing downward to make room for following bearing.

**NOTE:** The wormshaft will back out of the rack piston when rotated during bearing installation. Do not allow the wormshaft to back completely out of the rack piston.



80493

Fig. 2L-35 Rack Piston Ball Bearing Installation

(7) Fill one ball return guide half with petroleum jelly and install six remaining ball bearings in guide (fig. 2L-35). Be sure bearings in guide are in sequence with bearings in rack piston and that total of 24 ball bearings are installed (18 in rack piston and 6 in return guide).

(8) Assemble both ball return guide halves and insert guides in rack piston. Guides should fit loosely.

(9) Position ball return guide clamp over guides and install clamp attaching bolts and washers. Tighten bolts to 10 foot-pounds (14 N•m) torque.

(10) Insert Arbor Tool J-21552 into rack piston until it contacts wormshaft.

(11) Apply steady pressure against arbor tool to maintain contact with wormshaft and back wormshaft out of rack piston.

**NOTE:** Do not allow the arbor tool and wormshaft to separate during wormshaft removal. The ball bearings could drop out of their circuits and fall inside the rack piston making another disassembly/assembly procedure necessary.

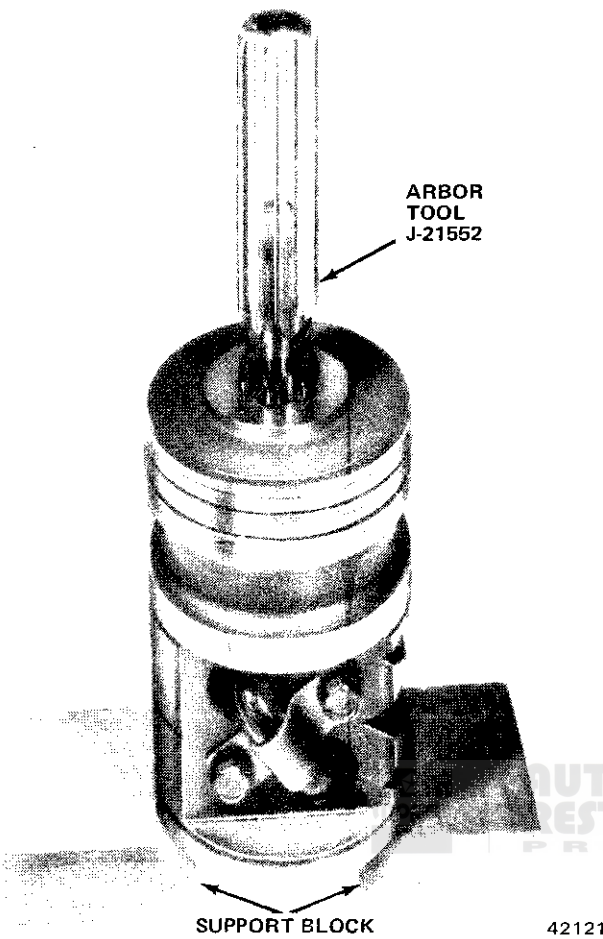


Fig. 2L-36 Arbor Tool Installed In Rack Piston

(12) Position assembled rack piston and arbor tool on end and support assembly on wood blocks until ready to install in housing (fig. 2L-36).

**NOTE:** Do not allow the arbor tool to separate from the rack piston.

### STEERING GEAR ASSEMBLY AND ADJUSTMENT

(1) Lubricate all components with power steering fluid.

(2) Remount steering gear in vise (fig. 2L-12). Clamp unmachined boss portion of housing in vise only.

(3) Install wormshaft lower thrust bearing and bearing races on wormshaft. Installation sequence is: race—bearing—race (fig. 2L-37). Coned sides of races must face rack piston when installed.

(4) Install stub shaft cap O-ring in valve body (if not installed previously). Be sure O-ring is seated against edge of stub shaft cap.

(5) Insert wormshaft into valve body. Rotate wormshaft until drive lugs engage in stub shaft cap and wormshaft locating pin engages in valve body notch (fig. 2L-38).

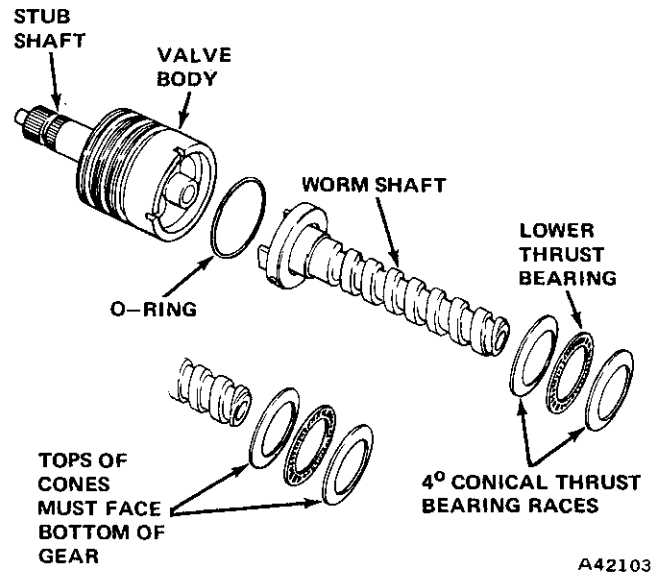


Fig. 2L-37 Wormshaft and Valve Body Assembly

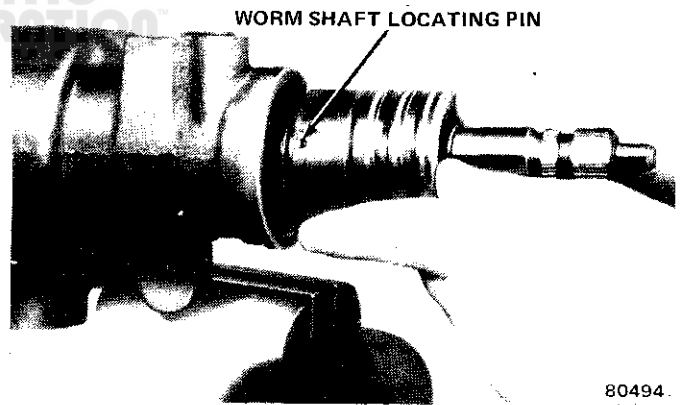


Fig. 2L-38 Valve Body-Wormshaft Installation

(6) Install assembled valve body and wormshaft in housing. Be sure wormshaft locating pin is still fully engaged in valve body notch before installing (fig. 2L-38).

**CAUTION:** Do not press against the stub shaft to install the valve body and wormshaft. This could cause the stub shaft to disengage from the valve body allowing the spool valve O-ring to slip into the valve body oil grooves. Perform installation by pressing directly on the valve body with the fingertips only (fig. 2L-38). In addition, be sure the valve body is properly seated before installing the adjuster plug. When the valve body is seated correctly, the fluid return port in the gear housing will be

fully visible (fig. 2L-39). If the port is not visible, the valve body and wormshaft are misaligned or the thrust bearing and races are improperly installed.

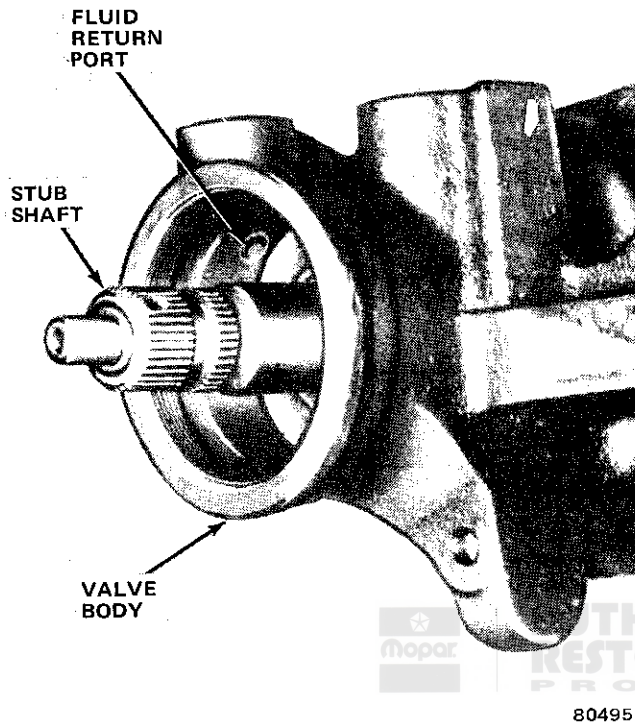


Fig. 2L-39 Seating Valve Body

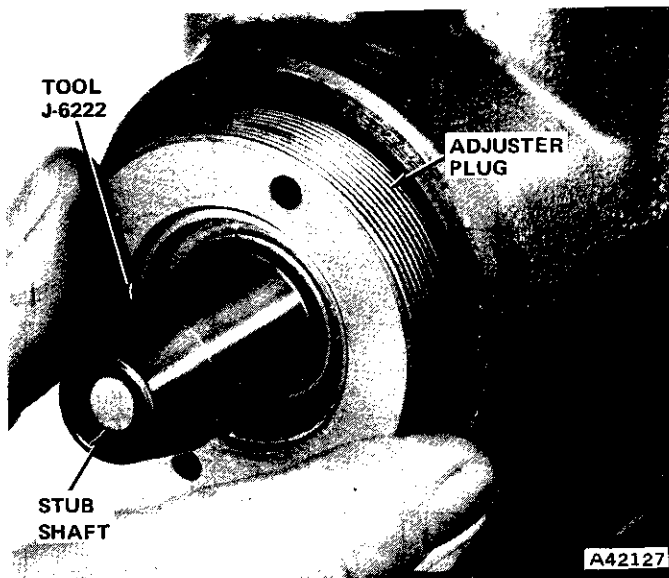


Fig. 2L-40 Adjuster Plug Installation

(7) Place Seal Protector Tool J-6222 over end of stub shaft and install adjuster plug in housing (fig. 2L-40). Tighten adjuster plug to 20 foot-pounds (27 N•m) torque.

(8) Remove seal protector tool from stub shaft.

(9) Install rack piston in housing. Be sure worm shaft remains engaged with stub shaft. Do not damage rack piston seal ring during installation.

(10) Align wormshaft with rack piston and turn stub shaft clockwise to engage wormshaft in rack piston. Maintain steady pressure on arbor tool until wormshaft is fully engaged in rack piston.

(11) Remove arbor tool when rack piston seal ring is inside housing.

(12) Rotate stub shaft until center tooth groove in rack piston is aligned with center of pitman shaft bore.

(13) Install side cover gasket on side cover. Be sure gasket rubber seal is seated in cover groove.

(14) Install side cover on pitman shaft.

(15) Thread side cover onto pitman shaft adjuster screw until cover bottoms against shaft.

(16) Install pitman shaft in housing and mesh center sector tooth of shaft with center tooth groove in rack piston.

(17) Align side cover on housing and install cover attaching bolts. Tighten bolts to 45 foot-pounds (61 N•m) torque. Be sure cover gasket is properly seated before installing cover bolts.

(18) Thread adjuster screw locknut half-way onto pitman shaft adjuster screw. Use hex wrench to prevent adjuster screw from turning while installing locknut.

(19) Install end plug in rack piston and tighten plug to 50 foot-pounds (68 N•m) torque.

(20) Lubricate housing end plug O-ring with petroleum jelly.

(21) Install housing end plug and seat plug against O-ring. If necessary, tap end plug lightly with plastic mallet to seat it. Do not displace O-ring during installation.

(22) Install housing end plug retainer ring. Position ring end gap one inch (25.4 mm) away from hole in side of housing. Tap end plug lightly to be sure plug and retainer ring are seated.

(23) Adjust wormshaft bearing preload and pitman shaft overcenter drag torque as outlined in Steering Gear Adjustment.

### Steering Gear Adjustment

The steering gear requires two adjustments which are: wormshaft bearing preload and pitman shaft overcenter drag torque.

Wormshaft bearing preload is controlled by the amount of compression force exerted on the conical wormshaft thrust bearing races by the adjuster plug.

Pitman shaft overcenter drag torque is controlled by the pitman shaft adjuster screw which determines the clearance between the rack piston and pitman shaft sector teeth.

## 2L-34 POWER STEERING GEAR AND PUMP

**CAUTION:** The following adjustment procedures must be performed exactly as described and in the sequence outlined. Failure to do so can result in damage to the gear internal components and poor steering response. Always adjust wormshaft bearing preload first; then adjust pitman shaft overcenter drag torque last.

### Wormshaft Bearing Preload

(1) Seat adjuster plug in housing using Spanner Wrench J-7624 (fig. 2L-16). Approximately 20 foot-pounds (27 N•m) torque is required to seat plug.

(2) Place index mark on gear housing in line with one of the holes in adjuster plug (fig. 2L-41).

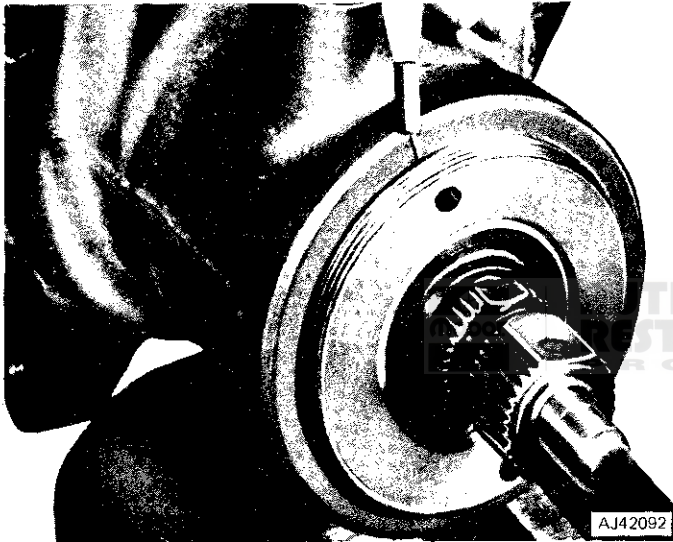


Fig. 2L-41 Marking Housing

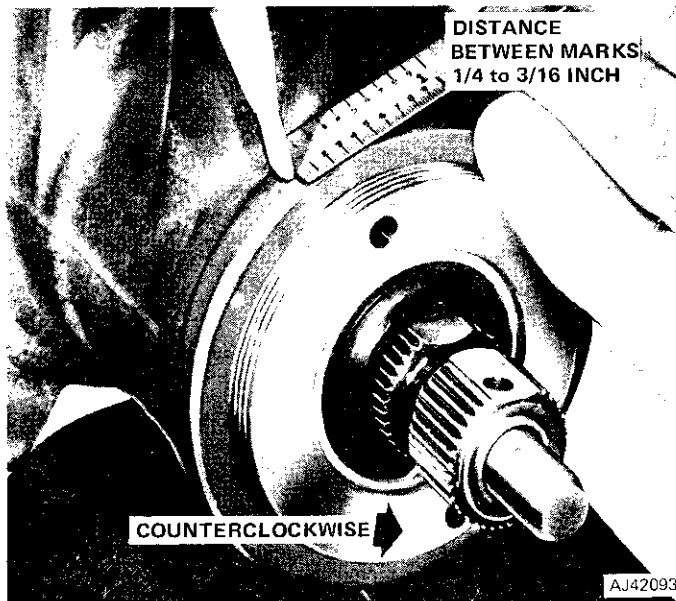


Fig. 2L-42 Remarking Housing

(3) Measure back (counterclockwise) 3/16 to 1/4 inch (4.7 to 6.35 mm) from first index mark and remark housing (fig. 2L-42).

(4) Turn adjuster plug counterclockwise and align adjuster plug hole with second mark made on housing.

(5) Install adjuster plug locknut. Place spanner wrench on adjuster plug to prevent it from turning and tighten locknut to 85 foot-pounds (115 N•m) torque using tool J-25194. Do not allow the adjuster plug to turn while tightening locknut.

(6) Turn stub shaft clockwise to stop, then turn stub shaft back one-quarter turn.

(7) Assemble torque wrench with maximum capacity of 50 inch-pounds (6 N•m) and 12-point deep socket and install wrench on splined end of stub shaft (fig. 2L-43).

(8) Measure torque required to turn stub shaft. Take torque reading with beam of torque wrench at or near vertical position while turning stub shaft at an even rate (fig. 2L-43).

(9) Record reading. Torque required to turn stub shaft should be 4 to 10 inch-pounds (0.45 to 1.1 N•m) torque.

**NOTE:** If the measured torque reading is above or below the specified limits, the adjuster plug may have turned when the locknut was tightened, or the gear may be incorrectly assembled, or the wormshaft thrust bearings and races may be defective. Repair as required and remeasure preload.

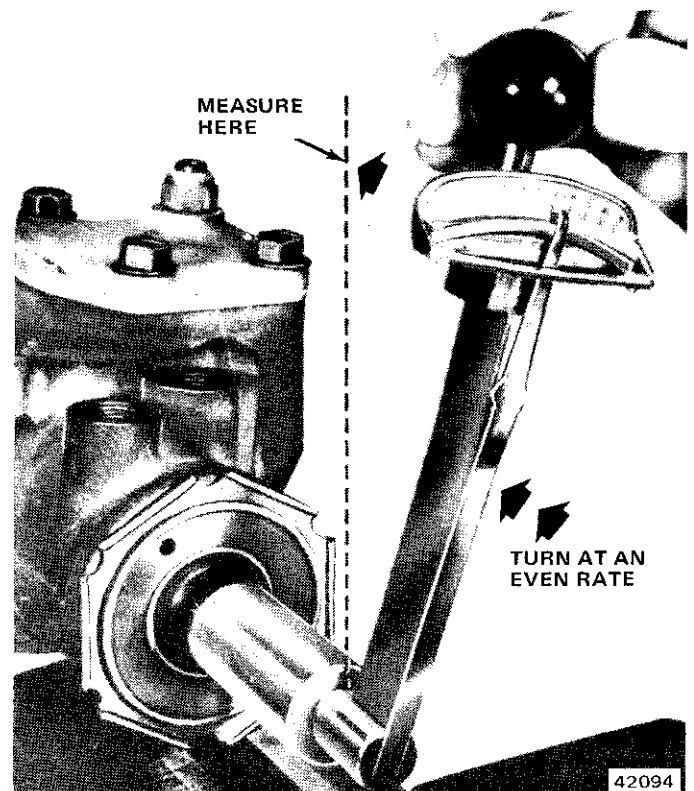


Fig. 2L-43 Measuring Wormshaft Bearing Preload

### Pitman Shaft Overcenter Drag Torque

(1) Turn pitman shaft adjuster screw counterclockwise until screw is fully extended, then turn screw back 1/2 turn clockwise.

(2) Rotate stub shaft from stop-to-stop and count total number of turns.

(3) Starting from either stop, turn stub shaft back 1/2 total number of turns. This is gear center.

**NOTE:** When the gear is centered, the flat on the stub shaft should face upward and be parallel with the side cover (fig. 2L-44). In addition, the master spline on the pitman shaft should be in line with the adjuster screw (fig. 2L-45).

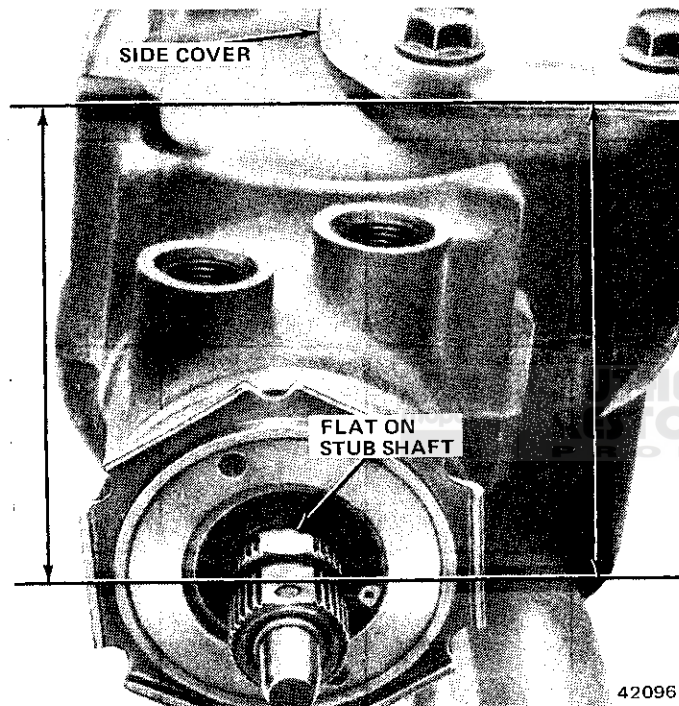


Fig. 2L-44 Stub Shaft Position With Gear Centered

(4) Install 50 inch-pound (6 N•m) torque wrench and deep socket on stub shaft and place wrench in vertical position to take reading (fig. 2L-46).

(5) Rotate torque wrench 45 degrees each side of center and record highest drag torque measured on or near center (fig. 2L-46). Record drag torque reading.

(6) Adjust drag torque by turning pitman shaft adjuster screw clockwise until desired drag torque is obtained. Adjust drag torque to following limits:

**On new gears**, add 4 to 8 inch-pounds (0.45 to 0.90 N•m) torque to previously measured wormshaft bearing preload **but do not exceed a combined total of 14 inch-pounds (2 N•m) drag torque.**

**On used gears (400 or more miles)**, add 4 to 5 inch-pounds (0.5 to 0.6 N•m) torque to previously measured wormshaft bearing preload **but do not exceed a combined total of 14 inch-pounds (2 N•m) drag torque.**

(7) Tighten pitman shaft adjuster screw locknut after adjusting overcenter drag torque. Tighten locknut to 35 foot-pounds (47 N•m) torque. Use hex wrench to prevent adjuster from turning while tightening adjuster

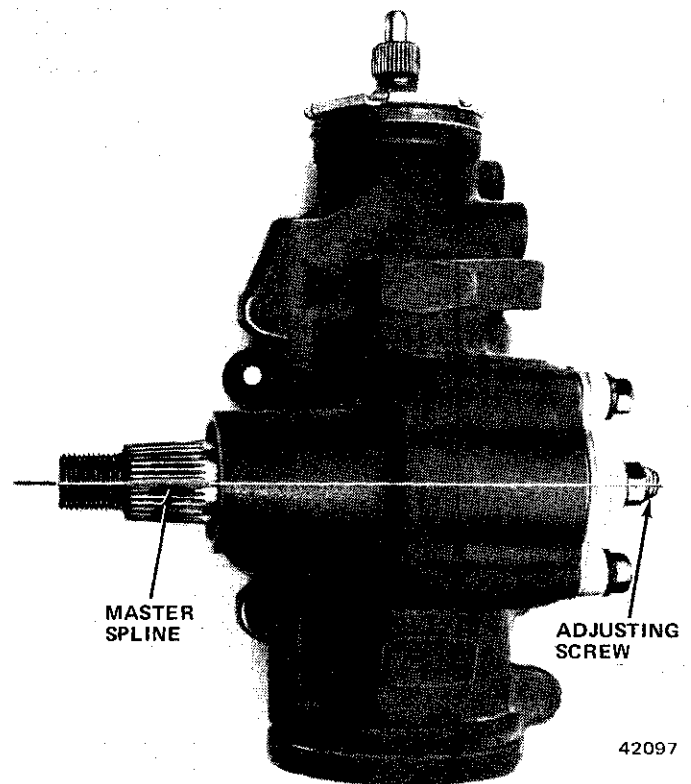


Fig. 2L-45 Pitman Shaft Master Spline Position With Gear Centered

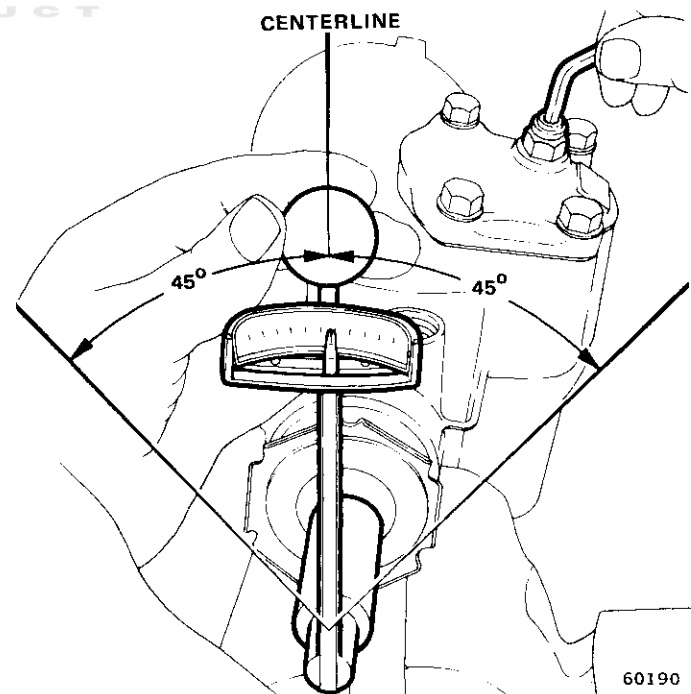


Fig. 2L-46 Measuring Pitman Shaft Overcenter Drag Torque

screw (fig. 2L-14).

(8) Install steering gear and fill power steering pump reservoir with Jeep Power Steering Fluid or equivalent.

(9) Bleed air from power steering system. Refer to Fluid Level and Initial Operation in Power Steering Pump section.



**SPECIFICATIONS**

**Power Steering Gear Specifications**

Type . . . . .	Recirculating Ball, worm and nut.	Steering Gear Adjustment:	
Bearings		Worm Bearing Preload . . .	4 to 10 inch-pounds (0.45 to 1.13 N·m) rotating torque. Refer to Steering Gear Adjustment.
Wormshaft Upper . . . . .	Needle Roller	Pitman Shaft Overcenter Drag Torque	
Lower . . . . .	Needle Roller	(New gear with less than 400 miles service) . . . . .	.4 to 8 inch-pounds (0.45-to 0.90 N·m) in addition to worm bearing preload but not to exceed total of 14 inch-pounds (1.58 N·m)
Pitman Shaft. . . . .	Needle Roller	(Used gear with over 400 miles service) . . . . .	.4 to 5 inch-pounds (0.45 to 0.56 N·m) in addition to worm bearing preload but not to exceed total of 18 inch-pounds (2.03 N·m)
Fluids. . . . .	Use Jeep Power Steering Fluid or equivalent only. Do not use transmission fluid.	Steering Ratio	
Power Steering System Fluid Capacity . . . . .	1-1/4 pints (0.59 liters)	CJ. . . . .	17.5:1 constant ratio
		Cke-Wag-Trk. . . . .	13/16:1 variable ratio
		Valve Body . . . . .	Three-way, open center, rotary-type.



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**Torque Specifications**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Adjuster Plug Locknut . . . . .	85	75-95	115	102-129
Flexible Coupling-to-Stubshaft Clamp Bolt (CJ) . . . . .	45	40-50	61	54-68
Flexible Coupling-to-Stubshaft Clamp Bolt (Cke-Wag-Trk) . . . . .	30	25-35	41	34-47
Gear Mounting Bolts (Cke-Wag-Trk) . . . . .	70	60-80	95	81-108
Gear Mounting Bracket-to-Frame Bolts (CJ). . . . .	55	50-65	75	68-88
Hose Fittings . . . . .	30	25-35	41	34-47
Intermediate Shaft Clamp Bolt/Nut . . . . .	30	25-35	31	34-47
Mounting Bracket-to-Gear Bolts (CJ). . . . .	70	60-80	95	81-108
Pitman Arm Nut . . . . .	185	170-210	251	230-285
Pitman Shaft Adjuster Locknut. . . . .	33	27-37	45	37-50
Return Guide Clamp Bolt . . . . .	6	4-10	8	5-14
Rack-Piston End Plug. . . . .	50	45-55	68	61-75
Side Cover Bolts. . . . .	40	30-45	54	41-61

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

# POWER STEERING PUMP

	Page		Page
Fluid Level and Initial Operation	2L-39	Pump Installation	2L-40
In-Vehicle Service	2L-37	Pump Removal	2L-39
Pump Assembly	2L-41	Specifications	2L-43
Pump Disassembly	2L-40		

## IN-VEHICLE SERVICE

### Pump Shaft Seal and Pump Pulley

#### Removal

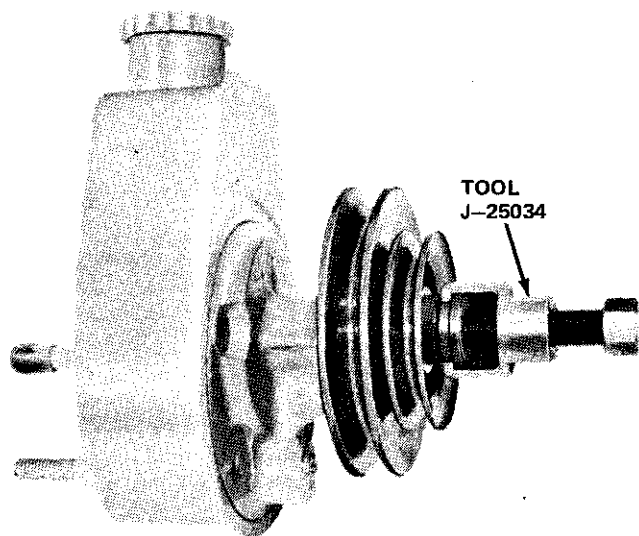
(1) Loosen pump belt adjusting bolts, push pump toward engine, and remove pump belt.

(2) Remove pump pulley using tool J-25034 (fig. 2L-47).

(3) Remove shaft seal using tool J-8842. Or, if seal remover tool is not available, remove seal as follows:

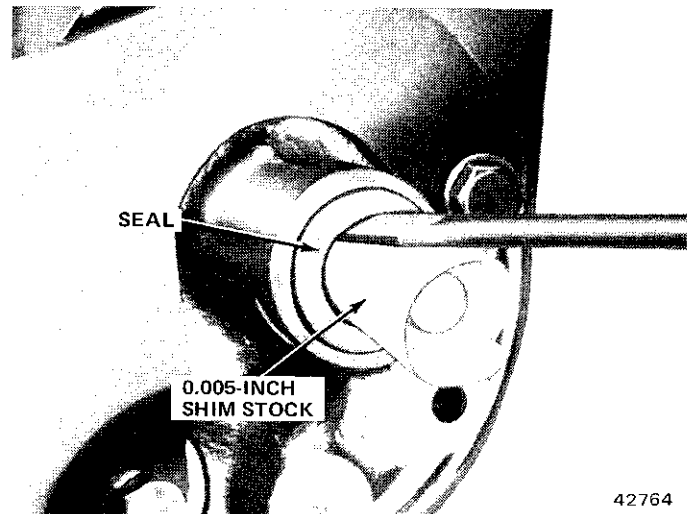
(a) Wrap length of 0.005-inch (0.12 mm) thick shimstock, approximately 2-1/2 inches (6.35 cm) long, around pump shaft. Work shimstock under and past shaft seal until shimstock bottoms in seal bore (fig. 2L-48).

(b) Cut metal body of shaft seal using sharp tool and pry seal out of pump body using screwdriver (fig. 2L-48). Do not scratch or nick pump shaft or seal bore during seal removal.



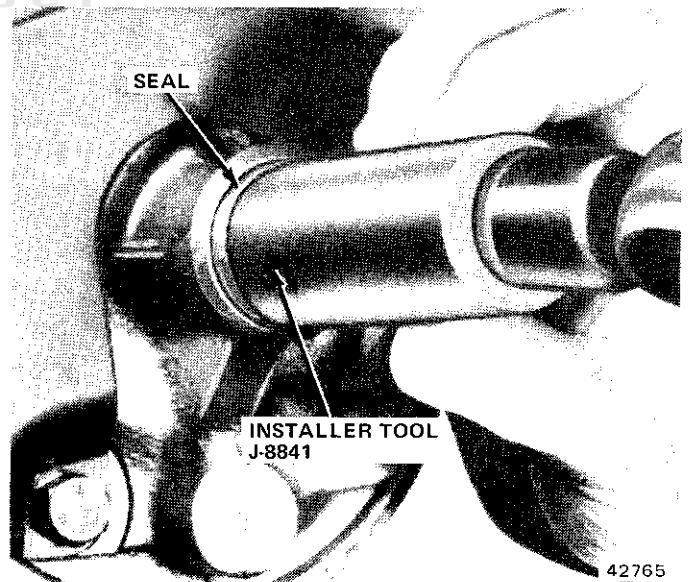
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Fig. 2L-47 Pump Pulley Removal



42764

Fig. 2L-48 Pump Shaft Seal Removal



42765

Fig. 2L-49 Pump Shaft Seal Installation

#### Installation

(1) Lubricate pump shaft and replacement seal with power steering fluid.

(2) Install seal on pump shaft and insert seal into pump body seal bore. Be sure spring side of seal faces toward pump body.

(3) Seat seal using tool J-7728 (fig. 2L-49).

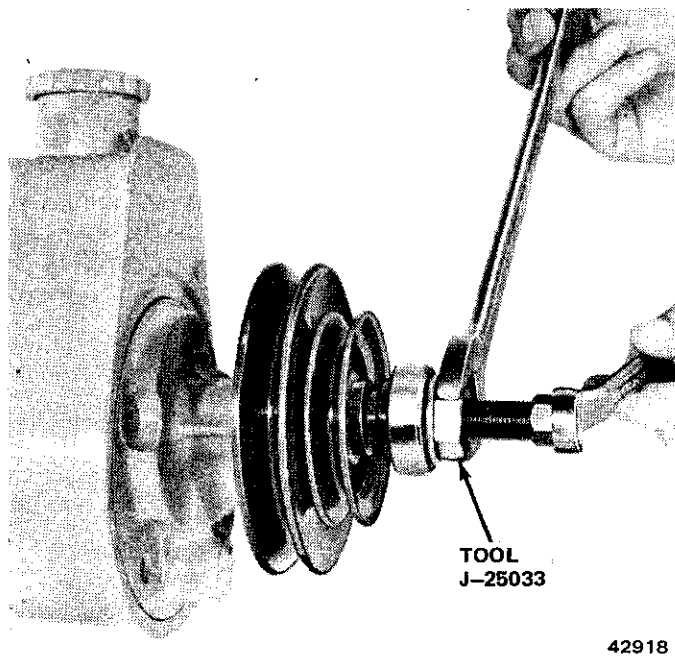


Fig. 2L-50 Pump Pulley Installation

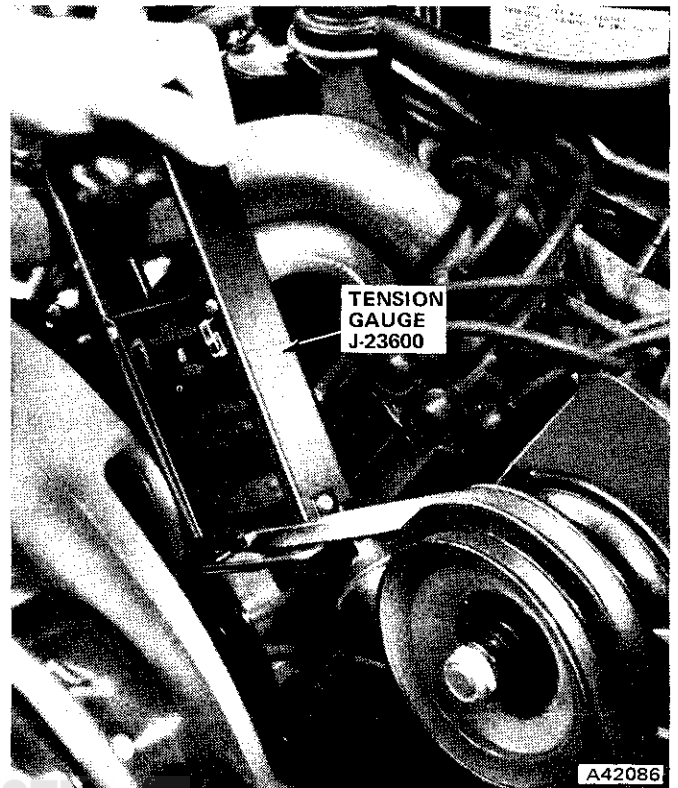


Fig. 2L-51 Checking Belt Tension

(4) Install pump pulley using tool J-25033 (fig. 2L-50).

(5) Install pump belt and adjust belt tension. Refer to Belt Tension Adjustment.

(6) Fill pump reservoir with power steering fluid and bleed air from system. Refer to Fluid Level and Initial Operation.

### Belt Tension Adjustment

Use Tension Gauge J-23600 to measure belt tension (fig. 2L-51). When using the gauge, position it at the center of the longest belt span to check tension. If checking tension on a notched belt, be sure the gauge finger is seated in one of the notched grooves in the belt.

(1) Loosen pump adjusting bracket bolts.

(2) Pull back on adjuster bracket with a 1/2-inch drive breaker bar until belt is tight. Tighten adjusting bracket bolts.

(3) Measure belt tension with gauge J-23600 (fig. 2L-51).

(4) Tighten or loosen pump belt until desired belt tension is obtained. Refer to Specifications for belt tension figures for various models.

(5) Tighten all pump mounting and adjusting bracket bolts to 30 foot-pounds (41 N•m) torque after adjusting belt tension.

### Flow Control Valve

#### Removal

- (1) Position drain pan under engine.
- (2) Disconnect pressure hose at pump. Cap hose to prevent dirt entry and excessive fluid loss.
- (3) Remove pump union fitting and O-ring (fig. 2L-52). Discard O-ring.
- (4) Remove flow control valve and spring using pencil-type magnet.

#### Installation

- (1) Lubricate replacement flow control valve and union fitting O-ring with power steering fluid.
- (2) Insert hex-end of flow control valve in replacement valve spring.
- (3) Install assembled valve and spring in pump bore, spring-end first.
- (4) Install replacement O-ring seal on pump union fitting and install fitting in pump. Tighten fitting to 35 foot-pounds (47 N•m) torque.
- (5) Connect pressure hose to pump. Tighten hose fitting to 35 foot-pounds (47 N•m) torque.
- (6) Fill pump reservoir with power steering fluid.
- (7) Start engine and check for leaks. Repair any leaks as necessary.
- (8) Bleed air from power steering system. Refer to Fluid Level and Initial Operation.
- (9) Remove drain pan.

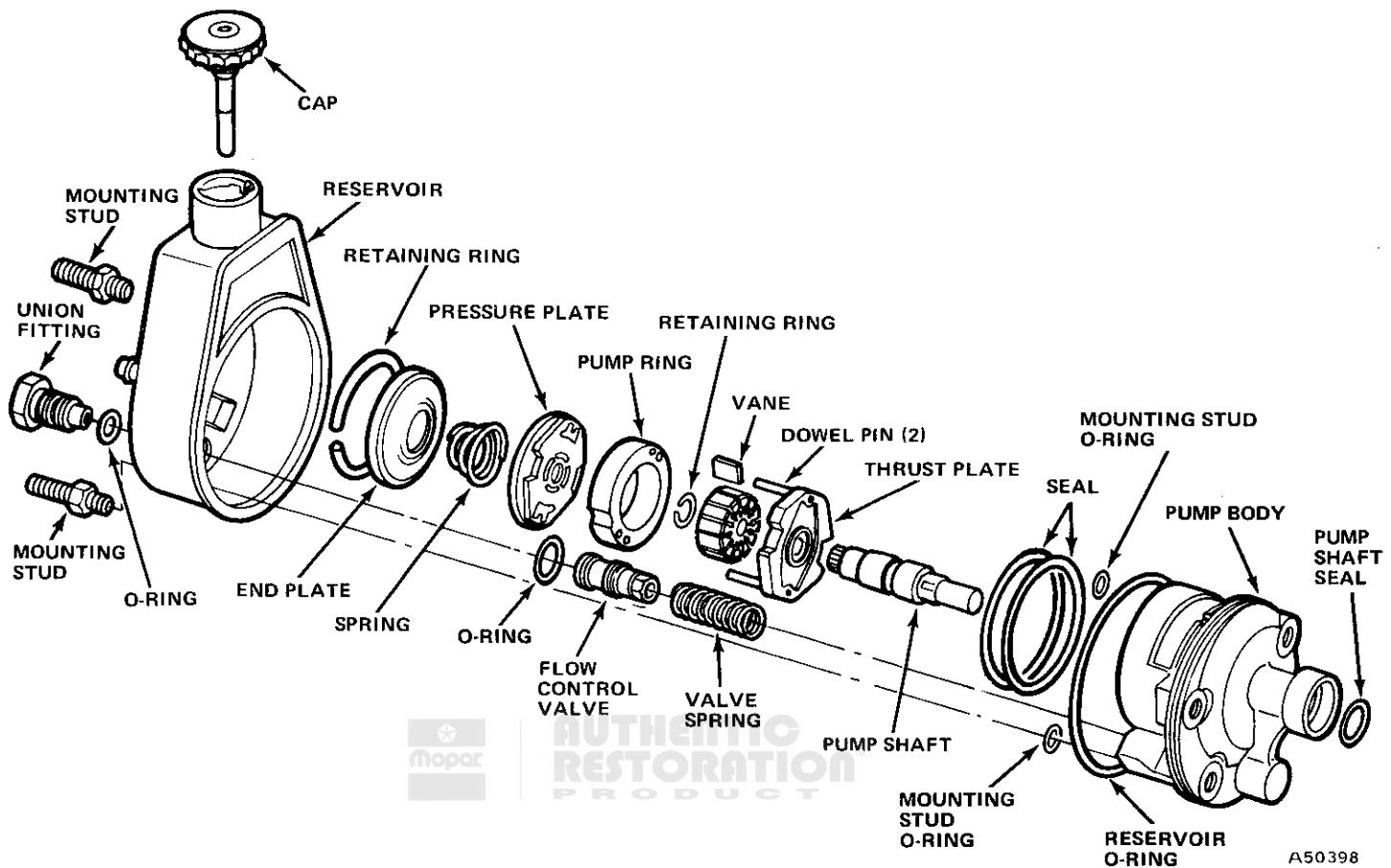


Fig. 2L-52 Power Steering Pump

## FLUID LEVEL AND INITIAL OPERATION

The power steering system must be purged of air whenever service procedures involving pump or gear disassembly or hose removal have been performed. Air must be removed from the system in order to obtain normal steering action and response. When necessary, bleed the power steering system as follows:

- (1) Fill pump reservoir with power steering fluid.
- (2) Operate engine until fluid reaches normal operating temperature of 170°F (76°C).
- (3) Stop engine.
- (4) Check and correct pump reservoir fluid level as necessary.
- (5) Turn wheels to full left turn position and add fluid to reservoir until at COLD mark on dipstick.
- (6) Start and operate engine at fast idle speed.
- (7) Recheck reservoir fluid level and add fluid until at COLD mark on dipstick.
- (8) Bleed air from system by turning wheels from side to side without contacting steering stops in either direction. Maintain fluid level just above pump body. Fluid with air in it will be full of bubbles and have light tan or tan-orange coloration.

(9) Continue turning wheels side to side until all air has been bled from system. Air must be eliminated before normal steering action can be obtained.

(10) When air has been purged from system, return wheels to straight-ahead position and operate engine for additional 2-3 minutes then stop engine.

(11) Road test vehicle to check steering action and response.

(12) Recheck fluid level. Level should be at HOT mark on dipstick after system has stabilized at normal operating temperature. Add fluid if necessary but do not overfill.

## PUMP REMOVAL

- (1) Loosen pump adjusting bracket bolts and nuts and remove pump belt. Also remove air pump belt if equipped.
- (2) Disconnect pressure and return hoses at pump. Cap hoses to prevent dirt entry.
- (3) On models with eight-cylinder engine, remove bolts attaching pump front mounting bracket to engine and remove pump and bracket as assembly.

## 2L-40 POWER STEERING GEAR AND PUMP

(4) On models with six-cylinder engine, remove pump mounting bolts and nuts and remove pump.

(5) On models with eight-cylinder engine, if pump is to be disassembled, remove front mounting bracket from pump.

### PUMP INSTALLATION

(1) On models with eight-cylinder engine, install front mounting bracket on pump.

(2) On all models, position pump in mounting bracket on engine and install pump-to-bracket attaching bolts and nuts.

(3) Fill pump reservoir with power steering fluid and turn pump pulley counterclockwise until bubbles no longer appear in fluid.

(4) Install pump drive belt. Also install air pump drive belt if equipped.

(5) Adjust belt tension. Pull back on adjuster bracket with breaker bar until belt is tight. Tighten adjusting bracket bolts.

(6) Check and adjust belt tension using Tension Gauge J-23600 (fig. 2L-51). Refer to Belt Tension Adjustment.

(7) Tighten all pump mounting bolts to 30 foot-pounds (41 N•m) torque.

(8) Fill pump reservoir and bleed air from power steering system. Refer to Fluid Level and Initial Operation.

### PUMP DISASSEMBLY

(1) Remove reservoir filler cap and drain fluid from pump.

(2) Reinstall filler cap and clean pump with solvent to remove exterior dirt.

(3) Remove pump pulley using tool J-25034 (fig. 2L-47).

(4) Mount pump in vise so pump shaft is pointing downward. Do not overtighten vise as pump body could be distorted.

(5) Remove pump union fitting and O-ring (fig. 2L-52). Discard O-ring.

(6) Remove pump mounting studs.

(7) Remove pump reservoir and reservoir O-ring. Rock reservoir back and forth to unseat it. Discard O-ring.

(8) Remove mounting stud O-rings from counterbores in pump body (fig. 2L-52). Discard O-rings.

(9) Remove end plate retaining ring. Unseat ring using punch inserted through 1/8 inch (3.17 mm) hole in pump body opposite flow control valve and remove ring using screwdriver (fig. 2L-53).

(10) Remove end plate and spring (fig. 2L-52). If plate sticks in pump body, tap plate lightly with plastic mallet to free it.

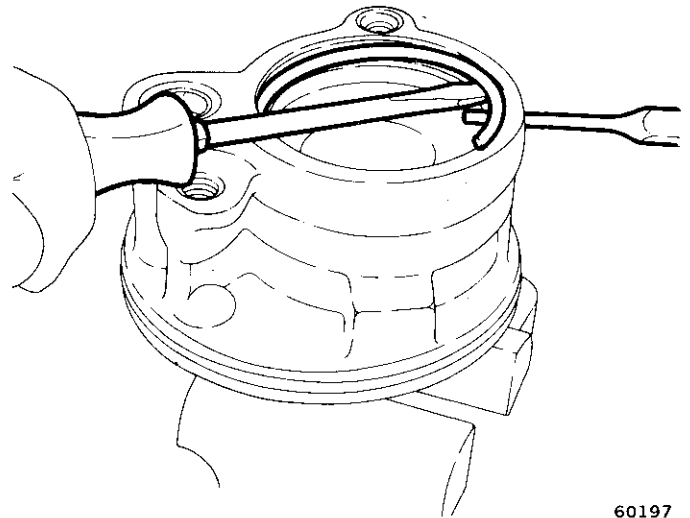


Fig. 2L-53 End Plate Retaining Ring Removal

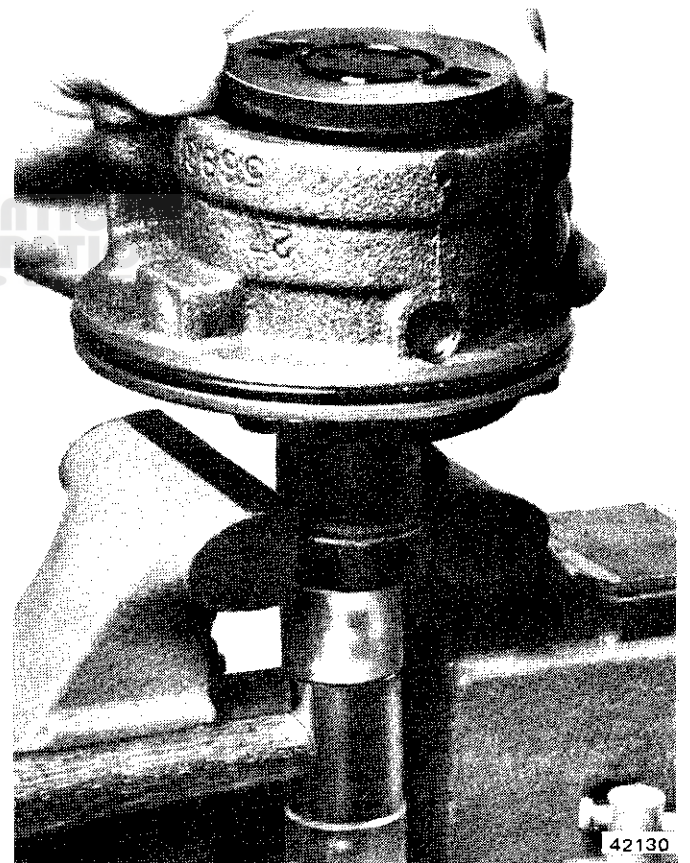


Fig. 2L-54 Pump Shaft Assembly Removal

(11) Remove flow control valve and valve spring from pump using pencil-type magnet. Or, remove pump from vise, invert pump, and allow valve and spring to slide out of pump bore.

(12) Remove pump shaft, thrust plate, rotor and vanes, pump ring, and pressure plate as assembly. Remount pump in vise so shaft bore faces downward and tap end of pump shaft with plastic mallet to remove assembly (fig. 2L-54).

(13) Remove pump shaft snap ring and remove pressure plate, pump ring, rotor and vanes, and thrust plate from shaft.

(14) Remove end plate O-rings from pump body bore. Discard O-rings.

(15) Remove pump shaft seal from pump shaft bore using tool J-8842.

### Cleaning and Inspection

Clean all parts in solvent and dry them using filtered compressed air.

Inspect the flow control valve and valve bore for pitting, scoring, or wear and inspect the valve spring for distortion or loss of tension. Insert the valve in the valve bore and check for free movement. The valve must not stick or bind. Replace the valve and spring as an assembly only if either part exhibits any of the above conditions. Replace the pump body if the valve bore is damaged.

Check the capscrew located in the end of the flow control valve. If loose, tighten it but take care to avoid scratching or scoring the valve surfaces. Minor surface irregularities can be removed using crocus cloth (only).

**NOTE:** The flow control valve and spring are serviced as an assembly only. Do not attempt to disassemble the flow control valve at any time.

Inspect the pressure plate, pump ring, and thrust plate surfaces for wear, cracks, scoring, or pitting. Also check the surfaces for flatness and for being parallel with the pump ring. Replace any part that is worn or damaged.

**NOTE:** A high polish will always be present on the pressure plate surfaces as a result of normal operating contact with the rotor. Do not confuse this polish with wear or scoring.

Inspect the rotor surfaces for pitting, wear, cracks, or scoring and check all the rotor vanes for free movement in the rotor slots. The vanes must not stick or bind. Replace the rotor if damaged or worn and replace the vanes if scored, worn, cracked, chipped, or if they stick or bind.

Inspect the pump shaft for nicks, scoring, wear, cracks, or worn splines. Replace the shaft if it exhibits any of these conditions.

Inspect the pump body and reservoir for cracks, porosity, or distortion and check the pump body bores and O-ring counterbores for damage. Replace either part if any of these conditions are noted.

### PUMP ASSEMBLY

**CAUTION:** Do not allow dirt to enter the pump during assembly. All parts must be clean and lubricated before installation. Perform all assembly operations on a clean work surface or a surface covered with clean, lint free

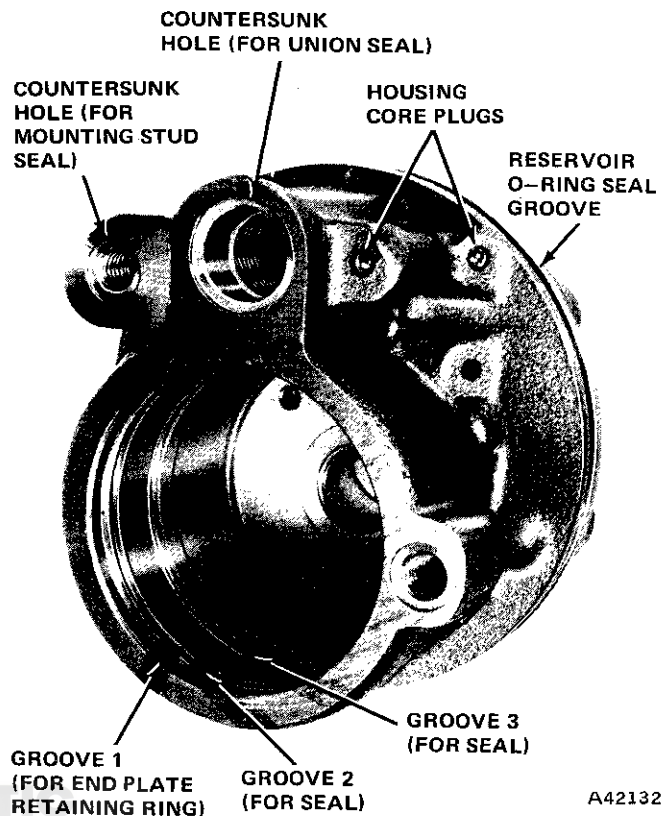


Fig. 2L-55 Pump O-Ring Seal Locations

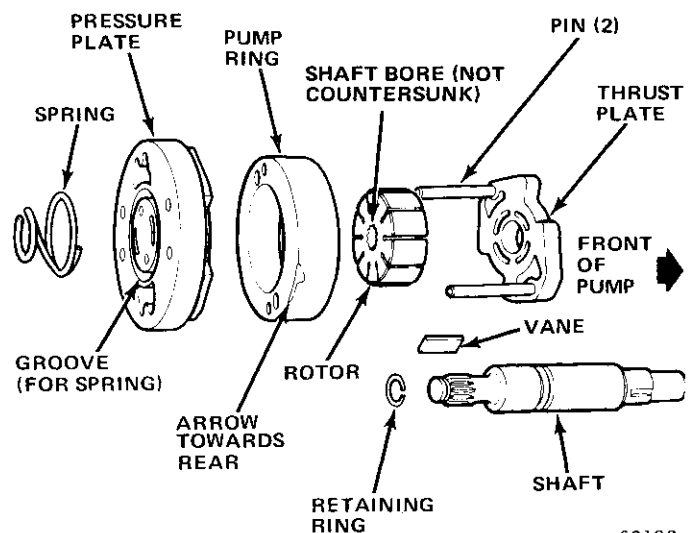


Fig. 2L-56 Pump Shaft Assembly Sequence

shop towels only. Install replacement O-rings, seals, and snap rings only during assembly. Used or worn seals will cause leaks, noise and rapid wear after assembly.

- (1) Lubricate pressure plate, end plate, and all replacement O-ring seals with petroleum jelly. Lubricate all other parts with power steering fluid.
- (2) Install one end plate O-ring seal in third (bottom) groove in pump body bore (fig. 2L-55).
- (3) Install dowel pins in thrust plate (fig. 2L-56).

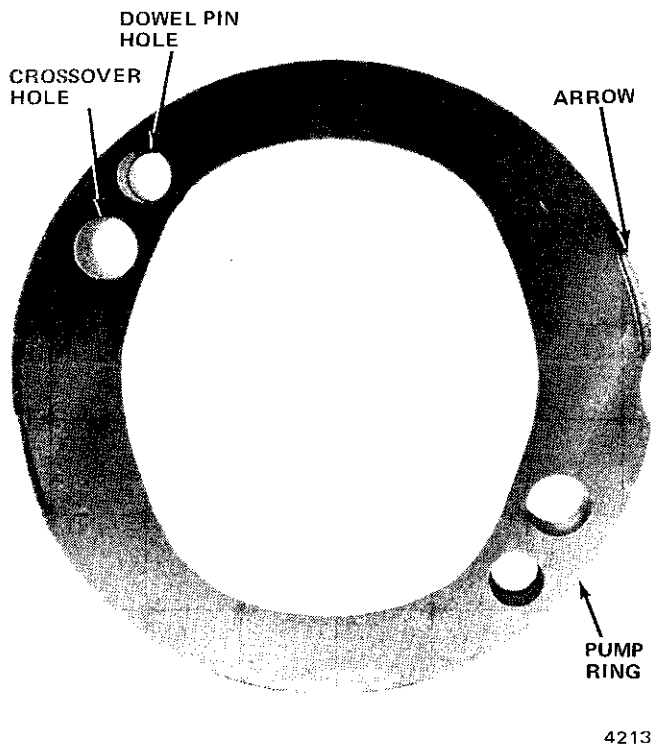


Fig. 2L-57 Pump Ring Dowel Hole Locations

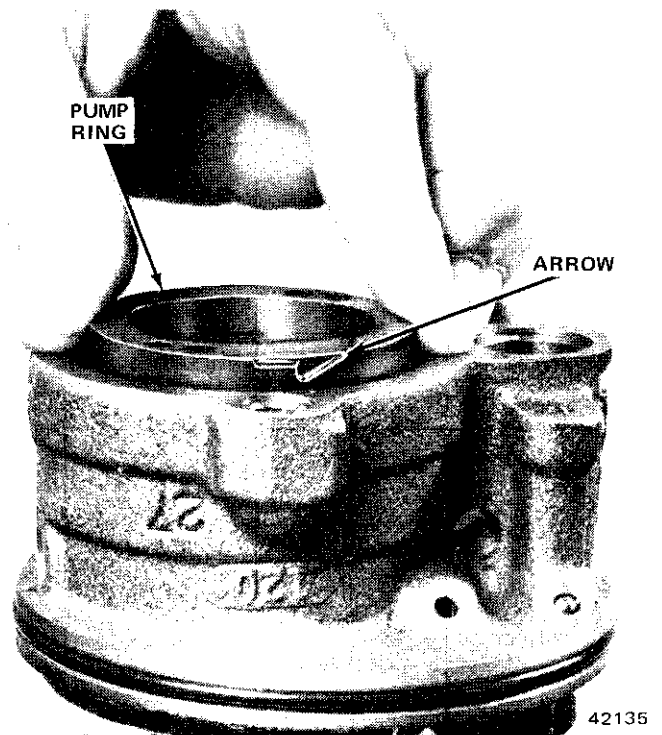


Fig. 2L-58 Pump Ring Installation

(4) Position rotor on thrust plate and align shaft bores in rotor and plate.

(5) Assemble pump shaft, thrust plate, and rotor. Insert splined end of shaft through thrust plate and rotor and install shaft snap ring (fig. 2L-56). Do not overspread snap ring. Open it only enough to install it.

(6) Install assembled thrust plate, rotor, and pump shaft in pump body bore.

(7) Align thrust plate dowel pins with dowel holes in pump ring (fig. 2L-57).

(8) Install pump ring on dowel pins and over rotor and thrust plate. Pump rotation arrow on pump ring must face upward when ring is installed (fig. 2L-58). Do not displace end plate O-ring during ring installation.

(9) Install rotor vanes in rotor slots (fig. 2L-59). Rounded edges of vanes must face outward.

(10) Lubricate pressure plate outside diameter and chamfered surface with petroleum jelly.

(11) Install pressure plate on thrust plate dowel pins. Spring groove in plate must face upward when installed (fig. 2L-56).

(12) Seat pressure plate using large socket. Position socket on plate and press downward approximately 1/16 inch (1.58 mm) to seat plate.

(13) Lubricate remaining end plate O-ring seal with petroleum jelly and install O-ring in second (center) groove in pump body bore (fig. 2L-55).

(14) Install pressure plate spring on pressure plate. Be sure spring is seated in plate spring groove (fig. 2L-56).

(15) Lubricate end plate outside diameter with petroleum jelly and install plate in pump body bore.

(16) Press end plate downward and install end plate retaining ring (fig. 2L-60).

(17) Insert hex end of flow control valve in valve spring and install assembled valve and spring in pump body valve bore (fig. 2L-61). Install assembly in valve bore spring-end first.

(18) Install mounting stud O-ring seals in pump body counterbores (fig. 2L-55). Lubricate O-rings with petroleum jelly before installation.

(19) Lubricate reservoir O-ring seal with petroleum jelly and install seal in pump body seal groove.

(20) Lubricate O-ring seal surface of pump reservoir with petroleum jelly and install reservoir on pump body. Be sure reservoir is aligned with mounting stud bores and seals.

**CAUTION:** Be careful to avoid displacing or damaging any of the O-ring seals during installation. Use a wood or plastic tool to keep the reservoir seal in its seal groove when installing the reservoir.

(21) Install mounting studs. Tighten studs to 35 foot-pounds (47 N•m) torque.

(22) Lubricate pump union fitting with petroleum jelly and install O-ring seal on pump union fitting.

(23) Install pump union fitting in flow control valve bore and tighten fitting to 35 foot-pounds (47 N•m) torque.

(24) Install pump pulley using tool J-25033 (fig. 2L-50).

(25) Install pump. Refer to Pump Installation.

(26) Fill pump reservoir and bleed air from system. Refer to Fluid Level and Initial Operation.

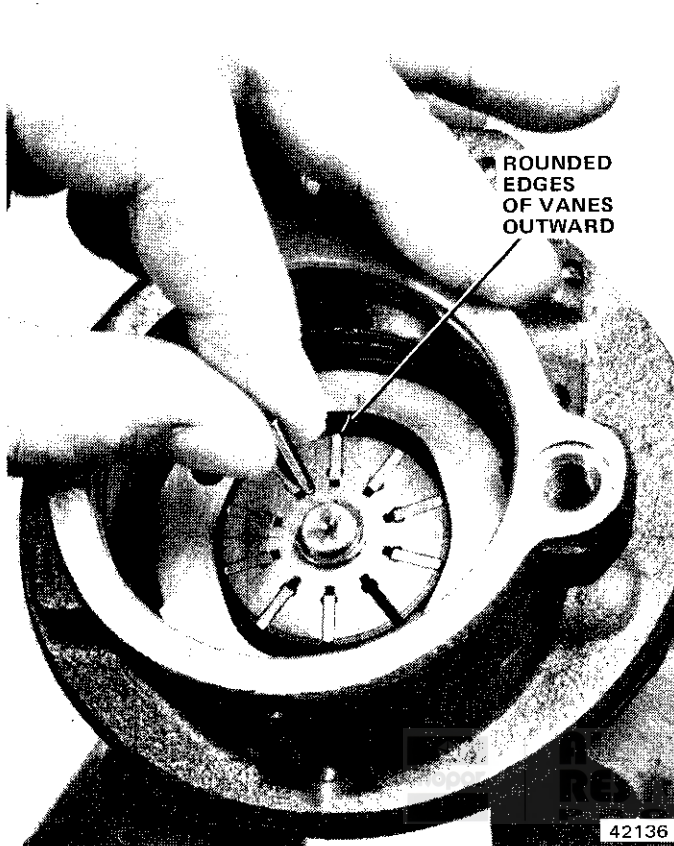


Fig. 2L-59 Rotor Vane Installation

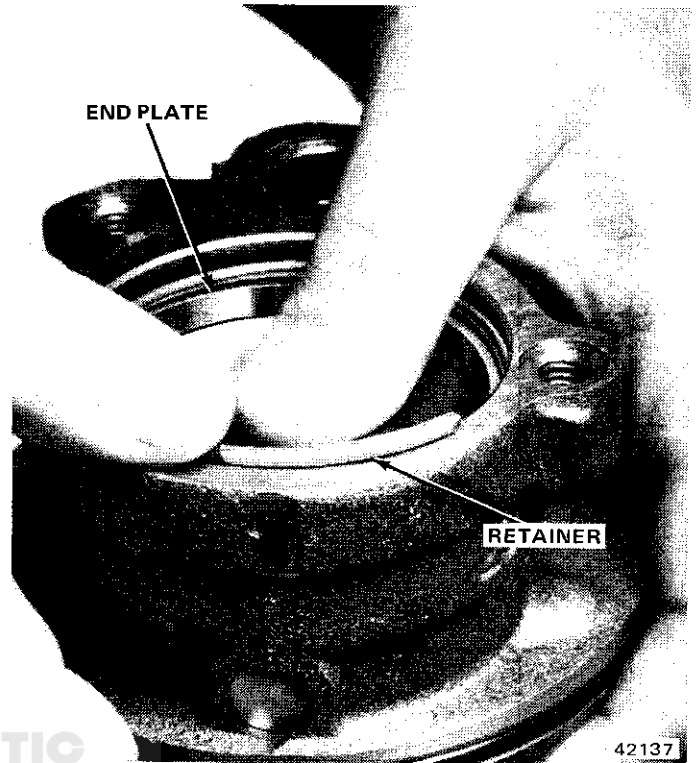


Fig. 2L-60 End Plate and Retaining Ring Installation

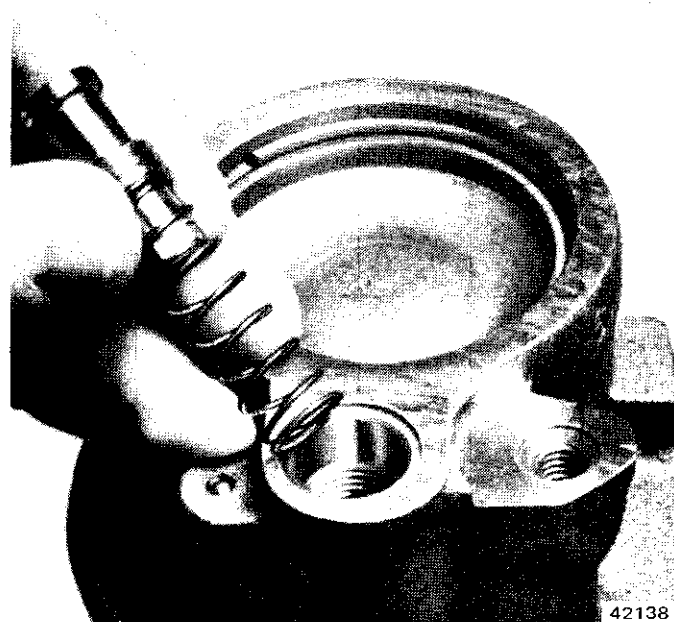


Fig. 2L-61 Flow Control Valve and Spring Installation

## SPECIFICATIONS

### Power Steering Pump Specifications

Pump Type	Vane-type, constant displacement, belt-driven hydraulic pump.
Capacity at 465 RPM	1.25 GPM
Flow Range	1.25 to 2.15 GPM
Relief Valve Setting (Maximum Pressure):	
CJ	1100-1200 psi (7584-8274 kPa)
Cke-Wag-Trk	1400-1500 psi (9653-10342 kPa)
Pressure Test Specifications:	
Initial pressure (engine at idle speed)	.80-125 psi (552-862 kPa)
Test pressures (gauge valve closed)	Pressures must be within maximum pressure specifications and not vary by more than 50 psi (345 kPa)
Turning	400 psi (2758 kPa)
Fluids	Use Jeep Power Steering Fluid or equivalent only. Do not use transmission fluid. Use fluids designed for power steering system use only.



## 2L-44 POWER STEERING GEAR AND PUMP

### Drive Belt Tension Specifications

	USA (pounds)		Metric (N)	
	New Belt*	Used Belt	New Belt*	Used Belt
Air Conditioner, Six-Cylinder . . . . .	125-155	90-115	556-689	400-512
Air Conditioner, Eight-Cylinder . . . . .	125-155	90-115	556-689	400-512
Air Pump (All except Six-Cylinder w/AC) . . . . .	125-155	90-115	556-689	400-512
Air Pump Six-Cylinder w/AC (3/8 inch belt) . . . . .	65-75	60-70	291-334	267-311
Fan . . . . .	125-155	90-115	556-689	400-512
Idler Pulley . . . . .	125-155	90-115	556-689	400-512
Power Steering Pump . . . . .	125-155	90-115	556-689	400-512

\*New belt specifications apply only to replacement belts. Once a belt has been tensioned and run, it is considered a used belt and should be adjusted to used belt specifications.

80503

### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Hose Fittings . . . . .	30	25-35	41	34-47
Pump Adjusting Bolts-Nuts . . . . .	35	30-40	47	41-54
Pump Mounting Bracket Bolts . . . . .	35	30-40	47	41-54
Pump Mounting Studs . . . . .	35	30-40	47	41-54
Pump Union Fitting . . . . .	35	30-40	47	41-54

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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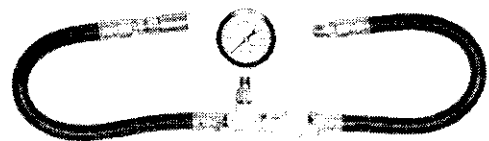
### Tools



J-4245  
SNAP-RING PLIERS



J-21553  
PITMAN SHAFT SEAL  
INSTALLER



J-21567  
PRESSURE TESTING GAUGE  
ASSEMBLY



J-21552  
RACK-PISTON ARBOR



J-6222  
ADJUSTER PLUG  
SEAL PROTECTOR



J-6221  
ADJUSTER PLUG  
BEARING REMOVER  
AND INSTALLER

J-21554  
ADJUSTER PLUG  
SEAL  
INSTALLER

J-6217  
CONNECTOR  
SEAT INSTALLER

J-8642  
SHAFT SEAL  
PROTECTOR

J-23600  
BELT TENSION  
GAUGE

J-8092  
HANDLE

J-7754  
TORQUE WRENCH  
(0-25 INCH POUNDS)

J-8841  
SEAL INSTALLER

J-21551  
PITMAN SHAFT  
BEARING REMOVER  
AND INSTALLER

J-6632  
PITMAN ARM  
PULLER

J-7624  
SPANNER  
WRENCH

J-25034  
REMOVER

J-8842  
SEAL REMOVER

J-25033  
INSTALLER

80501

70356

# STEERING LINKAGE 2M

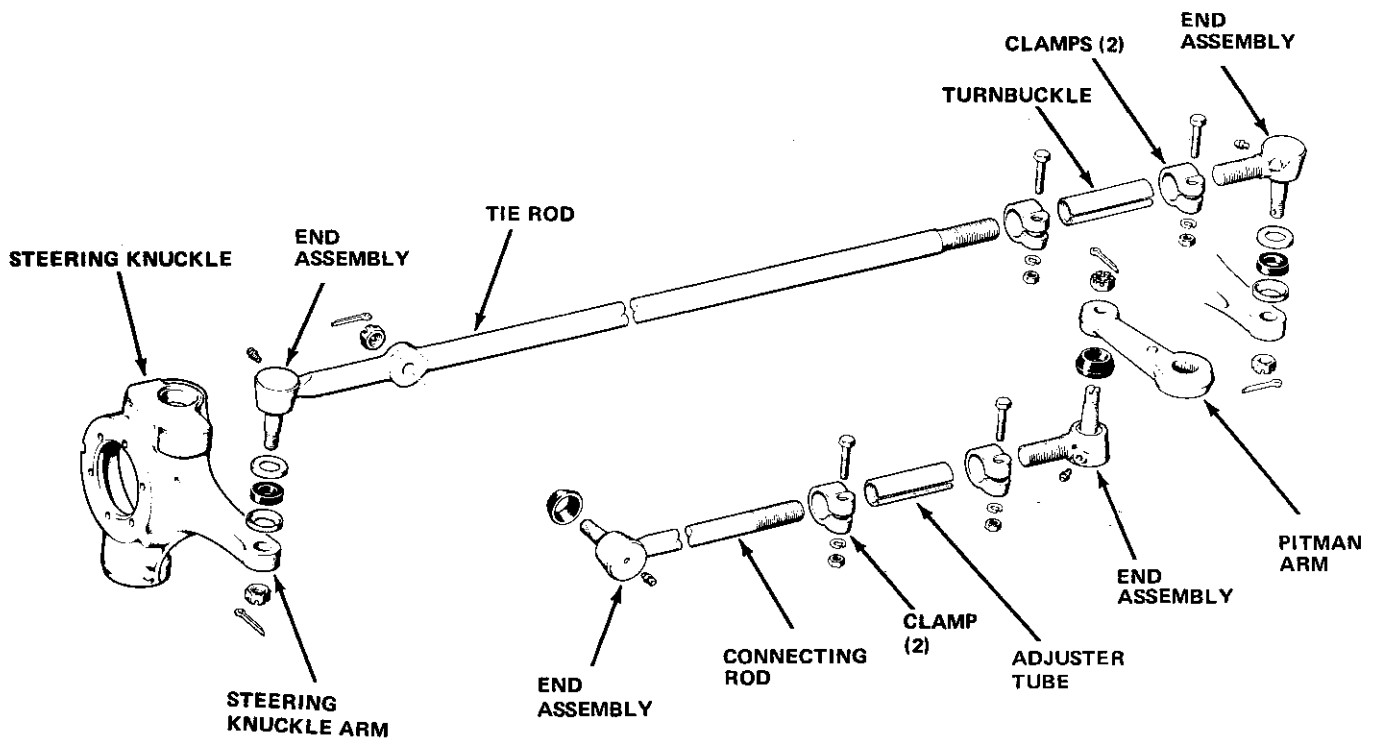
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Connecting Rod	2M-3
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Steering Wheel Spoke Alignment	2M-5
Tie Rod	2M-3

## GENERAL

The steering linkage consists of a steering gear pitman arm, a connecting rod, a tie rod, a steering damper, and an integral steering arm and steering knuckle. Ball ends and adjusting tubes are used on the tie rod and connecting rod for toe-in adjustment and steering wheel alignment (fig. 2M-1 and 2M-2).

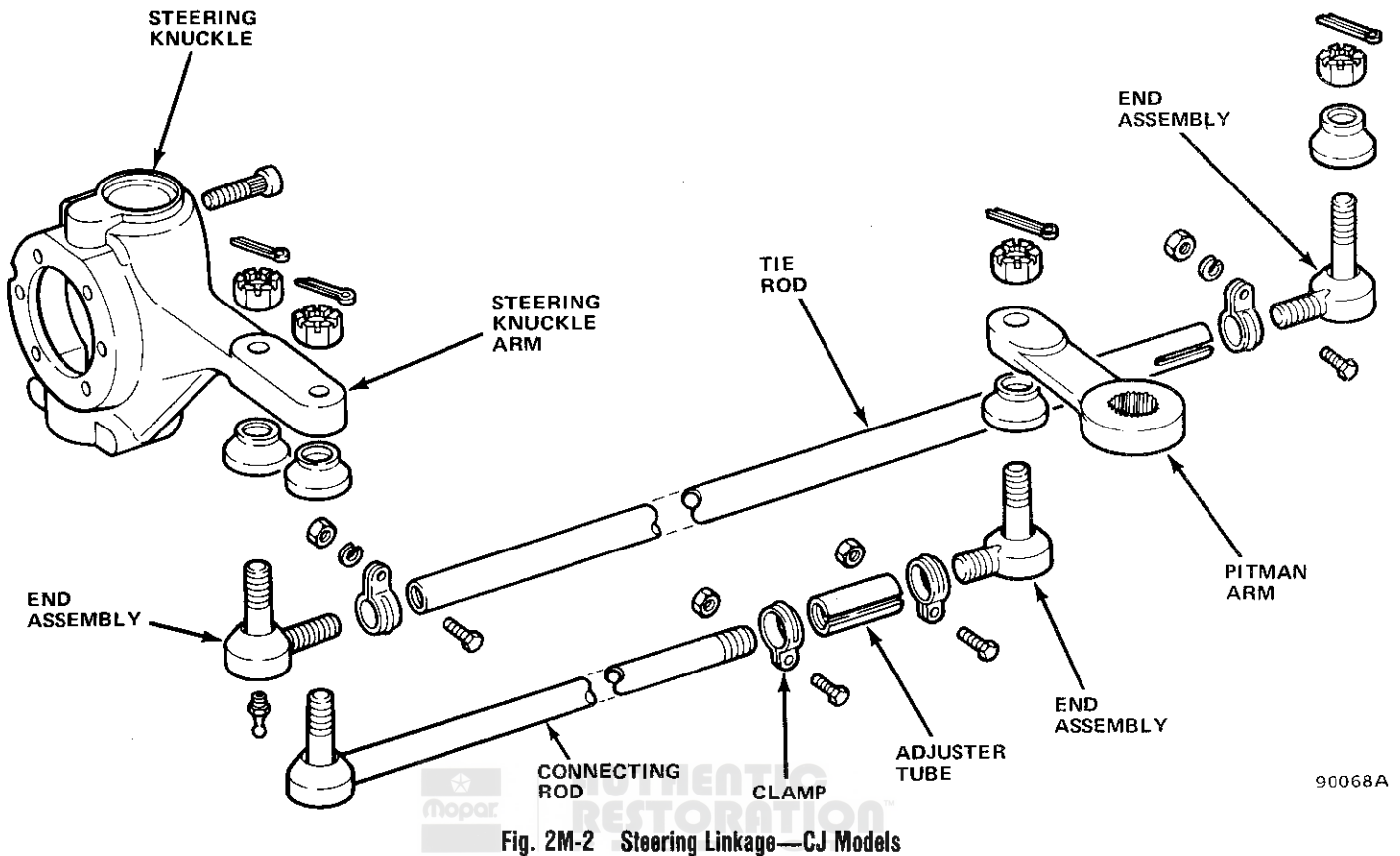
The connecting rod is attached to the pitman arm at one end and to the tie rod at the opposite end. The tie rod ends are connected to the steering knuckle arms. The steering damper is attached to the tie rod on one end and to a bracket on the left spring tie plate at the opposite end.



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Fig. 2M-1 Steering Linkage—Cherokee-Wagoneer-Truck

## 2M-2 STEERING LINKAGE



On Cherokee, Wagoneer and Truck models, the tie rod (fig. 2M-3) consists of a solid rod that is threaded on one end and has a ball end assembly at the opposite end. An adjusting tube and removable ball end complete the tie rod assembly. The tie rod threaded end has right-hand threads to accept the adjuster tube. On CJ models, the tie rod has ball ends and adjusting tubes at both ends. The ball end that connects to the tie rod is threaded into the adjusting tube. The tie rod has a large boss located about eight inches from the unthreaded end. A tapered hole machined in this boss accepts the connecting rod

end. The steering damper is connected to a bracket clamped to the center of the tie rod.

The connecting rod (fig. 2M-4) is threaded on one end and has a ball-end assembly at the opposite end. An adjusting tube and removable ball end complete the connecting rod assembly. On Cherokee, Wagoneer and Truck models, the end having the integral ball end assembly is connected to the tie rod. On CJ models, it is attached to the right hand steering arm. The threaded end, with the adjusting tube and removable ball end, is attached to the pitman arm.

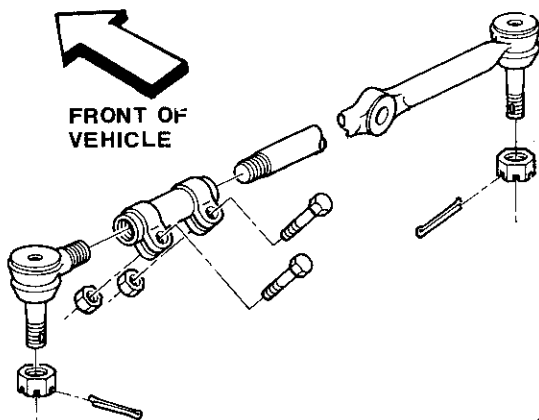


Fig. 2M-3 Tie Rod Assembly

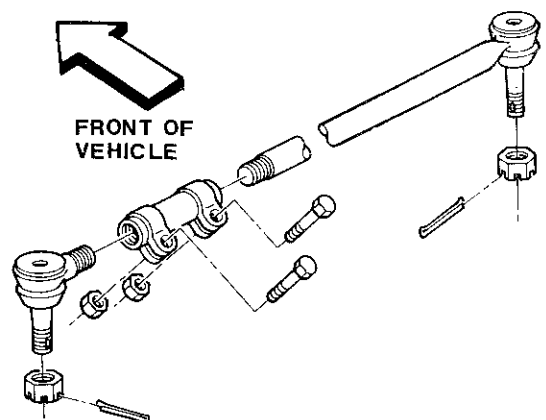


Fig. 2M-4 Connecting Rod Assembly

## Tie Rod

### Removal

- (1) Remove cotter pins and retaining nuts at both ends of tie rod and from end of connecting rod where it attaches to tie rod.
- (2) Remove nut attaching steering damper push rod to tie rod bracket and move damper aside.
- (3) Remove tie rod ends from steering arms and connecting rod using puller.

**NOTE:** After removal, the tie rod ends can be removed by loosening the adjusting tube clamp bolts and unthreading the ends.

### Installation

- (1) Attach tie rod ends to steering arms. Tighten nuts to 50 foot-pounds (68 N•m) torque and install replacement cotter pins.
- (2) Attach connecting rod to tie rod. Tighten nut to 60 foot-pounds (81 N•m) torque on CJ models and 70 foot-pounds (95 N•m) torque on Cherokee, Wagoneer and Truck. Install replacement cotter pin in retaining nut.
- (3) Attach steering damper to tie rod bracket.
- (4) Adjust toe-in as necessary.

## Connecting Rod

The steering connecting rod can be removed by removing the cotter pins and nuts from both ball ends and removing the rod. The steering connecting rod ball stud ends cannot be disassembled for service.

When installing the steering connecting rod, place the wheels in the straight-ahead position and place the steering arm parallel to the centerline of the vehicle. The steering gear pitman arm must be indexed with the alignment marks on the pitman arm and steering gear shaft and the steering gear must be centered. When the steering arm is correctly positioned, install the connecting rod.

## Steering Damper

The steering damper used on Cherokee, Wagoneer and Truck models has mounting eyelets at each end (fig. 2M-5). The damper used on CJ models has a mounting eyelet at the body end only as the push rod is threaded to accept a mounting bracket retaining nut (fig. 2M-6). The body end of the damper attaches to a stud on a bracket mounted between the left axle spring and axle spring pad. The push rod end is attached to a bracket that is clamped to the tie rod.

The steering damper is serviced as an assembly only. If damaged or leaking, replace the damper. However, the rubber mounting bushings used in the damper eyelets or on the push rod can be replaced individually if necessary.

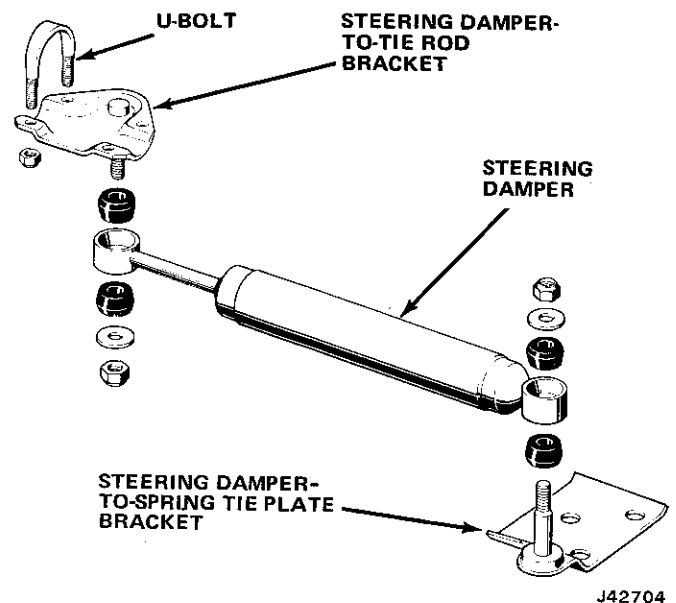


Fig. 2M-5 Steering Damper—Cherokee-Wagoneer-Truck

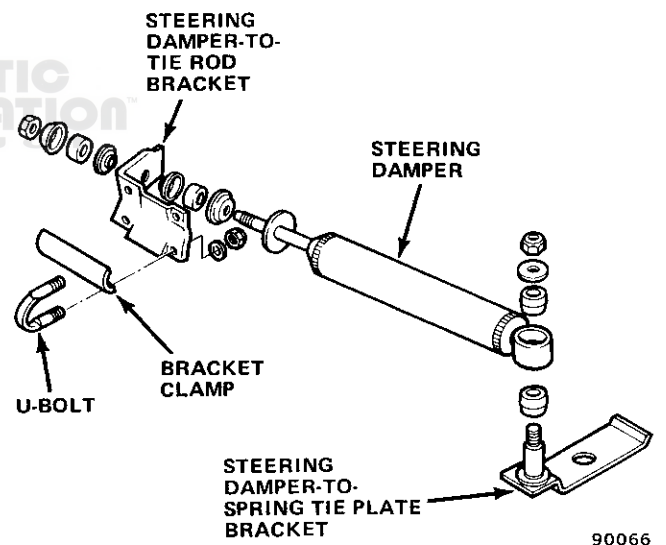


Fig. 2M-6 Steering Damper—CJ Models

### Removal

- (1) Place front wheels in straight-ahead position.
- (2) Remove locknut attaching damper to tie plate bracket and lift damper off stud.
- (3) Remove locknut attaching push rod end to tie rod bracket and remove damper assembly.

### Installation

- (1) Insert rubber bushings in damper eyelets or on push rod.
- (2) Position push rod on tie rod bracket stud and install attaching parts.
- (3) Install rubber bushings in damper body mounting eyelet.

## 2M-4 STEERING LINKAGE

(4) Extend damper piston rod (by pulling back on damper body) and install mounting eyelet on tie plate bracket stud.

(5) Install and tighten all locknuts securely.

### FRONT WHEEL ALIGNMENT

Alignment should be checked and adjusted using an alignment rack. To ensure correct alignment, the following inspection is recommended.

(1) Equalize tire pressures and place vehicle on level surface.

(2) Check steering gear-to-steering column alignment.

(3) Inspect steering knuckle pivots, spindle, and wheel bearings for looseness.

(4) Check for spring sag.

(5) Check brakes and shock absorbers for proper operation.

(6) Check steering gear adjustment.

(7) Check front and rear wheel tracking.

(8) Check for broken spring center bolts.

**NOTE:** Be sure all front suspension and steering system nuts and bolts are tight before checking wheel alignment.

(9) Check caster, camber and toe-in.

### Toe-In

Refer to figure 2M-7. The use of an alignment rack to measure toe-in is recommended.

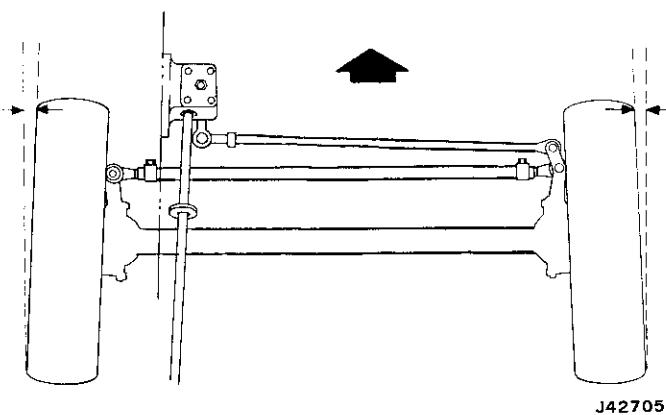


Fig. 2M-7 Front Wheel Toe-In (Top View)—Typical

The distance between the rear of the tires should be greater than at the front by  $\frac{3}{64}$  to  $\frac{3}{32}$  inch (1.19 to 2.38 mm).

To adjust toe-in, loosen the adjuster tube clamp bolts and turn the tie rod in or out with a small pipe wrench. The tie rod has both right and left-hand threads to provide equal adjustment at each wheel. After adjustment, tighten the clamp bolts to specified torque.

### Camber

Refer to figure 2M-8. Correct wheel camber of  $1\frac{1}{2}^\circ$  is preset in the front axle at the time of manufacture and cannot be altered by adjustment. It is important that camber be the same on both front wheels. Camber angle should be checked using wheel alignment equipment.

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

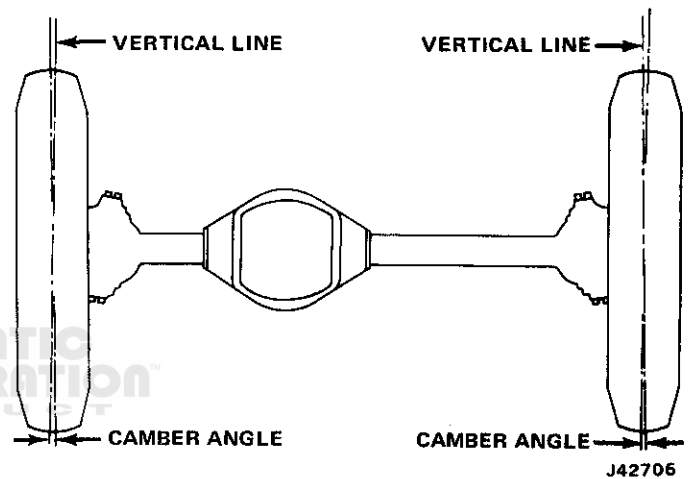


Fig. 2M-8 Front Wheel Camber (Front View)

### Caster

Refer to figure 2M-9. Axle caster is preset at  $+3^\circ$  for CJ models and  $+4^\circ$  for Cherokee, Wagoneer and Truck models. Caster should be checked using wheel alignment

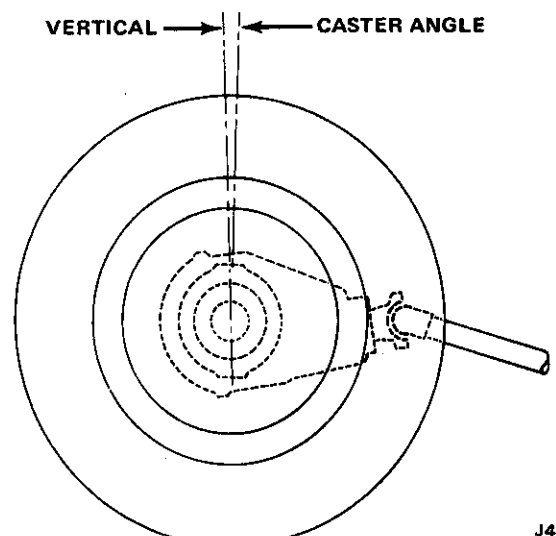


Fig. 2M-9 Front Wheel Caster (Side View)

equipment. If caster is incorrect, adjustment can be made by installing tapered shims between the axle pad and suspension springs.

If caster is correct and the axle is not bent or twisted, a satisfactory check may be made by road testing the vehicle and checking steering wheel return.

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

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

## STEERING WHEEL SPOKE ALIGNMENT

After checking and adjusting front wheel alignment, align the steering wheel spokes as follows:

- (1) Turn steering wheel until spokes are in centered position and clamp steering wheel in place.
- (2) Loosen connecting rod adjusting tube clamps and turn tube until front wheels are in straight ahead position.
- (3) Tighten adjusting tube clamps.
- (4) Road test and check steering wheel alignment.

## FRONT WHEEL SHIMMY

Front wheel shimmy can be caused by one or more of the following conditions:

- Loose front wheel bearings
- Worn, unbalanced, or out-of-round front tires
- Loose steering damper bracket
- Steering damper malfunction
- Worn or loose tie rod ends
- Worn, loose, or incorrectly preloaded steering knuckle ball studs
- Incorrect tire inflation pressures

The following procedure outlines a method for determining and correcting the causes of wheel shimmy:

- (1) Raise vehicle front end.
- (2) Inspect front tire condition and check and correct inflation pressures. Check tires for evidence of unbalance such as cupping, scalloping, flat spots, or bald spots. Balance or replace tires exhibiting these conditions.
- (3) Check and correct front wheel bearing adjustment if necessary. Refer to Chapter 2H for procedure.
- (4) Inspect steering damper mounting brackets or

retaining nuts for being loose. If loose, tighten nuts or center bracket on tie rod and tighten attaching bolts.

(5) Check steering damper operation. Disconnect damper at tie rod bracket and alternately compress and extend damper piston fully. Piston action should be smooth and uniform throughout each stroke. Higher resistance on extension stroke than compression stroke is normal condition.

(c) Replace damper if lack of resistance is evident.

(6) Inspect tie rod ends. Replace any tie rod end that exhibits excessive play.

(7) Inspect steering knuckle ball studs. Insert pry bar between knuckle and yoke, adjacent to ball stud, and pry against each stud. If studs do not move or appear to be loose in stud socket, proceed to next step. If any stud moves or appears loose, reseal both studs in that side of axle as follows:

- (a) Remove wheels and axle shafts.
- (b) Remove cotter pin and slotted from upper ball stud and loosen stud jamnut.
- (c) Unseat both ball studs by striking them with lead hammer and remove upper ball stud split ring seat using tool J-25158. Discard seat after removal.
- (d) Remove lower ball stud jamnut and remove steering knuckle. Discard jamnut after removal.
- (e) Clean split ring seat threads and lower stud taper in steering knuckle. Clean threads and tapered surfaces of both ball studs and clean threads in upper ball stud retaining nut.

(f) Position knuckle on axle yoke and install replacement lower ball stud jamnut finger tight (only).

(g) Install and tighten upper ball stud retaining nut until lower ball stud is pulled into tapered hole in axle yoke. Do not install split ring seat at this time.

(h) Tighten upper ball stud nut to 80 foot-pounds (108 N•m) torque then remove nut.

(i) Install and tighten replacement upper ball stud split ring seat to 50 foot-pounds (68 N•m) torque using tool J-25158. Tighten both upper ball stud retaining nut and lower ball stud jamnut to 100 foot-pounds (136 N•m) torque. Install replacement cotter pin in retaining nut. Do not loosen nut to install cotter pin.

(j) Install axle shafts and repeat procedure outlined in step (7).

(k) Install wheels and lower vehicle.

(8) On CJ models not equipped with steering damper, install steering damper kit if steering components are OK.

(9) Lower vehicle.

(10) Road test vehicle to verify effectiveness of repairs.

## 2M-6 STEERING LINKAGE

### SPECIFICATIONS

#### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Connecting Rod Clamp Bolt – CJ . . . . .	12	10-15	16	14-20
Connecting Rod Clamp Bolts – Cke, Wag, Trk . . . . .	30	25-35	41	34-47
Connecting Rod End-to-Tie Rod Nut (5/8-18) . . . . .	70 min.	*	95 min.	*
Connecting Rod End-to-Pitman Arm Nut (9/16-18) . . . . .	60 min.	*	81 min.	*
Pitman Arm to Pitman Shaft Nut . . . . .	185	160-210	251	217-285
Steering Damper Locknuts – Cke, Wag, Trk . . . . .	30	24-36	41	33-49
Steering Damper Bracket U-Bolts – CJ . . . . .	12	8-15	16	11-20
Steering Damper Locknut (3/8-24) CJ . . . . .	22	16-28	30	22-38
Steering Damper Locknut (7/16-20) CJ . . . . .	30	24-36	41	33-49
Upper Ball Stud Retaining Nut and Lower Bolt Stud Jam Nut . . . . .	100	—	136	—
Upper Ball Stud Split Ring Seat . . . . .	50	—	68	—
Tie Rod Clamp Bolt (5/16-24) CJ . . . . .	12	10-15	16	14-20
Tie Rod Clamp Bolt (7/16-14) Cke, Wag, Trk . . . . .	30	25-35	41	34-47
Tie Rod Stud Nuts – CJ . . . . .	40 min.	*	54 min.	*
Tie Rod Stud Nuts – Cke, Wag, Trk . . . . .	60 min.	*	81 min.	*
Wheel Nuts – CJ . . . . .	105	90-115	142	122-156
Wheel Nuts – Cke, Wag, J-10 Trk . . . . .	75	65-80	102	88-108
Wheel Nuts – J-20 Trk . . . . .	125	100-150	169	136-203

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

\*Tightened to castellated nut slot only. Do not loosen nut to obtain desired torque.

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#### Front Wheel Alignment Specifications

Steering Axis Inclination . . . . .	8-1/2°
Caster	
CJ . . . . .	+3°(+1°)
Cherokee, Wagoneer, and Truck . . . . .	+4°(+1°)
Camber . . . . .	+1-1/2°(+1/2°)
Toe-In . . . . .	3/64 to 3/32-inch (1.19 to 2.38 mm)
Turning Angle	
CJ . . . . .	31° to 32°
Cherokee, Wagoneer, and Truck . . . . .	37° to 38°

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# SUSPENSION

# 2N

## SECTION INDEX

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Front Axle Windup Bumper	2N-1	Shock Absorbers	2N-1
Front Spring	2N-3	Spring Bushing Replacement	2N-7
General	2N-1	Stabilizer Bar	2N-3
Rear Spring	2N-6	Torque Specifications	2N-8

### GENERAL

Jeep vehicles are equipped with semi-elliptic leaf springs and double-action hydraulic shock absorbers at front and rear. A front axle stabilizer bar is standard on Cherokee, Wagoneer, and J-10 Truck models with radial tires and on 8400 GVWR J-20 Truck models and CJ models with the molded hard top. A front stabilizer bar is optional on all other Jeep models.

Front and rear suspension springs are mounted parallel to the frame side rails. The forward end of the front springs and the rear end of the rear springs are attached to the frame by pivoting shackles. The opposite spring ends are attached to the frame by fixed pivot bolts. All spring ends have silent block-type rubber bushings which do not require lubrication.

The front springs are mounted below the axle on all Jeep vehicles. CJ models use multi-leaf front springs (fig. 2N-1). Cherokee, Wagoneer, and Truck models use tapered-leaf or multi-leaf front springs (fig. 2N-2).

The multi-leaf rear springs used on CJ models are mounted below the axle (fig. 2N-3).

The rear springs used on Cherokee, Wagoneer, and Truck models are either multi-leaf or tapered-leaf springs and are mounted above the axle (fig. 2N-4).

The leaf springs on all Jeep models are attached to the axle by U-bolts and tie plates and are positioned on the axle by spring saddles welded to the axle tubes. Spring center bolts and spring clips are used to align and hold the spring leaves in position. If the vehicle is used for severe, off-road operation, the springs should be examined periodically for broken or shifted leaves, loose or missing clips, and broken center bolts.

Squeaking noises can be generated when movement between the spring bushings and metal parts occurs. This noise can usually be eliminated by tightening the spring attaching bolts to the specified torque. However,

if squeak noises persist after bolt tightening, check for a bushing that is loose in the spring eye, or misaligned (not centered in spring eye), or spring misalignment caused by damaged suspension components. Repair as necessary if any of these conditions are discovered.

The spring eye bushings do not require any type of lubrication. Do not attempt to eliminate bushing noises by lubricating them. Grease and mineral oil-base lubricants can cause deterioration of the bushing rubber.

### FRONT AXLE WINDUP BUMPER

A front axle windup bumper is used on all models. The bumper consists of a stamped bracket with a rubber bumper attached to it (fig. 2N-6). The bracket is attached to the inner side of the right frame rail adjacent to and just above the front axle housing. During severe operation when extreme spring movement and front axle travel occurs, the bumper contacts a pad on the front axle housing to prevent excessive housing movement.

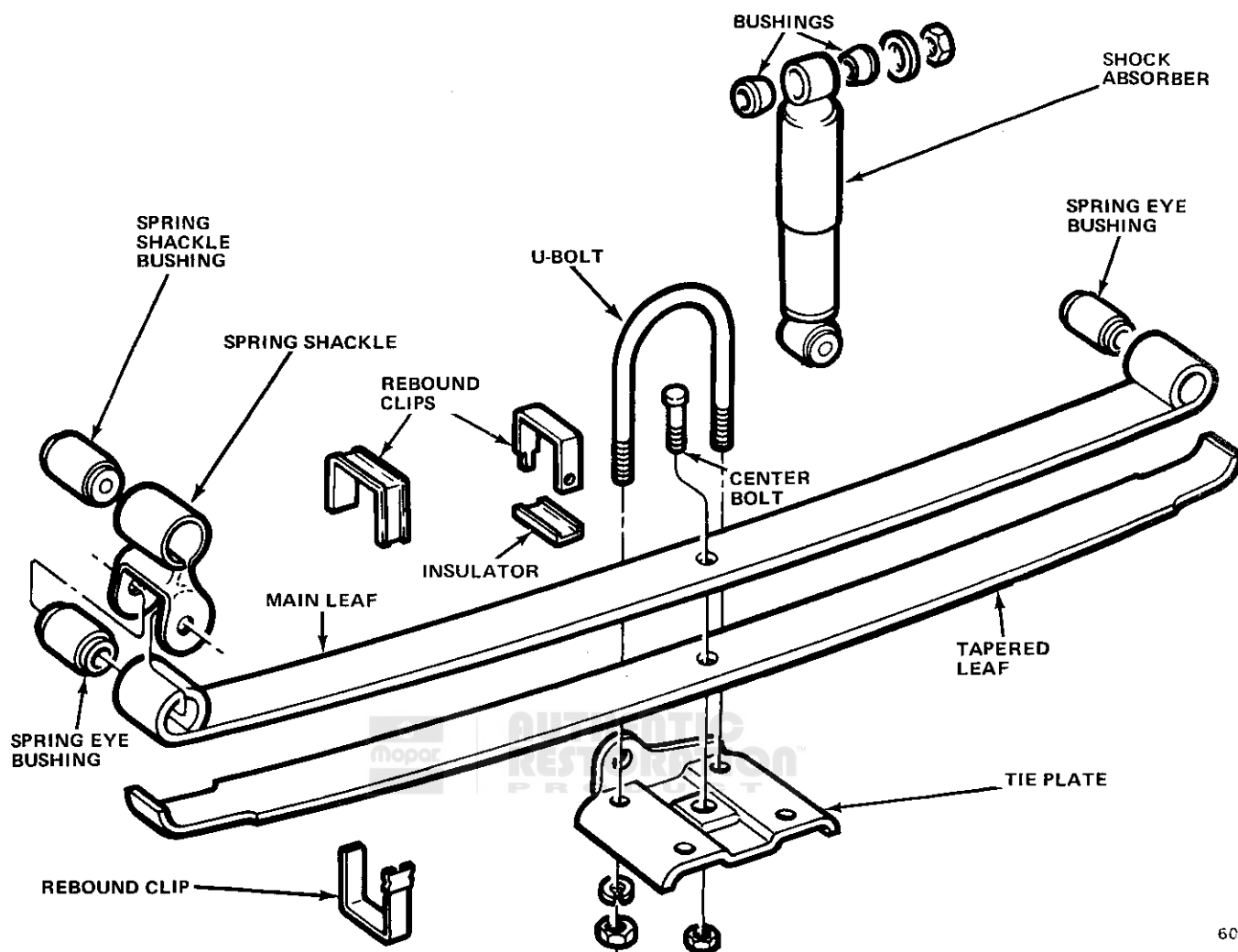
### SHOCK ABSORBERS

The hydraulic, dual-action shock absorbers used on Jeep vehicles are designed to control suspension spring movement. The shock absorber upper ends are attached to brackets located on the frame rails. The lower ends are attached to the spring tie plate or axle tube. Rubber bushings installed in the shock mounting eyes dampen out road shock and noise.

Squeak noises from the shock bushings can be generated if movement between the bushings and metal parts occurs. This noise can usually be eliminated by tightening the shock mounting nuts. However, if squeak noises persist, check for damaged or worn bushings or damaged shock mounting components. Repair as necessary if any of these conditions are discovered.







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Fig. 2N-2 Front Spring and Shock Absorber—Cherokee-Wagoneer-Truck Models

### Shock Absorber Replacement

- (1) Raise vehicle.
- (2) Position hydraulic jack under axle and raise axle to relieve springs of axle weight.
- (3) Remove washers and locknuts attaching shock absorber to upper and lower mounting pins.
- (4) Remove shock absorber and remove bushings from shock mounting eyes.
- (5) Install replacement bushings in shock mounting eyes. Do not lubricate bushings, install them dry.
- (6) Position replacement shock absorber on mounting pins.
- (7) Install shock absorber attaching washers and locknuts. Tighten locknuts to specified torque.
- (8) Lower vehicle and remove hydraulic jack.

### STABILIZER BAR

The stabilizer bar extends across the front undersides of the frame and is attached to the frame rails by clamps and rubber bushings (fig. 2N-7). The bar ends extend rearward to a position above the front springs and are

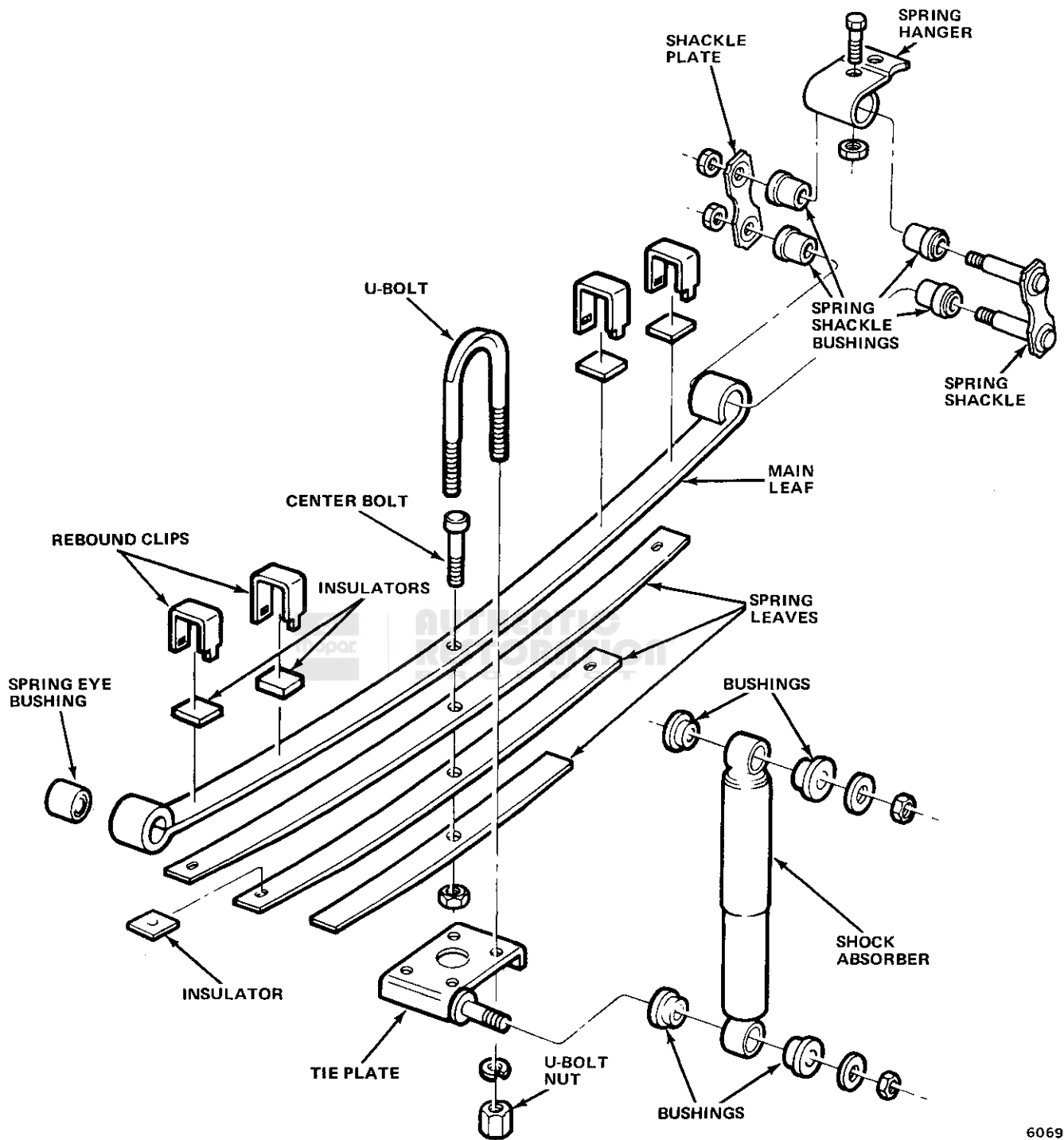
connected to the axle and springs by connecting links (fig. 2N-8).

### FRONT SPRING

#### Removal

- (1) Raise vehicle.
- (2) Support vehicle using safety stands placed under frame rails.
- (3) Position hydraulic jack under axle and raise axle to relieve springs of axle weight.
- (4) Disconnect stabilizer bar if equipped.
- (5) Remove spring U-bolts and tie plates.
- (6) Remove bolt attaching spring front eye to shackle.
- (7) Remove bolt attaching spring rear eye to spring hanger.
- (8) Remove spring.

**NOTE:** The spring can be disassembled by removing the spring rebound clips and spring center bolt. If the spring bushings are to be removed, refer to Spring Bushing Replacement.



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Fig. 2N-3 Rear Spring and Shock Absorber—CJ Models

**Installation**

- (1) Position spring rear eye in hanger bracket and loosely install attaching bolt and nut. Do not tighten bolt at this time.
- (2) Position spring front eye in shackle and loosely install attaching bolt and nut. Do not tighten bolt at this time.
- (3) Position axle on spring and install spring tie

- plate and U-bolts. Tighten U-bolt nuts to specified torque.
- other models.
- (4) Connect stabilizer bar if equipped.
- (5) Remove hydraulic jack used to support axle weight.
- (6) Remove support stands and lower vehicle.
- (7) Tighten spring front and rear attaching bolts and nuts to specified torque.



## 2N-6 SUSPENSION

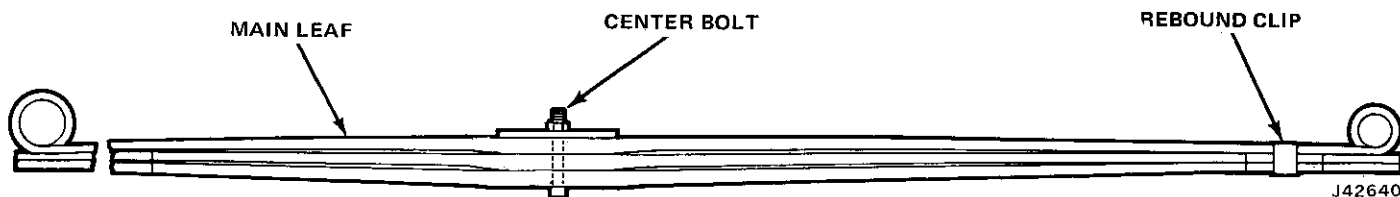


Fig. 2N-5 Tapered Rear Leaf Spring—Cherokee-Wagoneer-Truck Models (Typical)

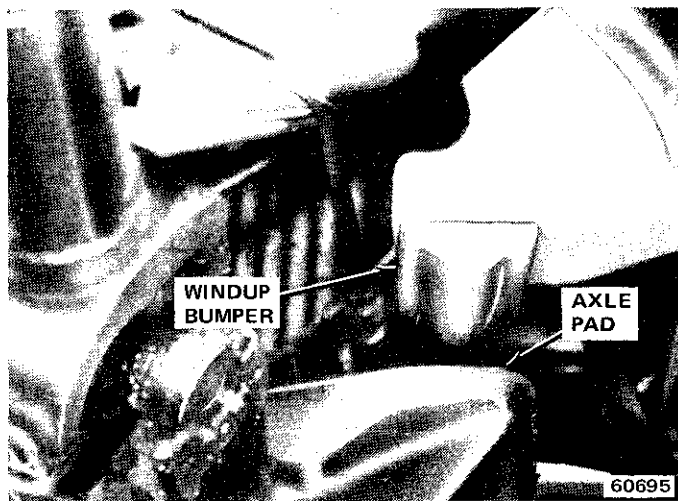


Fig. 2N-6 Front Axle Windup Bumper

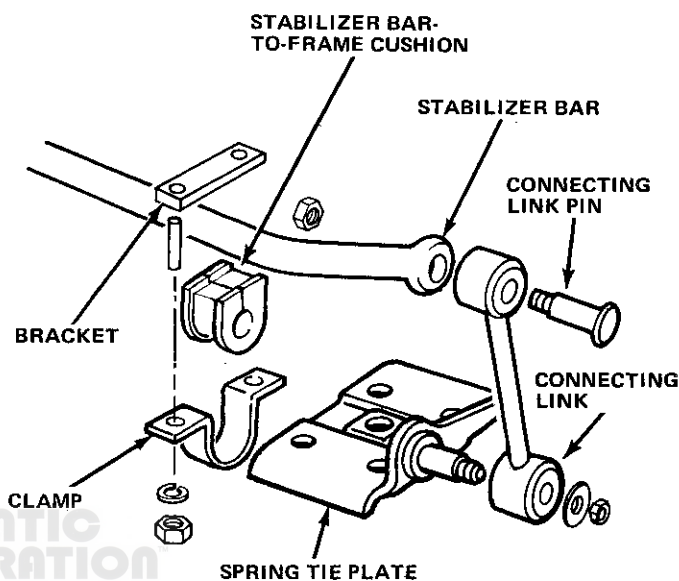


Fig. 2N-8 Stabilizer Bar Mounting

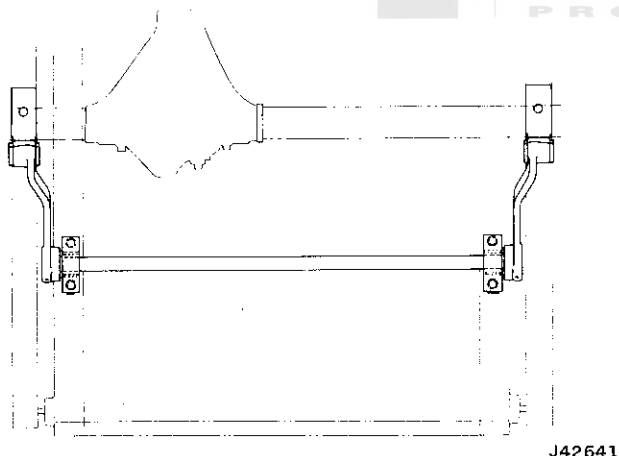


Fig. 2N-7 Stabilizer Bar Position

(5) Remove bolt attaching spring rear eye to shackle.

(6) Remove bolt attaching spring front eye to mounting bracket on frame.

(7) Remove spring.

**NOTE:** The spring can be disassembled by removing the spring rebound clips and spring center bolt. If the spring bushings are to be removed, refer to *Spring Bushing Replacement*.

### REAR SPRING

#### Spring Mounted Below Axle

##### Removal

- (1) Raise vehicle.
- (2) Support vehicle using safety stands placed under frame rails.
- (3) Position hydraulic jack under axle and raise axle to relieve springs of axle weight.
- (4) Remove tie plate U-bolts.

##### Installation

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

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

(3) Install spring tie plate and U-bolts. Tighten U-bolt nuts to specified torque.

(4) Remove hydraulic jack used to support axle.

(5) Remove support stands and lower vehicle.

(6) Tighten spring eye mounting bolts and nuts to specified torque.

## Spring Mounted Above Axle

### Removal

- (1) Raise vehicle.
- (2) Support vehicle using safety stands placed under frame rails.
- (3) If left-side spring is to be serviced, remove fuel tank skid plate.
- (4) Position hydraulic jack under axle and raise axle to relieve springs of axle weight.
- (5) Disconnect shock absorber at axle.
- (6) Remove wheel.
- (7) Remove tie plate U-bolts and tie plate.
- (8) Remove bolt attaching spring rear eye to spring shackle.
- (9) Remove bolt attaching spring front eye to spring hanger on frame rail.
- (10) Remove spring.

**NOTE:** The spring can be disassembled by removing the spring rebound clips and center bolt. If the spring bushings are to be removed, refer to Spring Bushing Replacement.

### Installation

- (1) Position spring front eye in spring hanger and loosely install attaching bolt and nut. Do not tighten bolt at this time.
- (2) Position spring rear eye in shackle and loosely install attaching bolt and nut. Do not tighten nut at this time.
- (3) Position axle on spring and install spring tie plate and U-bolts. Tighten U-bolt nuts to specified torque.
- (4) Connect shock absorber to axle.
- (5) Install wheel.
- (6) Install fuel tank skid plate if removed.
- (7) Remove hydraulic jack.
- (8) Remove support stands and lower vehicle.
- (9) Tighten spring attaching bolts to specified torque.

## SPRING BUSHING REPLACEMENT

### Small Bushing

- (1) Insert 3/8 by 8 inch (0.95 by 20.3 cm) length of threaded rod halfway through bushing.
- (2) Place suitable size socket on one end of rod with open end of socket toward bushing. Socket will serve as bushing driver.

**NOTE:** The socket must be large enough in diameter to bear against the metal outer sleeve on the bushing but still be small enough to pass through the spring eye.

- (3) Install one flat washer and one hex nut on rod behind socket (fig. 2N-9).

- (4) Install 2 inch (5.08 cm) long section of suitable size pipe on opposite end of threaded rod. Pipe will serve as bushing receiver.

**NOTE:** The inside diameter of the pipe must be large enough to accommodate the bushing but still seat against the spring eye surface properly.

- (5) Install flat washer and hex nut on rod to secure pipe section. Be sure flat washer is large enough in diameter to support and maintain alignment of pipe section.

- (6) Tighten both hex nuts finger-tight and align all components.

**NOTE:** Be sure socket is positioned in the spring eye and aligns with the bushing. The pipe section must butt against the spring eye surface so the bushing can pass through it. The socket will act as a press ram and press the bushing out of the spring eye.

- (7) Tighten nut at socket end of rod until bushing is pressed out of spring eye.

- (8) Remove bushing tools and old bushing.

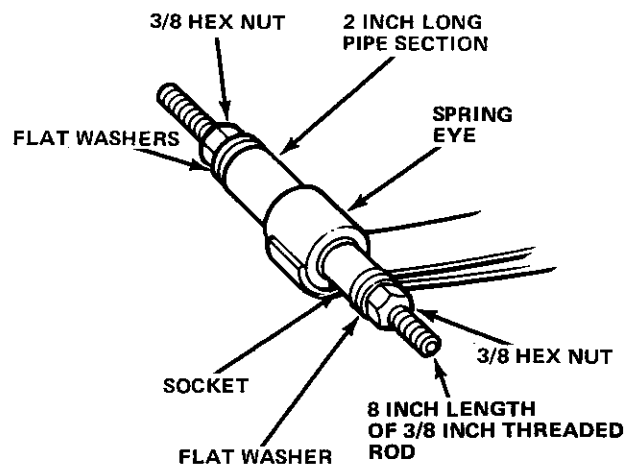
- (9) Install replacement bushing on threaded rod.

- (10) Assemble and align bushing tools as outlined in previous steps.

- (11) Align bushing with spring eye and press bushing into eye.

- (12) Loosen bushing tools and check bushing position. Bushing must be centered in spring eye. Ends of bushing must be flush or slightly below side surfaces of spring eye.

- (13) If bushing is not centered, reinstall bushing tools and correct bushing position as necessary.



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Fig. 2N-9 Bushing Replacement Tools—Small Bushing

## 2N-8 SUSPENSION

### Large Bushing

(1) Insert 1/2 by 11 inch (1.27 by 27.9 cm) length of threaded rod halfway through bushing.

(2) Install suitable size deep socket on one end of rod with open end of socket toward bushing. Socket will serve as bushing driver.

**NOTE:** The socket must be large enough in diameter to bear against the metal outer sleeve on the bushing but still be small enough to pass through the spring eye.

(3) Install one flat washer and one hex nut on rod behind socket (fig. 2N-10).

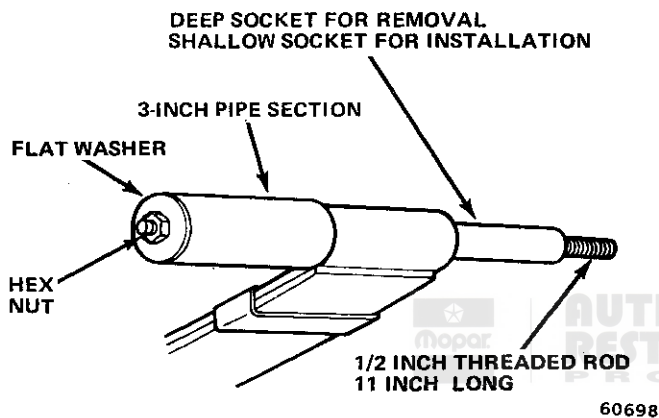


Fig. 2N-10 Bushing Replacement Tools—Large Bushing

(4) Install 3 inch (7.62 cm) long section of suitable size pipe on opposite end of rod. Pipe will serve as bushing receiver.

**NOTE:** The inside diameter of the pipe must be large enough to accommodate the bushing but still seat against the spring eye surface properly.

(5) Install flat washer and one hex nut on rod behind pipe section. Be sure flat washer is large enough in diameter to support and maintain alignment of the pipe section.

(6) Tighten both nuts finger-tight and align all components.

**NOTE:** Be sure the socket is positioned in the spring eye and aligns with the bushing. The pipe section must butt against the spring eye so that bushing can pass through it. The socket will act as a press ram and press the bushing out of the spring eye and into the section of pipe.

(7) Tighten nut at socket and press bushing out of spring eye.

(8) Remove tools and old bushing.

(9) Install replacement bushing on threaded rod and assemble bushing tools as outlined in previous steps.

(10) Align bushing with spring eye and press bushing into eye.

(11) Loosen tools and check bushing position. Bushing must be centered in spring eye. Ends of bushing must be flush with or slightly below side surfaces of spring eye.

(12) If bushing is not centered, reinstall tools and correct bushing position as necessary.

## SPECIFICATIONS

### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Shock Absorber Upper Locknut (7/16-20) . . . . .	35	25-40	47	34-54
Shock Absorber Lower Locknut (1/2-20). . . . .	45	35-50	61	47-68
Spring Pivot Bolts (CJ) . . . . .	100	80-120	136	108-163
Spring Shackle Nuts (CJ). . . . .	24	18-30	33	24-41
Spring U-Bolt Nuts (9/16-18) . . . . .	100	85-105	136	115-142
Spring U-Bolt Nuts (1/2-20) . . . . .	55	45-65	75	61-88
Spring Shackle and Pivot Bolts/Nuts (Cke-Wag-Trk) . . . . .	100	80-120	136	108-163
Stabilizer Bar Mounting Bracket Bolts (All) . . . . .	35	27-45	47	37-61
Wheel Nuts (CJ). . . . .	85	65-90	115	88-122
Wheel Nuts (Cke-Wag-J10 Trk) . . . . .	85	65-90	115	88-122
Wheel Nuts (J20 Trk). . . . .	130	110-150	176	149-203
Spring Center Bolts . . . . .	35	25-40	47	34-54
Stabilizer Bar Link Nuts . . . . .	55	48-62	75	65-84

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

Navigation Tools: Click on the "Chapter" below, or use the Bookmarks to the left.



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# SECTION 3 BODY





# WATER LEAK/ WIND NOISE DIAGNOSIS AND REPAIR

# 3A

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## WATER LEAKS

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### GENERAL

The problem of water leaks is closely related to dust leakage due to the fact that, under certain conditions, water can enter the vehicle body at any point where dirt and dust can enter.

The key to correcting any water leak problem is complete and accurate diagnosis. To do this a thorough check of the following five general causes of leakage must be accomplished:

- Maladjusted components
- Improperly installed, misrouted or faulty weatherstrips
- Omission of sealers
- Misfitted panels
- Missing body plugs

Leaks can be deceiving. The point where water is detected may not be the point where it entered the vehicle.

### Spray Test

The first thing to do on any water leak problem, is to pin-point the leak. The best way to do this is to perform a water spray test.

Sit inside the vehicle and have someone spray water over the suspected leak area. **Always start spraying along the bottom. By starting at the bottom, the exact level at which the leaks occur will be determined.** If water was sprayed at the highest point, water would be at all suspect areas and it would be difficult to determine the exact problem area.

Do not rush the water spray test. The water may have to flow awhile before it shows up. Try to simulate as close as possible the effect of wind-driven water.

### Ultrasonic Test

Another way to test the vehicle for water leaks is use the Listener Tool J-23455-01. This tool makes use of the fact that ultrasonic energy (high frequency sound) has certain properties that are similar to those of fluids (liquids and gases). Ultrasonic energy does not penetrate solids, such as glass or metal. It is, however, transmitted through cracks and openings, such as those that cause body, water, or air leaks.

An operating ultrasonic generator placed inside an automotive body will fill the vehicle with sound energy. **This energy will leak at the same locations that permit water and air leaks.** The water path or opening must be dry since the ultrasonic sound will be blocked if an opening or hole is full of water.

An ultrasonic generator and detector gun form an ideal combination for determining the location and magnitude of water and air leaks. The ultrasonic leak detector can be used effectively as a diagnostic tool realizing it is not an exact tool and has certain limitations.

### Light Test

Another method of finding water leaks is the light test. This method is good for finding sealer skips in the sheet metal joints and seams, particularly in the wheel-house area. Sit inside the vehicle and have someone pass

## 3A-2 WATER LEAK/WIND NOISE DIAGNOSIS AND REPAIR

a bright light along the seams and joints from under the vehicle.

### Water/Rust Streaks

Another thing to look for in diagnosing water leaks is a pattern of rust or water streaks on interior sheet metal and trim. For instance, a symptom of rear window leakage or inadequately sealed coach joint is water dripping into the rear compartment. This will show up as water or rust streaks on the rear compartment trim or wheelhouse.

### Adhesive, Sealant and Coating Materials

- Adhesives join or bond materials together
- Sealants close gaps or seams between sheet metal or materials and prevent the passage of water, dust, air, etc.
- Coatings protect against corrosion and abrasion, and dampen sound or vibration—and may also be used to seal out water and dust

### Bonding Surface Preparation

For the various materials to adhere and form an effective bond, it is essential that they are applied to clean, dry surfaces. After a water test, dry the joint or seam with clean dry compressed air then wipe the joint, or seam, with a cloth dampened in 3M General Purpose Adhesive Cleaner, or equivalent.

## WATER IN FRONT PASSENGER COMPARTMENT

### Windshield

Leaks can occur between the windshield glass and rubber weatherstrip or between the rubber weatherstrip and body pinchweld flange. Leaks between the windshield glass and rubber weatherstrip will be indicated by water which is visible on the inside of the glass or on the front floor. Leaks between the rubber weatherstrip and body pinchweld flange will track down to appear on the front floor. Also, water can enter at the weld studs or burn holes in the body pinchweld flange.

### Spray Diagnosis and Repair

- (1) Remove windshield reveal mouldings, as described in Chapter 3N.
- (2) Perform the following spray test using guidelines described under Spray Test above.
  - (a) Starting at base of windshield A-pillar on one side of vehicle, spray water onto glass across the bottom between the dash panel assembly and glass.
  - (b) Test vertical section of A-pillar and across top of glass.
  - (c) Repeat steps (a) and (b) for other side of vehicle.

- (3) If leaks are noted, dry out suspect area as described under Bonding Surface Preparation.

- (4) Seal windshield as described in detail in Chapter 3N.

- (5) Repeat spray test to ensure that an effective repair has been made.

- (6) Install windshield reveal mouldings.

### Ultrasonic Diagnosis and Repair

- (1) Dry suspect areas thoroughly, if an opening or hole is full of water, the ultrasonic sound will be blocked.

- (2) Remove windshield reveal mouldings, as described in Chapter 3N.

- (3) Using Listener Tool J-23455-01, perform Ultrasonic Test as follows:

- (a) Place transmitter in vehicle adjacent to windshield and turn switch on.

- (b) Close all doors, windows and air vents.

- (c) Slowly pass listener all around windshield opening.

- (d) Mark any area where a meter reading of approximately 5 obtained, as a indication of a possible leak.

- (4) Clean suspect area as described above under Bonding Surface Preparation.

- (5) Seal windshield as described in detail in Chapter 3N.

- (6) Repeat ultrasonic test to ensure that an effective repair has been made.

- (7) Install windshield reveal mouldings.

### Dash Panel Assembly

Water leaks can occur at the inside of dash panel assembly due to spot weld burn holes or excessive gaps and/or lack of sealer at the dash panel joints. Water leaks from these burn holes or joints will result in water puddles forming on the front carpet or floor pan. Water can also enter through the many holes stamped into the dash panel assembly due to, loose grommets and/or incorrectly installed components and attaching hardware. Water will appear on the front carpet or floor pan having tracked down the inside of the dash panel assembly.

### Spray Diagnosis and Repair

- (1) Pull back carpet and sound insulation material, if equipped.

- (2) Open hood.

- (3) Perform the following spray test using guidelines described under Spray Test above.

- (a) Starting at bottom of dash panel on one side of vehicle spray water onto suspect joints, grommets and components.

- (b) Spray water across top of dash panel.

- (c) Repeat spray test on other side of vehicle.

(4) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(5) Straighten any distorted flanges.

(6) Seal suspect spot weld burn holes and dash panel joints using 3M All-Around Autobody Sealant, or equivalent.

**NOTE:** Use care not to direct sealer into air ducts.

(7) Seal interior plenum chamber leaks by attaching a length of flexible plastic hose to nozzle of applicator gun specified for use with 3M Joint and Seam Sealer, or equivalent.

(8) Check all grommets to be sure they are correctly installed. If necessary, apply sealant to ensure a water tight seal.

(9) Make sure that all suspect components and attaching hardware are properly installed. If necessary, apply sealant to ensure a water tight seal.

(10) Repeat spray test to ensure that an effective repair has been made.

(11) Properly position sound insulation material and carpet, if equipped.

(12) Close hood.

#### Ultrasonic Diagnosis and Repair

(1) Dry suspect areas thoroughly. If an opening or hole is full of water, the ultrasonic sound will be blocked.

(2) Pull back carpet and sound insulation material, if equipped.

(3) Open hood.

(4) Close all windows, doors and air vents.

(5) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle adjacent to dash panel assembly and turn switch on.

(b) Slowly pass listener over each joint, grommet and component.

(c) Mark any area where a meter reading of approximately 5 is obtained, as a indication of a possible leak.

(6) Clean suspect area as described above under Bonding Surface Preparation.

(7) Straighten any distorted flanges or seams.

(8) Seal suspect spot weld burn holes and dash panel joints using 3M All-Around Autobody Sealant, or equivalent.

**NOTE:** Use care not to direct sealer into air ducts.

(9) Seal interior plenum chamber leaks by attaching a length of flexible plastic hose to nozzle of applicator gun specified for use with 3M Joint and Seam Sealer, or equivalent.

(10) Check all grommets to be sure they are correctly installed. If necessary, apply sealant to ensure a water tight seal.

(11) Make sure that all suspect components and attaching hardware are properly installed. If necessary, apply above sealant to ensure a water tight seal.

(12) Repeat ultrasonic test to ensure that an effective repair has been made.

(13) Properly position sound insulation material and carpet, if equipped.

(14) Close hood.

#### Front Floorpan, Side Sills, Cowl Side Panels or Front Hinge Pillars

Water can enter at dash panel assembly-to-front floor pan seams due to gaps, distorted panels and/or lack of sealer. Water appears under the front carpet or on front floor pan.

Leaks can occur between the side sills, front floorpan, cowl side panels or front hinge pillars due to excessive gaps and/or lack of sealer at the panel joints. Water leaks from these joints will result in a wet front carpet, sound insulation material or front floor pan.

Also, leaking floorpan plugs will allow water to enter the front floorpan area or under the carpet and sound insulation material.

#### Spray Diagnosis and Repair

(1) Remove front seat(s).

(2) Remove front carpet and sound insulation material, if equipped.

(3) Open hood.

(4) Perform the following spray test using guidelines described under Spray Test above.

(a) Spray water from under front fender at joint of floorpan and cowl side panel or front hinge pillar.

(b) Next spray across floorpan-to-dash panel seam and towards rear of vehicle at floorpan plugs.

(c) Move spray slowly upwards until water is directed at joint of dash panel-to-cowl side panel.

(d) Repeat spray test on other side of vehicle.

(e) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(5) Straighten any distorted panels.

(6) Seal suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

(7) Examine suspect area for loose or missing body plugs.

(a) Check that hardened sealer or road dirt is not preventing the plug from seating.

(b) Check hole to be sure that it is not distorted.

(c) If necessary, reshape floorpan at plug hole and add a bead of the above sealant around hole to ensure a satisfactory water tight seal.

(8) Repeat spray test to ensure that an effective repair has been made.

(9) Close hood.

## 3A-4 WATER LEAK/WIND NOISE DIAGNOSIS AND REPAIR

- (10) Install sound insulation material and front carpet, if equipped.
- (11) Install front seat(s).

### Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

- (2) Remove front seat(s).
- (3) Remove front carpet and sound insulation material, if equipped.
- (4) Close all windows, doors and air vents.
- (5) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle adjacent to suspect area and turn switch on.

(b) Slowly pass listener over each joint, plug and seam.

(c) Mark any area where a meter reading of approximately 5 is obtained as a indication of a possible leak.

(6) Clean suspect area as described above under Bonding Surface Preparation.

(7) Straighten any distorted panels.

(8) Seal suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

(9) Examine suspect area for loose or missing body plugs.

(a) Check that hardened sealer or road dirt is not preventing plug from seating.

(b) Check hole to be sure that it is not distorted.

(c) If necessary, reshape floorpan at plug hole and add a bead of sealant around hole to ensure a satisfactory water tight seal.

(10) Repeat ultrasonic test to ensure that an effective repair has been made.

(11) Install sound insulation material and front carpet, if equipped.

(12) Install front seat(s).

### Front Doors and Glass

An improperly adjusted door or defective sealing system will allow water to leak onto the front carpet or floor.

**NOTE:** Before starting door leak diagnosis, ensure that the door is correctly set within the body opening paying particular attention to the door flushness relative to surrounding surfaces. The mating surfaces of body opening and door rubber sealer must be wiped clean and dried. Also, make sure that the door glass is properly adjusted.

### Spray Diagnosis and Repair

(1) Perform the following spray test using guidelines described under Spray Test above.

(a) Starting at front lower corner of door, spray water between door lower edge to rocker panel.

(b) Move slowly up door to roof level.

(c) Move to door lower rear corner and spray water between door rear edge and adjacent panel.

(d) Move slowly up door to roof level.

(e) Test door top edge to roof section.

(f) Repeat spray test on other side of vehicle.

(2) If leaks are noted, dry suspect area as described above under Bonding Surface Preparation.

(3) Examine rubber sealers for damage, distortion or incorrect location. Damaged or distorted rubber sealers should be replaced, as outlined in Chapter 3J.

(4) Correct improperly installed rubber sealers as outlined in Chapter 3J.

(5) Repeat spray test to ensure that an effective repair has been made.

### Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Close all windows, doors and air vents.

(3) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle near suspect door and turn switch on.

(b) Slowly pass listener around all door edges and sealers.

(c) Mark any area where a meter reading of approximately 5 is obtained as a indication of a possible leak.

(4) Clean suspect area as described above under Bonding Surface Preparation.

(5) Examine rubber sealers for damage, distortion or incorrect location. Damaged or distorted rubber sealers should be replaced as outlined in Chapter 3J.

(6) Correct improperly installed rubber sealers as outlined in Chapter 3J.

(7) Repeat ultrasonic test to ensure that an effective repair has been made.

## WATER ON FRONT OR REAR SEATS

### Front and Rear Doors and Glass

Improperly adjusted doors or defective sealing systems will allow water to leak onto the front or rear seats.

**NOTE:** Before starting door leak diagnosis, ensure that the door is correctly set within the body opening paying particular attention to the door flushness relative to surrounding surfaces. The mating surfaces of body opening and door rubber sealer must be wiped clean and dried. Also, make sure that the door glass is properly adjusted.

**Spray Diagnosis and Repair**

Repeat Front Doors and Glass Spray Diagnosis and Repair procedures for both front and rear doors.

**Ultrasonic Diagnosis and Repair**

Repeat Front Doors and Glass Ultrasonic Diagnosis and Repair procedures for both front and rear doors.

**Rear Quarter Windows**

The stationary and opening rear quarter window seals can leak water that may appear on the rear seats.

**NOTE:** *Before starting rear quarter window leak diagnosis, make sure that the rear quarter windows are properly adjusted.*

**Spray Diagnosis and Repair**

- (1) Close and/or lock the windows.
- (2) Perform the following spray test using guidelines described under Spray Test above.
  - (a) Start spray test along lower edge.
  - (b) Spray water all around edges of window and opening.
  - (c) Repeat spray test on other side of vehicle.
- (3) If leaks are noted, dry suspect area as described above under Bonding Surface Preparation.
- (4) In instances of leakage from stationary quarter window, apply 3M Windshield Sealer, or equivalent, between glass and sealer or sealer and body flange.
- (5) Open rear quarter windows and examine rubber sealers for damage, distortion or incorrect position. Damaged or distorted rubber sealers should be replaced.
- (6) Correctly install rubber sealers as outlined in Chapter 3K.
- (7) Make sure that flange is free from buckles or protrusions.
- (8) Repeat spray test to ensure that an effective repair has been made.

**Ultrasonic Diagnosis and Repair**

- (1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.
- (2) Close all windows, doors and air vents.
- (3) Using Listener Tool J-23455-01, perform ultrasonic test as follows:
  - (a) Place transmitter in vehicle adjacent to rear quarter window and turn switch on.
  - (b) Slowly pass listener around window opening.
  - (c) Mark any area where a meter reading of approximately 5 is obtained as an indication of a possible leak.
  - (d) Repeat test on other side of vehicle.

(4) Clean suspect area as described above under Bonding Surface Preparation.

(5) In instances of leakage from stationary quarter window, apply 3M Windshield Sealer, or equivalent, between glass and sealer or sealer and body flange.

(6) Open rear quarter windows and examine rubber sealers for damage, distortion or incorrect location. Damaged or distorted rubber sealers should be replaced.

(7) Correctly install rubber sealers as outlined in Chapter 3K.

(8) Also, make sure that flange is free from buckles or protrusions.

(9) Repeat ultrasonic test to ensure that an effective repair has been made.

**WATER OFF HEADLINER**

**Luggage Racks**

**Spray Diagnosis and Repair**

- (1) Lower headliner in suspect area.
- (2) Perform the following spray test using guidelines described under Spray Test above.
  - (a) Spray water along luggage rack or skid strip mouldings.
  - (b) If necessary, repeat spray test on other side of vehicle.
- (3) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.
- (4) Remove luggage rack support posts, in suspect area, and seal wellnuts or screw holes to body using 3M Drip-Chek Sealer, or equivalent. Install support posts.
- (5) Remove luggage rack skid strips in suspect area, and ensure that all moulding clips are correctly installed.
  - (a) Replace improperly installed or defective moulding clips, if equipped.
  - (b) If necessary, add sealer to ensure a water tight seal.
  - (c) Install previously removed skid strips.
- (6) Repeat spray test to ensure that an effective repair has been made.
- (7) Install headliner.

**Ultrasonic Diagnosis and Repair**

- (1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.
- (2) Remove headliner.
- (3) Close all windows, doors and air vents.
- (4) Using Listener Tool J-23455-01, perform ultrasonic test as follows:
  - (a) Place transmitter in vehicle adjacent to suspect area and turn switch on.
  - (b) Slowly pass listener over each luggage rack support post or skid strip.

## 3A-6 WATER LEAK/WIND NOISE DIAGNOSIS AND REPAIR

(c) Mark any area reading approximately 5 on the meter as an indication of a possible leak.

(5) Clean suspect area as described above under Bonding Surface Preparation.

(6) Remove luggage rack support posts, in suspect area, seal wellnuts or screw holes to body using 3M Drip-Chek Sealer, or equivalent. Install support posts.

(7) Remove luggage rack skid strips, in suspect area, and ensure that all moulding clips are correctly installed, if equipped.

(a) Replace improperly installed or defective moulding clips.

(b) If necessary, add sealer to ensure a water tight seal.

(c) Install previously removed skid strips.

(8) Repeat ultrasonic test to ensure that an effective repair has been made.

(9) Install headliner.

### Drip Rail

#### Spray Diagnosis and Repair

(1) Drop headliner in suspect area.

(2) Perform the following spray test using guidelines described under Spray Test above.

(a) Spray water along drip rail, starting at front of roof.

(b) If necessary, repeat spray test on other side of vehicle.

(3) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(a) Examine suspect area for small pin holes in drip rail sealer.

(b) Apply 3M All-Around Autobody Sealant, or equivalent to drip rail and touch up with matching body color when sealant is dry.

(4) Repeat spray test to ensure that an effective repair has been made.

(5) Install headliner.

#### Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Remove headliner.

(3) Close all windows, doors and air vents.

(4) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle adjacent to suspect area and turn switch on.

(b) Slowly pass listener over suspect area.

(c) Mark any area reading approximately 5 on the meter as a indication of a possible leak.

(5) Clean suspect area as described above under Bonding Surface Preparation.

(a) Examine drip rail for small pin holes in drip rail sealer.

(b) Apply 3M All-Around Autobody Sealant, or equivalent, to drip rail and touch up with matching body color when sealant is dry.

(6) Repeat ultrasonic test to ensure that an effective repair has been made.

(7) Install headliner.

## WATER IN REAR PASSENGER COMPARTMENT

### Rear Floorpan, Side Sills and Rear Wheelhouse Panels

Water can enter at front floorpan-to-rear floorpan seams due to gaps, distorted panels and/or lack of sealer. Water from these leaks appears on the floorpan or under the rear carpet, if equipped.

Leaks can occur between the side sills or leading edge of rear wheelhouse panels due to excessive gaps and /or lack of sealer at the joints. Water leaks from these joints appears on the floorpan or as wet rear carpet or sound insulation material, if equipped.

Also, leaking rear floorpan plugs will allow water to enter under the carpet and sound insulation material, if equipped.

#### Spray Diagnosis and Repair

(1) Remove rear seat, if equipped.

(2) Remove rear carpet and sound insulation material, if equipped.

(3) Perform the following spray test using guidelines described under Spray Test above.

(a) Spray water from under vehicle at joint of rear floorpan-to-side sill.

(b) Next spray across front floorpan-to-rear floor pan seam and towards rear of vehicle at floorpan plugs.

(c) Move spray slowly along rear floorpan-to-rear wheelhouse panel seams.

(d) Repeat spray test on other side of vehicle.

(4) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(5) Straighten out distorted panels.

(6) Seal suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

(7) Examine suspect area for loose or missing body plugs.

(a) Check that hardened sealer or road dirt is not preventing the plug from seating.

(b) Check the hole to be sure that it is not distorted.

(c) If necessary, reshape floorpan at plug hole and add a bead of sealant around hole to ensure a satisfactory water tight seal.

(8) Repeat spray test to ensure that an effective repair has been made.

(9) Install sound insulation material and rear carpet, if equipped.

(10) Install rear seat, if equipped.

### Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Remove rear seat, if equipped.

(3) Remove rear carpet and sound insulation material, if equipped.

(4) Close all windows, doors and air vents.

(5) Using Listener Tool, J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle adjacent to suspect area and turn switch on.

(b) Slowly pass listener over each joint, plug and seam.

(c) Mark any area reading approximately 5 on the meter as a indication of a possible leak.

(6) Clean suspect area as described above under Bonding Surface Preparation.

(7) Straighten any distorted panels.

(8) Seal suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

(9) Examine suspect area for loose or missing body plugs.

(a) Check for hardened sealer or road dirt preventing plug from seating.

(b) Check hole to be sure that it is not distorted.

(c) If necessary, reshape rear floorpan at plug hole and add a bead of sealant around hole to ensure a satisfactory water tight seal.

(10) Repeat ultrasonic test to ensure that an effective repair has been made.

(11) Install sound insulation material and rear carpet, if equipped.

(12) Install rear seat, if equipped.

### Rear Doors and Glass

An improperly adjusted door or defective sealing system will allow water to leak onto the rear carpet or floorpan.

**NOTE:** *Before starting door leak diagnosis, ensure that the door is correctly set within the body opening paying particular attention to the door flushness relative to surrounding surfaces. The mating surfaces of body opening and door rubber sealer must be wiped clean and dry. Also, ensure that the door glass is properly adjusted.*

### Spray Diagnosis and Repair

Repeat Front Doors and Glass Spray Diagnosis and Repair procedures for the rear doors.

### Ultrasonic Diagnosis and Repair

Repeat Front Doors and Glass Ultrasonic Diagnosis and Repair procedures for the rear doors.

### Rear Quarter Windows

The stationary and opening rear quarter window seals can leak water that may appear on the rear carpet or floorpan.

**NOTE:** *Before starting rear quarter window leak diagnosis, ensure that the rear quarter windows are properly adjusted.*

### Spray Diagnosis and Repair

Repeat Rear Quarter Windows Spray Diagnosis and Repair procedures as described under Water on Front or Rear Seats.

### Ultrasonic Diagnosis and Repair

Repeat Rear Quarter Windows Ultrasonic Diagnosis and Repair procedures as described under Water on Front or Rear Seats.

### WATER IN CARGO AREA

#### Liftgate and Tailgate

Improperly adjusted liftgate, tailgate or defective sealing system will allow water to leak into the cargo area.

**NOTE:** *Before starting liftgate or tailgate leak diagnosis, ensure that the liftgate or tailgate are correctly set within the body opening. The mating surfaces of body opening and rubber sealer must be wiped clean and dry.*

### Spray Diagnosis and Repair

(1) Perform the following spray test using guidelines described under Spray Test above.

(a) Start a lower corner of liftgate or tailgate, spray water between lower edge and body panel.

(b) Move slowly up to top of liftgate, or tailgate.

(c) Move to opposite lower corner and spray between edge and adjacent body panel.

(d) Move slowly up to top of liftgate, or tailgate.

(e) Finally, test top edge to adjacent body panel.

(2) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(3) Examine rubber sealers for damage, distortion or incorrect installation. Damaged or distorted rubber sealers should be replaced, as outlined in Chapter 3H.

(4) Correct improperly installed rubber sealers as outlined in Chapter 3H.

(5) In instances of leakage from spot weld burn holes, apply 3M All-Around Autobody Sealant, or equivalent, and touch up with matching body color when dry.

(6) Repeat spray test to ensure that an effective repair has been made.



## 3A-8 WATER LEAK/WIND NOISE DIAGNOSIS AND REPAIR

### Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Close all windows, doors, and air vents.

(3) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle cargo compartment, turn switch on.

(b) Slowly pass listener around all edges and sealers.

(c) Mark any area reading approximately 5 on the meter as a indication of a possible leak.

(4) Clean suspect area as described above under Bonding Surface Preparation.

(5) Examine rubber sealers for damage, distortion or incorrect installation. Damaged or distorted rubber sealers should be replaced as outlined in Chapter 3H.

(6) Correct improperly installed rubber sealers as outlined in Chapter 3H.

(7) In instances of leakage from spot weld burn holes, apply 3M All-Around Autobody Sealant, or equivalent, and touch up with matching body color when dry.

(8) Repeat ultrasonic test to ensure that an effective repair has been made.

### Rear Floorpan, Wheelhouse Panels, Cross Sills, Quarter Panels, Center Panels, and Extensions

Water can enter at the rear floorpan, wheelhouse panels and quarter panel seams due to gaps, distorted panels and/or lack of sealer. Leaks can occur between the rear cross sill, center panel, rear floorpan or extension panels due to excessive gaps and/or lack of sealer.

Water can enter around rear taillamp housings or side marker lamps due to defective sealer/gasket or damaged housings. Also, leaking floorpan plugs will allow water to enter.

The light test, described above, may also be used for finding water leaks in the cargo area.

### Spray Diagnosis and Repair

(1) Remove spare tire.

(2) Remove cargo mat and/or carpet and sound insulation material, if equipped.

(3) Remove rear trim panels in suspect area.

(4) Perform the following spray test using guidelines described under Spray Test above.

(a) Spray water from under vehicle at rear floorpan, wheelhouse panels and quarter panel seams.

(b) Next spray water across rear floorpan, cross sill, center panel and extension panel seams.

(c) Also, spray water across rear floorpan and extension panel plugs.

(d) Move spray slowly upwards until water is directed at each wheelhouse panel seam.

(e) Direct spray on lamp housings and coach seams.

(f) Repeat spray test on other side of vehicle.

(5) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(6) Straighten any distorted panels.

(7) Seal small suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

(8) Seal large suspect joints or seams using 3M Underseal Rubberized Undercoating, or equivalent.

(9) Examine suspect area for loose or missing body plugs.

(a) Check for hardened sealer or road dirt preventing plug from seating.

(b) Check plug hole to be sure that it is not distorted.

(c) If necessary, reshape floorpan or extension panels locally and add a bead of sealant around hole to ensure a satisfactory water tight seal.

(10) Replace damaged or distorted lamp housing gaskets and/or seals. Also, tighten lamp housing attaching hardware.

(11) Seal coach seams with sealant and touch up with matching body color after sealant is dry.

(12) Tighten fuel tank filler neck screws and seal any holes or breaks in gasket and/or sealer with above sealant.

(13) Repeat spray test to ensure that an effective repair has been made.

(14) Install previously removed rear trim panels.

(15) Install sound insulation material, if removed, and cargo mat and/or carpet.

(16) Install spare tire.

### Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Remove spare tire.

(3) Remove cargo mat and/or carpet and sound insulation material, if equipped.

(4) Remove rear trim panels in suspect area.

(5) Close all windows, doors and air vents.

(6) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in cargo compartment, near suspect area, and turn switch on.

(b) Slowly pass listener around all suspect joints/seams.

(c) Mark any area reading approximately 5 on the meter as a indication of a possible leak.

(7) Clean suspect area as described above under Bonding Surface Preparation.

(8) Straighten any distorted panels.

(9) Seal small suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

- (10) Seal large suspect joints or seams using 3M Underseal Rubberized Undercoating, or equivalent.
- (11) Examine suspect area for loose or missing body plugs.
  - (a) Check for hardened sealer or road dirt preventing plug from seating.
  - (b) Check plug hole to be sure that it is not distorted.
  - (c) If necessary, reshape floorpan or extension panels locally and add a bead of sealant around hole to ensure a satisfactory water tight seal.
- (12) Replace damaged or distorted lamp housing gas-

- kets and/or seals. Also, tighten lamp housing attaching hardware.
- (13) Seal coach seams with sealant and touch up with matching body color after sealant is dry.
- (14) Tighten fuel tank filler neck screws and seal any holes of breaks in gasket and/or sealer with sealant.
- (15) Repeat ultrasonic test to ensure that an effective repair has been made.
- (16) Install previously removed rear trim panels.
- (17) Install sound insulation material, if removed, and cargo mat and/or carpet.
- (18) Install spare tire.

## **INTERIOR WIND NOISES**

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### **GENERAL**

A systematic diagnosis is necessary to isolate interior wind noises. The spot where the noise is heard may not be where the trouble really originates. Before proceeding with a noise diagnosis, consider the forces that act on the vehicle to generate wind noise.

Air impacts the windshield and is forced around the A-pillar and along the sides of the vehicle. This air motion causes a low pressure area that moves along with the vehicle near the A-pillar and along the sides of the body.

At the same time, air rammed into the vehicle interior by forward motion enters through the heating and ventilating to build a positive pressure inside the vehicle which tends to force the window glass outward.

To maintain a weather-tight, noise-free seal against these two forces, the doors and glass must be properly maintained and adjusted.

### **STATIC TEST**

Before beginning a static test, visually inspect the fit of the doors, liftgates, tailgates and glass. Proper door, liftgate, tailgate and glass adjustments will cure most interior wind noise problems. Also, thoroughly inspect all weatherstrips to make sure they are not damaged or incorrectly installed. Correct improperly installed, misrouted or faulty weatherstrips.

Close all the doors, windows, and vents and turn the blower motor on high. Use a stethoscope to listen for air leakage in the suspected area. If the air leakage appears to be excessive compared with the other side of the vehicle, perform the necessary repairs to correct the air leakage and recheck the repaired area.

Another way to static test the vehicle is to use the Listener Tool J-23455-01. This tool makes use of the fact that ultrasonic energy (high frequency sound) has certain properties that are similar to those of fluids (liquids and gases). Ultrasonic energy does not penetrate solids, such as glass or metal. It is, however, transmitted through cracks and openings, such as those that cause body, water, or air leaks.

An operating ultrasonic generator placed inside an automobile body will fill the vehicle with sound energy. This energy will leak at the same location that permits water and air leaks. However, if an opening or hole is full of water the ultrasonic sound will be blocked. The water path or opening must be dry.

An ultrasonic generator and detector gun form an ideal combination for determining the location and magnitude of water and air leaks. The ultrasonic leak detector can be used effectively as a diagnostic tool realizing it is not an exact tool and has certain limitations.

To use the Listener, place the tone generator inside the vehicle, close the doors and windows, and listen for the signal in the problem area with the listener. A meter in the listener measures the strength of the signal being received and gives a direct read-out on a dial. This gives an accurate reference point for checking the repair. If the first static test shows a high reading and the after-repairs test shows a low reading, the problem has been repaired.

### **ROAD TEST**

If the wind noise was not located and corrected during the static test, it will be necessary to road test the vehicle. Also, the vehicle should be road tested after repairs are completed to verify that the problem has

## 3A-10 WATER LEAK/WIND NOISE DIAGNOSIS AND REPAIR

been corrected. Be prepared to make minor adjustments or repairs on the road test.

Take the following tools and materials on the road test:

- Stethoscope
- Body tape
- Weatherstrip adhesive
- Caulking cord
- Silicone Spray
- Screwdrivers
- Knife
- Small socket wrench set

With the above tools and materials, have an assistant drive the vehicle to the test area. Make sure the test road is dry and smooth as possible. It is difficult to hear wind noise on wet, bumpy roads.

While the assistant drives the vehicle, move the stethoscope slowly along the suspected problem area, and listen for the point where the most noise is coming from. Make sure to test the vehicle with the fresh air vents open, because ram air pressure has an effect on the wind noise level. Also, drive the vehicle in both directions on the test road, as prevailing wind conditions could change the noise level.

After determining where the most noise is coming from, stop the road test and carefully inspect the problem area. If the cause is minor, repair it with the tools and material taken along and retest the vehicle to find out if the repair has worked.

If in doubt that the problem area has been found, cover the suspected area with body tape and continue the road test. If the noise has been eliminated with the body tape, the problem area has been located. However, if the noise continues, apply additional strips of body tape to other areas that may be causing the problem. Continue road testing and applying or removing strips of tape until the wind noise has been isolated.

Many wind noise problems can be satisfactorily repaired while on the road test. However, repair of some of the problems, like aligning a window frame or adjusting a door or window, may require returning to the shop for completion.

### DOOR ADJUSTMENTS

Refer to Chapter 3J for detailed procedures on door adjustments.

### LIFTGATE-TAILGATE ADJUSTMENTS

Refer to Chapter 3H for detailed procedures on liftgate-tailgate adjustments.

### WINDOW ADJUSTMENTS

Refer to Chapter 3J and 3K for detailed procedures on window adjustments.

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## EXTERIOR WIND WHISTLES

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Fender Mouldings	3A-11	Luggage Racks	3A-11
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### GENERAL

Noises generated by loose or unseated mouldings, trim, vibrating grille components, etc., can be difficult to diagnose. The most common noise is generally called a "tea kettle" whistle and is usually due to air flowing under instead of around or over a moulding.

### ROAD TEST

There is no way to simulate the air flow that makes exterior wind whistles, so a road test is usually necessary. Take along a roll of body tape to help isolate the problem areas when they are located on the road test. It is usually helpful to have an assistant drive the vehicle or locate the noise. Road test the vehicle with the front windows up and then down, to be sure the noise is coming from outside the vehicle. Also, drive the vehicle in both directions, as the prevailing wind could influence

the noise level. Try to determine from which area of the vehicle the wind whistle is coming:

- Grille area
- Hood bezel
- Fender mouldings
- Windshield reveal mouldings
- Luggage rack

When the source of the wind whistle has been found, isolate that component by applying body tape to the suspected area. Retest the temporary repair. If the body tape stops the whistle, align and tighten the moulding/bezel or apply 3M Clear Auto Sealer or equivalent to fill the gap that is causing the whistle.

### GRILLE AREA

A process of elimination is the only system to use in locating a wind whistle in the grille area. Make a wind

deflector from a piece of cardboard, large enough to cover one-half of the grille area. Tape this deflector to the right front area of the vehicle and road test the vehicle. If the wind whistle is still there, move the deflector to the left front and road test the vehicle. After determining which half of the grille area is causing the wind whistle, apply body tape to all the mouldings and components around the grille opening. Continue road testing the vehicle, progressively remove tape segments until you have isolated the wind whistle. Align and tighten the mouldings or fill the gap with a clear sealer.

**FENDER MOULDINGS**

Fender mouldings that are not properly aligned or tightly seated to the fender can cause a wind whistle. If this is the case, apply body tape to the suspected moulding and road test the vehicle. If the wind whistle has been eliminated with the body tape, align and tighten the moulding or fill the gap with a clear sealer.

**BODY MOULDINGS**

Body or windshield reveal mouldings that are not properly aligned or tightly seated can allow air to flow

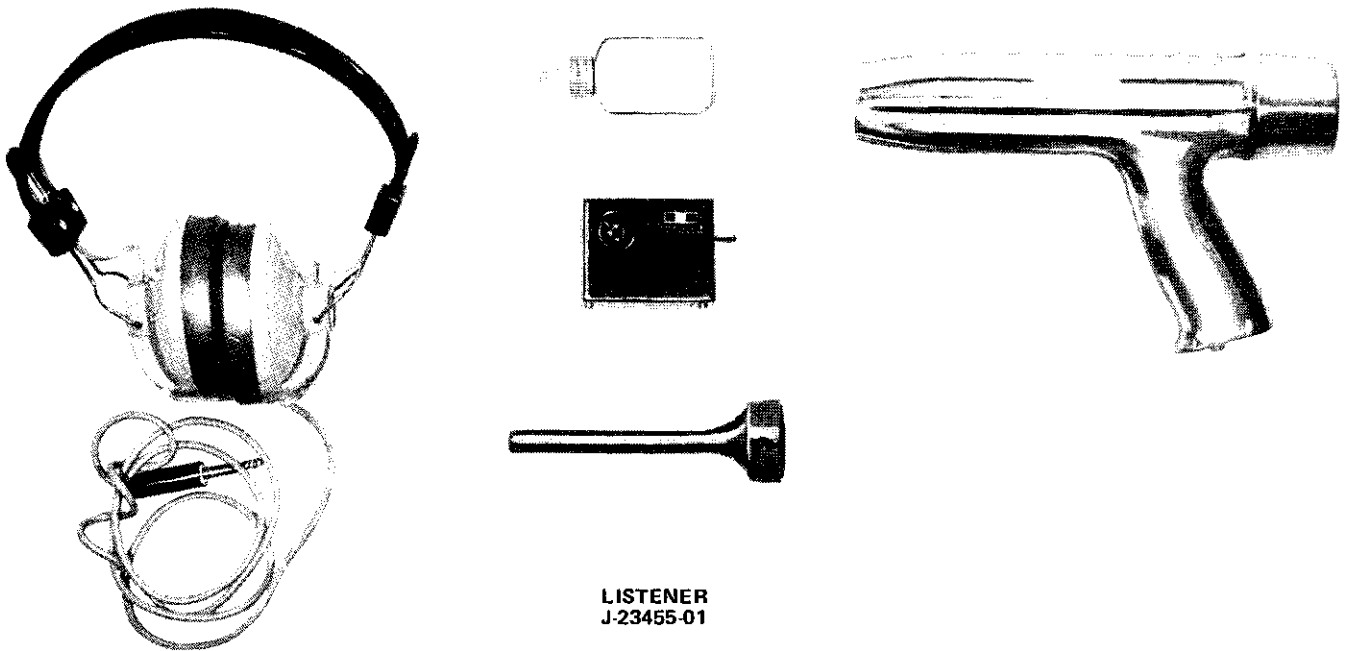
under rather than over them, generating a wind whistle. Apply body tape to the suspected area and road test the vehicle. If the wind whistle is still there, apply additional strips of body tape to the area, until the wind whistle source is located. If a large area has been covered with body tape, continue the road test and progressively remove body tape segments until the wind whistle has been isolated. Align and tighten the moulding or fill the gap with a clear sealer.

**LUGGAGE RACKS**

Luggage racks present a problem area similar to the grille area covered above. Make a deflector from cardboard, large enough to cover one-half the frontal area of the luggage rack. Tape the deflector to the luggage rack and road test the vehicle. If the wind whistle is still there, move the deflector to the other side and repeat the road test. After determining which side of the luggage rack is causing the wind whistle, apply body tape to all mouldings, supports and rails. Continue the road test and progressively remove tape segments until the wind whistle has been isolated. Align and tighten the mouldings, supports and rails or fill the gap(s) with clear sealer.



**Tools**



**LISTENER  
J-23455-01**



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**NOTES**

# METAL REPAIR AND PAINTING 3B

## SECTION INDEX

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Metal Repair	38-1	Painting Tips	38-2

### METAL REPAIR

The information contained herein provides instructions for bulge, crease and dent repair. The terms are defined as follows:

- **Bulge**—An impression in the metal from inside to outside.
- **Crease**—A depression in the metal up to 1/2-inch to 2 inches long or longer.
- **Dent**—A depression in the metal larger than 1/4-inch by 1/4-inch.

(1) Wash damaged area with mild detergent and water to remove dirt.

(2) Clean repair area using wax and silicone remover, such as DuPont Prep-Sol, Ditzler Acryli-Clean, or equivalent.

(3) Use a grinder to remove paint and to outline damaged area.

(a) Use a grade 24 disc for initial grinding.

(b) Follow up with a grade 50 disc to prevent coarse scratches from showing up in final finish.

(4) A bulge may require application of heat to shrink metal.

(a) Heat metal bulge with an oxygen-acetylene torch and immediately upset bulge area with a hammer and dolly.

(b) Do not attempt to hammer bulge below original contour completely while metal is hot or metal will be overshrunk.

(5) To restore contour of a bulge, crease or dent after straightening and grinding, apply plastic body filler, such as DuPont Polyester Autobody Filler, Ditzler "999" Body Filler, 3M Plastic Filler, or equivalent. For best results, mix plastic body filler and hardener according to manufacturer's instructions.

(6) Apply plastic filler with a plastic spreader. Use firm pressure to aid in removing air bubbles which will show up as pinholes.

(7) Use an air file or hand file board for shaping of plastic filler.

(a) For initial shaping of plastic filler, use a grade 36 paper.

(b) For final shaping and sanding contours in plastic filler, use a grade 40 paper.

(8) Featheredge paint into bare metal area as described in following steps.

(a) For rough featheredging, use a grade 80 disc on a random disc sander.

(b) For final featheredging, use grade 180 disc on random disc sander or 220 grade paper on a hand sanding block.

### PAINT REPAIR WITH ACRYLIC ENAMEL

Recent advancements in acrylic enamels have produced a repair procedure which can be used to effectively spot repair a panel or an area where panels join. This procedure should be used only on secondary surfaces of the vehicle (all surfaces below the level of the top of the wheel openings). If repair of a panel requires more than one-half the total panel area, the entire panel should be refinished.

(1) Using a mild detergent and water, wash complete panel and rinse thoroughly.

(2) Clean repair area with a wax and silicone remover, such as DuPont Prep-Sol, Ditzler Acryli-Clean, or equivalent.

(3) Remove loose paint and rust with body grinder. Featheredge area with sandpaper.

(4) Apply metal conditioner, following manufacturer's instructions.

(5) Wash area to be painted.

(6) Mask area to be painted.

(7) If bare metal is showing through paint in repair area, use following steps to prime area.

(a) Apply metal conditioner to bare metal according to manufacturer's instructions.

## 3B-2 METAL REPAIR AND PAINTING

(b) Mix primer following manufacturer's instructions.

(c) Apply primer and allow to air dry.

(d) Remove masking and wet sand repair area.

(e) If scratches or pin holes appear in surface, apply glazing putty according to manufacturer's instructions.

(f) After glazing putty dries, wet sand and clean area. Apply final coat of primer and allow to air dry.

(g) Wet sand and clean area with an after-sanding cleaner.

(8) Mask area to be painted.

(9) Mix acrylic enamel color using a paint shaker and following manufacturer's mixing instructions.

(10) Adjust air pressure at air regulator to obtain 40 psi at spray gun and spray test panel. Adjust gun to obtain desired pattern.

(11) Apply one medium color coat to primed area and allow paint to set up for 25 minutes.

(12) Apply two or more medium color coats. Overlap edges of each coat to produce a tapered edge. Allow each coat to flash completely.

(13) Adjust air pressure at air regulator to obtain 70 psi at spray gun and spray test panel. Adjust gun as necessary to obtain desired pattern and color match.

(14) Spray one full wet color coat over entire repair area. Overlap edges of previous coat.

(15) Empty gun and fill cup with enamel reducer. Reduce air pressure at air regulator to obtain 20 psi at spray gun.

(16) Spray blend-coat over edges of old and new paint.

(17) Spray one or two medium coats over entire area.

(18) Remove all masking when paint has tacked up.

**NOTE:** *If a haze appears over repair area after it has dried, rub area lightly with liquid polishing compound.*

### FINISHING METAL REPLACEMENT PARTS

Metal body service replacement panels or assemblies are painted with a black factory primer. For proper adhesion of acrylic enamel color coats in service, the following refinish steps are necessary.

(1) Wash part with paint finish cleaning solvent, such as DuPont Prep-Sol, Ditzler Acryli-Clean, or equivalent.

(2) Scuff sand part with 360 grade dry sandpaper. Avoid cutting through and rewash part.

(3) Mix primer/sealer following manufacturer's instructions.

(4) Apply primer/sealer and allow to air dry.

(5) Wet sand smooth and clean with after sanding cleaner.

(6) Apply acrylic enamel color coats as required.

### Painting Tips

- Use only one brand of refinish materials on each repair.
- Follow manufacturing instruction for use of refinish materials.
- Use recommended reducer according to shop temperature and humidity conditions.
- Mix paint thoroughly.
- Spray a test panel and adjust gun to obtain desired color before attempting to spray vehicle.
- When matching colors:
  - A given color can be darkened by:
    1. decreasing air pressure
    2. increasing fluid setting on gun
    3. moving gun closer to surface
  - A given color can be lightened by:
    1. increasing air pressure
    2. decreasing fluid setting on gun
    3. moving gun farther from surface

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### Metallic Color Guide

#### To Lighten a Metallic Color:

- Use a Fast-Drying Thinner
- Add More Reducer
- Raise Air-Pressure
- Apply Dryer Coats
- Wait Longer Between Coats
- Mist Coat
- Adjust Fluid Valve on Gun (Close)
- Adjust Air Valve on Gun (Open)
- Hold Gun Further From the Surface

#### To Darken a Metallic Color:

- Use a Slow-Drying Thinner
- Use Less Reducer than Normal
- Lower Air-Pressure
- Apply Wetter Coats
- Allow Less Waiting Time Between Coats
- Use Retarder in Paint
- Open Fluid Adjustment on Gun
- Close Air Adjustment on Gun
- Hold Gun Closer to the Surface

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(7) If part is a replacement fender, perform additional following steps:

(a) Clean inside of replacement fender and allow to dry.

(b) Apply 1/8-inch thick film of spray undercoating, using 3M Body Schutz Rubberized Coating (or equivalent) and 3M Applicator Gun (or equivalent), or a double coat of air-dry acrylic enamel to entire inside surface of fender.

**NOTE:** *Do not use aerosol spray undercoating.*

## FINISHING PLASTIC TRIM PARTS

### General

Paintable plastic interior trim parts can be divided into three general types:

- Polypropylene plastic (Rigid)
- ABS plastic (Rigid)
- Vinyl plastic (Flexible)

It is important to be able to identify each plastic in order to paint it satisfactorily.

The purpose of the following test is to determine the identity of a given plastic so that proper paint procedures and materials can be used.

### Test for Polypropylene and ABS Plastic

To determine if a service part to be painted is Polypropylene or ABS plastic, perform the following burn test:

- (1) From hidden backside of part, remove a sliver of plastic with a sharp knife.
- (2) Hold sliver of plastic with needlenose pliers and ignite plastic.
- (3) Observe burning plastic closely.
  - (a) Polypropylene burns with a clear blue flame which has a yellow tip and no readily visible smoke. When extinguished, it gives off a white smoke with a odor of paraffin.
  - (b) ABS plastic burns with an orange flame and readily visible black, sooty smoke which hangs temporarily in air.

### Test for Vinyl Plastic

To determine if a part to be painted is vinyl plastic, a copper wire test may be performed as follows:

- (1) Heat a copper wire in a suitable flame such as a propane torch until wire glows (red).
- (2) Touch heated wire to backside or hidden surface of part being tested in a manner so as to retain some of plastic material on wire.
- (3) Return wire and retained plastic to flame and observe for a green turquoise blue flame. A flame in this color range indicates that plastic being tested is vinyl.

### Procedure for Painting Rigid Polypropylene Plastic Parts

The system for painting polypropylene parts involves the use of a special primer. Since polypropylene plastic is rigid, it can be color coated after prime with appropriate Jeep color interior spray paint (plastic and vinyl) or equivalent.

**CAUTION:** *It is essential that the service part be primed first with a coating of Jeep 8993626 polypropylene primer (or equivalent) according to the instructions. Failure to use the required primer as directed will result in the color coat lifting or peeling.*

(1) Wash part thoroughly with paint finish cleaning solvent, such as DuPont Prep-Sol, Ditzler Acryli-Clean, or equivalent.

(2) Apply a thin, wet coat of polypropylene primer according to instructions on label. Wetness of primer is determined best by observing gloss reflection of spray application in adequate lighting. Be sure primer application includes all edges.

(3) Allow primer to flash completely.

(4) Apply appropriate color coat of interior spray paint and allow to air dry before installing part.

### Procedure for Painting Rigid ABS Plastic Parts

Rigid ABS plastic requires no primer. Jeep color interior spray paint (plastic and vinyl) or equivalent will adhere satisfactorily to rigid ABS plastics.

(1) Wash part thoroughly with a paint finish cleaning solvent, such as DuPont Prep-Sol, Ditzler Acryli-Clean, or equivalent.

(2) Color coat part using appropriate Jeep color interior spray paint (plastic and vinyl) or equivalent.

(3) Allow to dry and then install part.

**NOTE:** *Apply only sufficient color for proper hiding to avoid wash out of grain effect.*

### Procedure for Painting Flexible Vinyl Plastic Parts

The paint system for flexible vinyl plastic involves the use of Jeep interior spray paint (plastic and vinyl) or equivalent.

**NOTE:** *No special primer is required when painting flexible vinyl plastic parts.*

(1) Wash part thoroughly with a vinyl cleaner. Wipe off cleaner while still wet with a clean, lint-free cloth.

(2) Immediately after wiping surface dry, apply appropriate Jeep color interior spray paint (plastic and vinyl) or equivalent in wet coats allowing sufficient flash time between coats.

(3) Allow to dry completely before installing part.

**NOTE:** *Apply only sufficient color for proper hiding to avoid wash out of grain effect.*



## NOTES



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# INSTRUMENT PANELS AND COMPONENTS

# 3C

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## CJ INSTRUMENT PANEL

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### GENERAL

CJ instrument panels are of formed sheet metal construction and are reinforced with braces and fastened to adjacent body panels with screws.

A crash pad is available for CJ models and is attached to the instrument panel (fig. 3C-1).

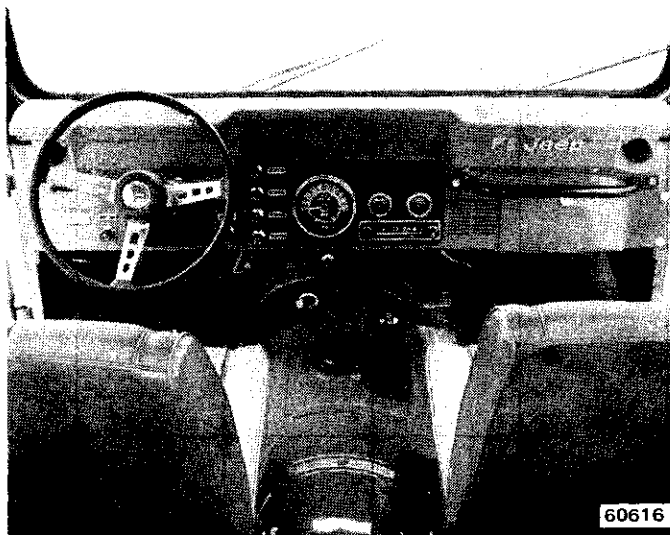


Fig. 3C-1 Instrument Panel

### INSTRUMENT CLUSTER

#### Removal

**NOTE:** If equipped with air conditioning, remove screws attaching evaporator assembly to instrument panel and lower evaporator assembly.

- (1) Disconnect battery negative cable.
- (2) Disconnect speedometer cable.
- (3) Remove cluster attaching screws and remove cluster.
- (4) Mark bulb and wire connectors, and disconnect cluster electrical connectors and lamps.

#### Installation

- (1) Connect cluster lamps and electrical connectors.
- (2) Position cluster on instrument panel and install attaching screws.
- (3) Connect speedometer cable.
- (4) Connect battery negative cable.

### INSTRUMENT PANEL

#### Removal

**NOTE:** If equipped with air conditioning, remove screws attaching evaporator assembly to instrument panel and lower evaporator assembly.

## 3C-2 INSTRUMENT PANELS AND COMPONENTS

- (1) Disconnect battery negative cable.
- (2) Remove screws attaching steering column bezel to instrument panel. Remove bezel.
- (3) Disconnect emergency brake bracket from instrument panel.
- (4) Disconnect speedometer cable.
- (5) Disconnect heater control cables from damper door levers.
- (6) Remove windshield clamp knobs and brackets.
- (7) Remove crash pad, if equipped.
  - (a) If equipped with a soft top, unsnap top snaps at windshield corners, unfasten straps at center and sides of front top support, lay top support back to rear, and release top from header retainer.
  - (b) If equipped with a hardtop enclosure, remove hardware attaching enclosure to windshield and rear quarter panels and support enclosure with wood blocking (fig. 3C-2).
  - (c) Fold windshield down onto hood.
  - (d) Remove screws attaching crash pad, if equipped, and remove crash pad.

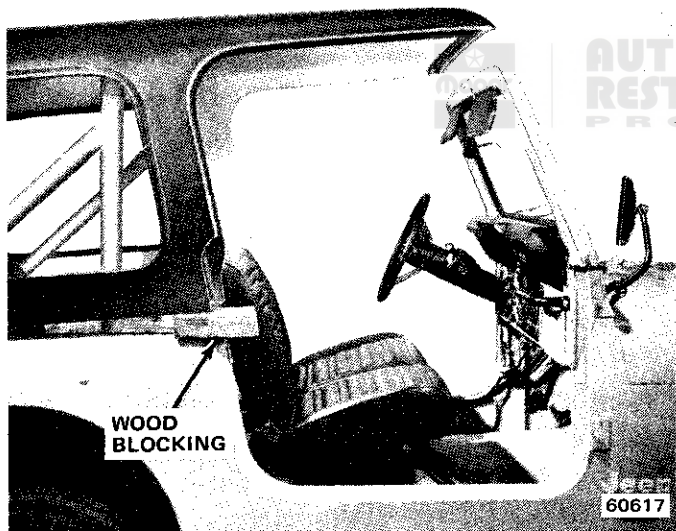


Fig. 3C-2 Hardtop Enclosure Supported with Wood Blocking

- (8) Disconnect all electrical connections.
- (9) Remove steering wheel.
- (10) Remove automatic transmission shift lever, if equipped.
  - (a) Place automatic transmission shift lever in Park.
  - (b) Drive out roll pin attaching shift lever to shift bowl and remove shift lever.
- (11) Remove instrument panel-to-dash panel attaching screws and remove instrument panel.

### Installation

- (1) Position instrument panel in vehicle and install attaching screws.

- (2) Install automatic transmission shift lever, if equipped. Insert shift lever in shift bowl and install roll pin.
- (3) Install steering wheel.
- (4) Connect all electrical connections.
- (5) Install crash pad, if equipped.
  - (a) Position crash pad on instrument panel and install attaching screws.
  - (b) Raise windshield to upright position.
  - (c) If equipped with a hardtop enclosure, remove wood blocking supporting top and lower top onto body and windshield. Install hardware attaching top to windshield and rear quarter panels.
  - (d) If equipped with a soft top, engage top with header retainer, position top support in upright position and fasten center and side straps, and fasten top snaps at windshield corners.
- (6) Install windshield brackets and clamp knobs.
- (7) Connect heater control cables to damper door levers.
- (8) Connect speedometer cable.
- (9) Install emergency brake bracket to instrument panel.
- (10) Position steering column bezel on instrument panel and install attaching screws.
- (11) Connect battery negative cable.

### CRASH PAD

#### Removal

- (1) If equipped with a soft top, unfasten top snaps at windshield corners, unfasten straps at center and sides of front top support, lay top support back to rear and release top from header retainer.
- (2) If equipped with a hardtop enclosure, remove hardware attaching top to windshield and rear quarter panels and support top with wood (fig. 3C-2).
- (3) Remove windshield clamp knobs and fold windshield down onto hood.
- (4) Remove screws attaching crash pad and remove crash pad.

#### Installation

- (1) Position crash pad on instrument panel and install attaching screws.
- (2) Raise windshield to upright position and install clamp knobs.
- (3) If equipped with a hardtop enclosure, remove wood blocking supporting top and lower top onto body and windshield. Install hardware attaching top to windshield and rear quarter panels.
- (4) If equipped with a soft top, engage top with header retainer, position top support in upright position and fasten center and side straps, and fasten top snaps at windshield corner.

**GLOVE BOX ASSEMBLY**

**Removal**

- (1) Remove glove box-to-instrument panel attaching screws.
- (2) Remove striker.
- (3) Compress glove box at the crease lines and remove box through opening.

**Installation**

- (1) Compress glove box at the crease lines and insert box in opening.
- (2) Install glove box-to-instrument panel attaching screws.
- (3) Install and adjust striker.

**Glove Box Door and Hinge**

**Removal**

The glove box door hinge mounting holes are elongated to provide adjustment. The hinge screws may be loosened and the door moved in the desired direction to fit the door opening.

- (1) Remove hinge-to-instrument panel attaching screws.
- (2) Remove door and hinge assembly.

**Installation**

- (1) Position door and hinge assembly on instrument panel.
- (2) Install hinge-to-instrument panel attaching screws.
- (3) Adjust door.

**Striker Adjustment**

The glove box door lock striker is attached to the instrument panel opening with sheet metal screws. The striker can be moved in or out for door closing adjustment.

**INSTRUMENT ILLUMINATION**

Instrument panel illumination is provided by three bulbs in the instrument cluster, six molded lamps in the instrument panel, and one bulb each in the voltmeter and oil gauge. Protection for the panel bulbs and lamps is provided by the 3-amp fuse located in the fuse panel. The 3-amp fuse is fed from the headlamp switch through a rheostat.

Do not pull on the bulb wires to remove the bulb socket. Grasp the socket and pull straight out.

To remove the molded lamps, remove the wire connectors. Squeeze the lamp together at the top and bottom to release the small retaining tabs. Push the lamp

through the panel (toward the steering wheel). To install the molded lamps, push into the panel until the retaining tabs snap into place.

**SPEEDOMETER**

A magnetic type speedometer is used on all CJ models. All speedometers are equipped with a ratchet device to prevent turning the odometer backward.

The following data is supplied for testing and calibrating the speedometer heads.

**Speedometer Calibration**

Shaft Speed (rpm)	Indication (mph)
167	9 to 11
500	30 to 32.5
1000	60 to 63
1500	90 to 94

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**Speedometer Head Replacement**

Speedometer head replacement includes resetting the replacement odometer to the same mileage as the one removed, unless such setting conflicts with local ordinances.

- (1) Remove cluster.
- (2) Carefully uncrimp lip of outer bezel. Remove outer bezel, glass and glass retaining bezel.
- (3) Remove attaching screws from speedometer housing. Remove speedometer and face plate assembly.
- (4) On replacement speedometer, unhook odometer retaining clip. Twist and push down to disengage clip.
- (5) Remove odometer and set to proper mileage. Refer to Odometer Setting Procedures.
- (6) Install odometer.

**NOTE:** Check anti-backup spring for proper positioning.

- (7) Install retaining spring clip using needlenose pliers. Do not force clip against dial face.
- (8) Check all light guards for proper positioning. Install speedometer and face plate assembly. Install speedometer attaching screws and washers.
- (9) Remove all fingerprints and debris from inside surface of glass.
- (10) Install glass, glass retaining bezel and outer bezel. Carefully crimp outer bezel lip four places.
- (11) Install cluster.

**Odometer Setting Procedure**

The following procedure applies with the odometer removed from the speedometer head. Refer to figure 3C-3.

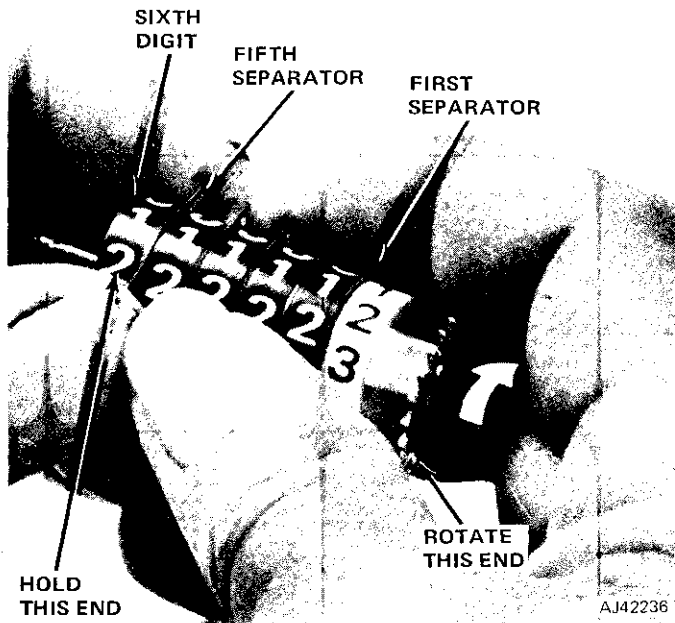


Fig. 3C-3 Advancing Odometer Reading (for Replacement Only)

Hold the fifth separator and rotate the last five numerals in their normal direction until the desired sixth digit is obtained. When the desired sixth digit is obtained, align the fourth separator in line with the fifth separator. Rotate the last four numerals, repeating the process until the desired total mileage is obtained. When installing the odometer, the separators must straddle a cross bar to maintain proper number alignment.

**Speedometer Cable Inspection**

Visually inspect cable for breaks, kink, cracks, burns or other physical damage. Remove core from cable assembly and place on a flat surface in the form of an inverted U and then cross the open ends. Hold one end in the left hand, the other in the right hand. Twist one end, applying light finger pressure to the other end. If the core is satisfactory, the turning action will be smooth. A damaged core will react by jumping about on a flat surface.

The speedometer cable requires graphite grease for lubrication.

**CLOCK**

The clock is attached to the instrument panel by a retaining bracket secured with two screws. To reset the clock, pull out the adjustment knob and rotate. Hands of *fast running* clocks should be turned *backward*, and *slow running* clocks *forward*. Clock speed will then be corrected automatically after one or two adjustments.

**CIGAR LIGHTER**

The cigar lighter is attaching to the bottom of the instrument panel on all CJ models.

The lighter can be removed by removing the battery feed wire and ground wire and unscrewing the shell that surrounds the lighter.

The lighter circuit is protected with a 10-amp fuse located at the fuse panel.

**CHEROKEE - WAGONEER - TRUCK INSTRUMENT PANEL**

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**GENERAL**

All Cherokee-Wagoneer-Truck instrument panels are of formed sheet metal construction and are reinforced with braces and fastened to adjacent body panels with bolts.

A vinyl-covered polyurethane crash pad is attached to the instrument panel on all models (fig. 3C-4).

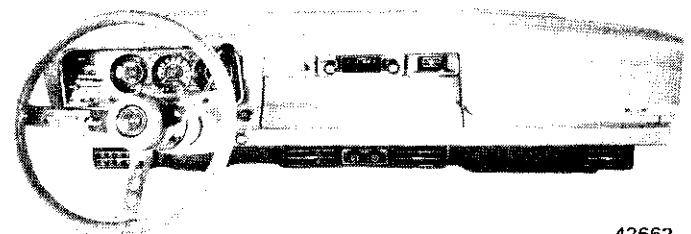


Fig. 3C-4 Instrument Panel

## INSTRUMENT CLUSTER

### Removal

- (1) Disconnect battery negative cable.
- (2) Disconnect speedometer cable.
- (3) Cover steering column to prevent damaging paint.
- (4) Remove cluster attaching screws and tilt top of cluster toward interior of vehicle.
- (5) Mark electrical connectors and hoses, and disconnect electrical connectors and heater vacuum hoses.
- (6) Disconnect blend air door control cable.
- (7) Remove cluster.

### Installation

- (1) Position cluster on instrument panel.
- (2) Connect blend air door control cable.
- (3) Connect electrical connectors and heater vacuum hoses.
- (4) Install cluster attaching screws.
- (5) Connect speedometer cable.
- (6) Connect battery negative cable.
- (7) Remove covering on steering column.
- (8) Check heater and gauge operation.

## INSTRUMENT PANEL

### Removal

- (1) Disconnect battery negative cable.
- (2) Remove instrument panel crash pad, as outlined in this chapter.
- (3) Remove evaporator assembly and ducts, if equipped with air conditioning.
- (4) Remove instrument cluster.
- (5) Remove radio, if equipped.
- (6) Remove parking brake lever assembly.
- (7) Remove air vent cables.
- (8) Disconnect electrical connectors and remove courtesy lights.
- (9) Disconnect defroster hoses.
- (10) Remove steering column trim panel.
- (11) Remove bolt from center of brace and lower steering column.
- (12) Remove instrument panel attaching screws and remove panel.

### Installation

- (1) Position instrument panel and install attaching screws.
- (2) Raise steering column and install bolt in center of brace.
- (3) Install steering column trim panel.
- (4) Connect defroster hoses.
- (5) Connect electrical connectors and courtesy lights.

- (6) Install air vent cables.
- (7) Install parking brake lever assembly.
- (8) Install instrument cluster.
- (9) Install radio, if removed.
- (10) Install evaporator assembly and ducts, if removed.
- (11) Install instrument panel crash pad.
- (12) Connect battery negative cable.

## CRASH PAD

### Removal

- (1) Remove windshield and windshield weatherstrip to expose crash pad retaining screws at base of windshield (refer to Windshield Removal—Chapter 3N).
- (2) Remove instrument cluster.
- (3) Remove glove box.
- (4) Remove ashtray and retainer.
- (5) Remove radio, if equipped.
- (6) Remove crash pad-to-instrument panel attaching screws and nuts.

**NOTE:** *The nuts are accessible through the cluster, ash receiver, and glove box openings.*

### Installation

- (1) Position crash pad on instrument panel.
- (2) Install attaching screws and nuts.
- (3) Install radio, if equipped.
- (4) Install ashtray and retainer.
- (5) Install glove box.
- (6) Install instrument cluster.
- (7) Install windshield weatherstrip and windshield (refer to Windshield Installation—Chapter 3N).

## GLOVE BOX ASSEMBLY

### Removal

- (1) Remove glove box-to-instrument-panel attaching screws.
- (2) Remove striker.
- (3) Remove lockout control switch, if equipped.
- (4) Move glove box down and out from rear of instrument panel.

**NOTE:** *On vehicles equipped with air conditioning, compress the glove box at the crease lines and remove box through opening.*

### Installation

- (1) Position glove box in glove box opening.
- (2) Install glove box-to-instrument panel attaching screws.
- (3) Install lockout control switch, if removed.
- (4) Install and adjust striker.

## INSTRUMENT PANELS AND COMPONENTS

### Glove Box Door and Hinge

#### Removal

The glove box door hinge mounting holes are elongated to provide adjustment. The hinge screws may be loosened and the door moved in the desired direction to fit the door opening.

(1) Remove hinge-to-instrument panel attaching screws.

**NOTE:** On vehicles equipped with air conditioning, the evaporator housing must be lowered to obtain access to the hinge-to-instrument panel attaching screws.

- (2) Remove door-to-hinge attaching screws.
- (3) Remove hinges and glove box door.

#### Installation

- (1) Position hinges on instrument panel and install attaching screws.
- (2) Install door-to-hinge attaching screws.
- (3) Adjust door.

### Striker Adjustment

The glove box door lock striker is attached to the instrument panel opening with sheet metal screws. The striker can be moved in or out for door closing adjustment.

### Lock Cylinder Replacement

The glove box lock assembly is inserted through the glove box door from the outside. The assembly is held in place by a screw through the lock clamp cup and into the lock case.

- (1) Insert key in lock and rotate cylinder counterclockwise to expose the tumblers.
- (2) Remove key and press retainer tumbler down.
- (3) Insert key and remove lock cylinder.
- (4) If replacement lock cylinder is being installed, insert original key into replacement cylinder and file tumblers flush with cylinder. Stake tumblers into cylinder.
- (5) Press retainer tumbler down on lock cylinder and insert key in cylinder.
- (6) Insert cylinder into lock case.
- (7) Hold cylinder in place and remove key.

### INSTRUMENT ILLUMINATION

Four bulbs provide lighting for the instrument cluster (fig. 3C-5) and two bulbs illuminate the heater control panel. Panel lights are fed from the fuse panel through the headlamp switch rheostat. To replace instrument cluster bulbs, reach up behind the cluster, twist the bulb socket counterclockwise (viewed from the rear) and pull out. To replace the heater control panel bulb, pry the bulb socket down to free the spring clip which attaches the socket to the panel.

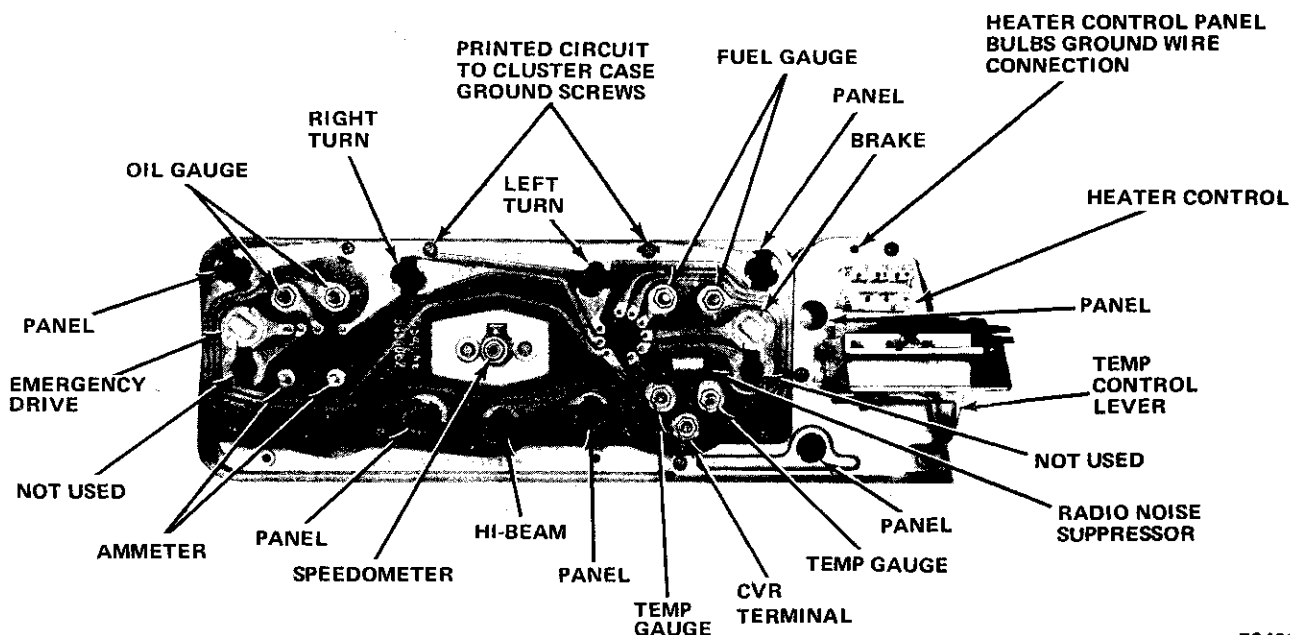


Fig. 3C-5 Instrument Cluster—Rear View

**SPEEDOMETER**

A magnetic type speedometer is used on all models.

All speedometers are equipped with a ratchet device to prevent turning the odometer backward.

The following data is supplied for testing and calibrating the speedometer heads.

**Speedometer Calibration**

Shaft Speed (rpm)	Indication (mph)
167	9 to 11
500	30 to 32.5
1000	60 to 63
1500	90 to 94

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**Speedometer Head Replacement**

Speedometer head replacement includes resetting the replacement odometer to the same mileage as the one removed, unless such setting conflicts with local ordinances.

- (1) Remove cluster.
- (2) Remove printed circuit board attaching screws and separate cluster case from bezel.
- (3) Remove two speedometer attaching screws and speedometer.
- (4) Remove odometer retaining clip.
- (5) Remove odometer.
- (6) Install odometer assembly.

**NOTE:** Check anti-backup spring for proper positioning.

- (7) Install retaining spring clip.
- (8) Install speedometer head.
- (9) Install printed circuit board.
- (10) Install cluster.

**Odometer Setting Procedure**

This procedure applies with the odometer removed from the speedometer head. Refer to figure 3C-6.

Hold the fifth separator and rotate the last five numerals in their normal direction until the desired sixth digit is obtained. When the desired sixth digit is obtained, align the fourth separator in line with the fifth separator. Rotate the last four numerals, repeating the process until the desired total mileage is obtained. When installing the odometer, the separators must straddle a cross bar to maintain proper number alignment.

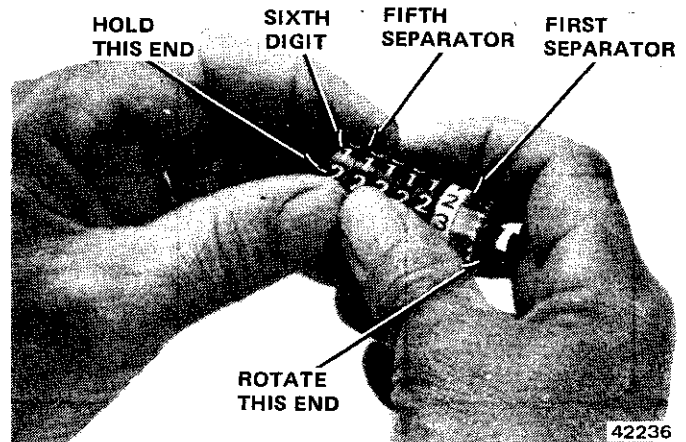


Fig. 3C-6 Advancing Odometer Reading (for Replacement Only)

**Speedometer Cable Inspection**

Visually inspect cable for breaks, kinks, cracks, burns, or other physical damage. Remove core from cable assembly and place on a flat surface in the form of an inverted U and then cross the open ends. Hold one end in the left hand, the other in the right hand. Twist one end, applying light finger pressure to the other end. If the core is satisfactory, the turning action will be smooth. A damaged core will react by jumping about on a flat surface.

The speedometer cable requires graphite grease for lubrication.

**CLOCK**

The clock is attached to the instrument panel with two nuts.

If the vehicle is not equipped with air conditioning, the clock may be removed by reaching behind the instrument panel and removing the nuts.

If the vehicle is equipped with air conditioning, access to the clock can be obtained by removing the glove box liner attaching screws and pulling down the top portion

To reset the hands of the clock, pull out the adjustment knob and rotate. Hands of a *fast-running* clock should be turned *backward*, and *slow-running* clocks *forward*. Allow 24-hours between adjustments. Clock speed will then be corrected automatically after one or two adjustments.

**CIGAR LIGHTER**

The cigar lighter is mounted on the instrument panel on all models.

The lighter can be removed by disconnecting the battery feed wire and unscrewing the shell that surrounds the lighter.

The lighter circuit is protected with a 10-amp fuse located at the fuse





# HEATER

# 3D

## SECTION INDEX

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## CJ HEATER

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Defroster Duct	3D-5	Heater and Defroster Operation	3D-2
Fan Control Switch	3D-4	Heater Core	3D-4
Fresh Air Intake Duct	3D-5	System Controls	3D-1

### GENERAL

The blend-air type heater and defroster system is used on all CJ vehicles. The blend-air method of heating uses a constant flow system with engine coolant continuously flowing through the heater core. The temperature of the heated air entering the passenger compartment is controlled by regulating the quantity of air which flows through the heater core air passages, then blending it

with a controlled amount of cool, fresh air which bypasses the heater core. System controls and operation are described in this section.

When servicing a malfunctioning heater system, refer to the Service Diagnosis for a list of the possible causes and recommended service procedures.

### SYSTEM CONTROLS

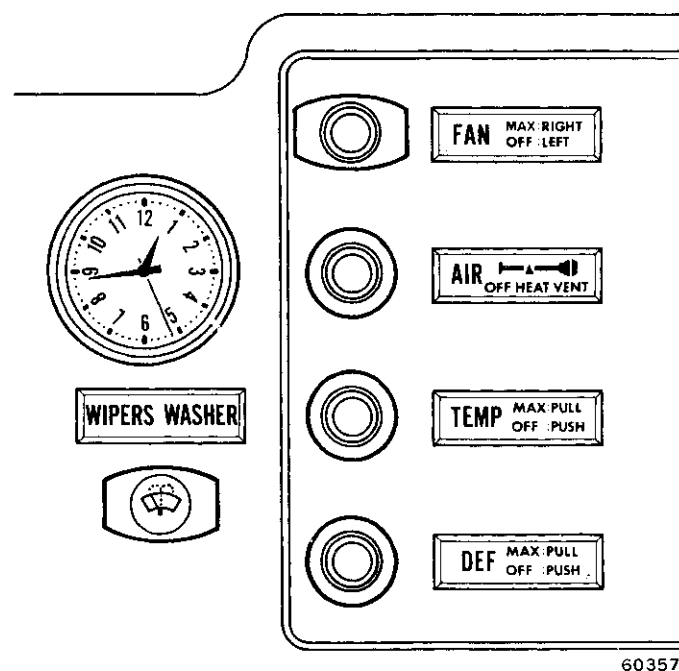
The heater and defroster controls consist of a fan control switch and three push-pull knobs and cable assemblies which are located on the instrument panel (fig. 3D-1).

The air control is a dual function control. When the control is pulled to the first position (Heat), it opens a door in the fresh air inlet to allow air to enter the heater. When the control is pulled completely out (Vent), it opens two additional doors (one in the left end of the fresh air inlet and one on the right side of the heater) to allow fresh air to enter the passenger compartment. A new fresh air duct has been added to direct fresh air to the driver's side.

The defrost control knob operates a door in the heater housing which regulates heater and defroster operation by directing the flow of air through the defroster hose or floor outlet.

The temperature control knob adjusts the amount of airflow around the heater core and through the heater core air passages. This regulates the degree of heat entering the passenger compartment.

The fan control is a four-position control switch (Off, Low, Med and High), which regulates the blower motor and airflow for heat and defrost.



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Fig. 3D-1 Heater and Defroster Controls

## 3D-2 HEATER

### HEATER AND DEFROSTER OPERATION

The heater is part of the engine cooling system and depends on normal engine operating temperature and airflow through the cowl fresh air intake to heat the interior of the vehicle. During heater operation, close the fresh air vent.

The air control knob operates a door in the fresh air intake duct which allows air to enter the heater housing. When the knob is pushed in, no air will enter the heater. As the knob is pulled out to the first position (Heat), the door opens, allowing airflow to the heater. The air control knob must be pulled to the Heat position to operate the heater.

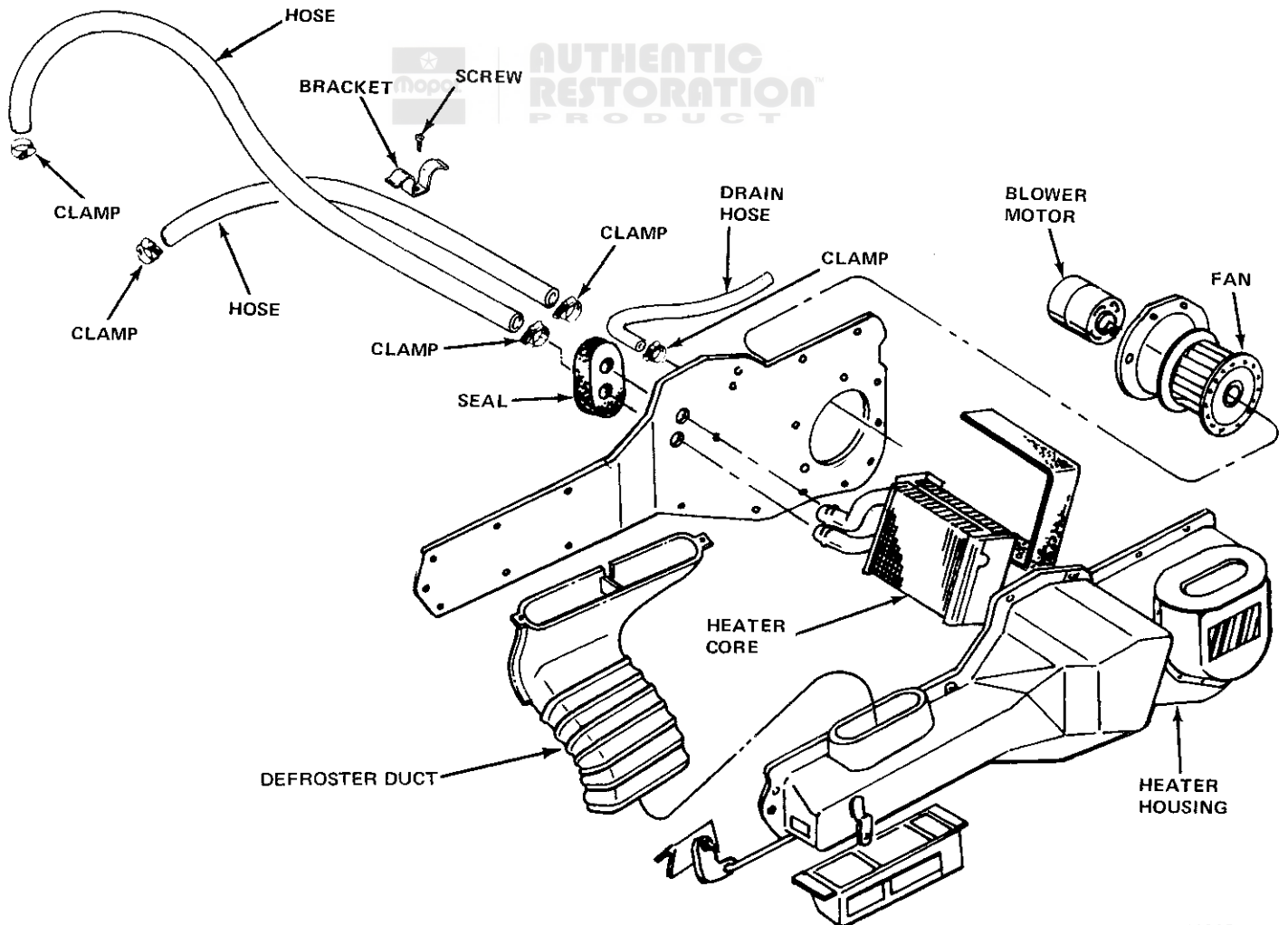
The temperature control knob operates the blend air door in the heater housing (fig. 3D-2). At the full out position, all air is directed through the heater core, providing maximum heat flow. At the full in position, all air is directed around the heater core, providing unheated fresh air. Any in-between position of the control allows a blend of cool, fresh outside air and heated air. The defrost control knob must be pushed in for the

blended air to enter through the floor heat duct. When the defrost control knob is pulled out completely, all airflow will be directed through the defroster hose and onto the windshield. Any in-between position of the defrost control divides the airflow between the defroster hose and the floor heat duct.

If additional airflow is required, the blower motor should be operated at one of the three available speeds.

### FRESH AIR VENTILATION

The fresh air ventilating system directs outside air through the air inlet to a door in the left end of the air inlet to provide air to the driver's side and also through a door on the right side of the heater to provide air to the passenger side. These doors are cable and linkage controlled. When the air control knob is pulled all the way out to the vent position, the driver's vent door is opened by linkage on the air inlet and the passenger vent door is opened by a cable that is attached to the linkage on the air inlet. When the air control is pushed in, no air will enter the vehicle.



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Fig. 3D-2 Heater and Defroster

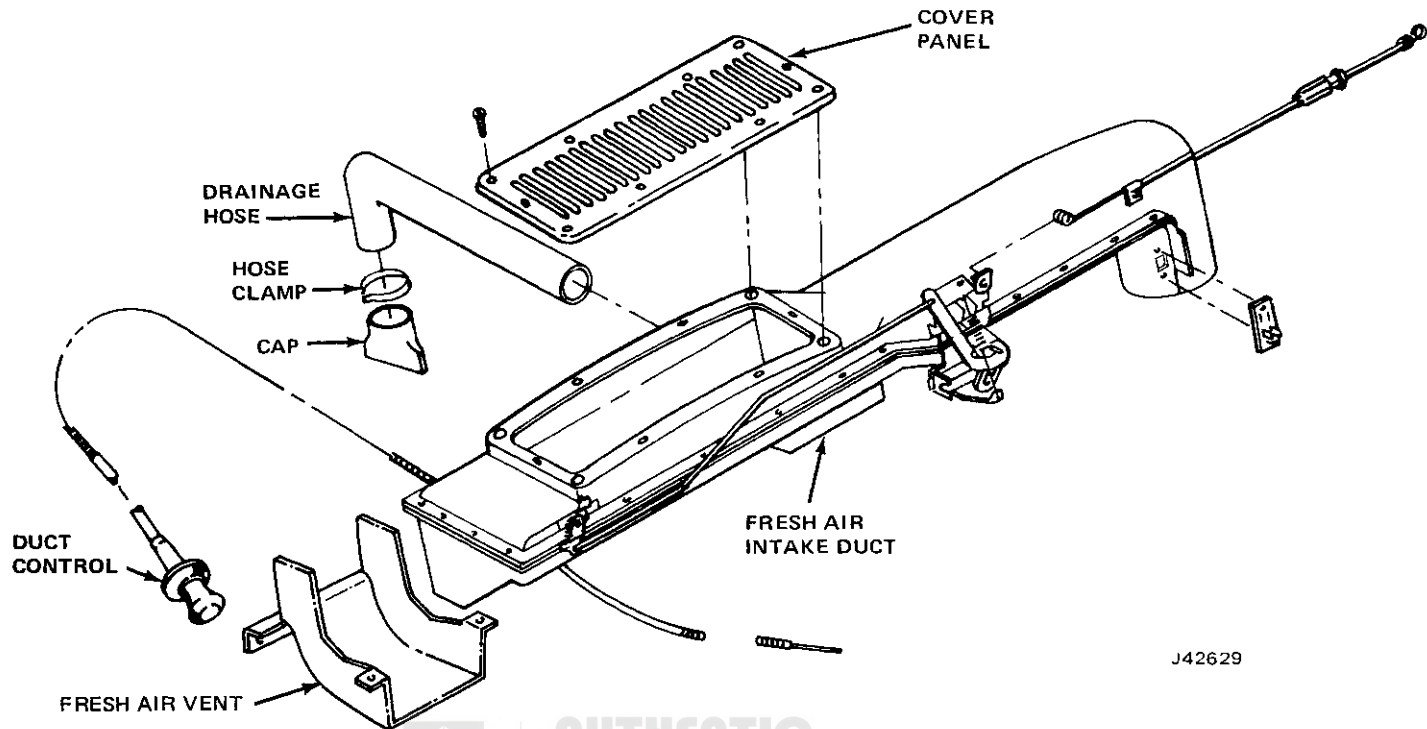


Fig. 3D-3 Fresh Air Intake

**Service Diagnosis**

Condition	Possible Cause	Correction
FAN MOTOR WILL NOT RUN AT ANY SPEED	<ol style="list-style-type: none"> <li>(1) Blown fuse</li> <li>(2) Loose connection</li> <li>(3) Poor ground</li> <li>(4) Faulty switch</li> <li>(5) Faulty motor</li> <li>(6) Faulty resistor</li> </ol>	<ol style="list-style-type: none"> <li>(1) Replace fuse</li> <li>(2) Inspect and tighten</li> <li>(3) Clean and tighten</li> <li>(4) Replace switch</li> <li>(5) Replace motor</li> <li>(6) Replace resistor</li> </ol>
FAN MOTOR RUNS AT ONE SPEED ONLY	<ol style="list-style-type: none"> <li>(1) Faulty switch</li> <li>(2) Faulty resistor</li> </ol>	<ol style="list-style-type: none"> <li>(1) Replace switch</li> <li>(2) Replace resistor</li> </ol>
FAN RUNS BUT DOES NOT CIRCULATE AIR	<ol style="list-style-type: none"> <li>(1) Intake blocked</li> <li>(2) Fan not secured to motor shaft</li> </ol>	<ol style="list-style-type: none"> <li>(1) Clean intake</li> <li>(2) Tighten securely</li> </ol>
HEATER WILL NOT HEAT	<ol style="list-style-type: none"> <li>(1) Coolant does not reach proper temperature</li> <li>(2) Heater core blocked internally</li> <li>(3) Heater core air-bound</li> <li>(4) Blend-air door not in proper position</li> </ol>	<ol style="list-style-type: none"> <li>(1) Check and replace thermostat if necessary</li> <li>(2) Flush or replace core if necessary</li> <li>(3) Purge air from core</li> <li>(4) Adjust cable</li> </ol>
WILL NOT DEFROST	<ol style="list-style-type: none"> <li>(1) Control cable adjustment incorrect</li> <li>(2) Defroster hose damaged</li> </ol>	<ol style="list-style-type: none"> <li>(1) Adjust control cable</li> <li>(2) Replace defroster hose</li> </ol>

### FAN CONTROL SWITCH

#### Removal

(1) Rotate knob until slot in neck of knob is visible. Insert a small bladed screwdriver in the slot and depress spring metal clip toward knob. This will relieve tension on the spring metal clip and allow knob to slide off shaft (fig. 3D-4).

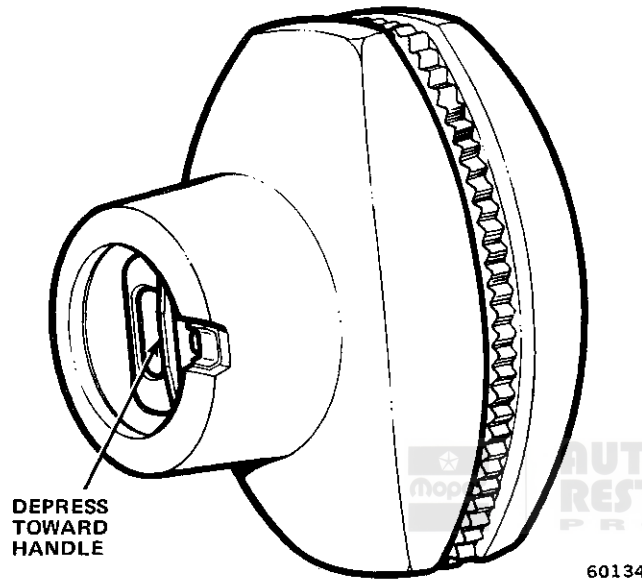


Fig. 3D-4 Fan Control Knob Locking Feature

- (2) Remove retaining nut and trim ring.
- (3) Remove switch from instrument panel and disconnect wires.

#### Installation

- (1) Connect wires and position switch in instrument panel.
- (2) Install trim ring and retaining nut.
- (3) Install control knob.

### CONTROL CABLES

#### Adjustment

The only cable that is adjustable is the cable from the air inlet linkage to the passenger vent door at the right side of the heater. This cable has a turnbuckle adjustment located approximately six inches above the cable attachment to the right side of the heater. Adjust this cable until the passenger vent door is closed when the air control knob is pushed in.

**NOTE:** If the cable is adjusted beyond the closed door position it will cause a bind in the linkage and may prevent the driver's vent door from closing.

#### Replacement

- (1) Disconnect cable from door and housing.

**NOTE:** The control cables are retained on the backside of the instrument panel by plastic tabs. To disengage the cables from the instrument panel, press the plastic tabs together and pull out the cable.

- (2) Remove cable from instrument panel.
- (3) Remove cable-to-damper door.
- (4) Route replacement cable through hole in instrument panel
- (5) Connect cable to door and housing.
- (6) Install cable to damper door.
- (7) Check operation.

### HEATER CORE

The heater housing assembly must be removed to gain access to the heater core.

#### Removal

- (1) Drain approximately two quarts of coolant from the radiator.
- (2) Disconnect heater hoses.
- (3) Disconnect damper door control cables.
- (4) Disconnect blower motor wire.
- (5) Disconnect water drain hose and defroster hose.
- (6) Remove nuts from heater housing studs in engine compartment.
- (7) Remove heater housing assembly by tilting down to disengage from air inlet duct and pulling to the rear of the vehicle.
- (8) Remove heater core from heater housing.

#### Installation

- (1) Install heater core in housing.
- (2) Position heater core housing and install attaching nuts.

**NOTE:** Make sure that the seals around the core pipes and blower motor are in position before installing the heater to the dash panel. Do not over-torque the heater to dash panel nuts as this can cause distortion of the heater assembly. Tighten until two threads are visible beyond the nut.

- (3) Connect water drain hose and defroster hose.
- (4) Connect blower motor wire.
- (5) Connect and adjust damper door control cables.
- (6) Connect heater hoses.
- (7) Replace coolant.
- (8) Check heater operation.

### BLOWER MOTOR

The heater housing assembly must be removed to replace the blower motor.

**Removal**

- (1) Remove heater assembly as outlined above.
- (2) Remove blower motor assembly-to-heater housing attaching screws and remove blower motor assembly.

**Installation**

- (1) Position blower motor assembly to heater housing and install attaching screws.
- (2) Reinstall heater assembly as outlined above.
- (3) Check blower motor and heater control operation.

**DEFROSTER DUCT****Removal**

- (1) Disconnect negative battery cable.
- (2) Drain two quarts of antifreeze from radiator.
- (3) Remove heater hoses.
- (4) Remove drain tube from heater housing.
- (5) Remove screws attaching evaporator housing to instrument panel and lower housing.
- (6) Disconnect wiring from A/C switch.
- (7) Remove screw attaching heater motor housing to bracket.
- (8) Remove nuts attaching heater housing-to-dash panel from engine compartment.
- (9) Disconnect speedometer cable.
- (10) Remove glove box.
- (11) Tilt heater housing assembly back and pull to rear and lower housing.
- (12) Disconnect heater control cables.
- (13) Remove fresh air cover panel from cowl.
- (14) Remove fresh air intake duct assembly.
- (15) Lower windshield.
- (16) Remove screws from defroster duct and remove defroster duct and tube.

**Installation**

- (1) Position defroster duct and install attaching screws and tube.
- (2) Raise windshield and secure.
- (3) Install fresh air intake duct assembly.
- (4) Install fresh air cover panel on cowl.
- (5) Install heater control cables.
- (6) Position heater housing assembly on dash panel.
- (7) Install nuts attaching heater housing to dash panel.
- (8) Install glove box.
- (9) Install speedometer cable.
- (10) Install screw attaching heater housing to bracket.
- (11) Connect wiring to A/C switch.
- (12) Install evaporator housing to instrument panel.

- (13) Connect drain tube to heater housing.
- (14) Connect heater hoses.
- (15) Refill radiator.
- (16) Connect negative battery cable.

**FRESH AIR INTAKE DUCT****Removal**

- (1) Disconnect negative battery cable.
- (2) Drain two quarts of antifreeze from radiator.
- (3) Remove heater hoses.
- (4) Remove drain tube from heater housing.
- (5) Remove screws attaching evaporator housing to instrument panel and lower housing.
- (6) Disconnect wiring from A/C switch.
- (7) Remove screw attaching heater motor housing to bracket.
- (8) Remove nuts attaching heater housing to dash panel from engine compartment.
- (9) Disconnect speedometer cable.
- (10) Remove glove box.
- (11) Tilt heater housing assembly back and pull to the rear a lower housing.
- (12) Disconnect heater control cables.
- (13) Remove fresh air cover panel from cowl.
- (14) Remove fresh air intake duct assembly.

**Installation**

- (1) Position defroster duct and install attaching screws and tube.
- (2) Raise windshield and secure.
- (3) Install fresh air intake duct assembly.
- (4) Install fresh air cover panel on cowl.
- (5) Install heater control cables.
- (6) Position heater housing assembly on dash panel.
- (7) Install nuts attaching heater housing to dash panel.
- (8) Install glove box.
- (9) Install speedometer cable.
- (10) Install screw attaching heater housing to bracket.
- (11) Connect wiring to A/C switch.
- (12) Install evaporator housing to instrument panel.
- (13) Connect drain tube to heater housing.
- (14) Connect heater hoses.
- (15) Refill radiator.
- (16) Connect negative battery cable.

# CHEROKEE - WAGONEER - TRUCK HEATER

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Control Cable	3D-8	Heater Control Panel	3D-7
Fresh Air Ventilation	3D-7	Heater Core	3D-9
General	3D-6	System Controls	3D-6

## GENERAL

The blend-air type heater and defroster system is used on all Cherokee, Wagoneer and Truck models. The blend-air method of heating uses a constant flow system with engine coolant continuously flowing through the heater core. The temperature of the heated air entering the passenger compartment is controlled by regulating the quantity of air which flows through the heater core air passages, then blending it with a controlled amount of cool, fresh air which bypasses the heater core. System controls and operation are described in this section.

When servicing a malfunctioning heater system, refer to the Service Diagnosis for a list of the possible causes and recommended service procedures.

## SYSTEM CONTROLS

The heater and defroster controls consists of a fan control switch, a vacuum control switch operated by three pushbuttons, and a slide temperature control lever (fig. 3D-5).

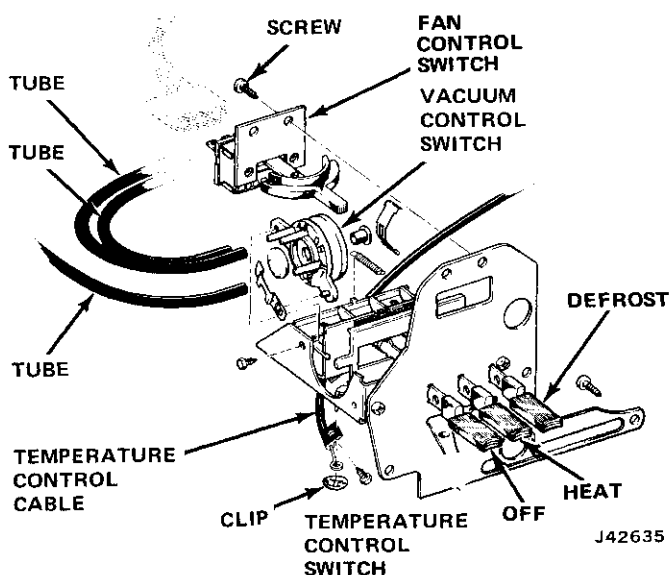


Fig. 3D-5 Heater and Defroster Controls

The three pushbuttons manually operate the vacuum control switch which directs vacuum to two vacuum motors, controlling airflow and point of air distribution.

The temperature control lever adjusts the amount of airflow around the heater core and through the heater core air passages. This regulates the degree of heat entering the passenger compartment.

The fan control is a four-position control switch (Off, Low, Medium, and High), which regulates the blower motor and airflow for heat, defrost, and fresh air ventilation.

There has been a vacuum storage tank added to prevent the heater doors from closing on acceleration and is located in the engine compartment in the center of dash panel.

## HEATER AND DEFROSTER OPERATION

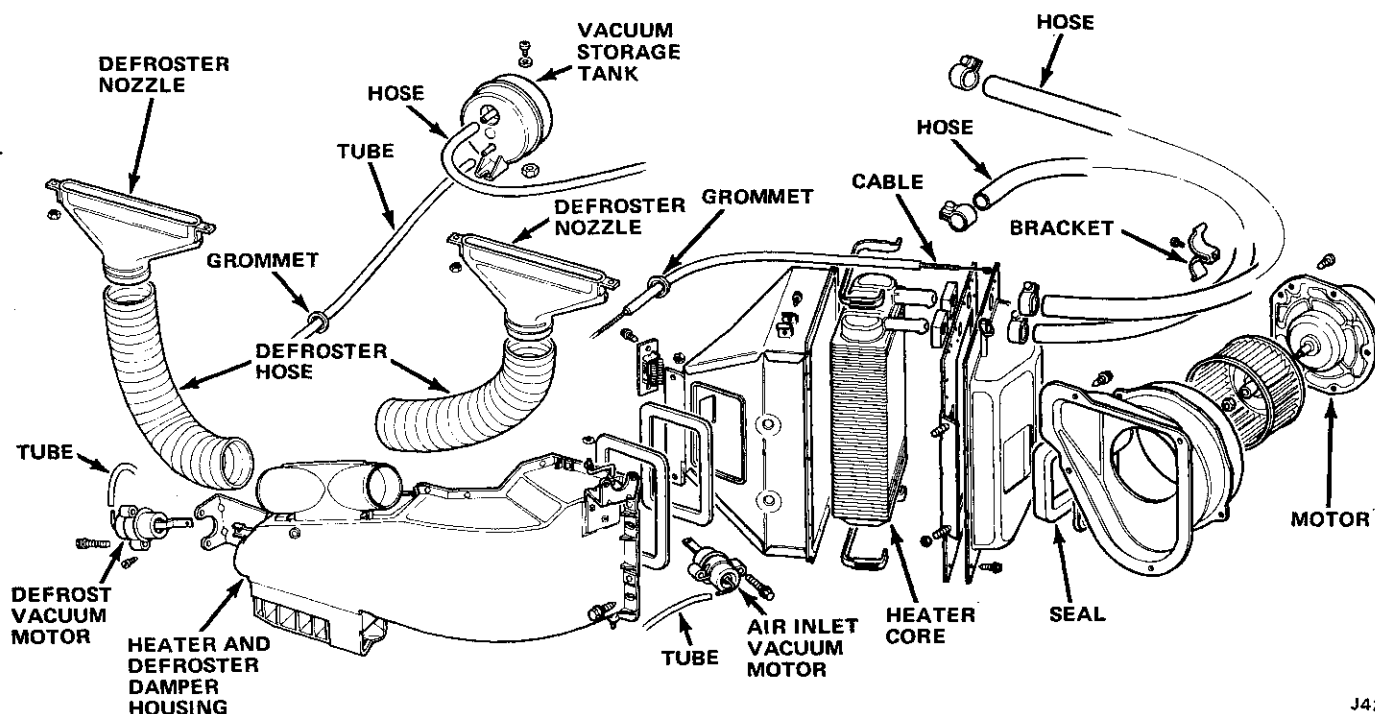
The heater is part of the engine cooling system and depends on normal engine operating temperature and airflow through the cowl fresh air intake to heat the interior of the vehicle. During heater operation, close the fresh air vents.

The Off, Heat and Def buttons (fig. 3D-5) on the heater control panel operate a vacuum control switch which controls two vacuum motors. When the off button is pressed, the vacuum switch shuts off vacuum to the air inlet door vacuum motor. A spring closes this door, preventing any outside air from entering the heater (fig. 3D-6).

When the Heat button is pressed, the air inlet door is opened by the air inlet vacuum motor and air will flow through the heat transition housing and out of the floor heat distributor.

When the Def button is pressed, the vacuum switch directs vacuum to the defrost vacuum motor, which closes the door to the floor heat distributor. Airflow is then directed through the defroster hoses onto the windshield. The air inlet door remains open to allow airflow through the heat transition housing.

The Temperature control lever operates the blend air door in the heater core housing. At the full right position, all air is directed through the heater core providing maximum heat flow. At the full left position, all air is directed around the heater core providing unheated fresh air. The temperature control lever may be placed in any in-between position to provide a blend of cool, fresh, outside air and heater air. However, either the Heat or Def button must be pressed before any air can enter the vehicle.



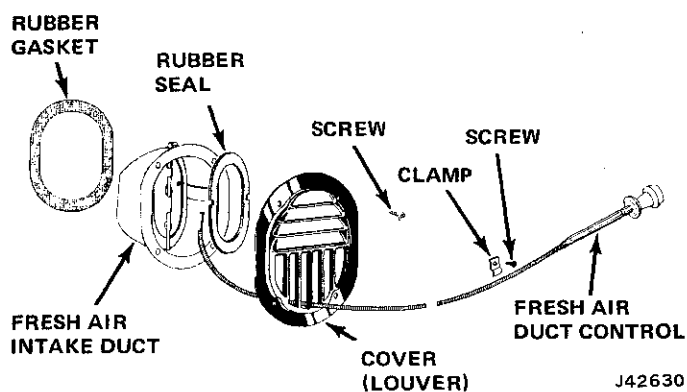
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Fig. 3D-6 Heater and Defroster

If additional airflow is required, the blower motor should be operated at one of the three available speeds.

### FRESH AIR VENTILATION

The ventilating system has two fresh air vents, one in the right cowl trim panel and one in the left cowl trim panel (fig. 3D-7). Both vents are cable controlled with the control knobs mounted on the instrument panel to the right and left of the steering column.



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Fig. 3D-7 Fresh Air Intake Duct and Control

### HEATER CONTROL PANEL

#### Removal

- (1) Disconnect battery negative cable.
- (2) Remove instrument cluster retaining screws.
- (3) Disconnect speedometer cable.

- (4) Disconnect electrical connectors from cluster.
- (5) Disconnect vacuum hoses from vacuum control switch.

**NOTE:** Tag hoses according to their numbered location for ease of assembly.

- (6) Remove cluster lamps.
- (7) Disconnect cable from temperature control lever.
- (8) Remove instrument cluster.
- (9) Remove heater and defroster control attaching screws and remove control from cluster.
- (10) Remove fan control switch attaching screws and remove switch.

#### Installation

- (1) Install fan control switch.
- (2) Install heater and defroster control to cluster.
- (3) Position instrument cluster in dash opening.
- (4) Install cluster lamps.
- (5) Connect cable to temperature control lever.
- (6) Connect vacuum hoses.
  - (a) Number 1 on vacuum control switch goes to defroster vacuum motor.
  - (b) Number 3 on vacuum control switch goes to vacuum storage tank.
  - (c) Number 4 on vacuum control switch goes to air inlet door vacuum motor.
- (7) Connect cluster electrical connectors.
- (8) Connect speedometer cable.
- (9) Install cluster retaining screws.
- (10) Connect battery negative cable.
- (11) Check heater, defroster and fan operation.



## Service Diagnosis

Condition	Possible Cause	Correction
FAN MOTOR WILL NOT RUN AT ANY SPEED	(1) Blown fuse (2) Loose connection (3) Poor ground (4) Faulty switch (5) Faulty motor (6) Faulty resistor	(1) Replace fuse (2) Inspect and tighten (3) Clean and tighten (4) Replace switch (5) Replace motor (6) Replace resistor
FAN MOTOR RUNS AT ONE SPEED ONLY	(1) Faulty switch (2) Faulty resistor	(1) Replace switch (2) Replace resistor
FAN RUNS BUT DOES NOT CIRCULATE AIR	(1) Intake blocked (2) Fan not secured to motor shaft (3) Inlet door not opening	(1) Clean intake (2) Tighten securely  (3) Replace defective vacuum motor, switch or hose.
HEATER WILL NOT HEAT	(1) Coolant does not reach proper temperature (2) Heater core blocked internally (3) Heater core air-bound (4) Blend-air door not in proper position	(1) Check and replace thermostat if necessary (2) Flush or replace core if necessary (3) Purge air from core (4) Adjust cable
WILL NOT DEFROST	(1) Vacuum motor not operating (2) Vacuum control switch inoperative (3) Defroster hose damaged	(1) Check for engine vacuum at vacuum motor (2) Check for engine vacuum at switch (3) Replace defroster hose

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## CONTROL CABLE

## Adjustment

The blend-air door control cable is equipped with a turnbuckle to simplify adjustment. The turnbuckle is located under the instrument panel to the right of the steering column.

(1) Rotate turnbuckle counterclockwise to obtain complete closing of the blend-air door when the temperature control lever is in the far left Cool position.

(2) Check blend-air door operation by moving temperature control lever-to-be the Warm position and back to the Cool position. Adjust cable if necessary.

## Replacement

- (1) Disconnect battery negative cable.
- (2) Remove instrument cluster retaining screws.
- (3) Disconnect speedometer cable.
- (4) Disconnect electrical connectors from cluster.
- (5) Disconnect vacuum hoses from vacuum control switch.

**NOTE:** Tag hoses according to their numbered location for ease of assembly.

- (6) Remove cluster lamps.
- (7) Disconnect cable from temperature control lever.
- (8) Remove instrument cluster.
- (9) Disconnect cable from temperature control lever.
- (10) Disconnect cable from blend-air door.
- (11) Connect cable to blend-air door.
- (12) Route cable through dash panel and connect to temperature control lever.
- (13) Position instrument cluster in dash opening.
- (14) Install cluster lamps.
- (15) Connect cable to temperature control lever.
- (16) Connect vacuum hoses.
  - (a) Number 1 on vacuum control switch goes to defroster vacuum motor.
  - (b) Number 3 on vacuum control switch goes to vacuum storage tank.
  - (c) Number 4 on vacuum control switch goes to air inlet door vacuum motor.

- (17) Connect cluster electrical connectors.
- (18) Connect speedometer cable.
- (19) Install cluster retaining screws.
- (20) Connect battery negative cable.
- (21) Check heater, defroster and fan operation.
- (22) Adjust cable.
- (23) Check cable operation.

## HEATER CORE

### Removal

- (1) Drain approximately two quarts of coolant from radiator.
- (2) Disconnect temperature control cable from blend-air door.
- (3) Disconnect heater hoses at heater core.
- (4) Disconnect blower motor resistor wires.
- (5) Remove heater core housing to dash panel attaching nuts.
- (6) Remove heater core housing assembly.
- (7) Remove attaching screws holding housing halves together and separate housing.
- (8) Remove heater core to housing attaching screws and remove core.

### Installation

- (1) Position heater core in housing and install attaching screws.
- (2) Seal and assemble two halves of heater core housing and install attaching screws.
- (3) Position heater core housing on dash panel and install attaching nuts.
- (4) Connect heater resistor wires.
- (5) Connect heater hoses.
- (6) Connect temperature control cable to blend air door.
- (7) Replace coolant.
- (8) Check heater operation.

## BLOWER MOTOR

### Removal

- (1) Disconnect blower motor electrical connector.
- (2) Remove blower motor-to-blower motor housing attaching screws and remove blower motor and fan assembly.

### Installation

- (1) Position blower motor and fan assembly on blower motor housing and install attaching screws.
- (2) Connect blower motor electrical connector.
- (3) Check blower motor operation.

## NOTES



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# AIR CONDITIONING 3E

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## GENERAL INFORMATION

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### SYSTEM COMPONENTS

**Compressor**—The compressor is a two-cylinder, belt-driven pump used to circulate and increase the pressure of the refrigerant in the system.

**Condenser**—The condenser is mounted in front of the radiator to allow air to flow over the cooling fins and remove heat from the refrigerant. As the refrigerant passes through the condenser, it liquifies (condenses).

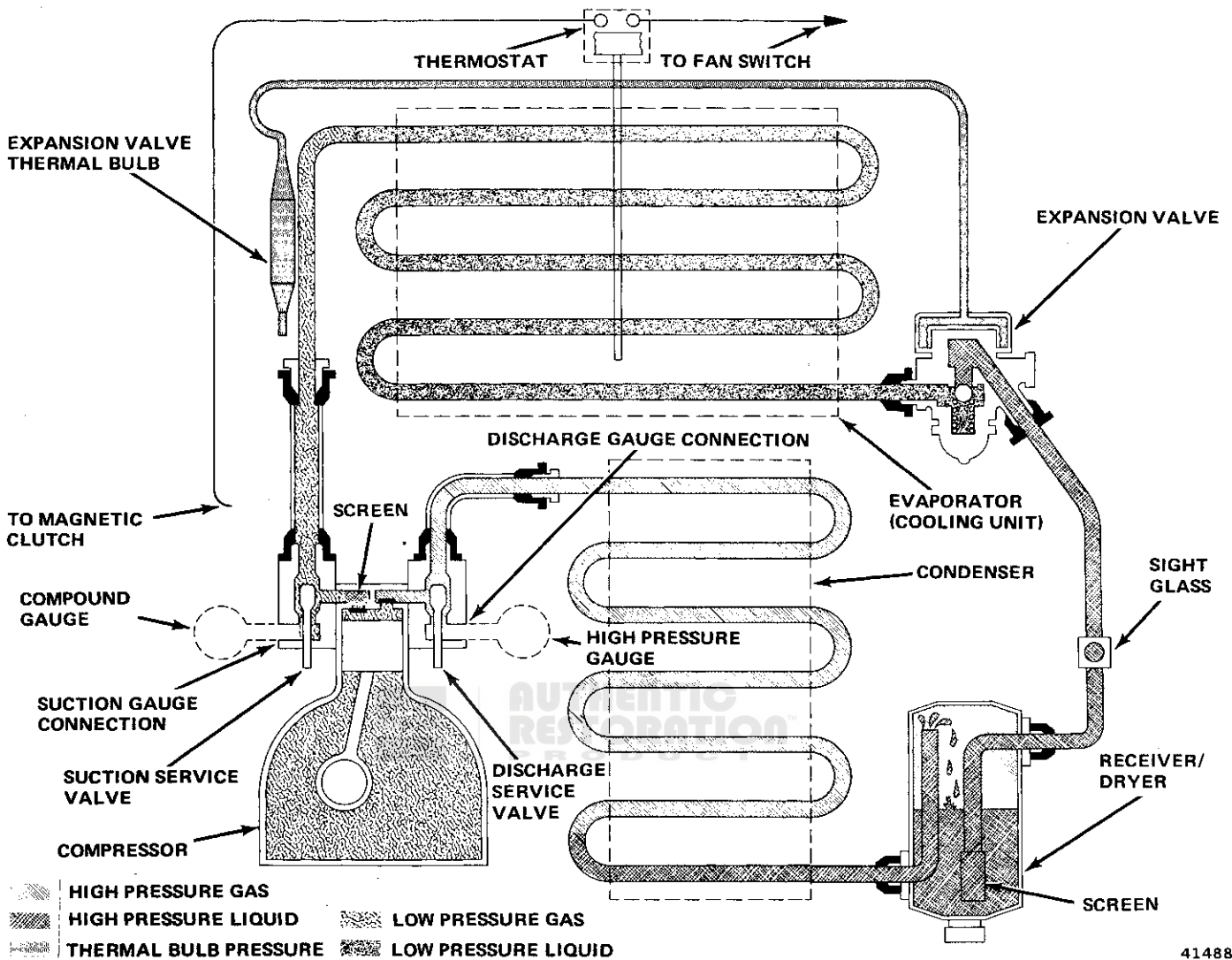
**Receiver/Drier**—The receiver/drier is a reservoir used to store the precise amount of refrigerant required by the system. The refrigerant level in the receiver/drier must be adequate to provide a steady flow of refrigerant to the expansion valve. The receiver/drier contains a desiccant to remove moisture from the system. The receiver/drier must be replaced anytime the system has been open to atmosphere due to a system component failure. If the charge is lost, the receiver/drier opening should be tightly capped immediately.

**Expansion Valve**—The thermostatic expansion valve is located at the inlet of the evaporator. It meters the refrigerant to the evaporator to maintain proper flow for the various evaporator heat load requirements encountered during operation. The metering action of the expansion valve is controlled by the temperature sensing bulb mounted on the outlet (suction) line of the evaporator.

**Evaporator**—The evaporator is an air cooler and dehumidifier. As the refrigerant enters the evaporator core, it begins to boil. The heat in the air passing over the evaporator transfers or gives up its heat to the boiling refrigerant. As the air cools, the moisture in the air condenses on the evaporator core and is drained off as water.

### SYSTEM OPERATION

The compressor increases the pressure and temperature of the system refrigerant (fig. 3E-1). The heated refrigerant vapor is then pumped into the condenser where it cools by giving off heat to air passing over the condenser fins. As the refrigerant cools in the condenser, it condenses into a liquid. Still under high pressure, the liquid refrigerant passes into the receiver. The receiver acts as a reservoir to furnish refrigerant to the expansion valve at all times. From the receiver, the high pressure liquid refrigerant passes to the expansion valve. The expansion valve meters refrigerant into the evaporator where a low pressure is maintained by the suction side of the compressor. As it enters the evaporator, the refrigerant immediately begins to boil by absorbing heat from the air passing over the evaporator core. Having given up its heat to boil the refrigerant, the air is cooled and passes into the passenger compartment of the vehicle. From the evaporator the vaporized refrigerant is drawn back to the compressor to repeat the cycle.



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Fig. 3E-1 Refrigeration Cycle

# GENERAL SERVICE PROCEDURES

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## GENERAL

The following service procedures apply to all factory installed air conditioning systems

## REFRIGERANT SAFETY PRECAUTIONS

The refrigerant used in air conditioning systems is dichlorodifluoromethane, commonly known as Refrig-

erant 12 OR R-12. It is transparent and colorless in both the liquid and vapor state. Since it has a boiling point of **21.7°F below zero** at atmospheric pressure, it vaporizes at all normal temperatures and pressures. The vapor is heavier than air, nonflammable and nonexplosive. It is nonpoisonous except when in direct contact with open flame, and is noncorrosive except when combined with water. Observe the following precautions when handling R-12.

R-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.

**WARNING:** Always wear safety goggles when servicing the refrigeration part of the air conditioning system. Keep a bottle of sterile mineral oil and a weak solution of boric acid 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 (R-12 is rapidly absorbed by oil). Next, wash the eyes with the weak solution of boric acid. Call a doctor immediately, even though irritation has ceased after the first aid treatment.

**WARNING:** Do not heat R-12 above 125°F.

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 is all the heat required for this purpose. Do not heat the refrigerant container with a blowtorch or any other means that would raise temperature and pressure above this temperature. Do not weld, steam clean or heat the system components or refrigerant lines.

**KEEP R-12 CONTAINERS UPRIGHT** when charging the system, so as to utilize the vapor instead of the liquid.

When metering R-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.

**WARNING:** Always work in a well-ventilated area.

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 R-12 vapor is normally nonpoisonous, 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 halide torch 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.

**SERVICE VALVES**

The discharge and suction service valves are mounted on the compressor cylinder head and are used for diagnosis, charging, discharging, evacuating, and component removal.

The service valves are three-position valves (fig. 3E-2). The normal operating position, shown in figure 3E-2, View B, has the valve stem turned **counterclockwise** to the **back-seated** (full-out) position.

When the valve stem is turned **clockwise** to the **front-seated** (full-in) position (fig. 3E-2, View A), the compressor is isolated from the system. This position is used when removing the compressor or when checking compressor oil level.

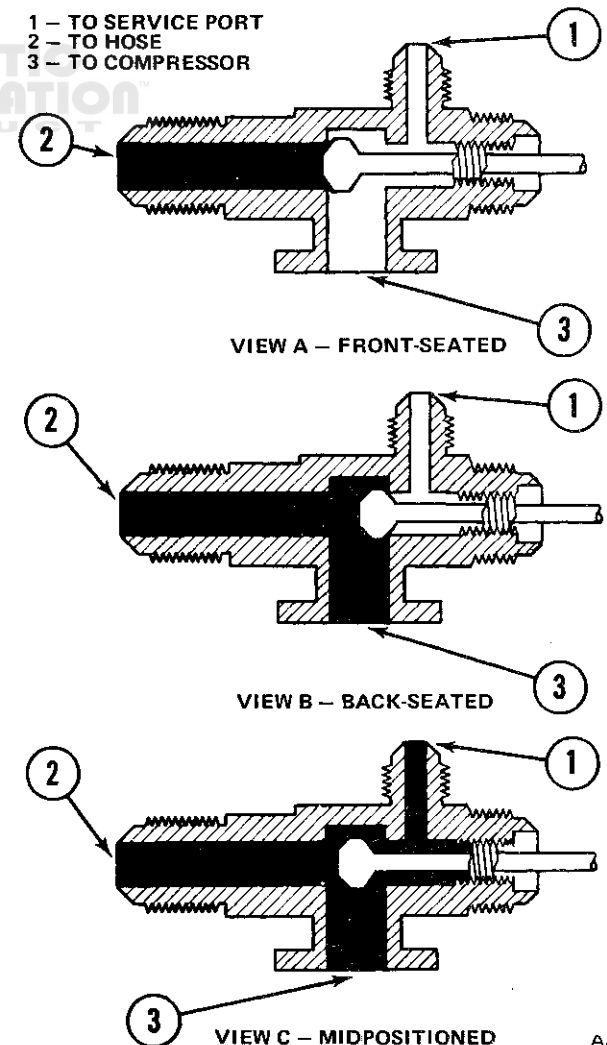


Fig. 3E-2 Service Valve Operating Positions

## 3E-4 AIR CONDITIONING

When the valve is **midpositioned** (cracked) (fig. 3E-2, View C), the gauge port is **open**. This position is used when charging, discharging, evacuating, and checking system pressure.

### PRESSURE GAUGE AND MANIFOLD ASSEMBLY

The Pressure Gauge and Manifold Assembly, tool J-23575 (fig. 3E-3), is the most important tool used to service the air conditioning system. The gauge assembly is used to determine system high and low side gauge pressures, the correct refrigerant charge, and in system diagnosis. It is designed to provide simultaneous high and low side pressure indications, because these pressures must be compared to determine correct system operation.

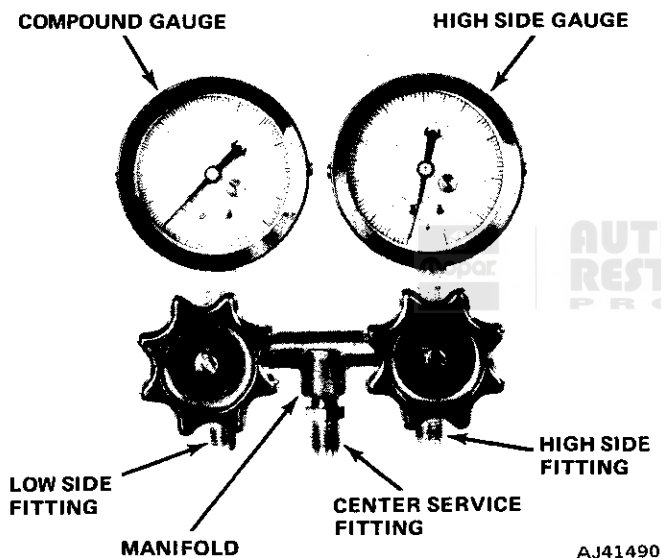


Fig. 3E-3 Pressure Gauge and Manifold Assembly, Tool J-23575

#### Low Side Gauge

The low side gauge is a compound gauge, which means that it will register both pressure and vacuum. The compound gauge is calibrated 0 to 150 psi pressure and 0 to 30 inches of mercury vacuum. It is connected to the suction service valve to check low side pressure or vacuum.

#### High Side Gauge

The high side gauge is used to check pressure in the discharge side of the air conditioning system.

#### Manifold

The gauges are connected into the air conditioning system through a manifold (fig. 3E-3). The manifold has three connections. The low side hose and fitting is connected directly below the low side gauge. The high side hose and fitting is connected below the high side gauge.

The center connection of the manifold is used for charging, discharging and evacuating. Both the high and low sides of the manifold have hand shutoff valves. The hand shutoff valves open or close the respective gauge connections to the center service connection or to each other. The manifold is constructed so that pressure will be indicated on the gauges regardless of hand valve position.

#### Connecting the Pressure Gauge and Manifold Assembly

- (1) Remove protective caps from service valve gauge ports and valve stems.
- (2) Close both hand valves on gauge manifold set.
- (3) Connect compound gauge hose (blue) to compressor suction service valve gauge port (low side).
- (4) Connect high pressure gauge hose (red) to discharge service valve gauge port (high side).

**NOTE:** If necessary, to facilitate installation of the gauge set, loosen the service valve-to-compressor fitting and **rotate the service valve slightly**. Do not allow line to contact engine or body components. Tighten the service valve-to-compressor fitting to 25 foot-pounds (34 N•m) torque or 15 foot-pounds (20 N•m) torque for flange type service valve screws.

- (5) Set both service valve stems to mid- or cracked position. The gauges will indicate high and low side pressures respectively.

(6) Purge any air from high side test hose by opening high side hand valve on manifold for 3 to 5 seconds (center connection on manifold must be open).

(7) Purge any air from low side test hose by opening low side hand valve on manifold for 3 to 5 seconds (center connection on manifold must be open).

(8) Air conditioning system may be operated with gauge manifold assembly connected in this manner. Gauges will indicate respective operative pressures.

#### CHECKING SYSTEM PRESSURES

The pressure developed on the high side and low side of the compressor indicate whether the system is operating properly.

- (1) Attach pressure gauge and manifold assembly.
- (2) Close both hand valves on gauge and manifold assembly.
- (3) Set both service hand valve stems to midposition.
- (4) Operate AC system with engine running at 1500 rpm and controls set for full cooling.
- (5) Insert thermometer into discharge air outlet and observe air temperature.
- (6) Observe high and low side pressures and compare with those shown in the Normal Operating Temperatures and Pressures chart. If pressures are abnormal, refer to Pressure Diagnosis chart.

Normal Operating Temperatures and Pressures \*

Relative Humidity (percent)	Surrounding Air Temperature (° F)	Engine Speed (RPM)	Maximum Desirable Center Register Discharge Air Temp. (° F)	Suction Pressure PSI (REF)	Head Pressure PSI (+25 PSI)
20	70	1500	40	11	177
	80		41	15	208
	90		42	20	226
	100		43	23	255
30	70	1500	40	12	181
	80		41	16	214
	90		42	22	234
	100		44	26	267
40	70	1500	40	13	185
	80		42	18	220
	90		43	23	243
	100		44	26	278
50	70	1500	40	14	189
	80		42	19	226
	90		44	25	251
	100		46	27	289
60	70	1500	41	15	193
	80		43	21	233
	90		45	25	259
	100		46	28	300
70	70	1500	41	16	198
	80		43	22	238
	90		45	26	267
	100		46	29	312
80	70	1500	42	18	202
	80		44	23	244
	90		47	27	277
	100		—	—	—
90	70	1500	42	19	206
	80		47	24	250
	90		48	28	284
	100		—	—	—

\*Operate engine with transmission in neutral. Keep vehicle out of direct sunlight.



### SIGHT GLASS

A sight glass is incorporated in the receiver-to-evaporator hose at the receiver end (fig. 3E-4) or in the top of the receiver/drier. The sight glass provides a visual check of the system refrigerant level. A continuous stream of bubbles will appear in the sight glass of a system which is NOT properly charged. Properly charged and completely discharged systems will appear similar through the sight glass because of a lack of bubbles. To distinguish between the two situations, cycle the magnetic clutch OFF and ON with the engine running at 1500 rpm. During the time the clutch is off, bubbles will appear if the refrigerant is in the system and will disappear when the clutch is on. If no bubbles appear when cycling the magnetic clutch, there is no refrigerant in the system since some bubbles would appear in a fully charged system. If the system is discharged, it will be necessary to leak test, repair as required, evacuate, and charge the system.

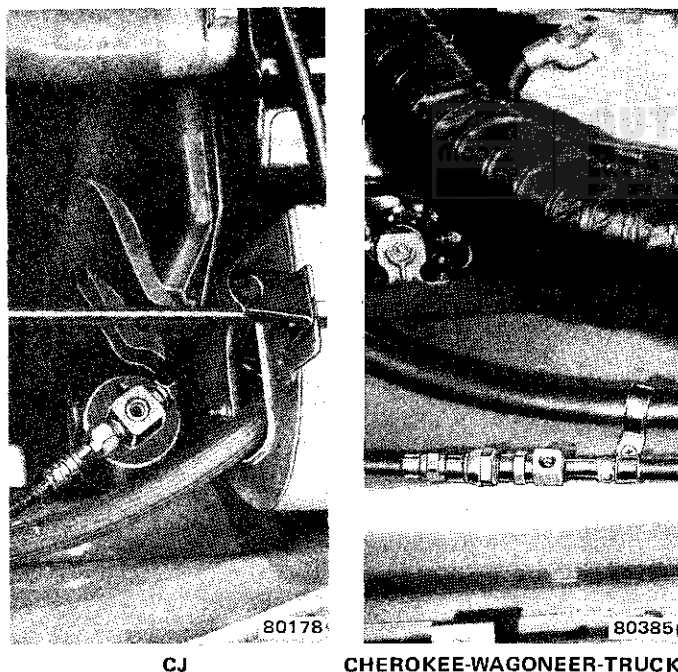


Fig. 3E-4 Sight Glass

### DISCHARGING SYSTEM

Refrigerant should be discharged from the system before replacing any part in the system except when servicing the compressor.

- (1) Connect pressure gauge and manifold assembly to proper service valves.
- (2) Turn both manifold hand valves to maximum counterclockwise (open) position.
- (3) Open both service valves a slight amount (from back seated position) and allow refrigerant to discharge slowly from system (fig. 3E-5).

**CAUTION:** Do not allow the refrigerant to rush out, as the oil in the compressor will be forced out along with it.

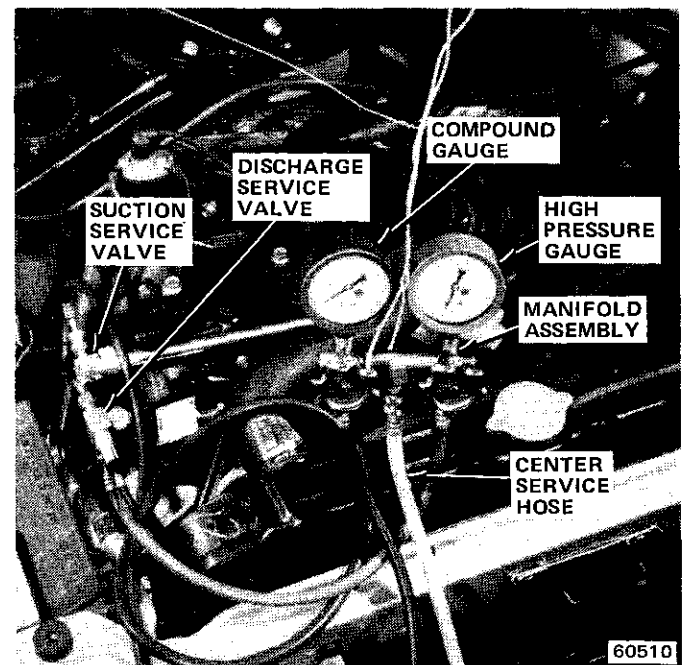


Fig. 3E-5 Pressure Gauge and Manifold Assembly Connections for Discharging System

### EVACUATING SYSTEM

A system with the refrigerant removed during repair, or one that is excessively low on refrigerant must be evacuated with a vacuum pump before new refrigerant is installed. The reason for evacuating a system is to remove any air and moisture that may have entered the system.

Moisture in any quantity is extremely harmful to the air conditioning system. Moisture may collect and freeze in the thermostatic expansion valve orifice, blocking refrigerant flow and preventing system cooling. Moisture will also react with R-12 to form hydrochloric acid which will corrode metal parts of the system. Corrosion particles may become detached and block the small passages and orifices in the system.

Unwanted air and moisture are removed from the system by proper evacuation of the system. A vacuum pump is used to lower the pressure sufficiently so that moisture boiling temperature is reduced to a point where the water will vaporize and can be evacuated from the system.

Water boils at 212°F at 14.7 psi (sea level). As the vacuum pump lowers the pressure of the closed air conditioning system, the boiling point of the moisture in the system will also be lowered. In evacuating the system, it is necessary to lower the boiling point of any moisture in the system to a point lower than the ambient (surrounding) temperature to ensure that all moisture is boiled

off. At an ambient temperature of 75°F, when the desired vacuum of 29.5 inches of Hg is reached, water will boil at approximately 54°F and a complete boiling off of all moisture in the system is assured when this vacuum reading has been reached.

At altitudes higher than sea level, it will not be possible to obtain a vacuum reading of 29.5 inches of Hg on the low side compound gauge. For each 1,000 feet of altitude, the vacuum gauge must be corrected by one inch of Hg to compensate for a change in atmospheric pressure. For example, at altitudes of 1,000 feet, a gauge reading of 28.5 inches of Hg will be the same as a gauge reading of 29.5 inches of Hg at sea level. When this vacuum is reached, a minimum of 30 minutes should be allowed in evacuating the system to ensure complete moisture removal.

### Evacuating Procedure with J-26695 Vacuum Pump

The J-26695 vacuum pump and motor is a self-contained unit equipped with a carrying handle and stand. The unit must be kept upright at all times to prevent oil from spilling.

(1) Connect Pressure Gauge and Manifold Assembly, tool J-23575.

(2) Discharge system.

(3) Connect center service hose to inlet fitting of vacuum pump (fig. 3E-6).

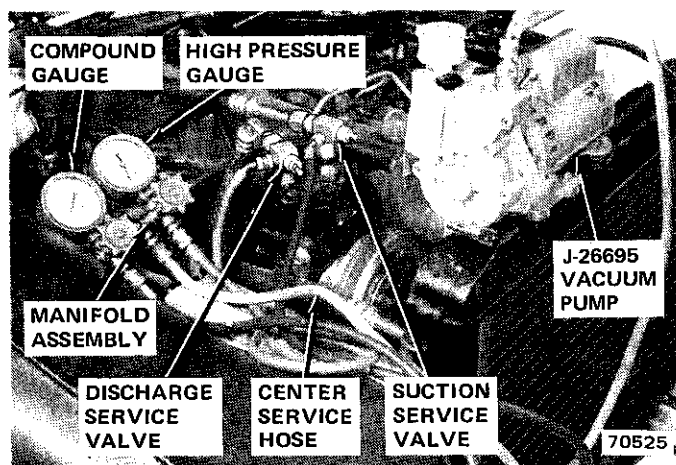


Fig. 3E-6 Evacuating System with J-26695 Vacuum Pump

(4) Open both manifold hand valves wide open.  
 (5) Start vacuum pump; note compound gauge reading.

(6) Operate pump a MINIMUM of 30 minutes after reaching lowest vacuum.

(7) Test system for leaks. Close both manifold hand valves, turn off vacuum pump, and note compound gauge reading. Gauge needle should remain stationary at point at which pump turned off.

(8) If gauge needle returns to zero rapidly, install a partial charge in system and locate leak with leak detector. Repair leak and repeat evacuation procedure.

(9) If gauge needle remains stationary and vacuum is maintained for 3 to 5 minutes, resume evacuation for minimum of 30 minutes.

(10) Close both manifold hand valves and stop vacuum pump.

(11) Disconnect center service hose from vacuum pump. System is now ready for charging.

### Evacuation Procedure with J-23500-01 Portable Air Conditioning Service Station

The J-23500-01 Portable Air Conditioning Service Station (fig. 3E-7) is a completely portable station equipped with vacuum pump, metering-charging cylinder, refrigerant supply, gauges, hoses and hand control valves.

The control switch for the vacuum pump is mounted on the front of the charging station power pack. It should be in the OFF position before inserting plug into the power source.

(1) Close all hand valves.

**NOTE:** Be certain system is completely depressurized before evacuating. With the system under pressure, refrigerant may enter vacuum pump and damage pump.

(2) Connect red charging hose to compressor discharge service on compressor and connect blue charging hose to compressor-suction service valve.

(3) Open both discharge and suction service valves to mid position. Fully open high and low pressure valves on charging station.

(4) Connect power pack cord to 110v wall outlet.

(5) Connect vacuum pump power cord to 110 volt pump receptacle on power pack, and switch vacuum pump on.

(6) Completely open vacuum pump valve.

(7) Operate pump until blue compound gauge on manifold indicates 29 inches of vacuum. Continue to operate pump for 30 minutes after system reaches 29 inches. It is recommended that a thermistor vacuum gauge be used to obtain a more precise vacuum reading.

(8) Fill charging cylinder, as described below, while system is evacuating.

(9) After evacuating system, close valve on vacuum pump and stop pump. Observe blue compound gauge to determine if a leak exists. System is now ready for charging.

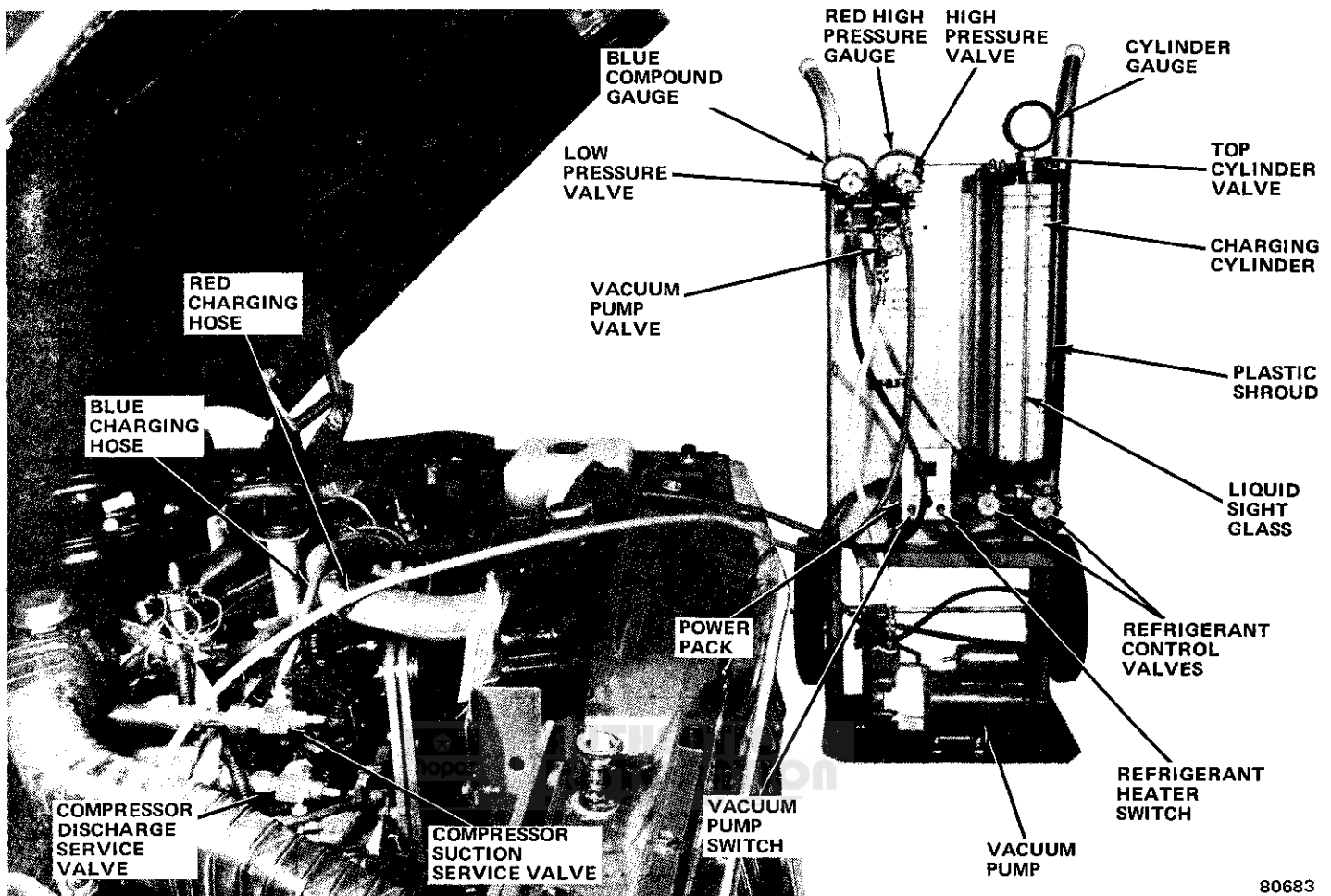


Fig. 3E-7 Portable Air Conditioning Service Station J-23500-01

## CHECKING FOR LEAKS

Whenever a system requires more than 1/2 pound of refrigerant after a season's operation, a serious leak is indicated which must be located and repaired.

Most leaks will be located at points of connection and are caused by vehicle vibration. Correction of this type of leak may only require retightening of the connection. However some leaks may occur only at periods of high traffic on a very warm day. This type of leak most often occurs through the compressor shaft seal or service valve gasket.

A system must contain an adequate quantity of refrigerant to be properly leak tested. If a system is completely discharged, evacuate and install 1/2 pound of refrigerant.

## Halide Torch Leak Detection

External leaks are detected and located with a halide torch, tool J-6084 (fig. 3E-8). The torch burns propane fuel and is equipped with a search hose. When air is drawn into the hose by the torch, it contacts a heated copper reactor ring in the torch. If refrigerant gas is present in the air, the normally light blue flame will

change color. A small refrigerant leak will change the flame color to yellow. A large refrigerant leak will change it to green or purplish-blue.

## Leak Test Procedure Using Halide Torch

(1) Open torch valve and light torch, adjusting flame high enough to heat copper reactor ring to a cherry red.

(2) Lower flame until it is about 1/4 inch above or even with copper reactor ring. A smaller flame is more sensitive to R-12 refrigerant.

(3) Move search hose slowly **under** all connections, joints, and seals. R-12 refrigerant is heavier than air, leaks may be detected more readily on lower side of areas being checked.

(4) Watch for color change of flame indicating area of leak.

**WARNING:** When R-12 refrigerant comes into contact with an open flame, phosgene gas is formed. **NEVER INHALE THE VAPORS OR FUMES FROM THE HALIDE TORCH; they are poisonous.**

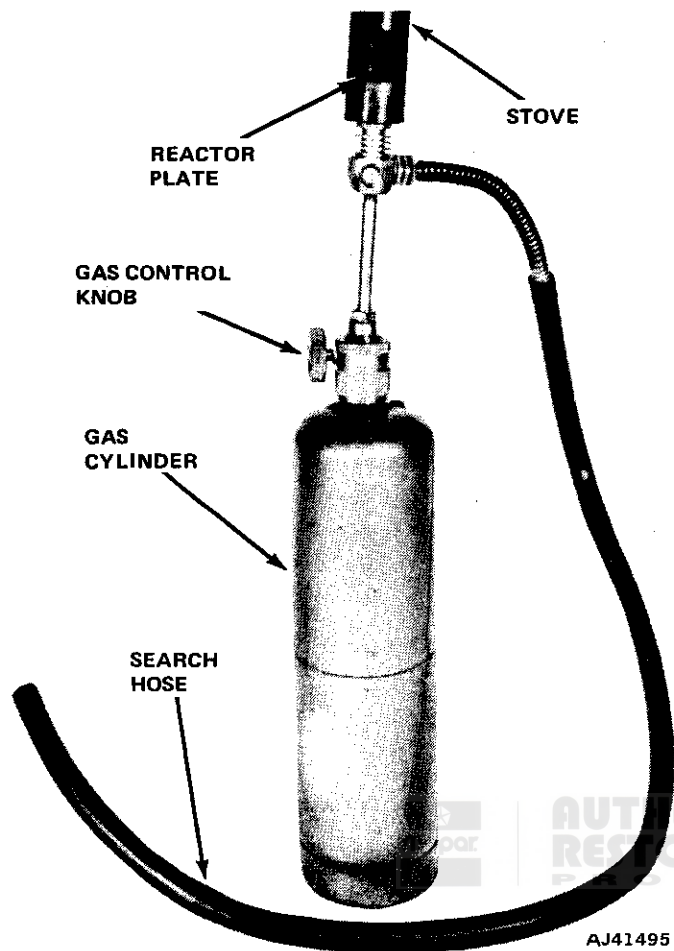


Fig. 3E-8 Halide Torch J-6084

- (5) Repair leaks, as required.
- (6) Evacuate system after all leaks are corrected.
- (7) Charge system.

### Electronic Leak Detection

External leaks are detected and located with the electronic leak detector, tool J-26933. The leak detector is an electronic instrument designed to detect R-12 refrigerant leaks as small as one-half ounce per year. The 18-inch flexible probe gets at inaccessible places. Follow the manufacturer's calibration instructions, included with the unit, to set up the electronic leak detector for proper operation.

**NOTE:** Using the Electronic Leak Detector, tool J-26933, will NOT expose the user to phosgene gas vapors or fumes.

### Leak Test Procedure Using Electronic Detector

- (1) Unwind flexible probe from case.
- (2) Activate Off/On switch, place flexible probe tip near leak port and adjust BAT thumbwheel a few teeth until light goes on and goes out when tip is removed from leak port.

(3) Move flexible probe slowly **under** suspected connections, joints, and seals. R-12 refrigerant is heavier than air, leaks may be detected more readily on lower side of areas being checked.

(4) When a leak is found, its presence will be indicated by the white signal light.

**NOTE:** If probe tip is held too long on the leak, the white signal light will go out.

- (5) Repair leaks, as required.
- (6) Evacuate system after all leaks are corrected.
- (7) Charge system.

### Filling Charging Cylinder

(1) Be certain refrigerant drum is inverted and valve is open.

(2) Open right hand valve at base of charging cylinder and fill with required amount of refrigerant to charge system (refer to Charge Capacity). Liquid refrigerant will be observed rising in charging cylinder sight glass.

(3) Crack open valve at top of cylinder when pressure in charging cylinder equals pressure in supply tank. This relieves head pressure and allows refrigerant to continue filling cylinder.

(4) Observe pressure gauge at top of cylinder and rotate plastic shroud until pressure heading column corresponds with gauge pressure in line with sight glass.

**NOTE:** If pressure gauge at top of cylinder reads 70 psi for example, find the column with the pressure heading of "70" and rotate shroud so the 70 column aligns with the sight glass.

(5) When refrigerant reaches desired level in sight glass, close both the right hand valve at base of the cylinder and refrigerant drum valve. Be certain top cylinder valve is fully closed.

**NOTE:** If bubbling occurs in sight glass, tilt charging station back momentarily.

(6) Connect heating element cord to heating element receptacle of power pack and switch ON heater. Allow refrigerant to heat (building up pressure proportionately) for about 10 minutes while vacuum pump is running.

### CHARGING THE SYSTEM

Before making a complete charge, check the compressor oil level, leak test if necessary, and evacuate the system.

### Charge Capacity

The recommended charge for the respective systems is as follows: CJ—2-1/2 pounds R-12; Cherokee, Wagoneer and Truck—2-1/4 pounds R-12. Capacities are also indicated on a decal attached to compressor.

### Charging Procedure with J-6272-02 Multi-Refrigerant Can Opener

The following charging procedure is based on the use of Pressure Gauge and Manifold Assembly J-23575, and Multi-Refrigerant Can Opener J-6272-02. Refer to figure 3E-9.

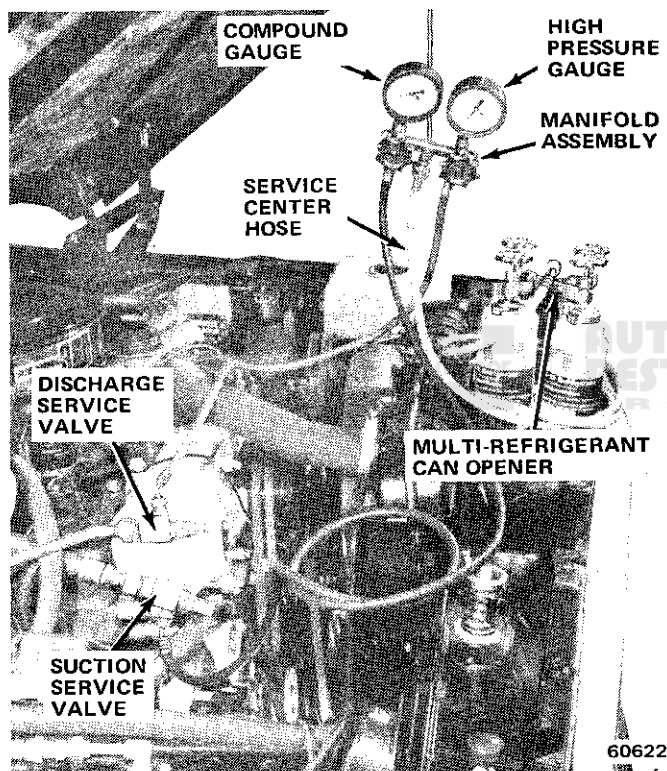


Fig. 3E-9 Charging System with Multi-Refrigerant Can Opener

**WARNING:** *Wear goggles to protect eyes.*

(1) Connect Pressure Gauge and Manifold Assembly J-23575 and evacuate system. Keep both service valves in mid or cracked position.

(2) Close both gauge hand valves.

(3) Disconnect service hose from vacuum pump and connect it to center of Multi-Refrigerant Can Opener J-6272-02. Close four petcock valves on dispenser.

(4) Attach necessary number of refrigerant cans to opener. Refer to Charge Capacity for proper weight of refrigerant necessary to charge vehicle being serviced.

(5) Open one petcock valve. Loosen center service hose at Pressure Gauge and Manifold Assembly allowing refrigerant to purge air from line. Tighten service hose connection and close petcock valve.

(6) Open suction (compound) gauge hand valve and one petcock valve. Do not open discharge (high pressure) gauge hand valve.

(7) Start engine and place AC controls in maximum cooling position. The compressor will operate and help pull refrigerant gas into suction side of system.

**NOTE:** *The refrigerant cans may be placed upright in warm water NO HOTTER THAN 125°F to speed up the charging process.*

(8) When first refrigerant can is empty, open another petcock valve to continue charging system.

(9) Continue charging until specified amount of refrigerant is in system. Frost line on refrigerant can will indicate what portion of refrigerant in can has entered system. This may be used as a guide when a system requires a fraction of a full can.

**NOTE:** *If an accurate scale is available, weigh the refrigerant cans before and during the charging procedure to assure that the correct amount of refrigerant is being used.*

(10) When system is fully charged, close suction (compound) gauge hand valve and all petcock valves.

(11) Operate system 5 to 10 minutes to allow it to normalize and to determine if system will cycle properly (refer to Checking System Pressures).

(12) Upon completion of operational check, back-seat suction and discharge service valves to their normal operating position by turning them fully counterclockwise.

(13) Loosen Pressure Gauge and Manifold Assembly service hoses to allow refrigerant trapped in hoses to discharge.

(14) Remove Pressure Gauge and Manifold Assembly and install dust caps on fittings.

### Charging Procedure with J-23500-01 Portable Air Conditioner Service Station

**NOTE:** *Fill charging cylinder as described above.*

**WARNING:** *Wear goggles to protect eyes.*

(1) Discharge and evacuate system as described above.

(2) Close low pressure valve on charging station, (fig. 3E-7) fully open left hand refrigerant control valve at base of cylinder and high pressure valve on charging station, and allow the required charge of refrigerant to enter high side of system. When full charge has entered system, close refrigerant control valve and high pressure valve on charging station.

**CAUTION:** *Do not permit liquid level to drop below "0" on cylinder sight glass.*

(3) Close manifold gauges after completion of charging, and check high and low pressures and system operation.

(4) Read gauges with high and low pressure valves on charging station closed. The low pressure gauge could be damaged if both high and low pressure valves of manifold are opened. The high pressure developed in discharge side (high side) of compressor would peg indicator needle of low pressure gauge and damage it.

(5) Close all valves on charging station and close refrigerant drum valve when all operations are completed.

(6) Upon completion of operational check, back-seat suction and discharge service valves to their normal operating position by turning them fully counterclockwise.

(7) Disconnect high and low pressure charging hoses from compressor with care. (A small amount of refrigerant remaining in hoses will escape.) Replace charging hoses on hose holder on charging station to keep air and dirt out of hoses.

(8) Open valve at top of cylinder to remove remaining refrigerant.

**NOTE:** The charging cylinder is not designed to store refrigerant.

(9) Replace quick seal caps on compressor service valves when service is complete.

## COMPRESSOR

The compressor is the belt-driven, two-cylinder reciprocating type. It is attached to the engine with a mounting bracket as shown in figures 3E-10 and 3E-11.

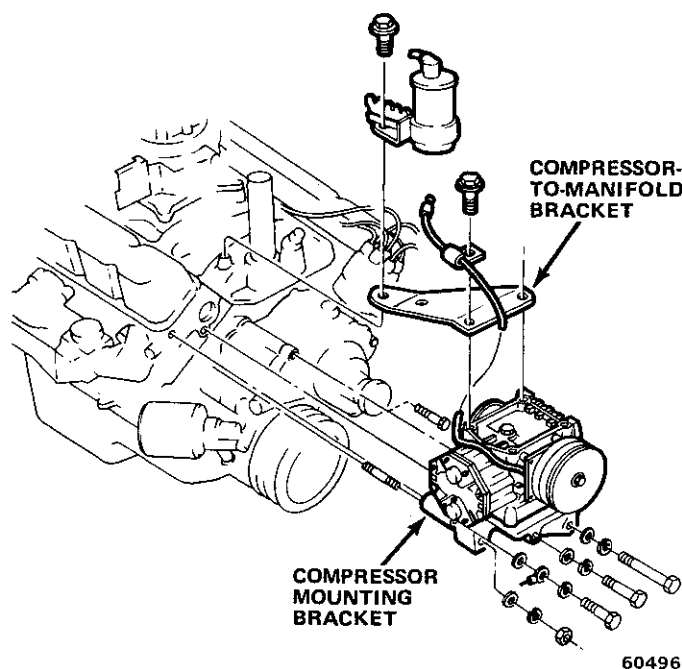


Fig. 3E-10 Compressor Mounting—Eight-Cylinder

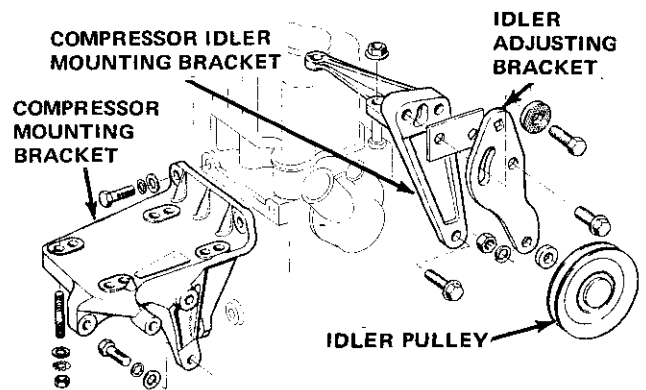


Fig. 3E-11 Compressor Mounting—Six-Cylinder

## Compressor Valve Leak Diagnosis

The compressor should be at operating temperature to perform an accurate test.

(1) Install Pressure Gauge and Manifold Assembly J-23575.

(2) Front-seat suction and discharge service valve by turning them clockwise.

(3) Discharge refrigerant remaining in compressor by opening suction gauge hand valve **slowly**.

(4) Open suction gauge hand valve and close high pressure gauge hand valve.

(5) Start engine and operate compressor. Pressure will build up rapidly. Stop compressor at 150 to 200 pounds pressure.

**NOTE:** Pressure should hold if the discharge valve is operating properly. Loss of pressure indicates leaking compressor discharge valve or head gasket.

## Compressor Belt Tension

Belt tensions are important and should be inspected at time of new vehicle pre-delivery and at subsequent scheduled maintenance intervals.

Belt Tension Gauge, J-23600, will provide accurate belt tension adjustments. Install the gauge on the longest accessible belt span. Belt tension for new vehicle pre-delivery and all belts with previous service should be 90 to 115 pounds.

Six-cylinder belt tension is adjusted by the idler mounting bracket. Eight-cylinder belt tension is adjusted by the alternator.

When a new belt is installed, it should be adjusted to 125 to 155 pounds (155 preferred) tension to compensate for the initial run-in loss that occurs within the first several minutes of operation.

**NOTE:** New-belt tension specifications apply only to service replacement belts. Once a belt has been tensioned and run, it is considered a used belt and should be adjusted to used-belt specifications.

## 3E-12 AIR CONDITIONING

A characteristic of the **Dacron type belt(s)** used to drive the AC compressor is that **it tends to increase in tension—rather than stretch—when subjected to heat.** The loss in belt tension which can be observed after the initial run-in is the result of wear-in which allows the belt to ride deeper in the V-groove of the pulleys.

If a belt is run with less than the specified tension, slippage can occur and cause the belt contact surfaces to become glazed. A glazed belt loses some of its load carrying capabilities and may slip even when adjusted to specified belt tension.

Belt **vibration**, particularly on six-cylinder models, is usually the result of improper belt tension. When excessive belt vibration or flutter is encountered, adjust the belt tension to specifications. Adjusting to higher tensions will not stop vibration but will increase stress on the idler assembly.

### Isolating the Compressor

It is not necessary to discharge the system for compressor removal. The compressor can be isolated from the remainder of the system, eliminating the need for recharging when performing compressor service.

- (1) Connect Pressure Gauge and Manifold Assembly J-23575.
- (2) Close both gauge hand valves and mid-position (crack) both service valves.
- (3) Start engine and operate air conditioning.
- (4) Turn suction service valve slowly clockwise toward front-seated position. When suction pressure is reduced to zero or less, stop engine and compressor and quickly finish front-seating suction service valve.
- (5) Front-seat discharge service valve.
- (6) Loosen oil check plug slowly to release any internal pressure in compressor. The compressor is now isolated from remainder of system. Service valves can be removed from compressor.

### Compressor Removal—Eight-Cylinder

- (1) Isolate compressor.
- (2) Remove both service valves and place protective caps over compressor head fittings and service valve openings.
- (3) Loosen and remove compressor belt(s).
- (4) Disconnect clutch wire.

**NOTE:** Remove alternator mounting bracket to obtain working clearance for removing compressor mounting bracket attaching bolts and nuts.

- (5) Remove compressor and mounting bracket as an assembly and place on work bench.
- (6) Remove bracket and bracket attaching nuts and studs.

### Compressor Installation—Eight-Cylinder

- (1) Install mounting bracket to compressor.
- (2) Install compressor and bracket assembly to engine.
- (3) Install alternator mounting bracket, if removed.
- (4) Install compressor drive belt(s) and adjust to proper tension.
- (5) Attach compressor service valves and lines.
- (6) Purge compressor of air and open service valves.
- (7) Connect clutch wire.

### Compressor Removal—Six-Cylinder

- (1) Isolate compressor.
- (2) Remove both service valves and cap compressor and valves.
- (3) Loosen compressor belt and move aside.
- (4) Remove alternator belt and adjusting bolt.
- (5) Remove upper alternator mounting bolt.
- (6) Loosen lower alternator mounting nut.
- (7) Remove back idler.
- (8) Remove compressor mounting nuts and remove compressor.

### Compressor Installation—Six-Cylinder

- (1) Position compressor and install mounting nuts.
- (2) Install back idler.
- (3) Install alternator upper mounting bolt.
- (4) Tighten lower mounting nut.
- (5) Install alternator adjusting bolt.
- (6) Install alternator drive belt and adjust to proper tension.
- (7) Install compressor drive belt and adjust to proper tension.
- (8) Attach compressor service valves and lines.
- (9) Purge compressor of air and open service valves.
- (10) Connect clutch wire.

### Compressor Front Seal Replacement

The compressor front seal is serviced in kit form. Kit components are shown in figure 3E-12. All seal parts must be replaced if a leak has been detected at the seal.

**NOTE:** A small amount of oil around the shaft seal is normal and does not indicate a seal leak. All seal parts were dipped in oil at the time of assembly and operation may force out surplus oil.

- (1) Isolate compressor.
- (2) Remove belt.
- (3) Remove clutch and woodruff key from compressor shaft.
- (4) Remove seal plate capscrews. Pry seal plate loose and remove seal plate and ring..
- (5) Carefully pry behind spring holder (that part of the seal assembly farthest back on the shaft) and remove seal assembly.

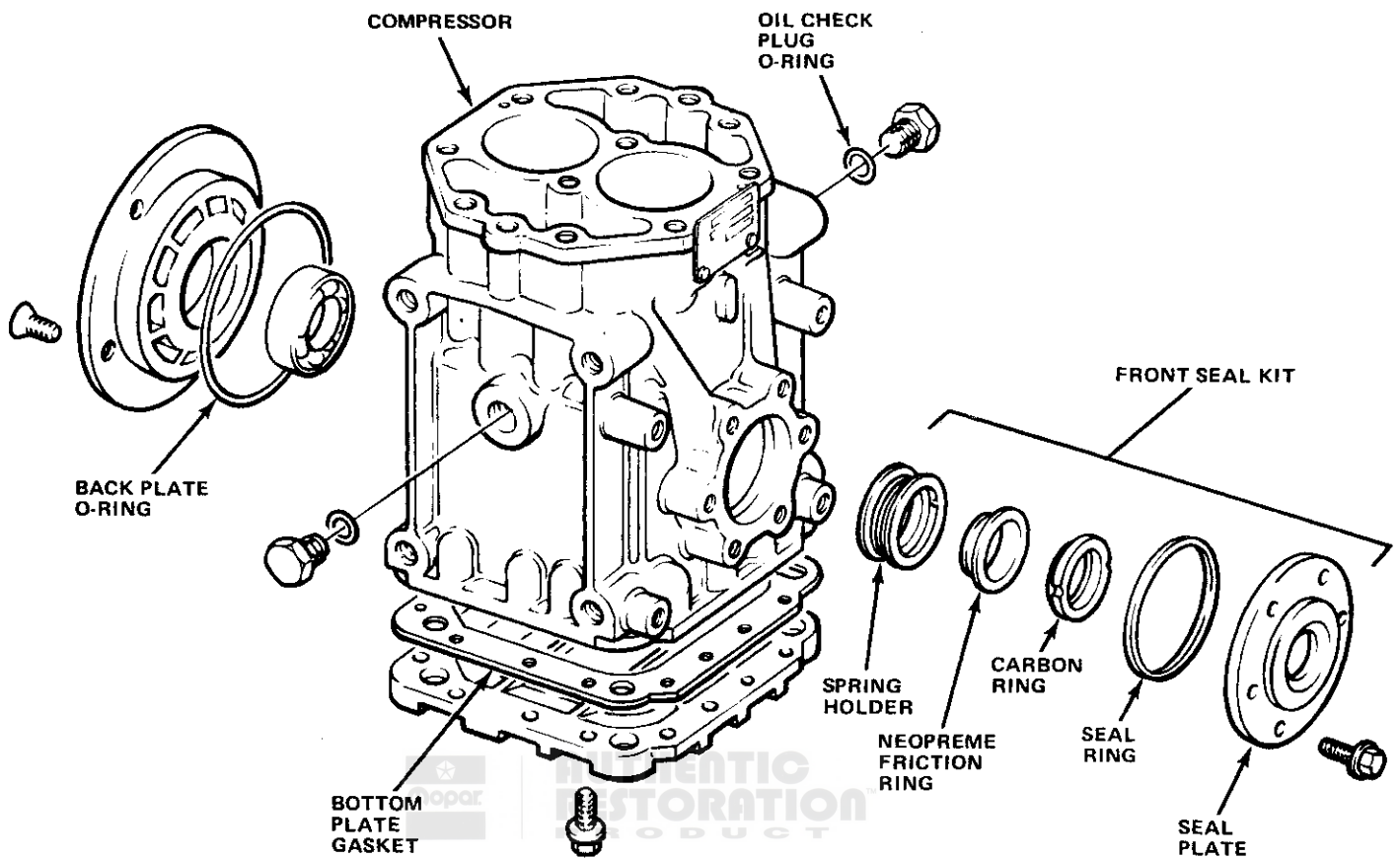


Fig. 3E-12 Compressor Seal Components and Gaskets

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(6) Lubricate new seal assembly with clean refrigeration oil.

**NOTE:** Cleanliness, careful handling, and clean refrigeration oil are important for successful seal replacement.

(7) Push neoprene friction ring and spring holder over compressor shaft.

(8) Move assembly in and out on the compressor shaft to seat neoprene friction ring.

(9) Push assembly in until spring holder contacts bearing race. Position carbon ring in spring holder with polished side facing out.

**NOTE:** The carbon ring must seat in the retainer. Engage notches in carbon ring with drive tangs in spring holder.

(10) Coat mating surfaces of compressor and seal plate with a film of refrigeration oil. Position the seal ring in groove on compressor.

(11) Install seal plate with polished face toward carbon ring.

(12) Install seal plate capscrews and tighten evenly. Center seal plate on shaft by lightly tapping plate. Tighten capscrews in a diagonal pattern to 6 foot-pounds (8 N•m) torque.

(13) Turn compressor shaft by hand, using clutch mounting bolt, to seat seal.

(14) Install clutch and woodruff key.

(15) Install belt.

(16) Purge compressor of air.

(17) Leak test system. Evacuate and charge if necessary.

### Back Plate O-Ring Seal Replacement

**NOTE:** It is not necessary to remove the compressor for seal replacement on six-cylinder engines.

(1) Isolate and remove compressor.

(2) Remove four back plate attaching screws using Torx Bit Tool J-25359-02.

(3) Remove back plate by gently prying it loose from crankcase. Pry in such a manner to pull parallel to bearing surface.

(4) Remove O-ring seal from back plate.

(5) Clean back plate and apply a light film of refrigeration oil to O-ring sealing area.

(6) Position O-ring seal on back plate and install back plate over rear bearing and into crankcase.



## 3E-14 AIR CONDITIONING

(7) Install four back plate attaching screws and tighten in a diagonal pattern to 13 foot-pounds (18 N•m) torque using Torx Bit Tool J-25359-02.

(8) Install and purge compressor of air.

(9) Leak test system. Evacuate and charge if necessary.

### Head, Valve Plate, and Gasket Replacement

(1) Isolate compressor.

(2) Remove service valves from compressor. Compressor head service valve ports are identified as **D** for discharge and **S** for suction.

(3) Remove compressor head attaching screws.

(4) Tap under valve plate ears (short, half-round projections on valve plate) to remove head and valve plate.

(5) Tap valve plate ears while holding the compressor head to separate head from valve plate.

(6) Clean all gasket material from head, valve plate, and compressor using care not to scratch or nick sealing surfaces.

(7) Coat all machined sealing surfaces with a light film of refrigeration oil.

(8) Install new valve plate cylinder gasket on compressor body, locating gasket on dowel pins.

(9) Install valve plate on compressor, locating it on dowel pins so that discharge valve is at top. Figure 3E-13 illustrates correct assembly sequence.

(10) Install new head gasket, locating it on dowel pins.

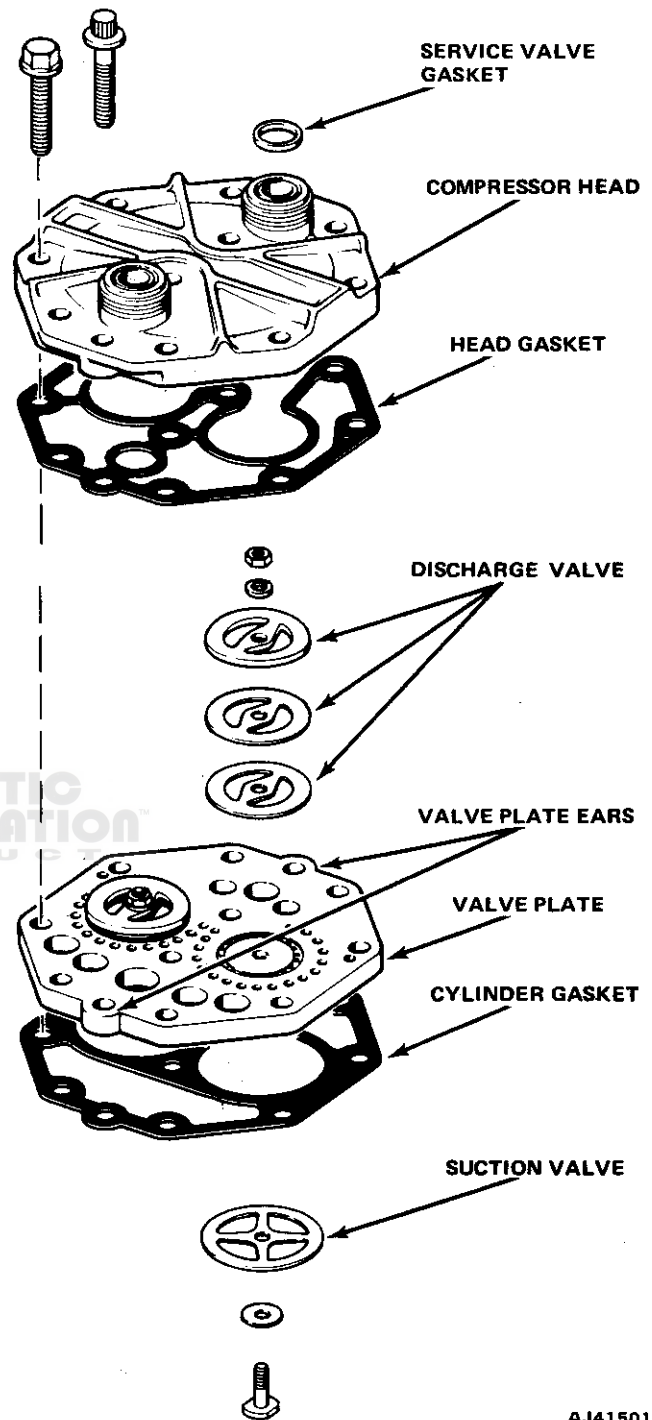
(11) Install head. Tighten compressor head cap-screws to 15 foot-pounds (20 N•m) torque, following sequence outlined in figure 3E-14.

(12) Coat service valve ports with a light film of refrigeration oil and install new service valve O-rings or gaskets, as required.

(13) Install service valves and tighten to 25 foot-pounds (4 N•m) torque for O-ring type valve or 15 foot-pounds (20 N•m) torque for attaching screws of flange type valve.

(14) Purge compressor of air.

(15) Leak test system. Evacuate and charge if necessary.



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### Bottom Plate Gasket Replacement

(1) Isolate and remove compressor.

(2) Remove bottom plate attaching screws and carefully remove bottom plate.

(3) Clean all gasket material from bottom plate and compressor using care not to scratch or nick sealing surfaces.

(4) Coat all sealing surfaces with a light film of refrigeration oil.

(5) Install a replacement bottom plate gasket and install bottom plate. Tighten bottom plate attaching screws to 15 foot-pound (20 N•m) torque.

(6) Install and purge compressor of air.

(7) Leak test system. Evacuate and charge if necessary.

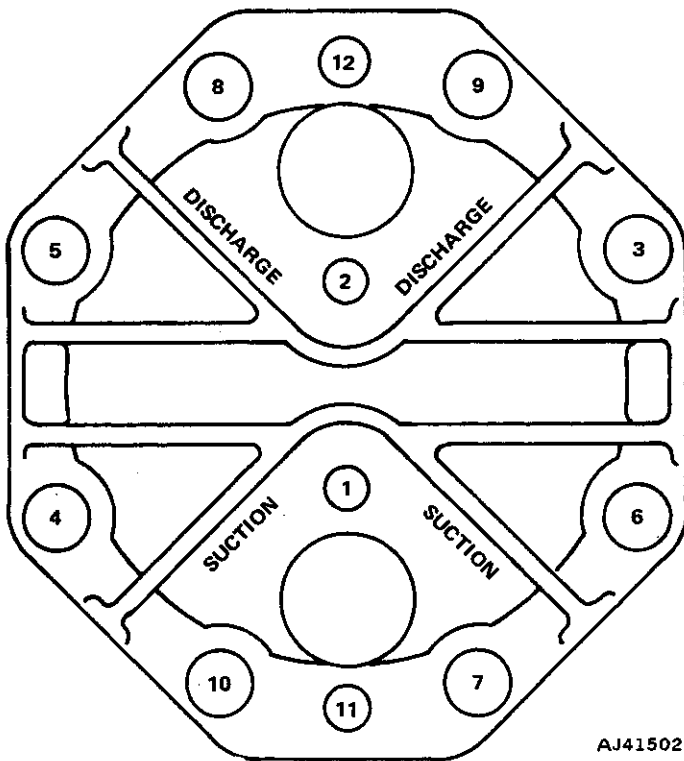


Fig. 3E-14 Compressor Head Capscrew Tightening Sequence

- (1) Isolate compressor.
- (2) Loosen crankcase oil check plug slowly to release any internal pressure in the compressor. Remove check plug when all pressure is relieved.
- (3) Fabricate a dipstick rod as shown in figure 3E-15.
- (4) Hold dipstick as vertical as possible and insert in check plug opening. Oil level should be within specified levels indicated in figure 3E-15.
- (5) Add clean refrigerant oil, if necessary.

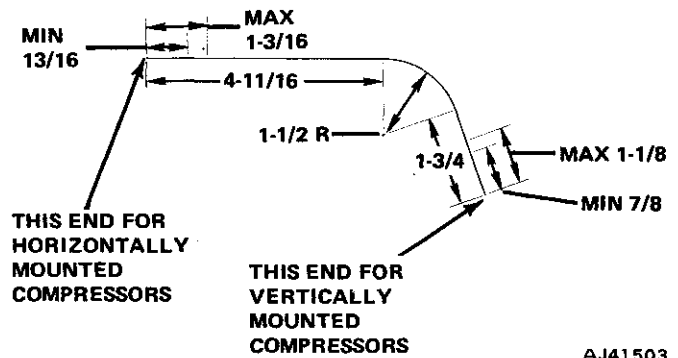


Fig. 3E-15 Oil Dipstick Fabrication Dimensions (Inches)

### Checking Compressor Oil Level

Initially, the compressor has 7 ounces of refrigeration oil in the crankcase (Approved oil: Sun Oil Suniso 5, Texaco Capella E, or equivalent). In normal operation, a small amount of oil is always circulating with the refrigerant in the system. Unless the system has developed a leak, the oil level will remain the same in the system.

**CAUTION:** The oil level should be checked whenever the system is discharged for a service part replacement, and especially after a rapid loss of refrigerant has occurred.

**NOTE:** Check compressor oil level with compressor in operating position, and only after the car interior air has been cooled to the desired temperature. Operating the system stabilizes the oil entrained in the system, and provides an accurate oil level reading. The oil check plugs are located on either side of the compressor crankcase.

Before installing a replacement compressor, check the oil level in the compressor to be replaced prior to removing it. The oil level in the replacement compressor must be adjusted to correspond with that of the replaced compressor.

**NOTE:** Refrigeration oil readily absorbs moisture. Keep the container capped until ready to use, and recap immediately after use.

- (6) Install oil check plug O-ring seal. Be sure O-ring is not twisted.

**NOTE:** Oil check plug leaks are usually due to a damaged O-ring or dirt on the seat.

- (7) Install plug and tighten to 4 foot-pounds (5 N•m) torque.
- (8) Purge compressor of air.

### Purging Compressor of Air

The compressor must be purged of air whenever it has been isolated for oil level check or other service procedures without discharging the entire system.

- (1) Cap service gauge ports on both service valves.
- (2) Back-seat the suction service valve to allow system refrigerant to enter compressor.
- (3) Place discharge service valve in mid- or cracked position.
- (4) Loosen discharge service valve gauge port cap to permit refrigerant to force any air out of compressor.
- (5) Back-seat discharge service valve and tighten gauge port cap.

The compressor is now ready for service.

### FLUSHING SYSTEM

Anytime a failure of the compressor causes foreign material to be passed into the system, the condenser must be flushed and the receiver/drier replaced. Filter screens in the compressor at the suction side and in the receiver/drier will confine foreign material to the compressor, condenser, receiver/drier and connecting hoses.

#### Flushing Procedure

(1) Install replacement compressor and connect service valves and hoses.

**NOTE:** *System must be in a discharged state.*

(2) Using Portable Air Conditioning Service Station J-23500-01, close all control valves, and connect red high pressure to compressor discharge service valve.

**WARNING:** *Wear goggles to protect eyes.*

(3) Open refrigerant drum valve. Bleed charging cylinder through valve located on back of control panel directly above cylinder. When two pounds of refrigerant is in charging cylinder, close bleed valve.

(4) Close refrigerant drum valve.

(5) Disconnect receiver/drier from condenser. Place a shop towel on condenser outlet to catch oil that will be forced from system.

(6) Center compressor discharge valve.

(7) Fully open high pressure valve on control panel and allow liquid refrigerant to flow through condenser.

**WARNING:** *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.*

(8) When charging cylinder is empty, close high pressure valve on control panel.

(9) Check compressor oil level.

(10) A replacement receiver/drier should be installed, and system evacuated before charging.

### MAGNETIC CLUTCH

The magnetic clutch consists of a stationary electromagnetic coil and a rotating pulley and plate assembly.

The electromagnetic coil is mounted on four bosses on the compressor. The pulley and plate assembly is mounted on the compressor shaft. When the air conditioner is off, the pulley is free to turn on the clutch hub bearing. When the clutch is energized, the plate is magnetically attracted to the pulley and turns the compressor crankshaft.

Do not attempt to replace the bearing, pulley or clutch plate separately. These components are serviced only as a complete assembly. The coil is serviced as a separate unit.

### Electrical Diagnosis

Refer to the Magnetic Clutch Troubleshooting guide when diagnosing magnetic clutch malfunctions.

### Diagnosis for Nolsy Clutch

Spin the pulley by hand. There must be no interference between the field and the rotor assembly. The clutch coil must be mounted properly using the special capscrews which position the field coil to the compressor.

A worn pulley bearing can be detected by the roughness felt when spinning the pulley. Do not attempt to replace the bearing. Replace the clutch as an assembly.

A replacement clutch may emit a short squeal when initially engaged. After a few cycles of operation, the noise will disappear.

### Clutch Removal

(1) Remove compressor belt(s).

(2) Energize the clutch or use a spanner wrench to hold clutch plate while removing the clutch-to-shaft attaching bolt and washer.

(3) Install a 5/8 inch by 11 standard thread bolt in the threaded center of the clutch plate.

(4) Tighten bolt and pull clutch from shaft.

**CAUTION:** *Do not pry on clutch to remove.*

(5) Remove four capscrews which attach magnetic coil and disconnect coil wire. Remove coil.

### Clutch Installation

(1) Install magnetic coil with four special capscrews provided with replacement unit. These capscrews are used to ensure coil is positioned properly on compressor.

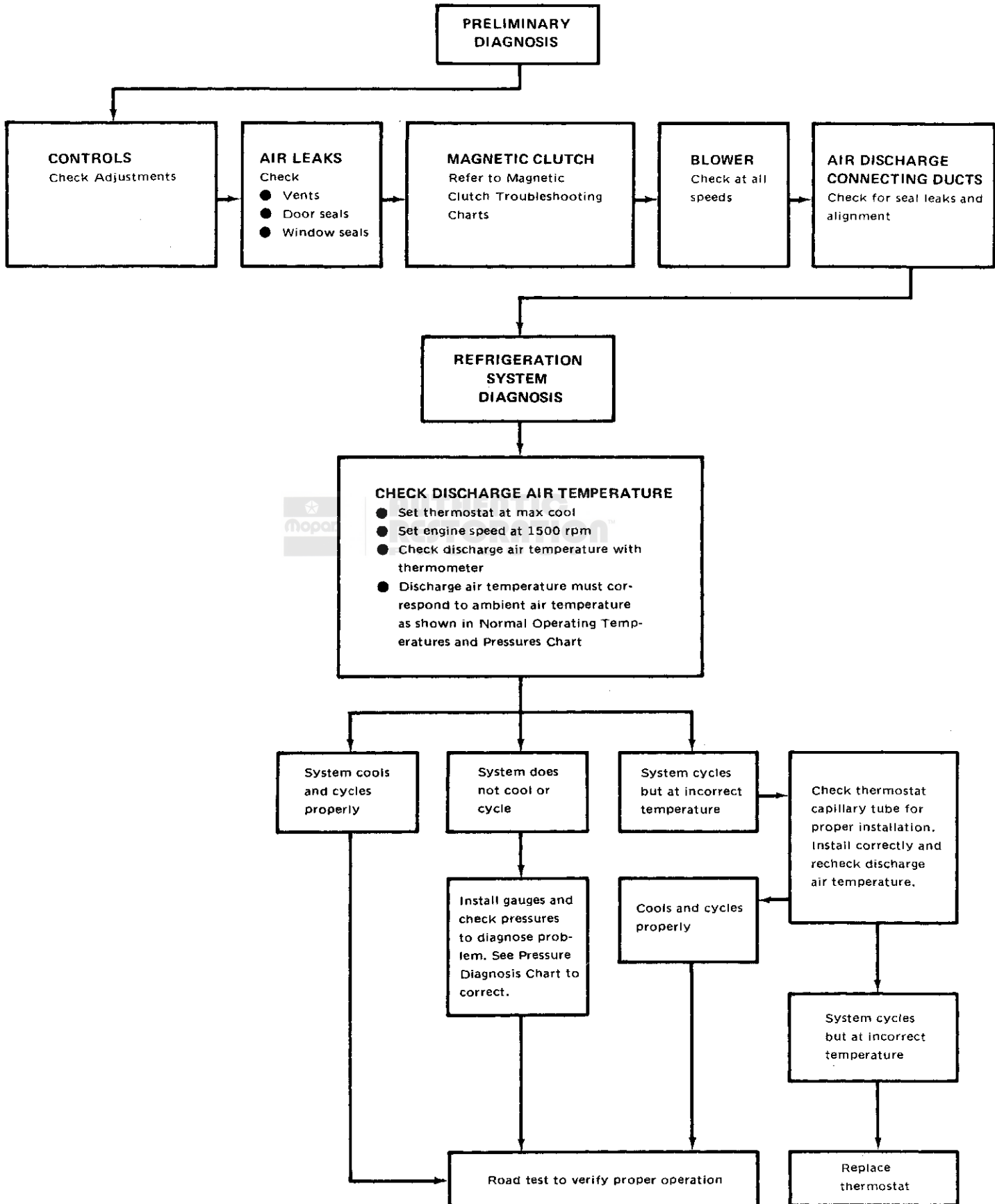
(2) Tighten capscrews to 7 to 10 foot-pounds (9 to 13 N•m) torque.

(3) Align clutch assembly with key and install clutch on shaft.

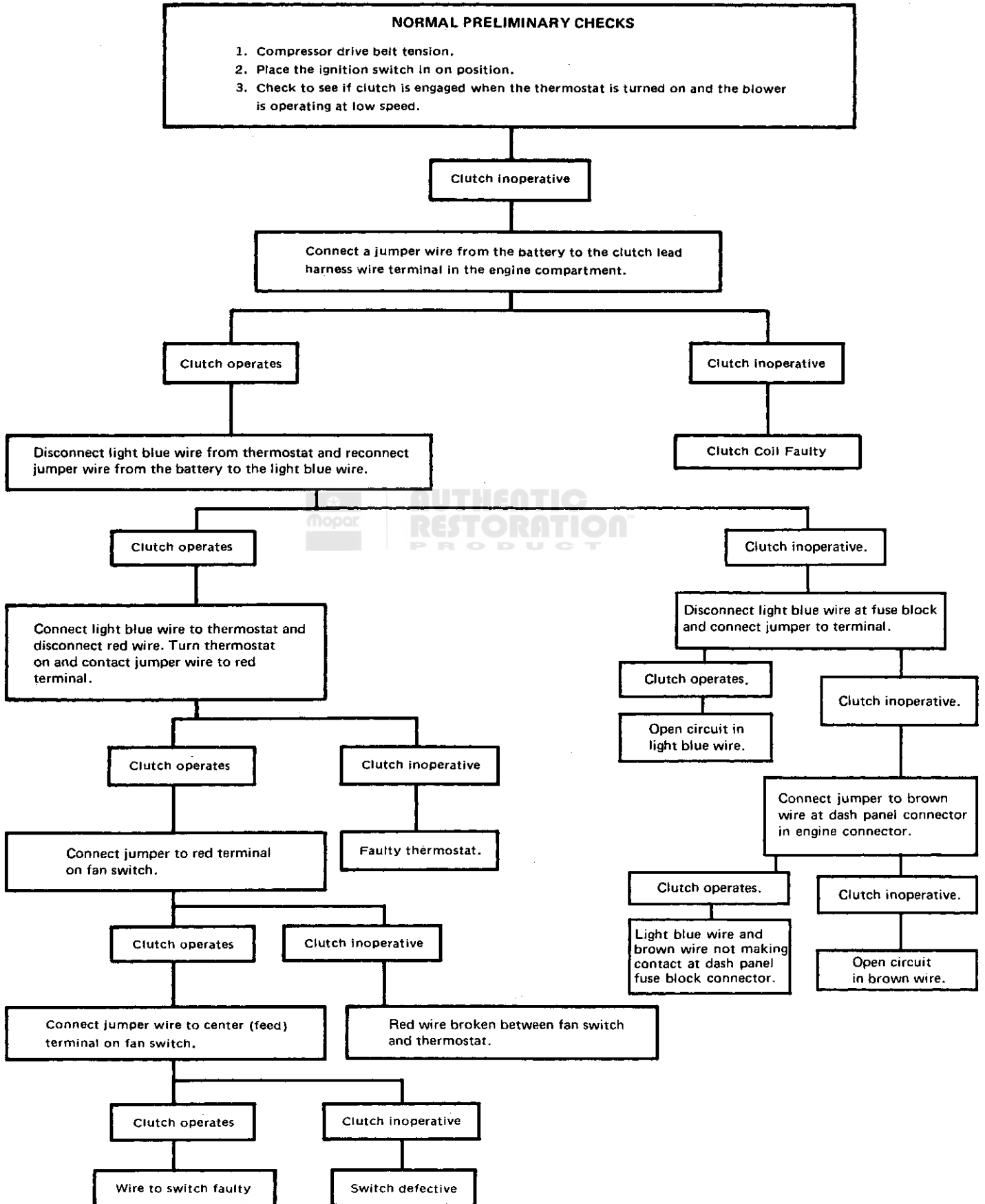
(4) Install clutch-to-shaft attaching washer and bolt and tighten to 20 foot-pounds (27 N•m) torque. Connect clutch coil wire and energize clutch to hold unit when tightening.

(5) Install compressor belt(s) and adjust belt tension to specifications.

**System Troubleshooting**



**Magnetic Clutch Troubleshooting**



**Performance Diagnosis—All Models**

Condition	Possible Cause	Correction
<p><b>COMPRESSOR NOISE</b></p>	<ul style="list-style-type: none"> <li>(1) Broken valves.</li> <li>(2) Overcharged.</li> <li>(3) Incorrect oil level.</li> <li>(4) Piston slap.</li> <li>(5) Broken rings.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Replace valve plate.</li> <li>(2) Discharge, evacuate, and install correct charge.</li> <li>(3) Isolate compressor and check oil level. Correct as necessary.</li> <li>(4) Replace compressor.</li> <li>(5) Replace compressor.</li> </ul>
<p><b>EXCESSIVE VIBRATION</b></p>	<ul style="list-style-type: none"> <li>(1) Incorrect belt tension.</li> <li>(2) Clutch loose.</li> <li>(3) Overcharged.</li> <li>(4) Pulley misaligned.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Set belt tension. Refer to Compressor Belt Tension</li> <li>(2) Tighten clutch.</li> <li>(3) Discharge, evacuate, and install correct charge.</li> <li>(4) Align pulley.</li> </ul>
<p><b>CONDENSATION DRIPPING IN PASSENGER COMPARTMENT</b></p>	<ul style="list-style-type: none"> <li>(1) Drain hose plugged or improperly positioned.</li> <li>(2) Insulation removed or improperly installed.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Clean drain hose and check for proper installation.</li> <li>(2) Replace insulation on expansion valve and hoses.</li> </ul>
<p><b>FROZEN EVAPORATOR COIL</b></p>	<ul style="list-style-type: none"> <li>(1) Faulty thermostat.</li> <li>(2) Thermostat capillary tube improperly installed.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Replace thermostat.</li> <li>(2) Install capillary tube correctly.</li> </ul>

Pressure Diagnosis—All Models

Condition	Possible Cause	Correction
LOW SIDE LOW— HIGH SIDE LOW	(1) System refrigerant low .	(1) Evacuate, leak test, and charge system.
LOW SIDE HIGH— HIGH SIDE LOW	(1) Internal leak in compressor — worn.  (2) Head gasket leaking. (3) Expansion valve. (4) Drive belt slipping.	(1) Remove compressor cylinder head and inspect compressor. Replace valve plate assembly if necessary. If compressor pistons, rings, or cylinders are excessively worn or scored, replace compressor.  (2) Install new cylinder head gasket. (3) Replace expansion valve. (4) Set belt tension.
LOW SIDE HIGH— HIGH SIDE HIGH	(1) Clogged condenser fins. (2) Air in system. (3) Expansion valve. (4) Loose or worn fan belts.	(1) Clean out condenser fins. (2) Evacuate, leak test, and charge system. (3) Replace expansion valve. (4) Adjust or replace belts as necessary.
LOW SIDE LOW— HIGH SIDE HIGH	(1) Expansion valve. (2) Restriction in liquid line. (3) Restriction in receiver. (4) Restriction in condenser.	(1) Replace expansion valve. (2) Check line for kinks — replace if necessary. (3) Replace receiver. (4) Replace condenser.
LOW SIDE AND HIGH SIDE NORMAL (INADEQUATE COOLING)	(1) Air in system. (2) Moisture in system.	(1) Evacuate, leak test, and charge system. (2) Evacuate, leak test, and charge system.

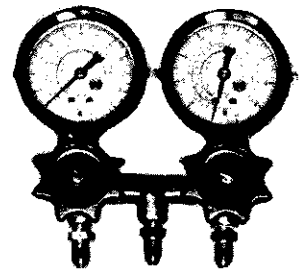
Tools



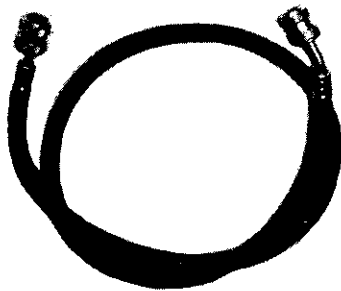
J-5453  
GOGGLES



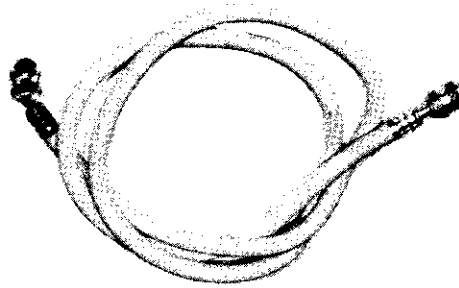
J-6105  
1/4-INCH RATCHET



B W R

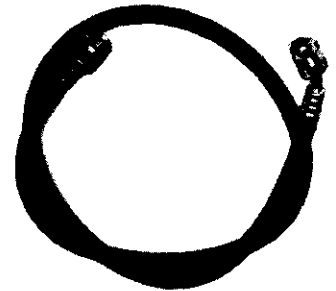


BLUE

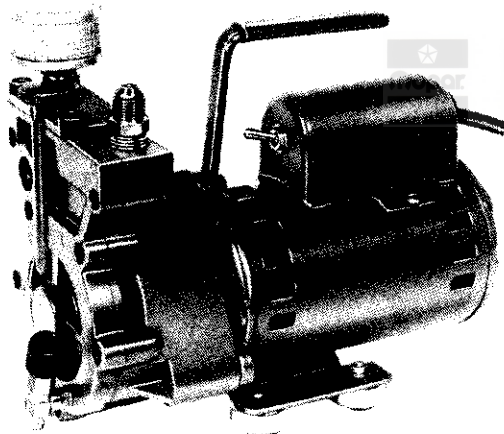


WHITE

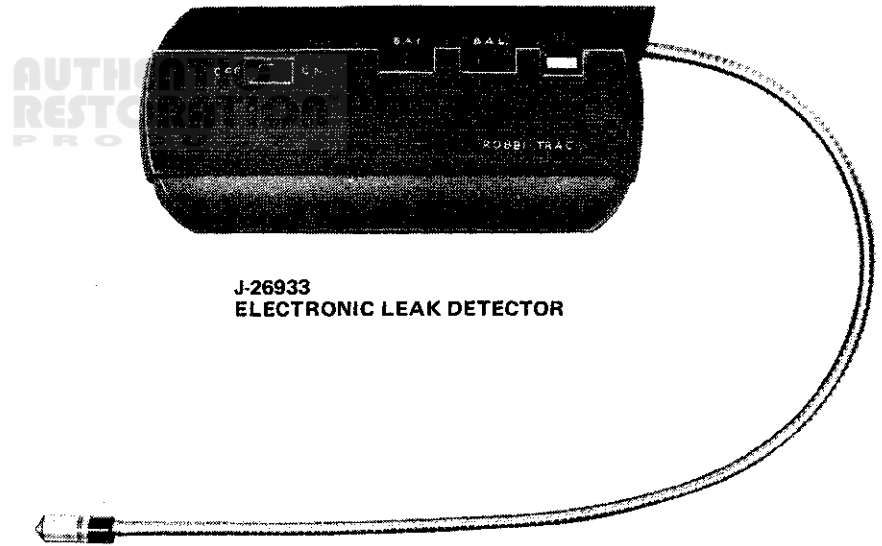
J-23575 PRESSURE GAUGE AND MANIFOLD ASSEMBLY



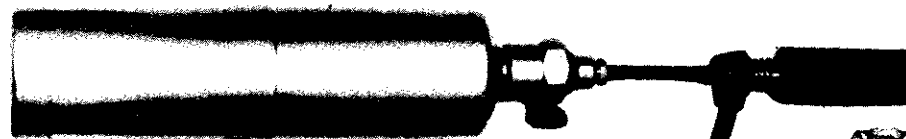
RED



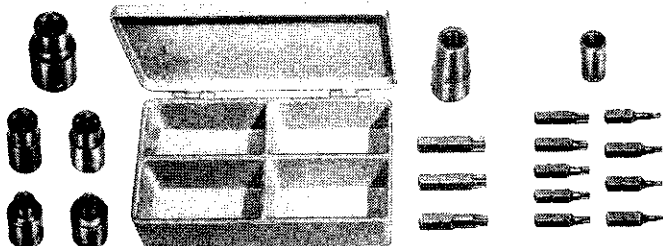
J-26695  
VACUUM PUMP



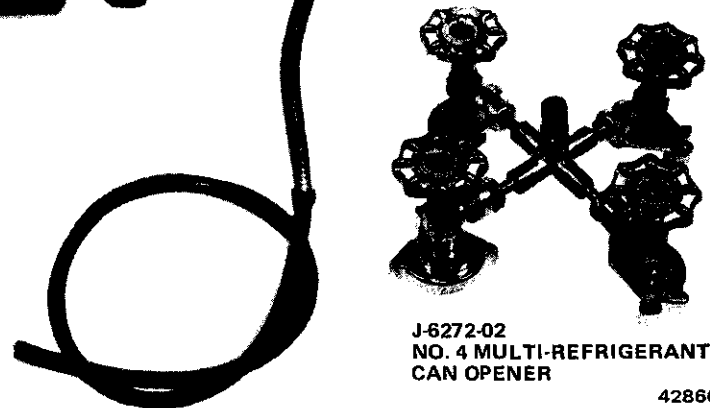
J-26933  
ELECTRONIC LEAK DETECTOR



J-6084  
HALIDE TORCH LEAK DETECTOR



J-25359-02  
TORX BIT AND SOCKET SET



J-6272-02  
NO. 4 MULTI-REFRIGERANT  
CAN OPENER



# CJ AIR CONDITIONING

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Control Operation	3E-22
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## GENERAL

When driving at normal highway speeds the CJ air conditioning system (fig. 3E-16) will provide maximum efficiency. However, when operating under stop-and-go city driving conditions, a slight reduction in cooling efficiency generally will be experienced.

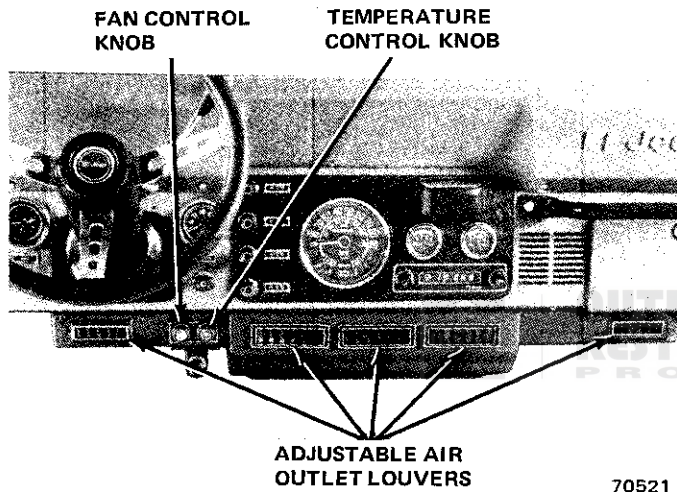


Fig. 3E-16 Air Conditioner—CJ Models

It is recommended that intermediate temperature and high fan setting be used for average city driving and intermediate temperature and medium fan setting for highway driving.

When driving at relatively high speed for an extended period of time, the cooling coil may possibly frost over, resulting in a temporary loss of cooling. Should this occur, simply turn the TEMP knob to OFF and allow the blower to operate for a few minutes to allow the cooling coil to defrost. Then turn the TEMP knob to a setting which is not as cold as the setting at which frosting occurred.

To maintain maximum cooling efficiency, periodically remove bugs and foreign matter from the condenser and radiator fins. DO NOT install a bug screen or other screen material in front of the condenser and radiator.

Water forming under a vehicle, at a point below the cooling case, is condensation water draining from the system and is considered normal.

The engine temperature gauge pointer will indicate a slightly higher than normal temperature when the air conditioning system is operating. However, should excessive overheating occur, check the condition of all water hoses, check the radiator for rust or scaling

conditions, and make sure that the condenser is free of bugs or other foreign matter.

The air conditioner also can be used for fast, efficient defogging of windows during cool, damp weather.

The condenser is mounted ahead of the radiator and the remaining components are in the engine compartment.

The compressor is a two-cylinder, belt-driven pump. An electromagnetic clutch couples the compressor to the drive pulley. The drive pulley freewheels when the air conditioner is not in use.

The start position on the ignition switch automatically disconnects all accessories, including the air conditioner, to reduce battery load and provide easier starting.

## CONTROL OPERATION

For fast, maximum efficiency, purge the vehicle of hot air by driving the equivalent of two or three city blocks with at least one window open. During this time, place the TEMP control in the MAX position and the FAN control in the HI position. This permits the evaporator to precool in hot weather.

Adjust the air outlets to obtain desired airflow distribution by moving the louver levers left, right, up, or down. Airflow can be adjusted for quick delivery to a specific spot or for gentle diffusion of air throughout the vehicle.

When the interior of the vehicle has cooled to the desired temperature, the FAN knob may be set to obtain the desired volume of air from the air outlets. The TEMP knob may be rotated to vary the temperature. It may be necessary to experiment with the TEMP knob to determine the settings best suited to various driving conditions. Generally, an intermediate temperature and high fan setting is comfortable for city driving, and a lesser fan setting comfortable for open road driving.

Run the engine well above idle speed for more efficient cooling under conditions in which the system is operated with the vehicle standing.

## CONTROL PANEL

### Fan Switch

The fan switch may be serviced by removing the access plate located on the lower evaporator core housing below the control panel.

### Temperature Control Thermostat

To service the temperature control thermostat, the evaporator core housing must be disassembled.

When installing a replacement temperature control thermostat, insert the capillary tube into the evaporator coil a minimum of two inches (fig. 3E-17).

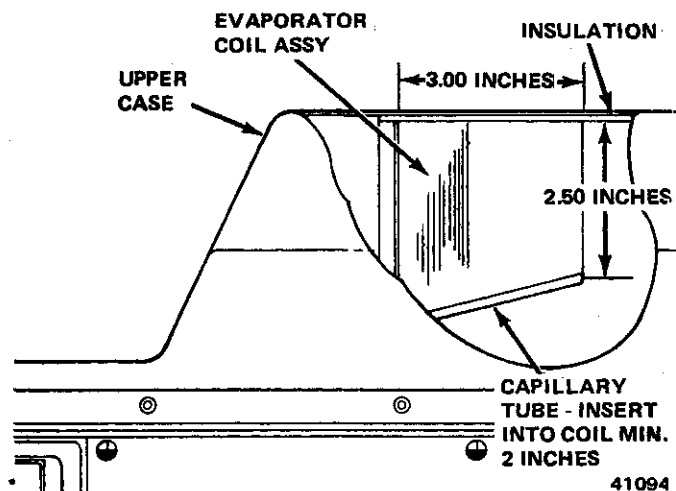


Fig. 3E-17 Capillary Tube Position

**CAUTION:** Handle the tube with care to avoid bends or kinks which could cause the thermostat to malfunction.

### CONDENSER AND RECEIVER/DRYER ASSEMBLY

#### Removal

- (1) Discharge refrigerant from system.

**NOTE:** Discharge system slowly to prevent loss of compressor oil.

- (2) Drain radiator.
- (3) Remove fan shroud and radiator.
- (4) Disconnect pressure line at condenser.
- (5) Remove condenser attaching screws and tilt bottom of condenser toward engine.

**NOTE:** Plug all open connections to prevent entry of dirt and moisture.

- (6) From underside of vehicle, disconnect receiver/dryer-to-evaporator hose at receiver/dryer.
- (7) Remove condenser and receiver/dryer assembly.
- (8) Remove receiver/dryer from condenser, if necessary.

#### Installation

- (1) If removed, install receiver/dryer to condenser.
- (2) Place condenser in position and connect receiver/dryer-to-evaporator hose at receiver/dryer.

- (3) Install condenser attaching screws.
- (4) Connect pressure line at condenser.
- (5) Install radiator and fan shroud.
- (6) Fill radiator.
- (7) Evacuate, leak test, and charge system.

### RECEIVER/DRYER

#### Removal

- (1) Discharge refrigerant from system.

**NOTE:** Discharge system slowly to prevent loss of compressor oil.

- (2) Disconnect evaporator and condenser lines from receiver/dryer.
- (3) Remove attaching screws from receiver/dryer bracket and remove receiver/dryer.

#### Installation

- (1) Install receiver/dryer to support bracket.
- (2) Install evaporator and condenser line to receiver/dryer.
- (3) Evacuate, charge system and leak test.

### EVAPORATOR HOUSING ASSEMBLY

#### Removal

- (1) Discharge system.
- (2) Disconnect inlet (suction) line at compressor.
- (3) Disconnect receiver/dryer-to-evaporator hose.
- (4) Remove hose clamps and dash grommet retaining screws.
- (5) Remove evaporator housing-to-instrument panel attaching screws and the evaporator housing-to-mounting bracket screw (fig. 3E-18).

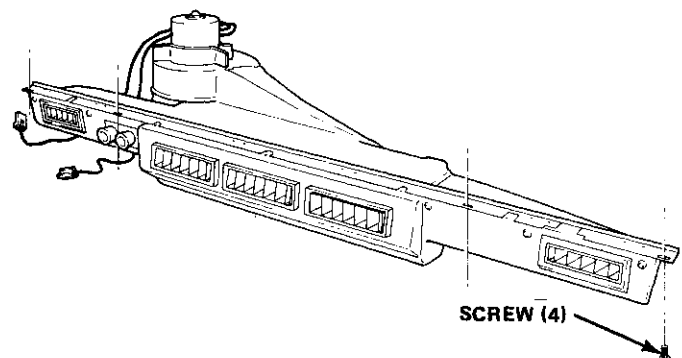


Fig. 3E-18 Evaporator Housing Mounting—CJ Models

- (6) Lower evaporator housing and pull hoses and grommet through opening.  
The blower motor, blower motor housing, and evaporator core may be serviced after the evaporator housing is removed (fig. 3E-19).

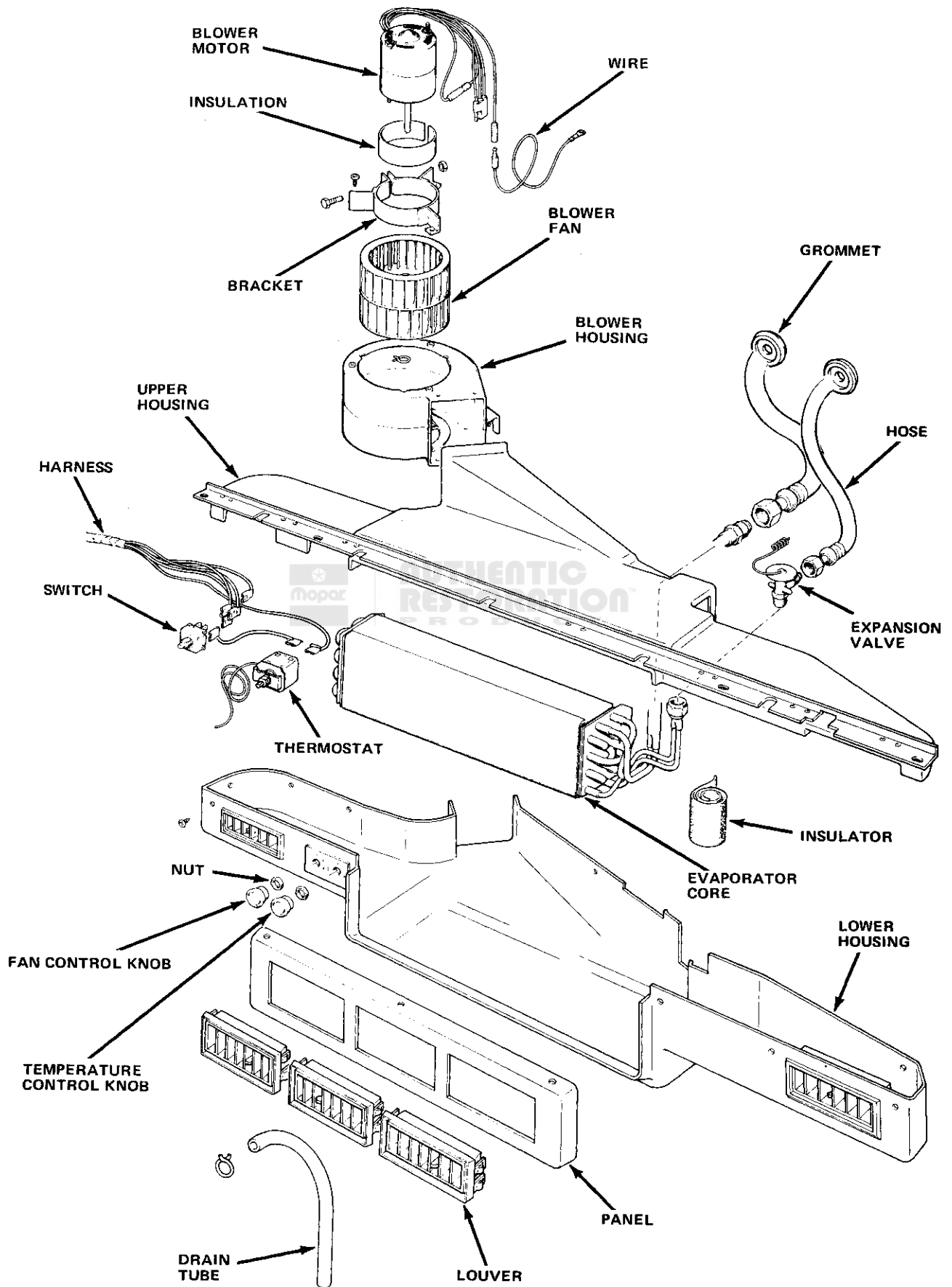


Fig. 3E-19 Evaporator Housing Assembly—CJ Models

**NOTE:** It is not necessary to discharge the system to service the blower motor. The evaporator housing may be lowered from the instrument panel to gain access to the blower motor attaching screws.

**Installation**

- (1) Push hoses through grommet opening, and install grommet by pushing toward engine compartment of vehicle and fasten to dash panel with two attaching screws.
- (2) Raise evaporator and install evaporator-housing-to-instrument-panel attaching screws and the evaporator-to-mounting-bracket screw.
- (3) Install hose clamps and grommet attaching screws.
- (4) Connect receiver/dryer-to-evaporator hose.
- (5) Connect inlet (suction) line to compressor.
- (6) Evacuate, leak test, and charge system.

**EXPANSION VALVE SERVICE**

The valve is preset and should not be adjusted. A defective valve requires replacement.

- (1) Discharge system.
- (2) Remove evaporator housing assembly.
- (3) Remove insulation wrapped around suction line and expansion valve. Mark capillary tube location on suction line.
- (4) Disconnect inlet and outlet connections, capillary tube clamp, and equalizer tube.
- (5) Remove expansion valve.
- (6) Clean suction line to provide a positive contact with replacement expansion valve capillary tube.
- (7) Connect inlet and outlet hoses. Clamp capillary tube at marked position and connect equalizer tube.

**NOTE:** Clamp capillary tube securely so that a firm contact with the suction line is formed.

- (8) Wrap expansion valve and line with insulation.
- (9) Install evaporator housing assembly.
- (10) Evacuate, leak test, and charge system.

# CHEROKEE - WAGONEER - TRUCK AIR CONDITIONING

	Page		Page
Condenser and Receiver/Dryer Assembly	3E-26	Evaporator Housing Assembly	3E-27
Control Operation	3E-26	Expansion Valve Service	3E-27
Control Panel	3E-26	General	3E-25

**GENERAL**

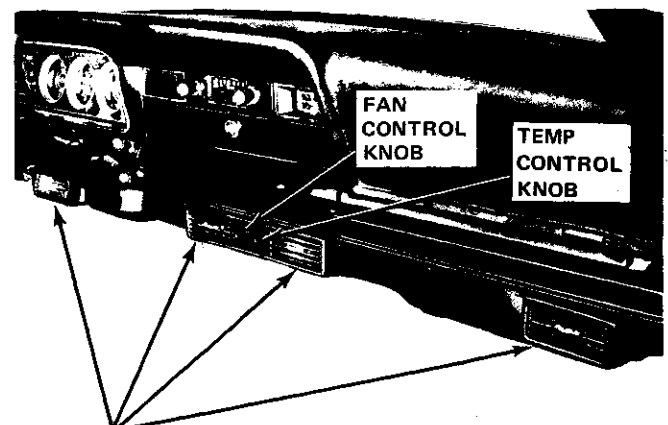
When driving at normal highway speeds the Jeep air conditioning system will provide maximum efficiency. However, when operating under stop-and-go city driving conditions a slight reduction in cooling efficiency generally will be experienced.

It is recommended that intermediate temperature and high fan setting be used for average city driving and intermediate temperature and medium fan setting for highway driving.

The air conditioning system, as shown for the Wagoneer in figure 3E-20, is applicable to Cherokee and Truck models.

When driving at relatively high speed for an extended period of time, the cooling coil may possibly frost over, resulting in a temporary loss of cooling. Should this occur, simply turn the TEMP knob to OFF and allow the blower to operate for a few minutes to allow the cooling coil to defrost. Then turn the TEMP knob to a setting which is not as cold as the setting at which frosting occurred.

To maintain maximum cooling efficiency, periodically remove bugs and foreign matter from the condenser and radiator fins. DO NOT install a bug screen or other screen material in front of the condenser and radiator.



ADJUSTABLE AIR OUTLET LOUVERS

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Fig. 3E-20 Air Conditioner—Cherokee-Wagoneer-Truck Models

Water forming under a vehicle, at a point below the cooling case, is condensation water draining from the system and is considered normal.

The engine temperature gauge pointer will indicate a slightly higher than normal temperature when the air conditioning system is operating. However, should excessive overheating occur, check the condition of all water hoses, check the radiator for rust or scaling conditions, and make sure that the condenser is free of bugs or other foreign matter.

The air conditioner also can be used for fast, efficient defogging of windows during cool, damp weather.

The condenser is mounted ahead of the radiator and the remaining components are in the engine compartment.

The compressor is a two-cylinder, belt-driven pump. An electromagnetic clutch couples the compressor to the drive pulley. The drive pulley freewheels when the air conditioner is not in use.

The start position on the ignition switch automatically disconnects all accessories, including the air conditioner, to reduce battery load and provide easier starting.

### CONTROL OPERATION

For fast, maximum efficiency, purge the vehicle of hot air by driving the equivalent of two or three city blocks with at least one window open. During this time, place the TEMP control in the MAX position and the FAN control in the HI or PC position. This permits the evaporator to precool in hot weather.

**CAUTION:** Do not leave fan control on PC for longer than 30 seconds. Move the fan control to HI position and raise all windows.

Adjust the air outlets to obtain desired airflow distribution by moving the louver levers left, right, up, or down. Airflow can be adjusted for quick delivery to a specific spot or for gentle diffusion of air throughout the vehicle.

When the interior of the vehicle has cooled to the desired temperature, the FAN knob may be set to obtain the desired volume of air from the air outlets. The TEMP knob may be rotated to vary the temperature. It may be necessary to experiment with the TEMP knob to determine the settings best suited to various driving conditions. Generally, an intermediate temperature and high fan setting is comfortable for city driving, and a lesser fan setting comfortable for open road driving.

Run the engine well above idle speed for more efficient cooling under conditions in which the system is operated with the vehicle standing.

### CONTROL PANEL

#### Fan Switch

The fan switch may be serviced by removing the access plate located on the lower evaporator core housing below the control panel.

#### Temperature Control Thermostat

To service the temperature control thermostat, the evaporator core housing must be disassembled.

When installing a new temperature control thermostat, insert the capillary tube into the evaporator coil a minimum of two inches (fig. 3E-21).

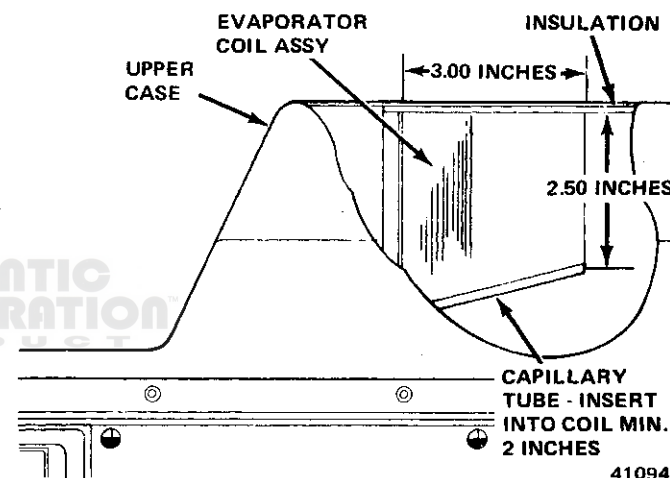


Fig. 3E-21 Capillary Tube Position

**CAUTION:** Handle the tube with care to avoid bends or kinks which could cause the thermostat to malfunction.

### CONDENSER AND RECEIVER/DRYER ASSEMBLY

#### Removal

- (1) Discharge refrigerant from system.

**NOTE:** Discharge system slowly to prevent loss of compressor oil.

- (2) Drain radiator.
- (3) Remove fan shroud and radiator.
- (4) Disconnect pressure line at condenser.
- (5) Remove condenser attaching screws and tilt bottom of condenser toward engine.

**NOTE:** Plug all open connections to prevent entry of dirt and moisture.

- (6) From underside of vehicle, disconnect receiver/dryer-to-evaporator hose at receiver/dryer.

(7) Remove condenser and receiver/dryer assembly.

(8) Remove receiver/dryer from condenser, if necessary.

### Installation

- (1) If removed, install receiver/dryer to condenser.
- (2) Place condenser in position and connect receiver/dryer-to-evaporator hose at receiver/dryer.
- (3) Install condenser attaching screws.
- (4) Connect pressure line at condenser.
- (5) Install radiator and fan shroud.
- (6) Fill radiator.
- (7) Evacuate, leak test, and charge system.

### RECEIVER/DRYER

#### Removal

- (1) Discharge refrigerant from system.

**NOTE:** Discharge system slowly to prevent loss of compressor oil

- (2) Remove headlamp trim ring.
- (3) Remove headlamp assembly.
- (4) Remove grille.
- (5) Remove bolt from top of inner panel. Pull panel back and block.
- (6) Remove evaporator and condenser line from receiver/dryer.
- (7) Remove screws from receiver/dryer bracket and remove receiver/dryer.

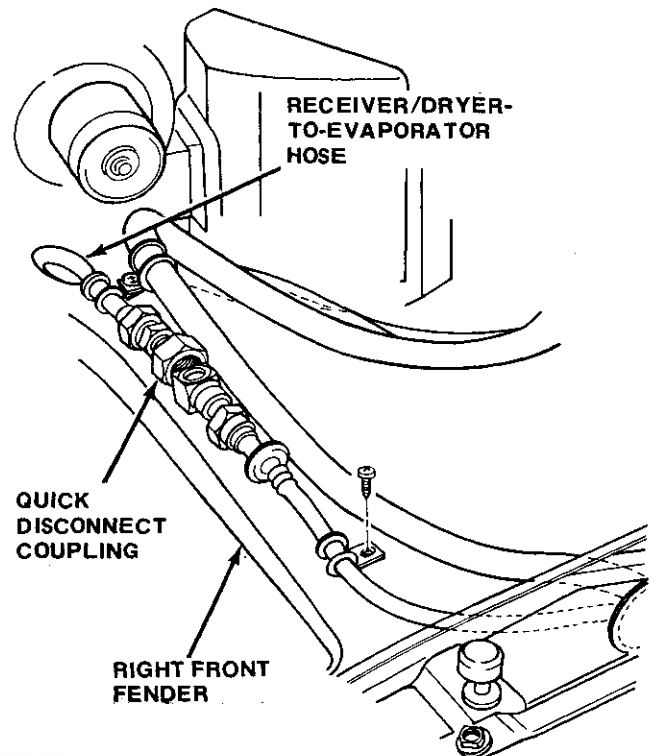
#### Installation

- (1) Install receiver/dryer to radiator support bracket.
- (2) Install evaporator and condenser lines to receiver/dryer.
- (3) Remove block and install inner panel bolt.
- (4) Install grille.
- (5) Install headlamp assembly.
- (6) Install headlamp trim ring.
- (7) Evacuate, charge system and leak test.

### EVAPORATOR HOUSING ASSEMBLY

#### Removal

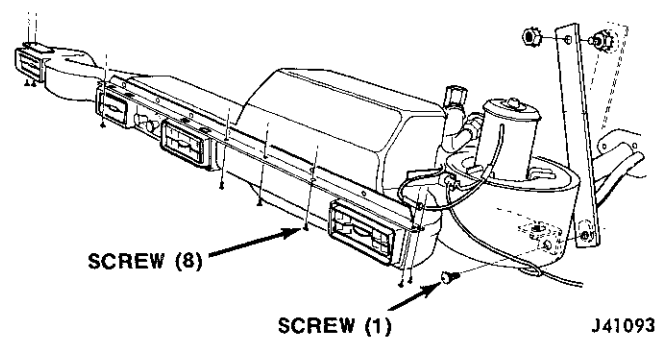
- (1) Discharge system.
- (2) Disconnect inlet (suction) line at compressor.
- (3) Disconnect receiver/dryer-to-evaporator hose at quick-disconnect coupling (fig. 3E-22).
- (4) Remove hose clamps and dash grommet retaining screws.



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Fig. 3E-22 Quick-Disconnect Coupling

- (5) Remove evaporator housing-to-instrument panel attaching screws and evaporator housing-to-mounting bracket screw (fig. 3E-23).



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Fig. 3E-23 Evaporator Housing Mounting—Cherokee-Wagoneer-Truck Models

- (6) Lower evaporator housing and pull hoses and grommet through opening.

The blower motor, blower motor housing, and evaporator core may be serviced after the evaporator housing is removed (fig. 3E-24).

**NOTE:** It is not necessary to discharge the system to service the blower motor. The evaporator housing may be lowered from the instrument panel to gain access to the blower motor attaching screws.

## 3E-28 AIR CONDITIONING

### Installation

(1) Push hoses through grommet opening, and install grommet by pushing toward engine compartment of vehicle and fasten to dash panel with two attaching screws.

(2) Raise evaporator and install evaporator-housing-to-instrument-panel attaching screws and evaporator-to-mounting-bracket screw.

(3) Install hose clamps and grommet attaching screws.

(4) Connect receiver-to-evaporator hose at quick-disconnect coupling.

(5) Connect inlet (suction) line to compressor.

(6) Evacuate, leak test, and charge system.

(1) Discharge system.  
(2) Remove evaporator housing assembly.  
(3) Remove insulation wrapped around suction line and expansion valve. Mark capillary tube location on suction line.

(4) Disconnect inlet and outlet connections, capillary tube clamp, and equalizer tube.

(5) Remove expansion valve.

(6) Clean suction line to provide a positive contact with replacement expansion valve capillary tube.

(7) Connect inlet and outlet hoses. Clamp capillary tube at marked position and connect equalizer tube.

**NOTE:** Clamp capillary tube securely so that a firm contact with suction line is formed.

### EXPANSION VALVE SERVICE

The valve is preset and should not be adjusted. A defective valve requires replacement.

(8) Wrap expansion valve and line with insulation.

(9) Install evaporator housing assembly.

(10) Evacuate, leak test, and charge system.

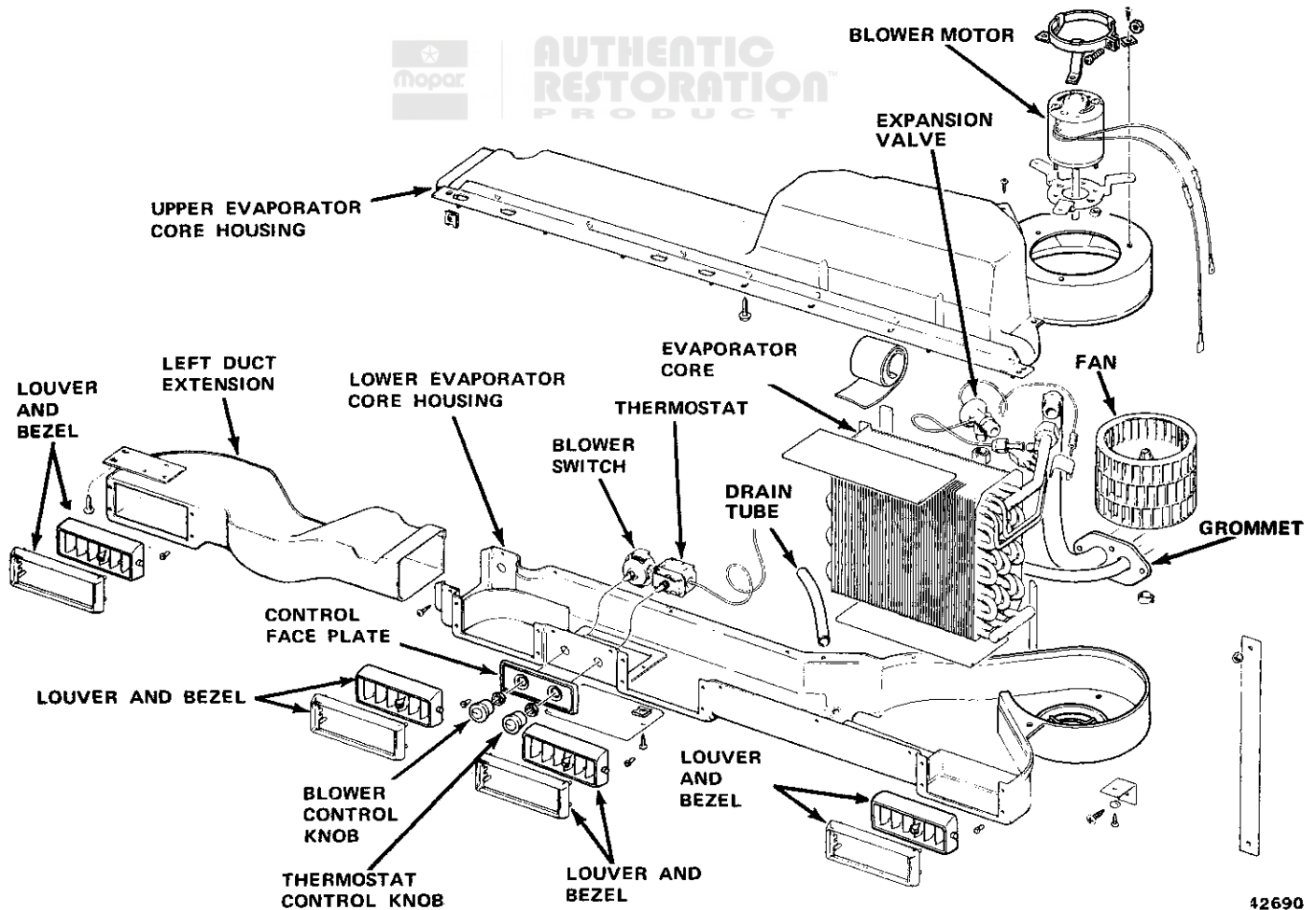


Fig. 3E-24 Evaporator Housing Assembly—Cherokee-Wagoneer-Truck Models

# BODY AND FRAME COMPONENTS

# 3F

## SECTION INDEX

	Page		Page
Bodies	3F-1	Grilles	3F-8
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## BODIES

	Page		Page
Body Construction	3F-1	Body Mouldings	3F-1

### BODY CONSTRUCTION

#### General

Jeep vehicles are of all-steel construction, with insulated body mounting points that provide a secure attachment to the chassis frame.

All major body panels are of heavy gauge steel, reinforced, flanged, and welded. The bodies are completely detachable from the chassis unit and are insulated from the frame by body spacers placed between the body and frame and held in position with body bolts.

Spacers are located between the body and chassis mounting points to insulate against vibrations and road noises.

Periodic inspection is necessary to determine the condition of body spacers and holddown bolts. Worn, loose,

or fatigued spacers permit the body to settle causing body lean or possible interference between the floorpan and various chassis components.

### BODY MOULDINGS

#### Trim Mouldings

Trim mouldings on the front fenders, front and rear doors and rear quarter are attached with adhesive backing, screws and snap-in clips. To replace mouldings, remove attaching screws and use a wedge-shaped fiber stick to pry mouldings from body.

#### Rocker Panel Mouldings

The CJ rocker panel mouldings are attached with screws. To replace rocker panel mouldings, remove attaching screws and moulding.

## FRAMES

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Frame Alignment	3F-7	Frame Straightening	3F-7
Frame Construction	3F-1		

### FRAME CONSTRUCTION

The frame is the foundation and structural center of the vehicle. In addition to carrying the load, it mounts and supports the power unit while maintaining correct

relationship and alignment of the power train. This relationship assures normal functioning of the units and freedom from excessive wear, stress, and strain. The frame is constructed of heavy channel steel side rails



### 3F-2 BODY AND FRAME COMPONENTS

and crossmembers. The crossmembers maintain the proper positions of the side rails in direct relationship to each other, providing maximum resistance to torsional twist and strains.

In the event of collision damage, it is important that the frame alignment be checked and realigned to frame dimensions shown on the individual dimension charts (fig. 3F-1 through 3F-5). Wheel geometry and axle alignment should be checked.

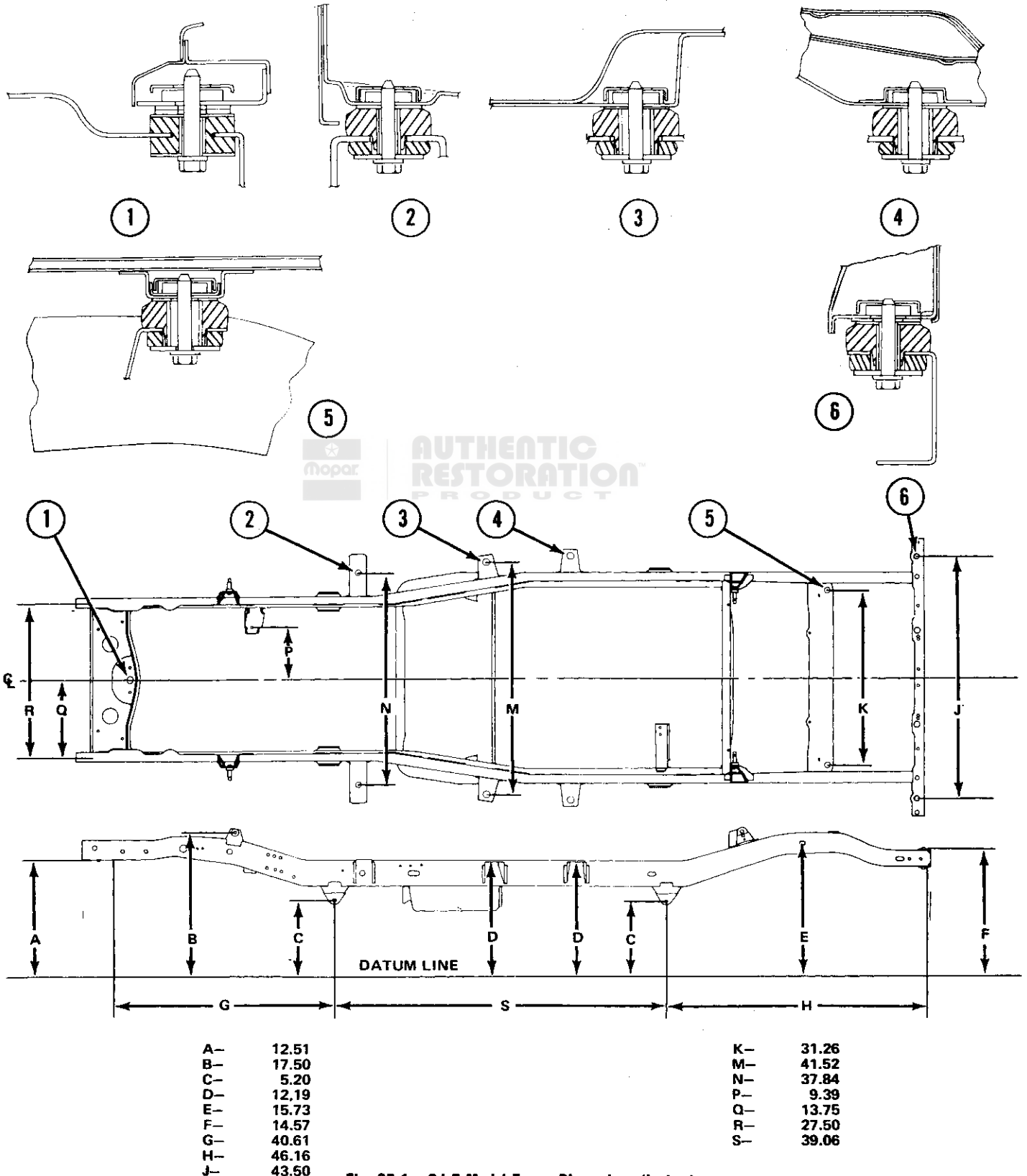
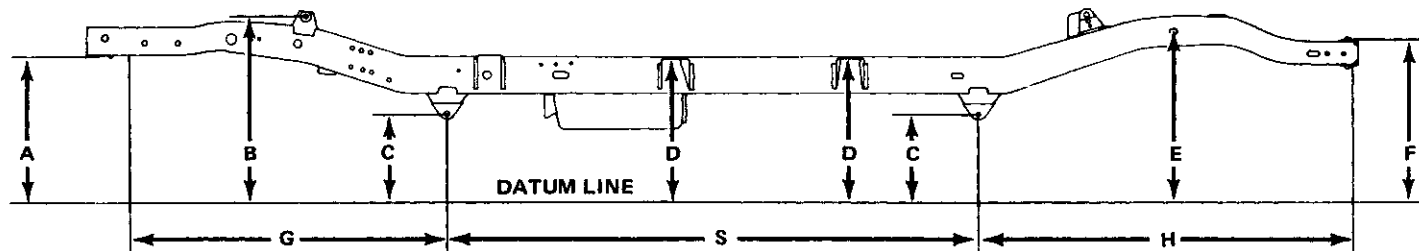
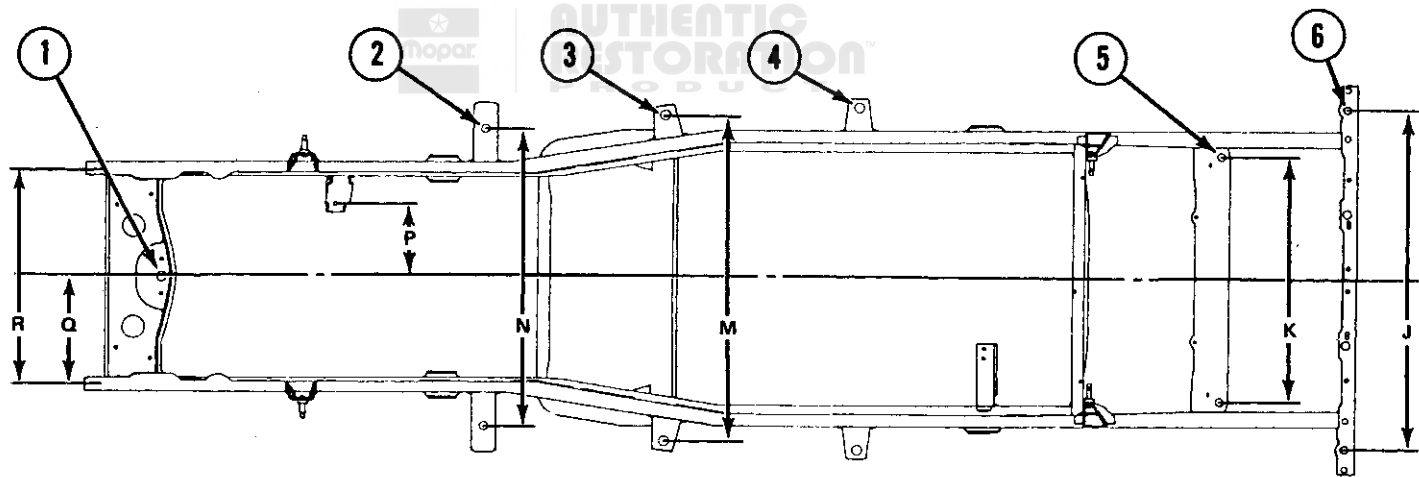
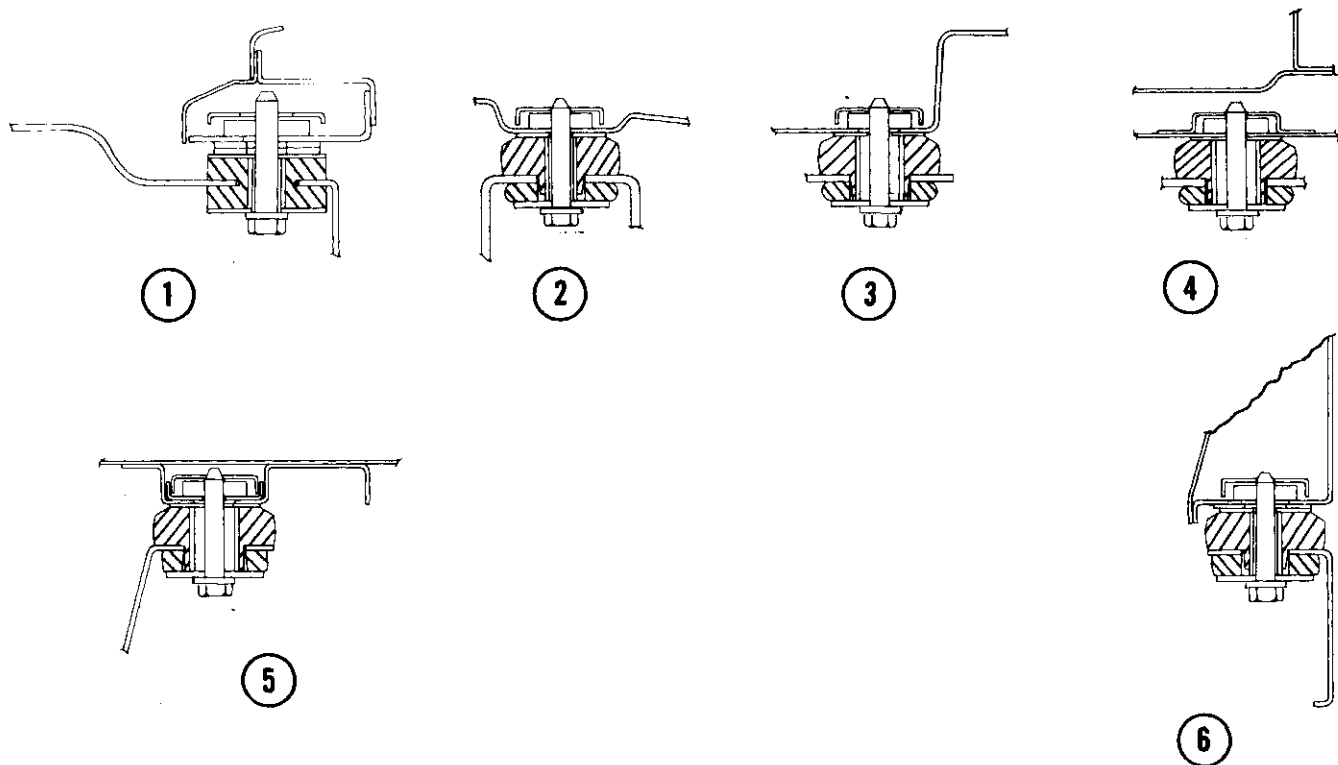


Fig. 3F-1 CJ-5 Model Frame Dimensions (Inches)

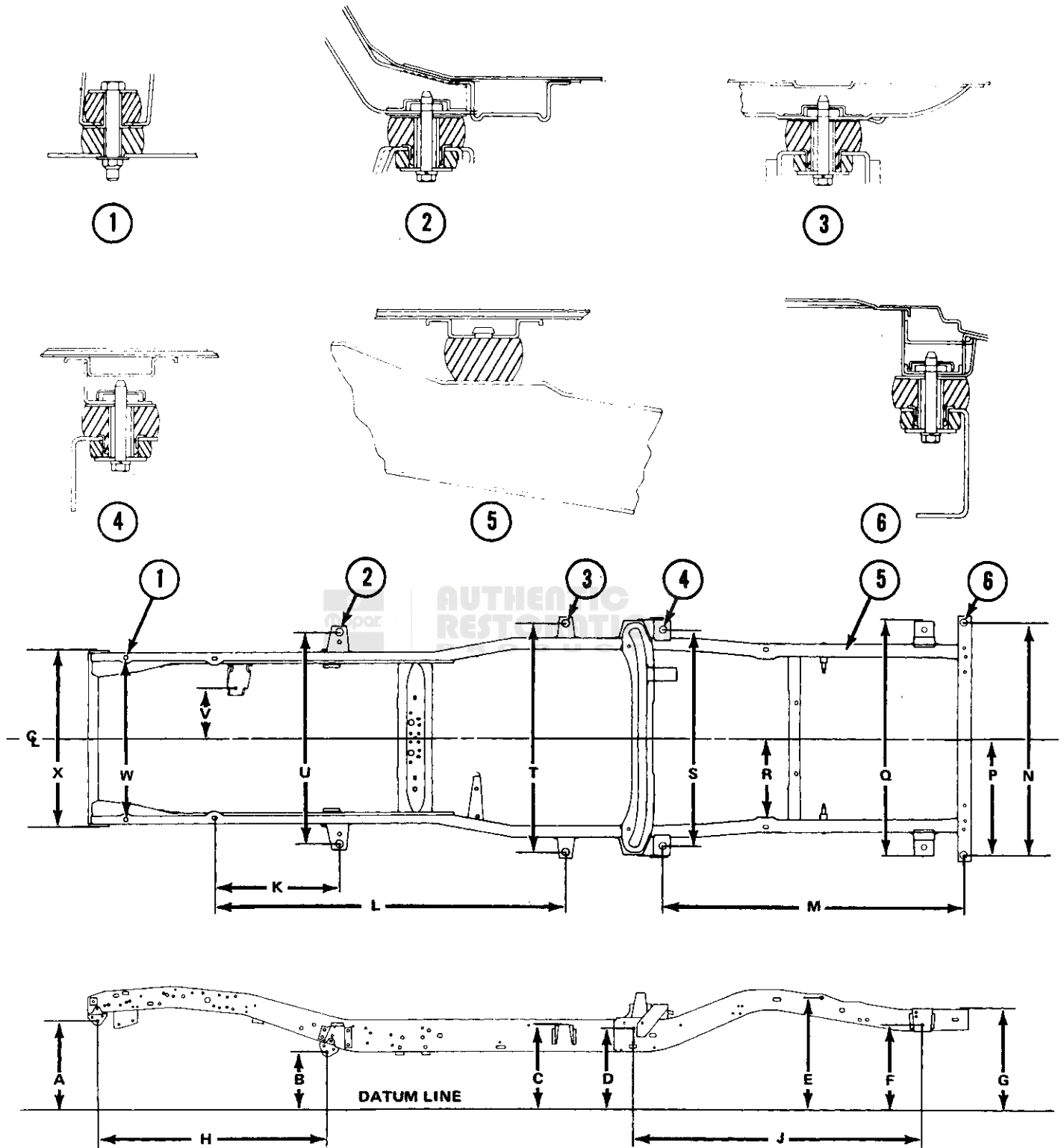


A-	12.51
B-	17.50
C-	5.20
D-	12.19
E-	15.73
F-	14.57
G-	40.61
H-	46.16
J-	43.50

K-	31.26
M-	41.52
N-	37.84
P-	9.39
Q-	13.75
R-	27.50
S-	49.06

Fig. 3F-2 CJ-7 Model Frame Dimensions (Inches)

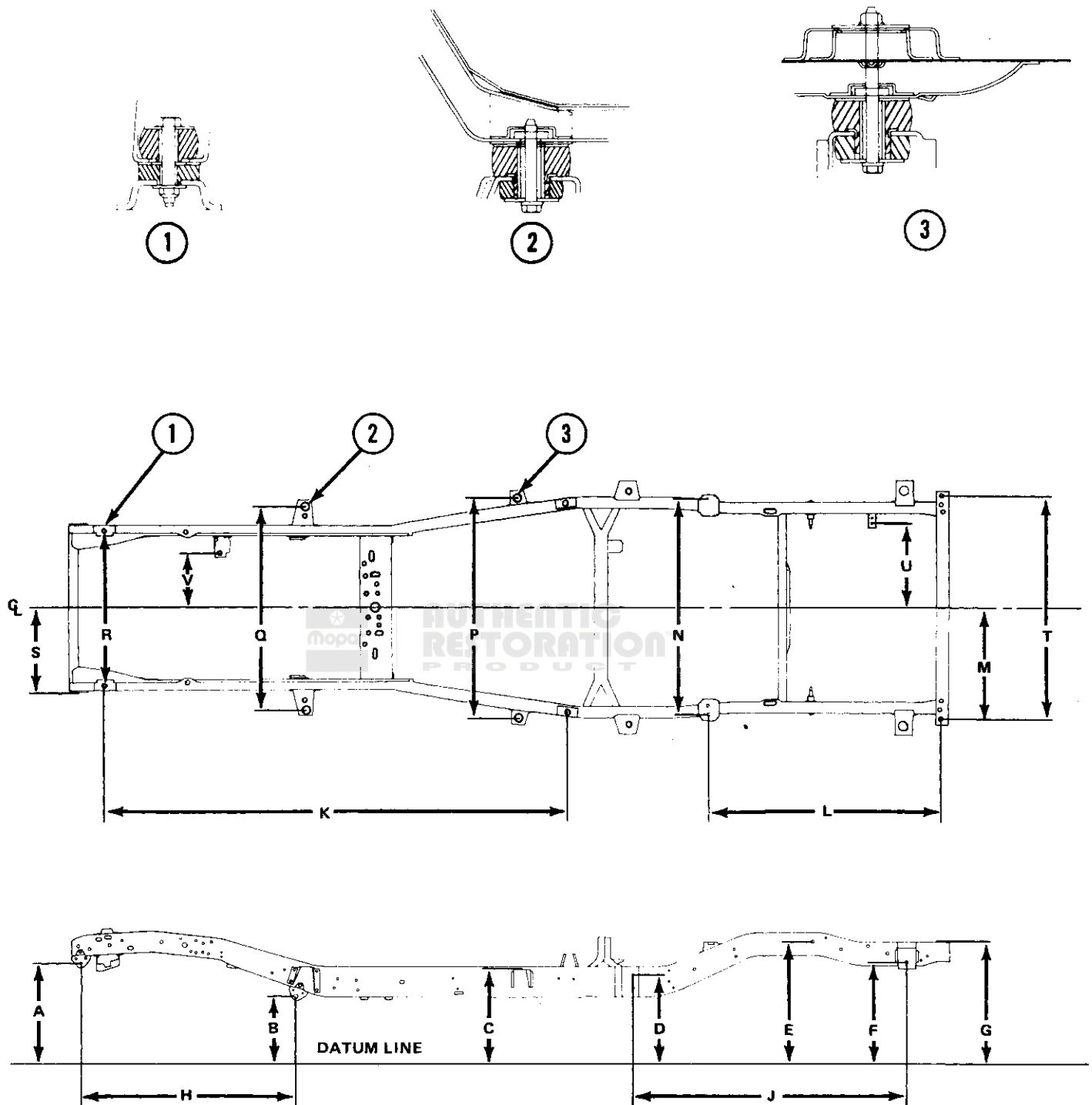
### 3F-4 BODY AND FRAME COMPONENTS



A -	12.05
B -	5.46
C -	10.60
D -	9.94
E -	16.17
F -	10.82
G -	14.03
H -	45.26
J -	57.25
K -	24.68
L -	69.00

M -	59.63
N -	46.76
P -	23.38
Q -	47.02
R -	17.88
S -	43.54
T -	45.88
U -	42.50
V -	11.52
W -	32.40
X -	35.22

Fig. 3F-3 Cherokee and Wagoneer Frame Dimensions (Inches)



A -	11.97	L -	48.79
B -	5.39	M -	23.38
C -	11.35	N -	45.72
D -	9.94	P -	45.92
E -	16.80	Q -	42.52
F -	12.55	R -	32.40
G -	16.78	S -	17.69
H -	45.23	T -	46.75
J -	57.22	U -	17.06
K -	96.80	V -	11.52

Fig. 3F-4 Truck Frame Dimensions-119 Inch Wheelbase (Inches)

### 3F-6 BODY AND FRAME COMPONENTS

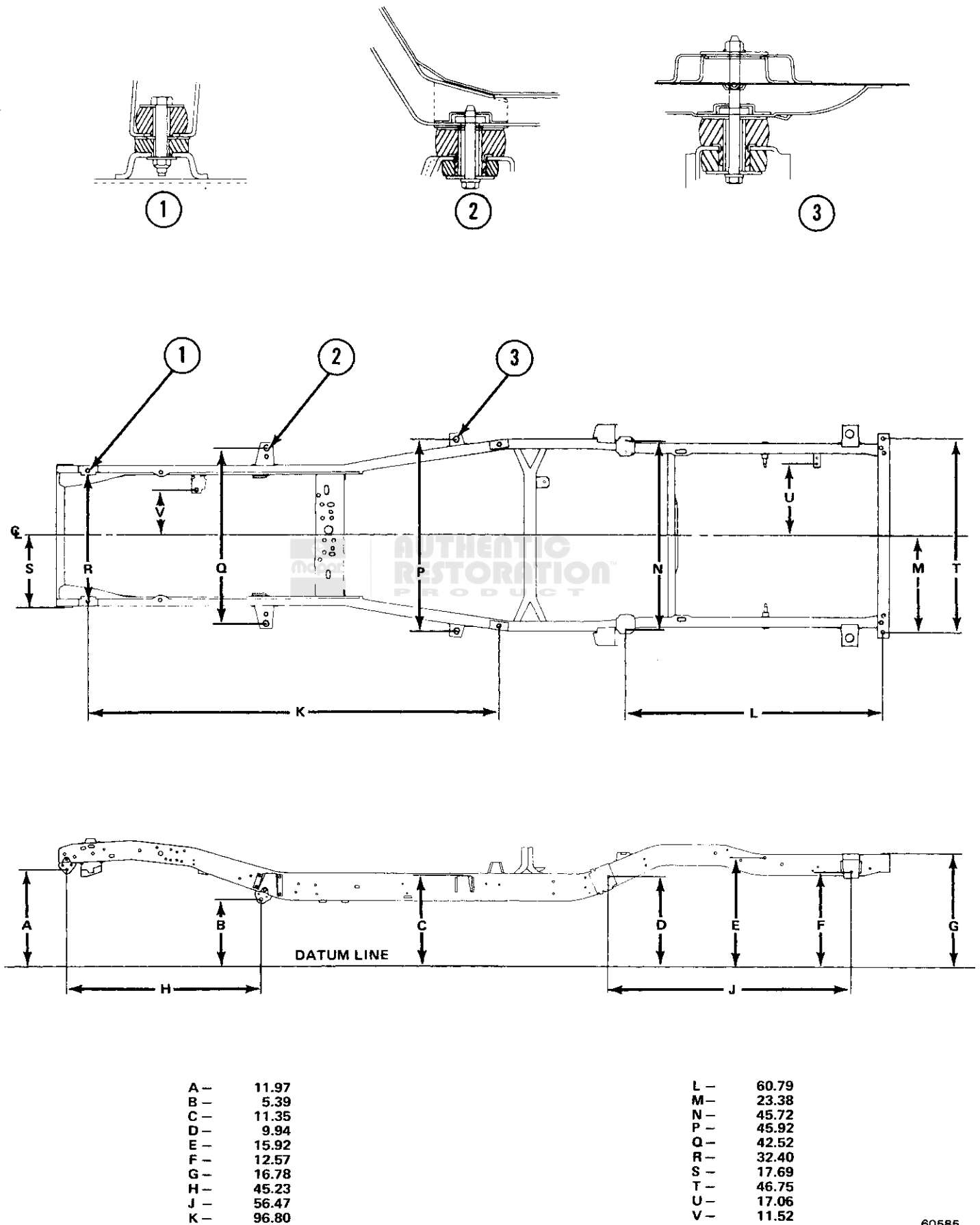


Fig. 3F-5 Truck Frame Dimensions-131 Inch Wheelbase (Inches)

## FRAME ALIGNMENT

The most efficient method of checking frame alignment is with a frame alignment machine.

**NOTE:** *The following procedure is adequate for checking most frame dimensions. However, if torsional twist or frame rail height is in question, the vehicle must be checked on an alignment machine using datum gauges. Follow alignment machine manufacturer's instructions.*

If a frame straightening machine is not available, frame alignment may be determined by using the "X" or diagonal method. Figures 3F-1 through 3F-5 provide all frame dimensions.

The most convenient method of checking frame dimensions is to locate with a plumb-bob and chalk mark on a level floor all dimensional points from which measurements are taken. This is known as "plumb-bobbing" the frame. If working on a cement floor, clean it so that the chalk marks will be visible underneath the frame. If working on a wooden floor, lay sheets of paper underneath the vehicle. Drop a plumb-bob from each point indicated in figures 3F-1 through 3F-5, marking the floor directly underneath the point. Satisfactory checking depends on the accuracy of the marks in relation to the frame.

To check points that have been marked, carefully move the vehicle away from the layout on the floor, and proceed as follows:

Check the frame at front and rear end using corresponding marks on the floor. If widths correspond to frame specifications, draw a centerline the full length of

the vehicle, halfway between the marks indicating front and rear widths. If frame width is not correct and the centerline cannot be laid out from checking points at the end of the frame, it can be drawn through intersections of any two pairs of equal dimensions.

With the centerline correctly laid out, measure the distance to several opposite points over the entire length of the frame. If the frame is in proper alignment, opposite measurement should be the same.

To locate the points at which the frame is sprung, measure the diagonals between selected points on the frame (fig. 3F-1 through 3F-5).

If the diagonals in each pair are within 1/8-inch, that part of the frame included between points of measurement may be considered as properly aligned. These diagonals should also intersect at the centerline. If the measurements do not agree within the above limits, it means that a frame alignment correction is necessary and will have to be made between those points that are not equal.

**NOTE:** *During the process of straightening the frame, be extremely careful not to overstretch the frame. This could cause the already aligned sections of the frame to become misaligned or weakened.*

## FRAME STRAIGHTENING

A bent or twisted frame may be straightened, provided the extent of misalignment is not excessive. Severely damaged frame parts should be replaced.

# PANELS

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Doors	3F-7	Radiator Grilles	3F-8
General	3F-7	Rear Quarter Panels	3F-8

## GENERAL

Assembled sections or any of the individual panels available for replacement are complete and may be installed as a unit. When only a portion of the unit is damaged, the damaged unit may be cut from the body at the location best suited for welding, and the new unit cut to the desired size and welded in place.

### Galvanized Panels

For protection against rust, panels vulnerable to corrosion on Cherokee, Wagoneer, and Truck vehicles are galvanized. A conversion coating must be applied to these panels prior to painting to ensure good adhesion of the paint.

## Replacement

Where replacement is required, careful examination should be made as to the extent of damage to determine which panels require replacement.

In most cases, the weld joints of one panel to another are visible and can be separated for installation of a new panel.

## DOORS

The complete door, with outer and inner door panels flanged and welded together and primed, is available as well as the outer panel only.

These outer panels may be used in cases in which the inner panel and pillar assemblies are not damaged to avoid the extra expense of using a complete door.

### REAR QUARTER PANELS

The rear quarter panels are welded to the body as indicated by dotted lines in figures 3F-6 through 3F-8.

Whenever a rear quarter panel is replaced, it is very important to apply a suitable rust preventive such as a weld primer to all mating surfaces prior to welding.

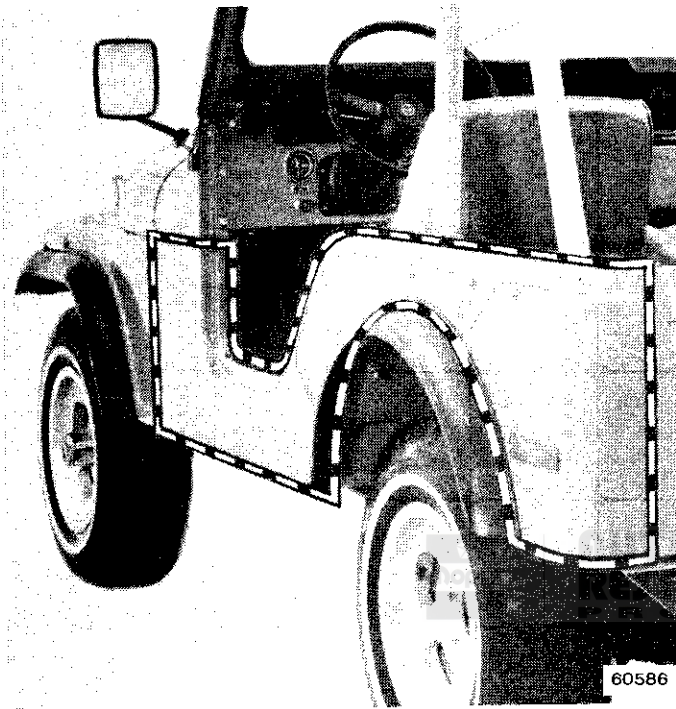


Fig. 3F-6 Rear Quarter Panel—CJ Models

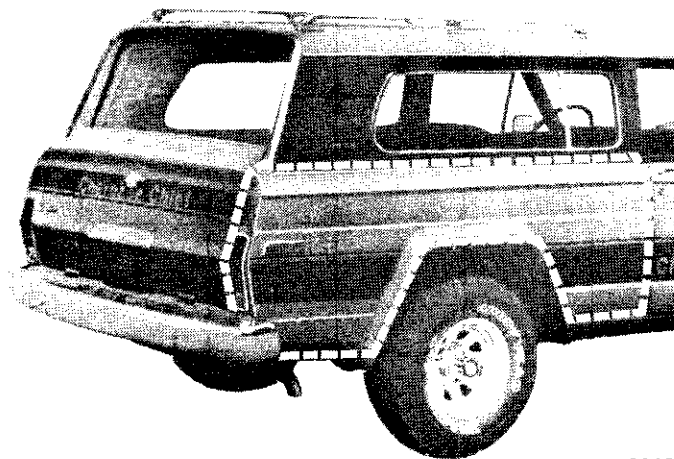


Fig. 3F-7 Rear Quarter Panel—2-Door Cherokee

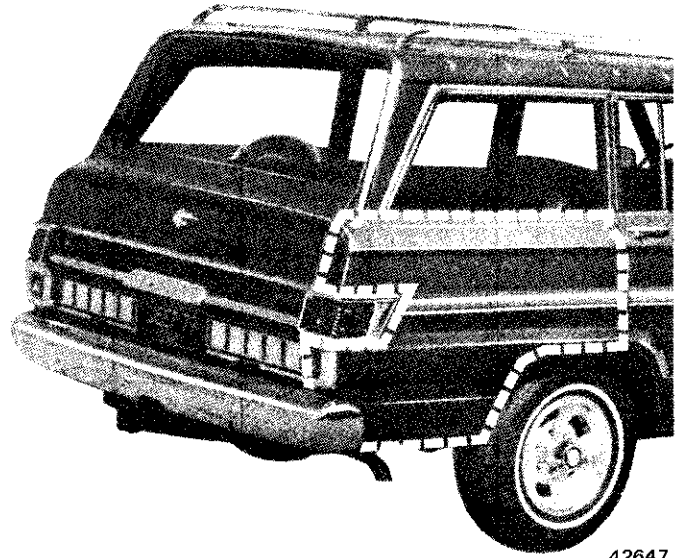


Fig. 3F-8 Rear Quarter Panel—Wagoneer (4-Door Cherokee Similar)

### RADIATOR GRILLES

#### CJ Models

The CJ grille and the support and baffle are welded together to form a maximum-strength radiator guard (fig. 3F-9).

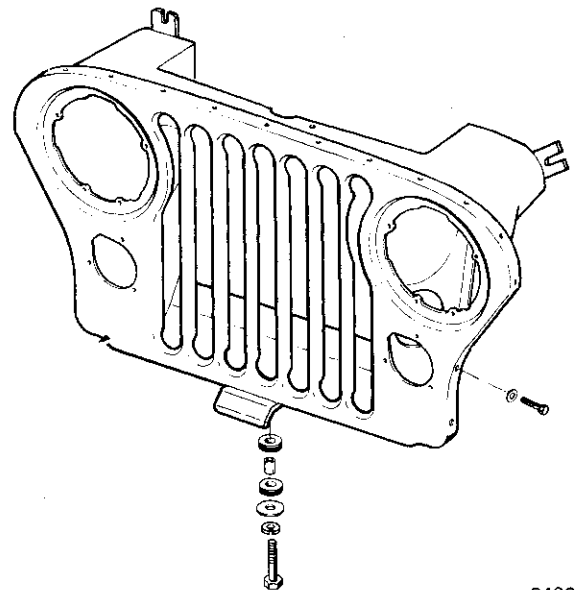


Fig. 3F-9 Grille Panel—CJ Models

#### Removal

- (1) Remove screws and washers attaching radiator and shroud to radiator guard panel.
- (2) Remove bolts and washers attaching guard panel to fenders.
- (3) Remove radiator grille to frame crossmember holddown assembly. Note sequence of parts.

- (4) Loosen nuts attaching two radiator support rods to radiator grille guard support brackets.
- (5) Remove rods from brackets.
- (6) Tilt guard panel forward and disconnect electrical wiring at head lamp sealed beam unit and parking lamp assembly wiring harness at connectors.
- (7) If equipped with air conditioning, proceed as follows:
  - (a) Discharge air conditioning system as outlined in Chapter 3E—Air Conditioning.
  - (b) Disconnect air conditioning high pressure line at condenser fitting. Cap line and condenser fittings to prevent entry of dirt and moisture.
- (8) Lift radiator guard panel from vehicle.

**Installation**

- (1) Position guard panel and connect electrical wiring at headlamp sealed beam unit and parking lamps.
- (2) If equipped with air conditioning, remove caps from fittings and connect line to condenser.
- (3) Position radiator support rods in radiator grille guard support brackets and install attaching hardware.

- (4) Install radiator grille to frame crossmember holddown assembly.
- (5) Position guard panel to fenders and install attaching bolts and washers.
- (6) Install radiator and radiator shroud to radiator guard panel attaching screws and washers.
- (7) If equipped with air conditioning, evacuate, leak test, and charge the system as outlined in Chapter 3E—Air Conditioning.

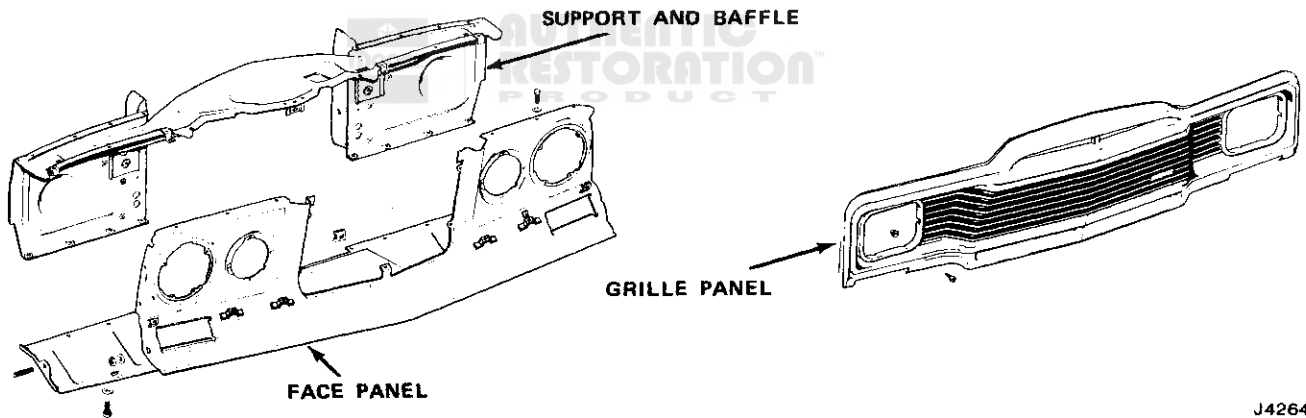
**Cherokee-Wagoneer-Truck Models**

**Removal**

- (1) Remove screws and washers attaching grille panel (fig. 3F-10).
- (2) Remove grille panel.

**Installation**

- (1) Position grille in body opening.
- (2) Install attaching screws and washers.



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**Fig. 3F-10 Grille Panel—Cherokee-Wagoneer-Truck**

**FENDERS**

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Cherokee-Wagoneer-Truck Models	3F-10
CJ Models	3F-9

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Fender Extensions	3F-10

**CJ MODELS**

**Replacement**

- (1) Remove or disconnect all items attached to apron of fender.
- (2) Disconnect electrical connector at side marker lamp.
- (3) Remove rocker panel moulding, if equipped.

- (4) Remove bolts and washers attaching fender and brace to dash panel (fig. 3F-12).
- (5) Remove bolts, washers, and nuts attaching fender to radiator grille guard panel.
- (6) Pull fender outboard and lift from vehicle.
- (7) Position fender on vehicle and install fender-to-radiator grille guard panel attaching bolts, washers, and nuts.



## 3F-10 BODY AND FRAME COMPONENTS

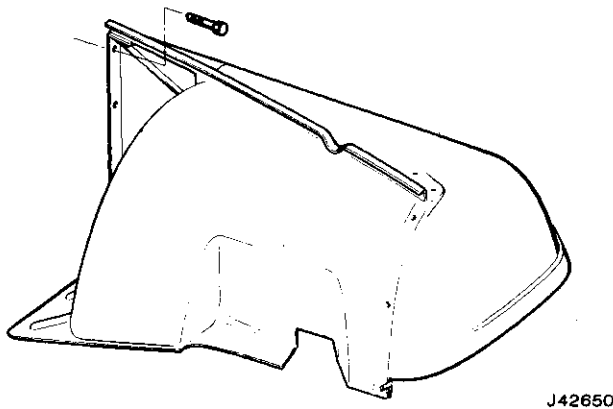


Fig. 3F-12 Front Fender—CJ Models

- (8) Install fender and brace-to-dash panel attaching bolts and washers.
- (9) Connect side marker lamp electrical connector.
- (10) Install and connect items previously removed from apron of fender.
- (11) Install rocker panel moulding, if equipped.

### CHEROKEE-WAGONEER-TRUCK MODELS

#### Removal

- (1) Remove front bumper.
- (2) Remove headlamp to gain access through opening.
- (3) Reach through headlamp opening and remove bolts and washers attaching fender to grille face panel.
- (4) Remove side marker lamp reflector lens and disconnect lamp socket assembly from lens.
- (5) Remove bolts and washers attaching fender to grille face panel.
- (6) Disconnect brace at fender (fig. 3F-13).

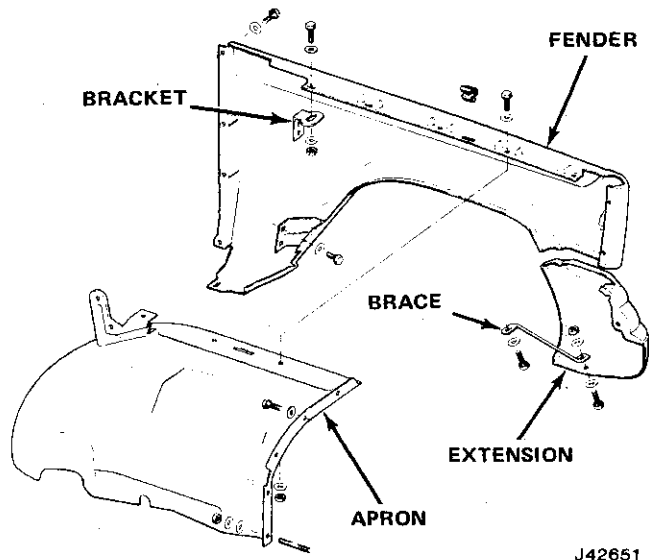


Fig. 3F-13 Front Fender—Cherokee-Wagoneer-Truck Models

(7) Remove bolts and washers attaching fender to rocker panel just below the hinge pillars.

(8) Remove bolts and washers attaching top of fender to fender apron, hood hinge support bracket, and fender-to-dash panel bracket.

**NOTE:** Note the number and position of shims between fender and rocker panels so they can be assembled in the same position.

- (9) Open doors and remove fender from vehicle.
- (10) Remove or disconnect all items attached to fender apron.
- (11) Remove bolts and washers attaching fender apron to radiator support and two brackets on firewall.

#### Installation

- (1) Spread sealer evenly over and along surfaces where fender and apron make metal-to-metal contact with other sheet metal parts.
- (2) Install apron and fender in place with finger-tightened bolts until all bolts and washers have been installed. Tighten all nuts and bolts.
- (3) Install and reconnect all items removed from fender and apron, such as wiring harness, electrical components.
- (4) Secure items, such as headlight, grille and front bumper, which were released or removed to facilitate removal of fender and apron.

### CJ FENDER EXTENSIONS

#### Removal

- (1) Remove screws attaching fender extension to fender (fig. 3F-14).
- (2) Remove extension from fender.

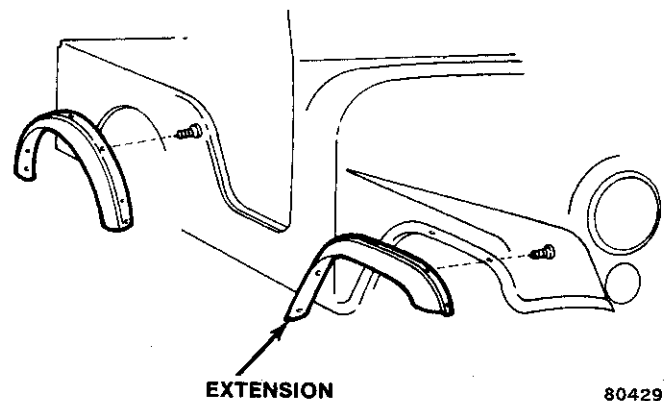


Fig. 3F-14 Fender Extension—CJ Models

#### Installation

- (1) Position fender extension on fender and align screw holes.
- (2) Install screws attaching fender extension to fender.

# BUMPERS

Page  
 Front Bumpers 3F-11  
 General 3F-11

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 Rear Bumpers 3F-12

## GENERAL

Front bumpers on CJ models are of one-piece construction. When vehicle is equipped with rear mounted spare, two separate bumperettes are used.

Front bumpers on the Cherokee, Wagoneer, and Truck models are one-piece chromed aluminum. Rear bumpers are the same construction and are used on the Cherokee and Wagoneer. Trucks, when equipped with a rear bumper, have a one-piece step bumper.

Front bumper guards are available as an option on standard bumpers on all models except CJ.

## FRONT BUMPERS

### CJ Models

#### Removal

(1) Remove nuts and bolts attaching front bumper rail (fig. 3F-15) to frame extensions.

(2) Remove front bumper rail from frame extensions.

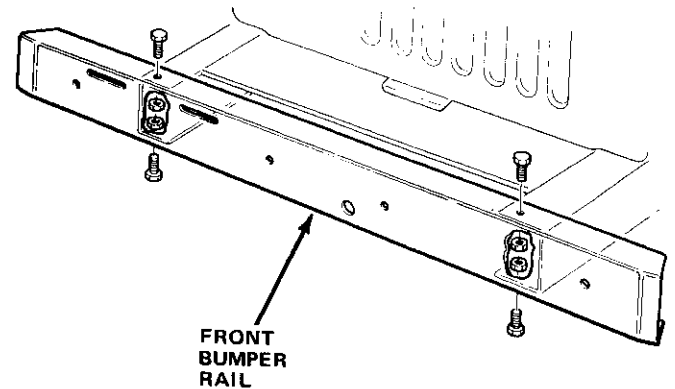


Fig. 3F-15 Front Bumper—CJ Models

#### Installation

- (1) Position front bumper rail on frame extension.
- (2) Install bolts and nuts attaching front bumper rail to frame extension.

### Cherokee-Wagoneer-Truck Models

#### Removal

- (1) Remove vertical bumper guard (fig. 3F-16) from bumper end rail, if equipped.

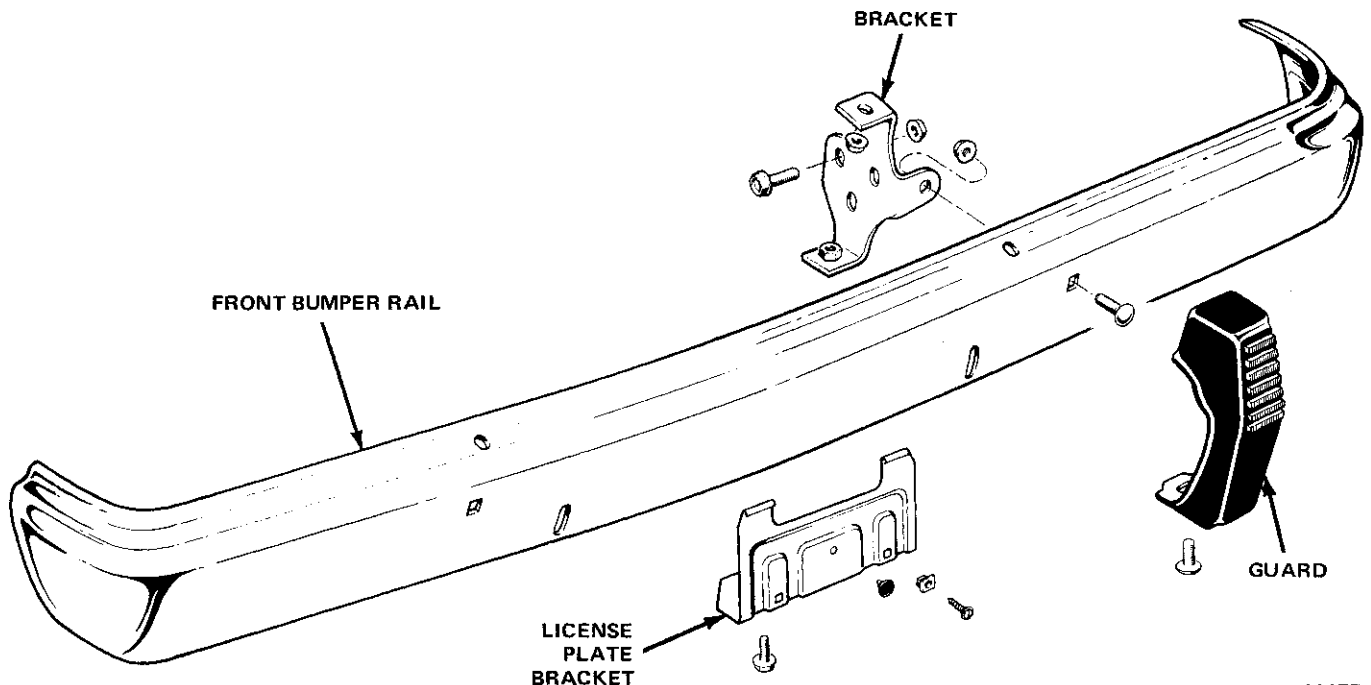


Fig. 3F-16 Front Bumper—Cherokee-Wagoneer-Truck Models

## 3F-12 BODY AND FRAME COMPONENTS

(2) Remove horizontal bumper guard from bumper end rail, if equipped.

(3) Remove nuts and bolts attaching bumper rail to frame mounted bumper brackets. Remove bumper rail from vehicle.

(4) Remove nuts and bolts attaching bumper brackets to vehicle frame. Remove brackets from vehicle frame.

### Installation

(1) Position brackets on vehicle frame and install attaching bolts and nuts.

**NOTE:** Do not tighten attaching hardware until complete bumper is assembled on vehicle frame and properly aligned.

(2) Position bumper rail on brackets and install attaching bolts and nuts.

(3) Align bumper assembly and tighten all attaching hardware.

(4) Install horizontal bumper guard, if equipped.

(5) Install vertical bumper guard, if equipped.

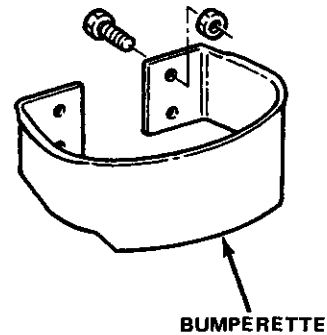
## REAR BUMPERS

### CJ Models

#### Removal

(1) Remove nuts and bolts attaching rear bumperettes (fig. 3F-17) to vehicle frame.

(2) Remove rear bumperettes from vehicle frame.



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Fig. 3F-17 Rear Bumperette—CJ Models

#### Installation

(1) Position rear bumperettes on vehicle frame.

(2) Install bolts and nuts attaching rear bumperettes to vehicle frame.

### Cherokee-Wagoneer

#### Removal

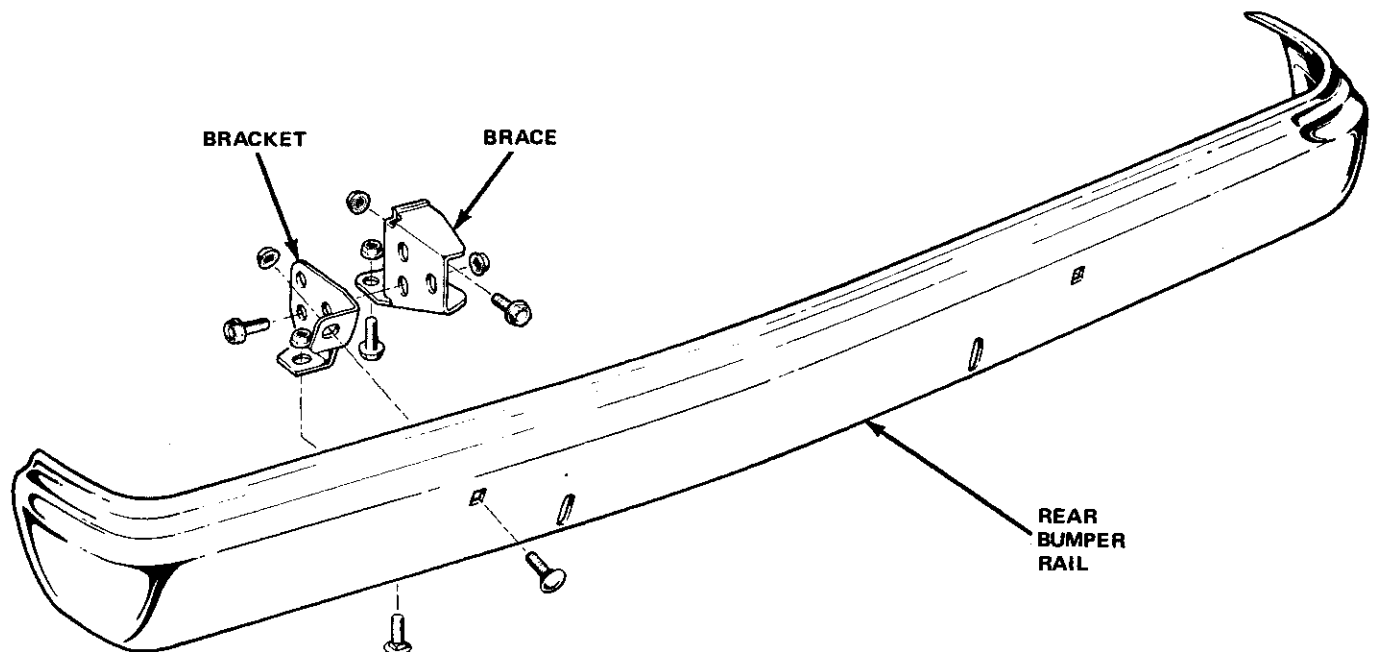
(1) Remove horizontal bumper guard (fig. 3F-18), from bumper end rail, if equipped.

(2) Remove nuts and bolts attaching bumper rails to bumper brackets.

(3) Remove bumper rail from vehicle.

(4) Remove nuts and bolts attaching brackets to vehicle frame.

(5) Remove brackets from vehicle frame.



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Fig. 3F-18 Rear Bumper—Cherokee-Wagoneer Models

**Installation**

(1) Position brackets on vehicle frame and install attaching bolts, washers and nuts.

**NOTE:** Do not tighten attaching hardware until complete bumper is assembled on vehicle frame and properly aligned.

(2) Position bumper rail on brackets and install attaching bolts and nuts.

(3) Align bumper assembly and tighten all attaching hardware.

(4) Install horizontal bumper guards on bumper end rails, if equipped.

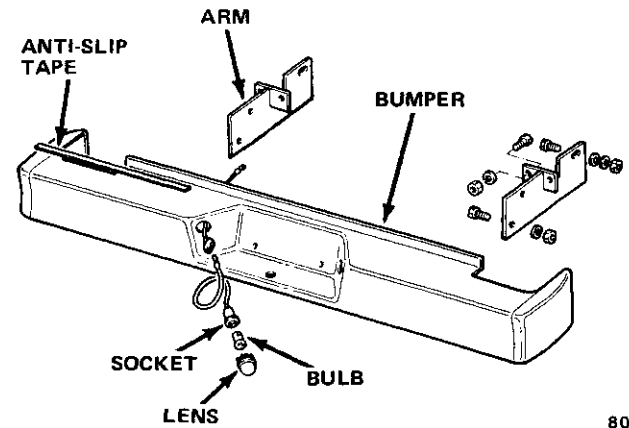


Fig. 3F-19 Rear Step Bumper—Truck Models

**Truck Models**

**Removal**

(1) Disconnect license lamp wiring (fig. 3F-19) from vehicle wiring.

(2) Remove nuts, washers and bolts attaching step bumper to arms.

(3) Remove step bumper from arms.

(4) Remove nuts, washers and bolts attaching arms to vehicle frame. Remove arms from vehicle.

**Installation**

(1) Position arms on vehicle frame and install attaching bolts, washers and nuts.

**NOTE:** Do not tighten attaching hardware until complete bumper is installed on vehicle frame and properly aligned.

(2) Position step bumper on arms and install attaching bolts, washers and nuts.

(3) Align bumper assembly and tighten all attaching hardware.

(4) Connect license lamp wiring to vehicle wiring.

# SWINGOUT SPARE TIRE CARRIERS

**CJ-7 MODELS**

**Removal**

(1) Remove spare tire from carrier (fig. 3F-20).

(2) Remove hinge pin nuts and bolts from upper and lower hinges.

(3) Unlatch handle from latch bracket and remove carrier and hinge spacer washers.

(4) Remove pin attaching latch handle to carrier and remove handle, spring and washer.

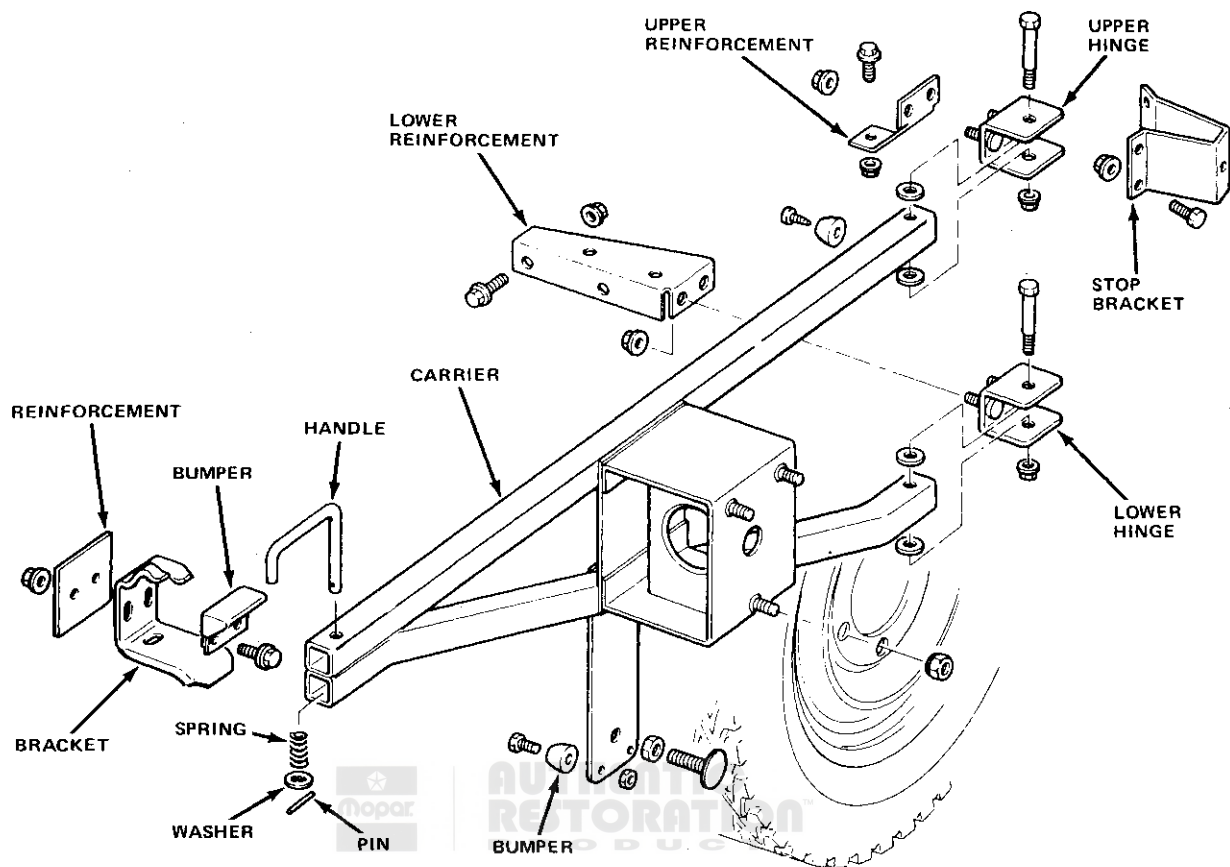
**Installation**

(1) Position spring, washer and handle in carrier and install attaching pin.

(2) Position hinge spacer washers and carrier in upper and lower hinges and latch handle in latch bracket.

(3) Install hinge pin bolts and nuts in upper and lower hinges.

(4) Install spare tire on carrier.



80426

Fig. 3F-20 Swingout Spare Tire Carrier—CJ-7 Models

## ROLL BARS

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CJ Models 3F-14

Page  
Truck Models 3F-14

### CJ MODELS

#### Removal

- (1) Remove padding from roll bar, if equipped.
- (2) Remove nuts, washers, reinforcements and bolts attaching bottom of roll bar angle to body (fig. 3F-21) using Torx Bit Tool J-25359-02.
- (3) Remove nuts, washers, spacers and bolts attaching side of roll bar angle to body using Torx Bit Tool J-25359-02.
- (4) Remove roll bar from body.

#### Installation

- (1) Position roll bar on body and align bolt holes with body.
- (2) Position spacers between body side panels and

roll bar bottom angle.

(3) Install bolts, washers and nuts attaching side of roll bar angle to body using Torx Bit Tool J-25359-02.

**NOTE:** Do not tighten attaching hardware until roll bar is completely installed and properly aligned.

(4) Install bolts, reinforcements, washers and nuts attaching bottom of roll bar angle to body using Torx Bit Tool J-25359-02.

(5) Align roll bar assembly and tighten all attaching hardware using Torx Bit Tool J-25359-02.

(6) Install padding on roll bar, if equipped.

### Truck Models

#### Removal

- (1) Remove off-road driving lamps from roll bar, if equipped.

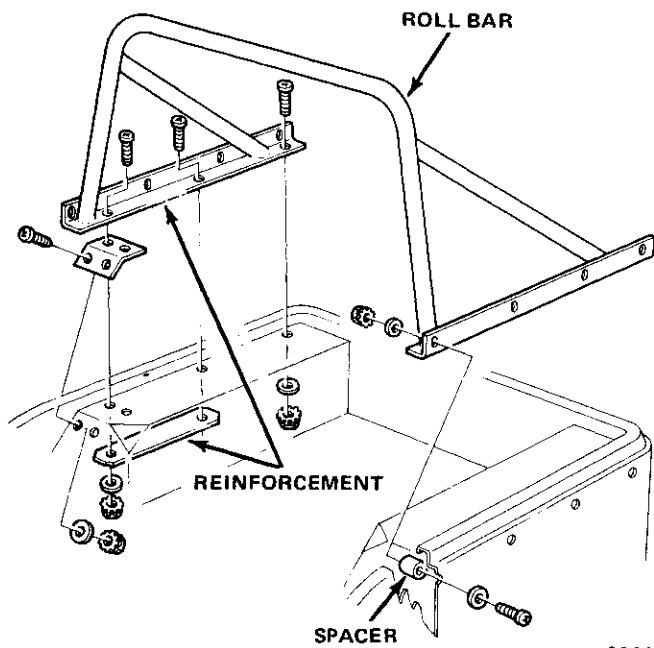


Fig. 3F-21 Roll Bar—CJ Models

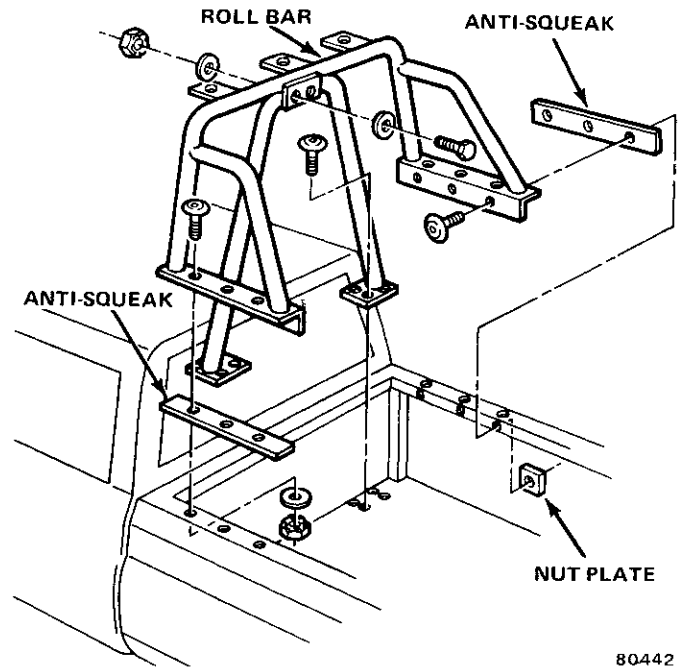


Fig. 3F-22 Roll Bar—Truck Models

(2) Remove CB radio antenna from roll bar, if equipped.

(3) Remove nuts, washers, bolts and nut plates (fig. 3F-22) attaching roll bar to side of pick up box, using Torx Bit Tool J-25359-02.

(4) Remove nuts, washers and bolts attaching roll bar to bed of pick up box, using Torx Bit Tool J-25359-02.

(5) Remove roll bar assembly and anti-squeak material from pick up box.

### Installation

(1) Position anti-squeak material and roll bar assembly on pick up box.

(2) Install bolts, washers and nuts attaching roll bar to bed of pick up box, using Torx Bit Tool J-25359-02.

**NOTE:** Do not tighten attaching hardware until roll bar is completely installed and properly aligned.

(3) Install bolts, washers, nuts and nut plates attaching roll bar to side of pick up box.

(4) Align roll bar assembly and tighten all attaching hardware using Torx Bit Tool J-25359-02.

(5) Install CB radio antenna on roll bar, if equipped.

(6) Install off-road driving lamps on roll bar, if equipped.

## BRUSH GUARDS

### CHEROKEE-TRUCK MODELS

#### Removal

(1) Remove bolts and washers attaching brush guard (fig. 3F-23) to frame rails.

(2) Remove nuts and bolts attaching brush guard to bumper bolts and remove brush guard.

#### Installation

(1) Position brush guard on bumper and install attaching bolts and nuts.

**NOTE:** Do not tighten attaching hardware until complete brush guard is assembled on vehicle and properly aligned.

(2) Install bolts and washers attaching brush guard to frame rails.

(3) Align brush guard assembly and tighten all attaching hardware.

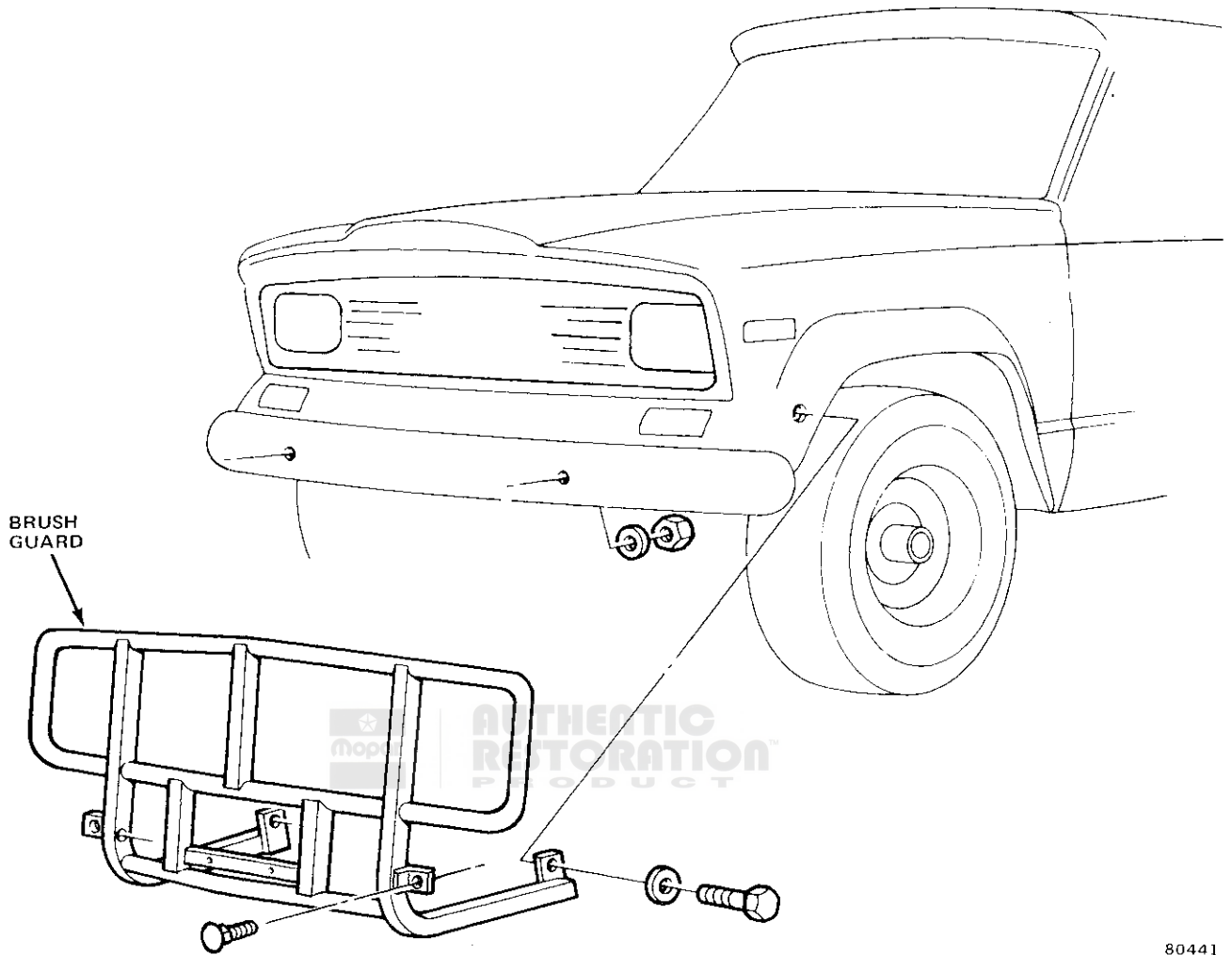
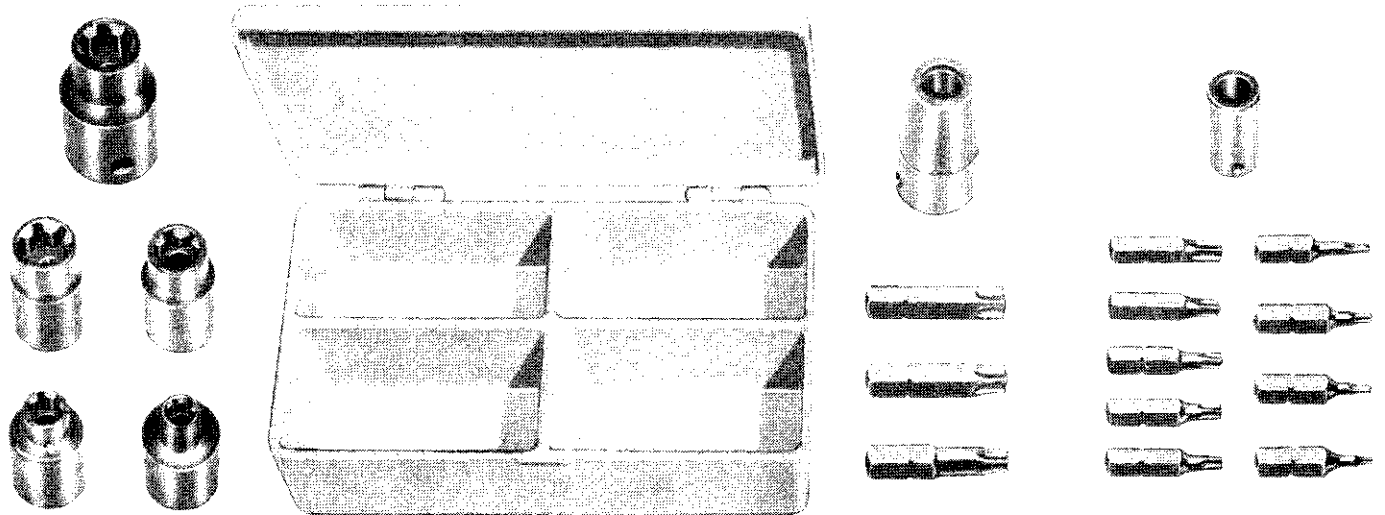


Fig. 3F-23 Brush Guard—Cherokee Truck Models

Tools



J-25359-02  
TORX BIT AND SOCKET SET

# HOODS

# 3G

## SECTION INDEX

	Page		Page
Hood Bumper	3G-3	Cherokee-Wagoneer-Truck Models	3G-1
Hood Lock	3G-3	CJ Models	3G-1

### CJ MODELS

#### General

The CJ hood consists of an outer flanged panel with inner U-channels welded at the front and rear of the hood panel.

#### Removal and Disassembly

- (1) Mark position of hinges on their respective mounting panels before removing hood.
- (2) Detach hood panel from hinges by removing attaching screws, lockwashers, and flat washers.
- (3) Disassembly of CJ hood is accomplished by removing hood prop rod, hood prop rod retainer clip, hood side catch brackets, footman loop, and windshield bumpers (fig. 3G-1).

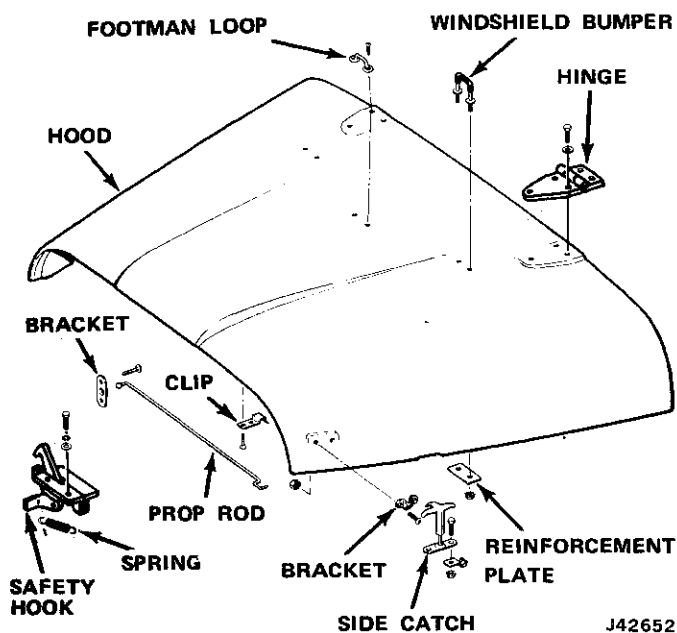


Fig. 3G-1 Hood and Related Parts—CJ Models

#### Assembly and Installation

- (1) Finger-tighten related component parts and assemblies to hood panel.
- (2) Position hood panel assembly and align hinges with scribe marks on the respective mounting panels. Torque all attaching screws.
- (3) Check hood alignment. Adjust if necessary.

#### Alignment

The hood hinge mounting holes are oversized to permit adjustment when aligning the hood.

**NOTE:** If the hood must be moved to either side, the hood lock striker, hood lever lock, and safety hook assembly, according to vehicle model, must first be loosened.

- (1) Loosen hinge mounting screws slightly on one side and tap hinge in opposite direction hood is to be moved.
- (2) Tighten screws.
- (3) Repeat procedure on opposite hinge.
- (4) Hook lock striker, hook lever lock, and safety hook assembly must be adjusted to ensure positive locking.
- (5) Shim between hinge and hood with caster and camber shims or flat washers at the rear screw if hood is low in relation to the cowl top.
- (6) Shim at the front screw if the hood is too high at the cowl.

### CHEROKEE-WAGONEER-TRUCK MODELS

#### General

The Cherokee, Wagoneer, and Truck hood consists of an outer flanged panel with reinforcements welded at front, rear and both sides.



## 3G-2 HOODS

### Removal and Disassembly

- (1) Mark position of hinges on their respective mounting panels before removing hood.
- (2) Detach hood panel from hinges by removing attaching screws, lockwashers, and flat washers.
- (3) Disassembly of hood is accomplished by removing hood lever lock assembly, left and right hood panel brace rods, and insulation pad (Cherokee and Wagoneer) cemented to the hood panel (fig. 3G-2).

### Assembly and Installation

- (1) Finger-tighten related component parts and assemblies to hood panel.
- (2) If Cherokee or Wagoneer hood panel insulation pad has been removed, clean off all loose cement and pad particles from panel to ensure good adhesion when recemented.

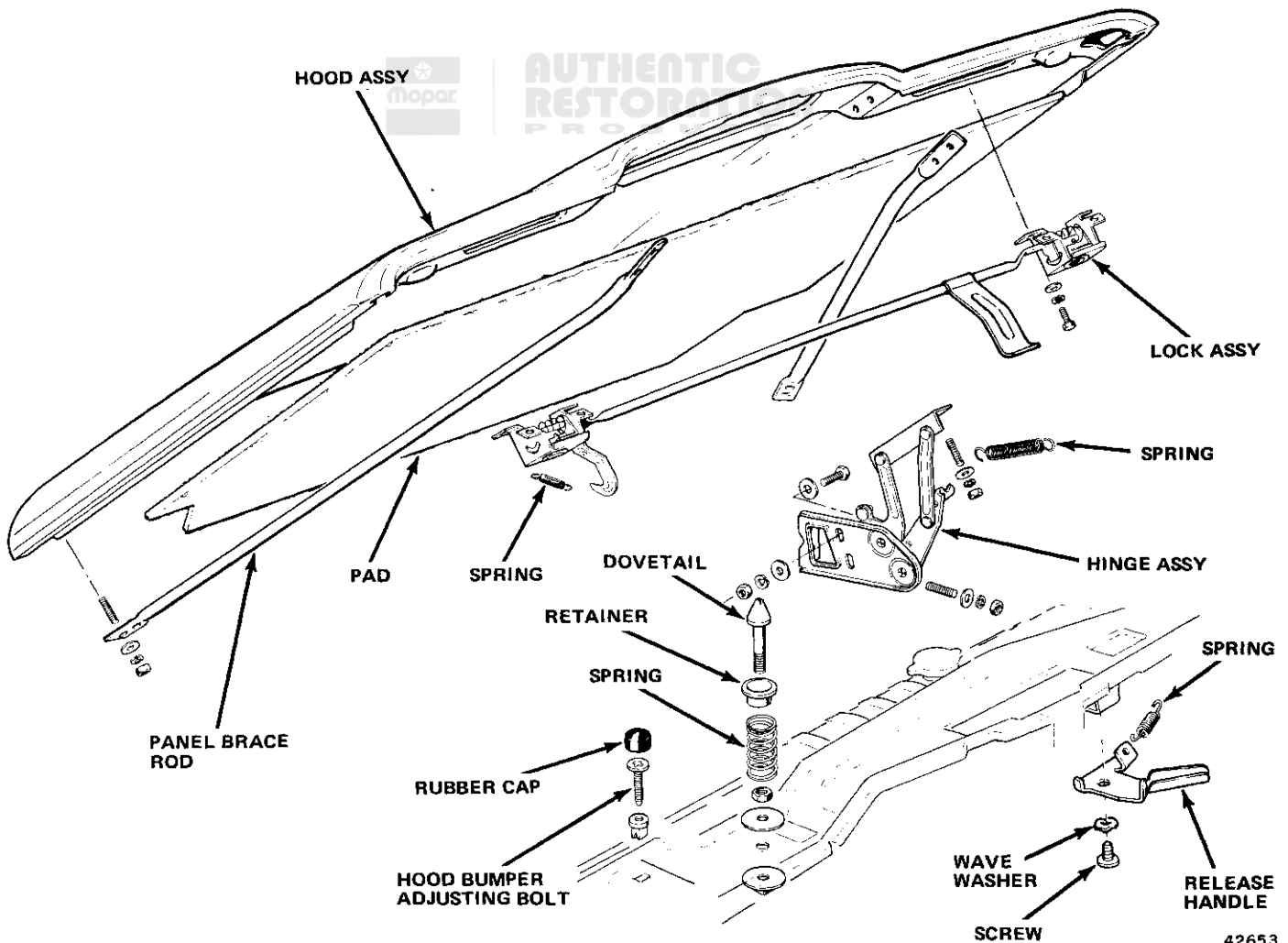
- (3) Position hood panel assembly and align hinges with scribe marks on the respective mounting panels. Torque all attaching screws.
- (4) Check hood alignment. Adjust if necessary.

### Alignment

The hood hinge mounting holes are oversized to permit adjustment when aligning the hood.

**NOTE:** If the hood must be moved to either side, the hood lock striker, hood lever lock, and safety hook assembly, according to vehicle model, must first be loosened.

- (1) Loosen hinge mounting screws slightly on one side and tap hinge in opposite direction hood is to be moved.
- (2) Tighten screws.
- (3) Repeat procedure on opposite hinge.



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Fig. 3G-2 Hood and Related Parts—Cherokee-Wagoneer-Truck Models

(4) Hook lock striker, hook lever lock, and safety hook assembly must be adjusted to ensure positive locking.

(5) Shim between hinge and hood with shims or flat washers at the rear screw if hood is low in relation to the cowl top.

(6) Shim at the front screw if the hood is too high at the cowl.

## HOOD LOCK

### CJ Models

The CJ hood is secured to the front fenders by two hood retaining latches. To release, pull the latches straight up and turn slightly at the end of travel. The hood now may be raised with the release of the safety catch by inserting fingers between the grille bars to the right of center and by pulling to the left on the catch. To

secure the hood in the raised position, remove the support bar from its retaining clip and insert the free end into the support bar bracket.

### Cherokee-Wagoneer-Truck Models

The hood lock and safety catch incorporates a release system, whereby the release lever operates the hood lock and the safety catch.

The hood lock release latch is located in upper horizontal opening at center of grille. To release the latch, rotate release lever and lift hood while holding lever in the released position.

### HOOD BUMPER

The hood bumpers on CJ Models are located across the top of the radiator grille guard and are not adjustable.

The hood bumpers on the Cherokee, Wagoneer, and Truck are adjustable. Rubber caps must be removed to adjust the bumper screws.



AUTHENTIC  
RESTORATION  
PRODUCTS



# LIFTGATES - TAILGATES

# 3H

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## CJ-7 LIFTGATES

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Hinge System	3H-3	Sealing System	3H-1
Liftgate Installation	3H-3	Support System	3H-3
Lock System	3H-2	Window System	3H-1

### SEALING SYSTEM

#### Rubber Sealer

The liftgate rubber sealer is made of molded latex foam with a smooth rubber skin on the outside.

Plastic retainers are used to retain the rubber sealer to the liftgate. Barbs on the retainers depress when inserted in the holes and spread when fully inserted.

#### Maintenance of Rubber Sealers

Cold weather may cause the rubber sealer to harden and lose resiliency. This may cause the liftgate to loosen in its opening, resulting in noise. When servicing, use a dampened cloth to clean rubber sealer. Clean dirt from all points where rubber sealer contacts the molded top and tailgate. Apply AMC Silicone Lubricant, or equivalent, to rubber sealer.

**CAUTION:** Do not use graphite, brake fluid, or wax on rubber sealer.

#### Replacement

Replacement rubber sealers are coated with powder to prevent stickiness in storage. Remove all powder with a dampened cloth before installation.

- (1) Carefully remove rubber sealer from liftgate,

using needlenose pliers to remove plastic retainers from liftgate panel holes.

- (2) Remove dust, dirt and old sealer from rubber sealer, liftgate and enclosure.

- (3) Install lower corner of sealer to liftgate first.

- (4) Press retainers, starting at lower edge of liftgate, into liftgate panel holes.

- (5) Apply a bead of 3M Auto Joint and Seam Sealer, or equivalent, around perimeter of liftgate between rubber sealer and liftgate flange to prevent water from passing seal and entering vehicle.

### WINDOW SYSTEM

#### Replacement

- (1) Unlock rubber weatherstrip (fig. 3H-1) using wood wand or fiber stick.

- (2) Use fiber stick to break seal between glass and rubber weatherstrip.

- (3) Push glass and weather strip toward outside of vehicle. Remove glass.

- (4) Remove weatherstrip from liftgate opening.

- (5) Inspect weatherstrip and clean sealer from glass cavity and flange cavity.

**NOTE:** Inspect for uneven surfaces or irregularities in the opening flange that could cause stress damage to the glass.

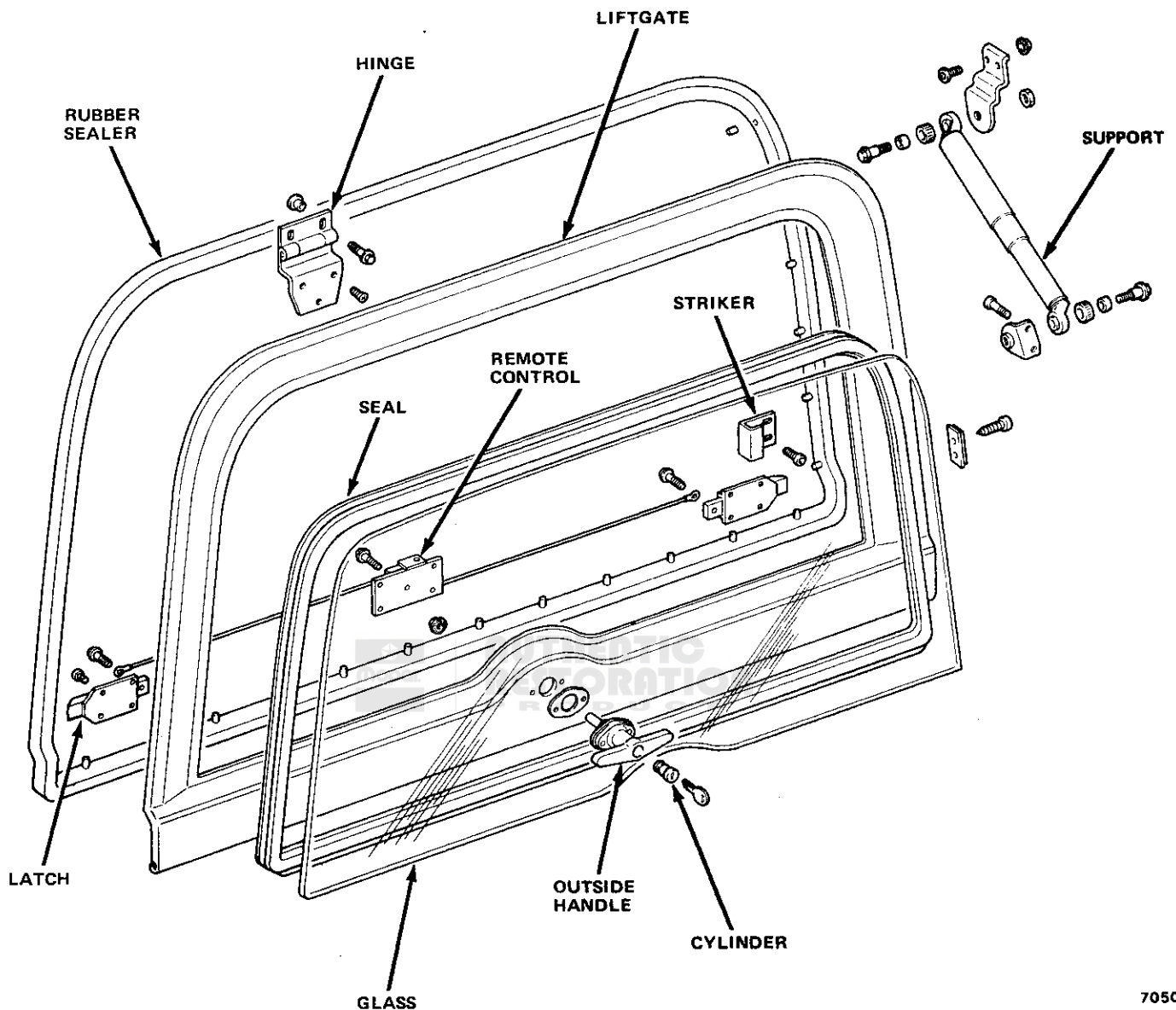


Fig. 3H-1 Liftgate Components

70509

(6) Before installing weatherstrip on flange, apply a 3/16-inch bead of 3M Auto Bedding and Glazing Compound, or equivalent, in weatherstrip flange cavity using a pressure-type applicator.

(7) Install weatherstrip on liftgate opening flange.

(8) Apply a liberal amount of liquid soap solution to glass cavity of weatherstrip.

(9) Position glass into upper glass cavity and into each side. Position wooden wand under glass and lift up and into lower cavity. Check for equal side clearance.

(10) Use wooden wand to lock weatherstrip.

**NOTE:** Soap solution should be removed from the weatherstrip and glass before installing sealer.

(11) Using a pressure-type applicator, apply 3M Windshield Sealer, or equivalent, between weatherstrip and glass on outside of glass around entire perimeter.

### LOCK SYSTEM

#### Outside Handle Replacement

(1) Remove screws attaching remote control to liftgate using Torx Bit Tool J-25359-02.

(2) Remove nuts attaching outside handle to liftgate and remove handle.

**NOTE:** The replacement outside handle is furnished without the lock cylinder. The lock cylinder is furnished un-coded without keys.

(3) Code existing door lock key to replacement cylinder.

(a) Insert key in replacement cylinder.

(b) File tumblers until flush with cylinder body.

(c) Remove and install key, and check that tumblers are flush with body.

(d) Install cylinder in replacement outside handle.

(4) Position outside handle in liftgate and install attaching nuts.

(5) Position remote control on liftgate and install attaching screws using Torx Bit Tool J-25359-02.

### Remote Control Replacement

(1) Loosen screws attaching remote control cables to latch. Disconnect cables from screws.

(2) Remove screws attaching remote control (fig. 3H-1) to liftgate using Torx Bit Tool J-25359-02.

(3) Position remote control on liftgate and install attaching screws using Torx Bit Tool J-25359-02.

(4) Connect remote control cables to latch screws and tighten screws.

### Latch Replacement

(1) Loosen screw attaching remote control cable to latch. Disconnect cable from screw.

(2) Remove screws attaching latch (fig. 3H-1) to liftgate using Torx Bit Tool J-25359-02. Remove latch.

(3) Position latch on liftgate and install attaching screws using Torx Bit Tool J-25359-02.

(4) Connect remote control cable to latch screw and tighten screw.

### Striker Adjustment

The strikers provide durable retention points for the latches and prevent movement of the liftgate. Strikers may be moved in or out to compensate for body and enclosure variations. Use Torx Bit Tool J-25359-02 for removal and adjustment.

## SUPPORT SYSTEM

### Replacement

(1) Open liftgate, support to prevent closing, and remove lockpins from support attaching screws.

(2) Remove screws attaching supports and remove supports.

(3) Install supports and attaching screws.

(4) Install lockpins on support attaching screws.

## HINGE SYSTEM

### Replacement

(1) Open liftgate, support to prevent closing, and remove lockpins from liftgate support attaching screws.

(2) Remove screws attaching supports to liftgate and fold supports downward.

**WARNING:** *Never remove supports with liftgate closed. The supports are under spring tension and may cause damage or personal injury if removed with liftgate closed. After removal, do not attempt to dismantle or repair the supports.*

(3) Using Torx Bit Tool J-25359-02, remove screws attaching hinge to liftgate.

(4) Using Torx Bit Tool J-25359-02, remove screws attaching hinge to enclosure. Remove hinge from enclosure.

(5) Clean replacement hinge in a suitable solvent and blow dry with compressed air.

(6) Color-coat hinge to match enclosure.

(7) Lubricate hinge with 3M 4-Way Spray lubricant, or equivalent.

(8) Position hinge on enclosure and install attaching screws, using Torx Bit Tool J-25359-02.

(9) Position liftgate on hinge and install hinge-to-liftgate attaching screws using Torx Bit Tool J-25359-02.

(10) Position supports on liftgate and install attaching screws.

(11) Install lockpins on support attaching screws.

### LIFTGATE REMOVAL

(1) Open liftgate, support to prevent closing, and remove lockpins from liftgate support attaching screws.

(2) Remove screws attaching supports to liftgate and fold supports downward.

**WARNING:** *Never remove supports with liftgate closed. The supports are under spring tension and may cause damage or personal injury if removed with liftgate closed. After removal, do not attempt to dismantle or repair the supports.*

(3) Using Torx Bit Tool J-25359-02, remove screws attaching hinges to liftgate and remove liftgate.

### LIFTGATE INSTALLATION

(1) Position liftgate on hinges and install hinge-to-liftgate attaching screws using Torx Bit Tool J-25359-02.

(2) Position supports on liftgate and install attaching screws

(3) Install lockpins on support attaching screws.

### LIFTGATE ALIGNMENT

(1) Open liftgate, support to prevent closing, and remove lockpins from liftgate support attaching screws (fig. 3H-1).

(2) Remove screws attaching supports to liftgate and fold supports downward.

**WARNING:** *Never remove supports with liftgate closed. The supports are under spring tension and may cause damage or personal injury if removed with liftgate closed. After removal, do not attempt to dismantle or repair the supports.*

(3) Using Torx Bit Tool J-25359-02, remove screws attaching latches to liftgate.

**NOTE:** *Do not disconnect remote control cables from latches.*

(4) Loosen screws, using Torx Bit Tool J-25359-02, attaching hinges.

## 3H-4 LIFTGATES—TAILGATES

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(5) Close liftgate and shift liftgate to obtain desired gap (side-to-side).

(6) Open liftgate and tighten hinge-to-liftgate screws using Torx Bit Tool J-25359-02.

(7) Position latches on liftgate and install attaching

screws using Torx Bit Tool J-25359-02.

(8) Position supports on liftgate and install attaching screws.

(9) Install lockpins on support attaching screws.

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# CJ-5 TAILGATE

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## GENERAL

The hinged tailgate is held in the closed, up position with hooks which pass through slotted brackets on the tailgate and on the body. The hinges are designed in such a way that the tailgate can be removed easily. The body half of the hinge is slotted and the tailgate half has a matching flat surface. However, to prevent accidental dropping of the tailgate, the flat surface on the left hinge pin is not in line with the flat surface on the right hinge pin.

## REMOVAL

(1) Rotate tailgate approximately 45 degrees from full up position and disengage right hinge.

(2) Rotate tailgate an additional few degrees and then disengage left hinge.

## INSTALLATION

(1) Hold tailgate at approximately 45 degrees from full up position and engage right hinge.

(2) Rotate tailgate an additional few degrees and then engage left hinge.

## ADJUSTMENT

(1) Loosen hinge attaching bolts and slide body half of hinge up, down, or to the side as needed.

(2) Tighten bolts.

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# CJ-7 TAILGATE

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## GENERAL

The tailgate is hinged at the bottom and held in the closed up position with dual latches. The tailgate is supported in the open position by two steel cables.

## REMOVAL

(1) Remove screws and wave washers attaching support cables to tailgate.

(2) With tailgate closed, remove screws attaching hinges to tailgate using Torx Bit Tool J-25359-02. Disengage latches and remove tailgate.

## INSTALLATION

(1) Position and align tailgate in body opening and engage latches.

(2) Install hinge attaching screws using Torx Bit Tool J-25359-02.

(3) Position support cables on tailgate and install attaching screws and wave washers.

## ADJUSTMENT

(1) Loosen hinge-to-body attaching screws and align tailgate to body opening.

(2) Tighten hinge attaching screws.

## HINGE REPLACEMENT

(1) Remove all hinge attaching screws using Torx Bit Tool J-25359-02 and remove hinge.

(2) Clean replacement hinge in a suitable solvent and blow dry with compressed air.

(3) Paint hinge to match body with Jeep exterior spray paint.

(4) Lubricate hinge with 3M 4-Way Spray lubricant or equivalent.

(5) Position hinge on body and tailgate and install attaching screws using Torx Bit Tool J-25359-02.

## RUBBER SEALER

The tailgate rubber sealer is made of molded latex foam with a smooth rubber skin on the outside.

Plastic retainers are used to retain the rubber sealer to the tailgate. Barbs on the retainers depress when inserted in the holes and spread when fully inserted.

## Maintenance of Rubber Sealers

Cold weather may cause the rubber sealer to harden and lose resiliency. This may cause the tailgate to loosen in its opening, resulting in noise. When servicing, use a dampened cloth to clean rubber sealer. Clean dirt from all points where the rubber sealer contacts the body. Apply AMC Silicone Lubricant or equivalent to rubber sealer.

**CAUTION:** Do not use graphite, brake fluid, or wax on rubber sealer.

## Replacement

Replacement rubber sealers are coated with powder to prevent stickiness in storage. Remove all powder with a dampened cloth before installation.

(1) Carefully remove rubber sealer from tailgate using needle-nose pliers to remove plastic retainers from tailgate panel holes.

(2) Remove dust and dirt from rubber sealer, tailgate, and body.

(3) Install lower corner of rubber sealer to tailgate first.

(4) Press plastic retainers into tailgate panel holes.

# CHEROKEE - WAGONEER TAILGATES

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## GENERAL

The tailgate is a horizontally hinged unit equipped with a manual or electrically operated window regulator. An access hole in the inner panel is for installing and servicing the window regulator and latch assemblies (fig. 3H-2).

The torque rods serve to counterbalance and assist in opening as well as closing the tailgate.

Tailgate hinges are accessible at the body side of the hinge for easier adjustment or replacement.

Tailgate weatherseal is body-mounted for better wind and water-leak resistance.

## ADJUSTMENT

Tailgate adjustment is similar to side door adjustments; proper alignment is obtained by changing the position of the hinges relative to the body and tailgate. On models equipped with carpeting, remove carpeting to gain access to hinge cover plates. Cherokee and Wagoneer vehicles have hinge cover plates in the body floor and tailgate for easy access to hinge screws (fig. 3H-2). The dovetail assemblies, which stabilize the tailgate and function as an overslam bumper, are adjusted by bringing the dovetail studs into alignment with the dovetail cap. The dovetail studs are located on the body pillars near the striker plates, and are adjustable. The dovetail caps are located on the tailgate and are nonadjustable.

## Hinges

(1) Remove dovetail studs from body pillars.

(2) If equipped with carpeting, remove carpeting to gain access to hinge cover plates.

(3) Remove two body hinge cover plates.

(4) Loosen screws attaching hinges to body and adjust floating plates until lower portion of tailgate closes flush or underflush with body sheet metal to ensure proper compression of weatherseal. Tighten hinge screws to 15 to 20 foot-pounds (20 to 27 N•m) torque.

(5) Install body hinge cover plates and carpeting, if equipped.

(6) Install and adjust dovetail studs.

## Dovetail Assemblies

(1) Loosen dovetail stud locking nuts.

(2) Close tailgate into locks.

(3) Adjust dovetail studs, using Torx Bit Tool J-25359-02, into dovetail caps and tighten stud locking nuts.

(4) Check tailgate for proper alignment and adjustment. Be sure tailgate latches properly with strikers and dovetails align into caps.

## Striker Assemblies

(1) Loosen dovetail stud locking nuts.

(2) Latch teeth should be aligned and nest in the center of the strikers.



### 3H-6 LIFTGATES—TAILGATES

(3) Add or remove striker shim to obtain this adjustment.

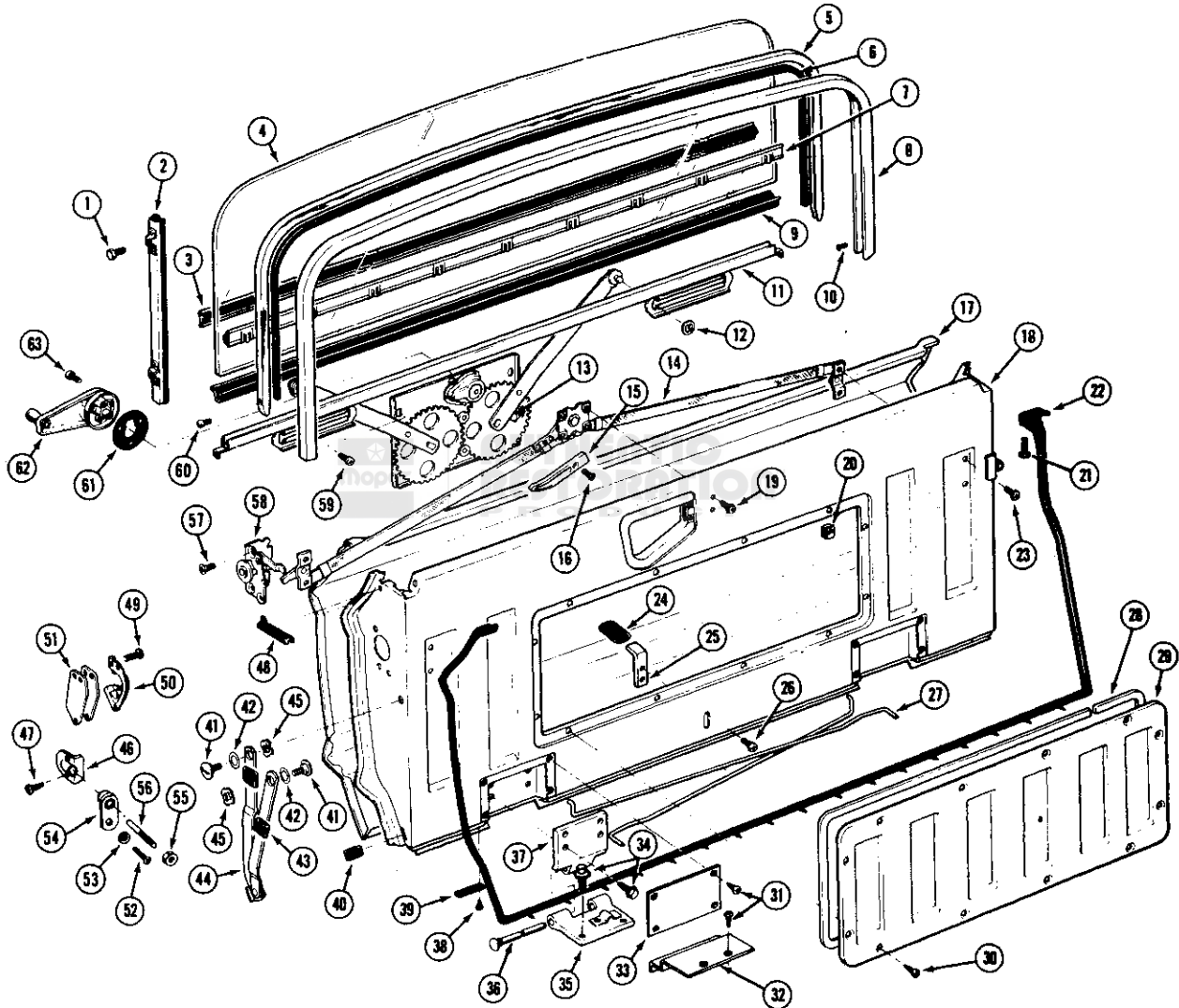
(4) Adjust strikers so latches enter the strikers freely and tailgate provides a flush fit with adjacent panels.

(5) Perform dovetail assemblies adjustment.

### HINGE REPLACEMENT

(1) Open tailgate. If vehicle is equipped with cargo area floor covering, remove mouldings and place floor covering aside.

(2) Remove access hole cover plates from body and tailgate.



1. Hexagon Screw
2. Lower Channel
3. Weatherstrip
4. Tailgate Glass
5. Run Channel
6. Upper Cushion
7. Weatherstrip
8. Glass Frame
9. Channel Sealer
10. Tapping Screw
11. Bottom Channel
12. Stud Retainer
13. Window Regulator
14. Remote Control
15. Release Handle
16. Oval Head Screw

17. Outer Panel
18. Tailgate
19. Machine Screw
20. Speed Nut
21. Plastic Rivet
22. Tailgate Sealer
23. Machine Screw
24. Bracket Bumper
25. Stop Bracket
26. Machine Screw
27. Torque Rod
28. Cover Gasket
29. Access Cover
30. Tapping Screw
31. Tapping Screw
32. Cover Plate

33. Cover Plate
34. Hinge Screw
35. Body Half Hinge
36. Hinge Pin
37. Tailgate Half Hinge
38. Plastic Rivet
39. Dust Seal
40. Arm Bumper
41. Shoulder Bolt
42. Spring Washer
43. Arm Sleeve
44. Support Arm
45. Lock Washer
46. Dovetail Cap
47. Tapping Screw
48. End Cap

49. Machine Screw
50. Tailgate Striker
51. Striker Shim
52. Machine Screw
53. Lock Washer
54. Tailgate Dovetail
55. Hexagon Nut
56. Dovetail Stud
57. Machine Screw
58. Tailgate Latch
59. Machine Screw
60. Machine Screw
61. Handle Gasket
62. Regulator Handle
63. Machine Screw

J41006

Fig. 3H-2 Tailgate With Manual Regulator—Cherokee-Wagoneer Models

(3) Raise tailgate to vertical position to unload counterbalance torque rods, and pry rods from clip welded to body half of hinge.

(4) Using a wax pencil, mark outline of existing hinge(s) on body and tailgate for reference.

(5) Support tailgate in horizontal position, remove screws attaching hinge(s), and remove hinge(s).

(6) Clean replacement hinges in a suitable solvent and blow dry with compressed air.

**CAUTION:** *Do not immerse hinge in solvent.*

(7) Color coat hinges to match body.

(8) Lubricate hinges with 3M 4-Way Spray lubricant, or equivalent.

(9) Install replacement hinge(s), being careful to align with wax pencil marks. Tighten screws to 15 to 20 foot-pounds (20 to 27 N•m) torque.

(10) Raise tailgate to vertical position and install counterbalance torque rods in welded clips on body half of hinges.

(11) Check tailgate alignment and adjust if necessary.

(12) Install access hole cover plates on body and tailgate and, if equipped, replace cargo area floor covering and mouldings.

## REMOVAL

(1) Remove carpeting from tailgate, if equipped.

(2) Remove tailgate access cover plate and disconnect wiring.

(3) Remove carpeting, if equipped, to gain access to hinge access hole cover plates.

(4) Remove hinge access hole cover plates on body.

(5) Close tailgate and drive out hinge pins.

(6) With tailgate in a vertical position, counterbalance torque rods are unloaded and can be removed from the clip which is attached to the body half of the hinge.

(7) Remove screws holding lower end of support arms to tailgate.

## INSTALLATION

(1) Attach support arms to tailgate and raise tailgate to a vertical position in tailgate opening.

(2) Insert curved end of one torque rod in hole at bottom edge of tailgate and right-angle tapered end of rod in clip which is attached to body half of the hinge. Attach other torque rod in same manner.

(3) Install hinge pins with head of pin on inboardside of hinge.

(4) Install hinge access hole cover plates on body.

(5) Install carpeting, if equipped.

(6) Connect wiring and replace tailgate access cover plate and carpeting, if equipped.

(7) Adjust tailgate.

## LOCK SYSTEM

### Remote Control Replacement

(1) Lower tailgate and move tailgate glass to the extreme out position so remote control assembly will be accessible. Tailgate glass should be supported to relieve stress on its lower edge.

(2) Remove carpeting from tailgate, if equipped.

(3) Remove access cover and tailgate latch handle from tailgate.

(4) Remove screws attaching center of remote control assembly.

(5) Remove screws from each end of remote control rods.

(6) Release lower edge of vinyl water shield on vehicle, if equipped.

(7) Pull rods down toward bottom of tailgate to obtain side clearance.

(8) Move remote control assembly toward side of tailgate and free remote control from latch opening in tailgate. Remove remote control assembly through access cover opening.

### Latch Replacement

(1) Lower tailgate and move tailgate glass to the extreme out position so remote control assembly will be accessible. Tailgate glass should be supported to relieve stress on its lower edge.

(2) Remove carpeting from tailgate, if equipped.

(3) Remove access cover and remove screws attaching ends of remote control rods to tailgate.

(4) Remove screws attaching latch assemblies to ends of gate and remove latch assemblies.

## WINDOW SYSTEM

### Glass Replacement

Tailgate glass is operated by a double-arm window regulator which is connected directly to an outside window regulator handle. The complete window assembly will slide up and out of the run channels when the pins at the ends of the regulator arms are withdrawn from the slot in the lifter channel.

(1) Remove access cover on inside tailgate panel and pry off retainers with a screwdriver.

**NOTE:** *Retainers can be damaged when removed and their condition should be checked. When installing retainers, the tabs must be firmly locked in groove of pin. If difficulty is experienced when installing retainers, they were probably damaged during removal and should be replaced.*

(2) When installing tailgate glass, check glass assembly and regulator separately to make sure that both operate freely before connecting the two together.

## 3H-8 LIFTGATES—TAILGATES

(3) Should difficulty be experienced in raising the window from its lowered position, replace existing glass stop bumper.

- (4) Push new bumper on bracket as far as possible.
- (5) Position free end to lay up against outside panel.

### Regulator Replacement

- (1) Remove access cover.
- (2) Remove tailgate window.
- (3) Remove regulator by sliding nameplate cover aside and rotating handle until hole in handle is aligned with screws that attach handle assembly to the tailgate. Remove attaching screws and handle.

- (4) Remove screws that attach regulator assembly to tailgate.

- (5) Remove regulator assembly through access cover opening.

- (6) After installation and before access cover is replaced, raise and lower window to check that window fits properly. The window regulator can be adjusted by loosening attaching screws and moving regulator assembly in slotted screw holes until proper window adjustment is obtained.

- (7) Adjust handle to be in vertical position when window is full up.

### Glass Adjustment

The tailgate glass, when closed, must seat fully into the upper glass channel to obtain a positive seal at the horizontal weatherstrip located at the top of the tailgate. If tailgate does not seat properly when closed, check the upper glass channel to be certain it is bottomed in the body opening, also check alignment of the tailgate glass run channel.

- (1) If adjustment is necessary, loosen two cap screws on either side panel of the tailgate (fig. 3H-3).

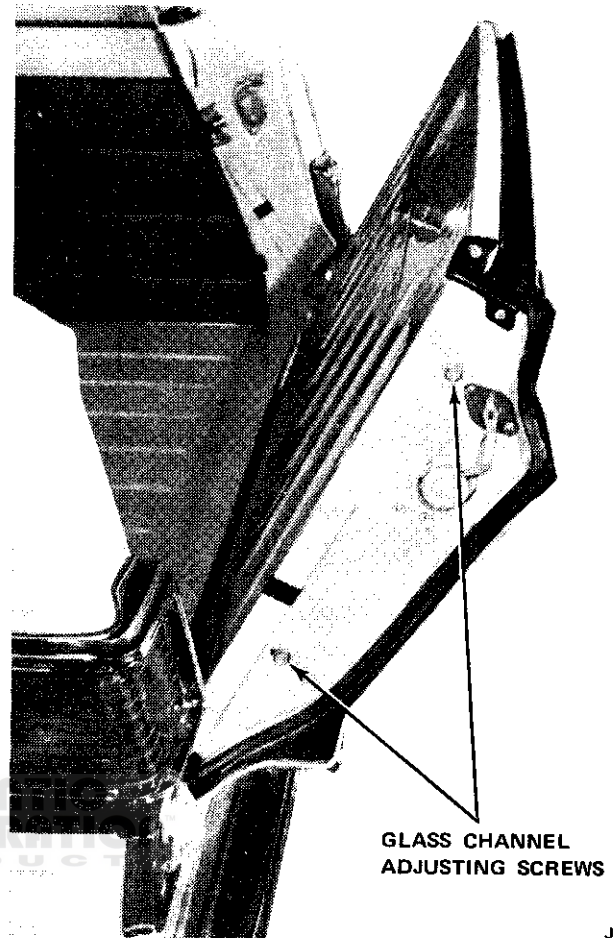
- (2) Raise and lower glass several times with tailgate in the closed position. This will align the glass with the channel.

- (3) Open tailgate slightly and tighten adjusting screws with tailgate in vertical position.

## POWER TAILGATE WINDOW SYSTEM

### General

A new electrically operated tailgate window is offered on Cherokee and Wagoneer models. When checking for tailgate window motor operation, be sure instrument panel switch black lead is properly grounded. The tailgate motor grounds through this switch. It is necessary to isolate the problem to one of the two operating circuits: (1) tailgate window operation from instrument panel switch and (2) tailgate window operation from tailgate window switch.



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Fig. 3H-3 Glass Channel Adjustment

### Operation

#### Instrument Panel Switch

Current is supplied from battery to ignition switch to fuse panel, through a 30-amp circuit breaker (located in the fuse panel), and to instrument panel tailgate window switch (fig. 3H-4).

**NOTE:** If the vehicle is equipped with a tailgate window defogger, the defogger and tailgate switches are serviced as an assembly. They cannot be replaced separately. Both switches must be replaced when either is defective.

#### Tailgate Window Switch

Current is supplied directly to fuse panel, through a 30-amp circuit breaker, and to red w/tr (No. 46) wire of tailgate window switch (fig. 3H-4).

### Testing

#### Instrument Panel Tailgate Window Switch

**NOTE:** Be sure instrument panel tailgate window switch black lead is properly grounded. The tailgate motor grounds through this switch.

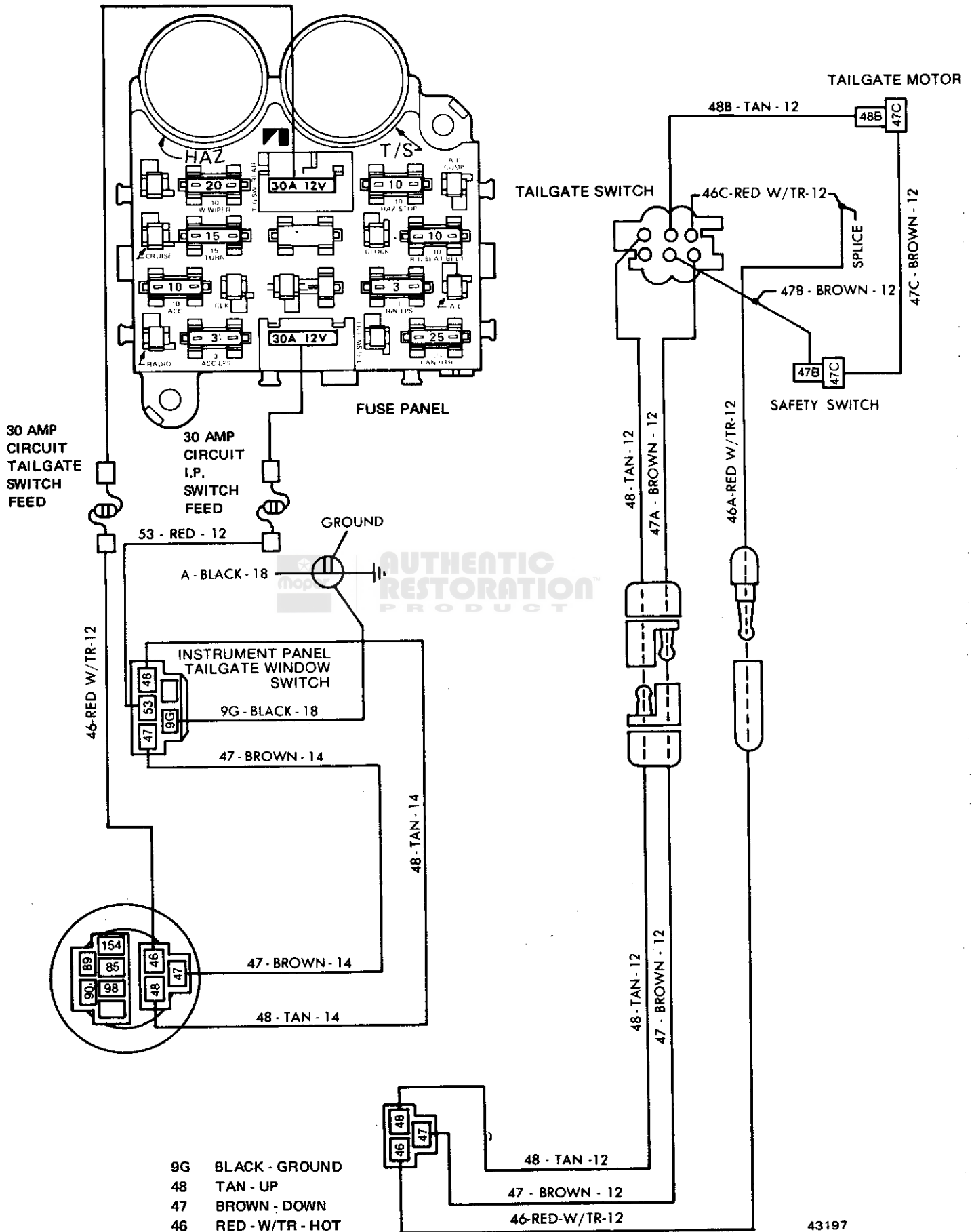


Fig. 3H-4 Power Tailgate Window Circuitry—Cherokee-Wagoneer Models

## 3H-10 LIFTGATES—TAILGATES

(1) Turn ignition switch to On position.

(2) Using a 12vdc test lamp, connect one end of test lamp to ground and place probe to red (No. 53) wire of switch. If lamp lights, voltage is present at switch. If lamp does not light, repair problem in feed circuit before proceeding.

(3) Place test lamp probe to brown (No. 47) wire of switch. Move switch to up position. If lamp lights, proceed to step (4). If lamp does not light, replace switch.

(4) Place test lamp probe to tan (No. 48) wire of switch. Move switch to down position. If lamp lights, proceed to Tailgate Window Switch Test. If lamp does not light, replace switch.

### Tailgate Window Switch

**NOTE:** Be sure instrument panel tailgate window switch black lead is properly grounded. The tailgate motor grounds through this switch.

(1) Using a 12vdc test lamp, connect one end of test lamp to ground and place probe to red w/tr (No. 46) wire of tailgate window switch. If lamp lights, proceed to step (2). If lamp does not light, repair problem in feed circuit before proceeding.

(2) Place test lamp probe to tan (No. 48A) wire of tailgate switch. Turn tailgate window switch key to down position. If lamp lights, proceed to step (3). If lamp does not light, replace switch.

(3) Place test lamp probe to brown (No. 47B) wire of tailgate switch. Turn tailgate window switch key to up position. If lamp lights, proceed to next test. If lamp does not light, replace switch.

### Tailgate Window Safety Switch

(1) Using a 12vdc test lamp, connect one end of test lamp to ground and place probe to brown wire of safety switch. Turn tailgate window switch to up position. If lamp lights, voltage is present at switch. If lamp does not light, repair feed circuits as necessary.

(2) Place test lamp probe to brown wire at switch. Turn tailgate window switch to up position and close safety switch. If lamp lights, proceed to next test. If lamp does not light, replace switch.

### Tailgate Window Motor

**NOTE:** Be sure instrument panel tailgate window switch black lead is properly grounded. The tailgate motor grounds through this switch.

(1) Using a 12vdc test lamp, connect one end of test lamp to ground and place probe to tan (No. 48B) wire at electrical motor. Close safety switch. Turn tailgate window switch to down position. If lamp lights and motor does not operate, replace motor. If lamp does not light, check feed circuit to motor and repair as necessary.

(2) Place test lamp probe to brown (No. 47C) wire at electric motor. Close safety switch. Turn tailgate window switch to up position. If lamp lights and motor does not operate, replace motor. If lamp does not light, check feed to motor and repair as necessary.

The ignition switch must be in either the accessory or ignition position to energize the window lift circuit.

The rear window control switch is located left of the steering column on the instrument panel. The switch is spring-loaded and will return to the neutral position.

The tailgate glass also can be lowered or raised, by inserting the ignition key in the tailgate lock. Turn the key to the left to lower and to the right to raise the tailgate glass.

After the glass has been lowered, the tailgate can be opened by lifting up on the tailgate latch release handle on the inside of the tailgate at the center.

**NOTE:** The tailgate safety switch is in series with the brown wire which feeds the up or down circuit of the tailgate motor. It prevents operation when the tailgate is open.

The proper assembly of all moveable parts is important for satisfactory operation of the tailgate window.

The glass assembly must be in alignment in the tailgate and glass slide channels to operate with free movement. The window regulator teeth in all gears, the coil springs, and the bottom channel slide sections must be lubricated with 3M 4-Way Spray lubricant, or equivalent, to ensure proper operation of the glass when it is raised or lowered.

### Safety Switch

A safety switch, mounted in the upper left side of the tailgate, prevents operating the glass when the tailgate is in the open position to avoid possible damage to glass channels and regulator.

### Circuit Breakers

The electric tailgate regulator motor and wiring harness are protected by two 30-ampere circuit breakers located in the fuse panel.

### Instrument Panel Switch

The rear window switch is mounted at the lower left side of the instrument panel. For removal, remove knob by depressing spring clip. Remove attaching screws. Disconnect wiring and remove switch.

### Wiring Harness

The tailgate circuit is a two-section wire harness: the body section, which is routed along the left side of the vehicle, and the section in the tailgate. The two harnesses are connected at the rear body crossmember.

Remove the tailgate access cover to gain access to the wiring harness.

### Key Lock

The tailgate key lock assembly is held in place by two special screws located under the key hole cover. Remove the screws using Torx Bit Tool J-25359-02.

### Window Switch

The tailgate window switch is mounted to the bottom side of the left regulator mounting support. It is fastened with two screws which are visible and accessible after the window regulator is removed.

### Regulator

#### Removal

- (1) Remove carpet from tailgate, if equipped.
- (2) Remove tailgate access cover plate.
- (3) Remove retainers attaching regulator arms to channel.
- (4) Disengage regulator arm pins from channel and raise glass.
- (5) Carefully support glass in the raised position.
- (6) Disconnect wiring harness from motor.
- (7) If regulator attaching screws are accessible, remove regulator attaching screws and regulator. If sector gears are covering attaching screws, proceed as follows:
  - (a) Remove motor attaching screws and disconnect motor drive from gear regulator.
  - (b) Grasp regulator arm as far outboard as access hole will allow.
  - (c) Push down on arm until holes in sector gears align with attaching screws, and motor.

(d) While holding regulator in this position, wedge screw between meshing teeth, using other hand.

(e) Remove regulator attaching screws, regulator and motor.

(8) Release spring tension by using a large screwdriver to snap the spring from under the tension bracket.

#### Installation

(1) Position spring on regulator and snap over tension bracket using large screwdriver.

(2) Position motor on regulator and install attaching screws.

(3) Position regulator in tailgate and install attaching screws.

(4) Connect wiring harness to motor.

(5) Position channel over regulator arm pins and install replacement retainers.

(6) Install access cover plate.

(7) Install carpet, if equipped.

### Motor

#### Removal

- (1) Remove tailgate window regulator, as outlined above.
- (2) Remove motor attaching screws (fig. 3H-5) and motor from regulator.

#### Installation

- (1) Position motor on regulator
- (2) Install motor attaching screws.
- (3) Install tailgate window regulator, as outlined above.
- (4) Check motor operation.

## TRUCK TAILGATE

### GENERAL

The tailgate on the pickup box is hinged at both sides. It is necessary to lower the tailgate for access to the cross-recessed countersunk attaching screws.

The tailgate on the pickup box is held in the up or closed position with spring-loaded latches at the top of the gate. A paddle handle, located in the center of the tailgate operates the latches at each side through connecting rods.

Pin type hinges are located on the sides of the pickup box. The hinge pin brackets are attached with cross-recessed countersunk attaching screws and cage nuts for

easier adjusting.

The left side hinge pin is a solid round bar. The right side pin is similar but with two flat surfaces which correspond with a notch and the two flat surfaces allow the tailgate to be removed quickly from the tailgate opening.

To remove, open and lower the tailgate. Remove the side supports and then raise the tailgate to about 45 degrees from horizontal. Disengage the right side hinge and move the tailgate to the right to disengage the left side hinge.

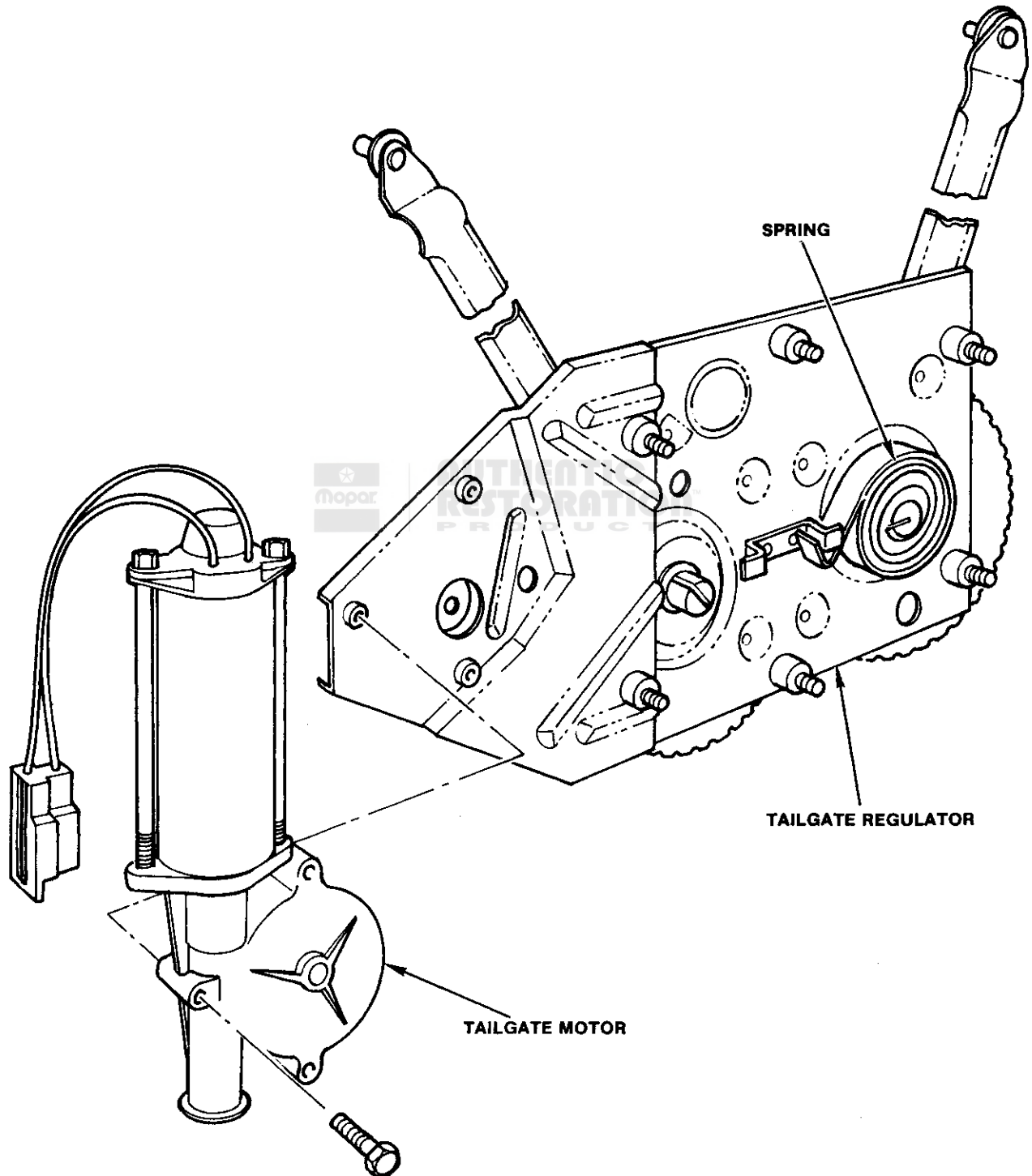


Fig. 3H-5 Power Tailgate Regulator and Motor

# DOORS

# 3J

## SECTION INDEX

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## CJ-7 WITH HARDTOP ENCLOSURE

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Hinge System	3J-3	Window System	3J-2
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### DOOR TRIM

#### Window Regulator Handle

Window regulator handles are attached to the splined shaft of the window regulator with a 5/32-inch Allen head screw. To remove the handle, remove the screw and pull the handle straight off the shaft.

Install the handle with the knob forward, the handle horizontal and the glass all the way up.

#### Door Assist Handle

##### Removal

- (1) Remove screws attaching door assist handle using Torx Bit Tool J-25359-02.
- (2) Remove handle from door.

##### Installation

- (1) Position handle on door.
- (2) Install attaching screws using Torx Bit Tool J-25359-02.

#### Trim Panel

Trim panels consist of fiber board composition covered with a vinyl material. They are fastened to the door with spring clips inserted into holes in the door inner panel.

##### Removal

- (1) Remove door assist handle.
- (2) Remove window regulator handle.
- (3) Pry trim panel-to-door clips along sides loose with Trim Pad Depressor Tool J-2631-01 and remove panel.

##### Installation

- (1) Position trim panel on door and install clips in holes in inner door panel.

**NOTE:** To prevent creasing the trim panel cover, do not hammer or exert excessive force on the clips.

- (2) Install window regulator handle.
- (3) Install door assist handle.

### SEALING SYSTEM

#### Water Shield

The water shield is attached to the door inner panel with adhesive. To remove water shield, use a putty knife between shield and door inner panel to break adhesive bond.

When installing water shield, be sure the slit lower portion is tucked inside the door panel at the access opening and that the shield is bonded securely to the door inner panel.



## 3J-2 DOORS

### Rubber Sealer

The door rubber sealer is made of molded latex foam with a smooth rubber skin on the outside.

Plastic retainers are used to retain the rubber sealer to the door below the belt line. Barbs on the retainer depress when inserted in the holes and spread when fully inserted. Above the belt line, the sealer is retained in a channel formed in the upper door frame.

### Maintenance of Rubber Sealers

Cold weather may cause the rubber sealer to harden and lose resiliency. This may cause the door to loosen in its opening, resulting in noise. When servicing, use a dampened cloth to clean rubber sealer. Remove dirt from all points where the rubber sealer contacts the body. Apply AMC Silicone Lubricant, or equivalent, to sealer.

**CAUTION:** Do not use graphite, brake fluid, or wax on rubber sealer.

### Replacement

Replacement rubber sealers are coated with powder to prevent sticking during storage. Remove powder with a dampened cloth before installation.

(1) Carefully remove rubber sealer from door using Weatherstrip Remover J-21104-01 to remove plastic retainers from panel holes. Remove upper portion from upper door frame with fingers or wooden wand.

(2) Remove dust and dirt from rubber sealer, door and body.

(3) Install upper front corner of sealer to door first using fingers or wooden wand to engage sealer into channel. Place inner shoulder of sealer in channel-to-window frame above belt line.

(4) Press retainers, starting at rear edge of door, into door panel holes.

## WINDOW SYSTEM

### Door Glass

#### Adjustment

One adjustment point is available which regulates the amount of effort required to raise and lower the door glass. The door glass division channel is adjustable fore and aft at the lower attachment point.

(1) Remove door trim panel and water shield.

(2) Loosen division channel lower adjusting screw and move division channel fore or aft to obtain the desired door glass operation (fig. 3J-1).

**NOTE:** Movement of division channel fore and aft reduces or increases free play between channels.

(3) Tighten division channel lower adjusting screw.

(4) Install water shield and door trim panel.

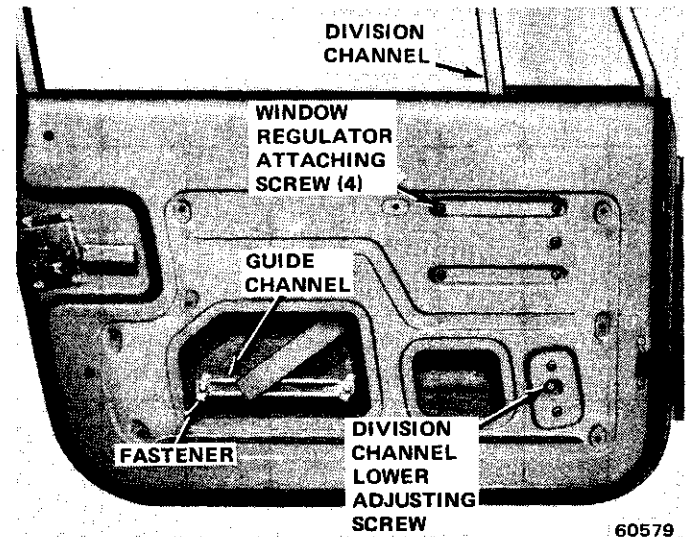


Fig. 3J-1 Door Glass Replacement—CJ Models

#### Removal

(1) Remove door trim panel and water shield.

(2) Remove glass down-stop.

(3) Remove screws attaching guide channel to plastic fasteners. Remove guide channel and plastic fasteners.

(4) Lower glass to bottom of door.

(5) Remove division channel upper attaching screw and lower adjusting screw. Disengage front three inches of glass weatherstrip from upper door frame. Remove division channel.

(6) Tilt glass toward hinge side of door and disengage from rear channel.

(7) Pull glass up and out of door panel.

#### Installation

(1) Lower glass into door with front of glass tilted down, while positioning glass into rear channel.

(2) Install plastic fasteners into glass.

(3) Slide glass down into bottom of door panel.

(4) Lower division channel into door and position glass in channel.

(5) Install upper attaching screw and lower adjusting screw. Engage weatherstrip in upper door frame.

(6) Slide guide channel onto regulator arm and position channel on glass. Install attaching screws.

(7) Install glass down-stop.

(8) Check operation and adjustment.

(9) Install water shield and door trim panel.

## Stationary Vent Window

### Removal

- (1) Remove door trim panel and water shield.
- (2) Lower glass to down-stop.
- (3) Remove division channel upper attaching screw and lower adjusting screw.
- (4) Disengage front three inches of weatherstrip from upper door frame. Lower division channel and tilt toward rear of door.
- (5) Remove stationary vent glass from weatherseal.

### Installation

- (1) Install stationary vent glass into weatherseal.

**NOTE:** *It is necessary to seat front edge of weatherstrip into door frame. Then, seat vent glass into weatherstrip.*

- (2) Install division channel into door and position channel on glass.
- (3) Install upper attaching screw and lower adjusting screw.
- (4) Engage weatherstrip in upper door frame.
- (5) Water test and check for leaks.
- (6) If water leakage is evident, apply 3M Windshield Sealer, or equivalent, or realign weatherseal.
- (7) Check operation and adjustment of door glass.
- (8) Install water shield and door trim panel.

## Window Regulator

### Removal

- (1) Remove trim panel and water shield.
- (2) Lower glass to expose guide channel fasteners. Remove fasteners and guide channel. Raise window to full up position and apply masking tape to glass and over top of window frame.
- (3) Remove regulator attaching screws. Remove regulator through access hole in inner door panel.

### Installation

- (1) Position regulator in door and install attaching screws.
- (2) Remove masking tape from glass and lower glass.
- (3) Slide guide channel onto regulator arm and position channel on glass. Install attaching screws.
- (4) Check operation.
- (5) Install water shield and door trim panel.

## LOCK SYSTEM

### Outside Handle Replacement

**NOTE:** *The replacement outside handle is furnished without the lock cylinder. The lock cylinder is furnished uncoded without the keys.*

- (1) Remove screws attaching outside door handle to door using Torx Bit Tool J-25359-02 and remove handle.
- (2) Code existing door lock key to replacement cylinder.
  - (a) Insert key in replacement cylinder.
  - (b) File tumblers until flush with cylinder body.
  - (c) Remove and install key, check that tumblers are flush with body.
  - (d) Install cylinder in replacement outside door handle.
- (3) Install outside door handle on door and install attaching screws using Torx Bit Tool J-25359-02.

### Latch Replacement

- (1) Remove screws attaching door latch to door using Torx Bit Tool J-25359-02 and remove latch.
- (2) Lubricate door latch with 3M 4-Way Spray lubricant, or equivalent.
- (3) Position door latch on door and install attaching screws using Torx Bit Tool J-25359-02.

## HINGE SYSTEM

### Adjustments

The doors are adjusted at the hinge mounting points on the body or door.

Enlarged holes are provided in the body, lower hinge only, for fore, aft and tilt adjustments. Enlarged holes are also provided in the door, upper and lower hinges, for up, down, fore, aft and tilt adjustments.

Prior to any door adjustment or alignment, the door latch must be removed to allow the door to close freely in proper alignment.

The door latch striker should be adjusted in or out to allow the door latch to be fully engaged. The door should be flush with the adjacent body panels.

### Replacement

- (1) Mark outline of existing hinge on body and door with wax pencil.
- (2) Remove hinge-to-body screws and hinge-to-door screws using Torx Bit Tool J-25359-02 and remove hinge.

**NOTE:** *Upper hinge is part of windshield hinge assembly. When replacing, adequately support windshield frame prior to removal and check alignment after installation.*

## 3J-4 DOORS

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(3) Clean replacement hinge in a suitable solvent and blow dry with compressed air.

(4) Color-coat hinge to match body using Jeep exterior spray paint, or equivalent.

(5) Lubricate hinge with 3M 4-Way Spray lubricant, or equivalent.

(6) Position hinge on door, align carefully with wax

pencil marks, and install screws using Torx Bit Tool J-25359-02.

(7) Position hinge on body, align carefully with pencil marks, and install screws using Torx Bit Tool J-25359-02.

(8) Check door alignment. Adjust if necessary (refer to Door Adjustment).

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# CHEROKEE - WAGONEER - TRUCK FRONT DOORS

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## DOOR TRIM

### Window Regulator Handle

Window regulator handles are attached to the splined shaft of the window regulator with a 5/32-inch Allen head screw. To remove the handle, remove the screw and pull the handle straight off the shaft.

Install the handle with the knob forward, the handle horizontal and the glass all the way up.

### Trim Panel

Trim panels consist of fiber board composition covered with a vinyl material. They are fastened to the door with spring clips inserted into holes in the door inner panel and screws along the bottom edge.

#### Removal

(1) Remove metal overlay strip on armrest, if equipped, and remove attaching screws and armrest.

(2) Remove window regulator handle and door latch remote control handle.

(3) Remove trim panel attaching screws on bottom of trim panel.

(4) Pry trim panel-to-door clips along sides loose with tool J-2631-01 and remove panel.

(5) Loosen setscrew securing remote control mirror control cable to escutcheon, if equipped.

#### Installation

(1) Insert remote control mirror control cable in escutcheon and tighten setscrew, if equipped.

(2) Position trim panel on door and install clips in holes in inner door panel.

**NOTE:** To prevent creasing the trim panel cover, do not hammer or exert excessive force on the clips.

(3) Install screws along bottom of trim panel.

(4) Install window regulator handle and door latch remote control handle.

(5) Install armrest and metal strip.

## SEALING SYSTEM

### Water Shield

The water shield is attached to the door inner panel with adhesive. To remove water shield, use a putty knife between shield and door inner panel to break adhesive bond.

When installing water shield be sure the slit lower portion is tucked inside the door panel at the access opening and that the shield is bonded securely to the door inner panel.

### Rubber Sealer

The door rubber sealer is made of molded latex foam with a smooth rubber skin on the outside.

The door rubber sealer is attached to the body opening around the door opening.

### Maintenance of Rubber Sealers

Cold weather may cause the rubber sealer to harden and lose resiliency. When servicing, use a dampened cloth to clean rubber sealer. Remove dirt from all points where the rubber sealer contacts the door. Apply AMC/Jeep Silicone Lubricant, or equivalent, to a dampened cloth and apply to rubber sealer.

**CAUTION:** Do not use graphite, brake fluid, or wax on rubber sealer.

**Replacement**

Replacement rubber sealers are coated with powder to prevent stickiness in storage. Remove all powder with a dampened cloth before installation.

- (1) Carefully remove rubber sealer from door opening.
- (2) Remove dust and dirt from rubber sealer, door and body opening.

- (3) Install upper front corner of sealer to body first.
- (4) Work rubber sealer onto flange completely around door opening.

**WINDOW SYSTEM**

**Door Glass**

**Removal**

- (1) Remove door trim panel and water shield.
- (2) Remove glass stop bracket (fig. 3J-2).

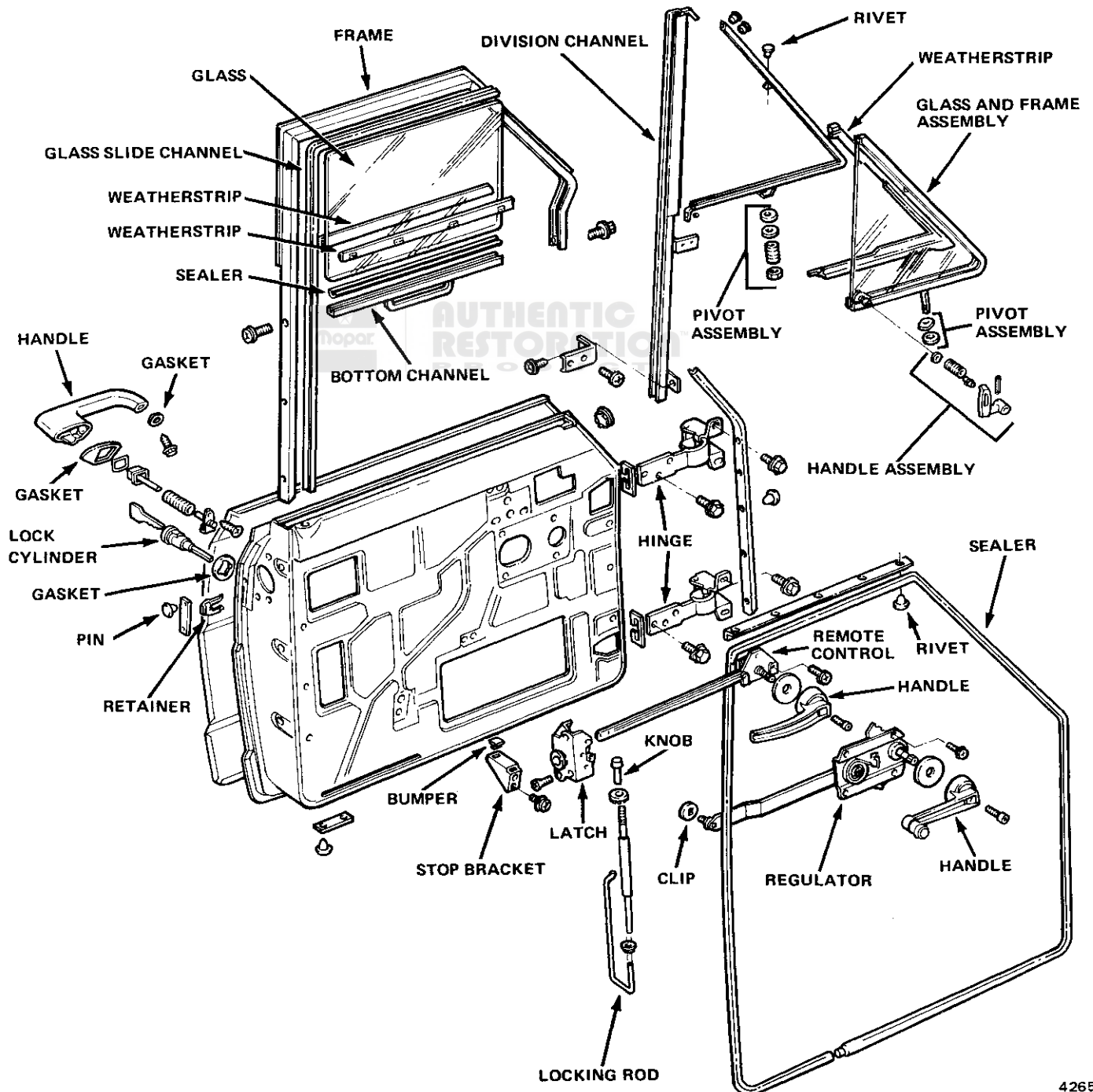


Fig. 3J-2 Front Door—Cherokee-Wagoneer-Truck Models

## 3J-6 DOORS

(3) Remove lower division channel attaching bracket.

(4) Remove division channel upper bracket-to-door panel attaching screws.

(5) Remove lock rod guide bushing.

**NOTE:** Move lock rod aside so glass may be lowered to bottom of door.

(6) Remove screws attaching remote control assembly to door panel and lower to bottom of door.

(7) Lower door glass and remove retaining clip.

(8) Lower glass to bottom of door.

(9) Push lower end of division channel toward front of door to release glass from channel.

(10) Move glass toward front of door to release it from rear channel.

(11) Rotate glass vertically 90° and guide it between inner and outer door panels.

### Installation

(1) Position door glass in lower section of door so lifter channel has recessed portion of guide groove toward inner door panel.

(2) Position glass in rear channel and position front channel so glass can be inserted.

(3) Slide glass up channels and crank regulator arm down to align pin at end of regulator arm with slot in lifter channel.

(4) Install retainer on regulator arm.

(5) Position remote control assembly and install attaching screws.

(6) Position lock rod and install lock rod guide bushing to door panel.

(7) Install door lock push knob.

(8) Install upper and lower division bar attaching brackets.

(9) Install glass stop.

(10) Check glass operation.

(11) Install water shield and trim panel.

### Vent Window

#### Removal

(1) Remove door trim panel and water shield.

(2) Remove door window glass.

(3) Remove upper glass channel.

(4) Remove vent assembly attaching screws on leading edge of door frame and under base of vent weatherseal (fig. 3J-2).

(5) Move vent assembly toward rear of door, tipping it to clear upper door frame.

(6) Pull ventilator assembly straight out until upper attaching bracket is above opening between outer and inner door panels.

(7) Rotate vent assembly 90° to position lower at-

taching bracket on run channel to clear opening between door panels.

(8) Remove vent assembly.

#### Installation

(1) Position vent assembly in door.

(2) Install vent assembly attaching screws through door frame.

(3) Install upper glass run channel.

(4) Install door window glass.

(5) Install water shield and door trim panel.

#### Glass Replacement

(1) Remove screw and washers securing vent glass to upper pivot.

(2) Remove vent glass from frame.

(3) Install vent glass in frame.

(4) Install washers and screw securing vent glass to upper pivot.

### Window Regulator

#### Removal

(1) Remove door trim panel and water shield.

(2) Lower glass and remove clip attaching regulator arm to glass bottom channel (fig. 3J-2).

(3) Raise and support glass.

(4) Lower regulator arm and remove attaching screws.

(5) Remove regulator through access hole in door.

#### Installation

(1) Install regulator in door and secure with attaching screws.

(2) Position regulator arm in glass bottom channel.

(3) Install retainer clip on regulator arm.

(4) Remove glass support.

(5) Install water shield and door trim panel.

### LOCK SYSTEM

#### Outside Handle

##### Removal

(1) Remove door trim panel and water shield.

(2) Raise window to fully closed position.

(3) Through opening in inner door panel, remove handle attaching screws and remove handle and gaskets.

##### Installation

(1) Position gaskets and handle on door and secure with attaching screws.

(2) Install water shield and door trim panel.

## Key Lock

### Removal

- (1) Remove rubber sealer along rear edge of door by prying out retaining pins to expose lock cylinder retainer (fig. 3J-2).
- (2) Using flat-bladed screwdriver, remove retainer.
- (3) Remove lock cylinder and extension rod from outside of door.

### Installation

- (1) Position lock cylinder in door, making sure extension rod is inserted in square hole in latch.
- (2) Install lock cylinder retainer.
- (3) Install rubber sealer with retaining pins.

### Lock Cylinder Coding

The lock cylinder is serviced in a kit which includes an uncoded cylinder, housing and a dust cover.

Whenever a lock cylinder replacement is required, the uncoded service cylinder can be coded to match the existing key.

- (1) Remove lock cylinder from door.
- (2) Remove dust cover from original lock housing and remove lock cylinder and discard.
- (3) Insert original key into new uncoded service lock cylinder.
- (4) Press cylinder into special Door Cylinder Lock Tumbler Filing Fixture, tool J-22977, with notched side of key up and long tumbler in slot (fig. 3J-3).
- (5) Hold filing fixture in vise and file tumblers flush with flat side of fixture. Use a standard 5/8-inch, double-cut bastard file. Finish filing with smooth mill file.
- (6) Remove lock cylinder from fixture and insert cylinder into opposite end of fixture with notched side of key down (fig. 3J-3).

**NOTE:** This side of the fixture can be identified as the end without the double slot cut out (180° apart).

- (7) File tumblers flush with flat side of fixture.

**NOTE:** Utilize the filing fixtures as a test gauge. Remove the fixture from the vise and if the tumblers are filed correctly, the lock cylinder will turn in the fixture.

- (8) Insert new lock cylinder into lock housing.
- (9) Install new dust cap and crimp ends of cap over lock housing.
- (10) Install lock cylinder in door.

### Latch and Remote Control

#### Removal

- (1) Remove door trim panel and water shield.
- (2) Remove lock cylinder.

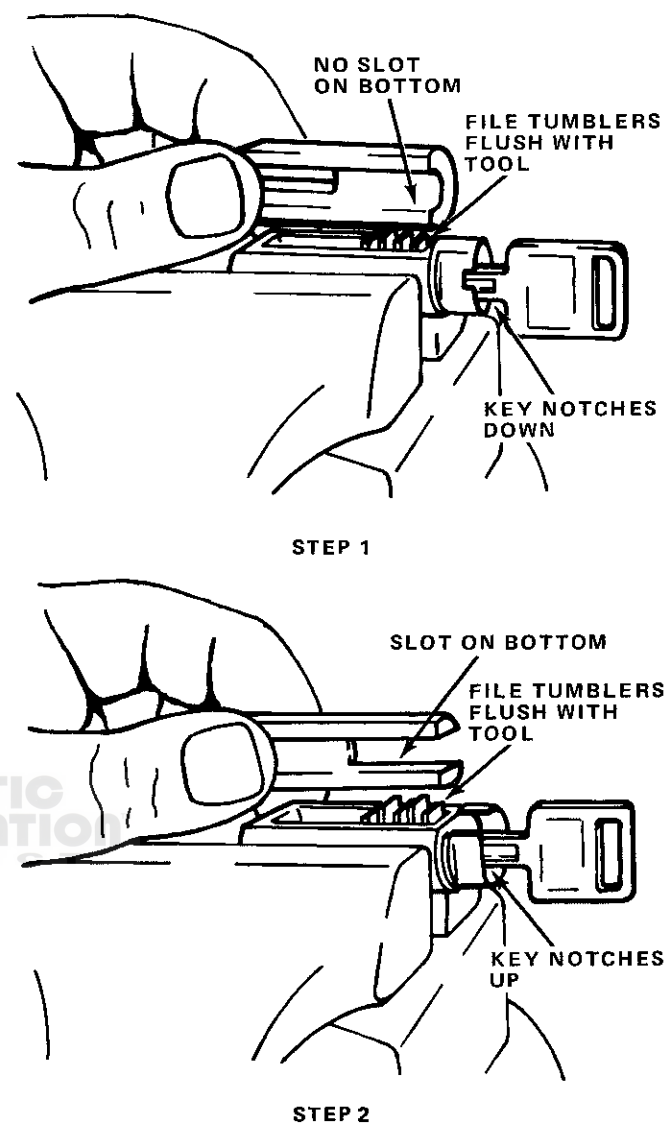


Fig. 3J-3 Filing Lock Tumblers

J42655

- (3) Remove screws from door lock remote control (fig. 3J-2). Push control in and lower to bottom of door.

- (4) Disconnect remote control arm from door latch and remove remote control assembly through access hole at bottom of door.

- (5) Remove screws attaching door latch to door panel using Torx Bit Tool J-25359-02.

- (6) Push door latch in and turn it 90° to free it from lock lever rod and remove through lower access hole.

#### Installation

- (1) Connect lock lever rod to door latch.
- (2) Position door latch on door panel and install attaching screws using Torx Bit Tool J-25359-02.
- (3) Connect remote control arm to door latch. Position remote control on door inner panel and install attaching screws.
- (4) Install outside lock assembly.
- (5) Install water shield and door trim panel.

## 3J-8 DOORS

### Locking Rod

#### Removal

- (1) Remove door trim panel and water shield.
- (2) Remove door lock push knob.
- (3) Push nylon bushing (on rod) off bracket.
- (4) Loosen latch mounting screws and disengage locking rod.

#### Installation

- (1) Engage locking rod and latch and tighten latch mounting screws.
- (2) Install nylon bushing on bracket.
- (3) Install door lock push knob.
- (4) Install water shield and door trim panel.

### HINGE SYSTEM

#### Replacement

- (1) Remove trim panel and water shield.
- (2) Disconnect door speaker wiring, if equipped.
- (3) Mark outline of existing hinges on body pillar and door for reference with wax pencil.
- (4) Position door in holding fixture.
- (5) Remove all hinge-to-body screws.
- (6) Remove door from vehicle.
- (7) Remove all hinge-to-door screws and remove hinges.
- (8) Clean replacement hinges in a suitable solvent and blow dry with compressed air.

**CAUTION:** *Do not immerse hinge in solvent.*

- (9) Color coat hinges to match body.
- (10) Lubricate hinges with 3M 4-Way Spray lubricant, or equivalent.
- (11) Position hinges on door, being careful to align

with scribe marks, install screws. Tighten screws to 25 to 35 foot-pounds (34 to 47 N•m) torque.

(12) Position door in body opening and align hinges with scribe marks on body pillar. Install and tighten two outside screws, then install and tighten inner screw on each hinge. Tighten screws to 25 to 35 foot-pounds (34 to 47 N•m) torque.

(13) Remove door holding fixture.

(14) Check door alignment. Adjust if necessary (refer to Door Adjustment).

(15) Connect door speaker wiring, if equipped.

(16) Install water shield and trim panel.

### Door Adjustments

The doors are adjusted at the hinge mounting points on the body or door.

Slotted holes are provided in the hinge for in or out adjustment on the pillars. The holes in the hinge set the door outboard slightly. To adjust the door inboard, loosen the hinge and push door open against door stop. Tighten hinge after correct alignment has been achieved.

Prior to any door adjustment or alignment, the adjustable striker must be removed to allow the door to close freely in proper alignment without striker interference.

The door lock striker is adjustable up, down, in or out and can be shimmed forward or back to hold the door in the properly aligned position.

The door latch striker should be set so that the latch enters the striker without binding, yet provides secure retention for the lock and prevents up and down or in and out movement of the door.

The striker also should be adjusted in or out to allow the door latch to be fully engaged. The door should be flush with the adjacent body panels.

**NOTE:** *It is possible to set the striker in so far that the door is closed tight but only the safety catch is engaged. This prevents locking the door with the key or the push-button lock rod.*

# CHEROKEE - WAGONEER REAR DOORS

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Lock System	3J-11		

## DOOR TRIM

### Window Regulator Handle

Window Regulator handles are attached to the splined shaft of the window regulator with a 5/32-inch Allen head screw. To remove the handle, remove the screw and pull the handle straight off the shaft.

Install the handle with the knob forward, the handle horizontal and the glass all the way up.

### Trim Panel

Trim panels consist of fiber board composition covered with a vinyl material. They are fastened to the door with spring clips inserted into holes in the door inner panel and screws along the bottom edge.

### Removal

- (1) Remove metal overlay strip on armrest, if equipped, and remove attaching screws and armrest.
- (2) Remove window regulator handle and door latch remote control handle.
- (3) Remove trim panel attaching screws on bottom of trim panel.
- (4) Pry trim panel-to-door clips along sides loose with tool J-2631-01 and remove panel.

### Installation

- (1) Position trim panel on door and install clips in holes in inner door panel.

**NOTE:** To prevent creasing the trim panel cover, do not hammer or exert excessive force on the clips.

- (2) Install screws along bottom of trim panel.
- (3) Install window regulator handle and door latch remote control handle.
- (4) Install armrest and metal strip.

## SEALING SYSTEM

### Water Shield

The water shield is attached to the door inner panel with adhesive. To remove water shield, use a putty knife between shield and door inner panel to break adhesive bond.

When installing water shield, be sure the slit lower portion is tucked inside the door panel at the access opening and that the shield is bonded securely to the door inner panel.

### Rubber Sealer

The door rubber sealer is made of molded latex foam with a smooth rubber skin on the outside.

The rubber sealer is attached to the door body opening.

### Maintenance of Rubber Sealers

Cold weather may cause the rubber sealer to harden and lose resiliency. This may cause the door to loosen in its opening, resulting in noise. When servicing, use a dampened cloth to clean rubber sealer. Clean dirt from all points where the rubber sealer contacts the body. Apply AMC Silicone Lubricant, or equivalent, to sealer.

**CAUTION:** Do not use graphite, brake fluid or wax on rubber sealer.

### Replacement

Replacement rubber sealers are coated with powder to prevent stickiness in storage. Remove all powder with a dampened cloth before installation.

- (1) Carefully remove rubber sealer from door opening.
- (2) Remove dust and dirt from rubber sealer, door and body.
- (3) Install upper front corner of sealer to door opening first.
- (4) Complete installation of rubber sealer to remainder of door opening.



**WINDOW SYSTEM**

**Door Glass**

**Removal**

- (1) Remove door trim panel and water shield.
- (2) Remove glass stop bracket.
- (3) Remove rear glass channel lower attaching bracket.
- (4) Lower door glass to obtain access to retainer clip.
- (5) Remove retainer clip, disengage pin from slot in channel and lower glass to bottom of door (fig. 3J-4).
- (6) Remove inner and outer belt weatherstrips.
- (7) Remove upper glass channel.

(8) Remove stationary vent assembly attaching screws (fig. 3J-4).

(9) Tilt top of vent assembly forward approximately one inch.

(10) Push lower end of rear glass channel toward rear of door to release glass.

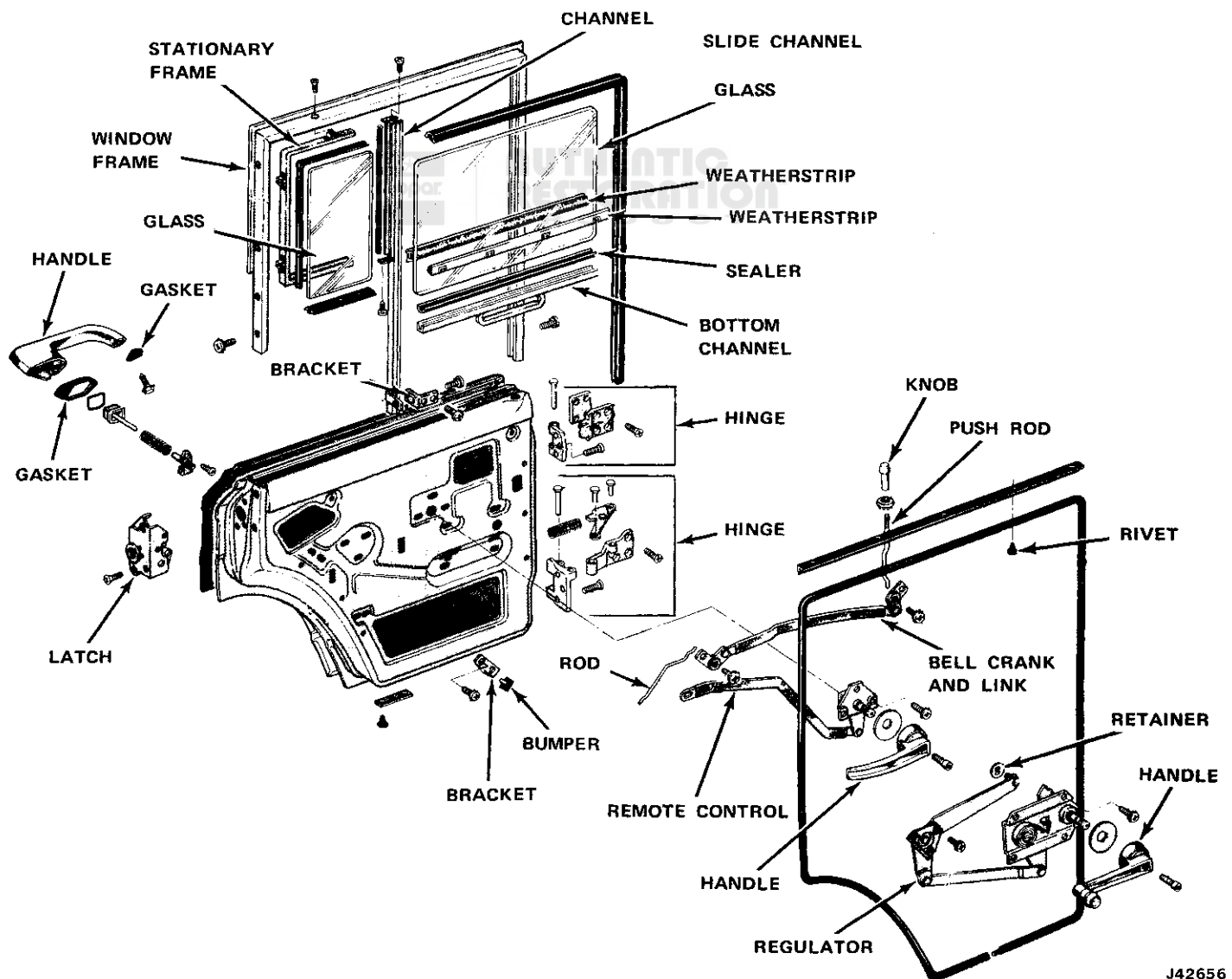
(11) Move glass toward rear of door to release glass from front channel.

(12) Rotate glass 90° and guide glass between inner and outer door panels.

**Installation**

(1) Position door glass in lower section of door so channel has recessed portion toward inner door panel.

(2) Position door glass in front run channel and push rear channel over glass.



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Fig. 3J-4 Rear Door—Cherokee-Wagoneer Models

(3) Slide glass up and crank regulator arm down until pin on regulator arm can be inserted in slot of lifter channel.

(4) Install retainer.

(5) Position stationary vent assembly and install attaching screws.

(6) Install upper glass run channel.

(7) Install inner and outer belt weatherstrip.

(8) Install rear channel attaching bracket.

(9) Install glass stop bracket.

(10) Check operation of glass.

(11) Install water shield and door trim panel.

## Vent Window

### Removal

(1) Remove door glass.

(2) Apply soap solution under vent weatherstrip and along inner and outer door panels.

(3) Slide vent assembly forward to center of door glass opening.

(4) Push vent assembly down through opening between inner and outer door panels to disengage assembly from upper door frame.

(5) Lower top of vent assembly down to clear upper door frame.

(6) Pull vent assembly straight up until all weatherseal is clear of door panel and vent assembly can be rotated.

(7) Rotate assembly to position lower attaching bracket on channel and pull assembly up and out between panels.

### Installation

(1) Install assembly between panels.

(2) Engage vent assembly in upper door frame and slide vent into position.

(3) Install door glass.

## Window Regulator

### Removal

(1) Remove trim panel and water shield.

(2) Remove regulator arm-to-glass bottom channel retaining clip.

(3) Push regulator pin out of glass channel.

(4) Remove regulator attaching screws and remove regulator.

### Installation

(1) Position regulator on inner door panel and secure with attaching screws.

(2) Install regulator pin in glass channel and install retaining clip.

(3) Install water shield and door trim panel.

## LOCK SYSTEM

### Outside Handle

#### Removal

(1) Remove door trim panel and water shield.

(2) Raise window to fully closed position.

(3) Through opening in inner door panel, remove handle attaching screws and remove handle and gaskets.

#### Installation

(1) Position gaskets and handle on door and secure with attaching screws.

(2) Install water shield and door trim panel.

### Locking Rod

#### Removal

(1) Remove door trim panel and water shield.

(2) Remove door lock push knob.

(3) Loosen latch mounting screws and disengage locking rod.

#### Installation

(1) Engage locking rod and latch and tighten latch mounting screws.

(2) Install door lock push knob.

(3) Install water shield and door trim panel.

### Remote Control and Lock Lever Rod

#### Removal

(1) Remove trim panel and water shield.

(2) Remove door lock push knob.

(3) Remove screws attaching lock control arm to inner door panel.

(4) Remove lock lever rod.

(5) Remove door latch attaching screws using Torx Bit Tool J-25359-02.

(6) Disconnect remote control arm and turn latch 90°.

(7) Remove lock lever rod and bellcrank (fig. 3J-4).

#### Installation

(1) Position latch in door and install lock lever rod and bellcrank.

(2) Connect remote control arm to latch and turn latch 90°. Secure latch to door panel with attaching screws using Torx Bit Tool J-25359-02.

(3) Install lock lever rod.

(4) Position lock control arm on inner door panel and install attaching screws.

(5) Install door lock push knob.

(6) Install water shield and trim panel.

**HINGE SYSTEM**

**Replacement**

- (1) Scribe outline of hinges on body pillar and door-for reference.
- (2) Position door in holding fixture.
- (3) Remove all hinge screws using Torx Bit Tool J-25359-02 and remove hinges. Retain shims.
- (4) Clean replacement hinges in a suitable solvent and blow dry with compressed air.

**CAUTION:** *Do not immerse hinge in solvent.*

- (5) Color-coat hinges to match body.
- (6) Lubricate hinges with 3M 4-Way Spray lubricant, or equivalent.
- (7) Position hinges on door with original shims, being careful to align with wax pencil marks, and install screws using Torx Bit Tool J-25359-02. Tighten screws to 12 to 18 foot-pounds (16 to 24 N•m) torque.
- (8) Remove door holding fixture.
- (9) Check door alignment. Adjust if necessary (refer to Door Adjustments).

**Door Adjustments**

The doors are adjusted at the hinge mounting points on the body or door.

Floating plates are located in the body pillars to permit adjustment up, down, in or out. To adjust forward or back, add or remove shims between the hinge and hinge pillar.

Prior to any door adjustment or alignment, the adjustable striker must be removed to allow the door to close freely in proper alignment without striker interference.

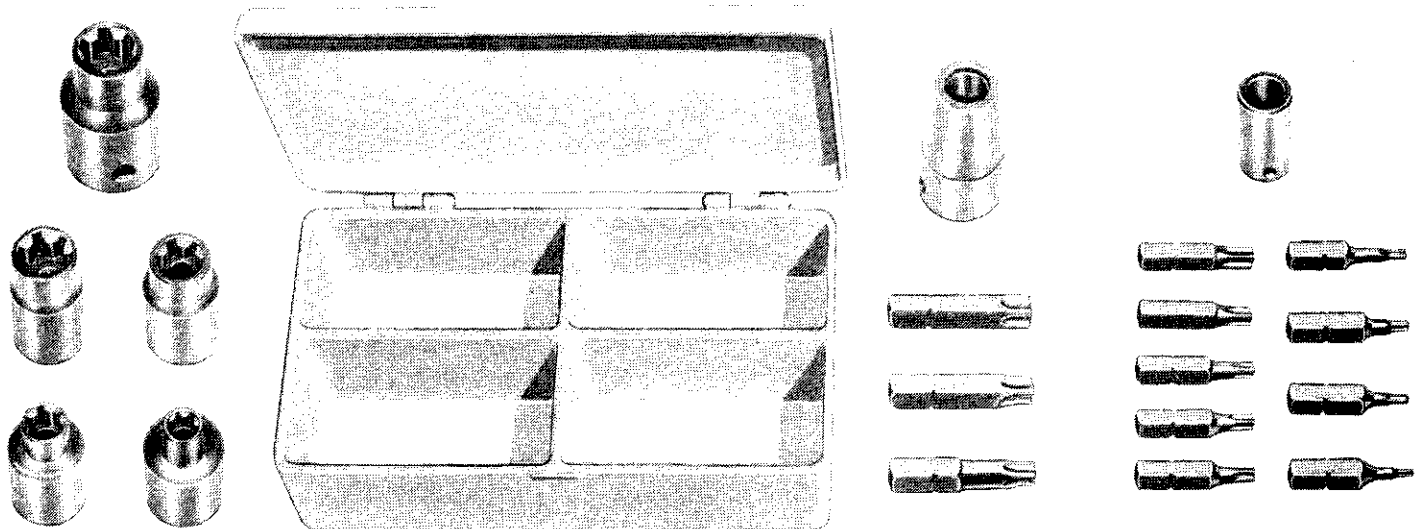
The door lock striker is adjustable up, down, in or out and can be shimmed forward or back to hold the door in the properly aligned position.

The door latch striker should be set so that the latch enters the striker without binding, yet provides secure retention for the lock and prevents up and down or in and out movement of the door.

The striker also should be adjusted in or out to allow the door latch to be fully engaged. The door should be flush with the adjacent body panels.

**NOTE:** *It is possible to set the striker in so far that the door is closed tight but only the safety catch is engaged. This will prevent locking the door with the key or the pushbutton lock rod.*

**Tools**



J-25359-02  
TORX BIT AND  
SOCKET SET

70119



J-2631-01  
TRIM PAD  
DEPRESSOR



J-21104-01  
WEATHERSTRIP  
REMOVER

# REAR QUARTER 3K

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Stationary Window—2-Door Cherokee	3K-2	Trim Panel	3K-1
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### TRIM PANEL

**NOTE:** The metal trim panels are held in place with sheet metal screws. Remove all attaching screws to remove panel.

#### Removal

- (1) Remove ash receiver, holder screws, and holder, if equipped.
- (2) Remove armrest metal overlay strip, if equipped, and remove attaching screws and armrest.
- (3) Remove trim panel screws at base of panel.
- (4) Pry loose trim panel attaching clips, using Trim Pad Depressor J-2631-01, along both vertical sides of panel and remove panel.

#### Installation

- (1) Inspect all panel attaching clips; replace any that are bent. To prevent damage to trim panel, do not hammer or exert excessive force on clips.
- (2) Install trim panel attaching screws.
- (3) Install armrest and armrest metal overlay strip, if equipped.
- (4) Install ash receiver holder and ash receiver, if equipped.

### PIVOT VENT WINDOW—CHEROKEE

**NOTE:** The glass only can be removed without removing weatherstrip, refer to Vent Window Glass below.

#### Removal

- (1) Remove mylar insert from weatherstrip.
- (2) Pull weatherstrip back and remove window frame-to-body screws from inside vehicle (fig. 3K-1).

**NOTE:** If weatherstrip sticks to body, use a wooden wand and pry loose at one corner.

- (3) Remove window frame and weatherstrip assembly.
- (4) Inspect weatherstrip and replace if necessary.

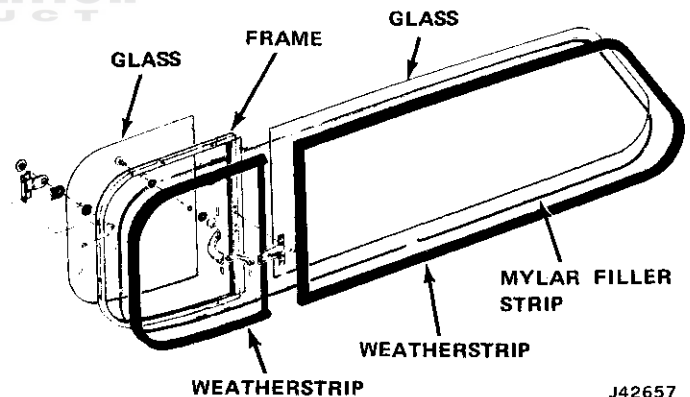


Fig. 3K-1 Rear Quarter Window—Cherokee

#### Installation

- (1) Lubricate weatherstrip with soap and water solution.
- (2) Place window frame and weatherstrip assembly into position in window opening.

**NOTE:** Apply 3M Windshield Sealer or equivalent at window frame rear corners.

- (3) Using wooden wand, work weatherstrip inner flange into position.
- (4) Obtain proper mylar alignment with weatherstrip and work into recess in weatherstrip.

## 3K-2 REAR QUARTER

### Vent Window Glass

#### Removal

- (1) Remove handle-to-frame attaching screws (fig.3K-1).
- (2) Remove glass hinge screws and washers.
- (3) Remove glass.

**NOTE:** *If glass sticks to hinges, remove glass by carefully pushing out hinge screw inserts.*

- (4) To remove handle assembly from glass, carefully drive out handle assembly-to-stud roll pin.
- (5) Unscrew stud nut and remove stud from glass.

#### Installation

- (1) Attach glass to frame using hinge screw inserts, washers, and screws.
- (2) Attach handle assembly to frame.
- (3) Attach stud and nut to glass, and connect stud to handle assembly with roll pin.
- (4) Latch window and check for water leaks.
- (5) If water leakage is evident, apply sealant in affected areas.

### STATIONARY WINDOW—2-DOOR CHEROKEE

**NOTE:** *On Cherokee models, the pivoting rear quarter vent window and frame may remain in the vehicle but removal of the mylar filler strip is required to accomplish removal of the stationary window.*

- (1) Free weatherstrip-to-body flange (on inside of vehicles) as follows: starting at top corner, using fingers or a wooden wand, pull weatherstrip down to clear flange while exerting an outward pressure on glass.
- (2) Push window and weatherstrip toward outside of vehicle.
- (3) Remove weatherstrip from glass and clean off sealer from glass cavity.
- (4) Before installing glass in weatherstrip, apply a 3/16-inch bead of 3M Windshield Sealer or equivalent in weatherstrip glass cavity using a pressure type applicator.
- (5) Lubricate weatherstrip with soapy water.
- (6) Place glass and weatherstrip into position in window opening.
- (7) With weatherstrip body flange in proper position at bottom of window opening, use a wooden wand and walk weatherstrip-to-body flange into position.
- (8) Clean excess sealer from glass.
- (9) Check for water leaks.
- (10) If water leakage is evident between weatherstrip and flange, apply 3M Auto Bedding and Glazing Compound or equivalent to affected areas and realign weatherstrip.

### STATIONARY WINDOW—CJ-7 WITH HARDTOP ENCLOSURE

#### Removal

- (1) Unlock rubber weatherstrip using wood wand or fiber stick.
- (2) Use fiber stick to break seal between glass and rubber weatherstrip.
- (3) Push glass and weatherstrip toward outside of vehicle. Remove glass.
- (4) Remove weatherstrip from opening.

#### Installation

- (1) Inspect weatherstrip and clean sealer from glass cavity and flange cavity.

**NOTE:** *Inspect for uneven surfaces or irregularities in the opening flange that could cause stress damage to the glass.*

- (2) Before installing weatherstrip on flange, apply a 3/16-inch bead of 3M Auto Bedding and Glazing Compound or equivalent in weatherstrip flange cavity using a pressure-type applicator.
  - (3) Install weatherstrip on liftgate opening flange.
  - (4) Apply a liberal amount of liquid soap solution to glass cavity of weatherstrip.
  - (5) Position glass into upper glass cavity and into each side. Position wooden wand under glass and lift up and into lower cavity. Check for equal side clearance.
  - (6) Use wooden wand to lock weatherstrip.
- NOTE:** *Soap solution should be removed from the weatherstrip and glass before installing sealer.*
- (7) Using a pressure-type applicator, apply 3M Windshield Sealer or equivalent between weatherstrip and glass on outside of glass around entire perimeter.

### STATIONARY WINDOW—4-DOOR CHEROKEE-WAGONEER

#### Removal

- (1) Remove interior garnish mouldings from around window and break seal loose between weatherstrip and body panels.
- (2) Push glass toward inside of vehicle.
- (3) Remove weatherstrip from around glass and clean old sealer from glass cavity and flange cavity.

#### Installation

- (1) Before installing glass in weatherstrip, apply a 3/16-inch bead of 3M Windshield Sealer or equivalent in glass cavity completely around weatherstrip using a pressure type applicator (fig. 3K-2).

(2) With glass installed in weatherstrip and before installing glass and weatherstrip into opening, insert a 1/4-inch cord completely around weatherstrip in flange cavity.

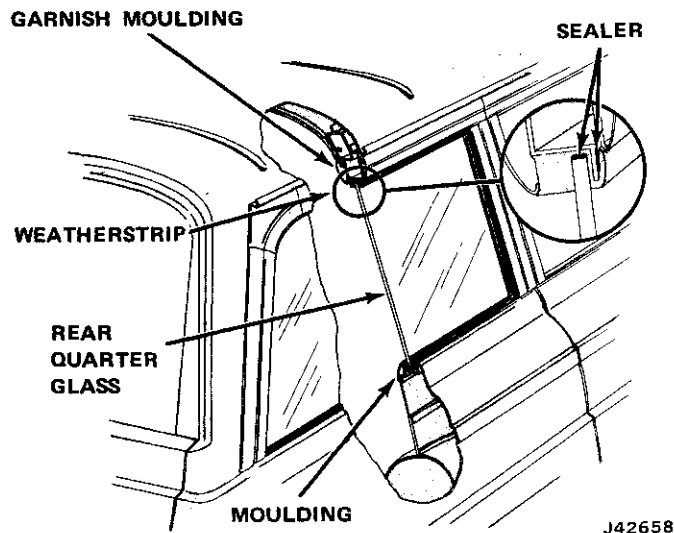


Fig. 3K-2 Rear Quarter Window—Cherokee-Wagoneer

**NOTE:** The ends of the cord should hang out over the outside surface of the glass approximately in the center of the upper weatherstrip.

(3) Place glass and weatherstrip into position in

window opening with ends of cord hanging outside vehicle (fig. 3K-3).

(4) Pull on ends of cord to pull lip of weatherstrip over body panel. With cord removed, weatherstrip should be positioned correctly.

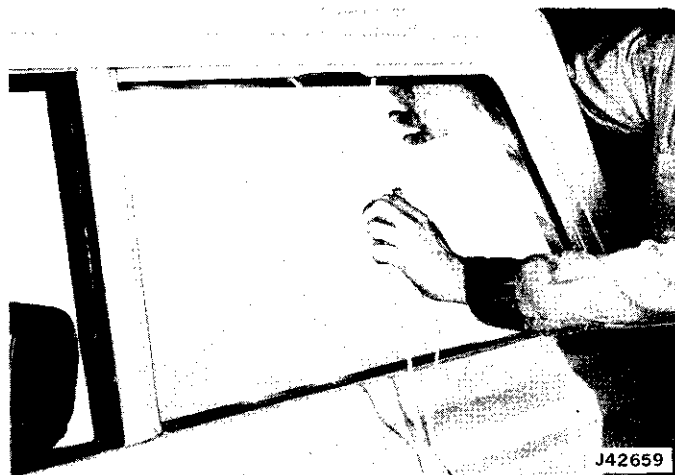


Fig. 3K-3 Rear Quarter Window Installation

- (5) Install interior garnish moulding.
- (6) Apply bead of 3M Auto Bedding and Glazing Compound or equivalent from outside of vehicle between weatherstrip and body panels.
- (7) Clean excess sealer from glass and exterior body surface.
- (8) Test window for water leaks.

**Tools**



TRIM PAD DEPRESSOR J-2631-01



# LUGGAGE RACKS 3L

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### GENERAL

The luggage rack (fig. 3L-1) consists of side rails, adjustable end rails, end and center supports, and roof mounted slats. A spanner wrench, located in the vehicle glove box, facilitates securing the adjustable end rails.

The ends and center supports are attached to the roof top with rubber-coated well nuts and machine screws. The roof slats are attached with sheet metal screws and pressure sensitive tape.

Luggage rack components can be replaced without removing the entire assembly from vehicle.

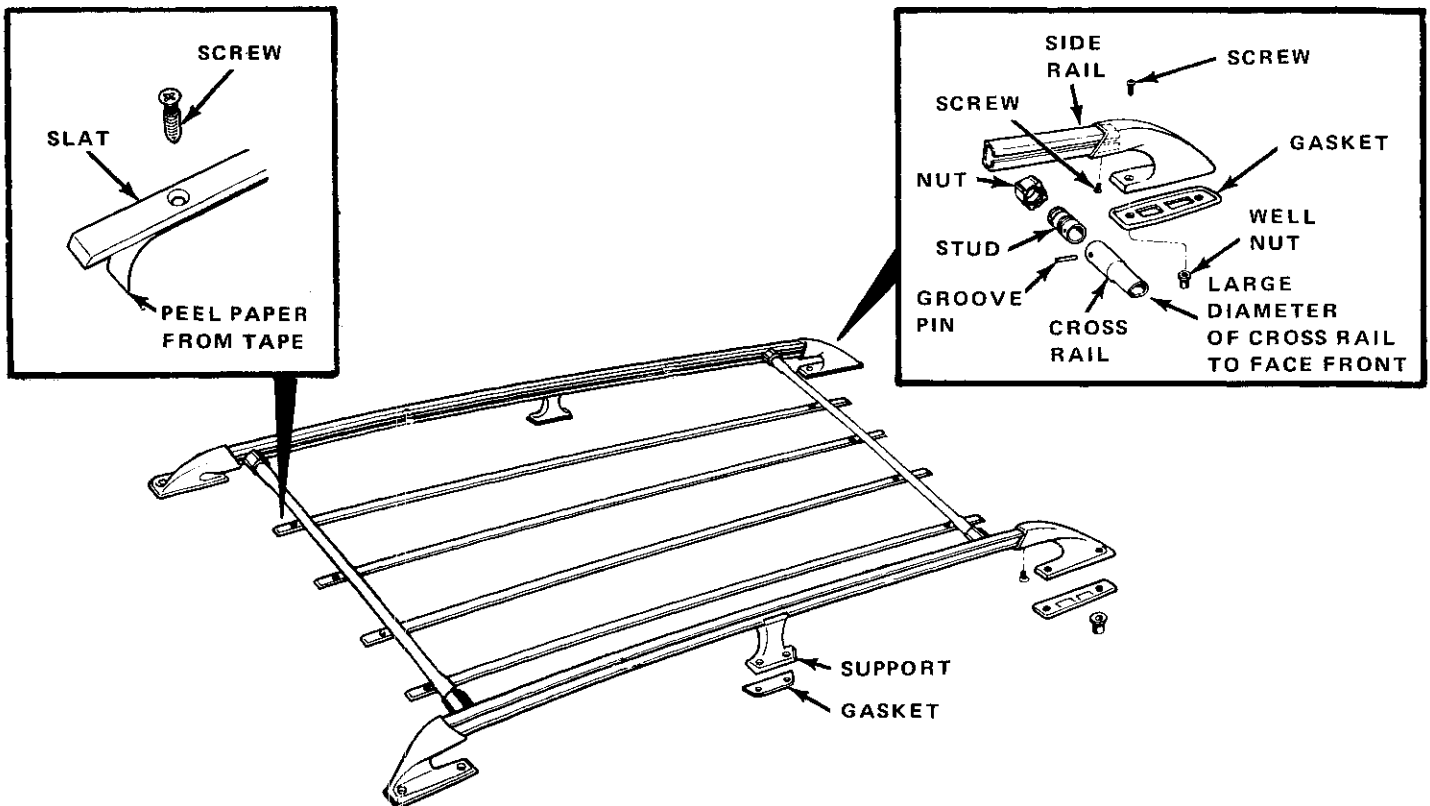


Fig. 3L-1 Luggage Rack



## 3L-2 LUGGAGE RACKS

### SUPPORT

#### Removal

- (1) Remove screw(s) attaching support to side rail.
- (2) Remove attaching screws from support.

**NOTE:** Do not apply extreme pressure to support attaching screws during removal or installation as this may cause the well nuts to drop between the roof panel and headliner.

- (3) Remove support and gasket from roof.

#### Installation

- (1) Position support on side rail.
- (2) Position support and gasket on roof.
- (3) Coat screw threads with 3M Drip-Chek Sealer or equivalent, and install screws. Tighten screws to 28 inch-pounds (3 N•m) torque.
- (4) Install screw(s) attaching support to side rail.

### ADJUSTABLE END RAIL

#### Removal

- (1) Remove screws attaching end supports to side rails.
- (2) Remove attaching screws from end supports.

**NOTE:** Do not apply extreme pressure to support attaching screws during removal or installation as this may cause the well nuts to drop between the roof panel and headliner.

- (3) Remove end supports and gaskets from roof.
- (4) Loosen adjustable end rail lock nuts and remove adjustable end rail from side rails.

#### Installation

- (1) Position adjustable end rail in side rails.
- (2) Position end supports on side rails.
- (3) Position end supports and gaskets on roof.
- (4) Coat screw threads with 3M Drip-Chek Sealer or equivalent, and install screws. Tighten screws to 28 inch-pounds (3 N•m) torque.
- (5) Install screws attaching end supports to side rails.
- (6) Tighten adjustable end rail lock nuts.

### SIDE RAIL

#### Removal

- (1) Remove screws attaching side rail to supports.

- (2) Remove screws attaching end support to roof.

**NOTE:** Do not apply extreme pressure to support attaching screws during removal or installation as this may cause the well nuts to drop between the roof panel and headliner.

- (3) Remove end support and side rail.

#### Installation

- (1) Position side rail on supports.
- (2) Position end support and gasket on roof.
- (3) Coat screw threads with 3M Drip-Chek Sealer or equivalent, and install screws. Tighten screws to 28 inch-pounds (3 N•m) torque.
- (4) Install screws attaching side rail to supports.

### ROOF SLAT

#### Removal

- (1) Remove screws attaching roof slat to roof.
- (2) Use 3M Release Agent or equivalent to soften adhesive bond.
  - (a) Using snorkel tube, spray between roof slat and roof panel.
  - (b) Allow 2 to 3 minutes for penetration and softening of adhesive bond.
- (3) Carefully pry roof slat up from roof using a wooden or fiber stick.
- (4) Remove roof slat.

#### Installation

**CAUTION:** Exercise care not to damage painted surface when using cleaning solvents. To determine if a solvent will damage the paint, test solvent on a hidden area of the vehicle.

- (1) Clean adhesive residue and wax from surface with cloth dampened with 3M General Purpose Adhesive Cleaner or equivalent.

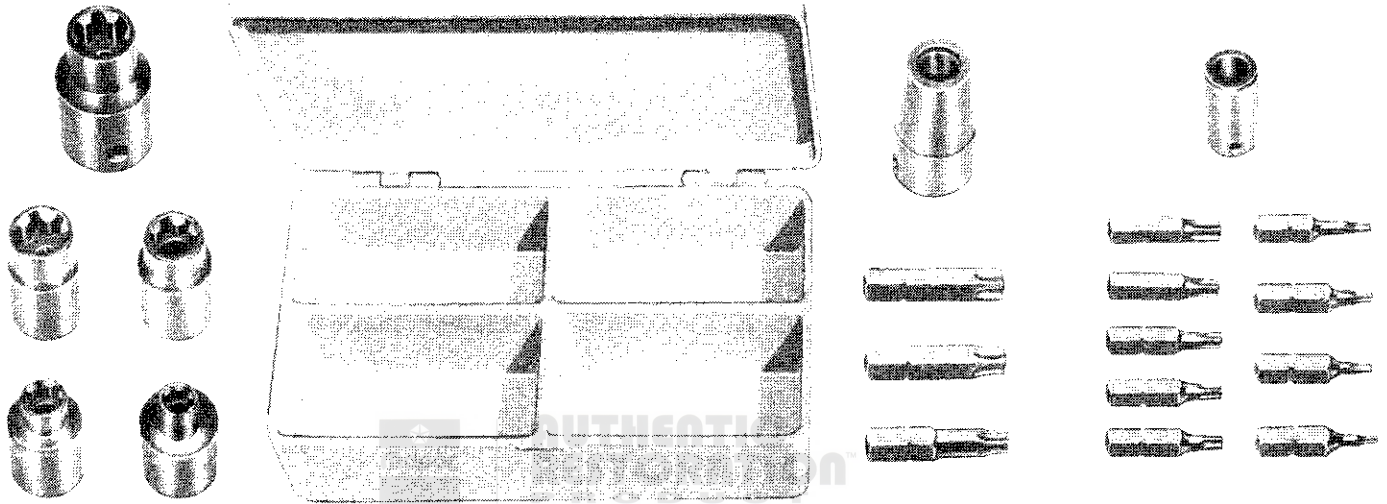
**NOTE:** Surface must be clean and dry for roof slat to adhere.

- (2) Heat metal to minimum 68°F with heat gun J-25070 or heat lamp.

**CAUTION:** Do not install roof slats on fresh paint that has not been properly cured.

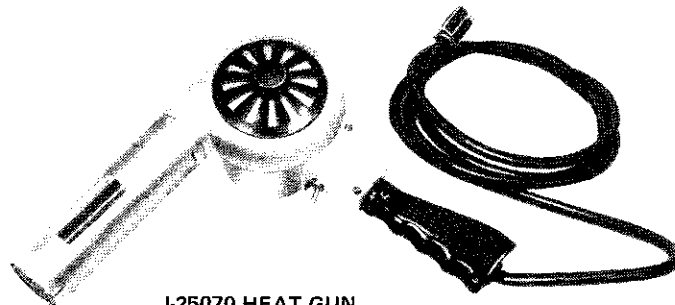
- (3) Peel backing paper from roof slat and position on roof.
- (4) Firmly press roof slat to roof with roller or heavy hand pressure.
- (5) Install screws attaching roof slat to roof.

Tools



J-25359-02  
TORX BIT AND SOCKET SET

70119

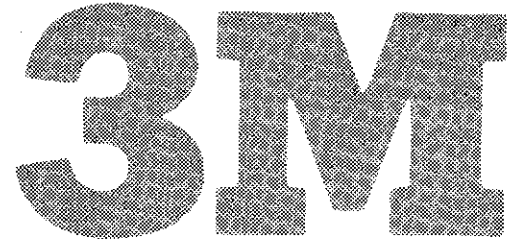


J-25070 HEAT GUN

70301



# SEAT ASSEMBLIES



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## FRONT SEATS

Cherokee-Wagoneer-Truck Bench Seats	Page 3M-4	CJ Console	Page 3M-5
Cherokee-Wagoneer-Truck Bucket Seats	3M-4	CJ 2/3-1/3 Style Seats	3M-1
CJ Bucket Seats	3M-1	Seat Belt	3M-6

### GENERAL

Bucket seats are standard on 2-door Cherokee and CJ models (fig. 3M-1) and optional on the Wagoneer, 4-door Cherokee, and Truck models. The passenger side bucket seat, except CJ, is adjustable fore and aft. On Cherokee 2-door and Truck models, the passenger side bucket seat has a forward tilting seat back for access to rear seat or tool storage area. A folding support for passenger side bucket seat on CJ models allows the whole seat to move forward for easier entry to the rear area.

On all Truck models, the bench seatback swings forward for access to the seatback storage area. The seatback locks automatically in the fully upright position to prevent it from tilting forward in the event of sudden stops. To release the seatback lock, pull up on the seatback release.

The fore-and-aft seat adjuster mechanism for Cherokee-Wagoneer-Truck models and left front CJ seats has a turnbuckle to allow for slight dimensional variances during production assembly of seats and seat support components. The turnbuckle permits the seat sliding and latching components to be adjusted for trouble-free operation. Adjustment of the turnbuckle is covered in this chapter.

All seat belts utilize quick-release buckle latches. Cherokee and Wagoneer models are equipped with three sets of rear seat belts; the two outboard seat belt retractors are anchored on the wheel housings.

### CJ BUCKET SEATS

The seats are removed by unfastening the supports and braces from the floorpan.

The left front seat frame attaches to the seat slides and the seat slides, in turn, attach to braces or supports which are fastened to the floorpan. The seat may be locked in the full forward position, or every half inch toward the full rear position, for a distance of approximately 2-1/2 inches on CJ-5 models and five inches on other models.

#### Removal

- (1) Remove screws (fig. 3M-1) attaching supports and braces to floorpan.
- (2) Remove seat assembly from vehicle.

#### Installation

- (1) Position seat assembly in vehicle.
- (2) Install screws attaching supports and braces to floorpan. Tighten screws to 15 foot-pounds (20 N•m) torque.

### CJ 2/3-1/3 STYLE SEATS

The seats are removed by unfastening the supports and/or braces from the floorpan.

The left front seat frame attaches to the seat slides and the seat slides, in turn, attach to braces or supports which are fastened to the floorpan. The seat may be

# 3M-2 SEAT ASSEMBLIES

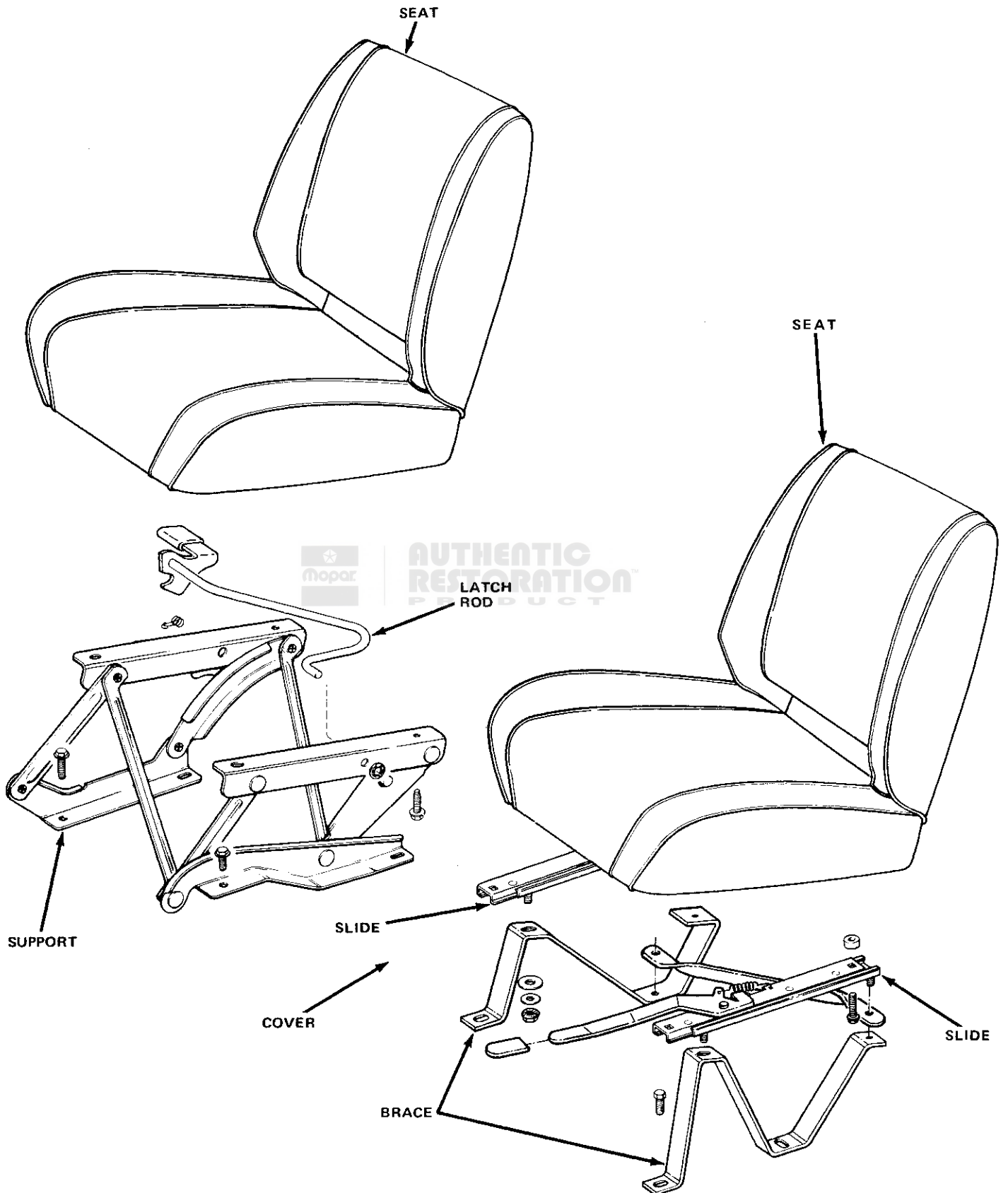


Fig. 3M-1 Bucket Seats—CJ Models

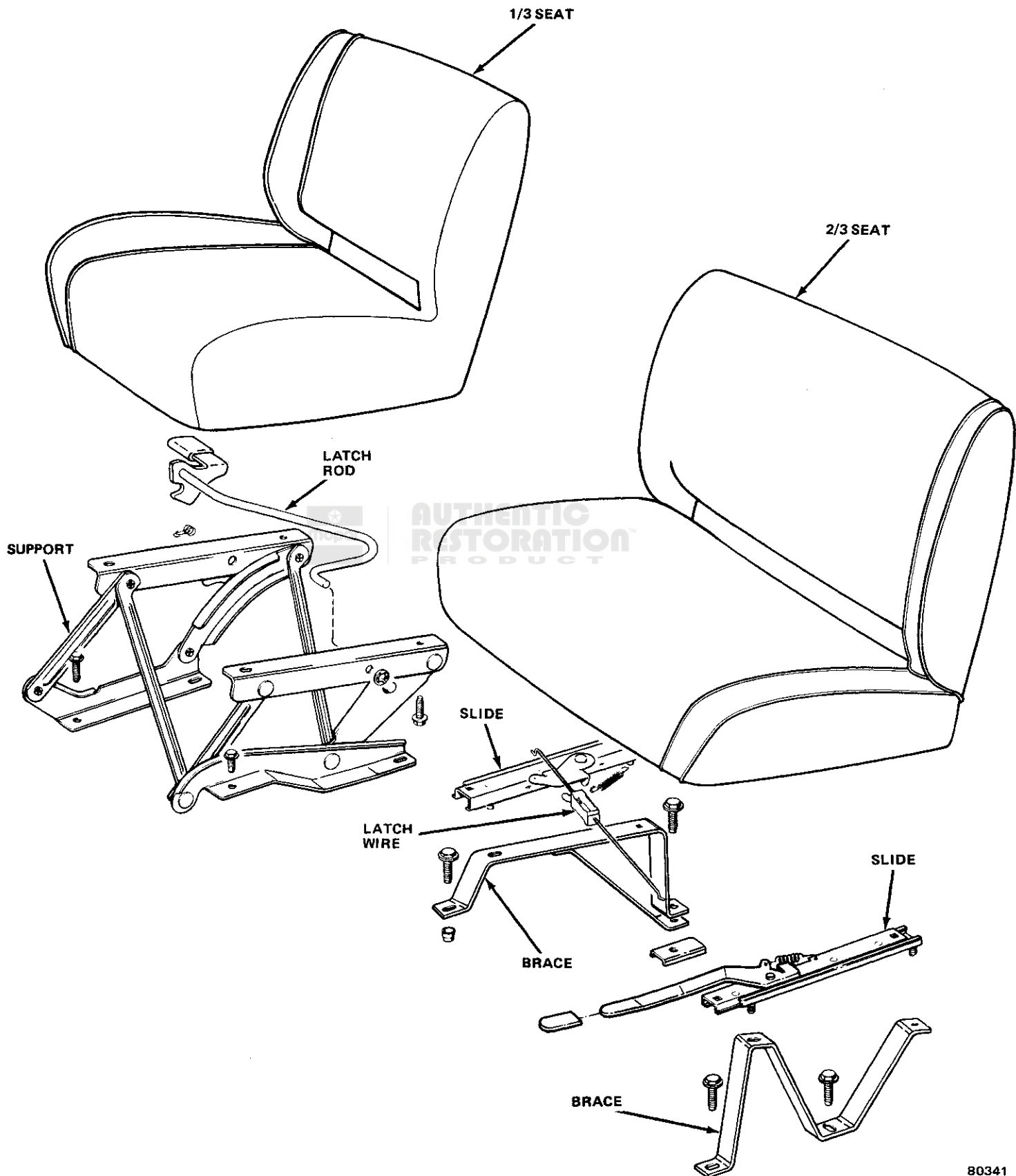


Fig. 3M-2 2/3-1/3 Style Front Seat—CJ Models

## 3M-4 SEAT ASSEMBLIES

locked in the full forward position, or every half inch toward the full rear position, for a distance of approximately 2-1/2 inches on CJ-5 models and five inches on other models.

On left front CJ seats, a latch wire connects the right and left spring-loaded locking levers, facilitating the simultaneous unlocking or locking of both seat adjusting slides.

### Removal

- (1) Remove screws (fig. 3M-2) attaching supports and/or braces to floorpan.
- (2) Remove seat assembly from vehicle.

### Installation

- (1) Position seat assembly in vehicle.
- (2) Install screws attaching supports and/or braces to floorpan. Tighten screws to 15 foot-pounds (20 N•m) torque.

## CHEROKEE-WAGONEER-TRUCK BUCKET SEATS

The seats are removed by unfastening the supports and/or braces from the floorpan.

The front seat frame attaches to the seat slides and the seat slides, in turn, attach to braces or supports which are fastened to the floorpan. The seat may be locked in the full forward position, or every half inch toward the full rear position, for a distance of approximately five inches.

### Removal

- (1) Remove screws attaching supports to floorpan.
- (2) Remove seat assembly from vehicle.

### Installation

- (1) Position seat assembly in vehicle.
- (2) Install screws attaching supports to floorpan. Tighten screws to 20 foot-pounds (27 N•m) torque.

## Forward Tilting Seat Back Replacement—Cherokee and Truck Models

- (1) If equipped with center armrest, remove bucket seat from vehicle.
- (2) Remove screw attaching side wing panel-to-hockey stick using Torx Bit Tool J-25359-02.
- (3) Remove screws attaching hockey sticks to bottom frame using Torx Bit Tool J-25359-02.
- (4) Remove seat back.
- (5) Position seat back on bottom frame and install screws attaching hockey sticks to bottom frame using Torx Bit Tool J-25359-02.
- (6) Position side wing panel on outboard hockey stick and install attaching screw using Torx Bit Tool J-25359-02.

- (7) Install bucket seat in vehicle, if removed.

## Tilt Lock Pawl Assembly

### Removal

- (1) Remove forward tilting seat back.
- (2) Remove screw attaching release handle-to-latching rod using Torx Bit Tool J-25359-02. Remove handle.
- (3) Remove screws attaching plastic bumpers using Torx Bit Tool J-25359-02. Remove bumpers.
- (4) Unzip upholstery and pull back.
- (5) Remove spring retainers attaching latching rod (fig. 3M-3).
- (6) Remove rod, pawl, and spring from seat.

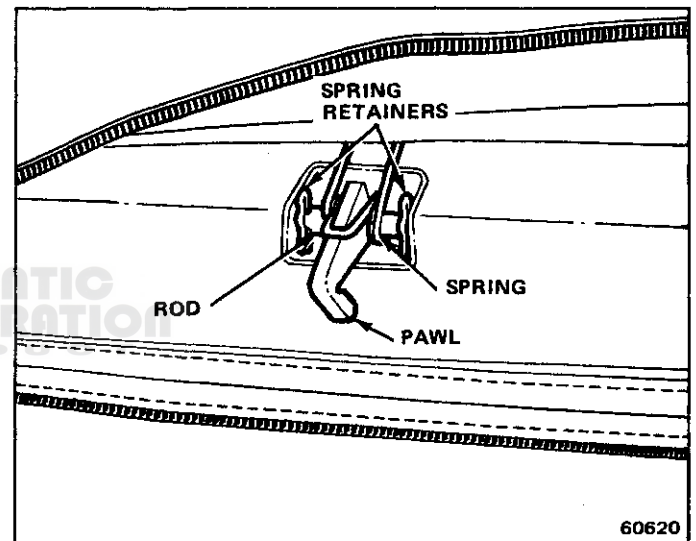


Fig. 3M-3 Tilt Lock Pawl Assembly

### Installation

- (1) Position pawl and spring in seat and install latching rod.
- (2) Install spring retainers attaching latching rod to seat.
- (3) Pull upholstery over pad, zip up and tuck end of zipper under upholstery.
- (4) Position plastic bumpers on seat and install attaching screws using Torx Bit Tool J-25359-02.
- (5) Position release handle on latching rod and install attaching screw using Torx Bit Tool J-25359-02.
- (6) Install forward tilting seat back.

## CHEROKEE-WAGONEER-TRUCK BENCH SEATS

The seats are removed by unfastening the supports and/or braces from the floorpan.

The front seat frame attaches to the seat slides and the seat slides, in turn, attach to supports which are fastened to the floorpan. The seat may be locked in the full forward position, or every half inch toward the full rear position, for a distance of approximately five inches.

On bench seats and bucket seats, a latch wire connects the right and left spring-loaded locking levers, facilitating the simultaneous unlocking or locking of both seat adjusting slides.

### Removal

- (1) Remove screws attaching supports to floorpan.
- (2) Remove seat assembly from vehicle.

### Installation

- (1) Position seat assembly in vehicle.
- (2) Install screws attaching supports to floorpan. Tighten screws to 20 foot-pounds (27 N•m) torque.

### Adjustment

- (1) Locate turnbuckle under the bench seat (fig. 3M-4). Loosen turnbuckle wingnut.
- (2) Tighten turnbuckle until slack is removed from wire.
- (3) Back off turnbuckle three turns.
- (4) Secure wingnut up against turnbuckle.
- (5) Check for proper seat adjustment operation. If right side of seat will not release, increase tension by tightening turnbuckle. If right side of seat will not lock in place, decrease tension by loosening turnbuckle.

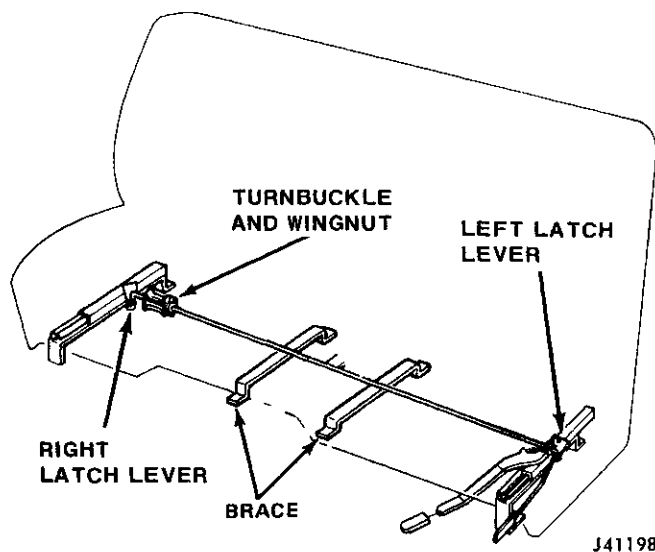


Fig. 3M-4 Front Seat Adjustment

### CJ FLOOR CONSOLE

The beverage container type floor console (fig. 3M-5), available only with bucket seat equipped models, is fabricated from molded plastic material. The floor console cover is provided with a lock and two depressions designed to hold beverage containers. The bottom of the floor console is equipped with a hole, in the rear, allowing ice water to drain onto the ground.

The oval head key is utilized to lock and unlock the cover.

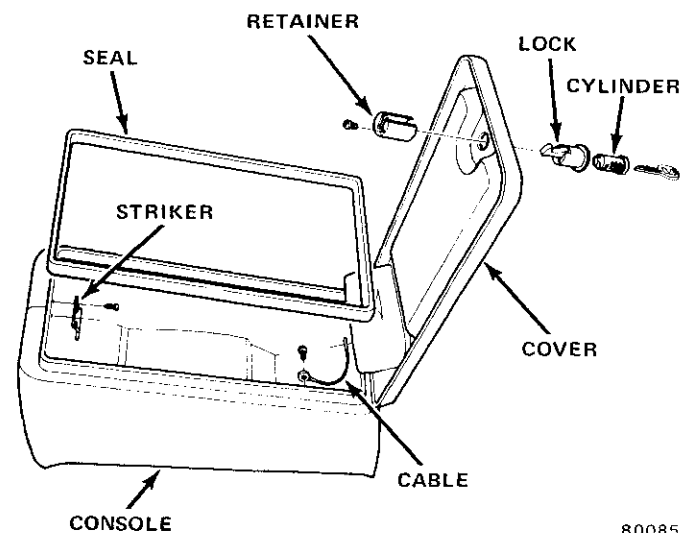


Fig. 3M-5 Floor Console Components

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### Removal

- (1) Open console cover.
- (2) Remove screws attaching console to floorpan.
- (3) Remove console assembly from vehicle.

### Installation

- (1) Position console assembly in vehicle.
- (2) Align drain hole with hole in floorpan and install attaching screws.
- (3) Close and latch console cover.

### Console Cover Seal

The console cover seal is attached to the console. The foam seal may be replaced after opening the cover.

### Console Cover Lock

#### Lock Cylinder Removal

- (1) Open console cover.
- (2) Remove screw attaching retainer to lock. Remove retainer from lock.
- (3) Remove lock, cylinder and key as a unit from cover.
- (4) Manually set latch to simulate closed cover position, turn key and cylinder counterclockwise and lift out of lock.

#### Lock Cylinder Installation

- (1) Manually set latch to simulate closed cover position.
- (2) Insert key and cylinder into lock and turn clockwise. Release latch and remove key.
- (3) Position assembled lock in cover and install retainer and attaching screw.



## 3M-6 SEAT ASSEMBLIES

### SEAT BELTS

#### Removal

- (1) Remove seat belt anchor bolt with Torx Bit Tool J-25359-02.
- (2) Remove seat belt.
- (3) Remove shoulder belt guide cover from guide, if equipped.
- (4) Remove guide bolt with Torx Bit Tool J-25359-02.
- (5) Obtain access to seat belt retractors by removing trim covers.
- (6) Remove seat belt retractors anchor bolts with Torx Bit Tool J-25359-02.

- (7) Remove seat belt retractor.
- (8) Inspect seat belt material for evidence of wear, cuts, or fraying. Replace as required.

#### Installation

- (1) Install seat belt and seat belt retractor anchor bolts. Tighten to 25 to 35 foot-pounds (34 to 47 N•m) torque.
- (2) Position shoulder belt guide on B-pillar and install bolt with Torx Bit Tool J-25359-02.
- (3) Install shoulder belt guide cover.
- (4) Install seat belt retractor trim cover.

## REAR SEATS

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### CJ SEATS

The rear seat assembly (fig. 3M-6) is mounted by bolts to supports which, in turn, are secured to the floorpan of the vehicle by bolts.

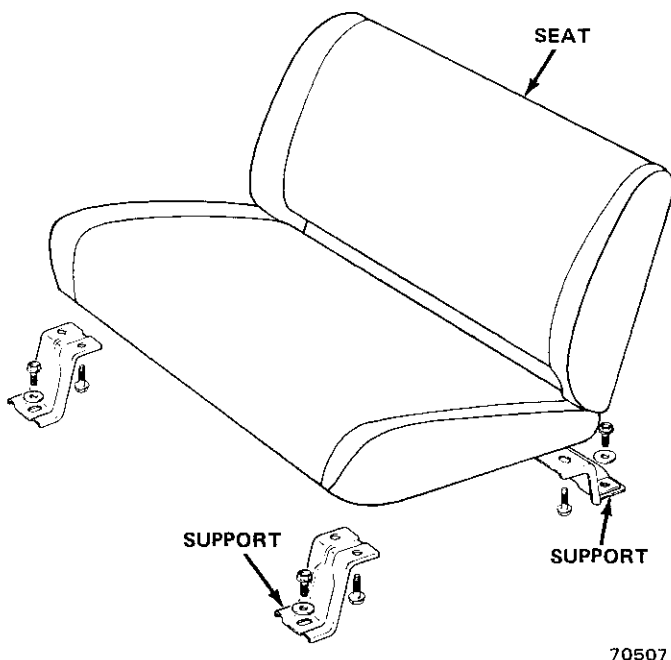


Fig. 3M-6 Rear Seat Assembly—CJ Models

All seats are of spring design and utilize padding and foam rubber in their construction.

#### Removal

- (1) Remove bolts attaching rear seat assembly to floorpan.
- (2) Remove rear seat assembly from vehicle.

#### Installation

- (1) Position rear seat assembly in vehicle.
- (2) Install bolts attaching rear seat assembly to floorpan.

### CHEROKEE-WAGONEER SEATS

The full width rear seat is attached to the floorpan by two hinges to allow the seat to be folded forward or removed to provide an enlarged rear cargo area (fig. 3M-7).

A latch on each side of the rear seat back engages a striker bolted into cage nuts on the rear wheelhouse panels. The cage nuts allow movement for striker adjustment.

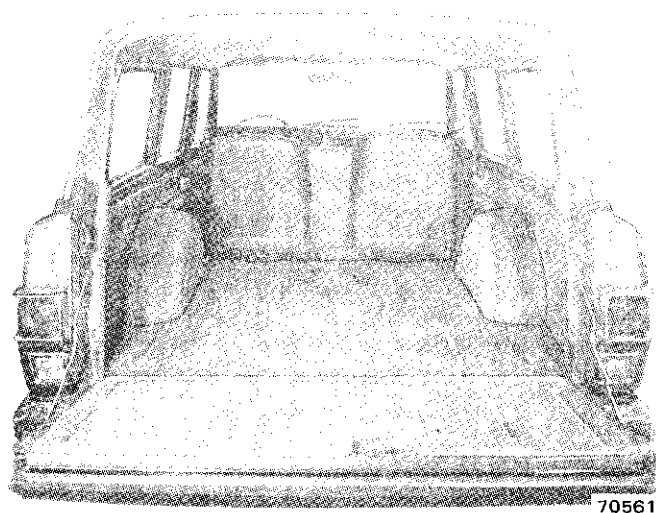


Fig. 3M-7 Rear Cargo Area with Rear Seat Removed

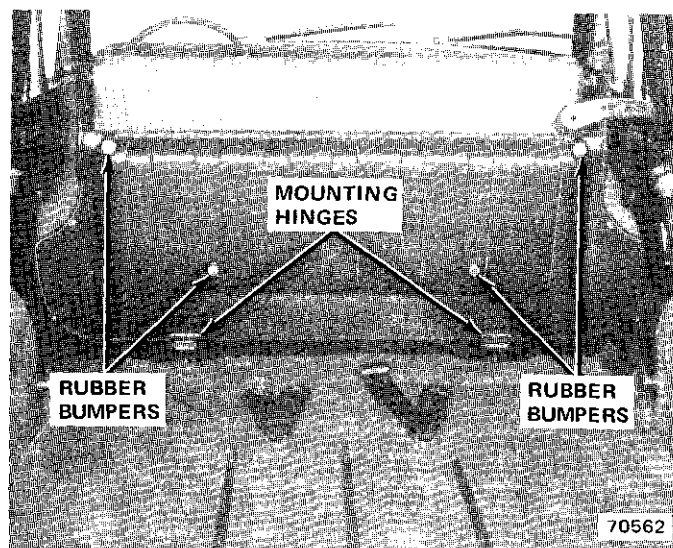


Fig. 3M-9 Rear Seat Assembly

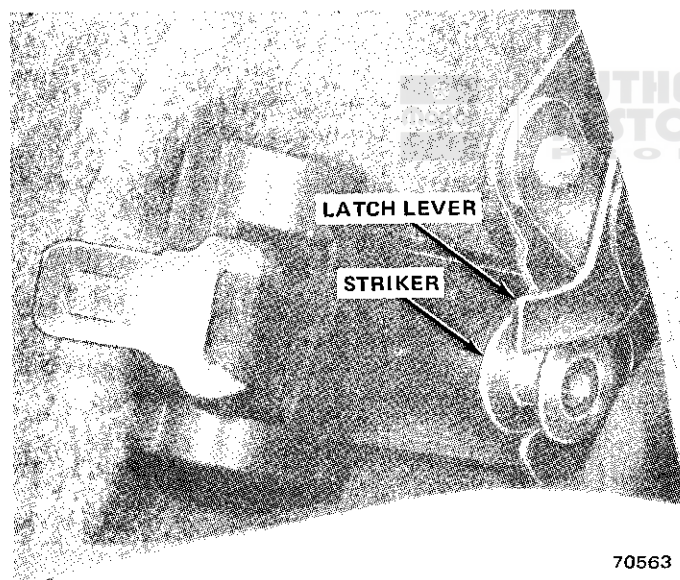


Fig. 3M-8 Rear Folding Seat—Latched Position

To tilt the seat back forward, release the latch on the right side by raising the latch lever (fig. 3M-8) and simultaneously pulling the seat back forward.

A rear seat holding strap, attached to the right door pillar, prevents the seat from falling backward when the seat is in the folded position. An eye on the strap is engaged with the chrome plated stud to prevent the seat from falling backward. The strap always should be connected to the stud whenever the seat is in the folded position.

### Removal

- (1) Release latch at lower right side of seat back. Raise complete seat assembly forward (fig. 3M-9).
- (2) Lift complete seat assembly from two floor mounting hinges.
- (3) Remove seat assembly from vehicle.

### Installation

- (1) Install seat assembly onto hinges.
- (2) Position seat back in proper location.
- (3) Secure seat back latch.

### Adjustment

- (1) Tilt seat back forward and loosen striker bolt to allow forced movement of striker.
- (2) Raise seat back to upright position and tap striker into position for maximum latch/striker engagement.
- (3) Unlatch seat back carefully so as not to change striker position and tighten striker securely.
- (4) Check striker/latch operation.

## SEAT BELTS

### Removal

- (1) Remove seat belt anchor bolt with Torx Bit Tool J-25359-02.

## 3M-8 SEAT ASSEMBLIES

- (2) Remove seat belt.
- (3) Remove shoulder belt guide cover from guide, if equipped.
- (4) Remove guide bolt with Torx Bit Tool J-25359-02.
- (5) Obtain access to seat belt retractors by removing trim covers.
- (6) Remove seat belt retractors anchor bolts with Torx Bit Tool J-25359-02.
- (7) Remove seat belt retractor.
- (8) Inspect seat belt material for evidence of wear,

cuts, or fraying. Replace as required.

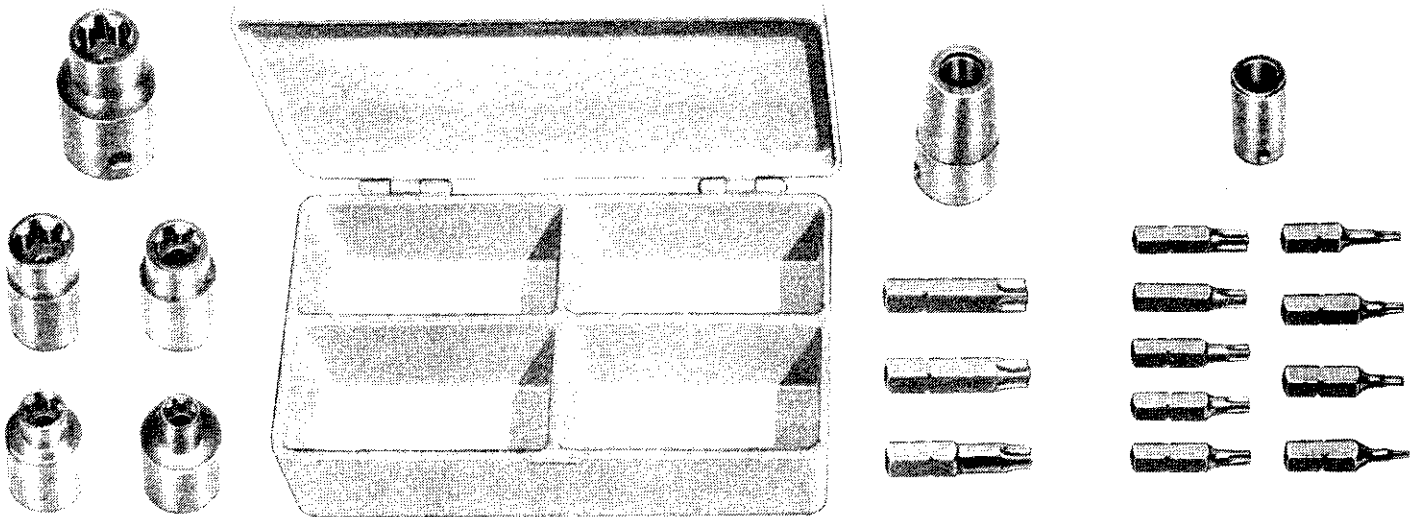
### Installation

- (1) Install seat belt and seat belt retractor anchor bolts. Tighten to 25 to 35 foot-pounds (34 to 47 N•m) torque.
- (2) Position shoulder belt guide on B-pillar and install bolt with Torx Bit Tool J-25359-02.
- (3) Install shoulder belt guide cover.
- (4) Install seat belt retractor trim cover.



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### Tools



J-25359-02 TORX BIT AND SOCKET SET

70119

# WINDSHIELD - REAR WINDOW

# 3N

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## WINDSHIELD

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CJ Folding Windshield	3N-1	Rear View Mirror Bracket	3N-5
CJ Windshield Glass	3N-2	Tools	3N-7

### GENERAL

The windshields on all models consist of two sheets of plate glass laminated together to form a one-piece safety glass.

All CJ windshields are retained in their openings by rubber weatherstrips (channels).

New for 1979, all Cherokee-Wagoneer-Truck model windshields are bonded to the rubber weatherstrip and the rubber weatherstrip is bonded to the body opening to improve glass retention and sealing.

The safety type glass is designed with adequate clearance to prevent stress and strains. When replacing cracked glass resulting from causes other than a direct blow or a known instance of temporary misalignment, it is very important that the cause of the breakage be determined and the condition corrected.

The inside rear view mirror bracket for all models is bonded directly to the windshield glass with a polyvinyl-butyl compound through a heat-induction process.

Service replacement windshield glass may have the rear view mirror bracket bonded to the windshield glass. In this case, the mirror is simply transferred from the damaged windshield to the bracket on the replacement windshield.

If the replacement windshield does not have a bonded mirror bracket or if the bonded bracket has been lost, a service kit is available for bracket installation. The kit is available from your local parts distribution center and consists of a replacement bracket and a firm-setting, two-component adhesive. Installation instructions are included in the kit, and also in this section.

**NOTE:** Do not attempt to remount the original bracket. Use a new bracket kit.

### CJ FOLDING WINDSHIELD

The windshield and frame assembly may be lowered to the hood by removing the knobs at each side of the windshield. When in the lowered position, always secure the windshield by passing the strap at the top of the windshield through the footman loop on the hood and drawing the strap up firmly.

#### Removal

- (1) Remove necessary top components from windshield frame.
- (2) Disconnect wiper motor wiring harness from switch.
- (3) Remove windshield hinge-to-frame attaching screws using Torx Bit Tool J-25359-02.
- (4) Remove windshield holddown knobs and remove windshield frame.

#### Installation

- (1) Position windshield frame on vehicle and install windshield hinge-to-frame attaching screws using Torx Bit Tool J-25359-02.
- (2) Install windshield holddown knobs.
- (3) Connect wiper motor wiring harness to switch.
- (4) Install necessary top components to windshield frame.

### CJ WINDSHIELD GLASS

#### Removal

- (1) Cover adjoining painted surfaces to protect finish.
- (2) Remove windshield wiper arms using wide blade screwdriver.
- (3) Remove inside rear view mirror from bracket.
- (4) Remove sun visors and defroster ducts.
- (5) Starting at top of windshield frame, pull glass weatherstrip away from flange while gently pushing out on glass.
- (6) Work entire weatherstrip from pinch weld flange and remove glass.

#### Installation

- (1) Using 3M Auto Bedding and Glazing Compound or equivalent, apply a 1/16-inch bead of sealer completely around weatherstrip in flange cavity.
- (2) Install weatherstrip on glass. Split in weatherstrip should be centered on bottom edge of glass.
- (3) Beginning at bottom of glass, work weatherstrip over flange using a fibre or wooden wand.
- (4) Apply 3M Windshield Sealer or equivalent, between weatherstrip and outside of glass around entire perimeter.
- (5) Clean off excess sealer.
- (6) Install inside rear view mirror on bracket.
- (7) Install defroster ducts and sun visors.
- (8) Install windshield wiper arms.
- (9) Test windshield installation for water leaks.

### CHEROKEE-WAGONEER-TRUCK WINDSHIELD GLASS

A self-curing urethane adhesive is used to bond the windshield glass to the rubber weatherstrip and the rubber weatherstrip to the body opening. This material provides the strength necessary to meet the FMVSS regulation covering windshield retention.

**NOTE:** FMVSS regulations require compliance to the standards throughout the life of the vehicle. Therefore, all windshields must be replaced with Windshield Glass Installation Kit (Urethane), Part Number 8128954, or equivalent, to assure compliance.

#### Tools and Materials

The following tools and materials are necessary for a windshield replacement:

- (1) Windshield glass installation kit consisting of the following components:
  - (a) Instruction sheets

- (b) One six-ounce cartridge of urethane adhesive
- (c) One pointed dispensing nozzle
- (d) Five daubers for applying glass and rubber cleaners and primers
- (e) Glass blackout primer
- (f) Rubber primer
- (g) Paint finish primer
- (h) Glass cleaner
- (i) Rubber cleaner
- (2) One six-ounce, hand-operated Adhesive Gun J-24811, or equivalent.
- (3) Electric Hot Knife J-24709-01, or equivalent.
- (4) Razor-blade type knife.
- (5) Masking tape.
- (6) Isopropyl alcohol (rubbing alcohol).
- (7) Clean wiping rags or paper towels.
- (8) Methyl-ethyl-ketone (MEK) or toluene.
- (9) Grow Chemical Solvent GS-35 or equivalent.

**NOTE:** Methyl-ethyl-ketone (MEK), toluene (toluene), and Grow Chemical Solvent GS-35 are usually available from chemical houses listed under SOLVENTS in the Yellow Pages of the telephone directory. If not available locally in small quantities, these solvents may be obtained from mail order chemical houses such as E. H. Sargent & Co. and Fisher Scientific, which have sales-service centers throughout the country. This is neither a complete list, nor a recommendation for the exclusive use of the chemical houses listed.

#### Water Leaks

Water leaks around windshields installed with urethane adhesive can be corrected without removing the windshield glass.

**NOTE:** If the windshield is structurally sound in the body opening, without large breaks in the bond, water leaks may be corrected by using a liquid butyl sealer such as 3M Windo-Weld Resealant or equivalent. When the windshield is not structurally sound in the body opening, the following procedure will apply and will require one Windshield Glass Installation Kit.

- (1) Remove windshield reveal moulding, if equipped.
- (2) Water test around the entire sealing area of windshield.
  - (a) Always begin water spray at lowest point and allow sufficient saturation before moving water spray upward.
  - (b) To best simulate normal conditions that cause water leaks, i.e., rain or washing, water test with a spray pattern rather than a heavy, solid stream of water which can create misleading symptoms.

**NOTE:** If leak is between windshield glass and rubber weatherstrip, or between rubber weatherstrip and body, carefully push outward on glass in area of leak to determine extent of leak. This operation should be performed while water is being applied to leak area. Mark extent of leak area.

(3) From outside body, clean dirt or foreign material from leak area with water; then completely dry area with compressed air.

(4) If leak is between glass and rubber weatherstrip, proceed as follows:

(a) Clean glass area to be resealed with windshield cleaner included in windshield installation kit.

(b) Using a dauber, apply glass blackout primer to edge of glass, in leak area.

(c) Using a clean dauber, apply rubber primer to rubber weatherstrip, in leak area.

(d) Apply urethane adhesive, using pointed nozzle supplied with kit, in leak area.

(5) If leak is between rubber weatherstrip and body, proceed as follows:

(a) Using a dauber as supplied in a windshield installation kit, apply rubber primer to rubber weatherstrip, in leak area.

(b) Using a clean dauber, apply paint primer, in leak area.

(c) Apply urethane adhesive in leak area using pointed nozzle supplied with kit.

(6) Water test windshield immediately using cold water spray. Allow water to spill over edge of glass and rubber weatherstrip. Do not direct hard stream of water on fresh urethane adhesive.

(7) Install all previously removed parts.

**Removal**

(1) Cover adjoining painted surfaces to protect finish.

(2) Remove windshield wiper arms using a wide blade screwdriver.

(3) On vehicles with stainless steel mouldings, perform the following steps.

(a) Remove moulding screws on the top and bottom of side mouldings.

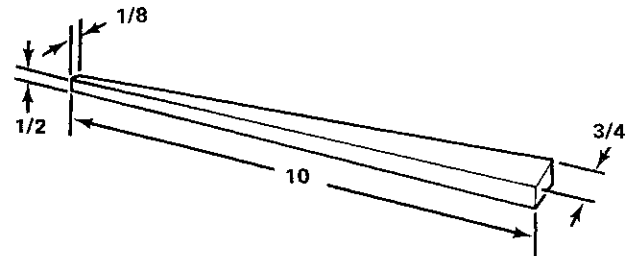
(b) Remove top corner moulding by lifting bottom and pulling outboard.

(c) Tip side mouldings toward center of vehicle and lift off.

(d) Remove top moulding.

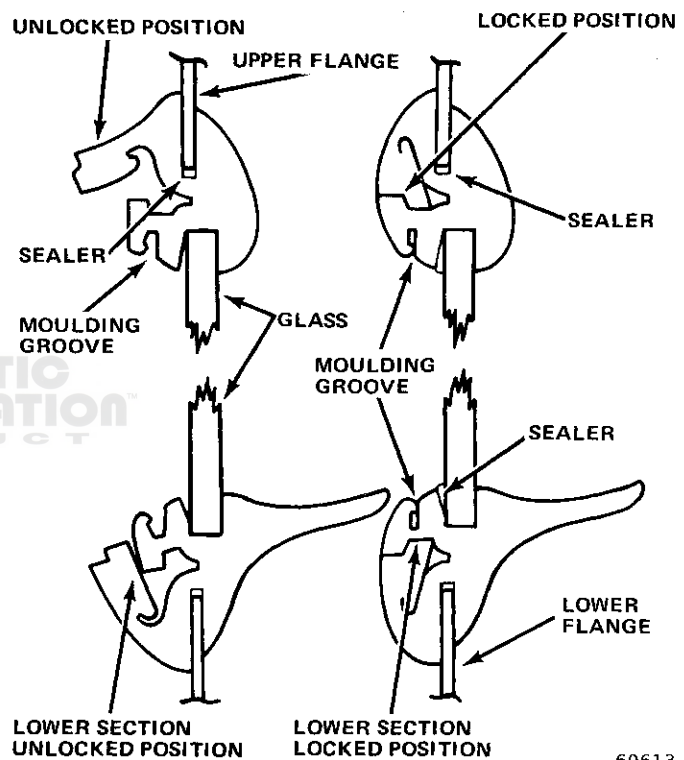
(4) Slide center moulding clip to left or right and remove bottom mouldings. This will expose the locking type weatherstrip.

(5) Use a wedge-shaped fiber or hardwood stick or wand as shown in figure 3N-1 to unlock the weatherstrip as shown in figures 3N-2 and 3N-3. (The locking type weatherstrip without mouldings is shown in figure 3N-3.)



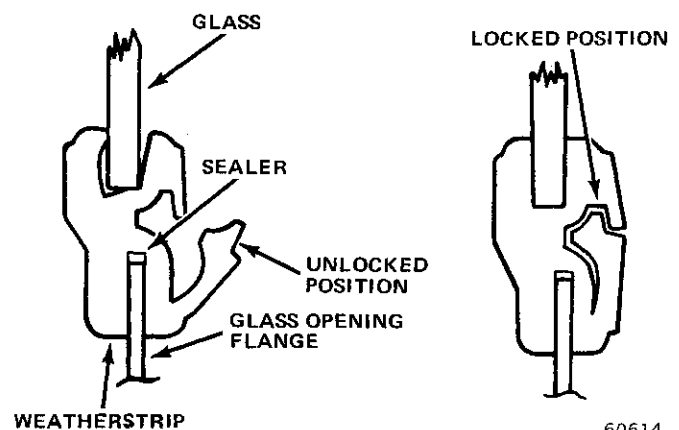
J42670

Fig. 3N-1 Wooden Wand Dimensions (Inches)



60613

Fig. 3N-2 Windshield Weatherstrip Cross Section—Moulding Removed



60614

Fig. 3N-3 Windshield Weatherstrip Cross Section

## 3N-4 WINDSHIELD—REAR WINDOW

(6) Unlock rubber weatherstrip starting at the bottom with a fiber stick or wand as shown in figure 3N-4.

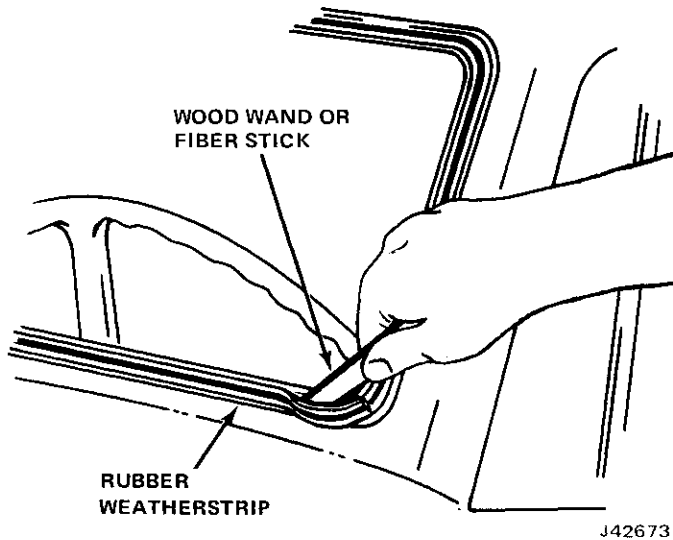


Fig. 3N-4 Unlocking Rubber Weatherstrip

(7) Remove inside rear view mirror from bracket.

(8) Use razor-blade knife to cut rubber weatherstrip, in locking lip groove, between glass and body flange.

(9) Remove windshield glass from body opening.

(10) Remove rubber weatherstrip from body opening flange.

**NOTE:** Inspect for uneven surfaces or irregularities in the windshield opening flange that could cause stress damage to the windshield glass.

(11) Remove old urethane adhesive from body opening flange using a razor-blade type knife or Electric Hot Knife J-24709-01 equipped with the Plow-Type Blade J-24851.

**NOTE:** Do not damage the painted surface of the body during above procedure.

### Installation

**NOTE:** Windshield installation should be accomplished in relatively warm surroundings so that the windshield rubber weatherstrip remains pliable making installation easier and reducing the possibility of breaking the windshield glass.

When a replacement windshield glass is installed, a replacement mirror bracket must be installed if the replacement windshield glass is not equipped with one. Follow the detailed procedure in this Chapter or with the mirror bracket kit supplied as a service part.

(1) Apply one-inch wide masking tape to outside of glass 1/2-inch inboard from edge of glass; apply tape to top, sides and bottom as shown in figure 3N-5.

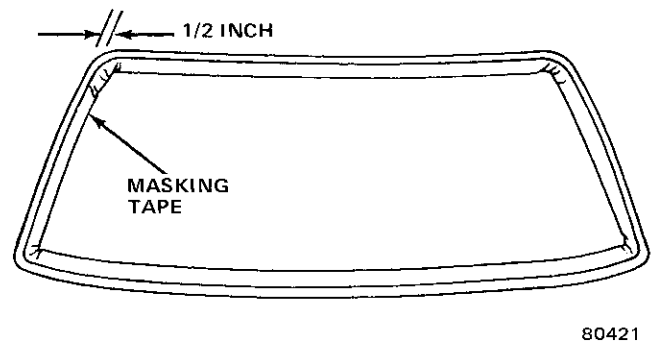


Fig. 3N-5 Installation of Windshield Glass Masking Tape

(2) Using dauber supplied in kit, wipe surface of glass to which glass blackout primer will be applied (between masking tape and including edge of glass).

(3) Using a clean dauber, apply 1/2-inch band of glass blackout primer around entire outside of glass and outer edge. Allow primer to dry for 10 minutes.

**CAUTION:** Use care not to spill or drip glass blackout primer on painted or trimmed surfaces. Wipe spills immediately as primer will etch trim or painted surfaces.

(4) Obtain replacement rubber weatherstrip. Using a clean dauber, wipe glass cavity and body flange cavity clean.

(5) Using another dauber, apply rubber primer around inside of glass cavity and body flange cavity. Allow primer to dry for 30 minutes.

(6) Using isopropyl alcohol dampened rag, wipe body opening flange clean and allow to dry.

(7) Apply 2-inch wide masking tape on outside of windshield opening at roof, A-pillars and cowl top to prevent damaging body paint.

(8) Using a clean dauber or brush, apply paint finish primer to body opening flange as shown in figure 3N-6. Allow primer to dry for 25 minutes.

**NOTE:** Do not use glass blackout primer on body opening flange.

(9) Apply smooth, continuous bead of urethane adhesive material inside of rubber weatherstrip body flange cavity. Bead should be 1/8-inch in diameter.

(10) Install rubber weatherstrip on windshield opening flange.

(11) Apply a liberal amount of soap and water solution to edge of windshield glass.

(12) Place a 1/8-inch diameter cord in bottom glass cavity of rubber weatherstrip.

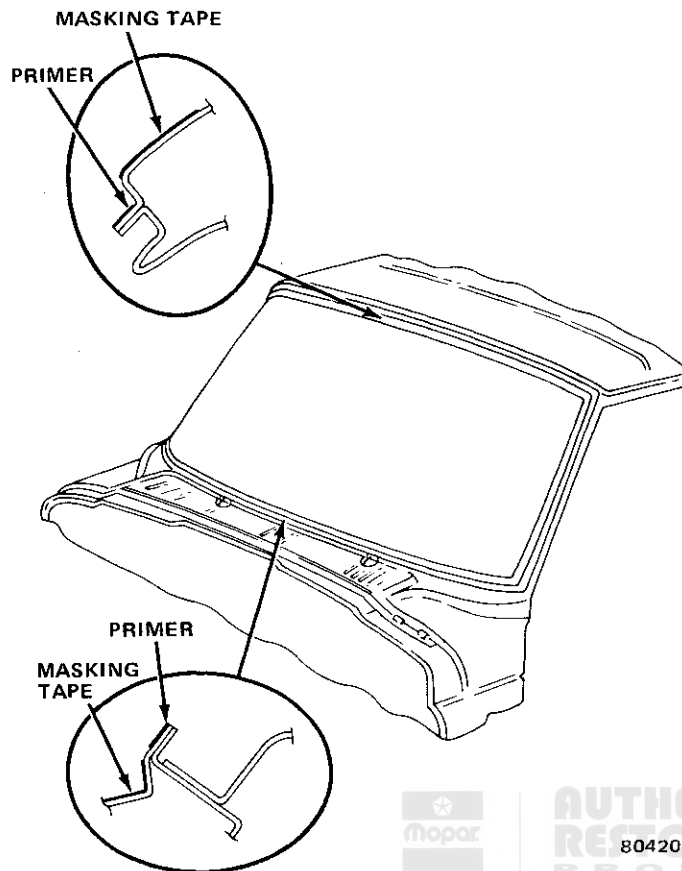


Fig. 3N-6 Installing Body Opening Masking Tape and Primer

(13) Remove masking tape from windshield glass.

(14) With two men working on the outside of vehicle, work windshield into upper glass cavity and into each side.

(15) Position a wooden wand (fig. 3N-1) under the bottom of the glass and lift windshield up and into lower glass cavity.

(16) Check for equal side clearances.

(17) Wipe soap and water solution from windshield glass and rubber weatherstrip.

(18) Apply smooth, continuous bead of urethane adhesive material around entire outside edge of windshield glass and rubber weatherstrip. Bead should be 1/8-inch in diameter.

(19) Use wooden wand to lock weatherstrip as shown in locked position (fig. 3N-2 and 3N-3).

**NOTE:** Urethane adhesive material begins to cure after 15-minute exposure to air and moisture.

(20) Water test windshield immediately using cold water spray. Do not direct hard stream of water on fresh urethane adhesive material. If leaks are encountered, apply extra urethane adhesive material with pointed nozzle.

(21) Bottom mouldings are installed one at a time. To facilitate installation, place a 1/8-inch diameter cord in weatherstrip moulding retaining groove along entire

length of weatherstrip, leaving enough cord hanging out at each end to permit a good grip on cord.

(22) Working first with either left or right bottom moulding, place moulding in groove.

(23) Starting at the outside corner of the weatherstrip, pull up on cord while lightly tapping top of moulding with rubber mallet. This will lock the moulding in the weatherstrip retaining groove. Continue the process until moulding is installed in weatherstrip. Repeat process with the other bottom moulding, again starting at the outside corner.

(24) Install center moulding clip to cover gap between left and right bottom moulding.

(25) The one-piece top moulding is installed in the same manner, except that the moulding is tapped upward into retaining groove.

(26) Side and upper corner mouldings can then be inserted in retaining groove and secured by installing upper and lower screws.

(27) Remove masking tape from body.

(28) Clean excess urethane adhesive material from windshield, body and mouldings with cloth dampened with Grow Chemical Solvent GS-35 or equivalent.

(29) Install side moulding screws.

(30) Install windshield wiper arms.

(31) Install inside rear view mirror on bracket.

## REAR VIEW MIRROR BRACKET

### Installation

(1) Locating windshield mounted rear view mirror bracket can be accomplished as shown in figures 3N-7 and 3N-8. Use wax pencil on outside of glass to locate mounting bracket.

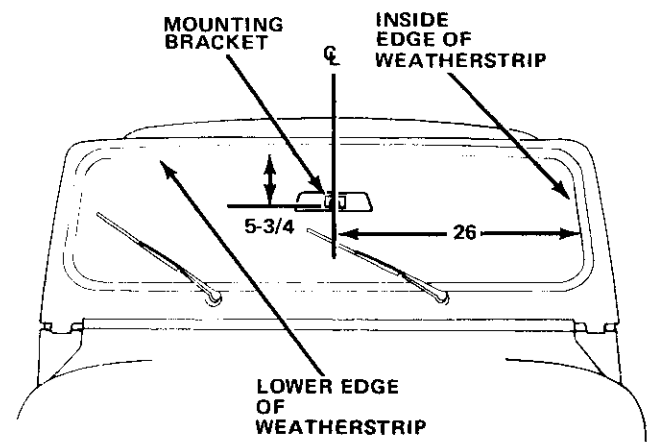
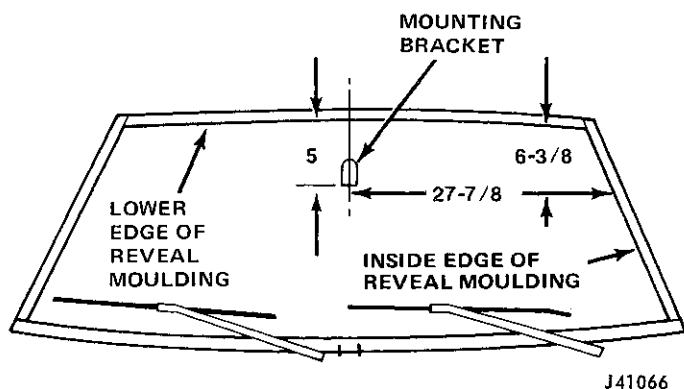


Fig. 3N-7 Windshield Mounted Rear View Mirror Bracket Location (Inches)—CJ Models



## 3N-6 WINDSHIELD—REAR WINDOW



**Fig. 3N-8 Windshield Mounted Rear View Mirror Bracket Location (Inches)—Cherokee-Wagoneer-Truck Models**

(2) If vinyl pad has remained on the windshield glass, apply low heat with an Electric Heat Gun J-25070 until vinyl softens. Then, peel pad from glass using care not to scratch or mar the glass surface.

(3) Clean bracket mounting area of windshield glass thoroughly. Use a mildly abrasive cleaning powder

(Ajax, Comet, or equivalent) applied to clean cloth saturated with alcohol.

(4) Remove all traces of cleanser by wiping area with a paper towel moistened with alcohol.

(5) Scuff bonding surface (the side without the 3/8-inch circular depression) of the mirror bracket with a clean piece of fine grit sandpaper. Apply alcohol to a clean towel and wipe surface clean.

(6) Apply a generous amount of the accelerator (supplied with kit) to mirror bracket mounting surface. Allow five minutes to dry.

(7) Apply a thin film of accelerator to windshield. Allow one minute to dry.

**CAUTION:** Do not touch surfaces to which accelerator has been applied or an imperfect bond could result.

(8) Apply one drop of adhesive at the center of the mirror bracket bonding surface. Use bottom of adhesive tube to distribute the adhesive evenly over the entire surface.

(9) Position bottom straightedge of the bracket on the horizontal line (fig. 3N-7 and 3N-8). Press bracket to glass and hold firmly for one minute. Be sure bracket is properly located as adhesive sets quickly.

# REAR WINDOW

## GENERAL

The rear window is a one-piece, tempered glass. The overall size of the glass varies with the different vehicles.

### CJ-7 With Hardtop Enclosure and Cherokee-Wagoneer Models

For service replacement and adjustment of tailgate window glass, refer to Chapter 3H—Liftgates-Tailgates.

## Truck Models

For service replacement of solid rear glass, refer to CJ Glass Removal or Installation.

The sliding rear window on J-10 and J-20 cabs which provides cab ventilation and ease of communication between passengers in the truck cab and camper body, is replaced as an assembly.

## SPECIFICATIONS

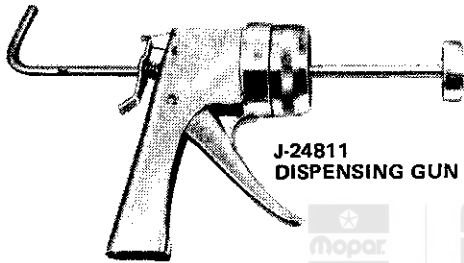
### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

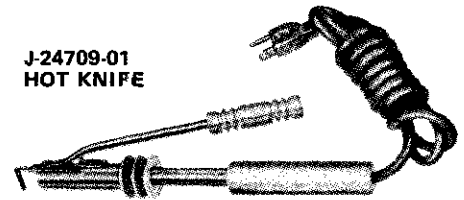
	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	In-Use Recheck Torque	Service Set-To Torque	In-Use Recheck Torque
Rear View Mirror Setscrew .....	15	12-20	2	1-2

All Torque values given in newton-meters and inch-pounds with dry fits unless otherwise specified.

Tools



J-24811  
DISPENSING GUN



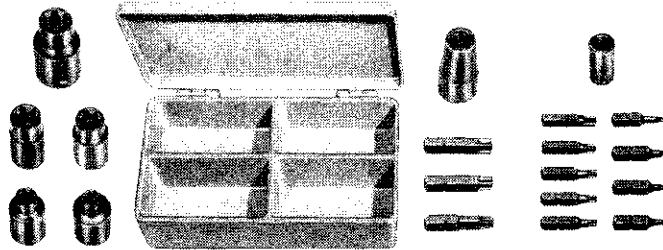
J-24709-01  
HOT KNIFE



J-25070  
HEAT GUN



J-24851  
PLOW-TYPE  
BLADE



J-25359-02  
TORX BIT AND SOCKET SET

 AUTHENTIC RESTORATION PRO

## NOTES



**AUTHENTIC  
RESTORATION™**

# HEADLINING- HARDTOP- EXTERIOR DECALS AND OVERLAYS

# 3P

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## HEADLINING

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### GENERAL

The headlining used in Cherokee, Wagoneer and Truck models is made of laminated polystyrene backing board which is finished, depending on the model, with either a plastic coating, a soft vinyl covering or a close knit fabric. Lines scored into the backing board allow the headlining to be shaped to fit the contour of the roof while providing added strength for self-support.

### CHEROKEE-WAGONEER MODELS

#### Removal

- (1) Remove sun visors, escutcheons and center support.
- (2) Remove windshield moulding and end caps.
- (3) Remove rear opening moulding and end caps.
- (4) Remove plastic trim center moulding and end cap retainers.
- (5) Remove lens from dome lamp and cargo lamp. Remove screws attaching lamp to roof bows. Remove and disconnect cargo lamp switch.
- (6) Remove coat hooks.
- (7) Free rear headlining from J-moulding by pulling down carefully at the center, while pushing up on either outside edge.
- (8) Push cargo lamp through die-cut opening in headlining.
- (9) Remove rear headlining through tailgate opening.

(10) Free front headlining from J-moulding by pulling down carefully at the center, while pushing up on outside edges.

(11) Remove front headlining through tailgate opening.

#### Installation

- (1) Position front headlining in vehicle and insert left side into J-moulding.
- (2) Pull dome lamp through die-cut opening in headlining and align front headlining to vehicle roof.
- (3) Pull down carefully at center of front headlining and insert right side of headlining into J-moulding.
- (4) Position rear headlining in vehicle and insert left side into J-moulding.
- (5) Pull cargo lamp through die-cut opening in rear headlining and align rear headlining to vehicle roof.
- (6) Pull down carefully at center of rear headlining while pushing up on right edge, and insert right side of headlining into J-moulding.
- (7) Check alignment of front headlining using sun visor and dome lamp holes and leading edge of headlining as guide. Adjust fore or aft as required.
- (8) Check alignment of rear headlining using the trailing edge as a guide. Adjust fore or aft as required.
- (9) Secure dome lamp and cargo lamp to roof bows and install lamp lenses. Install and connect cargo lamp switch.
- (10) Install plastic center mouldings and end cap retainers.

## 3P-2 HEADLINING—HARDTOP ENCLOSURE—EXTERIOR DECALS AND OVERLAYS

- (11) Install coat hooks.
- (12) Install rear opening moulding and end caps.
- (13) Install windshield moulding and end caps.
- (14) Install escutcheons, sun visors and center support.

### Roof Bow Adjustment

Noise from the headliner may be caused by improperly adjusted roof bows.

- (1) Remove headliner
- (2) Loosen roof bow attaching screws, using Torx Bit J-25359-02.
- (3) Insert screwdriver through hole in roof bow and raise roof bow against roof panel.
- (4) Tighten roof bow attaching screws using Torx Bit J-25359-02.
- (5) Install headliner.

### TRUCK MODELS

#### Removal

- (1) Remove sun visors and center support.
- (2) Remove lens from dome lamp. Remove screws attaching dome lamp to rear window panel.

- (3) Remove windshield moulding and end caps.
- (4) Pull down carefully at center of headlining while pushing up on outside edges to disengage headlining from J-moulding.
- (5) Push dome lamp through die-cut opening in headlining.
- (6) Remove headlining from vehicle.

#### Installation

- (1) Position headlining in vehicle and insert left side into J-mouldings.
- (2) Pull dome lamp through die-cut opening and align headlining to vehicle roof.
- (3) Pull down carefully at center of headlining while pushing up on right edge, and insert right side of headlining into J-moulding.
- (4) Check alignment of the headlining using the sun visor and dome lamp holes and headlining leading edge as guides. Adjust fore and aft as necessary.
- (5) Secure dome lamp to rear window panel and install dome lamp lens.
- (6) Install windshield moulding and end cap.
- (7) Install sun visors and center support.

## HARDTOP ENCLOSURE

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Removal	3P-2		

### GENERAL

A lightweight, removable hardtop enclosure is available for the CJ-7. The top is constructed of injection molded polycarbonate. The hardtop enclosure and steel liftgate are painted with a special spatter finish polyurethane enamel.

### REMOVAL

- (1) Remove screws attaching hardtop enclosure to windshield frame (fig. 3P-1).
- (2) Remove nuts, washers and screws attaching hardtop enclosure to rear quarter panels.
- (3) Remove hardtop enclosure from vehicle.

**CAUTION:** When removing hardtop enclosure, avoid damaging foam sealer installed between the hardtop enclosure and rear quarter panels.

### INSTALLATION

- (1) Inspect tabular windshield seal, bonded to hardtop enclosure, for damage. Replace if necessary.

- (2) Carefully position hardtop enclosure on vehicle.

**CAUTION:** When installing the hardtop enclosure, avoid damaging foam sealer installed between the hardtop enclosure and rear quarter panels.

- (3) Install screws, washers and nuts attaching hardtop enclosure to rear quarter panels.
- (4) Install screws attaching hardtop enclosure to windshield frame.

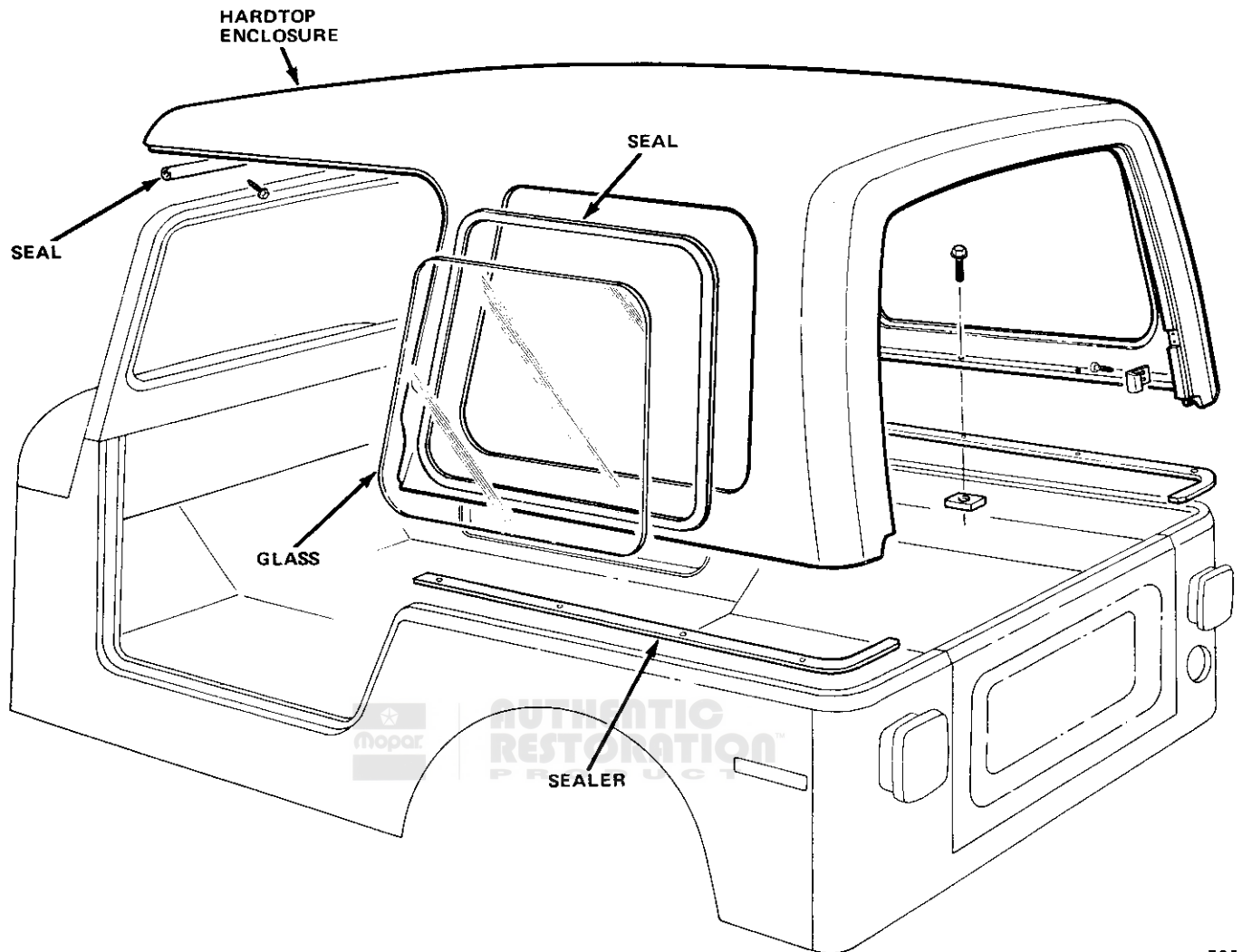
### REPAIR

In the event of top damage, the following material will be required for use with these repair procedures:

- Paint Repair Kit (White)\*
- Paint Repair Kit (Brown)\*
- Paint Repair Kit (Black)\*
- Structural Adhesive (3M Brand or equivalent)

\*Paint repair kits are available from parts distribution centers. The paint repair kits consist of:

- One quart spatter enamel
- One quart sealer coat



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Fig. 3P-1 Hardtop Enclosure Removal

- One pint catalyst
- One quart reducer MEK (methyl-ethyl-ketone)
- One Instruction Sheet

**NOTE:** Methyl-ethyl-ketone (MEK) is usually available from chemical houses listed under SOLVENTS in the Yellow Pages. If not available locally in small quantities, the solvent may be obtained from mail order chemical houses such as E. H. Sargent & Co. and Fisher Scientific, which have sales-service centers throughout the country. This is neither a complete list, nor a recommendation for the exclusive use of the chemical houses listed.

### Dent Repair

- (1) Use a grinder to remove paint and to outline damaged area.
  - (a) Use a grade 24 disc for initial grinding.
  - (b) Follow up with a grade 50 disc to prevent coarse scratches from showing up in final finish.

- (2) Apply plastic body filler, such as Ditzler 999 Body Filler or equivalent. For best results, mix plastic body filler and hardener according to manufacturer's instructions.

- (3) Apply plastic filler with a rubber or plastic spreader as shown in figure 3P-2. Use firm pressure with spreader to aid in removing air bubbles which will show up as pinholes.

- (4) Use an air file or hand file board for shaping of plastic body filler.

- (a) For initial shaping of plastic body filler use a grade 24 paper.

- (b) For shaping and sanding contours in plastic body filler, use a grade 36 or 40 paper.

- (c) For finish sanding plastic body filler, use a grade 40 paper.

- (5) Apply sealer and color coat (refer to Paint Repair Procedure).

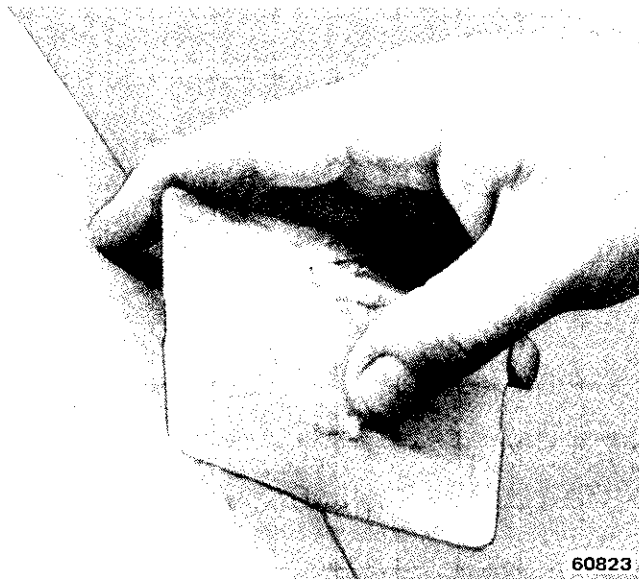


Fig. 3P-2 Applying Plastic Body Filler with Spreader

### Broken Section Repair

(1) Use a grinder to remove paint from both sides, and to outline damaged area.

(a) Use a grade 24 disc for initial grinding.

(b) Follow up with a grade 50 disc to prevent coarse scratches from showing up in final finish.

(2) Bevel edges of break on both sides, using a rotary file as shown in figure 3P-3.

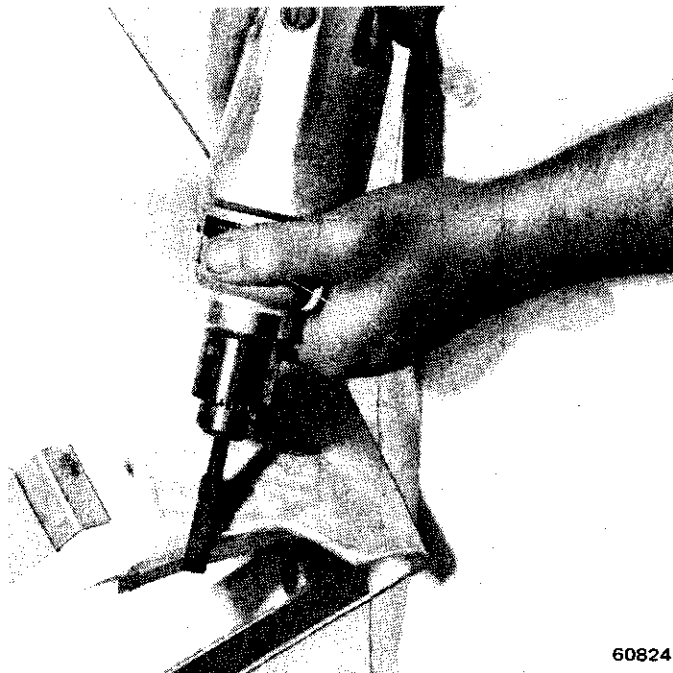


Fig. 3P-3 Beveling Edges of Broken Piece with Rotary File

**NOTE:** Edges should be beveled on the inside and outside on the enclosure to ensure sufficient surface area for bonding.

(3) Clamp broken piece into place leaving a 1/16-inch gap along break line.

(4) Mix Structural Adhesive, according to manufacturer's instructions, apply liberally to break as shown in figure 3P-4.

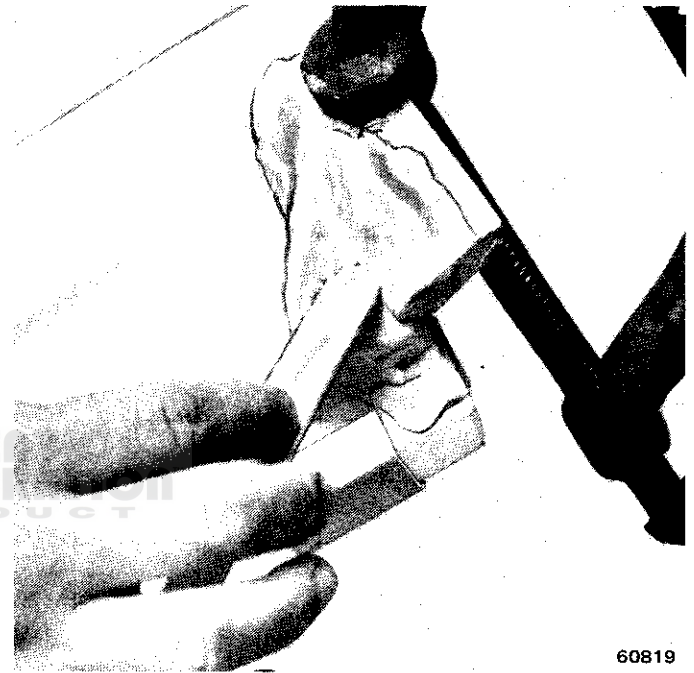


Fig. 3P-4 Applying Structural Adhesive to Broken Piece and Enclosure

(5) Use an air file or hand file board for shaping of hardened Structural Adhesive.

(a) For initial shaping, use a grade 24 paper.

(b) For shaping and sanding contours in Structural Adhesive, use a grade 36 or 40 paper.

(c) For finish sanding, use a grade 80 paper.

(6) Apply sealer and color coat (refer to Paint Repair Procedure).

### Fracture Repair

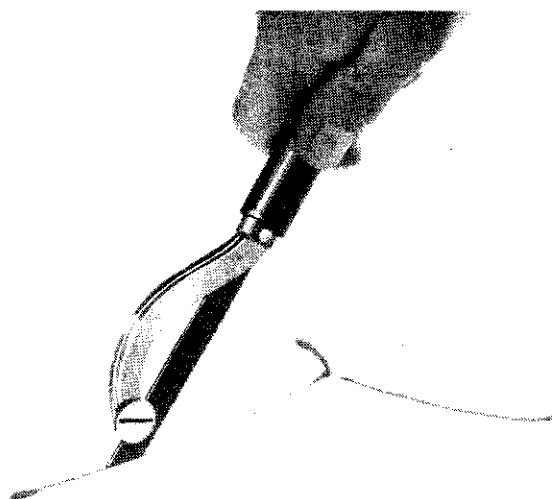
(1) Use a grinder to remove paint from both sides, and to outline damaged area.

(2) Stop-drill crack(s) using 1/8-inch drill bit as shown in figure 3P-5.

(3) Bevel edges of crack(s) on both sides, using a rotary file.

**NOTE:** Edges should be beveled on the inside and outside of the enclosure to ensure sufficient surface area for good bonding.

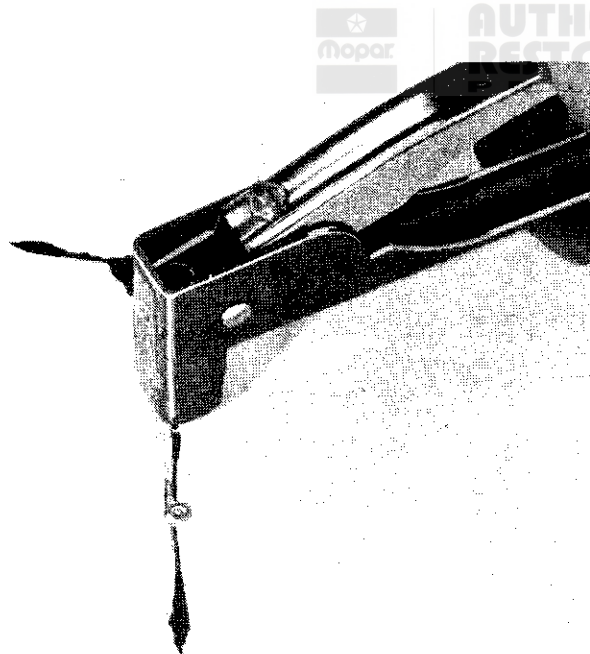
(4) Cut along length of crack(s) using hacksaw blade as shown in figure 3P-6.



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Fig. 3P-6 Cutting to Relieve Crack

**NOTE:** On crack(s) 6 inches or longer it is advisable to countersink pop rivets along length of crack(s) as shown in figure 3P-7.



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Fig. 3P-7 Installing Pop Rivets in Crack

(5) Mix Structural Adhesive, according to manufacturer's instructions, and apply liberally to crack(s) from inside and outside of enclosure as shown in figure 3P-8.

(6) Use an air file or hand file board and sanding block for shaping of Structural Adhesive.

- (a) For initial shaping, use a grade 24 paper.
- (b) For shaping and sanding contours in Struc-

tural Adhesive, use a grade 220 paper on a sanding block.

(c) For finish sanding, use a grade 320 paper.

(7) Apply sealer and color coat (refer to Paint Repair Procedure).



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Fig. 3P-8 Applying Structural Adhesive to Fractured Area

### Paint Repair

(1) Clean repair area using wax and silicone remover or such as DuPont Prep-Sol or Ditzler Acryli-Clean.

(2) Featheredge affected area as described in the following steps:

(a) For rough featheredging, use a grade 80 disc on a random disc sander.

(b) For final featheredging, use a grade 180 disc on a random disc sander or 220 grade paper on a hand sanding block.

(3) Mix sealer according to instruction sheet in kit.

**NOTE:** One paint repair kit is sufficient to paint a complete top. Do not mix more paint than is necessary to cover the area being repaired. The spray equipment being used must be clean.

**CAUTION:** The solvents in polyurethane enamel will dissolve residual lacquers left in the cup or spray gun and may clog the gun or affect the finish surface.

(4) Spray a test panel and adjust spray gun as necessary.

(5) Apply sealer coat to affected area and allow to dry to touch.



## 3P-6 HEADLINING—HARDTOP ENCLOSURE—EXTERIOR DECALS AND OVERLAYS

(6) Empty spray gun and mix texture color coat according to instruction sheet in kit. Stir thoroughly.

(7) Spray a test panel and adjust spray gun to obtain desired texture finish.

**NOTE:** *Paint must be applied in the desired texture finish. This paint does not wrinkle or change texture during drying. Normally, a standard siphon-feed spray gun will provide a satisfactory texture pattern. In some isolated cases, it may be necessary to use a pressure-feed type spray gun to produce a coarse enough texture.*

(8) Spray affected area with texture color coat, starting in the center and working to the outside edges.

(9) Empty spray gun and fill cup with reducer.

(10) Spray reducer on edges of painted area to eliminate overspray and blend in repair.

(11) Bake for 30 minutes at a temperature not to exceed 140°F or let air dry for 24 hours.

(12) Clean spray equipment thoroughly.

**NOTE:** *Equipment must be cleaned immediately after using polyurethane enamel. Once paint dries, there is no known solvent that will remove it.*

### SUN ROOF

A sun roof (fig. 3P-9) is available on CJ-7 models equipped with the hardtop option. The sun roof is raised by turning the operator knob clockwise. To remove the sun roof completely, raise the operator arms until the plastic safety stop contacts the opposite operator arm. Slide the safety stop up the operator arm and pull the operator arm forward, to disengage the arms from the

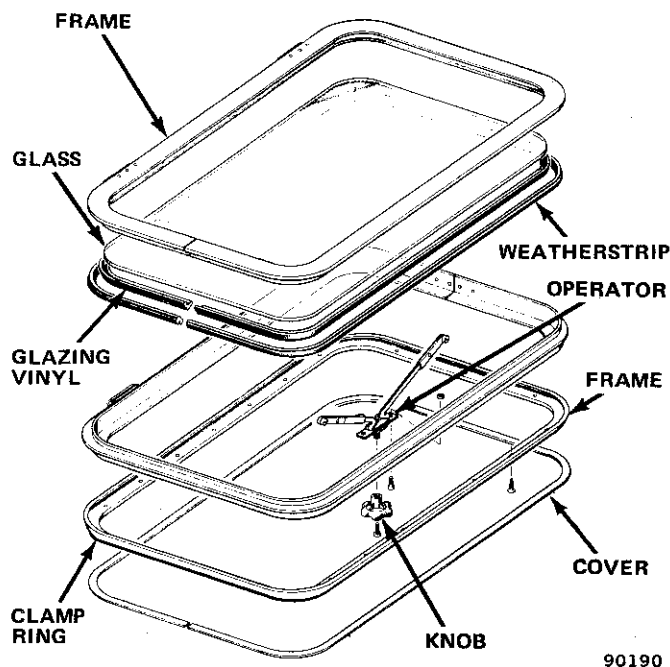


Fig. 3P-9 Sun Roof Components—CJ-7 Models with Hardtop

aluminum glass frame. Remove glass and frame assembly from the metal roof frame by rotating glass and frame assembly forward until hinges disengage from the metal frame.

### Glass/Frame Assembly

#### Removal

(1) Remove glass and aluminum frame assembly from vehicle and place upside down on clean work bench.

(2) Using wooden wand or fiber stick, pry vinyl glazing strip away from glass and frame, and remove glass.

#### Installation

(1) Remove any glass sealant residue on glass or frame sealing surfaces with 3M General Purpose Adhesive Cleaner or equivalent.

(2) Install a thin bead of 3M Clear Silicone Sealer or equivalent on glass frame sealing area.

(3) Install glass into frame and install a thin bead of 3M Clear Silicone Sealer or equivalent around the outer glass edge.

(4) Install vinyl glazing strip into frame channel and test for water leaks.

(5) Install glass and aluminum frame assembly in vehicle.

### Glass Frame Weatherseal

To remove glass frame weatherseal, use a wooden wand or fiber stick to pry weatherseal from sun roof glass frame. Clean weatherseal and adhesive residue from frame channel with 3M General Purpose Adhesive Cleaner or equivalent.

To install replacement weatherseal, first apply a thin bead of 3M Super Weatherseal Adhesive or equivalent to glass frame locating channel. Using wooden wand or fiber stick, install weatherseal in sun roof glass frame.

### Metal Frame/Clamp Ring

The sun roof metal frame and clamp ring are fitted together with self-tapping screws to properly locate the metal frame to the roof opening.

#### Removal

(1) Pry the sun roof screw vinyl cover from the clamp ring.

(2) Remove self-tapping screws and lower retaining ring.

(3) Break the sealant bond between metal frame and roof and remove metal frame from roof.

**Installation**

- (1) Lightly position metal frame to roof panel.
- (2) If sealing voids are evident, use 3M Auto Bedding and Glazing Compound or equivalent to insure a positive seal.
- (3) Locate clamp ring to underside of roof and install self-tapping screws.
- (4) Install vinyl cover around clamp ring.

**Operator**

The operator (regulator) is retained on the metal frame with two machine screws and hex nuts. To remove operator run the operator arms up until it lightly contacts the safety stop. Support the sun roof glass and frame assembly, and remove operator screws and nuts. Slide the safety stop up the operator arm and remove operator.

**EXTERIOR DECALS**

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<b>Repair</b>	3P-7		

**VINYL MOULDINGS REPLACEMENT**

The Jeep Wagoneer Limited model uses woodgrain surround scuff mouldings. The mouldings are made of extruded vinyl with an adhesive backing.

- (1) Use 3M Release Agent, or equivalent, to soften adhesive bond.
  - (a) Use shorkel tube, spray between moulding and panel.
  - (b) Allow 2 to 3 minutes for penetration.
  - (c) Spray a second application and wait 3 minutes for adhesive bond to soften.
- (2) Peel moulding from panel.
- (3) Clean any adhesive residue from surface with a cloth dampered with 3M General Purpose Adhesive Cleaner or equivalent.
- (4) To insure proper moulding alignment, stretch a piece of string at desired level along panel and secure ends with tape.
- (5) Position moulding on car with backing tape attached, and cut to fit.
- (6) Peel away backing tape and press moulding to panel with a roller or heavy hand pressure, parallel with string.
- (7) Remove string.
- (8) Check moulding alignment and trim moulding with razor blade, if necessary.
- (9) If moulding comes loose apply 3M Plastic and Emblem Adhesive, or equivalent to moulding surface and press firmly to body.

**GENERAL**

Exterior decals and stripes are made of tough, durable, weather-resistant solid vinyl and have a pressure-sensitive back. The pressure-sensitive back is protected by a paper backing which is removed at installation. The front (or face) of stripes and decals may be covered with an easy-release paper for protection during shipment or storage. The paper should be removed after installation.

**REPAIRS**

Small nicks or scratches can be touched up with paint in much the same manner as painted surfaces. Proper color match can be obtained by mixing small amounts of appropriate paint colors, then applying it to the affected area of the decal.

To repair blisters or air bubbles, pierce them with a sharp needle or pin. Work the trapped air out through the pin hole and press the decal firmly against the panel. It may be necessary to preheat the panel slightly, with Heat Gun J-25070, to soften the adhesive. Heat also may be used to remove small wrinkles or irregularities.

**REPLACEMENT**

**Preparation**

The temperature of the workroom should be between 65°F and 90°F. Decals should not be replaced in temperatures below 65°F.

The following equipment and materials are necessary for a quality installation:

- Woodgrain and Stripe Remover—3M, or equivalent
- Adhesive Remover—3M, or equivalent
- Liquid detergent (Joy, Vel, or equivalent)
- Wax and silicone remover (3M General Purpose Adhesive Cleaner, xylol, or equivalent)
- Isopropyl alcohol (rubbing alcohol)
- Squeegee (4 to 5 inches wide, plastic or hard rubber)
- Heat Gun J-25020 or infrared heat bulb with extension cord
- Clean wiping rags or paper towels
- Sharp knife, single-edge razor blade or X-acto knife
- Scissors
- Sharp needle or pin
- Grease pencil

#### Removal

- (1) Clean repair surfaces, adjacent panels and openings as required.
- (2) Remove decal overlapping parts from affected panel.
- (3) Mask off area surrounding the panel.
- (4) Spray 3M Woodgrain and Stripe Remover, or equivalent, on flange area first. Then spray entire decal to be removed (fig. 3P-10). Move spray back and forth across entire decal in a smooth steady motion. Make sure entire decal is coated with remover.

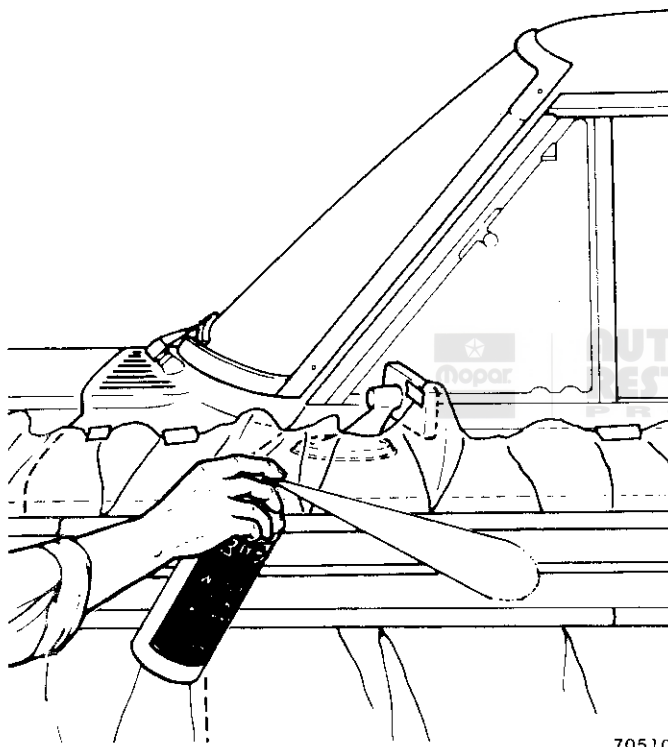


Fig. 3P-10 Spraying Remover on Decal

**CAUTION:** Woodgrain and Stripe Remover from 3M is designed for use on acrylic enamel surfaces only.

**WARNING:** Use 3M Woodgrain and Stripe Remover or equivalent only in a well-ventilated area. Observe manufacturer's warnings printed on label.

- (5) Spray entire panel again, this time moving the spray up and down the decal.
- (6) Allow remover to stay on decal for 20 minutes.
- (7) After 20 minutes, peel decal away from flange areas. Then, start in one corner and peel decal away from panel (fig. 3P-11). If there is any difficulty in peeling decal/overlay away from panel, use squeegee to assist in removal (fig. 3P-12).

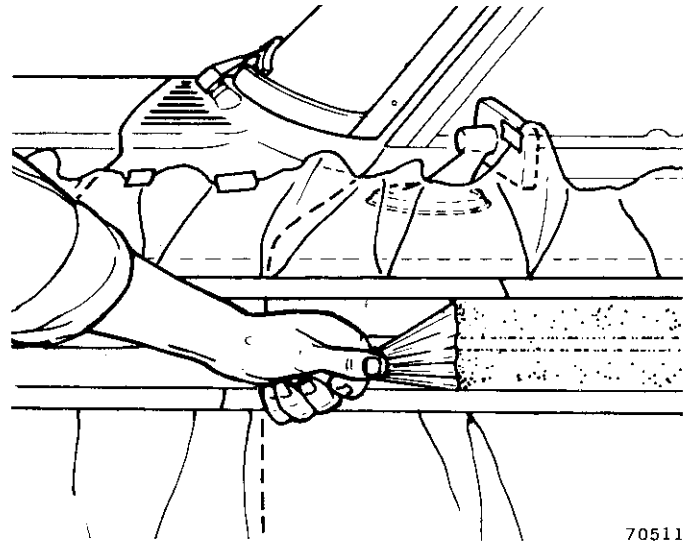


Fig. 3P-11 Peeling Decal from Panel

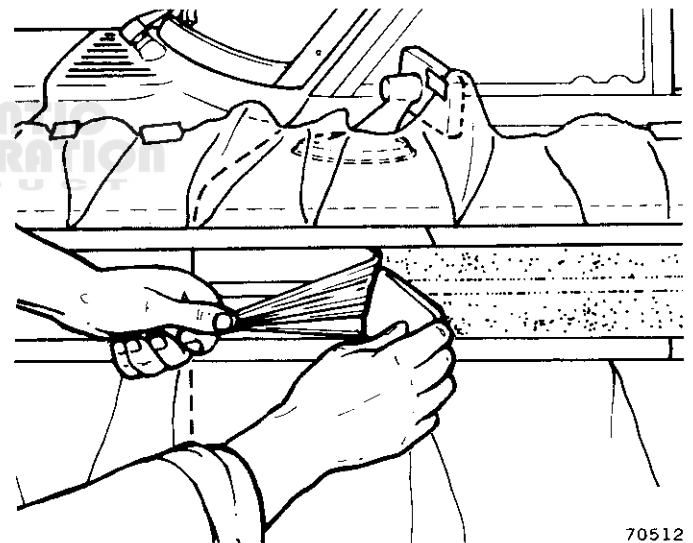


Fig. 3P-12 Using Squeegee to Assist in Removal of Decal

(8) Scrape all 3M Woodgrain and Stripe Remover from surface before proceeding.

(9) After decal is removed, spray panel again with 3M Adhesive Remover, or equivalent, to remove any remaining adhesive. Use a slow spray application and apply in a uniform criss-cross pattern to obtain a heavy coat.

**WARNING:** Use 3M Adhesive Remover, or equivalent, only in a well ventilated area. Observe manufacturer's warnings printed on label.

**CAUTION:** Leaving Remover on surface for too short or long a period may render product ineffective. Allow Remover to work on adhesive surface for three to five minutes.

(10) After five minutes, use squeegee to remove adhesive residue (fig. 3P-13).

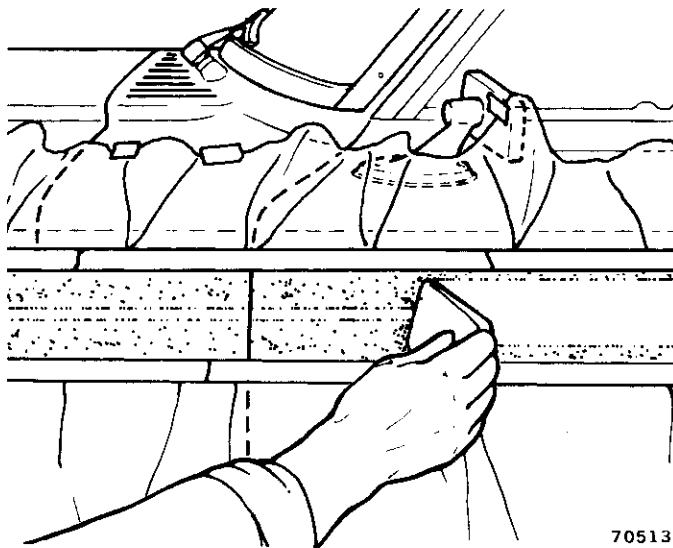


Fig. 3P-13 Using Squeegee to Remove Adhesive Residue

**NOTE:** If some adhesive is difficult to remove, spray additional remover on troublesome spots. Wait approximately two minutes and squeegee remaining spots. Repeat as necessary.

(11) Remove masking tape and paper.

(12) Wash entire panel with 3M General Purpose Adhesive Cleaner, or equivalent. If any spots of adhesive remain on panel, hard rubbing during the washdown will remove them.

### Installation

(1) Clean painted surface with wax and silicone remover. Use 3M General Purpose Adhesive Cleaner, or equivalent. Wipe surface with clean cloth and allow to dry.

**NOTE:** Freshly painted surfaces must be thoroughly dry. Residual solvents in fresh paint may cause decal to blister.

(2) Position decal on panel surface and mark the position with a grease pencil (fig. 3P-14). Ensure that 1/2-inch excess is allowed to be wrapped around the door and fender areas. Cut decal to approximate length using scissors.

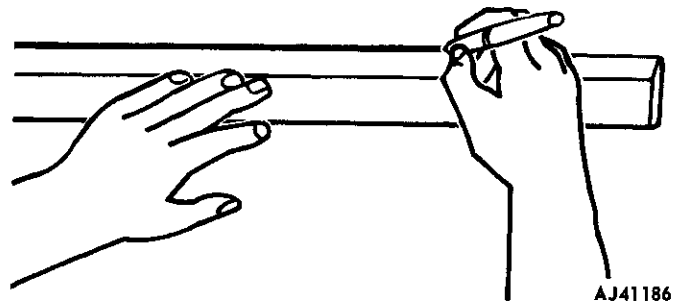


Fig. 3P-14 Marking Decal Position

(3) Position the decal on panel and hold in place with small strips of masking tape (fig. 3P-15). Be sure decal is aligned with decals on adjacent panels.

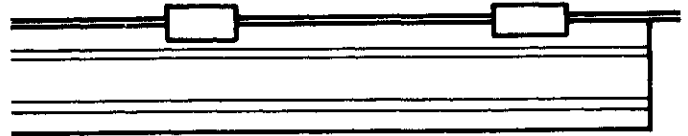


Fig. 3P-15 Positioning Decal on Panel

(4) Lift decal using masking tape as hinges (fig. 3P-16).

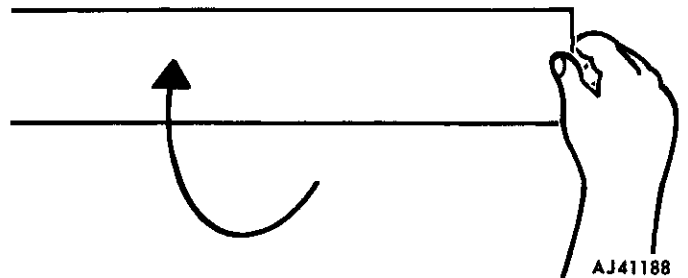


Fig. 3P-16 Lifting Decal

(5) Remove approximately 6 inches of paper backing from one end (fig. 3P-17).

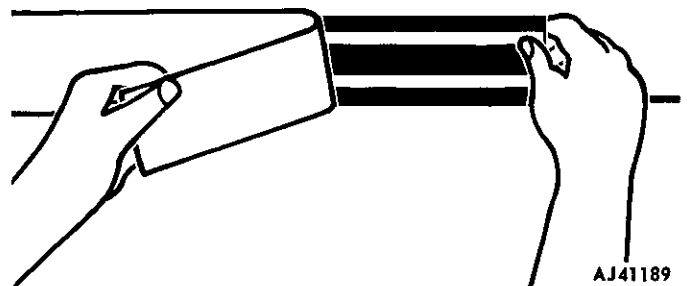


Fig. 3P-17 Removing Backing Paper

## 3P-10 HEADLINING—HARDTOP ENCLOSURE—EXTERIOR DECALS AND OVERLAYS

**NOTE:** To avoid pre-adhesion or stretching the decal, do not remove more than 6 inches of paper backing at one time.

(6) Fold decal back to aligned position. With firm strokes, squeegee decal to panel while removing paper backing (fig. 3P-18).

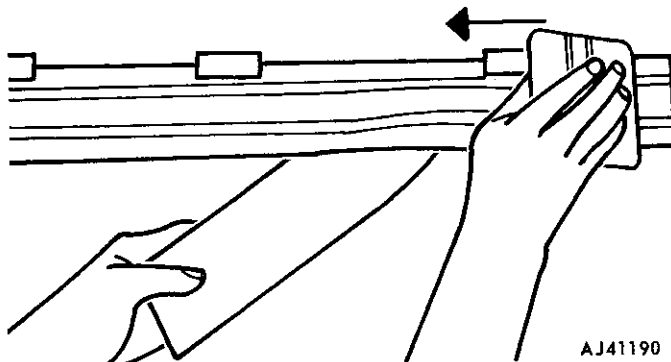


Fig. 3P-18 Installing Decal with Squeegee

(7) Where possible, extend decal 1/2 inch beyond corners or edges (fig. 3P-19) and wrap firmly using finger pressure and squeegee. Avoid trapping air in these areas.

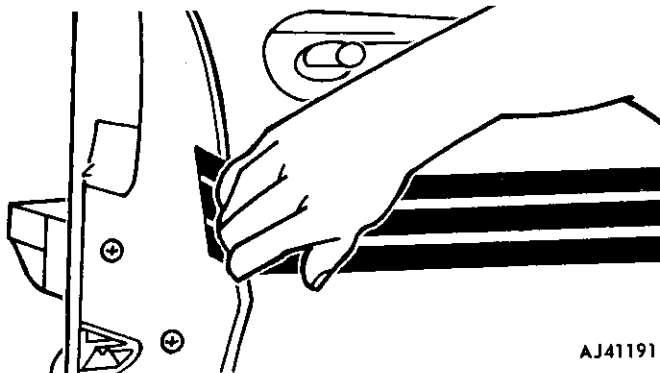


Fig. 3P-19 Installing Decal at Corners or Edges

(8) Remove easy-release paper from face of decal, if applicable.

(9) Inspect decal installation using reflected light to detect any irregularities that may have developed during installation. Remove all air or moisture bubbles.

(10) Install previously removed parts and clean up vehicle as required.

### Installation of Intricate Decals

For large, intricately shaped decals, the following procedure will simplify installation.

(1) The use of a wetting solution assures a better bond between decal and painted surface. Prepare a supply of wetting solution by thoroughly mixing two or three teaspoons of detergent (Joy, Vel, or equivalent) in one gallon of water.

**NOTE:** Too much detergent reduces the effectiveness of the bond. DO NOT USE SOAP.

(2) Place the decal on a clean, flat surface with paper backing side up. Bend a corner of the decal toward the decorative face side, and with a flick of the finger, separate the paper backing from the decal. Hold decal firmly to surface of table and remove paper backing. Under hot, humid conditions, a slight jerking motion aids in removing paper backing.

**CAUTION:** Always remove the paper backing from the decal; never remove the decal from the backing as stretching may result.

**NOTE:** Hold decal in corners when removing paper backing as fingerprints adversely affect the adhesion.

(3) Using clean sponge, apply ample wetting solution to decal adhesive and panel surface. The wetting solution permits ease of movement of decal while positioning it on panel surface.

(4) Immediately apply wetted decal to the panel surface. Apply wetting solution to decorative face of decal to allow the squeegee to slip during application.

(5) Squeegee a short section of decal at the center. Lift right or left side of decal, position it straight and close to panel, and squeegee toward lifted edge. Avoid stretching decal at lifted end. Squeegee outward from center with firm, overlapping strokes.

(a) Lift upper area of decal (up to bonded area) and, working upward from bonded section at center, squeegee decal into place.

(b) Lift lower area of decal (up to bonded area) and, working downward from bonded section at center, squeegee decal into place.

**NOTE:** If a wrinkle is trapped during squeegee operations, stop immediately. Carefully lift affected section. Align the section to the panel and remove wrinkle.

# EXTERIOR WOODGRAIN OVERLAYS

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Installation	3P-13	Repairs	3P-11
Preparation	3P-11	Vinyl Moulding Replacement	3P-11

## GENERAL

Exterior woodgrain overlay panels are made of a tough, durable, weather-resistant, opaque cast vinyl and have a pressure-sensitive back. The pressure-sensitive back is protected by a paper backing which is removed at installation. The woodgrain is embedded in the cast vinyl for a longer lasting, attractive appearance. In addition, the rear panels are retroreflective; that is, light is reflected back to its source by means of thousands of tiny glass beads impregnated in the cast vinyl.

## REPAIRS

Small nicks, bruises or scratches can be touched up with paint in much the same manner as painted surfaces. Proper color match can be obtained by blending small amounts of appropriate paint colors, then spot-painting the affected area of the overlay.

To repair blisters or air bubbles, pierce them with a sharp needle or pin. Work the trapped air out through the pin hole and press the overlay firmly against the panel. It may be necessary to preheat the panel slightly with Heat Gun J-25070 to soften the adhesive. Heat also may be applied to remove small wrinkles, irregularities, or bridging which may occur in the corners of the fuel tank filler opening.

**NOTE:** *Whenever the material must be stretched, do not slit or cut the overlay. Simply apply heat and press or squeegee the overlay smoothly and firmly into place.*

## PREPARATION

Workroom temperature should be between 65°F and 90°F. Overlays should not be replaced in temperatures below 65°F.

The following equipment and materials are necessary for a quality overlay installation.

- Woodgrain and Stripe Remover—3M, or equivalent
- Adhesive Remover—3M, or equivalent
- Liquid detergent (Joy, Vel, or equivalent)
- Wax and silicone remover (3M General Purpose Adhesive Cleaner, or equivalent)
- Isopropyl alcohol (rubbing alcohol)
- Squeegee (4 to 5 inches wide, plastic or hard rubber)
- Water bucket and sponge

- Sandpaper (No. 360 or No. 400, wet-or-dry type)
- Heat Gun J-25070 or infrared heat bulb and extension cord
- Clean wiping rags or paper towels
- Sharp knife or single-edge razor blade
- Scissors
- Sharp needle or pin
- Grease pencil

Prepare a supply of wetting solution by thoroughly mixing two or three teaspoons of detergent (Joy, Vel, or equivalent) in one gallon of water. The use of a wetting solution assures a better bond between overlay and painted surface. Too much detergent reduces the effectiveness of the bond. **DO NOT USE SOAP.**

Overlay replacement involving collision damage, or damage to underlying paint finish, requires that metal repair and refinish operations be completed before overlay is installed.

## VINYL MOULDING REPLACEMENT

The Jeep Wagoneer Limited model uses woodgrain surround scuff mouldings. The mouldings are made of extruded vinyl with an adhesive backing.

(1) Use 3M Release Agent, or equivalent, to soften adhesive bond.

(a) Use snorkel tube, spray between moulding and panel.

(b) Allow 2 to 3 minutes for penetration.

(c) Spray a second application and wait 3 minutes for adhesive bond to soften.

(2) Peel moulding from panel.

(3) Clean any adhesive residue from surface with a cloth dampened with 3M General Purpose Adhesive Cleaner or equivalent.

(4) To insure proper moulding alignment, stretch a piece of string at desired level along panel and secure ends with tape.

(5) Position moulding on car with backing tape attached, and cut to fit.

(6) Peel away backing tape and press moulding to panel with a roller or heavy hand pressure, parallel with string.

(7) Remove string.

(8) Check moulding alignment and trim moulding with razor blade, if necessary.

## 3P-12 HEADLINING—HARDTOP ENCLOSURE—EXTERIOR DECALS AND OVERLAYS

(9) If moulding comes loose apply 3M Plastic and Emblem Adhesive, or equivalent, to moulding surface and press firmly to body.

### REMOVAL

(1) Clean repair surfaces, adjacent panels and openings as required.

(2) Remove overlay, reveal mouldings, door handles, lock assembly, side marker lamps or other overlapping parts from the affected panel.

(3) Mask off area surrounding the panel.

(4) Spray 3M Woodgrain and Stripe Remover, or equivalent, on flange area first. Then spray entire overlay to be removed (fig. 3P-20). Move spray can back and forth across entire overlay in a smooth steady motion. Make sure entire overlay is coated with remover.

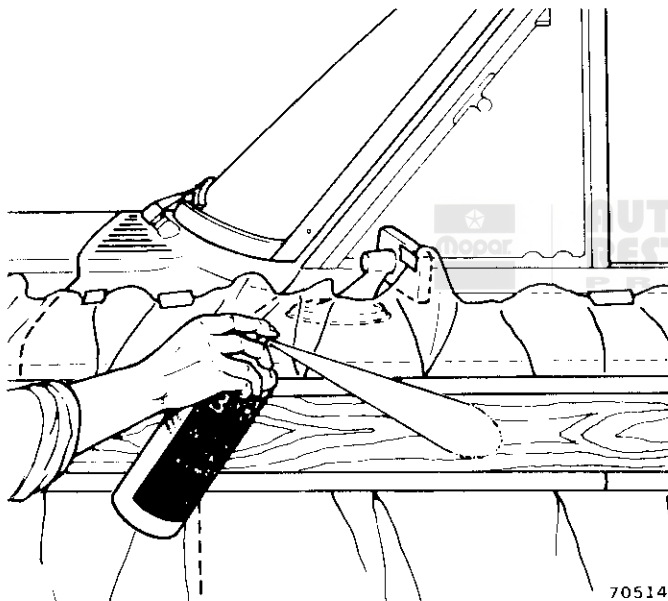


Fig. 3P-20 Spraying Remover on Overlay

**CAUTION:** Woodgrain and Stripe Remover from 3M is designed for use on acrylic enamel surfaces only.

**WARNING:** Use 3M Woodgrain and Stripe Remover, or equivalent, only in a well-ventilated area. Observe manufacturer's warnings printed on label.

(5) Spray entire panel again, this time moving the spray up and down the overlay.

(6) Allow remover to stay on overlay for 20 minutes.

(7) After 20 minutes, peel overlay away from flange areas. Then, start in one corner and peel overlay away from panel (fig. 3P-21). If there is any difficulty in peeling overlay away from panel, use squeegee to assist in removing it (fig. 3P-22).

(8) Scrape all Woodgrain and Stripe Remover from surface before proceeding.

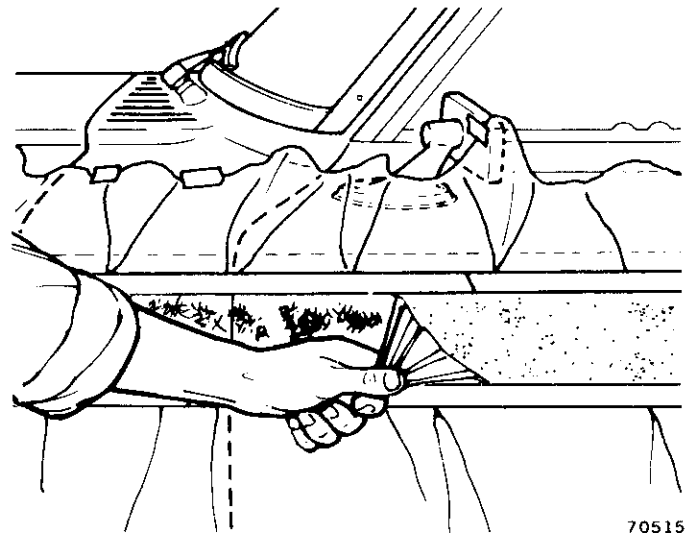


Fig. 3P-21 Peeling Overlay from Panel

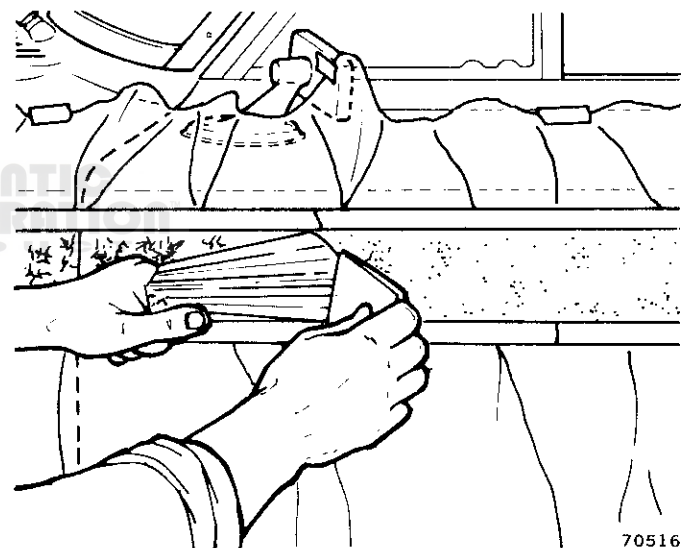


Fig. 3P-22 Using Squeegee to Assist in Removal of Overlay

(9) After overlay is removed, spray panel again with 3M Adhesive Remover, or equivalent, to remove any remaining adhesive. Use a slow spray application and apply remover in a uniform criss-cross pattern to obtain a heavy coat.

**WARNING:** Use 3M Adhesive Remover, or equivalent, only in a well ventilated area. Observe manufacturer's warnings printed on label.

**CAUTION:** Leaving remover on surface for too short or long a period may render product ineffective. Allow remover to work on adhesive surface for three to five minutes.

(10) After five minutes, use squeegee to remove adhesive residue (fig. 3P-23).

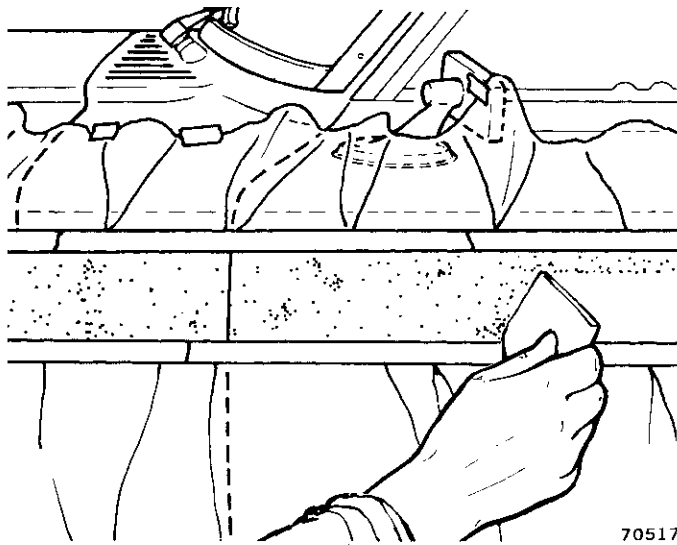


Fig. 3P-23 Using Squeegee to Remove Adhesive Residue

**NOTE:** If some adhesive is difficult to remove, spray additional remover on troublesome spots. Wait approximately two minutes and squeegee remaining spots. Repeat as necessary.

(11) Remove masking tape and paper.

(12) Wash entire panel with 3M General Purpose Adhesive Cleaner, or equivalent. If any spots of adhesive remain on panel, hard rubbing during the washdown will remove them.

## INSTALLATION

(1) Scuff-sand painted surface with No. 220 or No. 400 sandpaper by dry sanding. Freshly painted surfaces must be thoroughly dry. Residual solvents in fresh paint may cause overlay to blister.

(2) Clean painted surfaces with wax and silicone remover (3M General Purpose Adhesive Cleaner, or equivalent). Wipe surface with clean cloth and allow to dry.

(3) Position overlay on repair panel surface, and mark approximate outline on overlay with a grease pencil. Ensure that 1/2-inch excess is allowed to be wrapped around the door and fender areas. With scissors, cut overlay to approximate size. Overlay should be cut so that upper and lower edges extend halfway into area covered by mouldings.

(4) Place overlay on a clean, flat surface with protective paper backing side up. Bend a corner of the overlay toward the decorative face side, and with a flick of the finger, separate the paper backing from the overlay. Hold overlay firmly to the surface of a table and remove the paper backing. Under hot, humid conditions, a slight jerking motion aids in removing paper backing.

**CAUTION:** Always remove the paper backing from the overlay; never remove the overlay from the backing as film stretching may result.

**NOTE:** Hold overlay by corners when removing paper backing as fingerprints adversely affect the adhesion.

(5) Using clean sponge, apply ample wetting solution to overlay adhesive and to repair panel surface. The wetting solution permits ease of movement of the overlay while positioning it on a panel surface.

(6) Immediately apply wetted overlay to the repair panel surface. Position overlay in the center of the area to be covered with at least 1/2 inch extending beyond edges. Apply wetting solution to woodgrain surface of overlay to allow squeegee to slip during application.

(7) Squeegee from the center to edges of overlay with firm strokes to remove all air bubbles and wetting solution and to assure bonding of overlay to painted surface. On large overlays, the following steps will simplify installation:

(a) Squeegee a short, 4 to 6-inch horizontal section of overlay at center of panel. Lift right or left side of overlay, position it straight and close to panel, and squeegee toward lifting edge. Avoid stretching overlay at lifted end; squeegee progressively from middle with firm, overlapping strokes.

(b) Lift upper area of overlay (up to bonded area) and, working upward from bonded section at center, squeegee overlay into place.

(c) Lift lower area of overlay (up to bonded area) and, working downward from bonded section at center, squeegee overlay into place.

**NOTE:** If a wrinkle is trapped during squeegee operations, stop immediately. Carefully lift affected section. Realign section to panel and progressively remove wrinkle. Do not lift overlay if only a few bubbles are trapped.

(8) Notch corner or curved edges of overlay where necessary and trim off excess material.

(9) Allow 1/2-inch extra material beyond edges that are to be wrapped around flange areas.

**CAUTION:** Use extreme care to avoid spilling isopropyl alcohol (rubbing alcohol) on trim or painted surfaces. Wipe spills immediately as alcohol will discolor trim or painted surfaces on prolonged contact.

(10) To activate adhesive, wipe adhesive side of overlay with isopropyl alcohol.

(11) Warm overlay at edges by passing a heat source, such as Heat Gun J-25070, over the surface to soften it.

(12) Firmly press overlay into position with fingertips, a cloth, and finally a squeegee, alternately warming and pressing it until complete adhesion is obtained.

**NOTE:** Avoid undue pulling or stretching at ends of overlay as tearing could result.



### 3P-14 HEADLINING—HARDTOP ENCLOSURE—EXTERIOR DECALS AND OVERLAYS

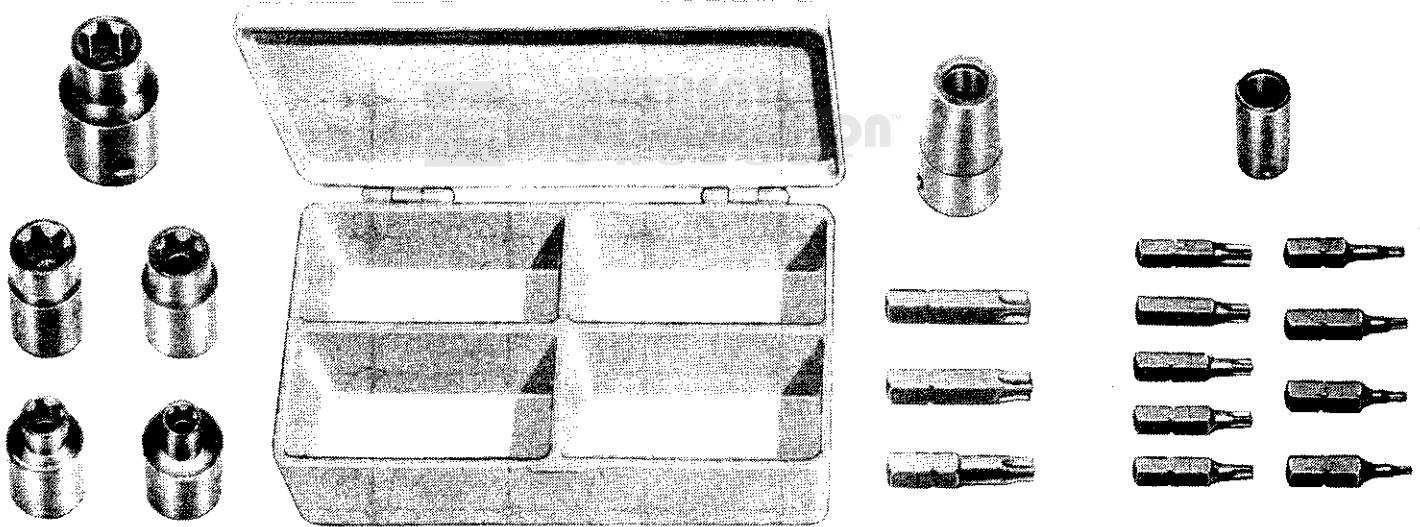
(13) Apply heat to overlay at door handle holes, side marker lamps and other depressions using Heat Gun J-25070. Press overlay uniformly into depressions to obtain formed bond.

(14) With sharp knife, carefully cut out excess overlay at door handles, side marker lamps and other openings in panel.

(15) Inspect overlay installation using reflected light to detect irregularities that may have developed during installation. Remove all air or moisture bubbles.

(16) Install previously removed parts and clean vehicle as required.

#### Tools



J-25359-02-TORX BIT SET

J-25070-HEAT GUN

# LIGHTING SYSTEMS

# 3R

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## EXTERIOR LIGHTING SYSTEMS

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### GENERAL

The wiring of the lighting systems is shown in the wiring diagrams which indicate the various units in relation to their positions in the vehicle. The wires in the various circuits are different colors or are marked by tracers.

All models have a 20-amp circuit breaker built into the switch for light system protection.

The upper and lower headlamp beams are controlled by a foot switch located on the toeboard.

### HEADLAMPS

All models are equipped with a single headlamp system.

The round headlamp used with the CJ system is identified by the number 2 embossed on the sealed beam face. The new large rectangular headlamp system is used on all Cherokee, Wagoneer and Truck models. All lamps contain two elements: one low beam and one high beam.

### Replacement

Each sealed beam headlamp can be replaced only as a complete unit.

### CJ Models

**NOTE:** *CJ headlamps have a number 2 molded into the glass at the top of the lens.*

(1) Remove attaching screw and pull door out slightly at bottom and push up to disengage upper retaining tab.

(2) Loosen screws in retaining ring, rotate ring to disengage from screws.

(3) Pull headlamp out and disconnect wire harness.

(4) Install replacement headlamp with number 2 at TOP of lamp.

(5) Install retaining ring and tighten screws.

(6) Install headlamp door and attaching screw.

(7) Check headlamp aim following procedure outlined below.

### Cherokee-Wagoneer-Truck Models

(1) Remove screws attaching retaining ring and remove ring.

(2) Pull headlamp out and disconnect wire harness.

(3) Install replacement headlamp and connect to wire harness.

(4) Install retaining ring and attaching screws.

(5) Check headlamp aim following procedure outlined below.

## 3R-2 LIGHTING SYSTEMS

### Headlamp Aiming Procedure

Lamps must be aimed on the **low beam**. They may be aimed either with mechanical aimers or by using a screen. Use HeadLight Aimer J-25300-10 which has the proper adapters for use with the new large rectangular headlamps used on the Cherokee, Wagoneer and Truck models, follow instructions supplied with the equipment for proper headlamp aiming. If a screen is to be used, preparation for aiming is as follows:

(1) Locate vehicle in darkened area with level floor and with screen (wall) having nonreflecting white surface.

(2) Mark reference line on floor 25 feet away from and parallel to screen (fig. 3R-1).

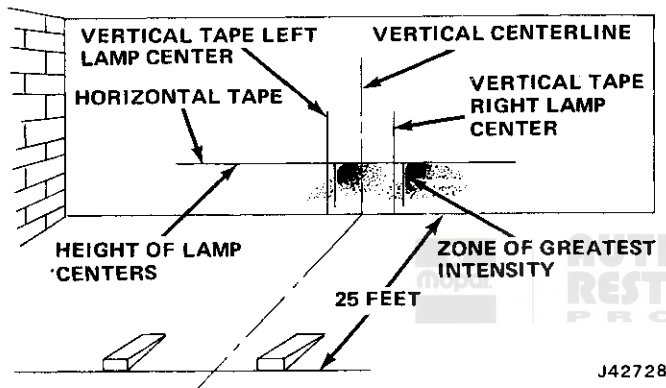


Fig. 3R-1 Headlamp Aiming

(3) Position vehicle perpendicular to screen and with headlamps directly over reference line.

(4) Locate middle tape on screen so it is aligned with centerline of vehicle.

(5) Equalize all tire pressures.

(6) Rock vehicle from side to side to equalize springs and shock absorbers.

(7) Measure distance between vehicle headlamp centers.

(8) Position marker tapes vertically on screen to right and left of middle tape at half this distance.

(9) Measure distance from center of each lamp to surface on which vehicle rests.

(10) Position marker tape horizontally on screen to cross vertical tapes at measured height of each lamp center respectively.

(11) Remove headlamp doors, if equipped.

(12) Clean headlamps.

(13) Turn headlamps on LOW beam.

**NOTE:** Cover the lamp not being aimed.

(14) Turn vertical aiming screw counterclockwise until lamp beam is considerably lower than horizontal reference line on screen (fig. 3R-2).

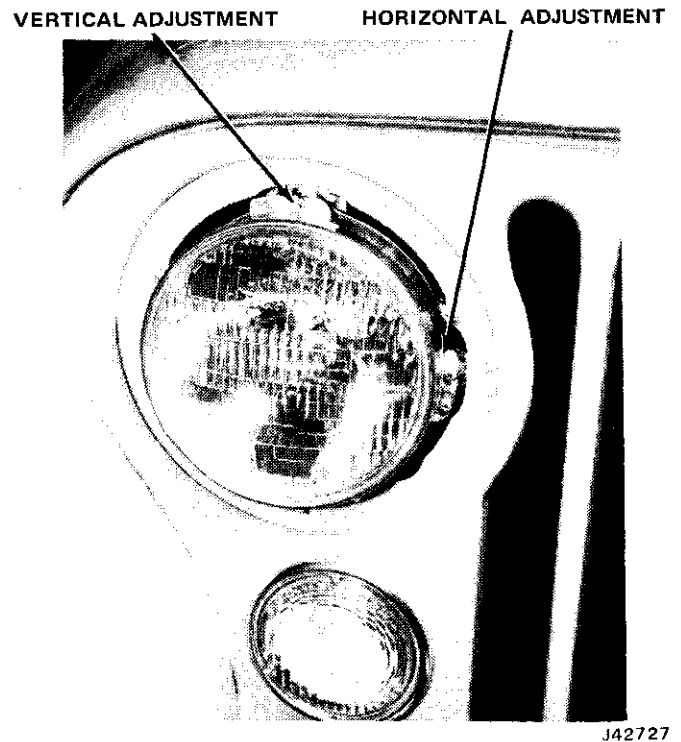


Fig. 3R-2 Headlamp Adjustment, Typical

(15) Turn screw clockwise until top edge of high intensity area is even with horizontal line.

(16) Turn horizontal aiming screw counterclockwise until beam is off centering tape.

(17) Turn same screw clockwise until left edge of high intensity area is 2 inches to right of lamp centerline (fig. 3R-1).

(18) Cover lamp that has been aimed and aim other lamp using same procedure.

### Headlamp Switch

The switch is a two-position switch containing a rheostat for controlling instrument panel light brightness (fig. 3R-3). Rotating the knob clockwise dims the panel lights. Rotating the knob fully counterclockwise turns on the dome and courtesy lamps.

### Headlamp Switch Replacement

(1) Disconnect harness connector plug from switch.

(2) Pull control knob out to second position.

(3) From behind instrument panel, depress knob release button (as shown in figure 3R-3, inset) and pull knob out of switch.

(4) Remove retaining nut and bezel.

(5) Remove switch through rear of instrument panel.

(6) When installing switch, make sure harness connector plug on switch is secure.

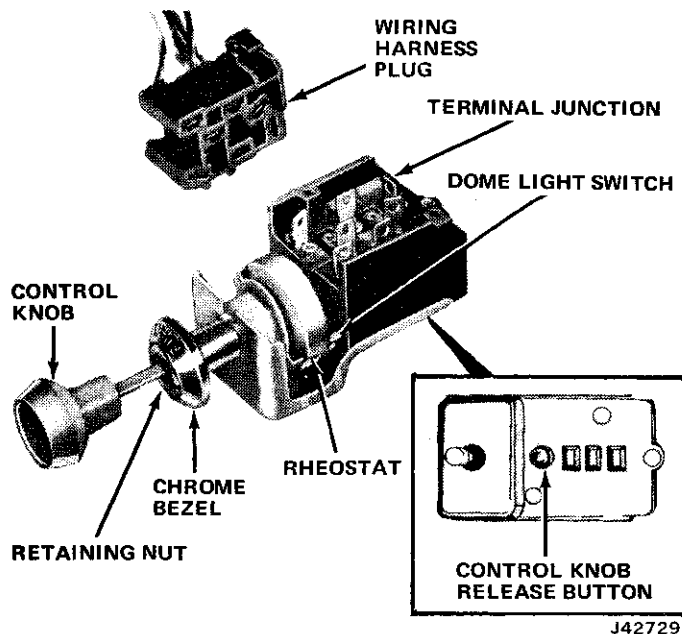


Fig. 3R-3 Headlamp Switch

**Dimmer Switch Replacement**

Refer to figure 3R-4.

- (1) Remove harness plug from switch.

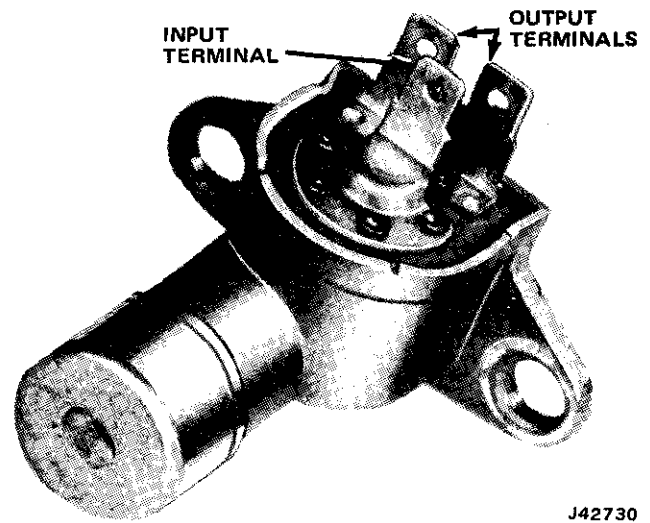


Fig. 3R-4 Headlamp Dimmer Switch

- (2) Remove screws attaching dimmer switch to floorboard.

- (3) Remove switch.

- (4) Check operation of dimmer switch with test light. Connect one test lamp lead to switch input terminal (fig. 3R-4). Probe each output terminal with other test lamp lead. Current flow should alternate from one output terminal to the other as the switch is operated.

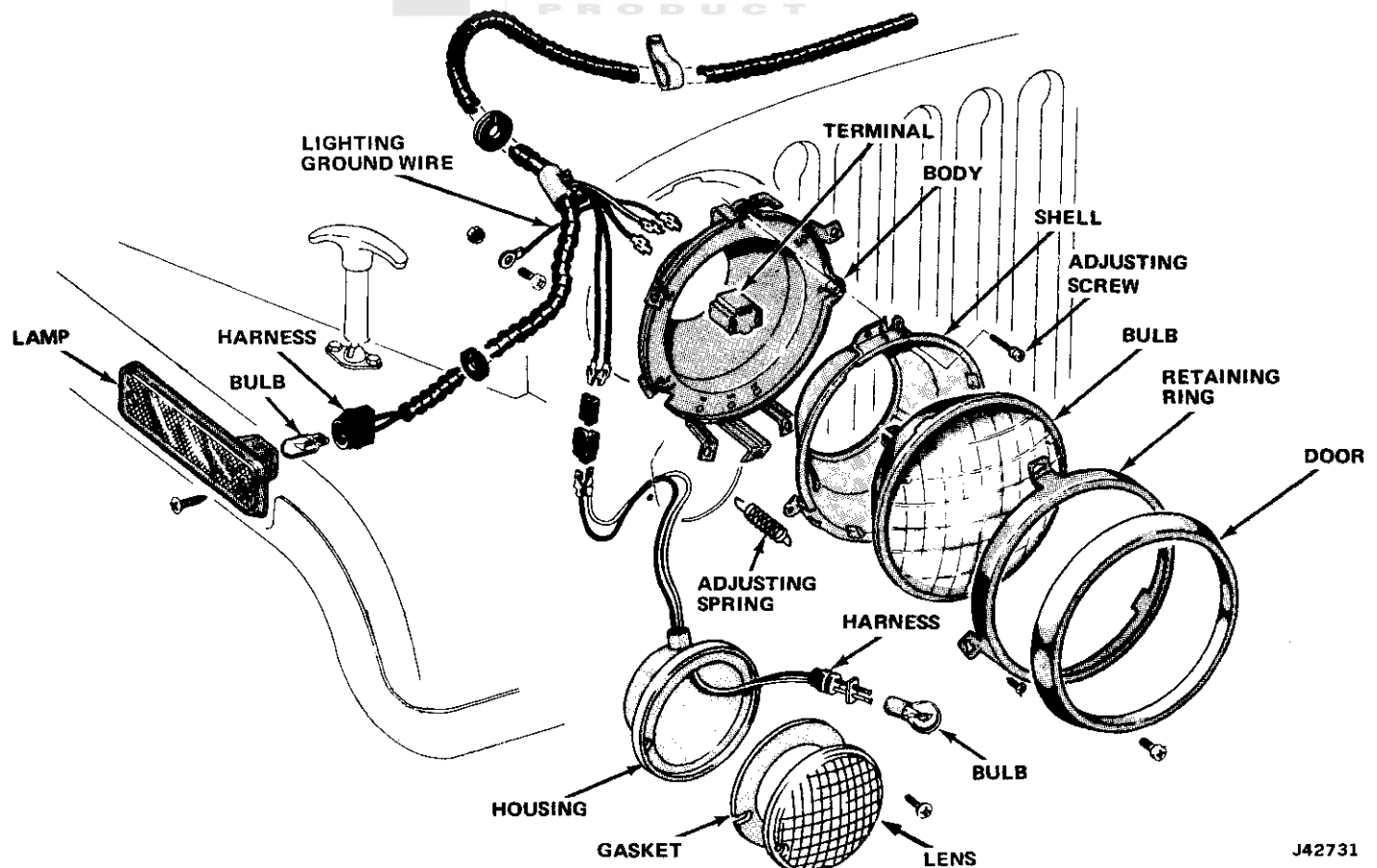


Fig. 3R-5 Headlamp, Parking, Directional and Side Marker Lamps—CJ Models

## 3R-4 LIGHTING SYSTEMS

### PARKING, SIDE MARKER AND DIRECTIONAL LAMPS

#### CJ Models

The parking lamps are mounted in the radiator guard panel just below the headlamps (fig. 3R-5). The lamps are on when headlamp switch knob is pulled out.

#### Parking and Directional Bulb

- (1) Remove lens attaching screws.
- (2) Remove lens.
- (3) Replace bulb.

#### Parking Lamp Assembly

- (1) Remove lens attaching screws.
- (2) Remove lens and gasket.
- (3) Remove housing from front panel.
- (4) Disconnect wire connector from harness.

#### Side Marker Bulbs

- (1) Reach under fender and twist socket a quarter

turn counterclockwise to remove from housing.

- (2) Replace bulb.

#### Cherokee-Wagoneer-Truck Models

The parking lamps are mounted in the panel just above the bumper (fig. 3R-6).

The front side marker lamps flash in unison with the front directional indicator bulb when the headlamps are not on. When the headlamps are on, the side markers flash alternately with the front directional signal lamps. Side markers and parking lamps come on when the headlamp switch is pulled out to any position.

To replace parking lamp bulbs on Cherokee, Wagoneer and Truck models, remove the lens and gasket to gain access to the bulb.

To replace side marker lamps, remove the lamp assembly. Twist the socket 1/4-turn counterclockwise to remove. Remove the bulb by pulling it straight out from the socket.

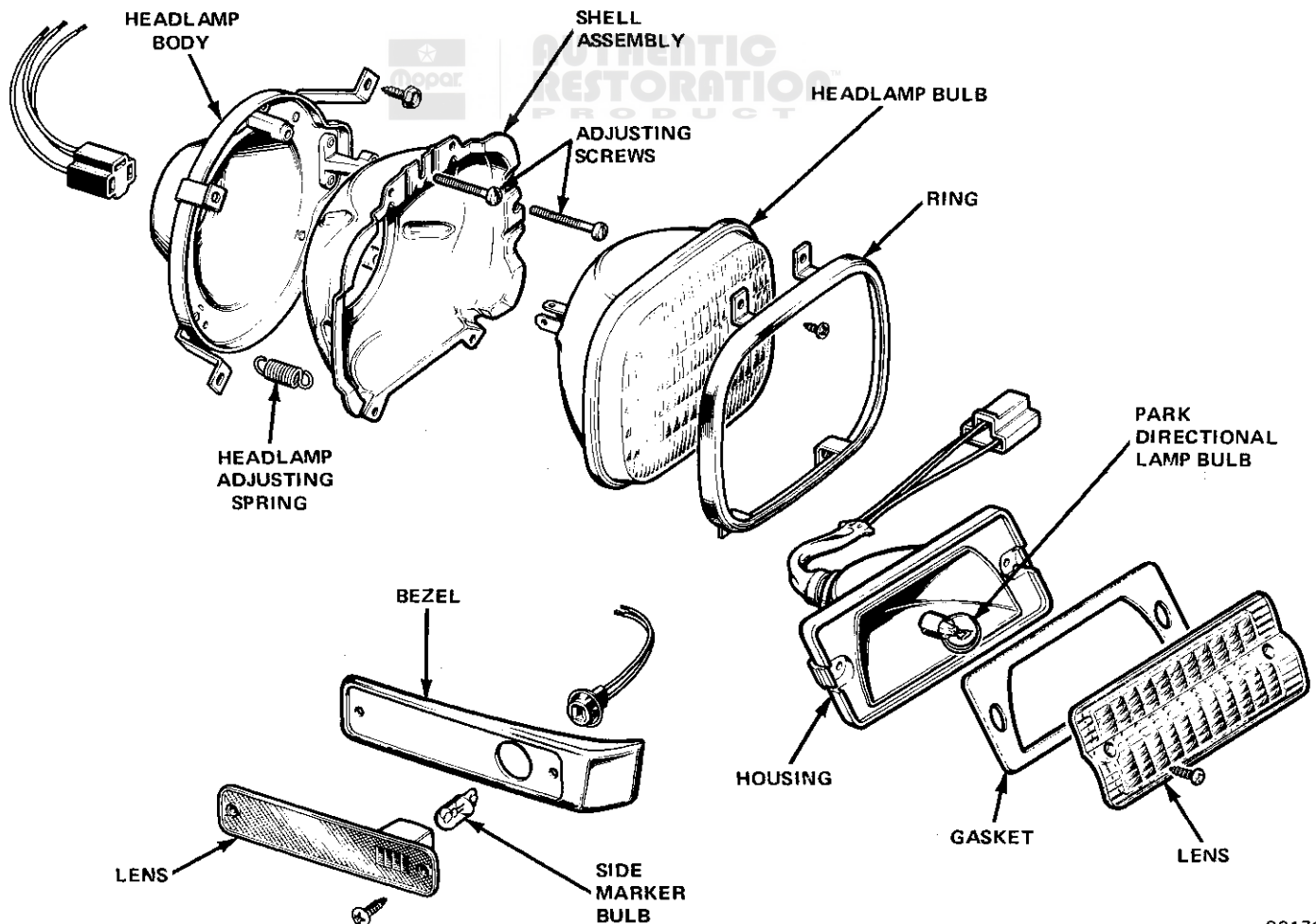


Fig. 3R-6 Headlamp, Parking, Directional and Side Marker Lamps—Cherokee-Wagoneer-Truck Models

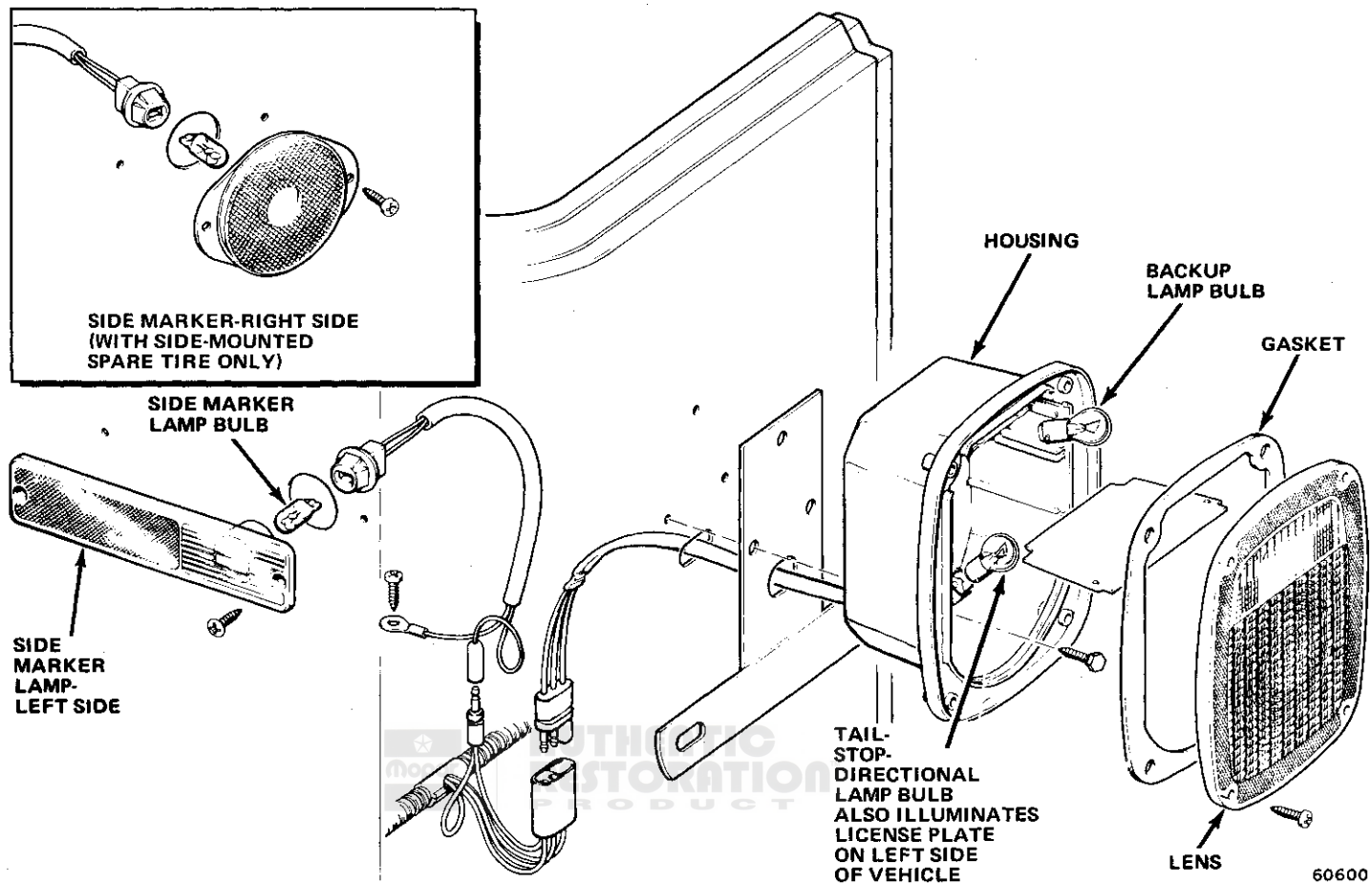


Fig. 3R-7 Rear Directional, Stop, Backup, Taillamps and Side Marker Lamps—CJ Models

**REAR DIRECTIONAL, SIDE MARKER, STOP AND TAILLAMPS**

**CJ Models**

Refer to figure 3R-7 for parts identification.

**Taillamp Bulb Replacement**

Remove lens attaching screws, lens and gasket. Clean lens and reflector before installing.

**Taillamp Housing Replacement**

Disconnect wiring, remove taillamp lens, and remove three screws attaching taillamp assembly body and remove from rear of body.

**Side Marker Bulb Replacement**

Turn the bulb socket 1/4-turn counterclockwise and remove bulb and socket.

**Cherokee**

Refer to figure 3R-8 for parts identification.

**Taillamp Bulb Replacement**

Remove taillamp lens and remove bulb. Clean lens and housing before installing.

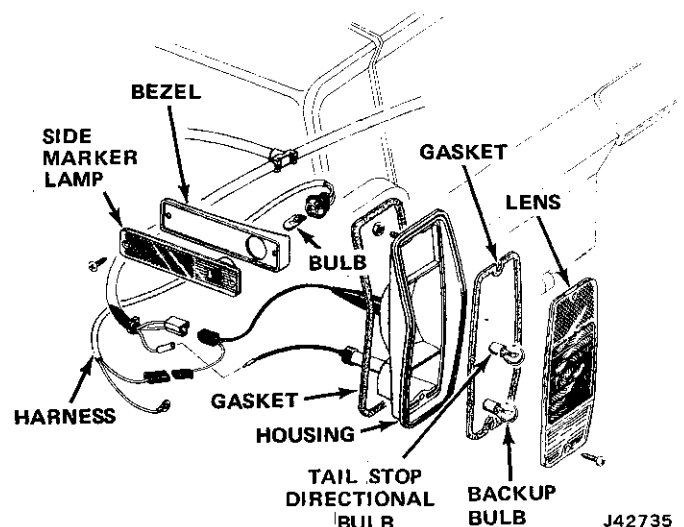


Fig. 3R-8 Rear Directional, Stop, Backup and Taillamps—Cherokee

## 3R-6 LIGHTING SYSTEMS

### Taillamp Housing Replacement

(1) Remove interior rear quarter trim panel. On right side, pull panel out at top to remove. On left side, trim panel is attached with expandable clips. Use care in prying these clips out of their recesses so panel is not bent or damaged.

(2) Disconnect taillamp harness.

(3) Remove four attaching nuts and push housing out from corner posts.

### Wagoner

Refer to figure 3R-9 for parts identification.

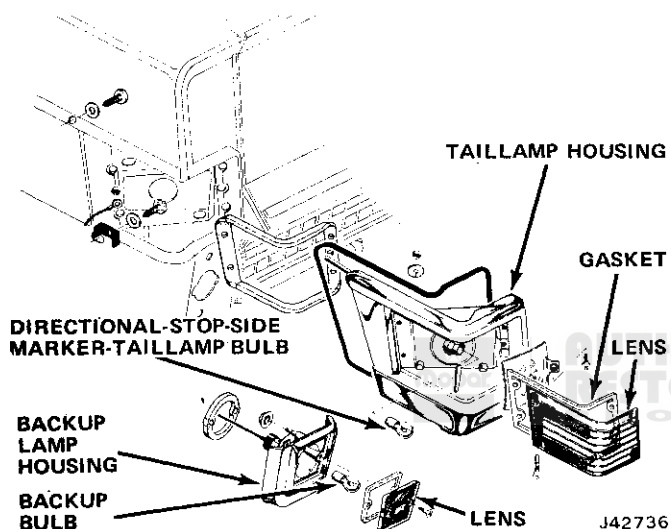


Fig. 3R-9 Rear Directional, Stop, Backup and Taillamps—Wagoner

### Taillamp Bulb Replacement

Remove four lens attaching screws and lens. Replace bulb. Clean lens and reflector before installing.

### Taillamp Housing Replacement

Refer to figure 3R-9 and follow housing replacement procedure as outlined for Cherokee models.

### Truck

The lamp assemblies are mounted in the pickup box end caps (fig. 3R-10).

### Taillamp Bulb Replacement

Remove lens attaching screws, lens and bulb. Clean lens and reflector before installing.

### Taillamp Housing

- (1) Remove lens attaching screws and lens.
- (2) Remove housing attaching screws.
- (3) Remove housing and disconnect lamp harness.

### License Plate Lamp

#### CJ Models

The left taillamp illuminates the license plate. Refer to figure 3R-7.

#### Cherokee and Wagoner

The license plate lamp is attached to the tailgate and is a sealed unit. The lamp is removed by removing the lamp attaching screws and disconnecting the wire harness.

#### Truck

The license plate lamp is attached to the rear frame crossmember. Bulb replacement is accomplished by removing the bulb lens. The ground circuit for the license plate bulb is completed through metal-to-metal contact between the bulb bracket, license plate bracket, and the frame (fig. 3R-10).

When equipped with step bumper, the lamp wiring must be disconnected from the original lamp and connected to the step bumper license lamp extension wire.

### BACKUP LAMPS AND SWITCHES

To replace a bulb, remove the backup lamp or taillamp lens, as required.

#### Switch Adjustment and Replacement—Manual Transmission

The backup lamp switch is threaded into the right rear corner of the transmission cover housing. The backup lamp switch is actuated by the reverse shift rail.

The backup lamp switch is not serviceable or adjustable and must be replaced as a unit.

**NOTE:** Jumper wires are used at the neutral safety switch connector and the automatic transmission backup lamp switch connector to complete the circuit on vehicles equipped with manual transmission.

#### Switch Adjustment and Replacement—Automatic Transmission

A combination backup and neutral safety switch is mounted on the steering column. This switch is adjustable. If defective, the switch must be replaced.

To adjust the backup lamp switch, place the transmission shift lever in the R position. Loosen (do not remove) the two switch attaching screws. Turn the ignition switch to the On position. Rotate the switch one direction or the other until the backup lamps operate. Tighten the attaching screws. Check the switch for an engine start in the N and P positions. The engine must not start in R, D, 2 or 1 position.

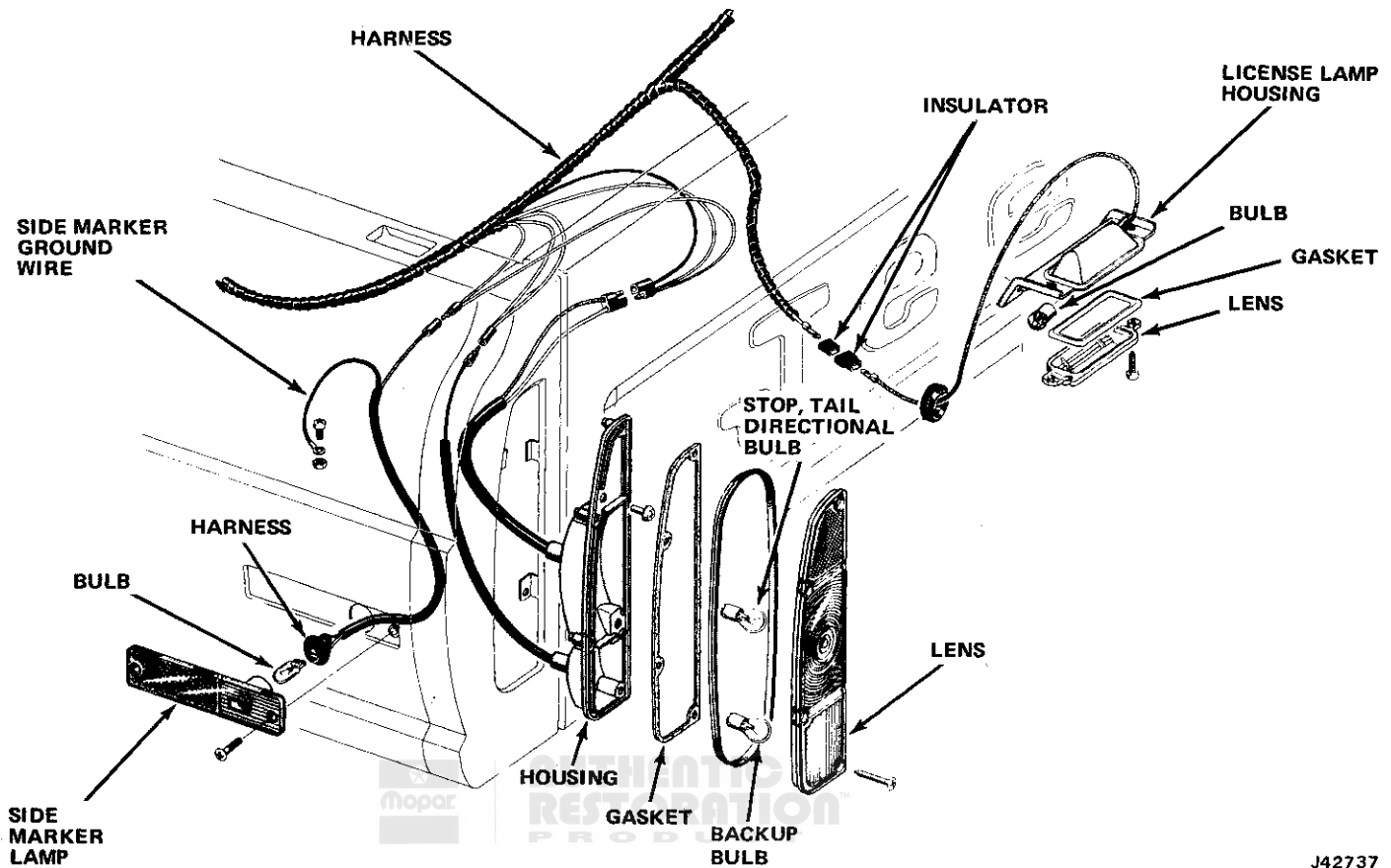


Fig. 3R-10 Rear Directional, Stop, Backup, Taillamps and Side Marker—Truck

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As an aid to adjusting the backup lamp switch, install a test lamp to the lamp side of the switch and ground one side of a test lamp. When the test lamp lights, the backup lamps are operating.

**CARGO LAMP**

A cargo lamp is offered on some Truck models (fig. 3R-11). The cargo lamp bulb is replaced by removing the outer lens.

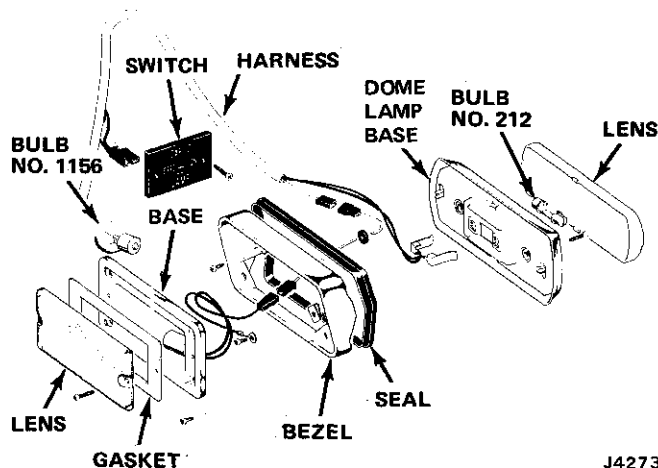


Fig. 3R-11 Cargo Lamp—Truck

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**DIRECTIONAL SIGNAL SWITCH**

The most frequent causes of failure in the directional signal system are loose connections and burned out bulbs. A flashing rate approximately twice the normal rate usually indicates a shorted out bulb in the circuit.

If a three-lamp flasher is installed in a vehicle having only two lamp bulbs per side, the lamps will light but will not flash. If a two-lamp flasher is used on a vehicle having three lamps, the too-high current draw will cause the lamps to flash too fast.

If there is no signal at any front, rear or indicator lamp, check the fuse.

If fuse checks okay, substitute a known good flasher. If a new flasher does not cure trouble, check signal system wiring connections at fuse and at steering column connector.

**NOTE:** If brake stoplamps function properly, rear signal lamp bulbs are okay.

The directional flasher is mounted directly to the fuse panel. Refer to the wiring diagram at the rear of the manual for circuitry.

**Switch Removal**

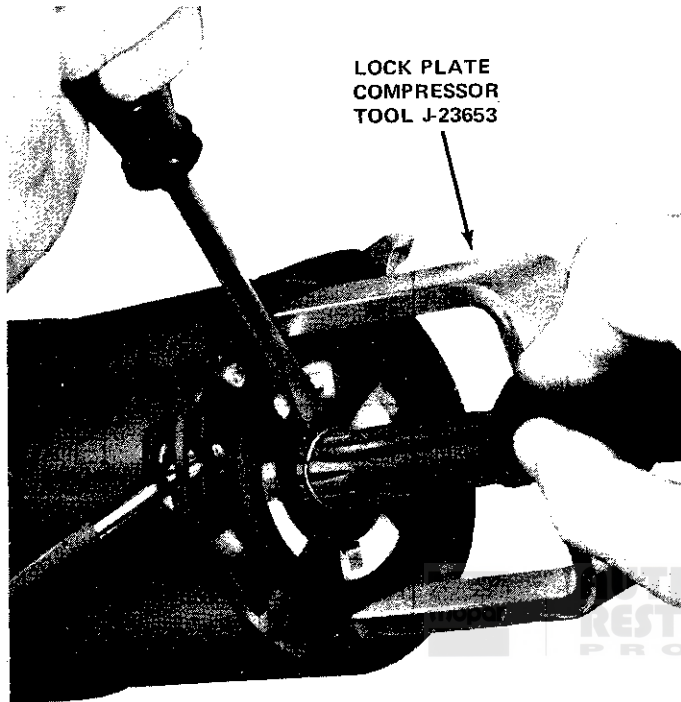
- (1) Disconnect battery negative cable.



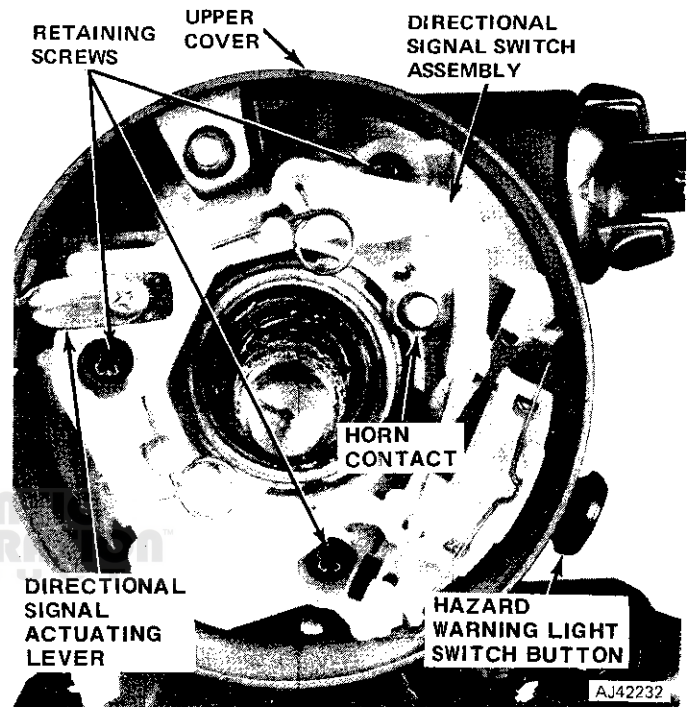
## 3R-8 LIGHTING SYSTEMS

- (2) Remove horn center button by pulling straight out.
- (3) Remove screws, bushing, receiver and spring.
- (4) Remove steering wheel nut. Note alignment of steering wheel to steering shaft index marks for later installation.

- (5) Remove steering wheel with Steering Wheel Puller J-21232-01.
- (6) Lift lock plate cover.
- (7) Use Lock Plate Compressor Tool J-23653 to depress lock plate (fig. 3R-12).
- (8) Pry round wire snap ring from steering shaft groove.



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Fig. 3R-12 Lock Plate Snap Ring Removal

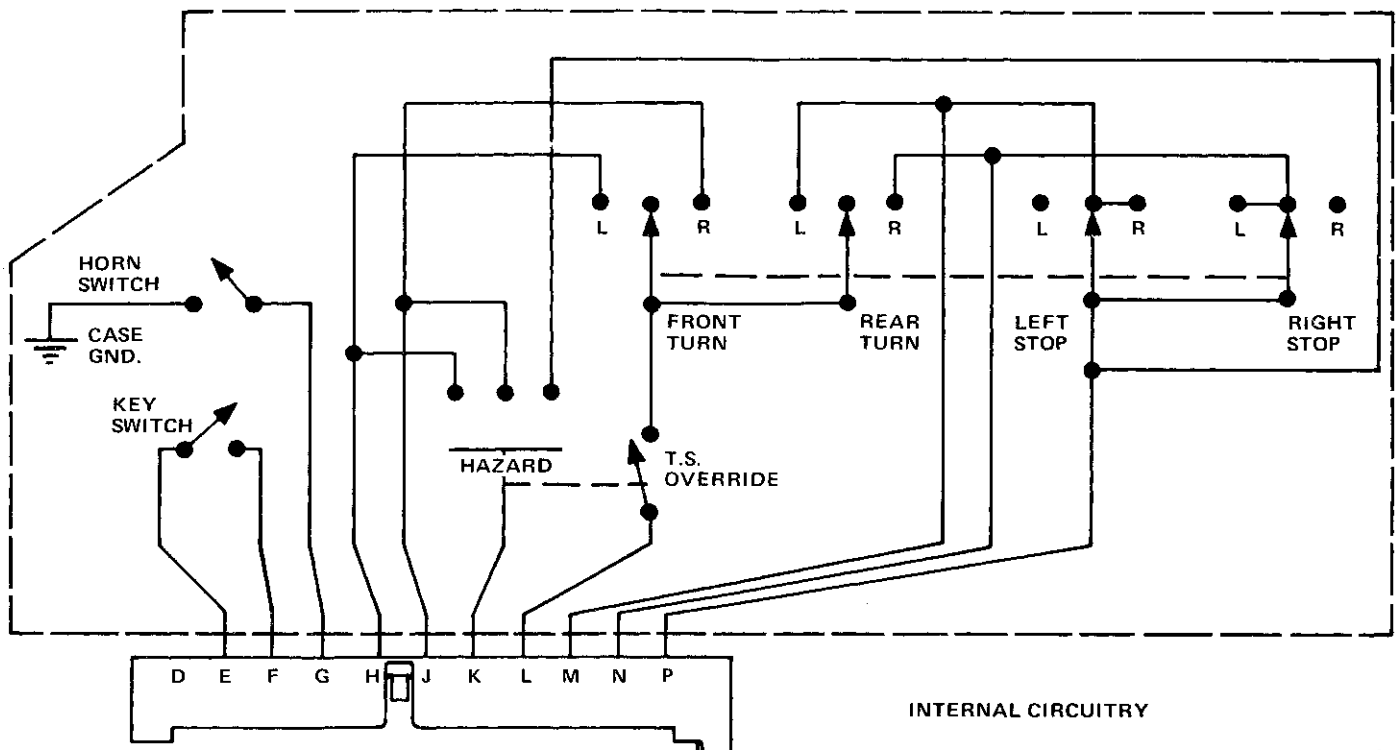


Fig. 3R-13 Directional Signal Switch

(9) Remove Lock Plate Compressor Tool, snap ring, lock plate, directional signal canceling cam, upper bearing preload spring and thrust washer from steering shaft.

(10) Place directional signal actuating lever in right turn position and remove lever.

(11) Depress hazard warning light switch, located on right side of column adjacent to the key lock, and remove button by turning in a counterclockwise direction.

(12) Remove directional signal wire harness connector block from its mounting bracket on right side of lower column.

**NOTE:** On vehicles equipped with automatic transmission, use a stiff wire, such as a paper clip, to depress the lock tab which retains the shift quadrant lamp wire in the connector block.

(13) Remove directional signal switch retaining screws and pull directional signal switch and wire harness from column (fig. 3R-13).

### Switch Installation

(1) Guide wire harness into position and carefully align switch assembly.

**NOTE:** Assure that actuating lever pivot is correctly aligned and seated in the upper housing pivot boss prior to installing the retaining screws.

(2) Install directional signal lever and actuate directional signal switch to assure correct operation.

(3) Place thrust washer, spring, and directional signal canceling cam on upper end of steering shaft.

(4) Align lock plate splines with steering shaft splines and place lock plate in position with directional signal canceling cam shaft protruding through dogleg opening in lock plate.

(5) Install snap ring.

(6) Install lock plate cover.

(7) Install steering wheel. Align mark on steering wheel with previously noted mark on housing.

(8) Install washer and nut. Tighten nut to specified torque.

(9) Install spring. **Raised side** of spring must be up.

(10) Install receiver and bushing. Receiver must be free to move after bushing screws are tightened.

(11) Line up notch on receiver with nib on horn button. Push button until it snaps into place.

### 4-WAY EMERGENCY FLASHER (HAZARD WARNING)

All models are equipped with a four-way emergency flasher system. With the switch activated, the two front and two rear directional signal lamps flash on and off simultaneously with both directional signal indicator lamps on the instrument clusters.

This system makes use of the conventional directional signal wiring and bulbs, but has a separate battery feed wire, flasher unit and switch. It is possible to leave a vehicle with the 4-way flasher operating, with the ignition switch and vehicle doors locked. When the 4-way flasher is turned on, the normal directional signal supply is disconnected at the directional signal switch and a separate battery feed circuit is connected into the switch from the fuse panel. The 4-way flasher circuit uses a special heavy-duty flasher. Since the 4-way warning flasher is of the heavy-duty type, it will flash from one to six bulbs at a constant rate. Flashing indicator lights do not necessarily mean that *all* signal bulbs are flashing.

The 4-way emergency flasher switch is a part of the directional signal switch.

To operate the system, push in on the switch button.

The 4-way flasher can only be canceled by pulling out on the flasher switch knob.

Refer to Directional Signal Switch for 4-way flasher switch removal or replacement procedure.

The battery feed for the 4-way flasher system is from the fuse panel.

### STOPLAMP SWITCH

The stoplamp switch is self-adjusting and is the same for all models. The switch is retained in its mounting bracket by a spring clip which engages the threaded portion of the switch housing (fig. 3R-14). The switch may be removed by pulling straight out of the mounting bracket and retainer.

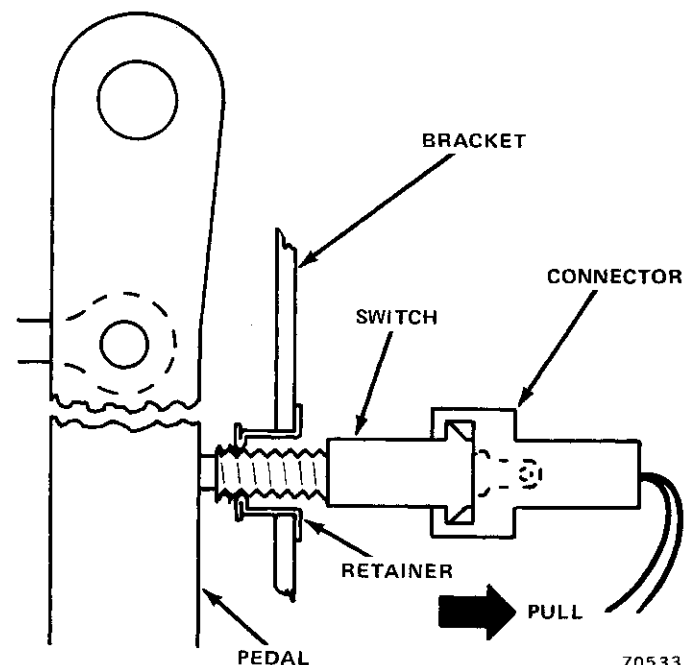


Fig. 3R-14 Stoplamp Switch

## 3R-10 LIGHTING SYSTEMS

### Adjustment

(1) Depress brake pedal and hold in depressed position.

(2) Push stoplamp switch completely into mounting bracket until switch bottoms.

(3) Release brake pedal and allow it to return to undepressed position. Brake pedal will push switch to properly adjusted position.

(4) Check switch operation. Stoplamps should operate after  $\frac{3}{8}$  inch to  $\frac{5}{8}$  inch of pedal travel.

### Stoplamp Switch Electrical Test

This test requires a voltmeter.

(1) Ground one lead of voltmeter.

(2) Probe each connection of stoplamp switch with other lead of voltmeter.

(a) With switch plunger depressed (brake not applied), one switch connector should indicate voltage and the other should not.

(b) With switch plunger released (brake applied), both switch leads should show voltage.

### OFF-ROAD DRIVING LAMPS

The off-road driving lamps (fig. 3R-15) are installed on Truck models equipped with an roll bar. The fuse holder and switch (fig. 3R-16) are located on the instrument panel to the left of the steering column.

**NOTE:** On California vehicles, the fuse must be removed from the fuse holder for street use.

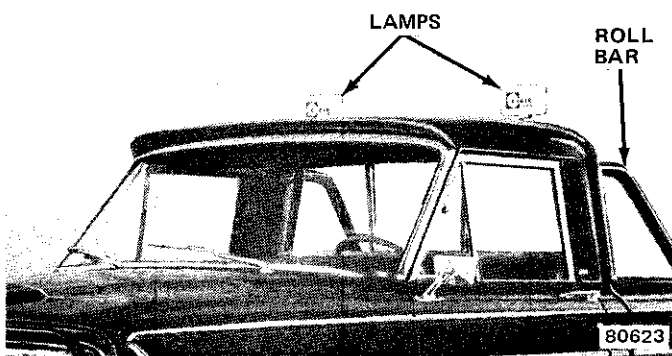


Fig. 3R-15 Off-Road Driving Lamps and Roll Bar—Truck Models

### Aiming Lamps

(1) Position vehicle on a flat surface, facing and approximately 25 feet from a wall.

(2) Remove lamp stone shields.

(3) Install fuse in fuse holder, if removed.

(4) Loosen lamp attaching bolts. Turn ignition switch and lamp switch on, adjust lamp beams as follows:

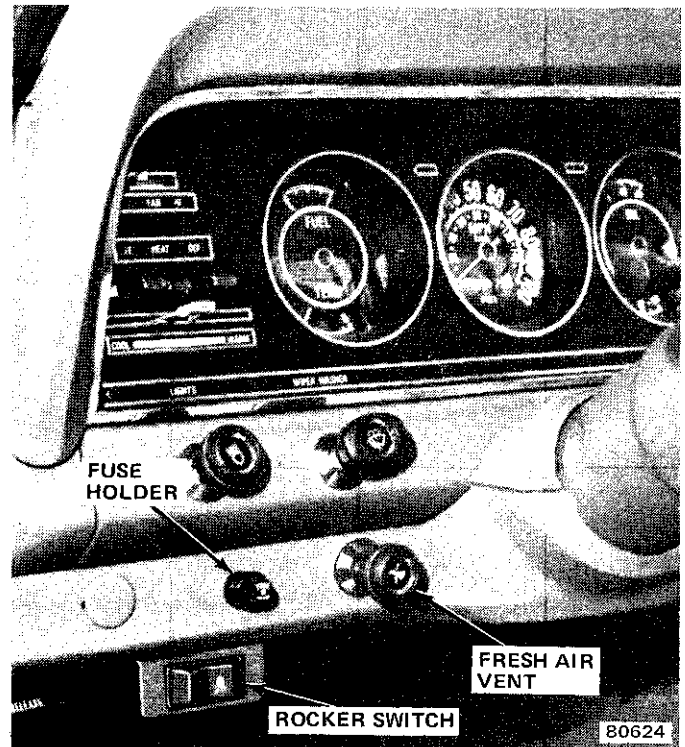


Fig. 3R-16 Fuse Holder and Switch Location—Truck Models

(a) Horizontal distance between light beams on wall should be same as distance between lamps on roll bar.

(b) Vertical height of light beams on wall should be one inch less than installed height of lamps on roll bar.

(5) Tighten lamp attaching bolts.

(6) Turn off ignition switch and lamp switch.

(7) Install lamp stone shields.

(8) Remove fuse from fuse holder, on California vehicles.

### Lamp Element Replacement

(1) Remove stone shield from lamp (fig. 3R-17).

(2) Remove screws attaching bezel to lamp body. Remove bezel from lamp body.

(3) Remove lens and reflector assembly from lamp body.

(4) Remove bulb holder from lens and reflector assembly.

(5) Remove lamp element from bulb holder and install replacement lamp element.

(6) Install bulb holder in lens and reflector assembly.

(7) Position lens and reflector assembly in lamp body with TOP of lens at top of lamp body.

(8) Position bezel on lamp body and install attaching screws.

(9) Install stone shield on lamp.

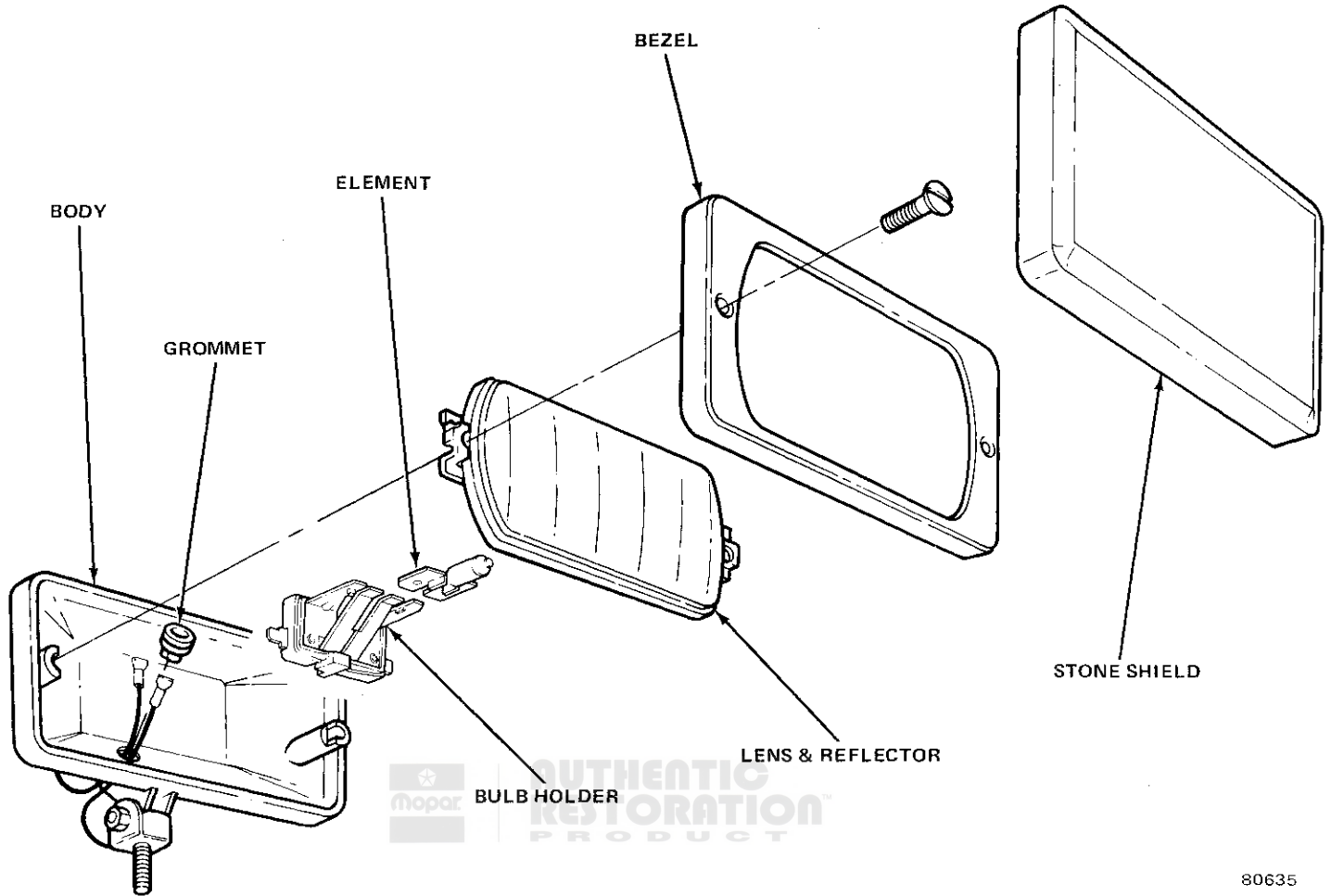


Fig. 3R-17 Off-Road Driving Lamp Components

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**Switch Bulb Replacement**

- (1) Remove bulb holder from switch (fig. 3R-18).
- (2) Remove bulb from bulb holder.
- (3) Install replacement bulb in bulb holder and install bulb holder in switch.

**Switch Replacement**

- (1) Disconnect electrical leads from switch and note or tag leads so they may be installed in the correct position.
- (2) Compress sides of switch body and remove switch from bracket (fig. 3R-18).

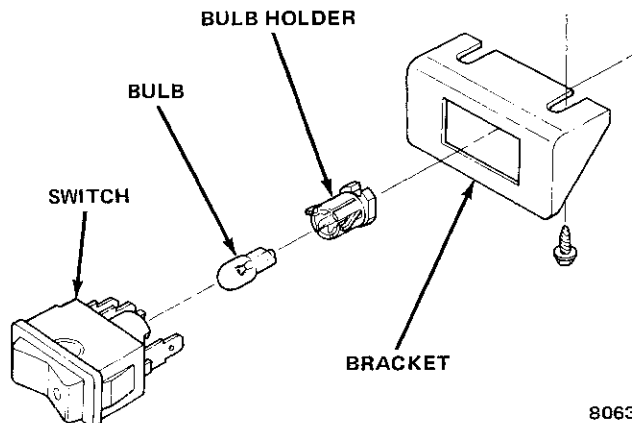


Fig. 3R-18 Off-Road Driving Lamp Switch Components

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- (3) Install replacement switch in bracket and connect electrical leads to switch terminals as noted above.

**ENGINE COMPARTMENT LAMP**

This optional lamp obtains current at the battery terminal of the starter solenoid. A single wire incorporating a fusible link for protection passes current to the lamp assembly. The lamp assembly has a mercury switch which completes the circuit through the hood assembly when the hood is open. When the hood is closed, the mercury within the lamp assembly opens the circuit and the lamp does not light (fig. 3R-19).

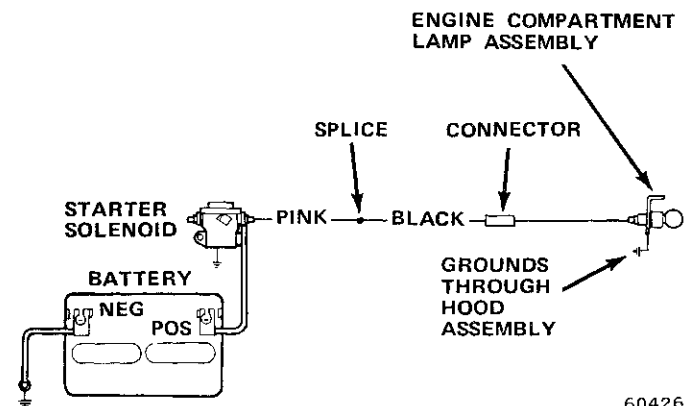


Fig. 3R-19 Engine Compartment Lamp Wiring

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# INTERIOR LIGHTING SYSTEM

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Courtesy Lamps/Dome Lamps	3R-12	Instrument Cluster Lamps	3R-13
Dome/Reading Lamp	3R-12	Lighted Vanity Mirror	3R-13

## COURTESY LAMPS/DOME LAMPS

### CJ Models

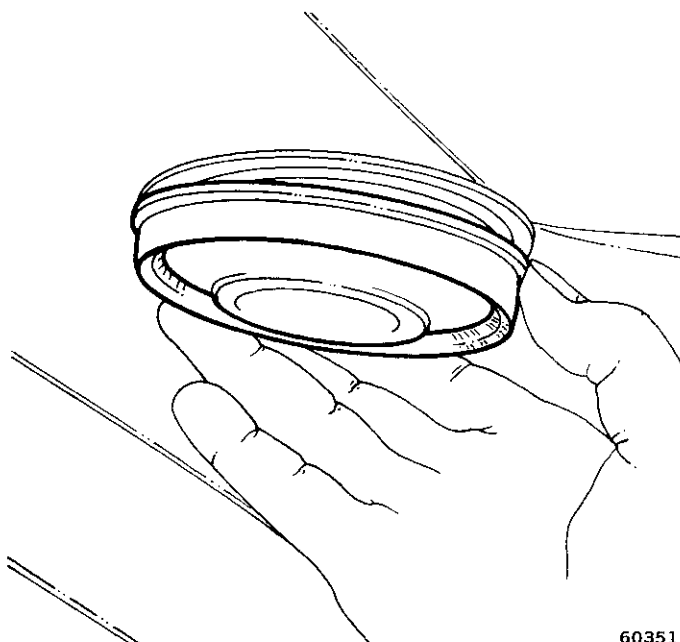
The courtesy lamps are located beneath each end of the instrument panel and are operated by rotating the headlamp switch knob counterclockwise to the stop.

Current passes from the headlamp switch through the lamp and back to ground at the headlamp switch. No door switches are used.

### Cherokee-Wagoneer Models

The courtesy and dome lamps operate when the doors are opened. The door pillar switch provides a ground for the circuit.

Battery feed is from the headlamp switch. When the doors are closed, the dome and courtesy lamps are operated by rotating the headlamp switch knob counterclockwise to the stop. The ground for the lamps is then through the headlamp switch. The standard round dome lamp lens has three irregularly spaced barbed tabs that are inserted into slots in the dome lamp base to retain it. The lens is removed by pulling it downward or by prying it down with a small screwdriver (fig. 3R-21).



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Fig. 3R-21 Removing Dome Lamp Lens—Cherokee-Wagoneer Models

To install, align the lens tab with the proper slots and snap it into place.

### Truck Models

The courtesy and dome lamps operate when the doors are opened. The door pillar switch provides a ground for the circuit.

Battery feed is from the headlamp switch. When the doors are closed, the dome and courtesy lamps are operated by rotating the headlamp switch knob counterclockwise to the stop. The ground for the lamps then is made through the headlamp switch.

The dome lamp lens can be removed by squeezing the lens together to disengage the retaining tabs (fig. 3R-22). The dome lamp assembly can be removed after removing two attaching screws. The dome lamp bracket in the Truck cab is centrally located above the rear window.

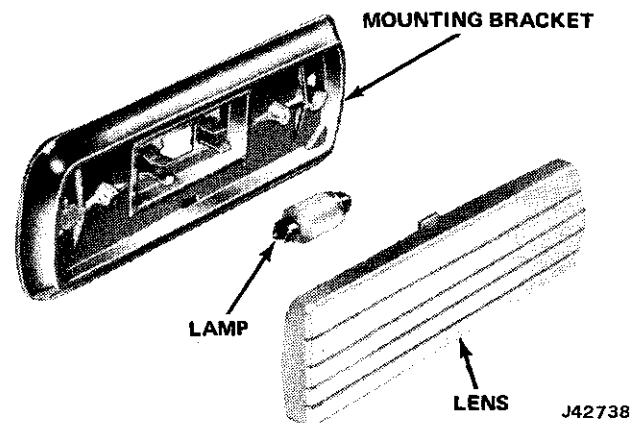


Fig. 3R-22 Dome Lamp—Truck Models

## DOME/READING LAMP

### Cherokee-Wagoneer Models

The dome/reading lamp replaces the standard dome lamp as an optional accessory. The dome lamp is operated by the headlamp switch or door switches like the standard dome lamp. Two reading lamps are built into the lamp housing and illuminate the driver or passenger

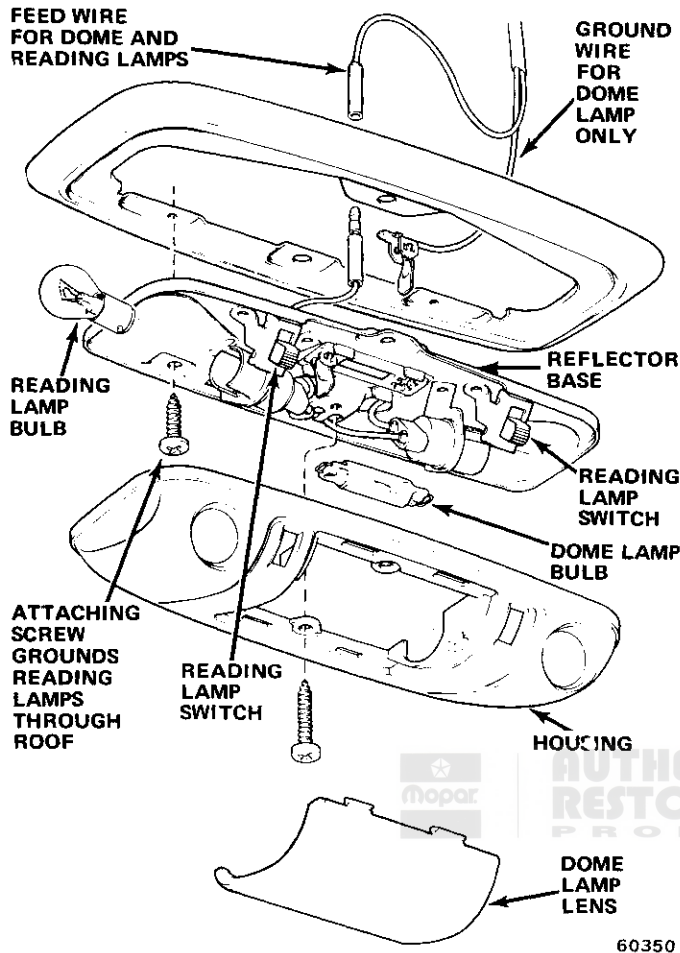


Fig. 3R-23 Dome/Reading Lamp—Cherokee-Wagoneer Models

seat position. The reading lamps are operated individually by a sliding switch located next to each lamp (fig. 3R-23). The reading lamps are grounded through the lamp assembly attaching screws to the roof bow. Refer to Wiring Diagrams at the end of this manual for details.

### LIGHTED VANITY MIRROR

#### Cherokee-Wagoneer Models

The lighted vanity mirror (fig. 3R-24) is attached to the passenger sun visor. It has one lamp assembly mounted at each end of the vanity mirror. The lamp switch is located on the right side of the mirror assembly.

The lighted vanity mirror assembly is equipped with a short harness and connector to allow removal without dropping the headliner. The short harness is connected to the dome/reading lamp harness. The circuit is

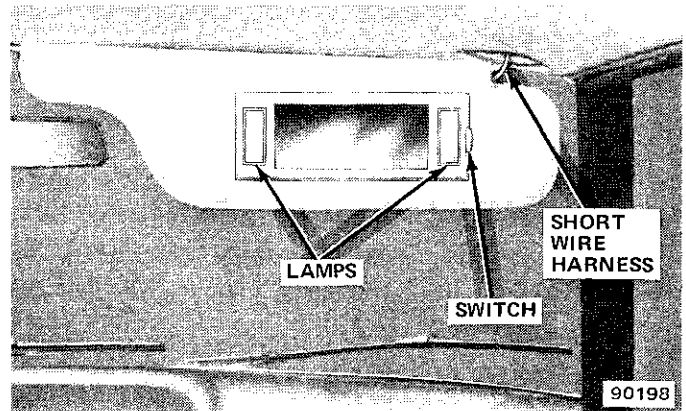


Fig. 3R-24 Lighted Vanity Mirror—Cherokee-Wagoneer Models

grounded at the front roof bow and obtains current from the dome/reading lamp circuit. Refer to Wiring Diagrams at the end of this manual for details.

### CARGO LAMP

#### Cherokee-Wagoneer Models

The cargo lamp is located in the rear headlining and controlled by the headlamp switch, door switches, and cargo lamp switch. The cargo lamp switch may be operated from the rear of the vehicle after lowering the tailgate glass. The cargo lamp switch provides an additional ground switch for the cargo lamp.

### GLOVE BOX LAMP

Current passes from the stoplight switch feed to the glove box lamp socket. The glove box lamp switch is grounded to the instrument panel and thus has no ground wire. When the glove box is open, the switch completes the ground circuit through the instrument panel. Refer to Wiring Diagrams at the end of this manual for details.

### INSTRUMENT CLUSTER LAMPS

The instrument cluster lamps are covered in detail in Chapter 3C.

# CHASSIS WIRING HARNESS

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Fuse Panel	3R-16
Ignition Switch	3R-15

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Wiring Harness Components	3R-14

## WIRING HARNESS COMPONENTS

### Main Harness Connector

All models have a main wiring harness connector located at the left upper corner of the dash panel. This connector is made up of the engine and forward lamp harness at the engine compartment and the fuse and instrument panel harness at the passenger compartment side.

The connector can be removed from the dash panel by removing the center bolt from the engine compartment side and the two attaching screws from the driver's side. Be careful not to bend the male spade terminals when removing or installing the connector. The center of the connector is filled with a non-conductive grease to prevent corrosion of the terminals. If any wires are replaced on the engine compartment side, the terminal opening must be resealed with a durable waterproof sealer. **Do not use string-type body caulk as a sealer.**

### Fusible Links

Fusible links are harness wires covered with a special non-flammable insulation. The links protect circuits which are not normally fused due to carrying high amperage loads or because of their location in the chassis.

They are used to prevent major harness damage in the event a short circuit, short to ground or overload condition occurs.

All Jeep models are equipped with fusible links, located in the engine compartment, which protect the circuits shown in the Wiring Diagrams.

Each link is of a fixed value for the specific load. Replacement links are listed in the parts catalog.

**NOTE:** Failure of a fusible link is often caused by a grounded circuit; therefore, the cause of the failure must be determined prior to installing a new link.

### Fusible Link Replacement

- (1) Disconnect battery negative cable.
- (2) Follow one end of the link to the terminal end.

Follow the remaining end to wire harness.

- (3) Remove harness tape approximately 2 inches from where link enters harness; the soldered splice will be visible.

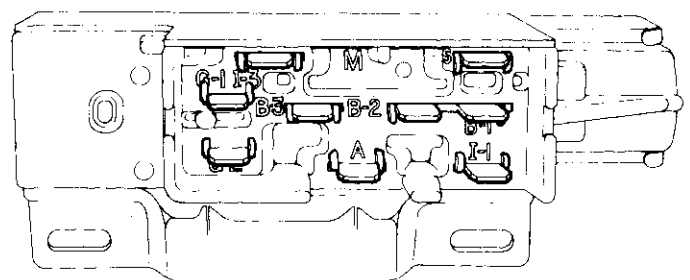
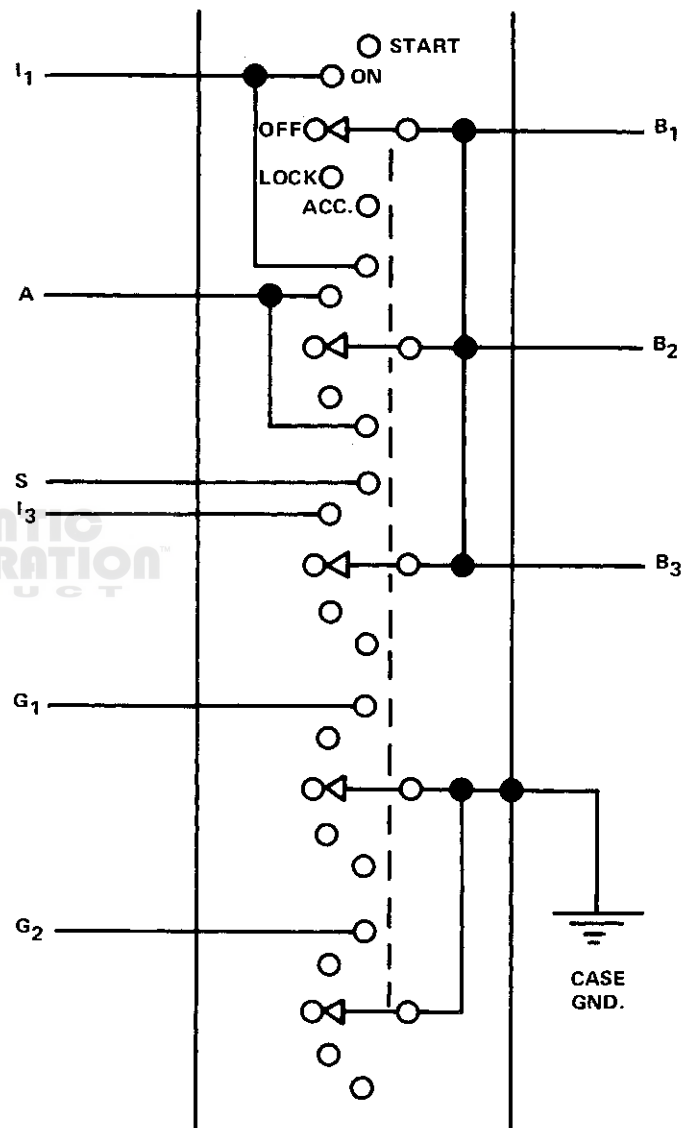


Fig. 3R-25 Ignition Switch Terminals

(4) Following the wiring diagram, determine which circuit(s) may have caused the failure. Test the circuit(s) using an ohmmeter or test light until ground condition is located and corrected.

(5) Unsolder link from harness, solder replacement link to harness wire(s).

**NOTE:** Solder joint **MUST** be made with rosin core solder only. **DO NOT** use acid or acid core solder. Protect harness wires from damage when soldering.

(6) Tape harness using plastic electrical tape.

(7) Route wire as originally installed and make connection.

(8) Connect battery negative cable and check operation of the circuit(s) involved.

### IGNITION SWITCH

The ignition switch is mounted on the lower section of the steering column and is connected to the key lock assembly by a remote lock rod.

### Removal

(1) Place key lock in Off—LOCK position and remove two switch attaching screws.

(2) Disconnect switch from remote rod.

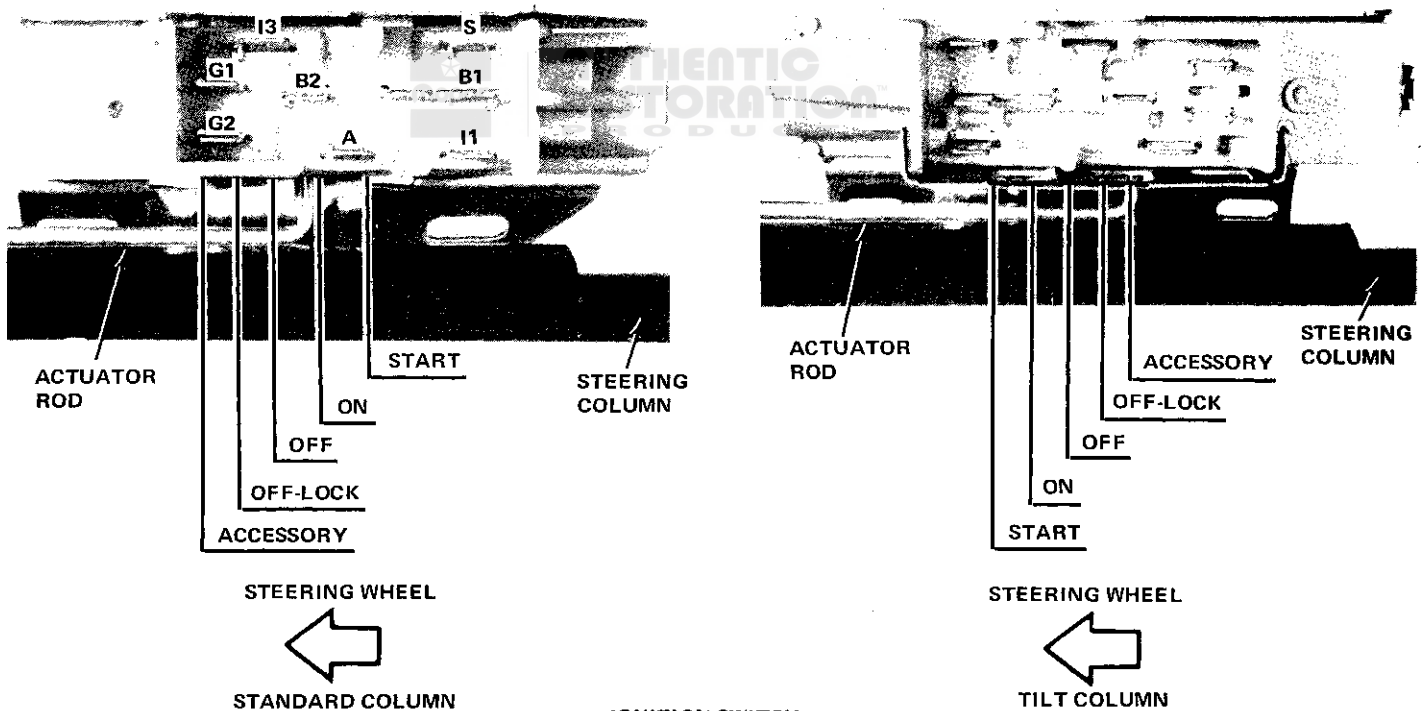
(3) Disconnect harness connector and remove switch from steering column.

### Testing

The ignition switch terminals are shown in figure 3R-25.

To test the ignition switch circuitry and continuity, place the slide bar in the position to be tested and use either an ohmmeter or Continuity Light J-21008.

Ignition switch slide bar positions can be easily identified by first locating the alignment hole located in the flat portion of the switch adjacent to the terminals. Starting from the alignment hole end of the switch, the switch positions are: Accessory, Off—LOCK, Off, On, and Start. Each position has a detent stop except START which is spring loaded to release when the key is released.



POSITION	CIRCUIT	
START	I-1, B-1 & S G-1, G-2	CONNECTED GROUNDED
ON	I-1 & B-1 A & B-2 I-3 & B-3	CONNECTED CONNECTED CONNECTED
OFF		OPEN
OFF-LOCK		OPEN
ACCESSORY	A & B-2	CONNECTED

B-1, B-2 & B-3 (COMMON CONNECTION)

Fig. 3R-26 Ignition Switch Positions



## 3R-16 LIGHTING SYSTEMS

No electrical resistance should be indicated (test lamp on) between two connected terminals. The maximum voltage drop between any two connected terminals, as shown in the Ignition Switch Chart, should not exceed 12.5 millivolts per amp. For example: If a 10-amp load is drawn through the switch, maximum voltage drop should be  $10 \times 0.0125$  or 0.125 volt.

### Installation

#### Standard Column

(1) With actuator rod disconnected, position switch as shown in figure 3R-26.

(2) Move slider to extreme left (Accessory position).

**NOTE:** The left side of the ignition switch is toward the steering wheel.

(3) Position actuator rod in the slider hole and install switch to steering column being careful not to move the slider out of the detent.

(4) Hold key in Accessory position and push switch down column slightly to remove slack in actuator rod.

(5) Tighten attaching screws securely.

(6) Connect white connector and then black connector to switch.

(7) Install steering tube cover.

#### Tilt Column

(1) With actuator rod disconnected, position switch as shown in figure 3R-26.

(2) Move slider to extreme right (Accessory position).

**NOTE:** The right side of the ignition switch is downward from the steering wheel.

(3) Position actuator rod in slider hole.

(4) Install switch to steering column but do not tighten attaching screws.

(5) Lightly push switch down column (away from steering wheel) to remove lash in actuator rod, while holding key in Accessory position. Be careful not to move slider out of detent.

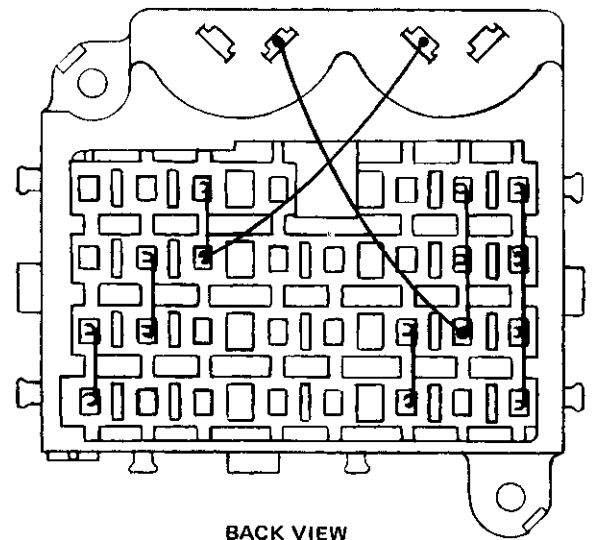
(6) Tighten attaching screws securely.

(7) Connect white connector and then black connector to ignition switch.

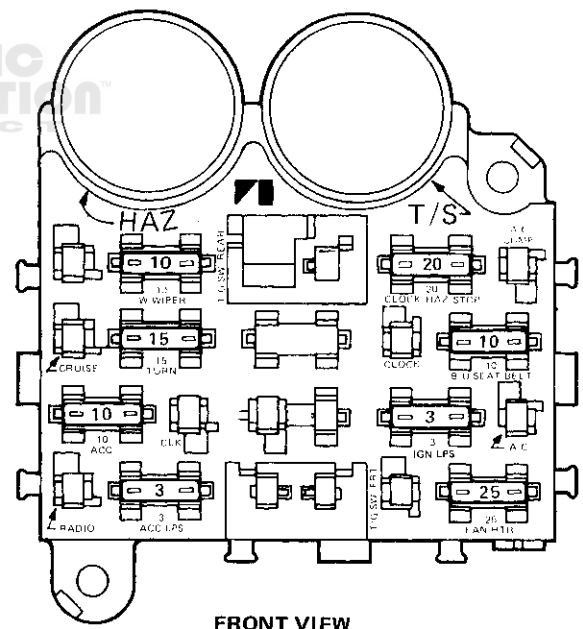
(8) Install steering tube cover, if removed.

### FUSE PANEL

The fuse panel is located on the passenger compartment side of the dash panel, attached to the main harness connector.



BACK VIEW



FRONT VIEW

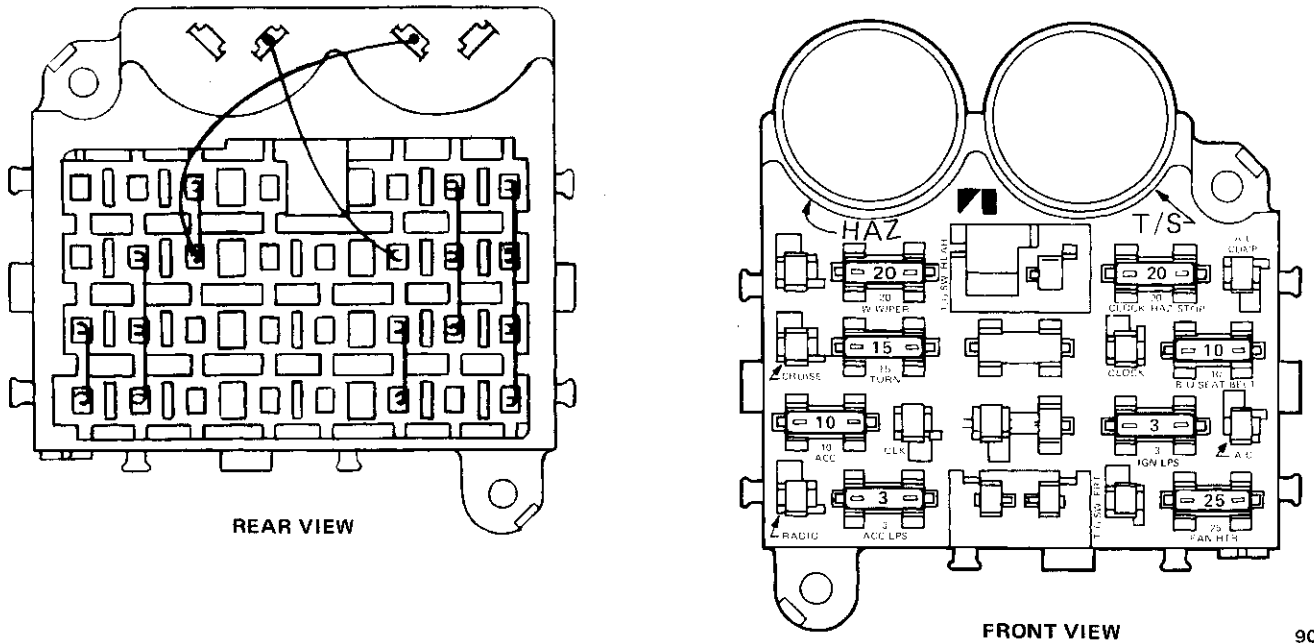
90199

Fig. 3R-27 Fuse Panel Circuitry and Fuse Application—CJ Models

### CIRCUIT BREAKERS

#### CJ Models

Headlamps are protected by a 20-ampere circuit breaker located in the headlamp switch.



**Fig. 3R-28 Fuse Panel Circuitry and Fuse Application—  
Cherokee-Wagoneer-Truck Models**

90200

### Cherokee-Wagoneer-Truck Models

Headlamps are protected by a 20-ampere circuit breaker located in the headlamp switch.

The tailgate window circuits are protected by two 30-ampere circuit breakers located in the fuse panel.

One circuit breaker is used in the instrument panel switch circuit and the other is used in the tailgate key operated switch circuit.

### Torque Specifications

Service Set-To Torques should be used when assembling components.

Service In-Use Recheck Torques should be used for checking a pre-torqued item.

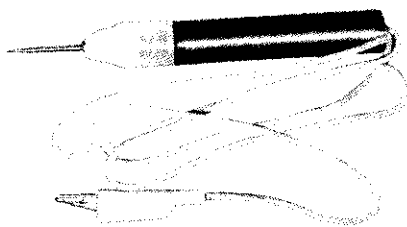
	Service Set-To Torque		Service In-Use Recheck Torque	
	(USA) In-Lbs	(METRIC) Nm	(USA) In-Lbs	(METRIC) Nm
Steering Wheel Nut .....	35 ft-lbs	48	30-40 ft-lbs	41-54
Directional Signal Switch Handle .....	25	3	15-30	2-3
Hazard Warning Knob Mounting Screws .....	5	0.5	2-5	0.2-0.5

All Torque values given in inch-pounds with dry fits unless otherwise specified.

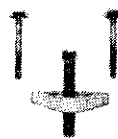
**Tools**



**J-25300-10  
HEADLIGHT AIMER**



**J-21008  
CONTINUITY LIGHT**



**J-21232-01 FRONT PUMP  
OIL SEAL REMOVER  
(STEERING WHEEL PULLER)**



**J-23653 LOCK  
PLATE COMPRESSOR**

# HORN SYSTEMS 3S

## SECTION INDEX

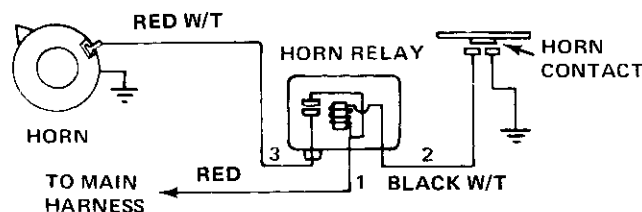
	Page		Page
General	3S-1	Horn System Diagnosis and Repair	3S-1
Horn Adjustment	3S-2	Specifications	3S-2

### GENERAL

The horn circuit includes horn(s), horn relay, battery, steering column wiring harness, horn ring, and the body sheet metal.

A cadmium-plated ground screw is used to attach the horn(s) to the body. **Do not** substitute other types of ground screws as they may become corroded and cause a loss of ground.

To reduce the current flow through the horn ring contacts, a relay is used between the battery and horn. The horn relay consists of an electromagnet and a set of contacts arranged so that when the magnet is energized an armature is attracted and the contacts close. A spring keeps the contacts open when the unit is at rest. The horn-ring contacts carry only relay current, while the relay opens and closes the circuit between the horn and battery (fig. 3S-1).



80264

Fig. 3S-1 Horn Circuit Schematic

A fusible link is incorporated in the main wiring harness to furnish protection against major harness damage.

When a grounded circuit or overload occurs in the horn circuit, damage will be limited to the fusible link.

### HORN SYSTEM DIAGNOSIS AND REPAIR

In case of horn system failure, proceed as follows:

(1) Using a test light or voltmeter, check for battery voltage in the red lead to relay before individual components are tested or replaced.

(2) A lack of voltage indicates fusible link or harness is open and cause of failure must be determined and repaired prior to installing a replacement fusible link or other components.

(3) The replacement fusible link is supplied in the proper length with a terminal connector on one end.

(4) Inspect wiring between horn, relay and battery for loose connections, faulty insulation, corroded terminals, or improper ground connection at horn base.

(5) If horn does not operate when ring or button is depressed, ground number 2 terminal (fig. 3S-1) of horn relay with a jumper lead. If horn operates, this indicates proper operation of horn and relay.

(6) Inspect horn ring switch and wire from switch to relay carefully for source of trouble.

**CAUTION:** Do not ground red lead.

(7) If horn does not operate, ground number 2 terminal and connect a jumper lead from horn relay terminals 1 to 3.

(8) If horn now operates, a faulty horn relay is indicated.

(9) If it does not operate, check wiring and connections between the horn relay terminal number 3 and horn for continuity.

(10) Connect a jumper lead from horn base to the vehicle chassis or engine and repeat the above tests.

(11) If horn now operates, remove attaching screw, horn and mounting bracket, clean mating surfaces.

(12) Install horn, mounting bracket and attaching screw, tightened screw to 15 foot-pounds (20 N•m) torque.

(13) If horn still does not operate, horn is inoperative and must be replaced.

## 3S-2 HORN SYSTEMS

(14) To check for bad component ground, place a voltmeter between component and ground. If a sizable voltage is shown on the meter, repair the poor ground connection.

(15) Continuous horn operation is usually caused by improper ground in horn ring or button wiring.

### HORN ADJUSTMENT

Adjust current by turning the adjusting screw counterclockwise to decrease the current until the specified current is reached. Current adjustment is very sensitive. Therefore, care must be taken not to turn the horn adjustment screw too far. Turn only 1/10 of a turn at one time.

(1) Check for normal battery voltage (about 12.6 volts).

(2) Connect ammeter in series between horn and battery and read current as shown in figure 3S-2.

(3) Adjust current to 4.5 amps.

**NOTE:** Do not stuff rags or other materials in the horn protector to muffle the sound while adjusting, as this changes the vibration frequency and would give a raise in current setting. When adjusting a set of horns, each horn should be connected and adjusted separately, then check for tone by operating as a pair.

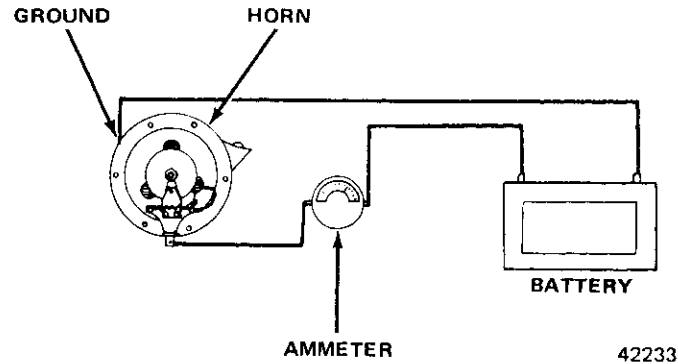


Fig. 3S-2 Connection for Horn Adjustment

42233

### SPECIFICATIONS

#### Electrical Specifications

Item	Current Flow
Horn	4-5 Amps

70446

### Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft.lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Horn Bracket Screw	15	8-17	20	11-23

All Torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

70445

# WINDSHIELD WIPERS 3T

## SECTION INDEX

	Page		Page
Cherokee-Wagoneer-Truck Windshield Wipers	3T-4	CJ Windshield Wipers	3T-1

## CJ WINDSHIELD WIPER

	Page		Page
General	3T-1	Wiper and Washer Control	3T-2
Pivot Shaft Body and Linkage	3T-2	Wiper Arm Replacement	3T-2
Two-Speed Wiper Motor	3T-2	Wiper Blade Replacement	3T-1
Washer Pump	3T-3		

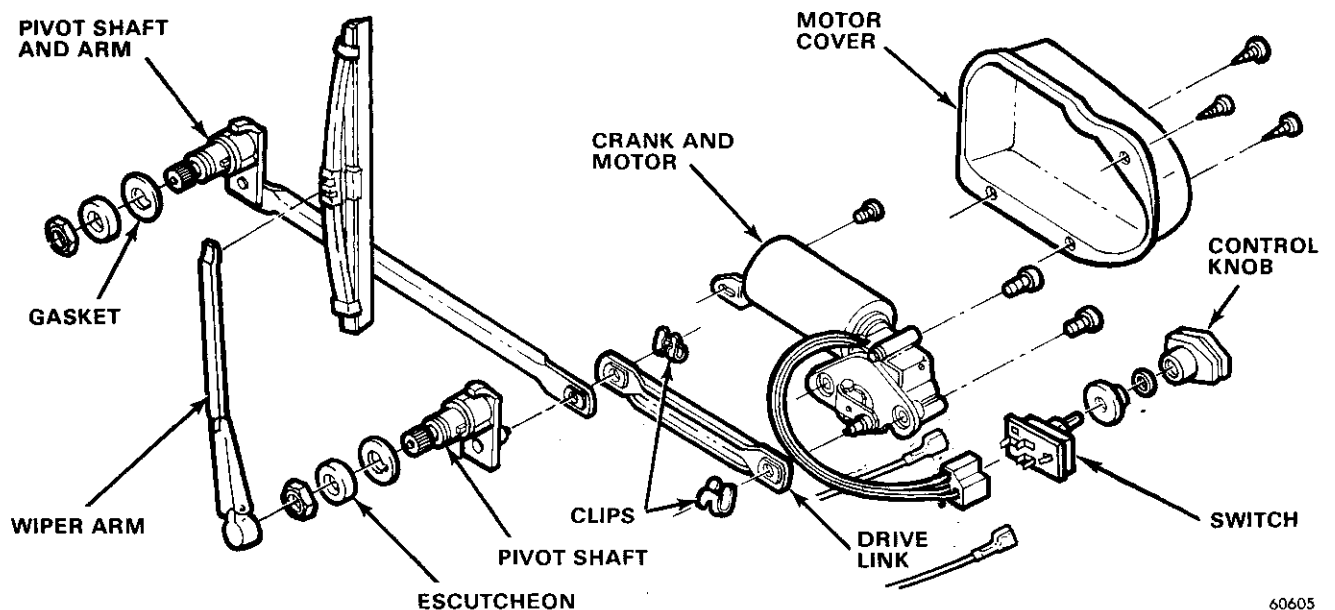
### GENERAL

All CJ models are equipped with a two-speed, electric wiper motor.

The motor is mounted on the lower left corner of the windshield (fig. 3T-1).

### WIPER BLADE REPLACEMENT

The wiper blade assembly is removed from the wiper arm by holding the blade away from the windshield, and pushing it firmly against the tip of the arm to compress the locking spring and disengage the retaining pin. At



60605

Fig. 3T-1 Windshield Wiper Components

## 3T-2 WINDSHIELD WIPERS

the same time, pivot the blade clockwise to unhook it from the end of the arm.

To install, place blade assembly on wiper arm and snap blade assembly into position.

### WIPER ARM REPLACEMENT

(1) To remove windshield wiper arm from pivot shaft body carefully pry up on wiper arm as shown in figure 3T-2.

(2) To install, push wiper arm over pivot shaft. Be sure pivot shaft is in park position and wiper arm is positioned as shown in figure 3T-3.

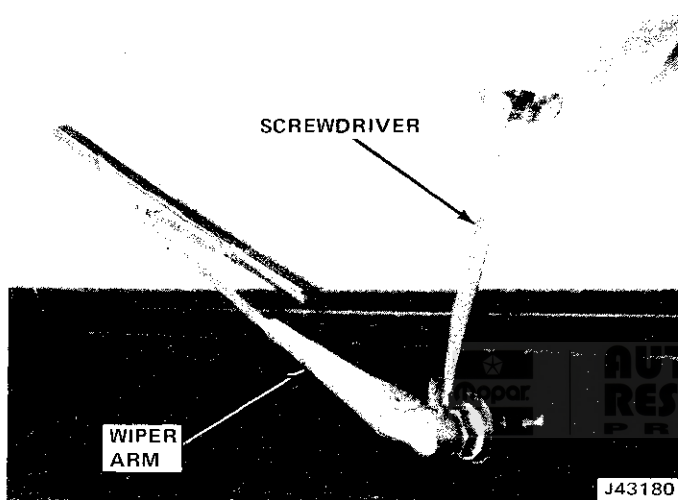


Fig. 3T-2 Wiper Arm Removal

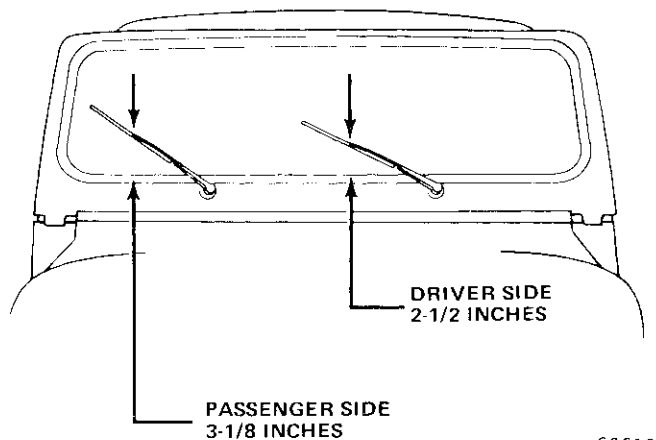


Fig. 3T-3 Wiper Arm Park Position

### PIVOT SHAFT BODY AND LINKAGE

#### Removal

- (1) Remove right and left wiper arms.
- (2) Remove nuts attaching pivots to windshield frame.

(3) Remove necessary top components from windshield frame.

(4) Remove right and left windshield holddown knobs and fold windshield down.

(5) Remove right and left access hole covers.

(6) Disconnect wiper motor drive link from left wiper pivot.

(7) Remove pivot shaft body and linkage from access hole.

#### Installation

(1) Install pivot shaft body and linkage in windshield frame.

(2) Connect wiper motor drive link to left wiper pivot.

(3) Install right and left access hole covers.

(4) Raise windshield to upright position and install right and left windshield holddown knobs.

(5) Install nuts attaching pivots to windshield frame.

(6) Install right and left wiper arms.

(7) Install necessary top components on windshield frame.

### WIPER AND WASHER CONTROL

The control switch is mounted on the instrument panel. The switch is a through-type multi-position switch which does not require grounding for proper operation.

The two-speed wiper motor is energized for continuous wiping action by turning the control knob in a clockwise direction.

The electric washer pump is operated by depressing the wiper control knob.

#### Removal

(1) On models with air conditioning, remove screws attaching evaporator assembly to instrument panel and lower evaporator assembly.

(2) Remove control knob.

(3) Remove nut and switch.

(4) Mark wire color locations on switch and disconnect wires.

#### Installation

(1) Connect wires to switch, in proper location as noted above.

(2) Position switch in instrument panel and install attaching nut.

(3) Install control knob.

(4) Install evaporator assembly, if removed.

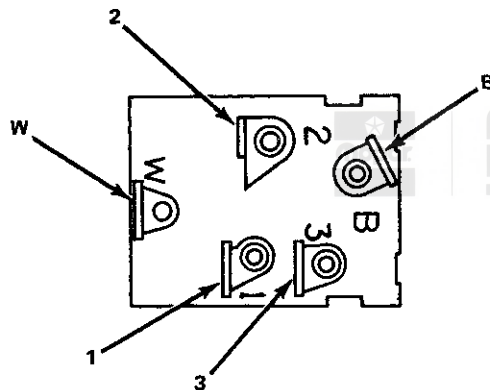
### TWO-SPEED WIPER MOTOR

The wiper motor is protected by a 10-amp fuse in the fuse panel.

When the wiper switch is moved to the low speed position, current flows from the fuse panel to terminal B (fig. 3T-4) of the wiper switch, through the wiper switch to terminal 2, then through the green wire to the motor low-speed brush and through the armature to ground.

With the wiper switch in the high speed position, current flows from the fuse panel to terminal B of the wiper switch, through the wiper switch to terminal 3, then through the red wire to the motor high speed brush and through the armature to ground.

When the wiper switch is turned off, current flows from the fuse panel to terminal B of the wiper switch, through the wiper switch to terminal 1, then through the black wire to the park contact points to the motor low speed brush and through the armature to ground. When the cam on the wiper drive gear opens the park contact points, the feed circuit to the motor low speed brush is interrupted and the motor is in park.



Selector Position	
Off or Park	B-1
Low Speed	B-2
High Speed	B-3
Wash	B-W

80343

Fig. 3T-4 Continuity Test for Wiper Switch

### Troubleshooting Procedures

The wiper motor may be operated independently of the switch to aid in determining defective components.

**NOTE:** The wiper motor must be grounded for proper operation and during all wiper tests.

With ignition switch on, check for 12 volts at switch terminal B. If 12-volt test lamp lights but wiper motor does not operate, connect a jumper wire from ground strap on motor to a good body ground. If motor still does

not operate, disconnect wiring from switch. Using a jumper wire, connect switch terminals 2 and B. This connection should give low speed operation. If wiper motor does not operate in low speed, there is an open in the green wire, a defective internal motor connection or a stuck low speed brush.

To obtain high speed, connect a jumper wire between terminals 3 and B. If wiper motor fails to operate, there is an open in the red wire, a defective internal motor connection, or a stuck high speed brush.

With the wiper blades in a position other than park, connect a jumper wire between terminals 1 and B. The wiper blades should run on low speed and stop in the park position. If the motor does not run after making the jumper connection, there is an open in the black wire, a defective internal motor connection, a misaligned or damaged set of contact points or a bad connection through the park point set to the low speed brush. If the wiper motor runs but does not park, the cam on the drive gear is not sufficiently breaking the contact points.

If wiper motor operation is intermittent, a defective solder joint, wiring connection, body ground or worn brush may cause the condition.

### Removal with Crash Pad

**NOTE:** Without crash pad, remove wiper motor cover.

- (1) Remove necessary top components from windshield frame.
- (2) Remove right and left windshield holddown knobs and fold windshield down.
- (3) Remove left access hole cover.
- (4) Disconnect drive link from left wiper pivot.
- (5) Disconnect wiper motor wire harness from switch.
- (6) Remove attaching screws and remove wiper motor.

### Installation With Crash Pad

- (1) Position wiper motor on windshield frame and install attaching screws.
- (2) Connect wiper motor wire harness to switch.
- (3) Connect drive link to left wiper pivot.
- (4) Install left access hole cover.
- (5) Raise windshield to upright position and install right and left windshield holddown knobs.
- (6) Install necessary top components on windshield frame.

### WASHER PUMP

The electric washer pump assembly is mounted in the water reservoir. The impeller motor case is grounded to the body sheet metal by a black ground wire. It is energized by a yellow feed wire from the single blade terminal on the control switch.



# CHEROKEE - WAGONEER - TRUCK WINDSHIELD WIPER

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Diagnosis and Circuitry	3T-6	Wiper Arm Replacement	3T-4
General	3T-4	Wiper Blade Element Replacement	3T-4
Intermittent Governor	3T-15	Wiper Blade Replacement	3T-4
Tools	3T-18	Wiper Motor	3T-15
Specifications	3T-18	Wiper Pivot Shaft Body and Linkage	3T-5

## GENERAL

The new two-speed electric windshield wipers and electric washers are standard equipment. An optional intermittent wiper system provides a pause between wipe cycles for use during conditions of very light precipitation.

The controls for the windshield wipers are mounted on the instrument panel to the left of the steering column.

The electric wipers are operated by turning the control knob to the right. For intermittent operation, turn knob to the left. Electric washers are actuated by depressing the wiper control knob.

The wiper arms are actuated by a link and pivot assembly attached to the wiper motor.

The wiper motor is mounted to an adapter plate mounted to dash panel.

The wiper arms move in a tandem-like action and park to the right side of the vehicle.

**CAUTION:** *The wiper arms and blades must not be moved manually from side to side or damage could result.*

## WIPER BLADE REPLACEMENT

(1) To remove wiper blade from mounting pin on wiper arm, insert screwdriver into spring release opening of blade saddle and depress spring clip. Pull blade from arm (fig. 3T-5).

(2) To install, push blade saddle onto mounting pin so that spring clip engages pin. Be sure blade is securely attached to arm.

## WIPER BLADE ELEMENT REPLACEMENT

(1) Squeeze latch lock release and pull element out of lever jaws (fig. 3T-6).

(2) To install, insert replacement element through each of the lever jaws. Be sure element is engaged in all lever jaws.

## WIPER ARM REPLACEMENT

(1) Raise blade end of arm from windshield and move spring tab away from pivot shaft. Disengage aux-

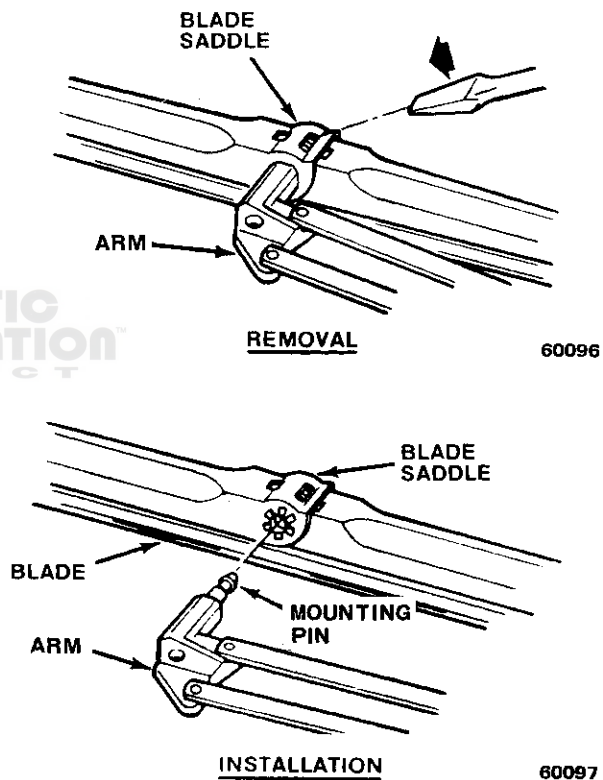


Fig. 3T-5 Wiper Blade Replacement

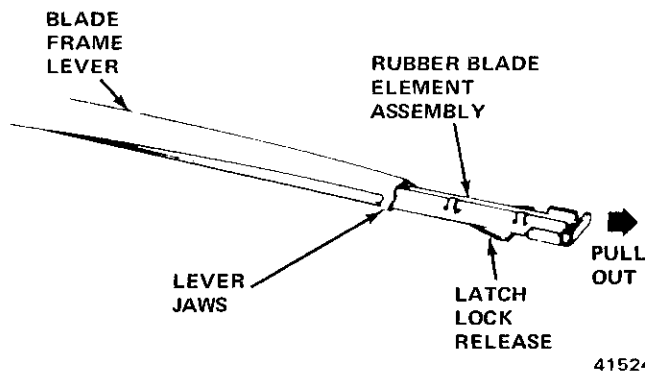


Fig. 3T-6 Wiper Blade Element Replacement

iliary arm retainer clip (driver's side only) from pivot pin and pull wiper arm from pivot shaft.

(2) To install, position auxiliary arm, if equipped, over pivot pin and engage retainer clip. Push wiper arm over pivot shaft. Be sure that pivot shaft is in park position and wiper arm is positioned as shown in figure 3T-7.

(3) Wet windshield and recheck Park position by operating wiper motor several times—ON and OFF.

- (2) Disconnect drive arm from motor crank.
- (3) Remove individual links where necessary to remove pivot shaft bodies without excessive interference.

**WIPER PIVOT SHAFT BODY AND LINKAGE**

**Removal**

(1) Remove wiper arms, pivot shaft nuts, washers, escutcheons, and gaskets (fig. 3T-8).

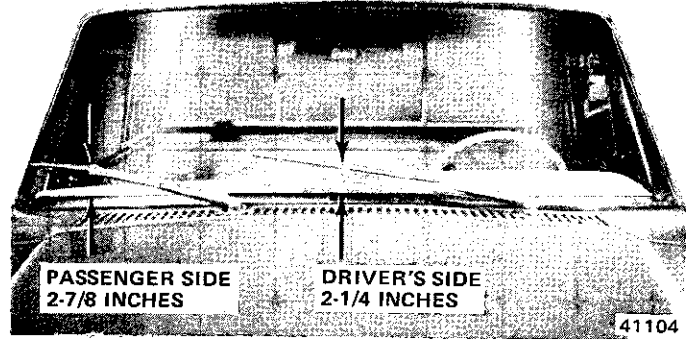


Fig. 3T-7 Wiper Arm Park Location Measurements (Inches)

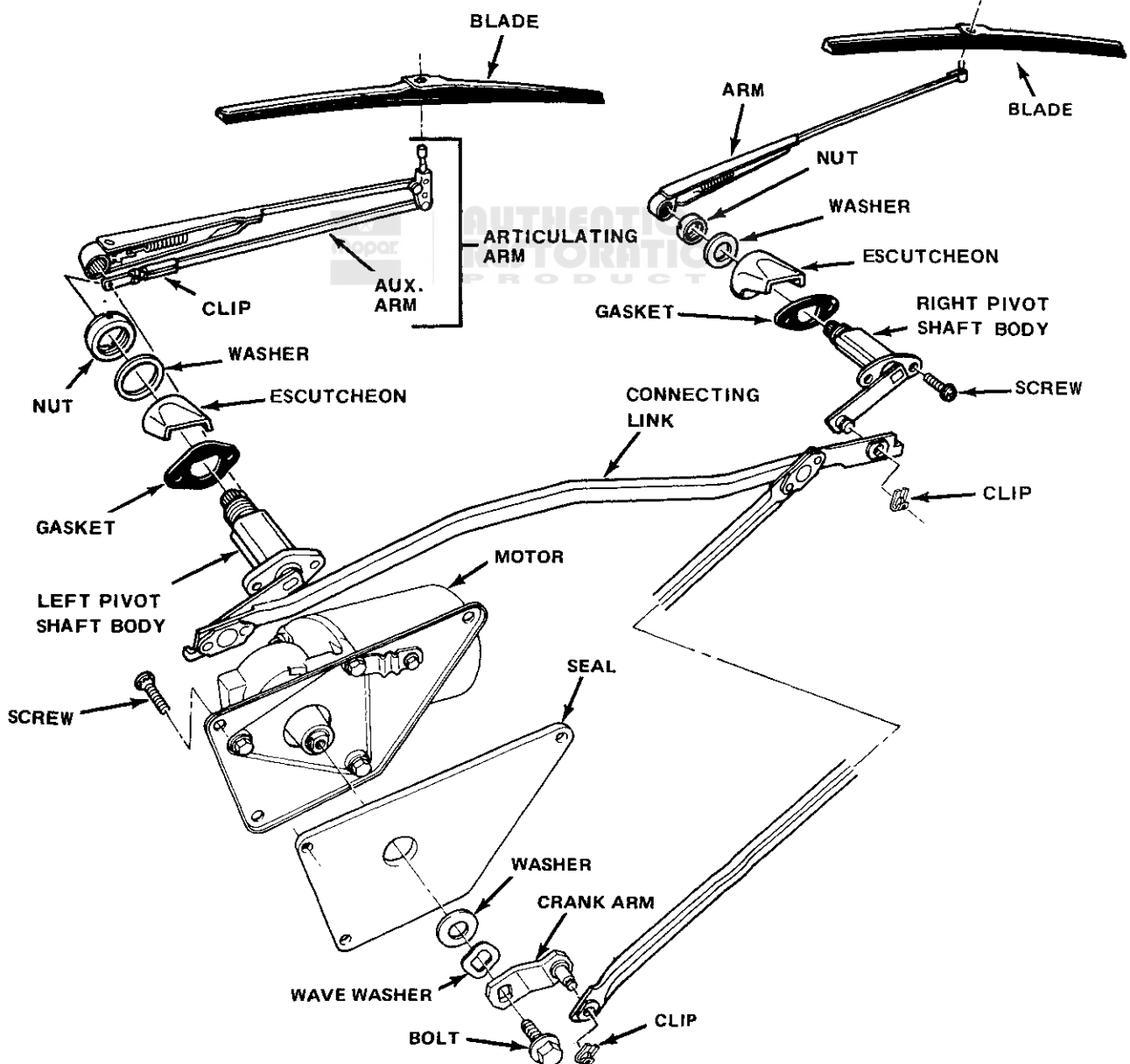


Fig. 3T-8 Windshield Wiper Components

## 3T-6 WINDSHIELD WIPERS

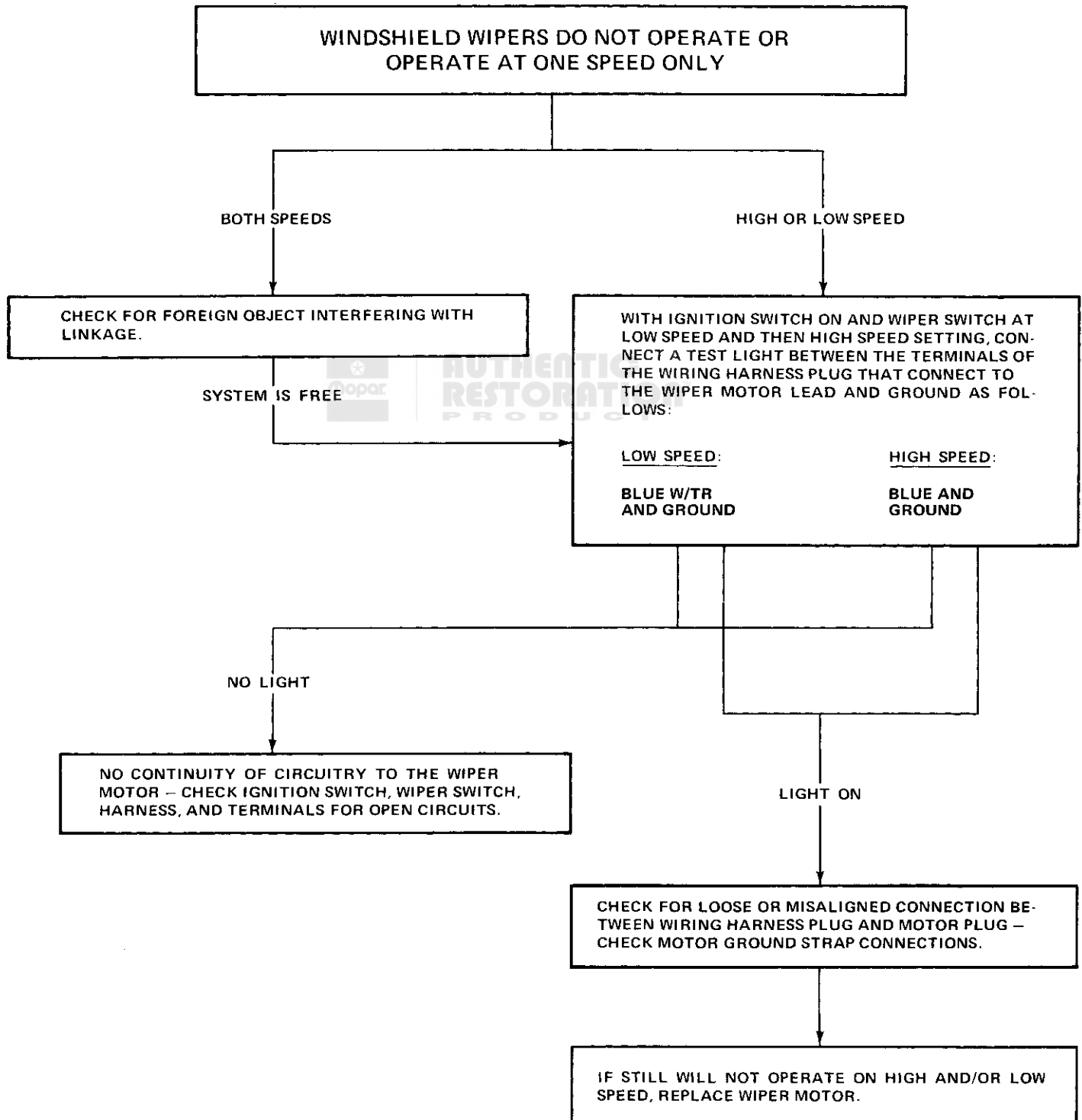
### Installation

- (1) Install wiper pivot shafts and linkage.
- (2) Connect drive arm to motor crank.
- (3) Install gaskets, escutcheons, washers, pivot shaft nuts, and wiper arms.

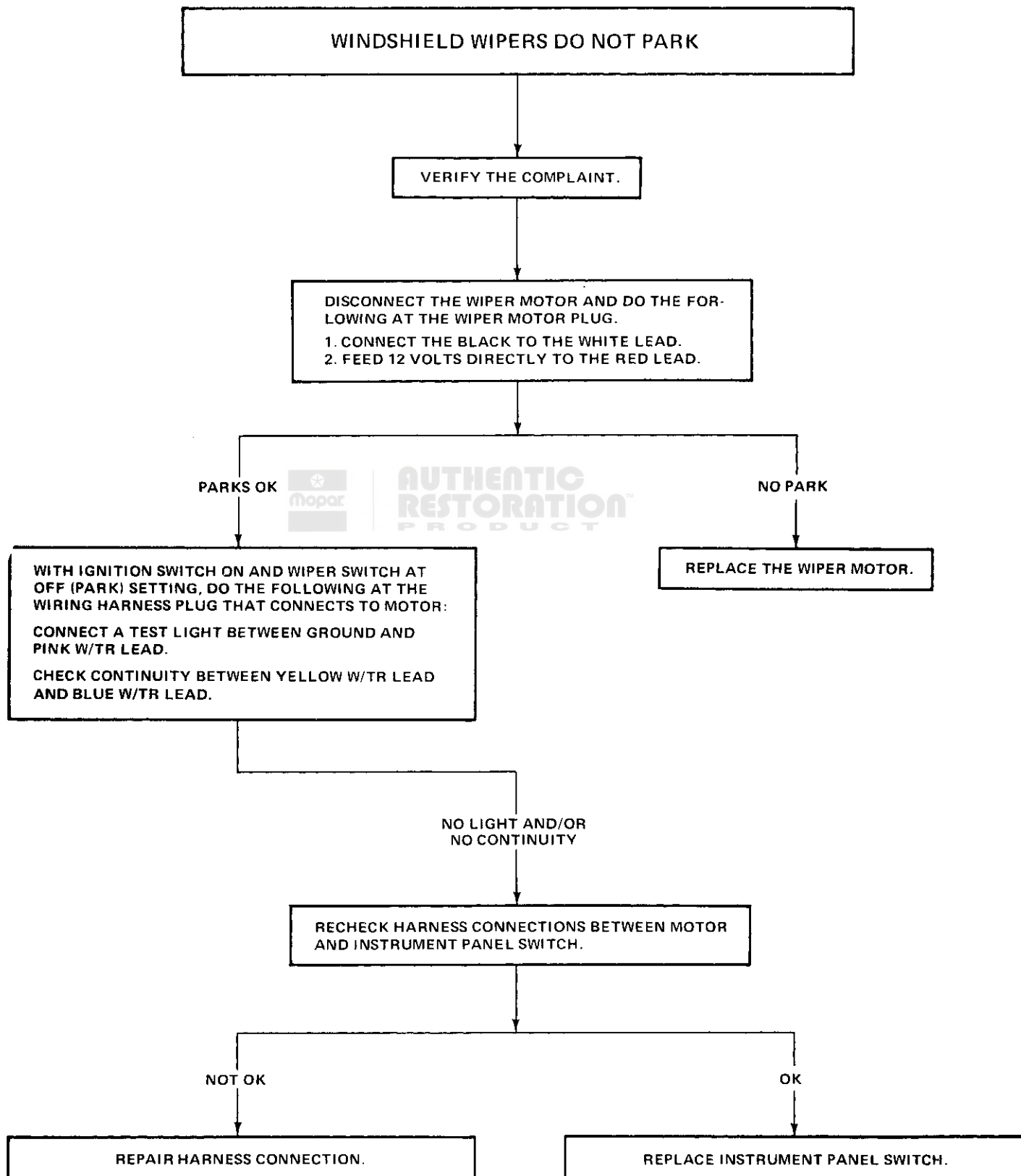
### DIAGNOSIS AND CIRCUITRY

This section is a guide to troubleshooting the windshield wiper system used on Cherokee, Wagoneer and Truck models. It consists of two parts: Diagnosis Charts and Circuitry Illustrations.

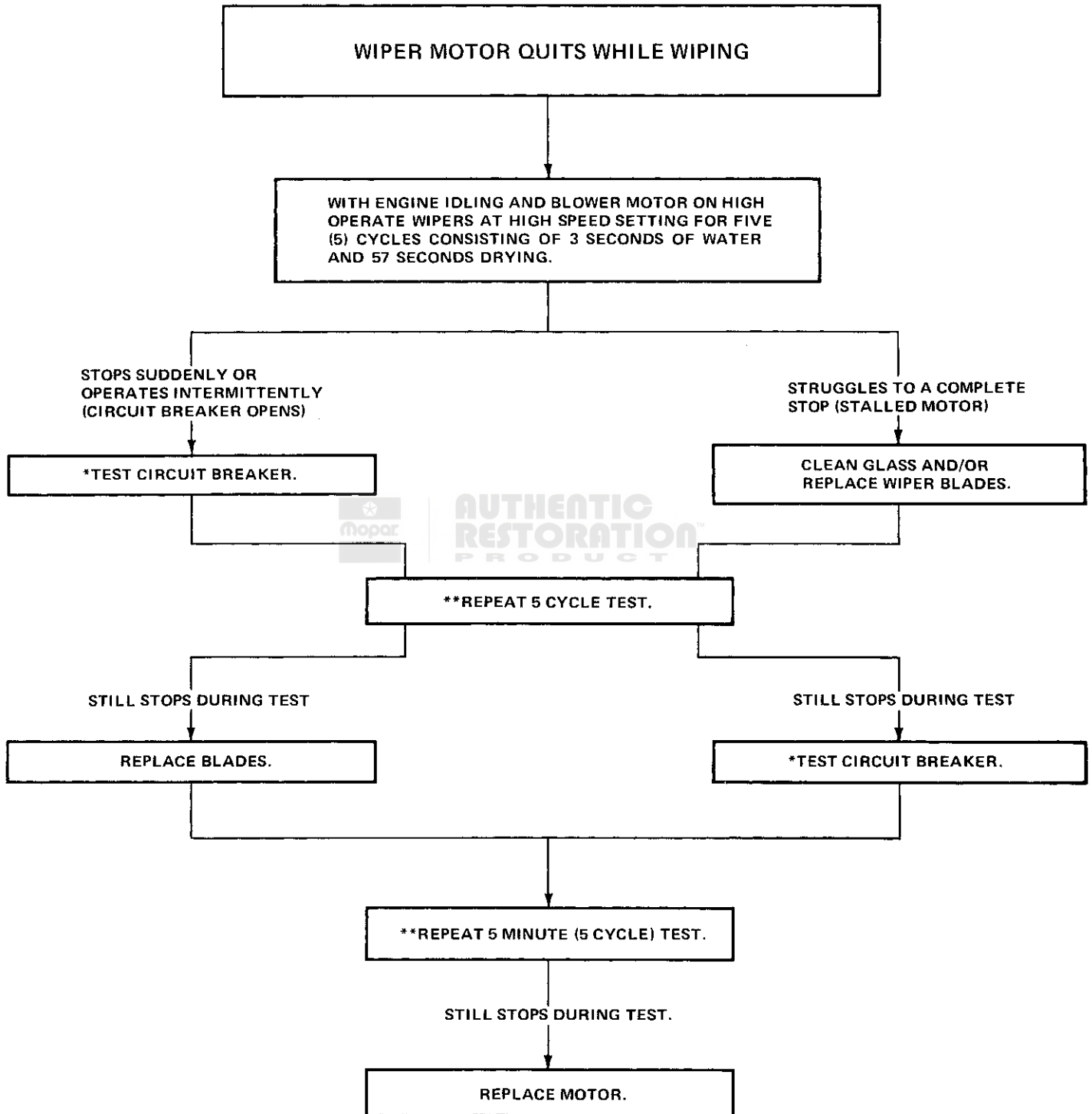
#### Service Diagnosis



Service Diagnosis (Continued)



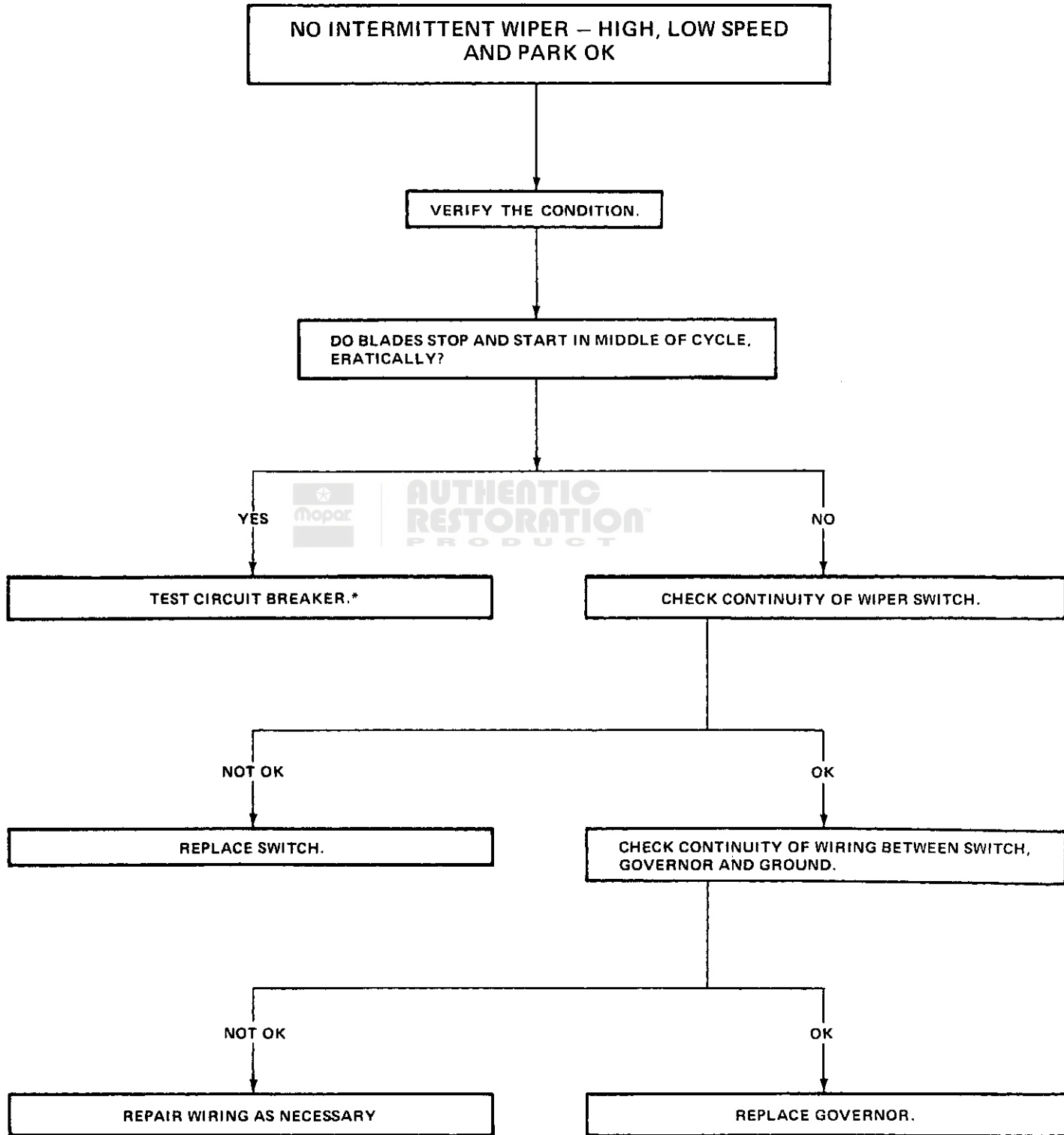
Service Diagnosis (Continued)



\* CIRCUIT BREAKER IS INTEGRAL WITH INSTRUMENT PANEL SWITCH.

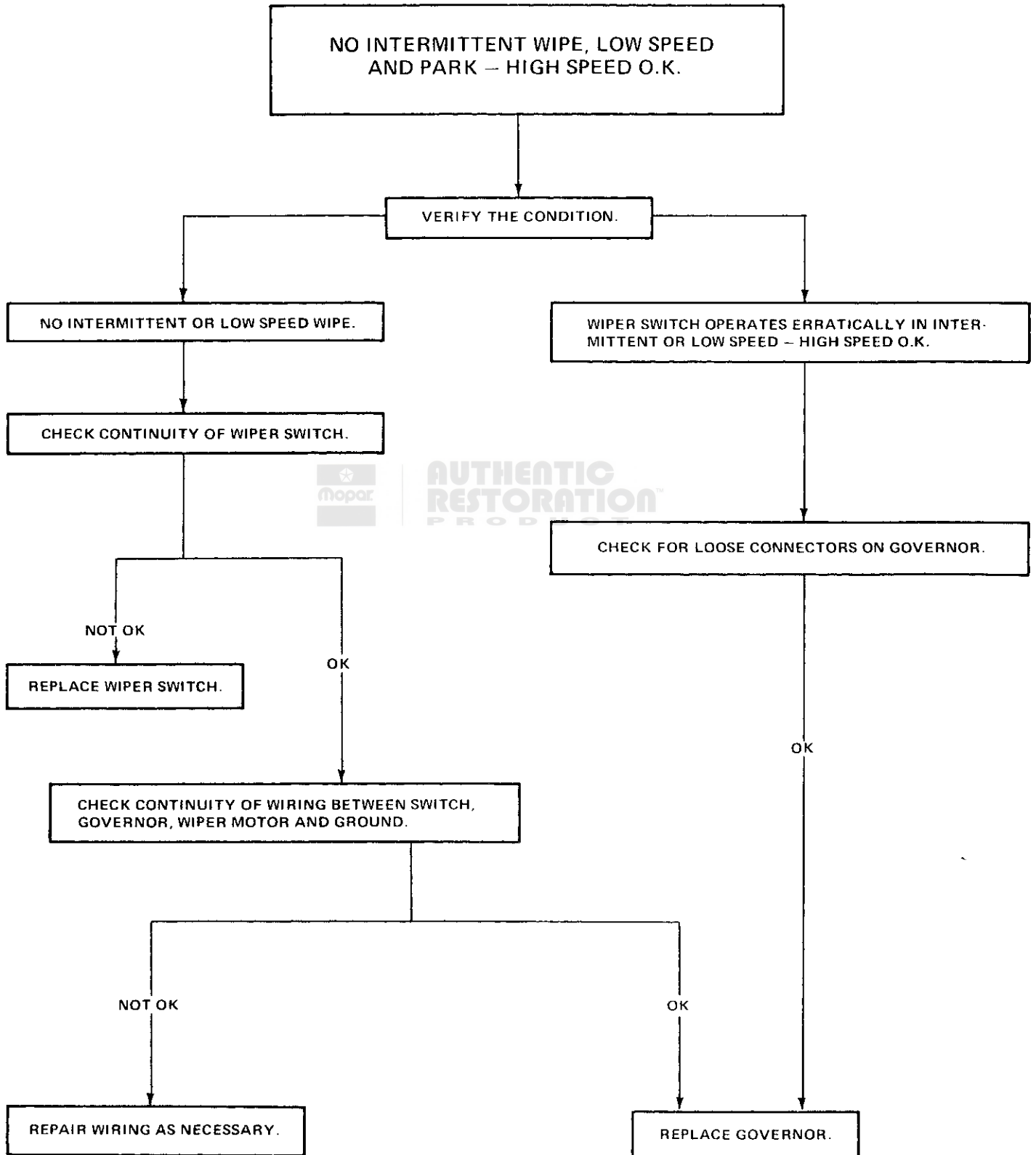
\*\* ALLOW MOTOR TO COOL TO 140° F OR LOWER BEFORE STARTING REPEAT TESTS. IF MOTOR IS 140° F OR LOWER, THE HAND CAN BE HELD AGAINST MOTOR WITHOUT DISCOMFORT.

Service Diagnosis (Continued)



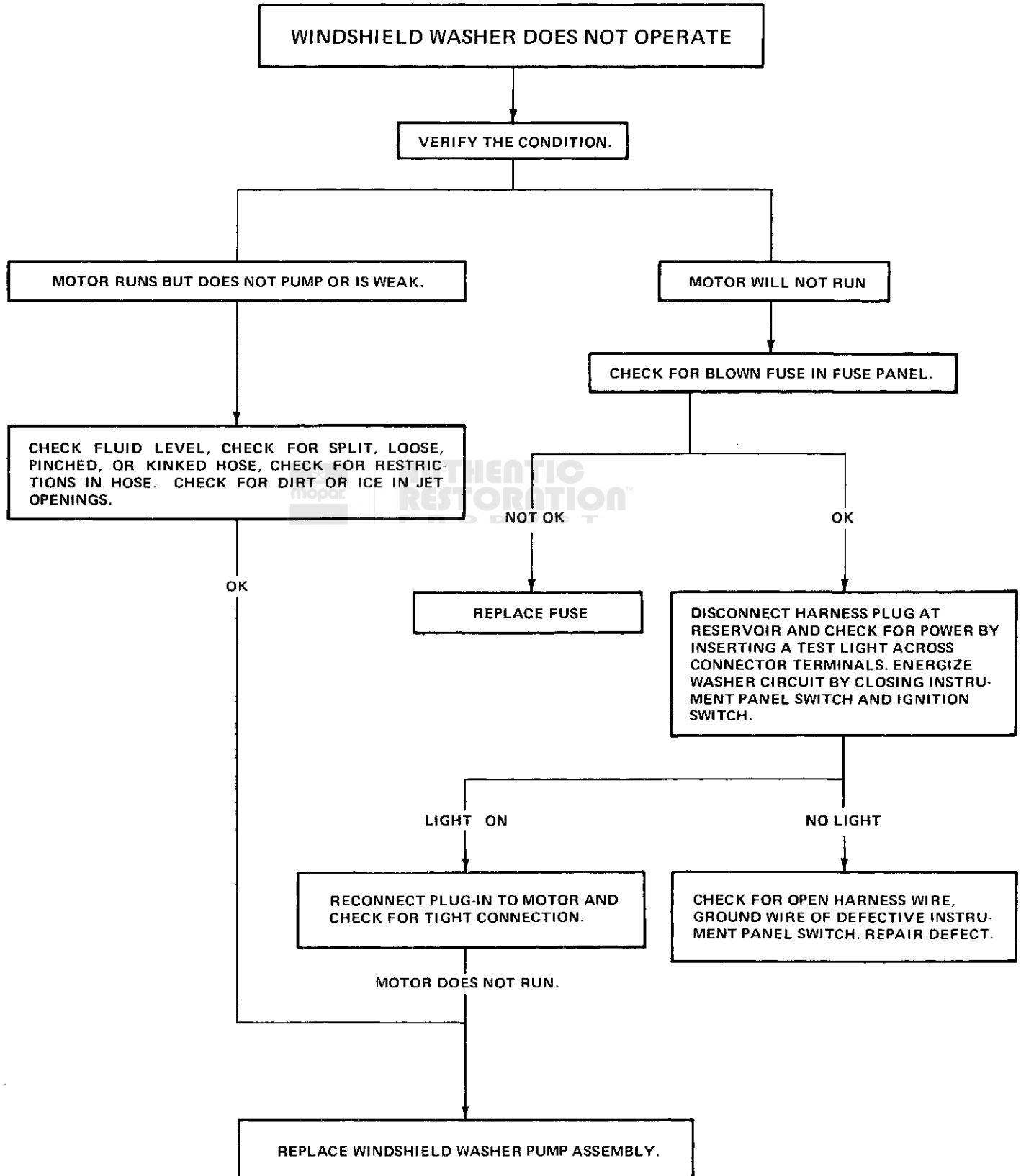
\*WIPER SWITCHES HAVE INTERNAL CIRCUIT BREAKERS WHICH REQUIRE REPLACEMENT OF ENTIRE SWITCH.

Service Diagnosis (Continued)



AUTHENTIC RESTORATION PRODUCTION

Service Diagnosis (Continued)





# 3T-12 WINDSHIELD WIPERS

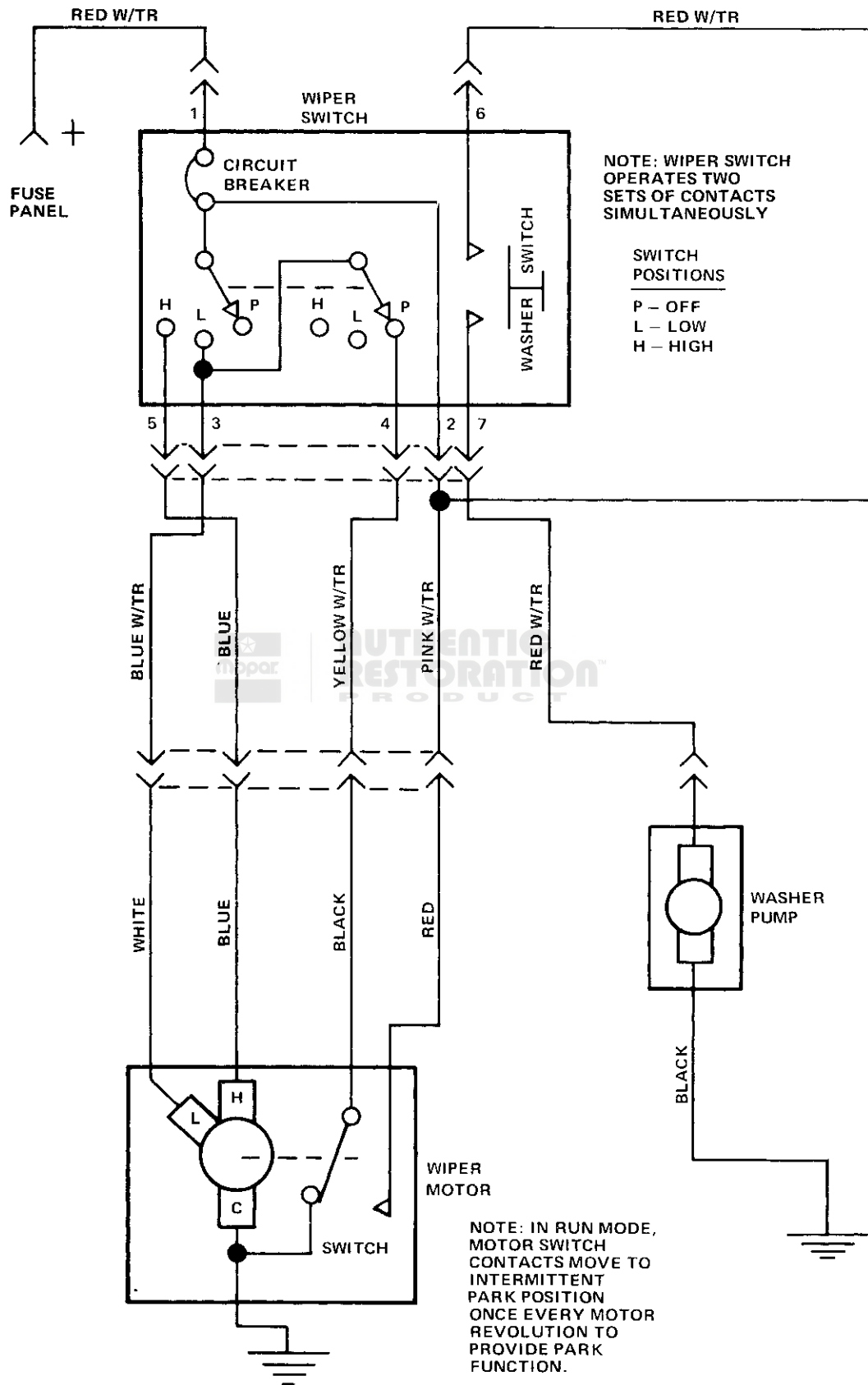


Fig. 3T-9 Windshield Wiper Circuitry

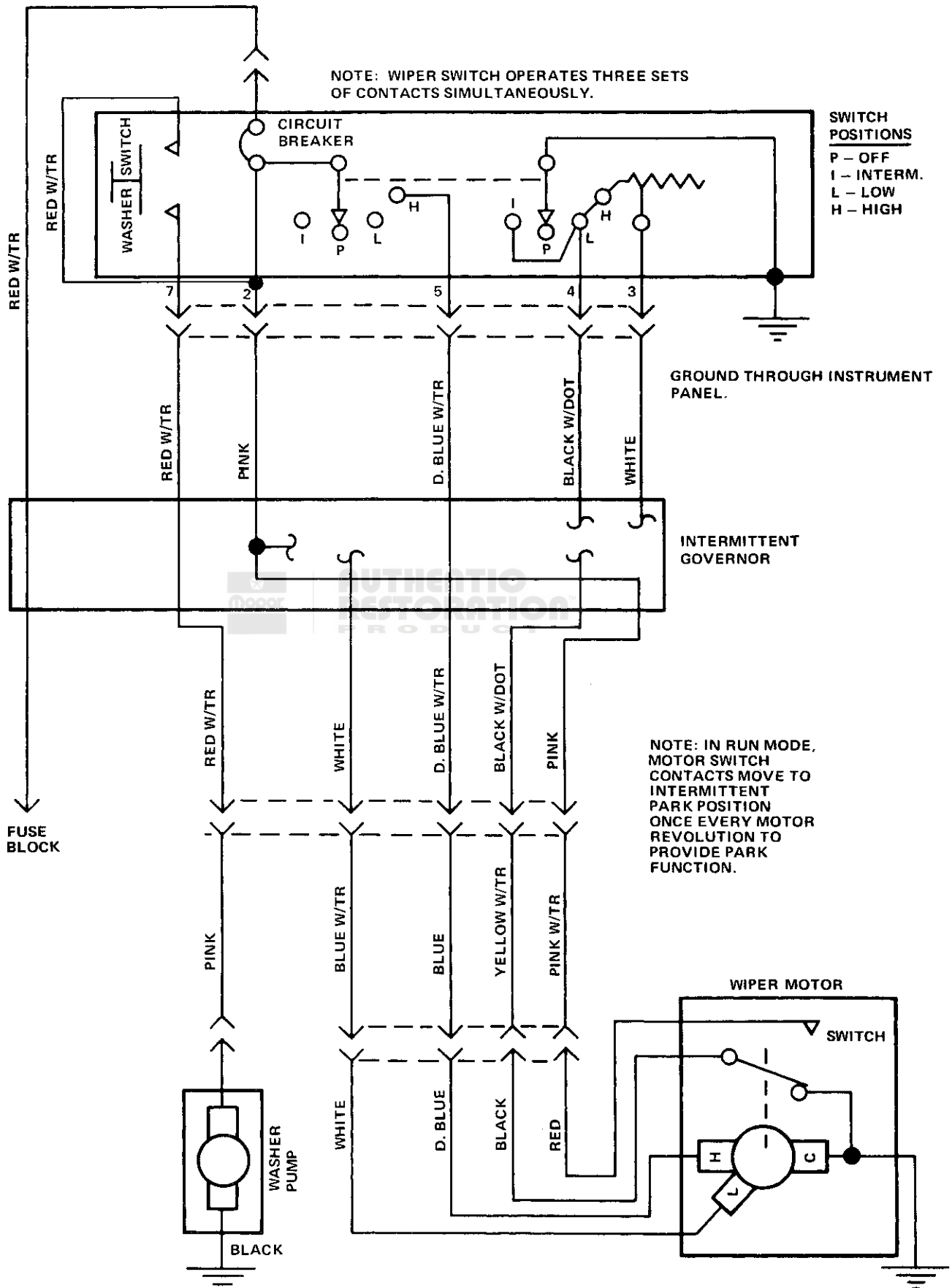


Fig. 3T-10 Windshield Wiper With Intermittent Governor Circuitry

**CONTROL SWITCH**

**Removal**

A one-way friction spring in the control knob retains it to control switch shaft. This one-way spring allows knob to be installed but prevents its removal unless spring tension is released.

- (1) Disconnect battery negative cable.
- (2) To remove, locate small notch at base of knob and insert a small screwdriver at that point. Apply pressure to release spring and pull knob from shaft.
- (3) Remove slotted trim nut from front of switch.
- (4) Push switch through instrument panel, disconnect from harness and remove.

**Installation**

- (1) Connect switch to harness and push through instrument panel.
- (2) Install slotted trim nut on front of switch and tighten.
- (3) Align control knob and push on shaft.
- (4) Connect battery negative cable.

**Switch Test**

(1) Check wiper switch continuity using Continuity Light J-21008 or an ohmmeter. Continuity should exist between terminals at various switch positions as shown in figure 3T-11.

(2) Variable resistance between number 4 and 5 terminals of an intermittent wiper system must be checked with an ohmmeter. This resistance controls governor operation for intermittent wiping. If intermittent wipe cycle is not operating, but system does operate at both low and high speed, resistance between number 4 and 5 terminals should be checked. With switch control knob rotated to full counterclockwise position, ohmmeter should indicate 5600 to 8400 ohms. As control knob is rotated in a clockwise direction, resistance should decrease to a minimum of 100 to 900 ohms.

(3) If continuity and resistance do not check out as specified, switch must be replaced. Check wiring for proper continuity if switch tests indicate proper operation.

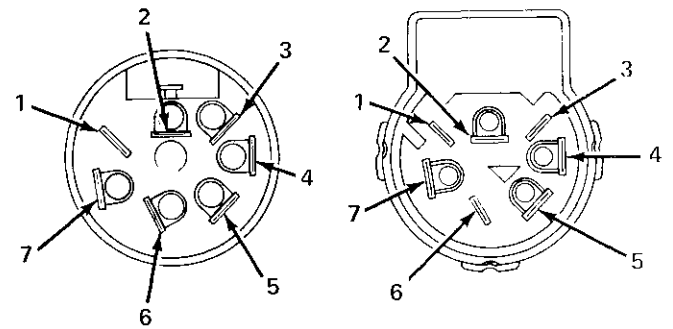
**Circuit Breaker Test**

The circuit breaker is located in the wiper control switch and has a rating of 7 amps.

Two separate tests are necessary to check for correct circuit breaker operation.

**Test 1**

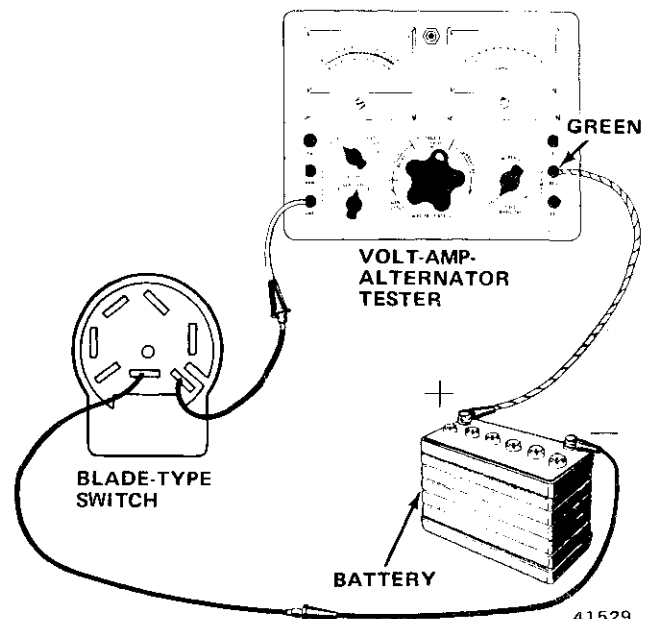
Connect switch to tester as shown in figure 3T-12. Adjust current draw until it equals circuit breaker rating. Leave switch connected to tester for 10 minutes. Current reading on ammeter should remain at rated current. If circuit breaker opens during ten minute period, replace wiper switch assembly.



	Standard	Intermittent
Off or Park	1-2 3-4	1-2 4-5
Low Speed	1-2-3	1-2 4-5 to Case 4-5
High Speed	1-2-5	1-2-3 4-5 to Case 4-5
Intermittent		1-2 4-5 to Case 4-5 Variable Resist. 1-9K to 7 K
Wash	1-2 6-7	1-2 6-7

41528

Fig. 3T-11 Continuity Test for Wiper Switches



41529

Fig. 3T-12 Circuit Breaker Test

**Test 2**

Connect switch as shown in figure 3T-12. Adjust current draw until it is twice switch rating. Current reading on ammeter should drop to zero within 15 seconds. If it takes longer than 15 seconds for circuit breaker to open (current reading drops to zero), replace wiper switch assembly.

**INTERMITTENT GOVERNOR**

To check the intermittent governor accurately requires electronic testing equipment. However, if the intermittent wipe cycle is not satisfactory, check related components such as the motor, control switch, and connecting wires. If all components function properly, install a new governor.

The electronic governor assembly is contained in a two-inch cube which is attached to an instrument panel bracket adjacent to the wiper control switch. The 6-inch governor lead plugs into the wiper control switch and the shorter, 4-inch lead plugs into the instrument panel harness (fig. 3T-13).

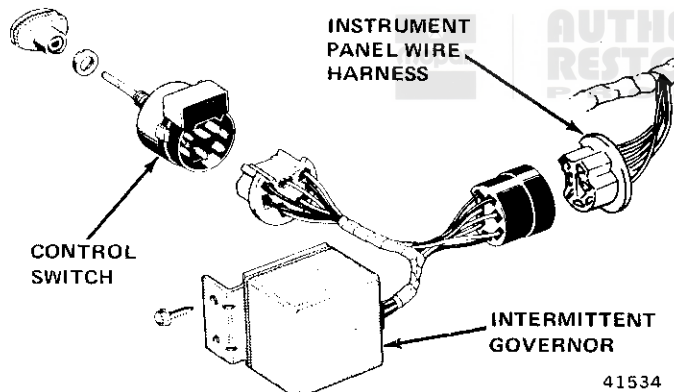


Fig. 3T-13 Intermittent Governor

**WIPER MOTOR**

**Removal**

- (1) Remove screws attaching motor adapter plate to dash panel.
- (2) Separate wiper wiring harness connector at motor.
- (3) Pull motor and linkage out of opening to expose drive link-to-crank stud retaining clip. Raise up lock tab of clip with a flat blade screwdriver and slide clip off stud.
- (4) Remove wiper motor assembly.

**Installation**

- (1) Position wiper motor assembly and insert crank stud into drive link bushing.

- (2) Press retaining clip onto stud and slide it in place in stud groove (fig. 3T-14). Check for positive retention.

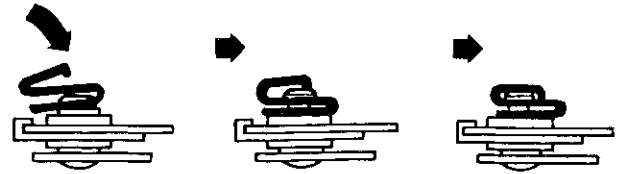


Fig. 3T-14 Linkage Retainer Clip Installation Sequence

- (3) Install wiper motor attaching screws. Tighten attaching screws to 25 inch-pounds (3 N•m) torque.

**Current Draw Test—On Vehicle**

- (1) Remove wiper arms and blades and disconnect motor lead.
- (2) Connect negative lead of ammeter to positive battery post (fig. 3T-15).

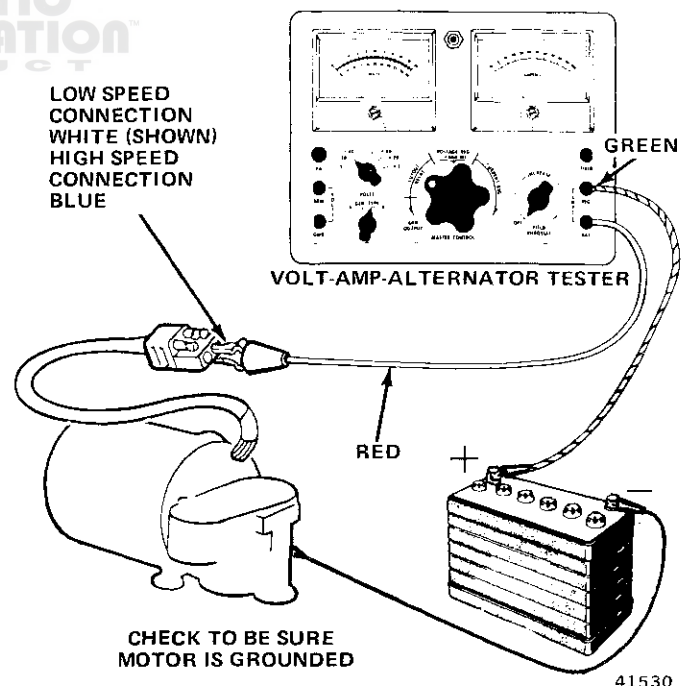


Fig. 3T-15 Wiper Motor Current Draw Test Connections

- (3) Connect other ammeter test lead to blue wire w/tracer terminal (low speed) of motor harness. Current draw should be approximately one amp but not more than three amps.

- (4) Connect blue wire terminal (high speed). Current draw should remain about the same. In either case, current draw should not exceed three amps.

### Park Test

(1) Disconnect motor from harness connection. Temporarily contact a battery feed to either blue or blue w/tracer wire to move wiper arms and blades away from normal park position.

(2) Insert jumper wire from white to black wire terminals (fig. 3T-16).

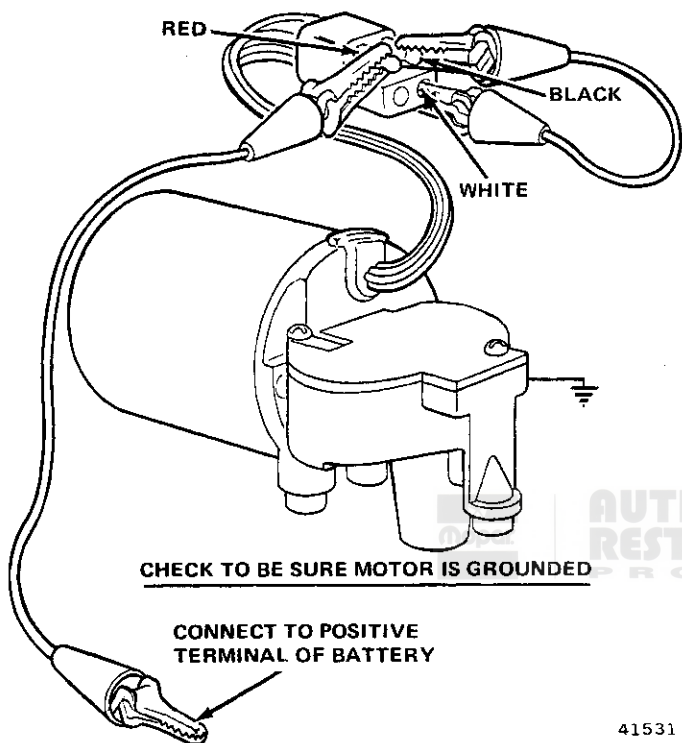


Fig. 3T-16 Park Test

(3) Contact a battery feed to red wire terminal of motor harness. Motor should operate until wipers have reached normal park position.

(4) If wiper motor does not park correctly, replace or repair wiper motor.

### Disassembly

**CAUTION:** The motor field consists of two permanent ceramic-type magnets which can be damaged by pounding on the motor housing or the magnets.

**NOTE:** Mark position of drive crank with respect to output shaft for correct assembly.

(1) Remove drive crank attaching nut, drive crank, spring washer, and plain washer (fig. 3T-17).

(2) Remove screws attaching mounting bracket to motor. Separate bracket from motor and remove screw attaching ground strap to bracket.

(3) Remove screws attaching gear housing cover to housing. Remove cover and gasket.

(4) Remove idler gear and pinion by pressing shaft (with push nut) out of gear housing.

(5) Remove motor through-bolts and motor housing.

**NOTE:** The field magnets will hold the armature in the motor housing as it is removed from the gear housing.

(6) Remove end play spring, output gear and shaft, switch lever, switch washer, and seal from gear housing.

(7) Remove brushes, harness, and springs from end head.

(8) Remove end head assembly.

(9) Remove parking lever pin from gear housing.

(10) Remove all old lubricant from gear housing and components.

(11) Inspect gear housing and all components for damage or excessive wear. Replace damaged or excessively worn components.

(12) Apply a coating of American Motors All Purpose Lubricant, or equivalent, to all bearing surfaces and gears.

### Assembly

(1) Position gear housing on a flat surface with inside of housing facing up.

(2) Position switch washer and switch lever in gear housing with cam rider pointing toward output shaft hole.

(3) Install seal and output gear and shaft in gear housing. Make certain switch lever is clear of cam and gear assembly.

(4) Position idler gear and pinion on shaft, and insert shaft through switch lever and switch washer into gear housing. Use a drift and hammer to lightly tap shaft to proper depth. **A 0.001 to 0.007-inch clearance between push nut and gear must be maintained to prevent preloading the idler gear.**

(5) Install end play spring in gear housing.

(6) Install parking lever pin in gear housing.

(7) Attach brush terminals and switch terminals to end head.

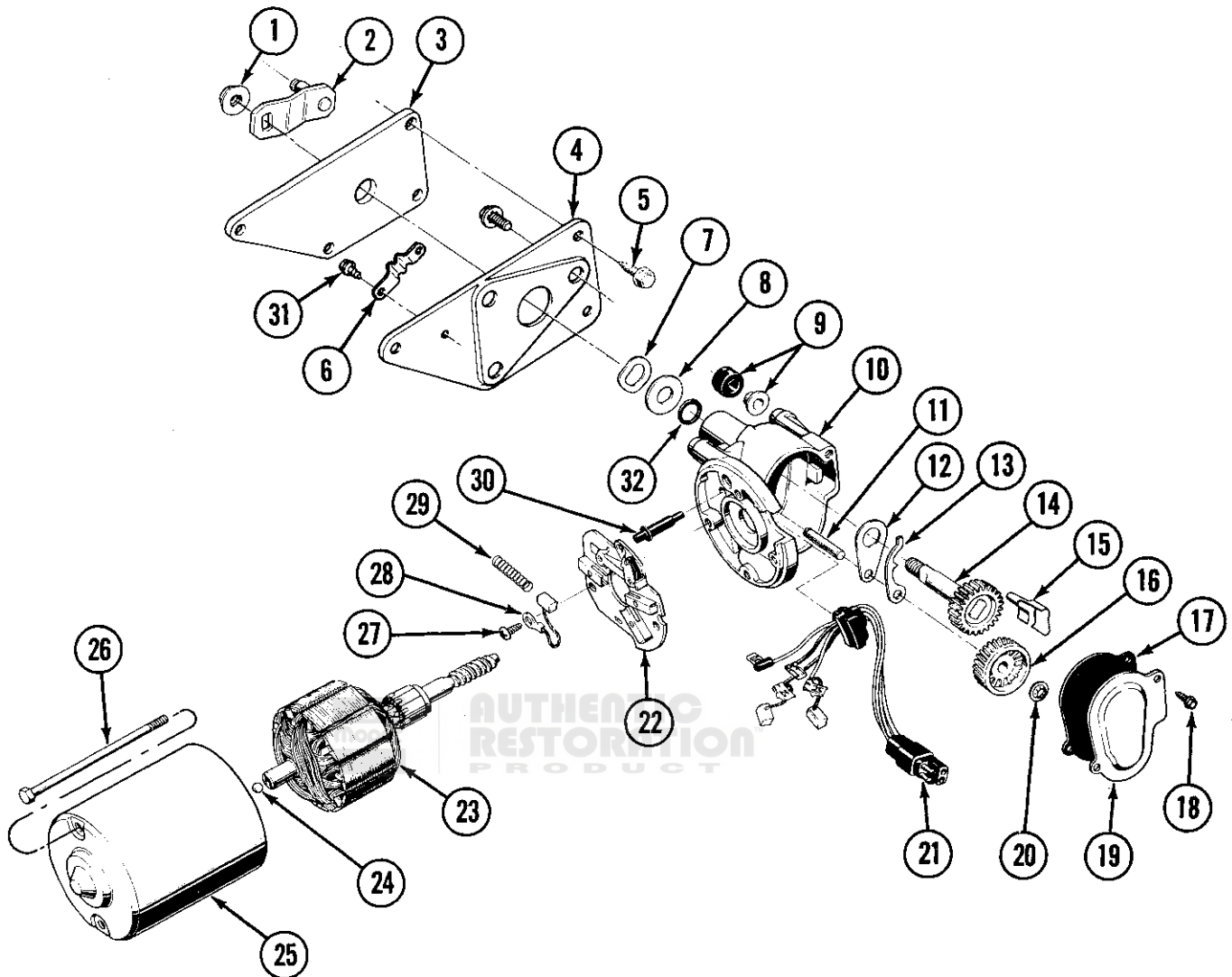
(8) Position end head on gear housing and secure with attaching screws.

(9) Install springs and brushes in end head. Hold each brush in the fully retracted position with tag wire as shown in figure 3T-18.

(10) Apply a small amount of lubricant to armature end shaft and ball.

(11) Install armature in gear housing and remove tag wire brush retainers.

**NOTE:** Make certain plastic thrust button in end play spring is bearing against end of armature shaft.



- |                  |                           |                       |
|------------------|---------------------------|-----------------------|
| 1. NUT           | 11. SHAFT                 | 22. END HEAD          |
| 2. DRIVE CRANK   | 12. SWITCH WASHER         | 23. ARMATURE          |
| 3. SEAL          | 13. SWITCH LEVER          | 24. BALL              |
| 4. BRACKET       | 14. OUTPUT GEAR AND SHAFT | 25. MOTOR HOUSING     |
| 5. SCREW         | 15. END PLAY SPRING       | 26. BOLT              |
| 6. GROUND STRAP  | 16. IDLER GEAR AND PINION | 27. SCREW             |
| 7. SPRING WASHER | 17. GASKET                | 28. BRUSH             |
| 8. PLAIN WASHER  | 18. SCREW                 | 29. SPRING            |
| 9. GROMMET       | 19. COVER                 | 30. PARKING LEVER PIN |
| 10. GEAR HOUSING | 20. PUSH NUT              | 31. SCREW             |
|                  | 21. BRUSHES AND HARNESS   | 32. SEAL              |

Fig. 3T-17 Wiper Motor and Transmission Components

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(12) Install motor housing on armature, holding armature worm gear to prevent magnetic field from pulling armature out of position in gear housing.

(13) Align indicator marks on motor housing and gear housing before inserting through-bolts.

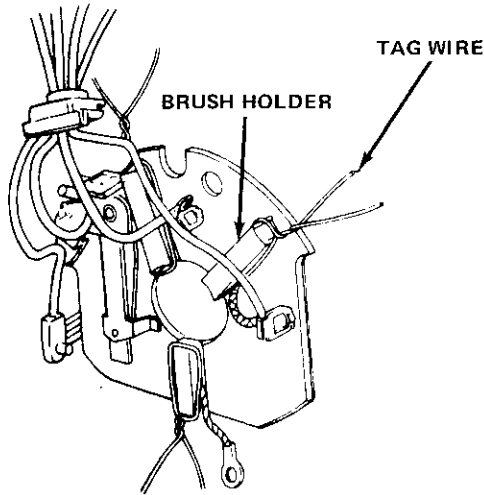
(14) Install through-bolts securing motor housing to gear housing.

(15) Apply generous amount of lubricant to gear housing cavity.

(16) Position gasket and cover on gear housing and install two attaching screws.

(17) Position motor assembly and ground strap on mounting bracket and install ground strap attaching screw.

# 3T-18 WINDSHIELD WIPERS



80490

Fig. 3T-18 Tag Wire Brush Retainers

(18) Install grommets in mounting bracket and secure motor assembly to bracket with attaching screws. Tighten attaching screws to 23 inch-pounds (3 N•m) torque.

(19) Install plain washer and spring washer on output shaft, position drive crank on output shaft in the marked position from which it was removed, and install nut. Tighten nut to 120 inch-pounds (14 N•m) torque.

## WINDSHIELD WASHERS

The electric pump assembly is mounted in the bottom of the water reservoir. The impeller motor case is grounded to the car body by a ground wire. It is energized by a feed wire from the No. 6 and 7 terminals on the control switch.

## SPECIFICATIONS

### Torque Specifications

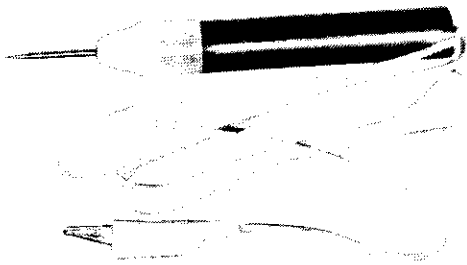
Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (in.lbs.)		Metric (N•m)	
	Service Set-To Torque	In-Use Recheck Torque	Service Set-To Torque	In-Use Recheck Torque
Wiper Motor MTG. Plate to Cowl	23	15-35	3	2-4
Windshield Wiper Pivot to Cowl	118	100-135	13	11-15

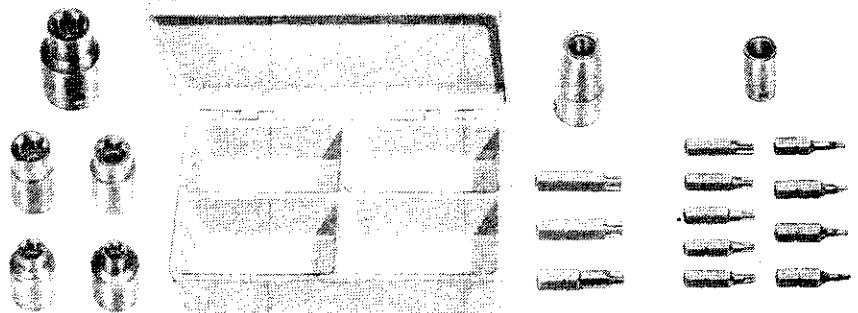
All Torque values given in newton-meters and inch-pounds with dry fits unless otherwise specified.

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## Tools



J-21008  
CONTINUITY LIGHT



J-25359-02  
TORX BIT AND  
SOCKET SET

70119

# TAILGATE WINDOW DEFOGGER

# 3U

## SECTION INDEX

	Page		Page
General	3U-1	Testing	3U-2
Grid Repair	3U-3		

### GENERAL

The electrically-heated tailgate window grid consists of two vertical bus bars and horizontal rows of heating elements of silver-bearing, ceramic enamel compound that is fused to the inside surface of the tailgate glass. A control switch, pilot lamp, timer-relay and wire harness complete the circuit.

Braided wire, soldered to each bus bar at 2-1/2-inch intervals, serves as the electrical feed and ground for the grid. The grid feed wire is attached to the timer-relay, mounted inside the tailgate. The feed to the relay is supplied by a wire attached to the new fuse panel power tailgate terminal (fig. 3U-1).

A separate control circuit, connected to the heater control switch, operates the relay and timer in the relay.

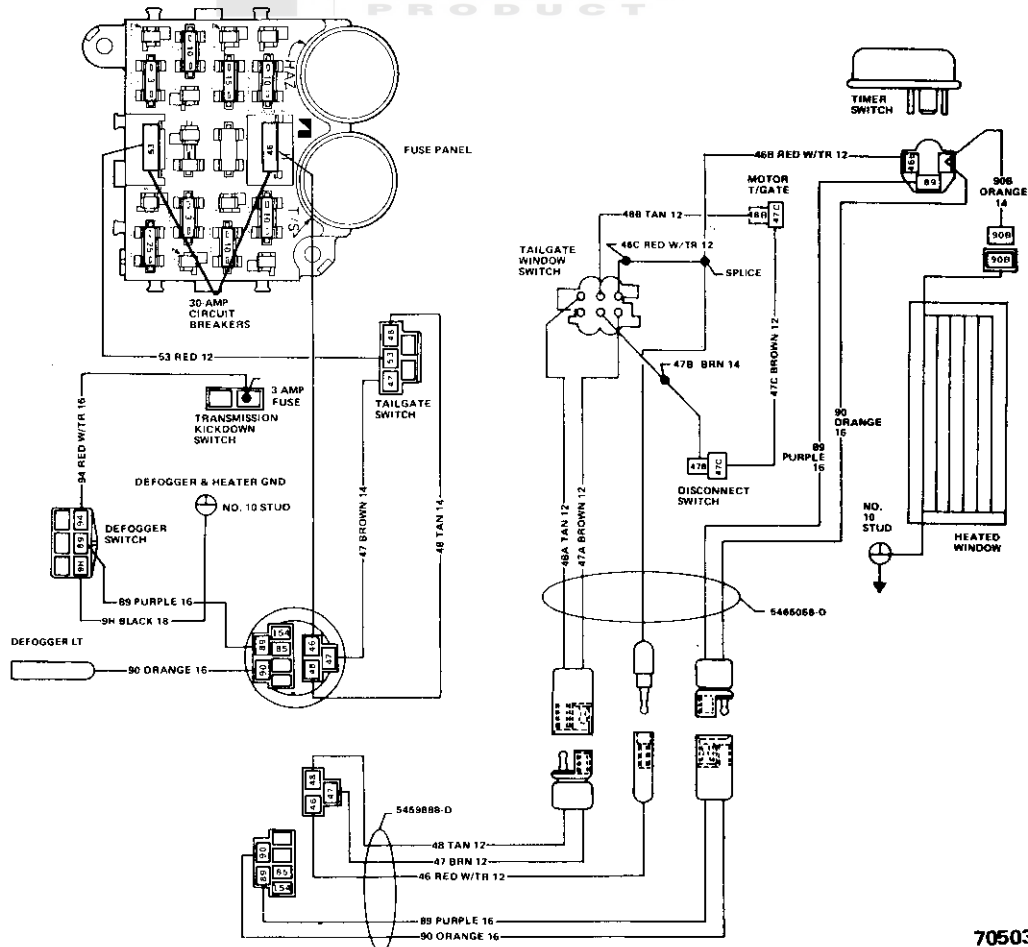


Fig. 3U-1 Heated Rear Window Wiring Diagram



## 3U-2 TAILGATE WINDOW DEFOGGER

With the control switch on the instrument panel activated and ignition switch On, the relay contacts close. The timer in the relay operates the defogger for 8 to 12 minutes, depending on the ambient temperature, or until the control switch or ignition switch is turned Off. The pilot lamp indicates system operation.

**NOTE:** The defogger switch and the electric tailgate window switch are serviced as an assembly.

### TESTING

#### Switch Test

(1) Turn ignition switch On and press defogger switch.

(2) Disconnect optional equipment wiring harness at connector under dash. Connect a 12-volt test lamp from purple wire (89) to a good ground (fig. 3U-1). Test lamp should light.

(3) Shut off defogger switch and test lamp should not light.

(4) To test indicator light, disconnect orange wire from lamp. Connect a jumper wire from accessory terminal of new fuse panel to orange wire. With ignition switch turned to Accessory position, the lamp should light.

#### Relay Test

**NOTE:** Terminals on the relay are labeled X, L and P.

(1) Attach negative lead of voltmeter to ground. Probe red w/tr wire (X-terminal) with voltmeter positive lead. Voltmeter should indicate battery voltage regardless of ignition switch position.

If no voltage is indicated, operate the tailgate window. (The tailgate window and rear window defogger are fed by the same wire.) If the window operated, the wire between the window switch and relay is open.

(2) Probe orange wire (L-terminal) with voltmeter positive lead. No voltage should be indicated.

(3) Turn ignition switch to On or Accessory position. Voltmeter should indicate voltage. If no voltage is indicated, relay is defective, or is not receiving voltage from purple wire (P-terminal).

If relay activates properly, it should remain energized 8 to 12 minutes before opening (ignition switch must remain On). If the time period is too short or excessively long, relay is defective.

(4) If relay did not energize, connect jumper wire to known good 12-volt source in tailgate and probe relay P-terminal. If relay clicks when probed, trace purple wire for open or short.

If relay does not click when probed by jumper, check relay ground and repair if necessary. If relay still fails to operate, it is defective.

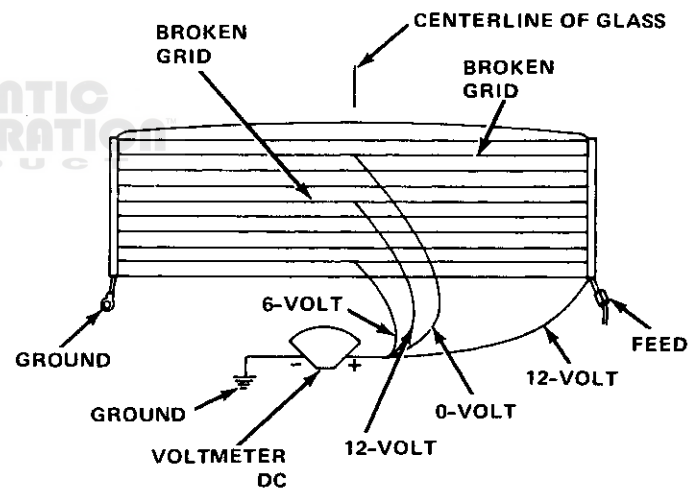
#### Grid Test

When a grid is inoperable due to an open circuit, the area of glass normally cleared by that grid will remain fogged or iced until adequately warmed by the adjacent grids. Use the following procedure to locate a broken grid.

(1) With engine running at idle, press tailgate window defogger switch. Defogger lamp should light, indicating defogger operation.

**NOTE:** The feed wire is connected to the right side (passenger side) of the window and the ground connection is on the left side of the window.

(2) Use 12vdc voltmeter and contact positive lead of voltmeter to right side (feed) vertical bus element on inside surface of glass. Contact negative lead to left side (ground) bus element (fig. 3U-2). Voltage drop indicated on meter should be 11 to 13 volts. Connect negative lead of voltmeter to good ground—meter reading should not change.



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**Fig. 3U-2** Voltmeter Connections and Voltage Drop for Grid Continuity

(3) Keep negative lead connected to ground. Use positive lead and carefully contact each grid at approximate centerline of window.

(4) Voltage drop of one-half full amount, approximately six volts, indicates good grid or closed circuit.

(5) Full voltage drop of 12 volts at centerline indicates break in grid between positive lead and ground.

(6) No voltage drop (0 volts) at centerline indicates break in grid between centerline and voltage source or feed.

(7) The exact location of the break can then be pinpointed by moving the positive lead to the left or right along the grid until an abrupt change in the voltage reading is noticed.

### Grid Repair

Once a broken or open grid is located, repairs can be accomplished using the grid repair kit in accordance with the following procedure.

(1) Using suitable marking pencil, mark location of broken or open grid on exterior surface of glass.

(2) Using fine steel wool, lightly rub area to be repaired (inside of tailgate window). Clean area with isopropyl alcohol (rubbing alcohol).

(3) Attach two strips of cellulose tape (inside of tailgate window) above and below break in grid as shown in figure 3U-3.

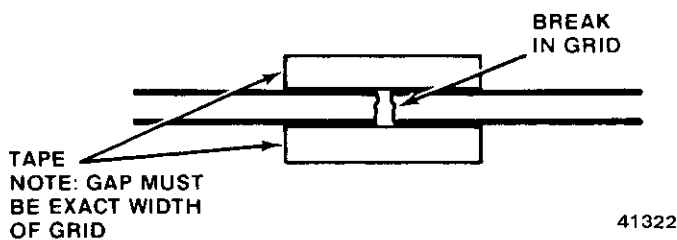


Fig. 3U-3 Tailgate Window Defogger Grid Repair

(4) Mix repair coating until uniform in consistency, with silver particles mixed throughout fluid. Apply coating to break in grid with small brush furnished in kit. Apply heavy coat of mixture, extending approximately 1/4 inch on either side of break.

(5) Start engine and press defogger switch. Run engine for one minute. Turn ignition switch off.

(6) Apply second heavy coat of mixture to break in grid, extending about 1/4 inch on either side of break.

(7) Start engine and press defogger switch. Run engine until defogger completes cycle (pilot light goes off). Turn ignition switch off.

(8) Remove cellulose tape from inside of tailgate window.

(9) Check repaired area for continuity. **Do not touch repaired area.**

**CAUTION:** Do not clean repaired area for 24 hours. Then clean inside of tailgate window with liquid window cleaner.

(10) Clean pencil markings from exterior surface of glass.



# RADIO SOUND SYSTEMS 3V

## SECTION INDEX

	Page		Page
Antenna	3V-11	Radio Reception Characteristics	3V-4
Antenna Trimmer	3V-2	Radio Replacement	3V-9
Bulb Replacement	3V-10	Speaker Harness Test	3V-13
CB Radio Diagnosis	3V-9	Speaker Replacement	3V-13
CB Radios	3V-3	Speakers	3V-12
Controls	3V-2	Specifications	3V-13
General	3V-1	Tools	3V-13
Radio Interference Diagnosis	3V-6	Tuning CB Antenna/Splitterbox	3V-11

### GENERAL

All Jeep radios are transistorized with pushbutton tuning and have an output impedance of 3.2 ohms. They operate with the ignition switch in the On or Accessory positions. All models use non-adjustable, whip-style antennas. Antennas used with CB radios are slightly longer than those used with other radios.

The AM or FM stations may be preselected, using the five pushbuttons, or manually tuned. On all radios, the left-hand knob controls power (on and off) and volume. The right-hand knob controls station selection. All radios also have adjustment for the bass and treble tone quality.

AM/FM, and AM/FM/CB Stereo radios are available on all Cherokee, Wagoneer and Truck models.

AM/FM radios have a slide switch to select AM or FM reception and controls for left-right, front-rear speaker balance. During stereo reception, a small indicator glows. The light is off during FM monaural reception. Cherokee and Wagoneer models use four speakers with the stereo radio. A speaker is mounted in each front door and rear quarter trim panel. A front-to-rear speaker fader control is used with the 4-speaker system. It is located behind the manual station tuning knob. Truck models use a 2-speaker system with the stereo radio. A speaker is mounted in each front door.

In addition to the above features, all Citizen Band (CB) radios have a switch to change from broadcast band radio listening into the CB receive or transmit mode.

**CAUTION:** Do not operate the CB radio with the antenna disconnected. Radio damage can result.

The radio manufactured date, model and serial number are stamped on the radio case.

### Setting the Pushbuttons

To set each pushbutton for automatic tuning, proceed as follows:

- (1) Move vehicle outside building and away from high tension lines.
- (2) Permit radio to warm up for several seconds.
- (3) Pull pushbutton out about 1/2 inch to unlock tuner.
- (4) Select a station with manual tuning knob.
- (5) Push the button in as far as it goes (to lock the tuner) and then release it. This station is now set for automatic tuning.
- (6) Follow the same procedure for the remaining buttons.

### Radio Polarity

When servicing the radio, the A (power) lead must be connected to the positive side of the power source. If connected to the negative side, the radio will not operate and damage to components will result.

The radio is grounded internally. The ground return circuit is completed by grounding the radio chassis to the instrument panel. When testing on the bench, a ground jumper wire must be attached between the radio chassis and the negative terminal of a 12-volt battery or power supply to complete the power circuit.

## 3V-2 RADIO SOUND SYSTEMS

### ANTENNA TRIMMER

Antenna trimmer adjustment is necessary to match the vehicle radio circuit to the vehicle antenna. The adjustment should be made after installation of a radio or antenna, or after repair to a radio. The adjustment also should be checked whenever radio reception is unsatisfactory.

### Adjuster Location

- AM and AM/FM radio: just above the tuning control.
- AM/FM stereo with tape player: in the tape cartridge slot.
- AM/FM/CB: just left of pushbuttons on face plate.

### Trimmer Adjustment

The trimmer adjustment should be made when the radio is tuned to a very weak station. It is not necessary to be able to receive an understandable station. The object is to obtain the greatest volume while the volume control is at a medium setting.

- (1) Switch radio to the AM broadcast band.
- (2) Turn on radio and allow to warm up for several seconds.
- (3) Turn station control knob to 1400 KC range and obtain a radio station signal. Turn to medium volume.
- (4) On AM and AM/FM radios, remove inner and outer station tuning control knobs (radios without tape player). On AM/FM/Tape radios, open tape door. On AM/FM/CB radio the AM adjustment is on the face of the radio. The CB adjustment procedure is found in the Tuning Antenna Splitter section.
- (5) Engage small slotted screw head with standard screwdriver.
- (6) Turn screw left or right until the greatest volume can be obtained **without touching the volume control**.
- (7) Install inner and outer tuning control knobs, if removed.

## CONTROLS

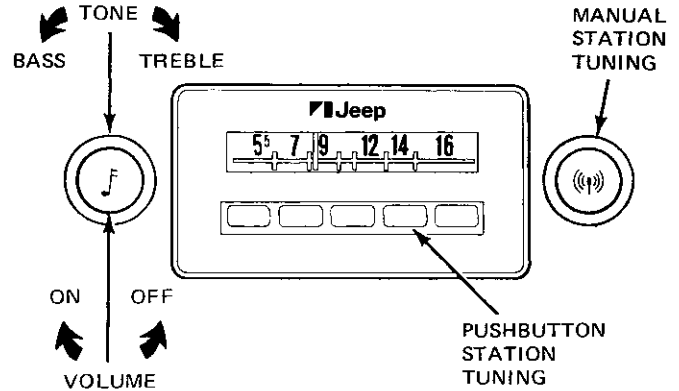
### AM Radio

The AM radio (fig. 3V-1) has one dash-mounted speaker as standard equipment. The dial bulb is controlled by the on-off switch; therefore, the bulb has no brilliance control.

### AM/FM Multiplex Radio

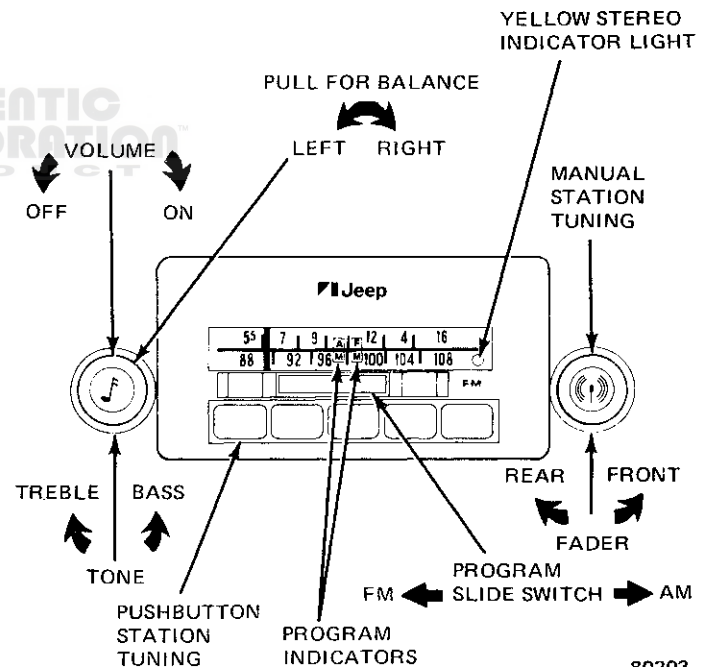
All Cherokee and Wagoneer models have optional four-speaker systems, one speaker in each front door with rear speakers mounted in the rear trim panels.

The radio has external fader and balance controls (fig. 3V-2). An indicator light will come on whenever the radio is receiving a stereo signal.



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Fig. 3V-1 AM Radio Controls



80203

Fig. 3V-2 AM/FM Stereo Radio Controls

### AM/FM Multiplex Tape Radio

The AM/FM multiplex radio has a built-in, 8-track stereo tape player (fig. 3V-3). AM or FM program selection is made by moving the slide switch (located on the right of the dial face) up or down for the desired programming. Left to right balance has been preset for equal balance and should not require any adjustment. However, should it become necessary to adjust for left-to-right balance, the balance control is located in the tape cartridge slot and is adjustable with a small standard screwdriver (fig. 3V-4).

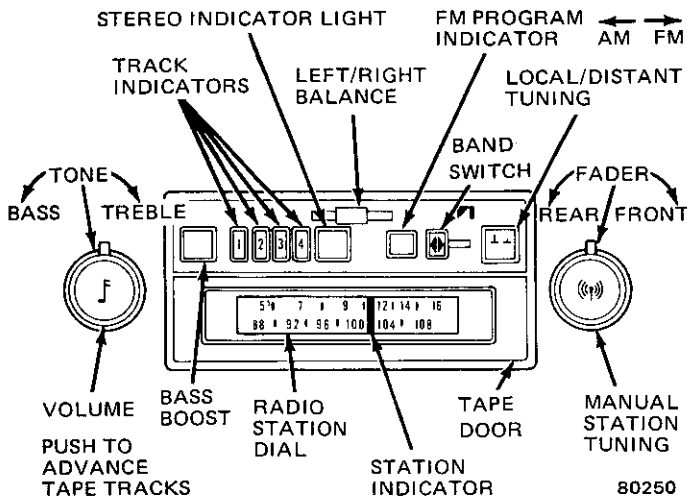


Fig. 3V-3 AM/FM Multiplex Tape Radio

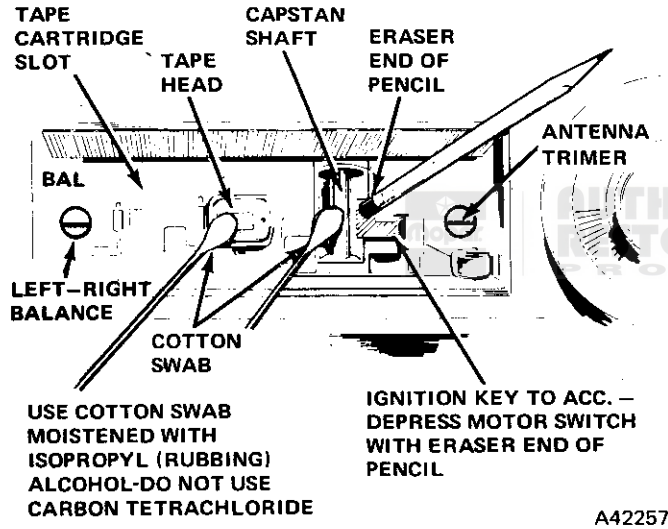


Fig. 3V-4 Tape Head and Capstan Cleaning Procedure

**Tape Player Operation**

To operate the tape player, place the tape cartridge, open tape end first and labeled side up, in the slot and push in until it is firmly seated. The unit will play the selection on the inserted tape.

To manually change selections, push in and release the left-hand volume control. Each program track will automatically change and play in succession without pushing control.

To turn the tape player off, pull the tape cartridge out approximately one inch.

**Stereo Test Tape**

A Stereo Test Tape Cartridge, J-22683-01, is available for checking the operation of the tape player. This tape provides a means of checking the player for proper tape speed, crosstalk and sound. Follow the instructions on the tape cartridge.

**Tape Head and Capstan Cleaning**

One major cause of improper tape player operation is oxide buildup on the head. During normal operation, iron oxide particles are loosened from the tape and built up on the head. This accumulation of oxide can cause poor playback and some up and down tape travel. The head and drive capstan should be cleaned whenever the unit is serviced, or when poor playback or tape travel is noted.

Cleaning may be done either in the vehicle or on a service bench. To clean the head, use a cotton swab moistened with commercially available tape head cleaner or isopropyl alcohol. Wipe capstan and tape head dry (fig. 3V-4). If a commercial tape head cleaner is used, follow the manufacturer's recommended cleaning procedure.

**CB RADIOS**

**CB Radio Controls**

Refer to figures 3V-5 and 3V-6.

- *S-RF Meter*: indicates output power when transmitting and the input signal strength when receiving.
- *Stand-By Mode Switch*: permits listening to the AM or FM broadcast band until receiving a CB call. In the STAND-BY position, the radio automatically receives CB transmission. The operator can also transmit while in the STAND-BY mode or return to radio listening by operating the microphone switch. When another CB call occurs, the radio will receive the call. In the RADIO position, only AM or FM broadcasts will be heard without CB interruption. Calls cannot be transmitted in the RADIO position. In the CB position, calls can be transmitted but there will be no AM or FM reception.
- *Delta Tune Control*: aligns receiving set with a set that is transmitting slightly off frequency.
- *Squelch Control*: affects the sensitivity of the receiver and eliminates receiver background noise when no signal or a weak signal is being received.

**CB Operation**

**To Receive**

- (1) Center speaker balance control.
- (2) Rotate squelch control fully counterclockwise.
- (3) Set Radio/CB selector switch to CB position.
- (4) Rotate On-Off switch clockwise until noise or signal is heard in speaker.
- (5) Check to see that CB Channel indicator light is illuminated.
- (6) Select desired channel.

## 3V-4 RADIO SOUND SYSTEMS

(7) Rotate CB squelch control slowly clockwise until background noise just disappears. Do not advance control too far as weaker signals will not be heard.

### To Transmit

- (1) Select desired channel for transmitting.
- (2) Depress microphone button and speak in a normal voice.
- (3) Check relative output power on S-RF meter.
- (4) To receive, release microphone button.

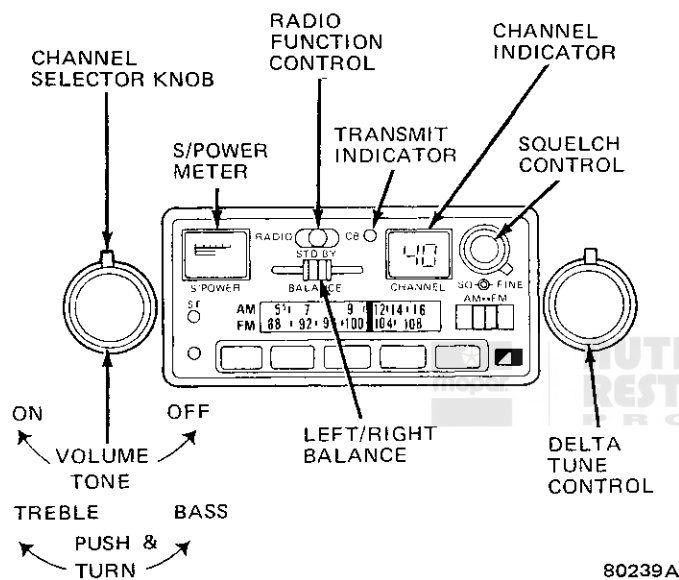


Fig. 3V-5 AM/FM/CB Radio—CB Controls

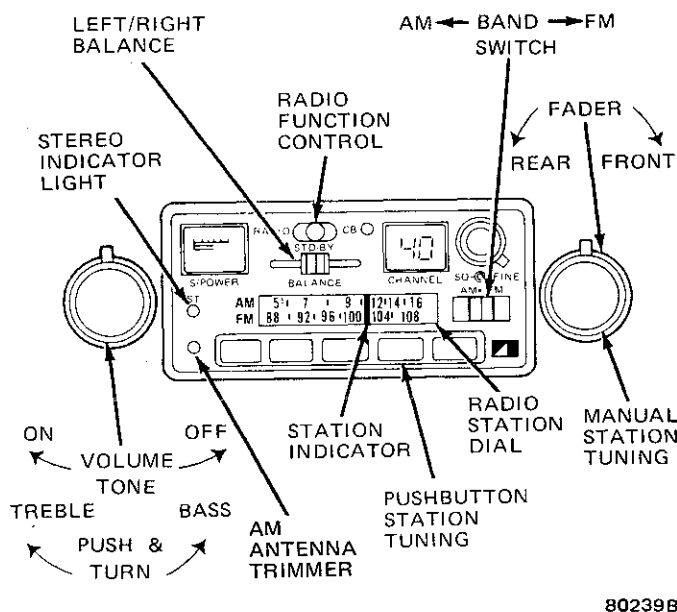


Fig. 3V-6 AM/FM/CB Radio—AM/FM/Controls

## RADIO RECEPTION CHARACTERISTICS

### Definitions of Frequently Used Terms

**AM (Amplitude Modulation):** Common system of radio broadcasting (520 to 1610 kHz).

**Antenna:** Device used for transmitting and receiving radio signals.

**Circular Polarization:** A technique of transmitting radio signals to minimize the affects of fading.

**Distortion:** False reproduction of the original transmitted signal.

**FM (Frequency Modulation):** System of radio broadcasting (88 to 108 mHz) with the added advantage of wider audio frequency response.

**Fading:** Variation of intensity of received radio signals.

**Flutter:** Momentary loss of received radio station, sometimes referred to as *picket-fencing*.

**Hertz:** Cycles per second.

**Ignition Noise:** Undesirable radio signals or noise that interfere with the reception of desired radio signal.

**Monaural:** A system utilizing a single signal on a single radio frequency (station) as distinguished from a dual channel system (FM stereo).

**Multipath Reception:** Signal loss or reduction due to a direct signal and a reflected signal arriving at the antenna simultaneously.

**Selectivity:** The ability of a radio receiver to accept the signal of one station while rejecting signals of undesirable adjacent stations.

**Sensitivity:** The ability of the radio receiver to receive weak stations.

### AM and FM Reception

The following is a brief explanation of AM and FM reception characteristics.

#### Signal Transmission

The range of normal hearing is approximately 30 Hz (cycles per second) to 14,000 Hz. AM has a range of 50 to 5000 Hz., while FM covers the entire range of normal hearing. Both AM and FM are received on a regular radio as a monaural signal.

FM/Stereo receivers are capable of receiving both monaural and FM stereophonic broadcasts. These broadcasts are sometimes referred to as multiplex.

**Fading**—Fading is not usually a problem with AM because of its long distance reception capability (fig. 3V-7). FM, on the other hand, is limited to line-of-sight reception (25 to 40 miles) under average conditions of terrain and transmitted power (fig. 3V-8). The area of good FM-Stereo reception may even be slightly less than that of regular FM because of stronger signal requirements. Figure 3V-9 illustrates fading of an FM signal due to differences in terrain. Reception behind hills may

be noisy (hissing or popping). This noisy reception is sometimes referred to as flutter or picket fencing.

Flutter is produced in the fringe area when objects come between the station and the receiver. The signal will be lost momentarily then it will return. The rate

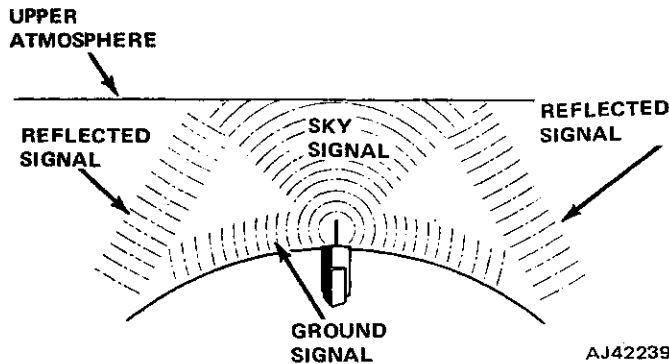


Fig. 3V-7 AM Reception—Long Distance; Follows Curvature of Earth; Reflected by Upper Atmosphere

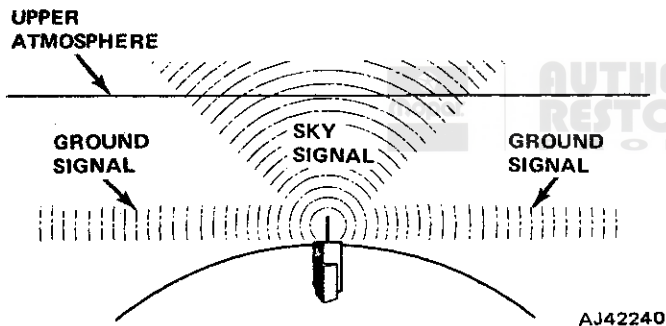


Fig. 3V-8 FM Reception—Shorter Distance; Does Not Follow Curvature of Earth; Not Reflected by Upper Atmosphere

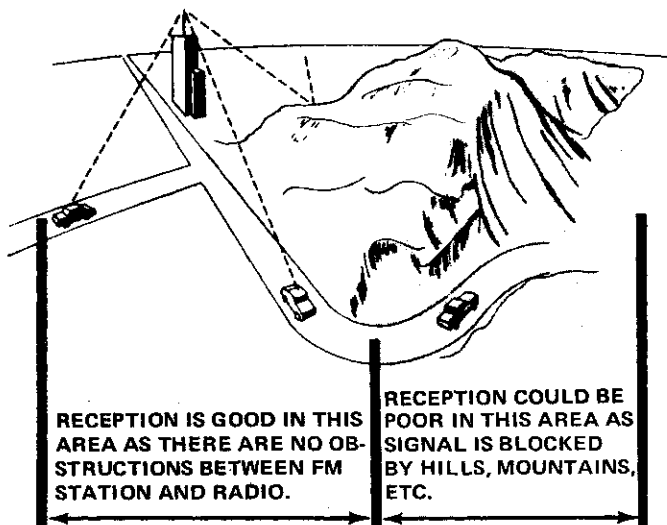


Fig. 3V-9 FM Fading

which the flutter occurs is dependent upon the vehicle's speed in passing objects. The effect is very similar to the way a television set flutters in the fringe area when an airplane passes between it and the station.

**Multipath Reception**—The fact that FM can be received quite well between tall buildings can unfortunately cause a detrimental side effect, namely multipath reception (fig. 3V-10). It is caused by a direct signal and a reflected one arriving at the vehicle's antenna causing distortion, partial or complete loss of the station, or poor FM-Stereo reception. This type of interference is usually of short duration since the area of interference is usually only a few inches or feet across. It is mostly encountered in downtown areas.

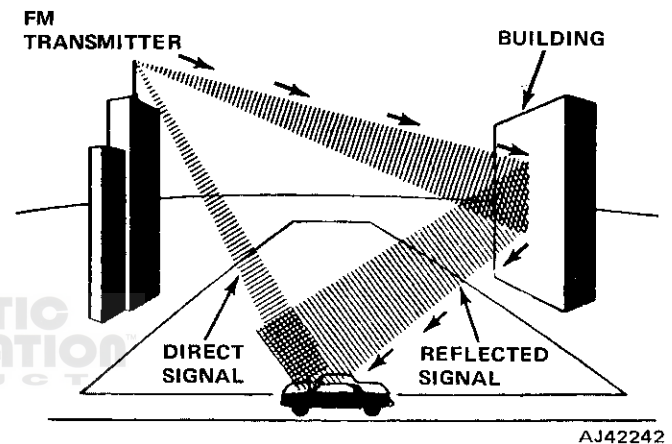


Fig. 3V-10 Multipath Reception

**Interference and Ignition Noise**—AM reception is susceptible to certain types of electrical interference. These include power lines, thunderstorms, and other situations where electrical charges in the air cause disturbances resulting in buzzing and static.

**Ignition Noise Interference**—FM does not usually suffer from the electrical disturbances that can affect an AM receiver. Ignition noise is more prevalent when listening to weaker stations. The noise also occurs if the radio is tuned off-station slightly. To improve reception, make sure the radio is tuned exactly to the station or tune to a station with a strong signal. This increases station signal strength, the FM circuit rejects the noise, and it disappears. Noise will not be noticed in metropolitan areas or within approximately 25 miles of the station.

**Other FM Interference**—Occasionally, when listening to a station while driving in the vicinity of another station (especially one with a strong signal), the possibility of receiving both stations simultaneously can exist. The phenomenon is called adjacent channel interference or cross-modulation.

**Using Control Effectively**—Proper use of radio controls will enhance listening pleasure.



## 3V-6 RADIO SOUND SYSTEMS

(1) Always fine-tune radio manually for clearest sound and minimum noise.

(2) Weak FM stereo signals are inherently noisier than monaural ones when received on an FM stereo radio. To prevent this type of noise from being heard, the FM Stereo radio automatically switches from stereo to the monaural mode. The Stereo-Indicator light goes out, both speakers still operate, but without the stereo effect. When the signal strength increases to a noise-free level, the receiver switches back to the stereo mode. This action is automatic and requires no adjustment.

(3) Occasionally, conditions will be such that noise-free reception simply cannot be attained. If this occurs, set the tone control to the bass (counterclockwise) position to reduce the noise level. When out of the noisy area, set the tone control back to its normal position.

### CB Radio Reception

The range of CB broadcasts and reception depends on weather conditions, amount of air traffic, strength and condition of transmitter and receiver, and the adjustment of antenna and splitter box. Range also depends on the movement between the transmitter and receiver. Reception will be clearer in open spaces with little air traffic than in congested metropolitan areas. Hilly terrain may also affect operation. Electrical interference affects reception similar to AM broadcasts.

Reception should not be fuzzy or screechy unless the network is congested.

### RADIO INTERFERENCE DIAGNOSIS

#### General

The object of this diagnosis is to present a systematic approach to troubleshooting interference (noise) problems. First, determine if the noise is normal by referring to Radio Reception Characteristics. If the noise is abnormal, the following procedures outline methods of determining interference point of entry and elimination.

There are two major ways interference enters the radio—the antenna and the A-line or power feed wire to the radio.

#### Interference Entry—Antenna

Disconnect the antenna. If this causes the noise to stop, the problem is reduced to three possibilities:

- A defective antenna; refer to Radio Antenna Ohm-meter Tests
- Noise radiated upward from the dash
- Noise radiated from the engine compartment

#### Noise Radiated Upward from Dash

This noise can be determined by fabricating a tool out of a piece of aluminum or copper screen approximately 36 inches by 12 inches (fig. 3V-11).

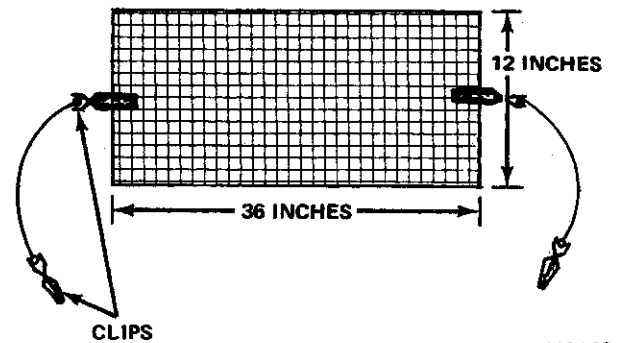


Fig. 3V-11 Improvised Noise Suppression Tool

Lay the screen across the top of the dash and attach the clips to body grounds. If the noise is diminished or disappears, the noise is being radiated up through the dash.

To determine exactly where the noise source is, a useful noise probe can be improvised from an antenna lead-in cable.

To make the probe, cut or remove the lead-in from the antenna at the antenna, remove approximately 2 inches of the outer plastic covering and the woven wire shield (fig. 3V-12).

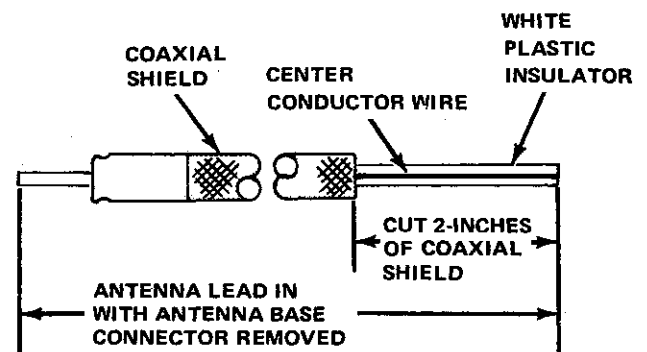


Fig. 3V-12 Noise Probe Fabrication

(1) Disconnect original antenna lead-in and plug in noise probe.

(2) Turn radio on and use probe to discover hotspot or source of noise. Do not touch the end of the probe with your hand as this would give an incorrect indication. As the probe comes closer to the noise source, the loudness of the noise will increase.

(3) If the source is found to be a switch, connect a 0.5-mfd capacitor from the power feed side of the switch to a good chassis ground.

(4) Gauges and sender units generally can be silenced by installing 0.5-mfd capacitors at their terminals. Install a 0.5-mfd capacitor at the battery terminal

of the CVR or a 0.1-mfd, radio-type capacitor directly across the CVR terminals.

(5) If the source is found to be a wire, reroute the wire, or wrap a piece of screen around the wire or wire harness and attach one or more ground leads to the wire screen. It also may be possible to screen off the area found to be radiating noise. Be sure to ground the screen.

(6) If the noise is found to be an electric motor, install a 0.25-mfd coaxial (feed-through) capacitor in series with the motor.

### **Noise Radiated from the Engine Compartment**

These noises can be separated into three areas:

- Primary Ignition Noise
- Secondary Ignition Noise
- Alternator Whine (Antenna)

#### **Primary Ignition Noise**

This type of noise generally affects the AM band. The noise usually appears as:

- Frequency varying with engine rpm
- Loudness varying with engine rpm
- Stops instantly when the ignition is turned to the Off position and turned to Accessory position

The first two classifications are usually the result of poor grounds on the coil capacitors or a wire routing problem. Cleaning the grounds or rerouting the wires may solve the problem.

An extra long antenna lead-in may be prepared as shown in figure 3V-12, and used as a hotspot probe.

Remove the ignition coil and its mounting bracket. Clean the paint off the bracket and the engine block, then assemble tightly. In many cases, this helps reduce the amount of interference radiated from the ignition system. Also, the installation of a hood bonding strap or device will help reduce interference radiated from the ignition system. Be sure to check the coil polarity.

In some rare cases, extra suppression may be required if the vehicle is operating in fringe areas. For those special cases perform the following steps:

- (1) Install a 0.1-mfd coaxial capacitor as close as possible to the coil battery terminal, not the distributor terminal. Do not use an ordinary bypass capacitor.
- (2) Install a 0.005-mfd, 1000-volt ceramic disc capacitor at the coil distributor terminal.
- (3) Install a 0.5-mfd coaxial capacitor at the alternator output terminal. Be sure it is rated to handle the maximum alternator voltage.

#### **Secondary Ignition Noise**

Secondary ignition noise will always affect FM and, if severe enough, may also affect AM. Normally one of two conditions will be found in the radio.

- Ignition noise all across FM band (and possible on AM)

- Ignition noise (loud) in between stations but not on a strong station

When these conditions exist in the radio, the problem is more than likely the result of:

- Distributor cap carbon ball eroded, or cracked or loose cap
- Rotor with a burned carbon contact spot
- Secondary wire not seated in the coil or distributor
- Defective coil
- An oil film on some of the lead terminals
- Copper core secondary wiring
- Defective or improper spark plugs

If a wire was found not seated, remove the wire and check for carboned end. It is not advisable to repair an end terminal on carbon core wire; replace the entire cable.

If the noise in question sounds like one or two cylinders and definitely not all of them, then the problem is after the coil. Using the fabricated noise probe, which plugs into the radio, have someone sit in the vehicle and listen to the radio. Move the probe from plug to plug. The person in the vehicle should notice an appreciable increase in the plug noise when the defective plug is reached.

It is a good idea to install resistor spark plugs when experiencing spark plug noise. If the vehicle has copper core secondary wiring, these wires should be replaced with original equipment, carbon core resistor wires.

#### **Alternator Whine (Antenna)**

Alternator whine can be described as an annoying, high-pitched whistle, or a siren-type sound that increases and decreases with engine rpm.

Methods of eliminating alternator whine and engine interference noise:

- (1) Install front fender ground straps.
- (2) Install hood bonding strap or device.
- (3) Run offending wire through a shielded (grounded) cable.
- (4) Clean slip rings and be sure the brushes are making good contact.

#### **A-Line (Power Feed Wire to Radio)**

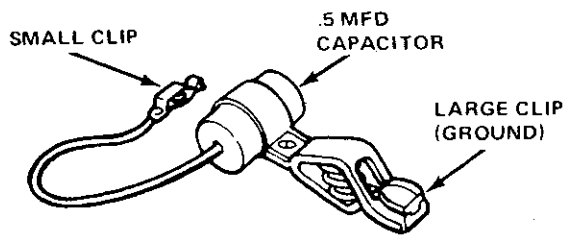
If disconnecting the antenna did not eliminate radio noise, the noise is probably on the A-line.

Motor noise on the A-line is usually the result of voltage spikes on this line being so large that the input filter circuit in the radio cannot handle them. There are two ways to handle this problem:

- (1) Locate the cause of line noise and eliminate it.
- (2) Add external filters to reduce the spikes to a point where the radio filter can handle the spikes.

A grounded capacitor touched to all hot electrical connections will often identify the offenders (fig. 3V-13).

The fabricated antenna probe (fig. 3V-12) also can be used to find hotspots.



AJ42249

**Fig. 3V-13 Interference Eliminator Test Device**

In general, any adjacent metal parts which are separated by mastic or paint must be connected together electrically.

Effective bonding requires more than physically clean surfaces and self-tapping screws. Tooth-type lockwashers must be used to cut into the surface layers of metal. Grounding straps must be as short and as heavy as possible.

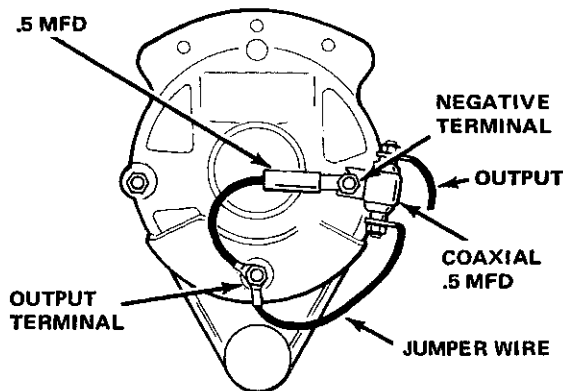
A-line noise is normally the result of:

- Alternator whine (A-line)
- Wiring harness too close to ignition wiring
- Radio noise suppressor
- Poor radio grounding

### Alternator Whine (A-Line)

Alternator whine does not stop instantly when the key is turned quickly to the accessory position at fast idle. It is a high pitched whine which increases with rpm. Correct alternator whine as follows:

(1) Install a 0.5 to 2.0 mfd bypass capacitor from the alternator output terminal to ground (fig. 3V-14).



AJ42250

**Fig. 3V-14 Alternator Noise Suppression**

(2) Install a coaxial capacitor in alternator output wire (fig. 3V-14).

(3) Replace alternator diodes.

### Wiring Harness Close to Ignition Wiring

Noise carried to the radio normally can be corrected as follows:

- (1) Relocate harness wiring away from ignition wires.
- (2) Install 0.5-mfd capacitors on each fuse panel lead. Be sure capacitor is grounded.

### Instrument Cluster Radio Noise Suppressor

A noise suppressor is installed on Cherokee, Wagoneer and Truck models equipped with a radio. This suppressor (choke) is plugged into the back of the cluster on a printed circuit board. Be sure the choke has not been installed over the copper strip installed on vehicles not originally equipped with a radio.

Tap on the instrument panel with the ignition in the On position and the Acc position to activate the CVR point movement. If noise only occurs in the On position, repair noise suppressor as follows:

- (1) Remove radio choke.
- (2) Remove plastic covering.
- (3) Unsolder one end of coil wire and remove approximately 6-1/2 inches of wire.
- (4) Resolder wire end.
- (5) Wrap coil with several turns of plastic electrical tape and install choke.

### Poor Radio Ground

To check for a poor ground, attach a jumper wire to the radio case and connect to a good chassis ground. If there is no change in radio noise, the radio has a good ground.

If noise changed, check for loose mounting screws and a poor ground.

### Other Sources of Interference

#### Speaker Leads

To determine if speaker leads are inducing or picking up noise, lay the wires on top of the carpet with the wires separated. If the noise is gone, the harness is at fault. Perform one or more of the following:

- (1) Separate coil wires by installing a loom over each of the wires.
- (2) Install a 0.001-mfd, thumbnail-type capacitor across each speaker.
- (3) Remove ground wire from harness and ground each rear speaker at the rear of vehicle.

Speaker-induced noise will normally not occur on front-mounted instrument panel speaker systems. It is more apt to occur on four-speaker systems and when the fader control is in the mid-position.

**Defective Radio**

Exchange with a known good radio to determine if the radio is defective.

**Direct Entry into the Radio**

- (1) Be sure radio has a good ground.
- (2) Tighten all radio chassis screws.

**Wheel and Tire Static**

Wheel static is another source of interference. This is a running noise most likely to be encountered when the vehicle is in motion on a hard, dry-surfaced road. The noise will remain when the vehicle is coasting with the engine and all electrical equipment turned off. The static occurs in the front wheels due to insulating film produced by the lubricant in the wheel bearings.

In some instances, static discharges take place between the tire and the road surface. An anti-static powder kit is available from radio supply houses which applies conducting material to the inside surface of the tire to eliminate noise from this source. Tire static can be checked by washing the tire with water. The water provides a conduction path to ground for the discharges. Tire static is most likely to be encountered during hot, dry seasons.

**Turn and Stop Signals**

The flasher in the turn signals and the switch in the stop signal may cause popping noises in the radio. In most cases, the noises are interference due to arcing in the contacts. The correction is a 0.5-mfd bypass capacitor installed at the battery connection of the switch or the flasher. It is less likely, but possible, that the low frequency components of the interruptions are reaching audio stages of the radio. The test is to check if the noise is present with the volume control turned down. If so, install a 1,000-mfd condenser.

**Horn Noise**

The diagnosis and cure for a growling noise in the radio when the horn is operated is the same as for Turn and Stop Signals detailed above. The suppressor capacitors are installed at the point where the battery lead feeds the horn relay.

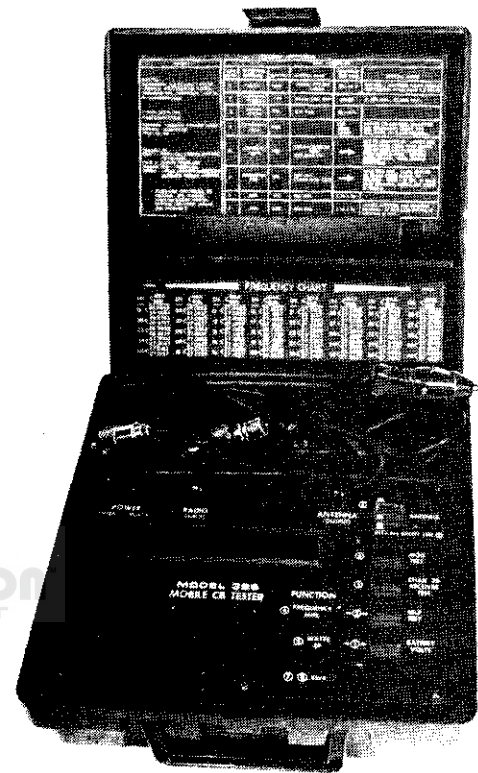
Be sure the horn relay cover is not loose.

**Accessories**

Electric windshield wipers, blower motors, window regulator motors, or any brush-type motors, generally can be suppressed by installing 0.25-mfd capacitors at the terminals.

**CB RADIO DIAGNOSIS**

For possible CB radio problems, refer to *CB Radio Reception* to determine if the condition is normal. If problem still exists, use CB Radio test instruments (fig. 3V-15) to diagnose trouble.



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Fig. 3V-15 Amserv AMX 386S Mobile CB Tester

**RADIO REPLACEMENT**

**CJ Models**

**NOTE:** *If equipped with air conditioning, remove screws attaching evaporator assembly to instrument panel and lower evaporator assembly.*

- (1) Disconnect battery negative cable.
- (2) Remove radio control knobs, attaching nuts, and bezel.
- (3) Disconnect radio support bracket from instrument panel.
- (4) Remove radio by tilting it downward and toward steering wheel.
- (5) Disconnect antenna lead, speaker wires, and feed wire.
- (6) Remove bracket from radio and install on replacement radio.
- (7) Connect antenna lead, speaker wires, and feed wire to replacement radio.

Operating Instructions for Amserv AMX 386S Mobile CB Tester

NOTES
<p><b>CAUTION:</b> Do not key microphone without antenna connected or antenna button in int. position if antenna is not connected.</p> <p><b>RADIO UNDER TEST CONTROL SETTINGS</b> Squelch - Minimum (audible noise) Volume - Mid-Range Channel - 2</p> <p><b>FAILURE OF -</b> Test 1 - Probable Faulty Battery or Harness Test 2,7 - Faulty Model 386S Tests 3 to 6 - Faulty CB Test 8 - After antenna adjustment indicates faulty antenna.</p> <p>*Limits set for typical CB systems. See specific manufacturers specifications for other radio's and antenna's.</p>

TEST PROCEDURE					
Test Step	Function Setting	Antenna	Instructions	*Readings Min.-Max.	Special Notes
1	Watts	Int.	Press-Battery Volts	12.0-16.0	Key mic., battery volts should not change more than 0.5 volts.
2	Frequency MHZ	Int.	Press-Self Test	➔	27,2035 min., 27,2065 max.
3	Watts RF	Int.	Key Mic.	03.0 Min.	
4	Frequency MHZ	Int.	Key Mic.	See Freq. Chart	Rotate CB channel selector. See frequency chart for min./max. on each channel.
5	Frequency MHZ	Int.	Press-Receiver Test (Channel 20)	➔	Set to channel 20. Listen for clear tone (1kHz) from radio. Adjust squelch clockwise, tone should reappear.
6	Frequency MHZ	Int.	Key Mic. Press-Mod. Test	➔	Talk into mic., voice should be heard from Model 386 speaker. Note - if mic. is held near speaker, squealing sound is normal.
7	SWR	Int.	Key Mic.	1.00-1.20	
8	SWR	Ext.	Key Mic.	1.00-3.50	Adjust antenna for minimum reading.

CB RADIO FREQUENCY CHART

CH. < MAX. MIN.	CH. < MAX. MIN.	CH. < MAX. MIN.	CH. < MAX. MIN.	CH. < MAX. MIN.	CH. < MAX. MIN.	CH. < MAX. MIN.	CH. < MAX. MIN.
01 < 26.9663 26.9637	06 < 27.0263 27.0237	11 < 27.0863 27.0837	16 < 27.1563 27.1537	21 < 27.2163 27.2137	26 < 27.2663 27.2637	31 < 27.3163 27.3137	36 < 27.3663 27.3637
02 < 26.9763 26.9747	07 < 27.0363 27.0337	12 < 27.1063 27.1037	17 < 27.1663 27.1637	22 < 27.2263 27.2237	27 < 27.2763 27.2737	32 < 27.3263 27.3237	37 < 27.3763 27.3737
03 < 26.9863 26.9837	08 < 27.0563 27.0537	13 < 27.1163 27.1137	18 < 27.1763 27.1737	23 < 27.2363 27.2337	28 < 27.2863 27.2837	33 < 27.3363 27.3337	38 < 27.3863 27.3837
04 < 27.0063 27.0037	09 < 27.0663 27.0637	14 < 27.1263 27.1237	19 < 27.1863 27.1837	24 < 27.2463 27.2437	29 < 27.2963 27.2937	34 < 27.3463 27.3437	39 < 27.3963 27.3937
05 < 27.0163 27.0137	10 < 27.0763 27.0737	15 < 27.1363 27.1337	20 < 27.2063 27.2037	25 < 27.2563 27.2537	30 < 27.3063 27.3037	35 < 27.3563 27.3537	40 < 27.4063 27.4037

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- (8) Install radio in instrument panel.
- (9) Connect radio support bracket to instrument panel.
- (10) Install radio bezel, attaching nuts, and control knobs.
- (11) Connect battery negative cable.

- (10) Install radio attaching nuts and control knobs.
- (11) Connect rear support bracket.
- (12) Connect feed wire to fuse panel.
- (13) Connect speaker leads to radio.
- (14) Connect antenna lead(s).
- (15) Connect microphone lead to radio, if equipped.
- (16) Install glove box liner and lock striker.

**Cherokee-Wagoneer-Truck Models**

- (1) Open glove box door and remove glove box liner and lock striker.
- (2) Disconnect microphone lead from radio, if equipped.
- (3) Disconnect antenna lead(s).
- (4) Disconnect feed wire from fuse panel.
- (5) Disconnect speaker leads from radio.
- (6) Disconnect rear support bracket from radio.
- (7) Remove radio control knobs and attaching nuts.
- (8) Push radio back to clear instrument panel and remove it through glove box opening.
- (9) Install radio in instrument panel.

**BULB REPLACEMENT**

**All Models**

**NOTE:** AM/FM/CB radio bulb replacement is accomplished by exchanging the radio.

- (1) Remove radio.
- (2) Remove radio dial cover retainers and cover.
- (3) Rotate manual tuning control to move pointer to extreme left or right.
- (4) Remove dial light reflector clips and deflector.
- (5) Remove bulb and bulb diffuser.

- (6) Install diffuser on bulb and install bulb.
- (7) Install dial light deflector.
- (8) Install dial cover.
- (9) Install radio.

## ANTENNA

### AM and AM/FM Models

All antennas must have good ground to eliminate static noises. The mast of the antenna is not grounded except through the radio. The base of the antenna is grounded to the vehicle sheet metal. The coaxial shield (the wire mesh) surrounding the center conductor wire of the antenna lead-in cable is grounded to the radio and the antenna base.

### Tests

There are three antenna tests to be made with the use of an ohmmeter:

- Mast to ground
  - Tip of mast to tip of conductor
  - Body ground to battery ground
- Refer to figure 3V-16.

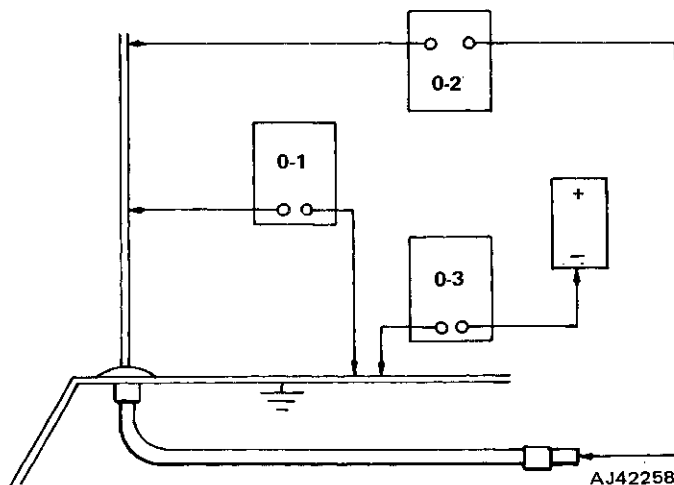


Fig. 3V-16 Antenna Ohmmeter Test

### Mast-to-Ground Test

This test verifies that the antenna is making electrical contact with the radio and that the mast is insulated from the base.

(1) Touch one ohmmeter prod to tip of antenna mast and other prod to antenna base (0-1). With antenna installed in radio, there should be continuity (approximately 15 ohms).

(2) Disconnect antenna from radio and repeat step (1). There should not be any continuity with antenna disconnected from radio.

### Tip of Mast-to-Tip of Conductor Test

This test verifies that the antenna does not have an open circuit.

- (1) Disconnect antenna from radio.
- (2) Touch one ohmmeter prod to mast tip and other prod to tip of lead-in (part inserted into the radio) (0-2). There should be continuity (fraction of an ohm).

### Body Ground-to-Battery Ground Test

This test verifies that the antenna base has a good ground. Touch one ohmmeter lead to the fender and the remaining prod to the battery negative post (0-3). The resistance should be extremely low (less than one ohm).

### AM/FM/CB Radio

VSWR is a measurement of the magnetic fields which reflect back into the antenna. Besides limiting the range of the transmitter, these also cause a heat build-up which can damage the transmitter circuitry. A high VSWR reading indicates a high level of reflected magnetic fields. A reading less than 2.0:1 is excellent. A reading above 3.5:1 is excessive and requires adjustment (see—VSWR Reading by CB Channels chart). VSWR readings can vary depending upon atmospheric conditions. VSWR can also vary with respect to surrounding objects that affect reflection and conductivity.

### VSWR Reading by CB Channels

CB CHANNELS	VSWR READING
1 thru 5	Less Than 3.5:1
6 thru 10	Less Than 3.0:1
11 thru 15	Less Than 2.5:1
16 thru 25	Less Than 2.0:1
26 thru 30	Less Than 2.5:1
31 thru 35	Less Than 3.0:1
36 thru 40	Less Than 3.5:1

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### Tuning the CB Antenna/Splitterbox

Tuning the CB antenna or splitterbox involves reducing the SWR level by using a VSWR meter or the Amserv AMX 386S Mobile CB Tester and chart covering operating instructions for Amserv AMX 386S Mobile CB Tester. Trim the antenna/splitterbox as follows:

**NOTE:** When checking SWR, vehicle should be located out-of-doors and at least 100 feet from other vehicles, people, or buildings. Doors of test vehicle should be closed.

- (1) Disconnect coaxial cable at inline connection near splitterbox.
- (2) Connect transmitter end of coaxial cable to a jumper coaxial cable.

## 3V-12 RADIO SOUND SYSTEMS

**NOTE:** Jumper should not exceed 18 inches.

(3) Connect jumper coaxial cable to transmitter terminal of test instrument.

(4) Connect splitterbox end of coaxial cable to antenna terminal of test instrument.

**NOTE:** If a VSWR meter is used, it is recommended to connect a 50-ohm dummy load to VSWR meter antenna connection. Radio will not transmit with a dummy load.

(5) With engine running, turn radio on, key mike, and measure SWR on channels 1 and 40 following test instrument manufacturer's instructions.

(a) If SWR reading on test instrument is less than 3.5 between channels 1 and 40 and within 0.5 of one another, no further adjustment is required.

(b) If SWR reading on test instrument is more than 3.5 between channels 1 and 40 adjust splitterbox.

(6) Adjust splitterbox using a 5/64-inch hexagon non-metallic alignment tool (available at most radio/television repair shops).

**NOTE:** If a metal Allen wrench is used for the adjustment, remove the wrench from the splitterbox before reading the test instrument.

(a) Insert alignment tool into splitterbox adjusting slug.

(b) Turn slug clockwise or counterclockwise, in one quarter turn increments, until SWR reading on test instrument is less than 3.5 between channels 1 and 40 and within 0.5 of one another, no further adjustment is required.

(c) If desired SWR reading cannot be obtained the antenna base slug must be adjusted.

(7) Turn transmitter channel selector to channel 20 and record SWR reading.

(8) Disconnect antenna mast from base and remove protective mylar tape from antenna base.

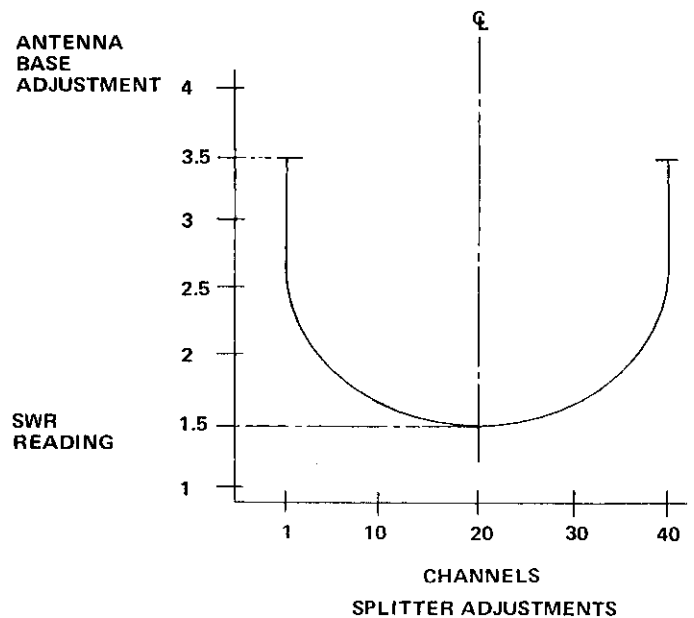
(9) Adjust antenna base slug using a 5/64-inch Allen wrench at least 3-1/2-inches long.

(a) With antenna mast installed, insert wrench into antenna base slug and turn slug clockwise or counterclockwise, in one quarter turn increments, to obtain lowest possible SWR reading on test instrument.

(b) Readjust splitterbox as outlined above.

Changing the splitterbox adjustment will lower or raise the frequency of the best channel match. Changing the load coil adjustment in the antenna base will raise or lower the SWR curve (fig. 3V-16).

**NOTE:** Although you are not talking while checking VSWR, a carrier signal is being transmitted which can eliminate another transmission. Try to pick a time when the channel is not in use to check VSWR.



80703

Fig. 3V-16 Typical SWR Curve

## SPEAKERS

Speakers have an impedance of either 3.2 or 8 ohms. A speaker should be replaced with a speaker having the proper part number. If the exact replacement is not available, select a speaker which matches the ohm value stamped on the radio chassis with a black ink stamp.

AM/FM stereo radios are more critical in the selection of a speaker than are AM radios. A noticeable deterioration in sound will be noticed if the correct speaker is not used.

Stereo speakers are paired together for a truer stereo sound, right front with right rear, left front with left rear.

## Speaker Repairs

A speaker, once it has been damaged, is usually not repairable and should be replaced. Defective speakers usually have one or more of the following symptoms:

- Loose mounting.
- Screws or other objects stuck to back of magnet.
- Audio distortion, particularly on the low frequency notes and at high volume.
- Rattles and buzzes caused by foreign material hitting or rubbing against the speaker cone.
- Raspy noises caused by foreign matter inside the speaker restricting free movement of the speaker cone.
- Muffled sound caused by speaker opening obstruction.

Use a light to check the speaker opening(s).

If the entire speaker is not visible through the speaker grille openings, remove the obstruction as follows:

**Front Door Speakers**

- (1) Remove door trim panel lower screws.
- (2) Carefully lift the door trim panel away from door to expose speaker.
- (3) Cut out excess water dam paper around speaker.
- (4) Install door trim panel lower screws.

**NOTE:** Be sure the speaker mounting screws are tightened securely.

**Speaker Harness Test**

**Ground Condition**

- (1) Disconnect speaker feed wires at radio connector and each individual speaker.

**NOTE:** When reconnecting the speaker harness to the radio, be sure the antenna lead-in cable is fully engaged in the radio socket.

- (2) Connect one lead of an ohmmeter to the speaker feed wire and the other lead to a good ground. An infinity reading should be indicated. Check each individual speaker wire in this manner.

- (3) If resistance is indicated on the ohmmeter, the wire being checked is grounded.

**NOTE:** Grounded speaker harnesses are generally caused by screws piercing wire harness.

**Short Condition**

- (1) Disconnect speaker feed wires at the radio connector and at each individual speaker.
- (2) Connect ohmmeter leads to speaker feed wires at the radio connector.
- (3) An infinity reading should be indicated.
- (4) If resistance is indicated on ohmmeter, the feed wires being checked are shorted.

**Speaker Test**

Speakers may be isolated for grounds by testing the impedance with an ohmmeter. Connect ohmmeter between the two speaker leads. The specified value should match the ohm value stamped on the radio chassis.

**Radio Speaker Replacement**

**CJ Models**

To remove the speaker, remove the four attaching nuts from the mounting studs.

**Cherokee-Wagoneer-Truck Models**

The AM speaker is located above the radio. To remove the speaker, remove the radio, then remove the four attaching nuts from the speaker mounting studs.

On vehicles equipped with a stereo radio, interior trim panels must be removed for access to the speaker.

**SPECIFICATIONS**

**Radio Bulb Chart**

	Number of Bulbs/ Bulb Trade Number
CJ . . . . .	1/1892
Cherokee-Wagoneer-Truck . . . . .	1/1893

70320

**Tools**



J-22683-01  
STEREO TEST TAPE

70319



## NOTES



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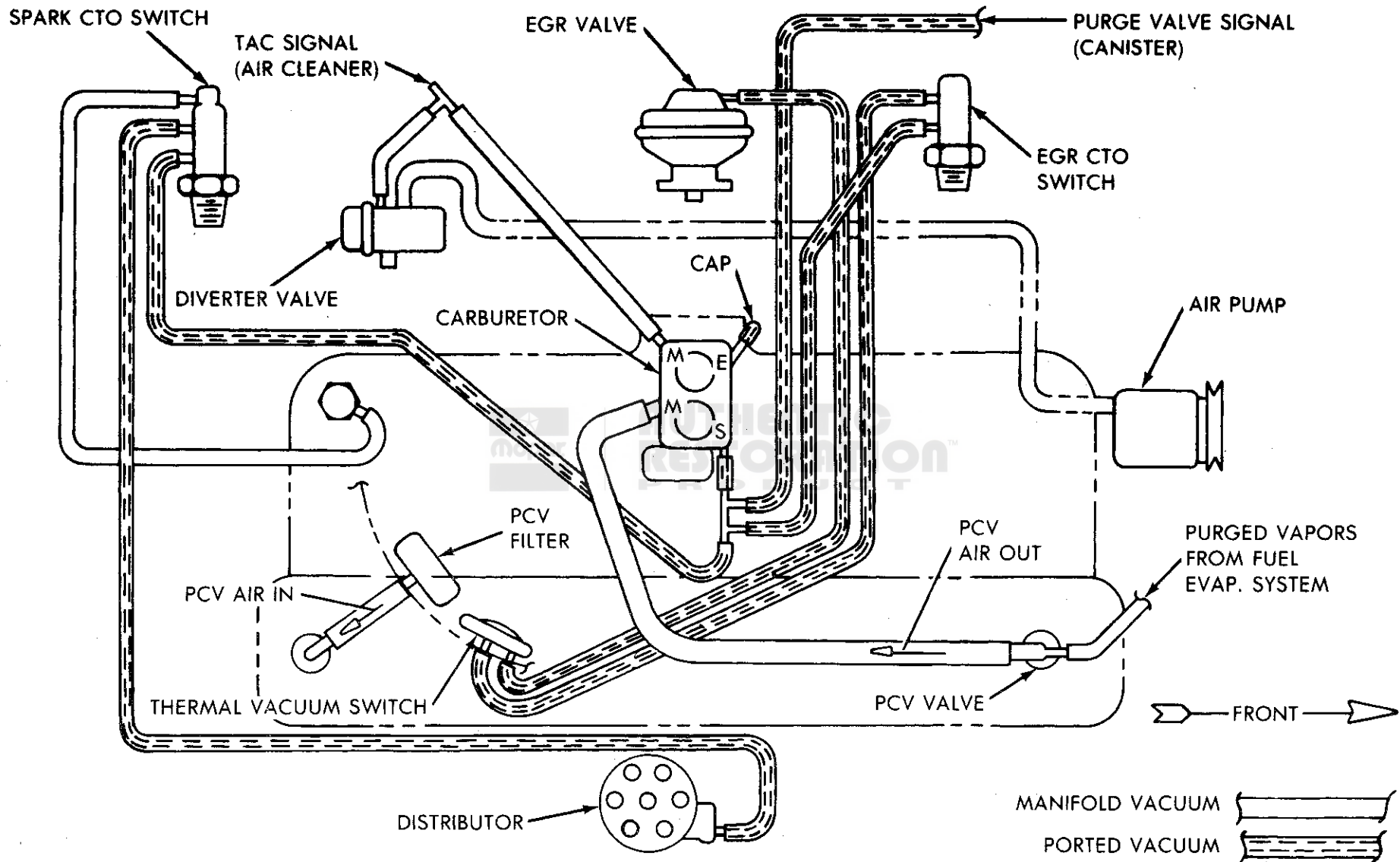
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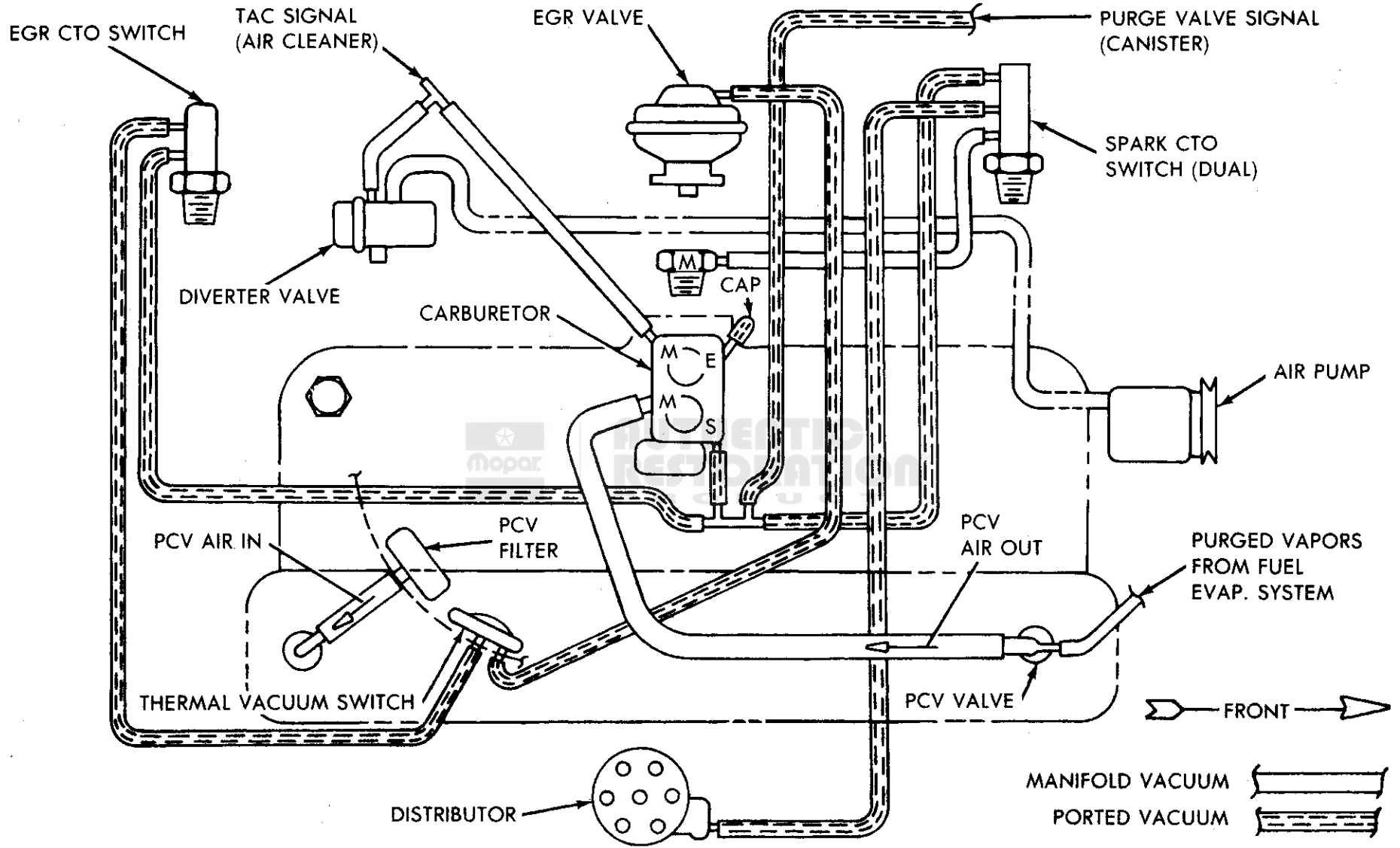
**VACUUM LINE  
ROUTING DIAGRAMS**

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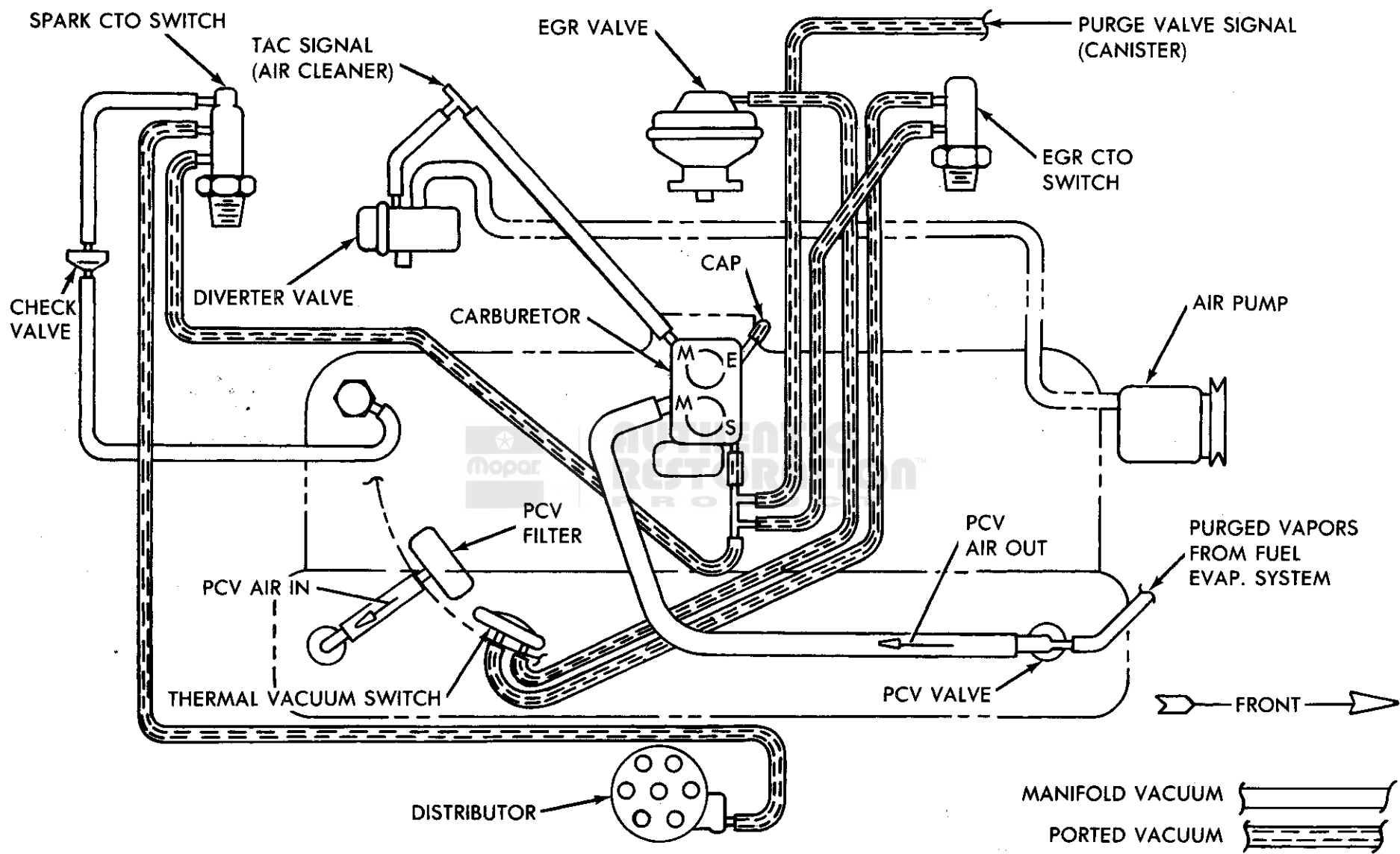


49-STATE, 258 CID ENGINE WITH MAN. TRANS.—CJ-CHEROKEE-J-10 TRUCK MODELS

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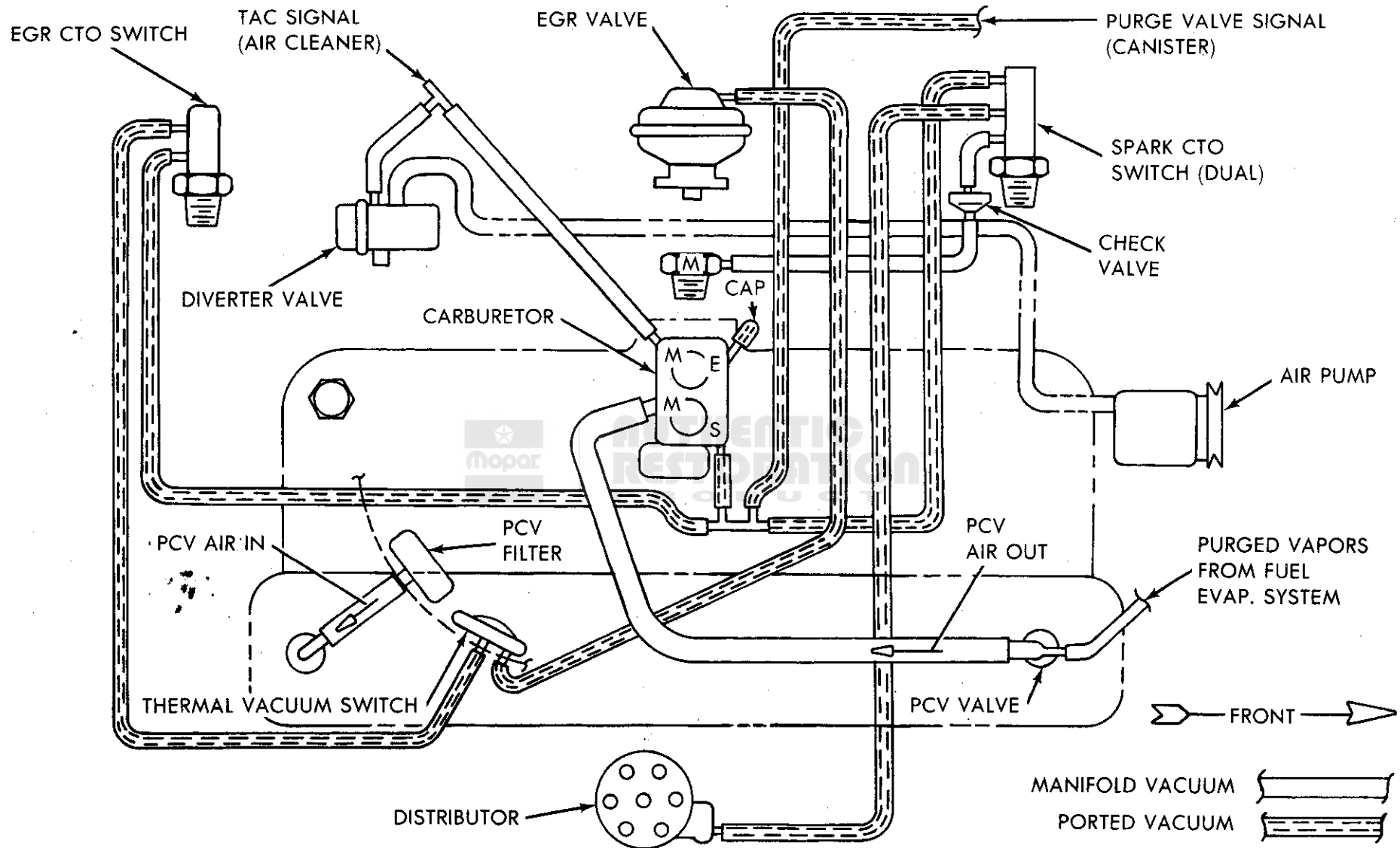


49-STATE 258 CID ENGINE WITH MAN. TRANS. AND H.D. COOLING—CJ-CHEROKEE-J-10 TRUCK MODELS



49-STATE 258 CID ENGINE WITH AUTO. TRANS.—CJ-7 CHEROKEE-WAGONEER-J-10 TRUCK MODELS

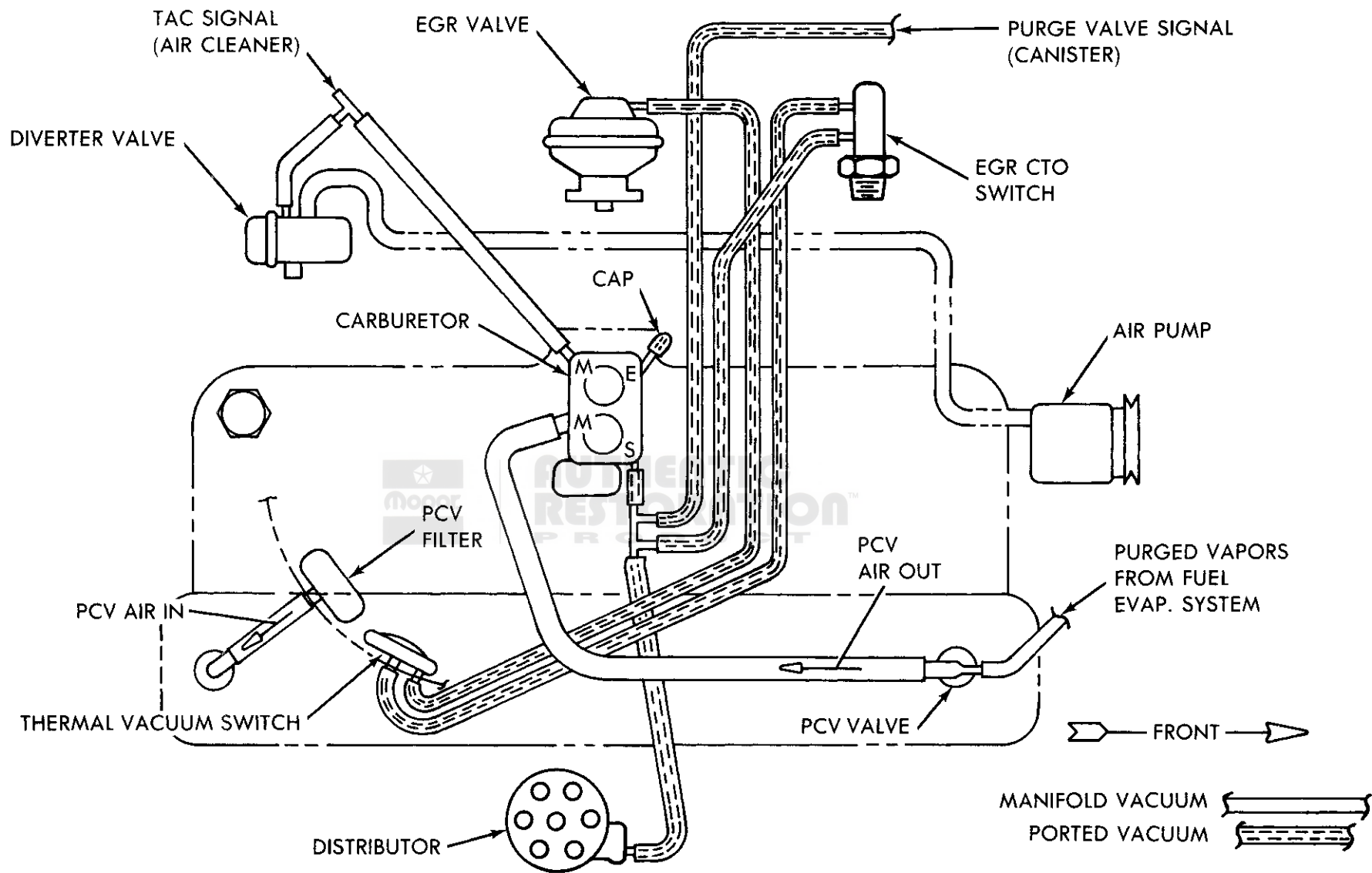
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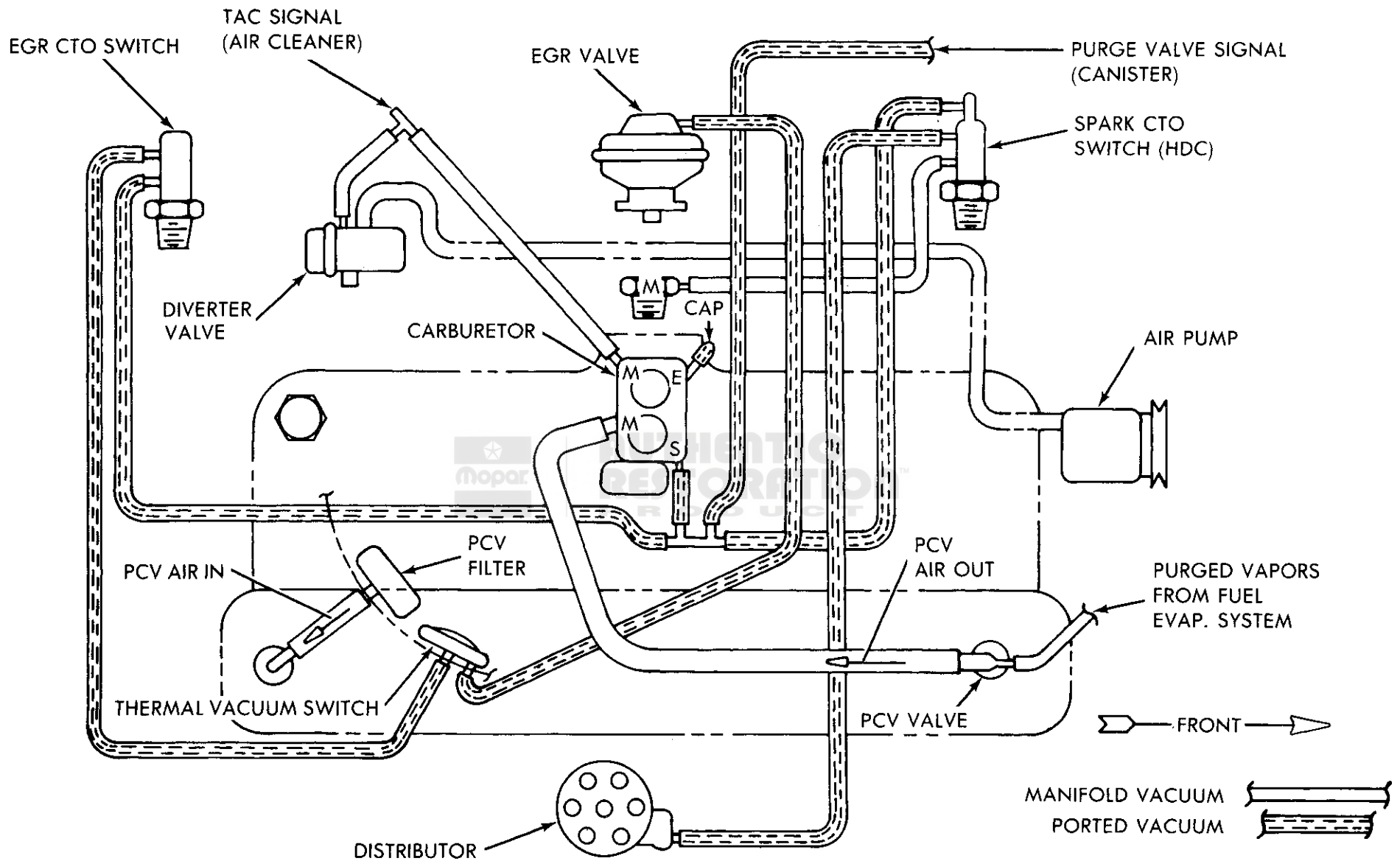
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49-STATE 258 CID ENGINE WITH AUTO. TRANS. AND H.D. COOLING—CJ-7-CHEROKEE-WAGONEER-J-10 TRUCK MODELS



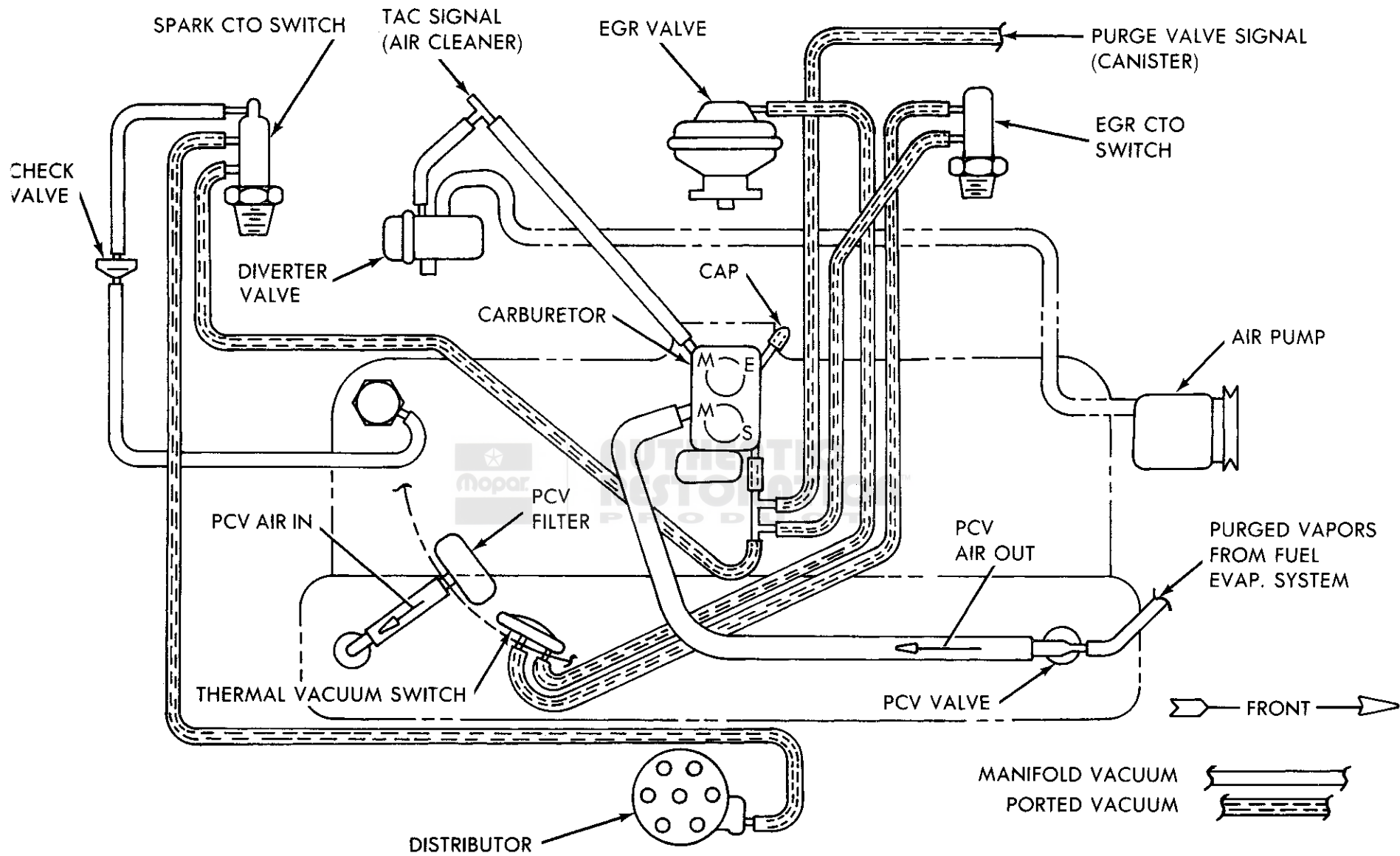


CALIFORNIA 258 CID ENGINE WITH MAN. TRANS.—CJ MODELS

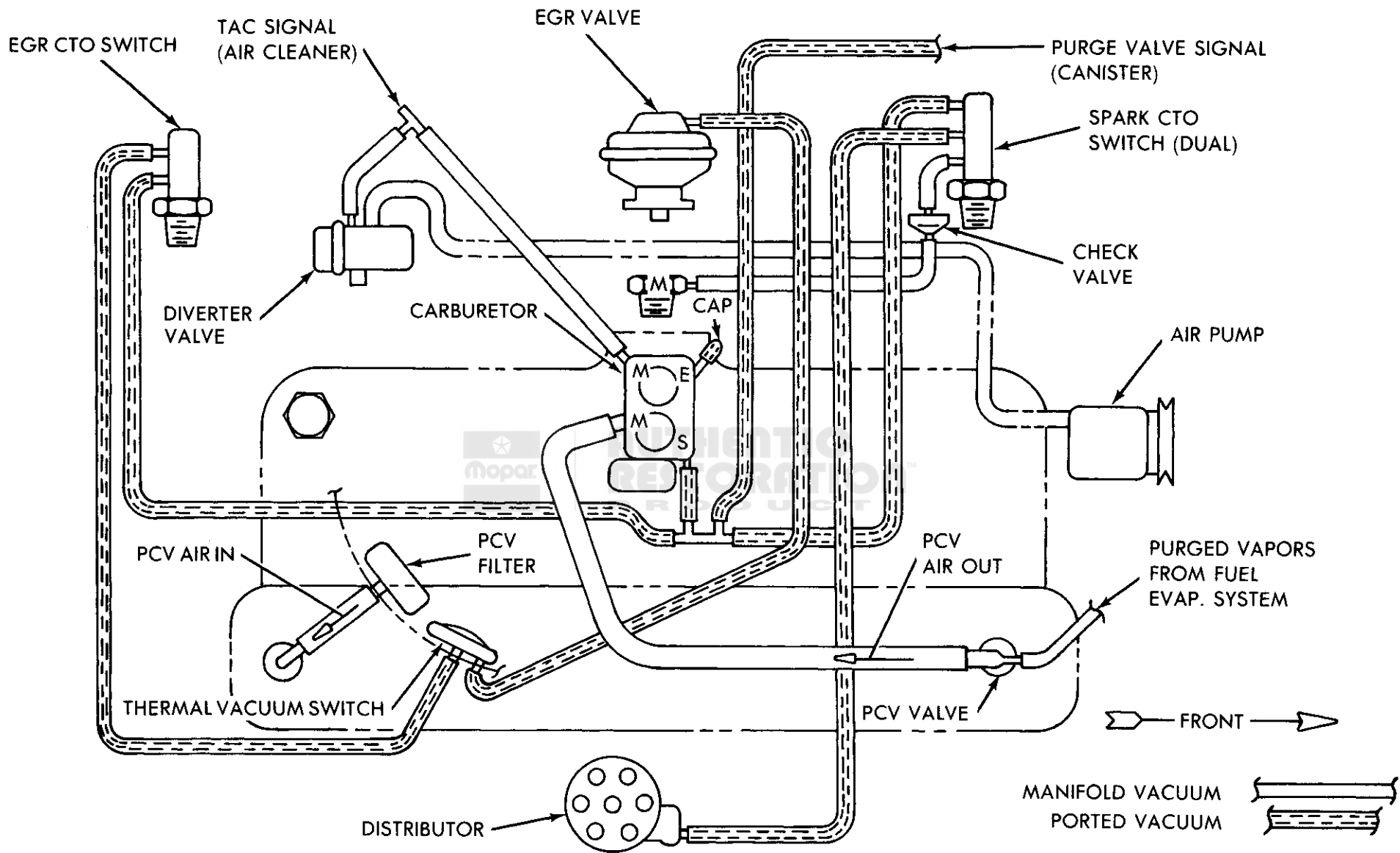


CALIFORNIA 258 CID ENGINE WITH MAN. TRANS. AND H.D. COOLING—CJ MODELS

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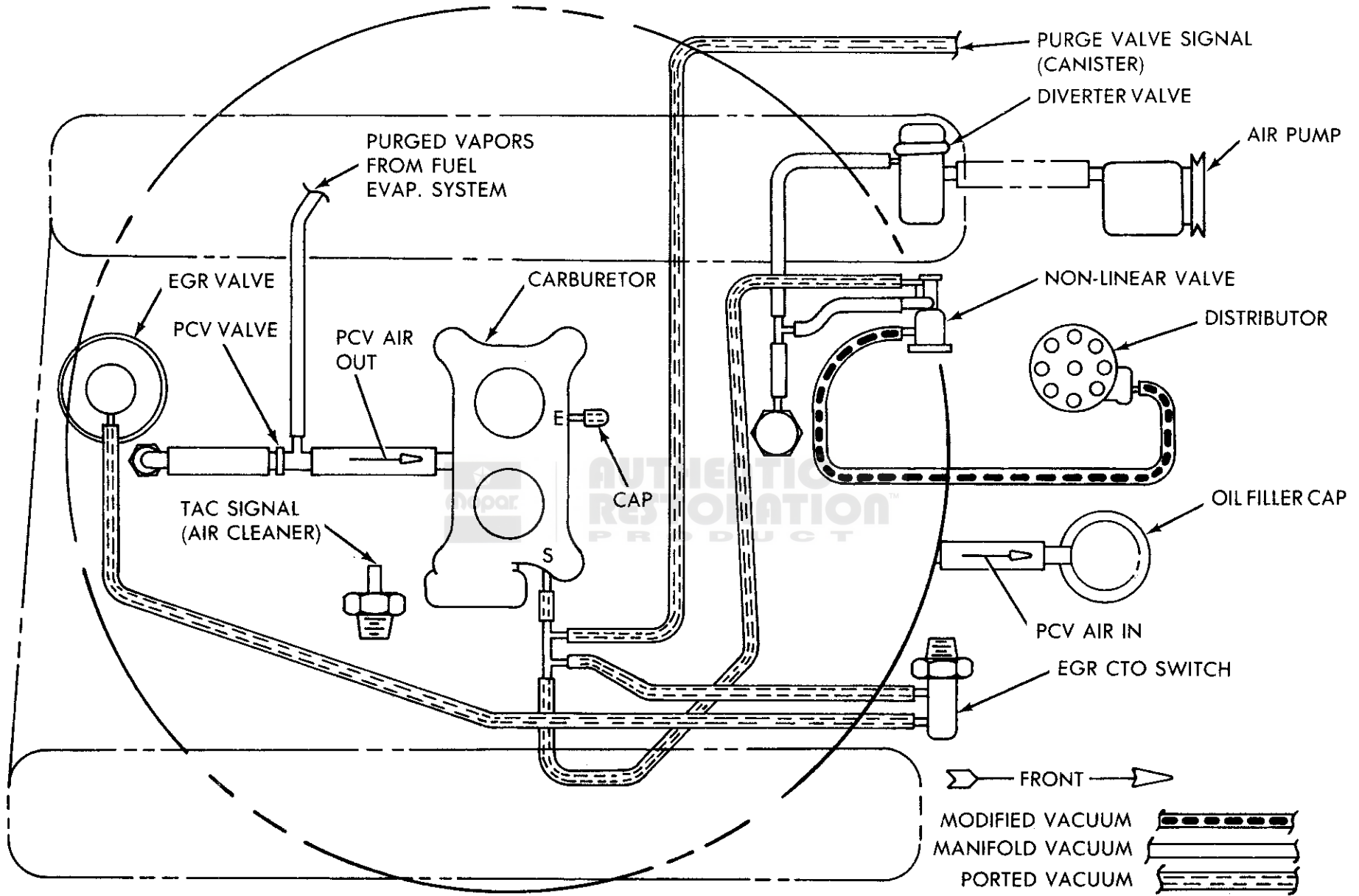


CALIFORNIA 258 CID ENGINE WITH AUTO. TRANS.—CJ-7

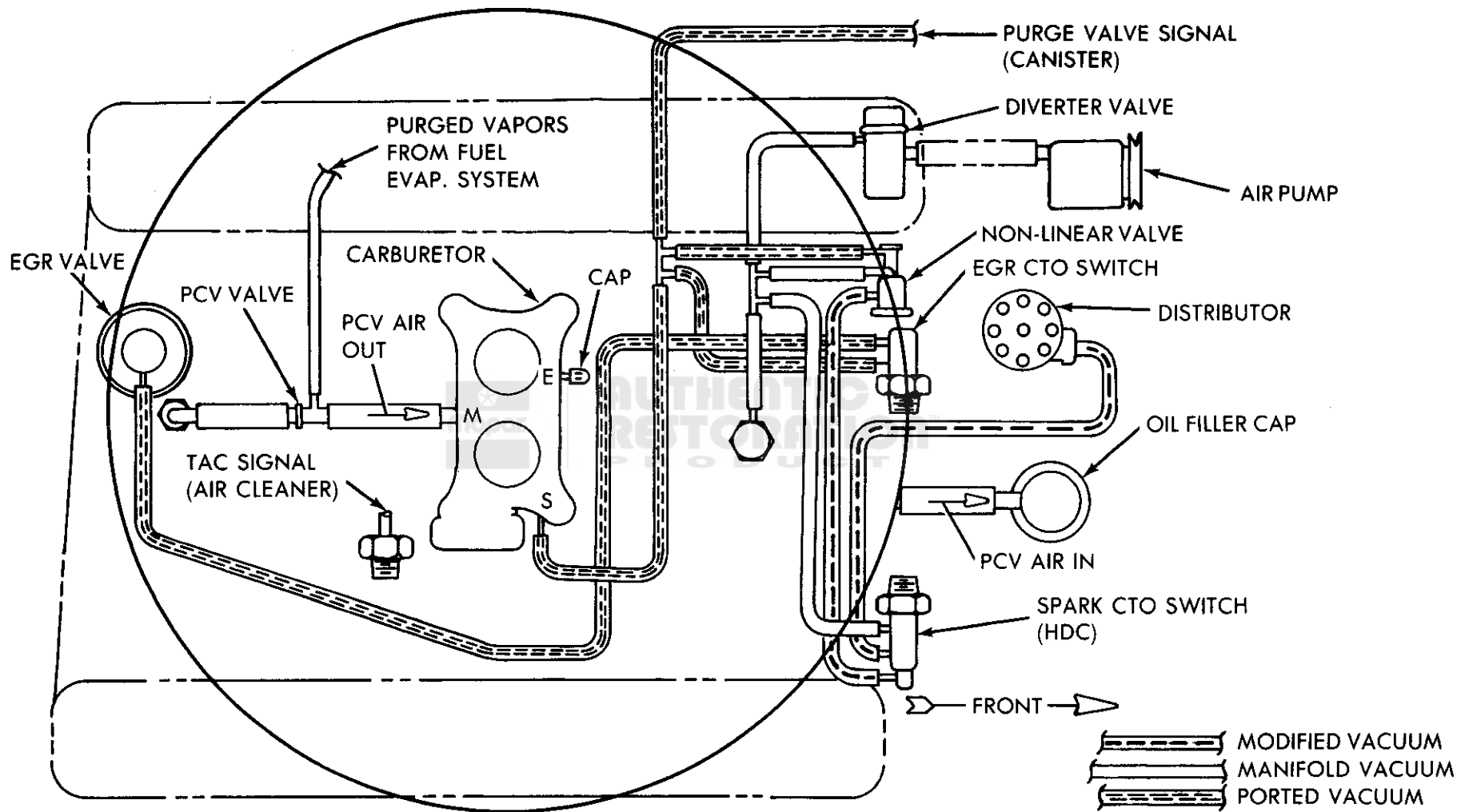


CALIFORNIA 258 CID ENGINE WITH AUTO. TRANS. AND H.D. COOLING—CJ-7

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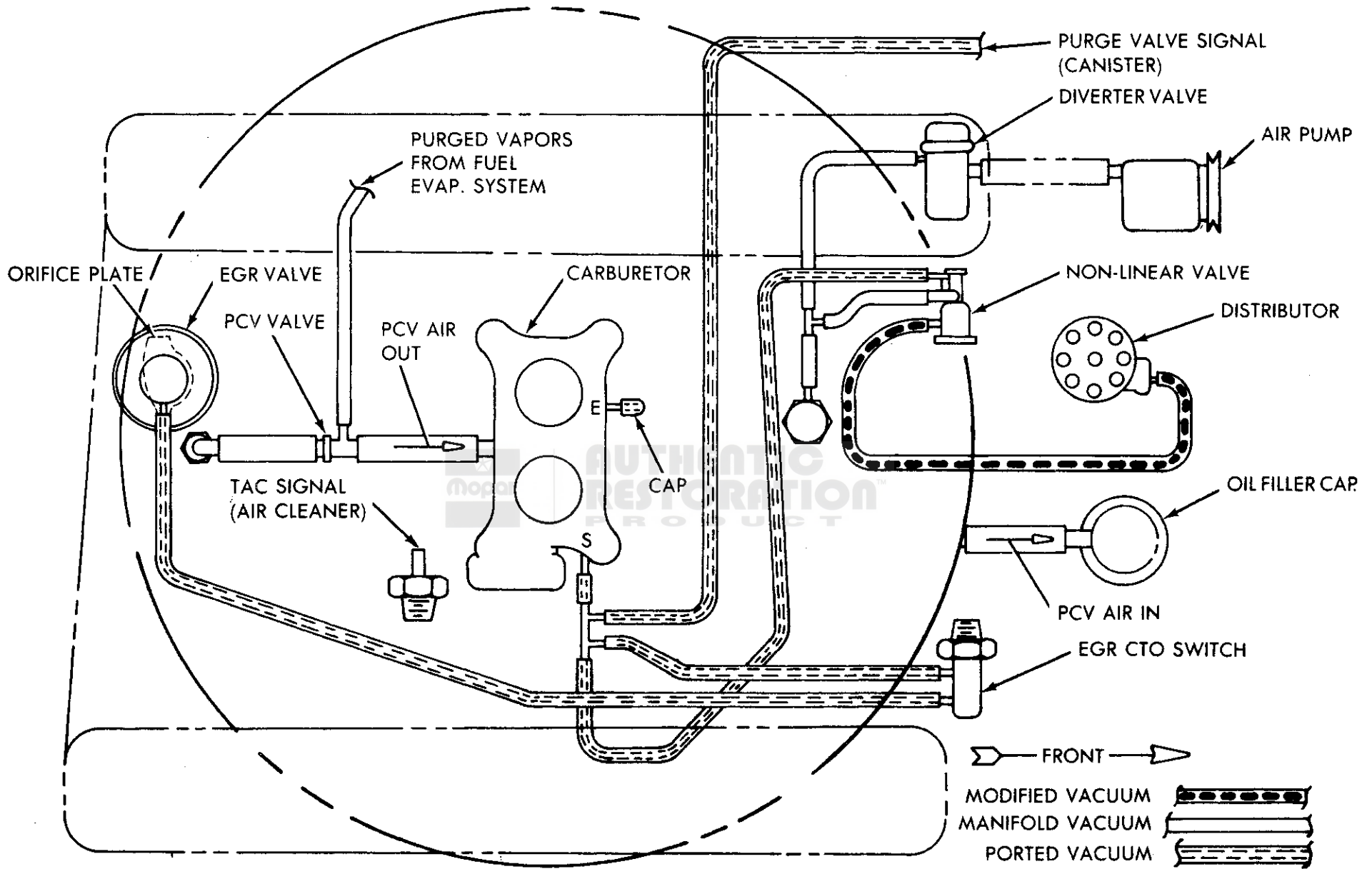


49-STATE 304 CID ENGINE WITH MAN. TRANS.—CJ MODELS

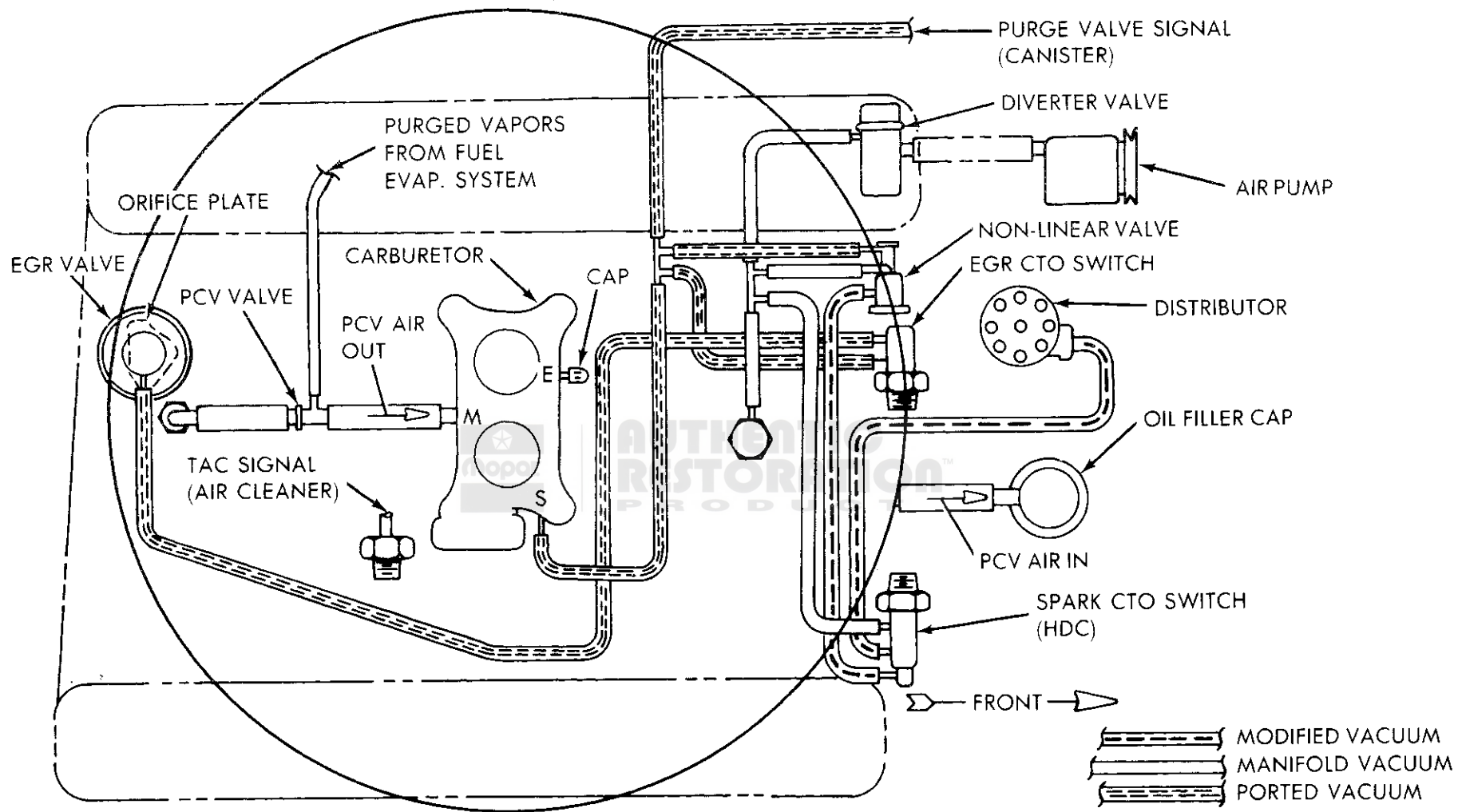


49-STATE 304 CID ENGINE WITH MAN. TRANS. AND H.D. COOLING—CJ MODELS

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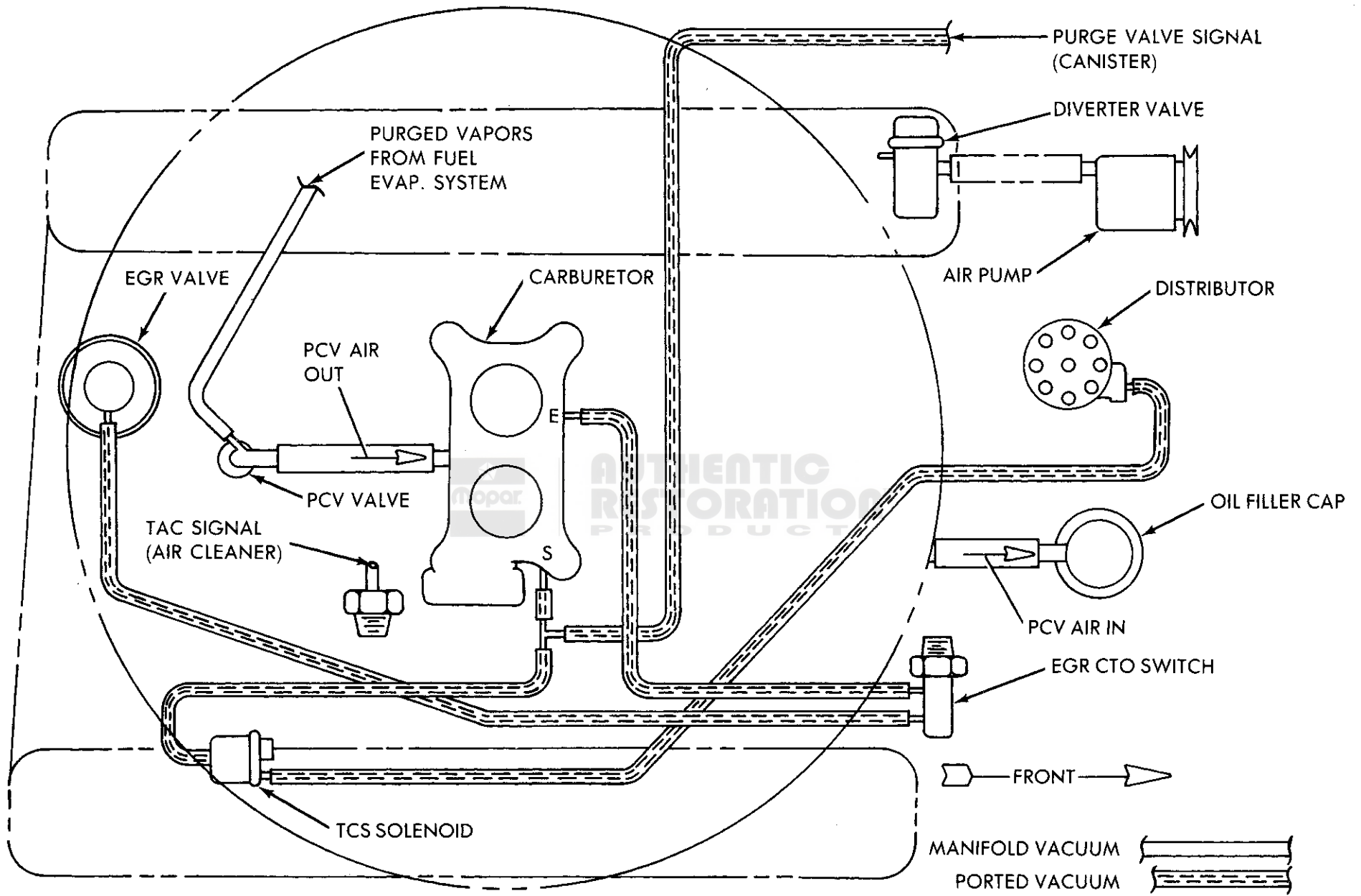
49-STATE 304 CID ENGINE WITH AUTO. TRANS.—CJ-7



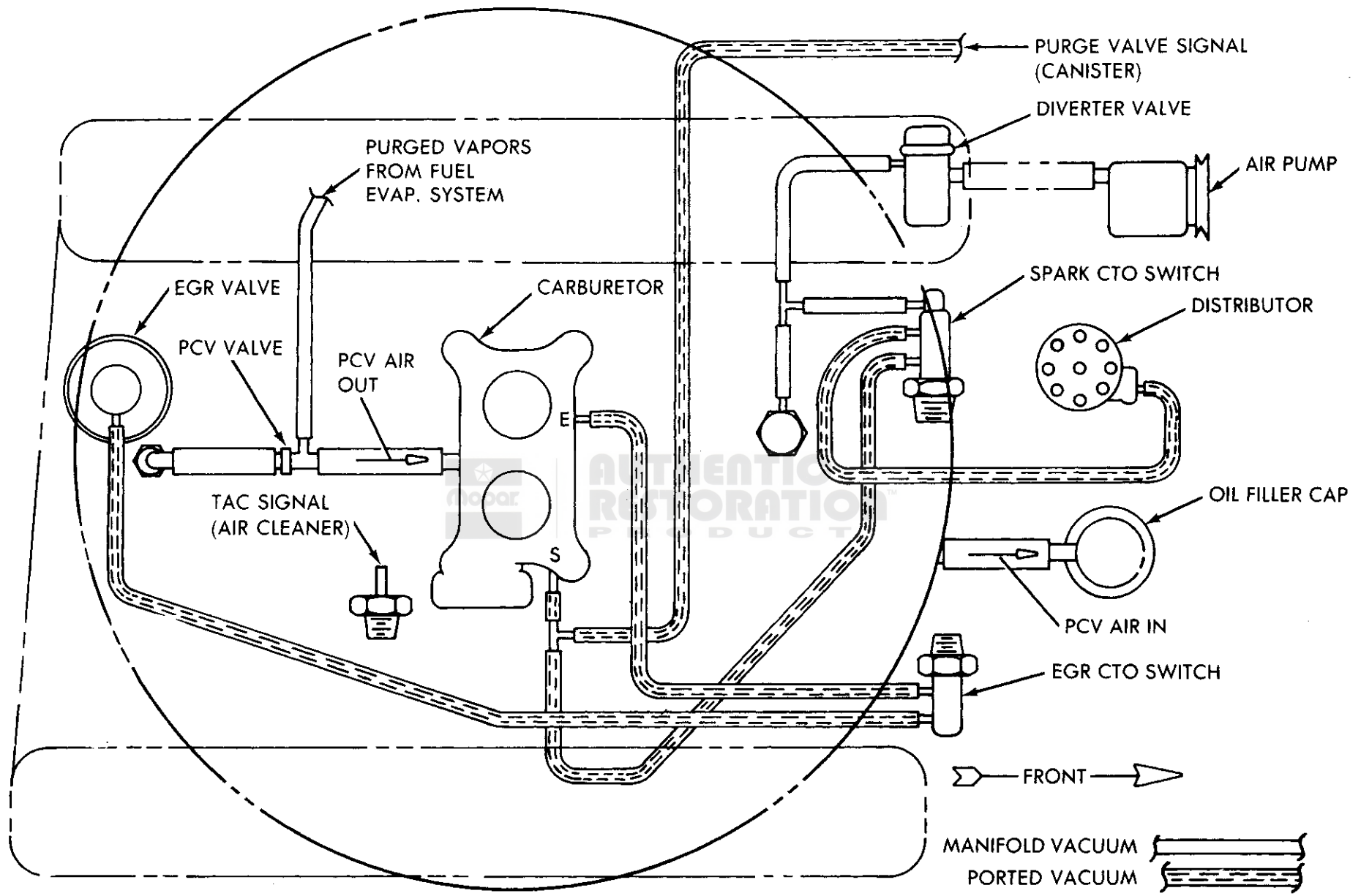
49-STATE 304 CID ENGINE WITH AUTO. TRANS. AND H.D. COOLING—CJ-7

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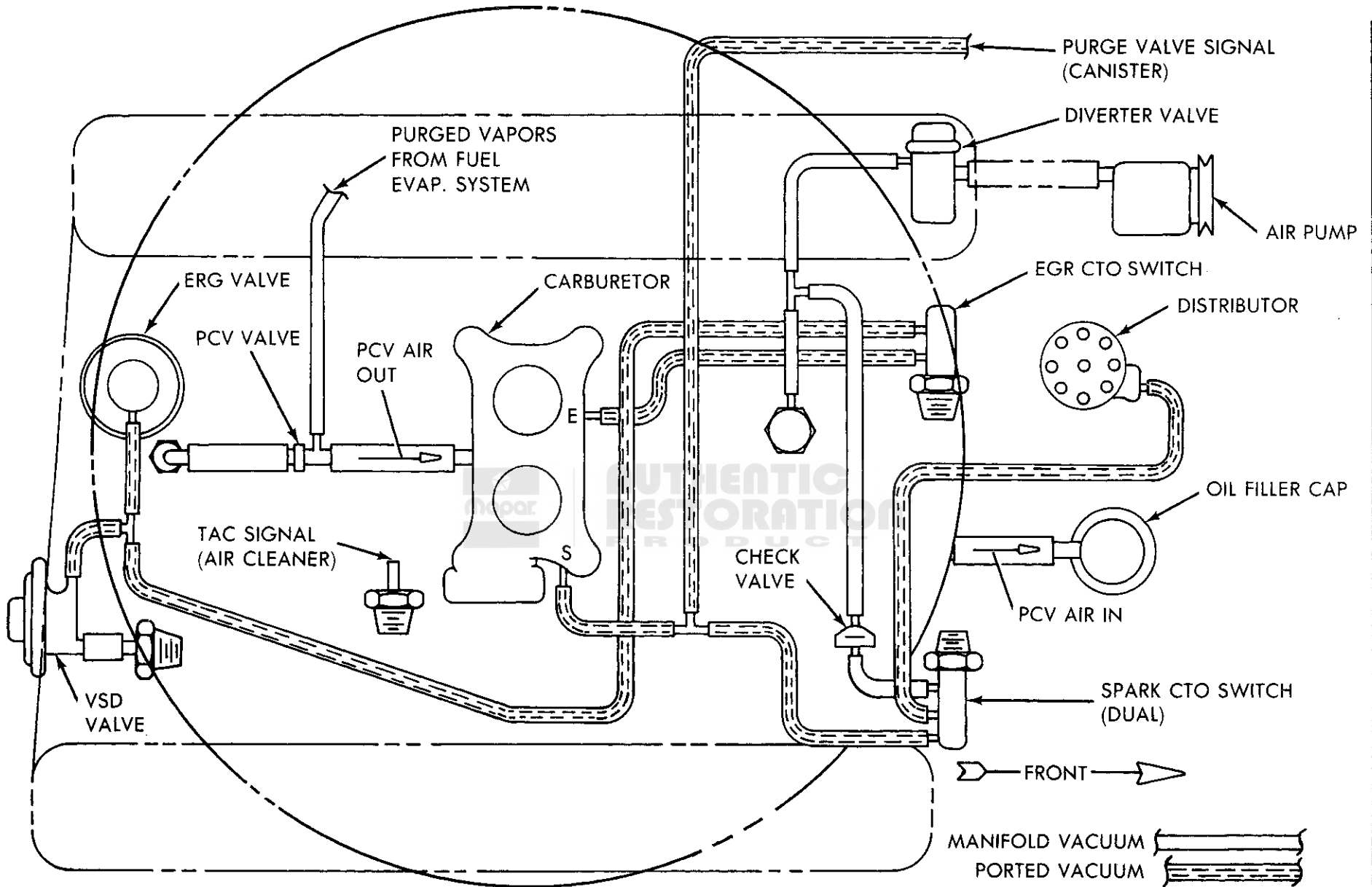


CALIFORNIA 304 CID ENGINE WITH MAN. TRANS.—CJ MODELS

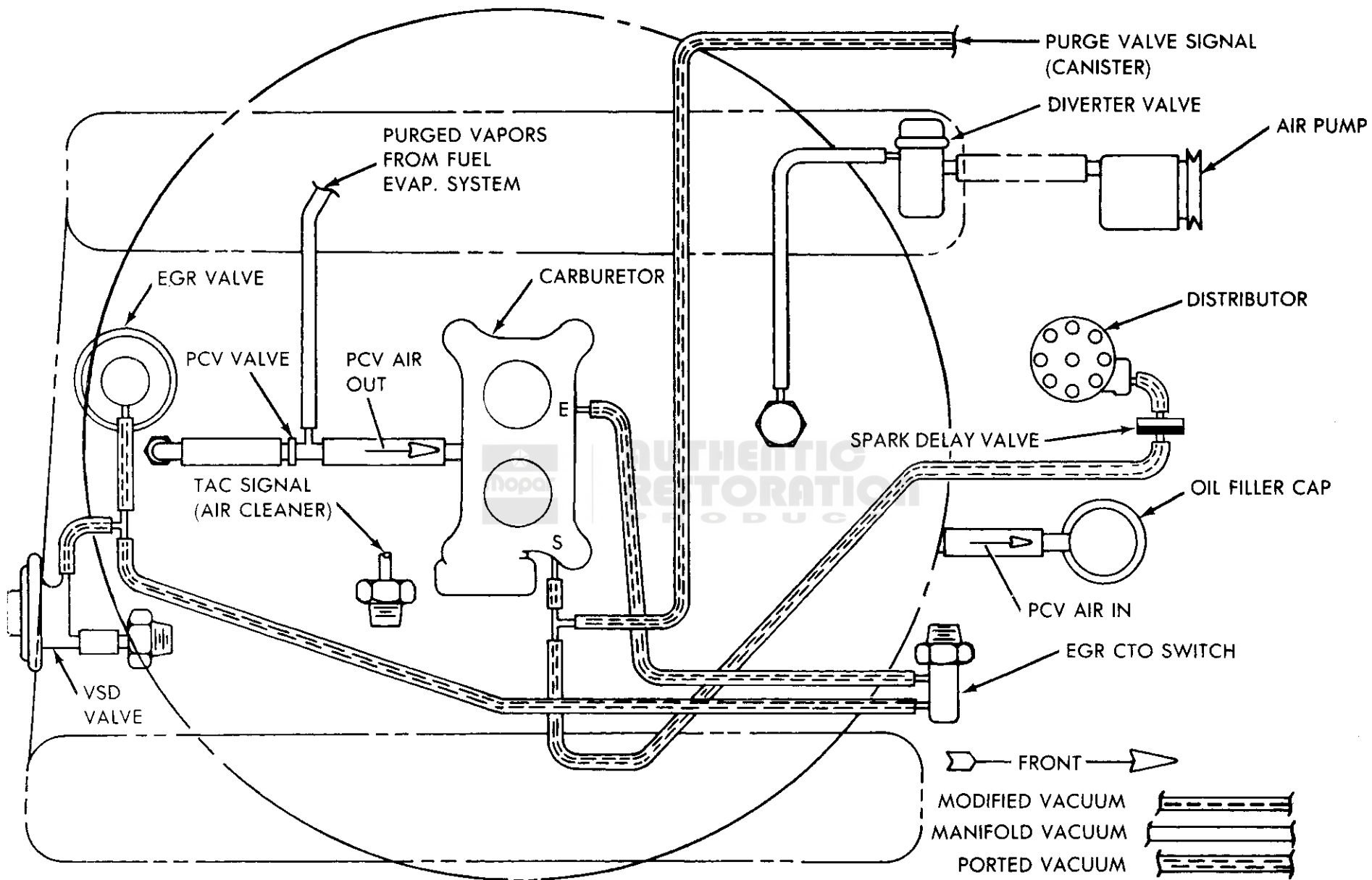


49-STATE 360 CID ENGINE WITH AUTO. TRANS.—CHEROKEE-WAGONEER-TRUCK MODELS

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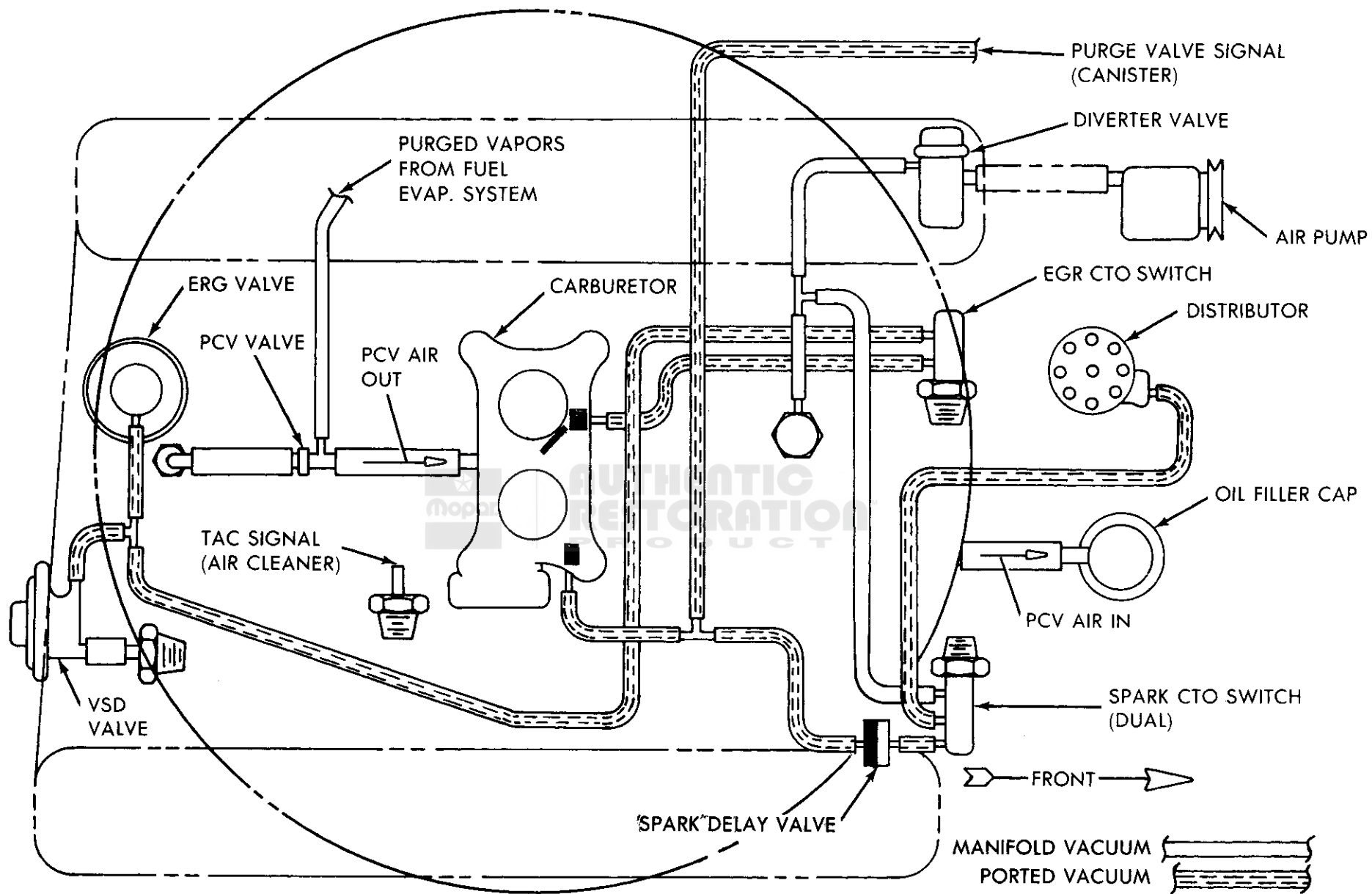


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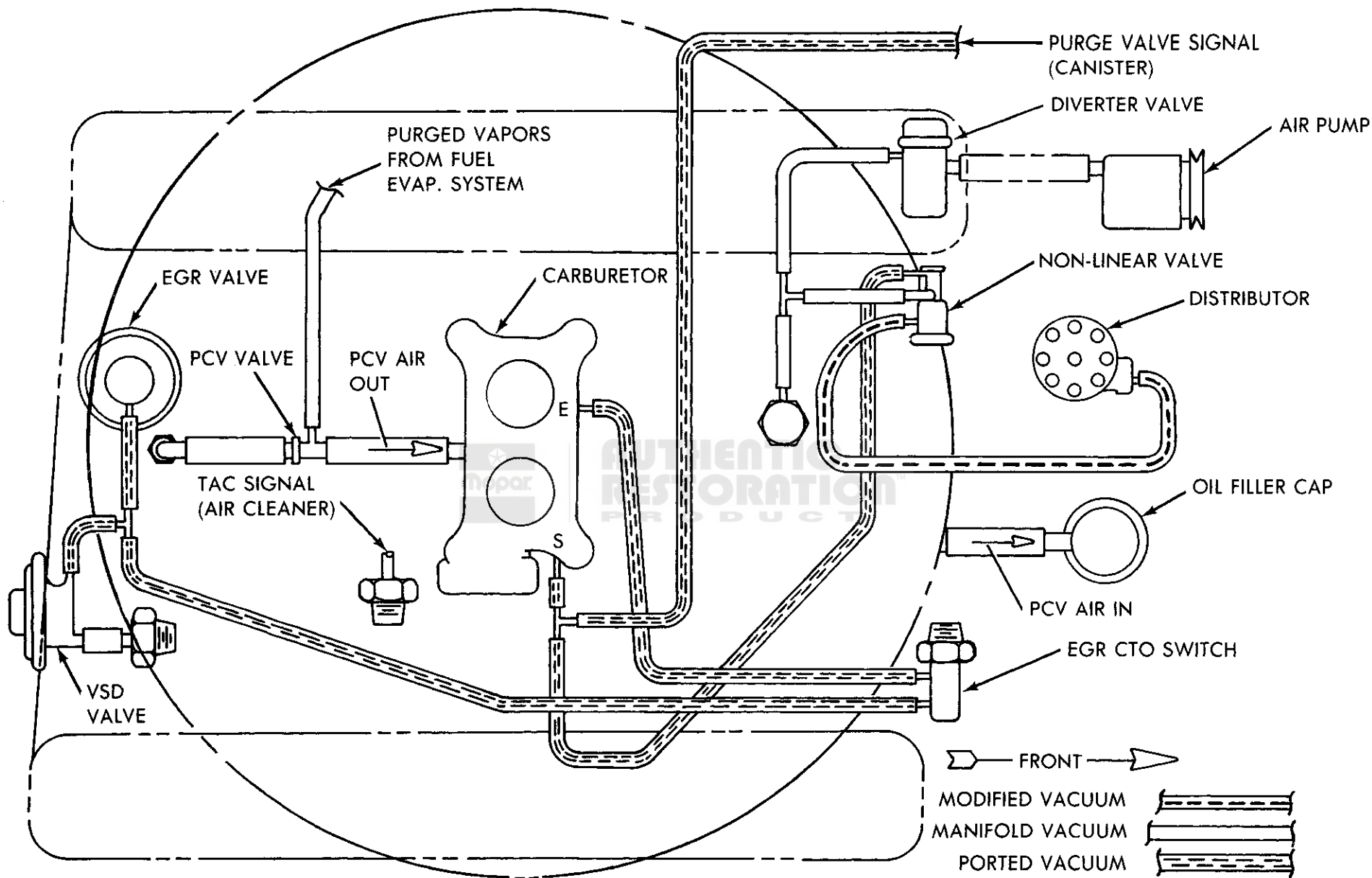
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CALIFORNIA 360 CID ENGINE WITH MAN. TRANS.—CHEROKEE MODELS



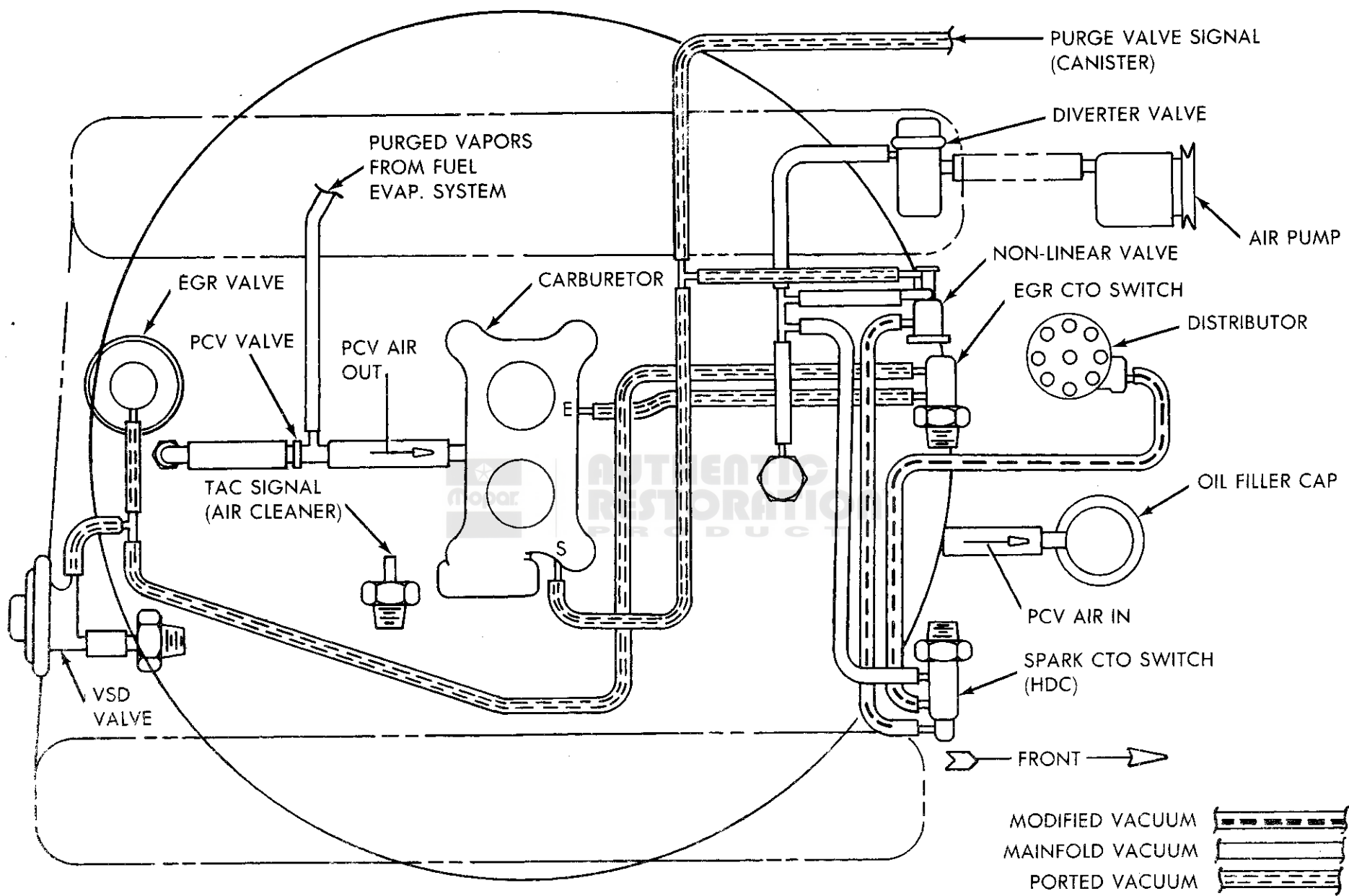
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CALIFORNIA 360 CID ENGINE WITH MAN. TRANS. AND H.D. COOLING—CHEROKEE MODELS

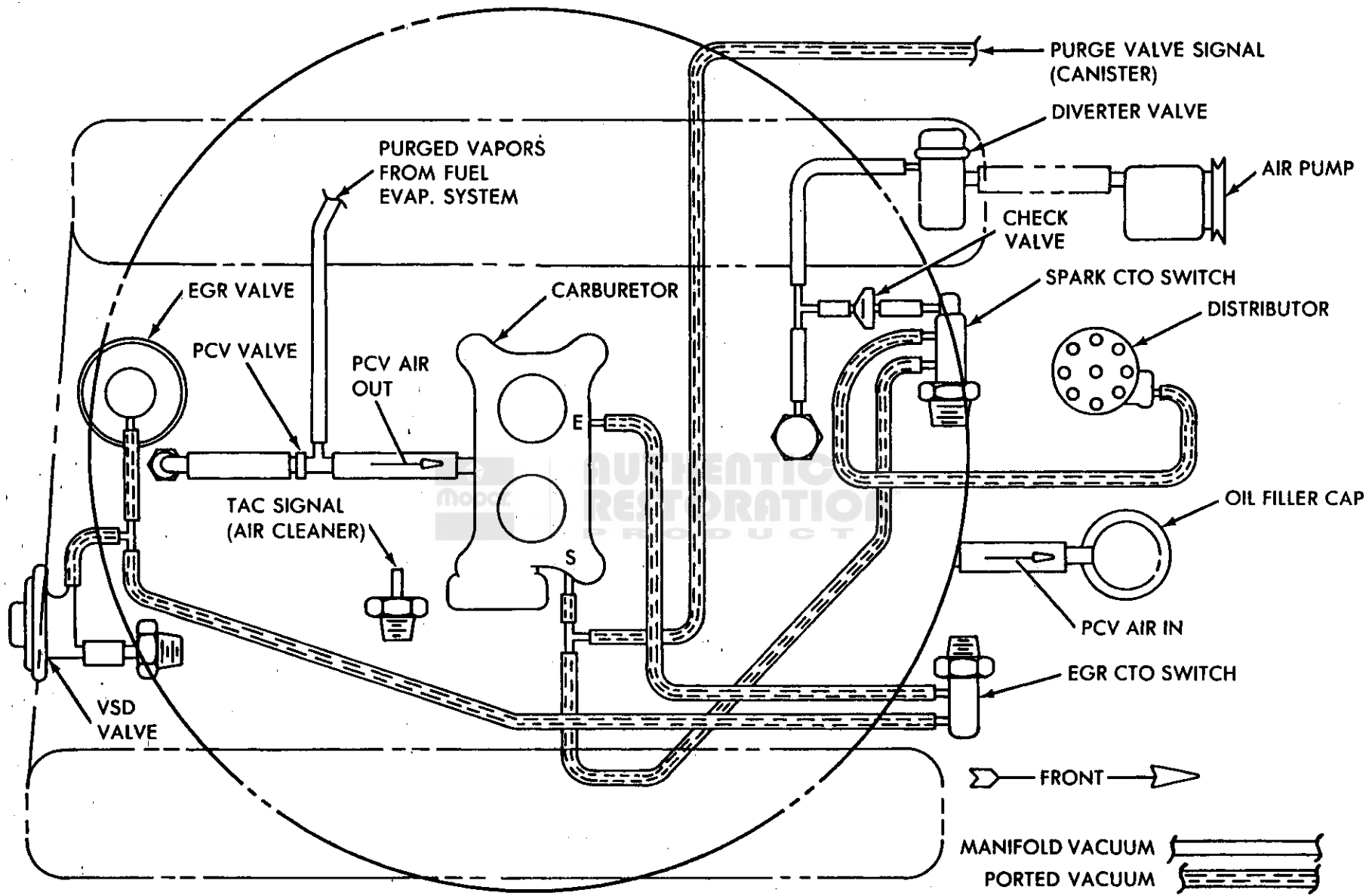


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CALIFORNIA 360 CID ENGINE WITH MAN. TRANS.—TRUCK MODELS



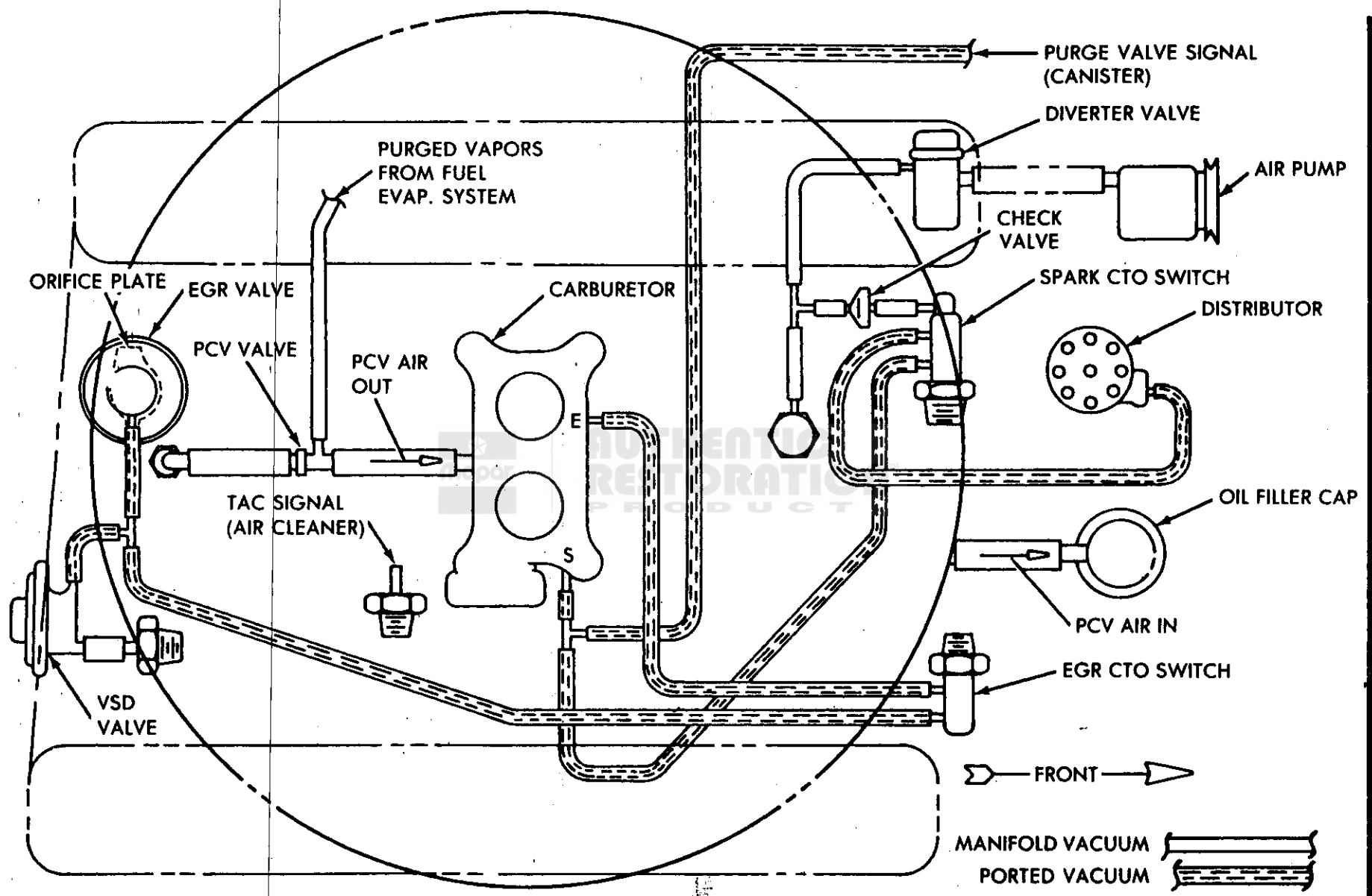
CALIFORNIA 360 CID ENGINE WITH MAN. TRANS. AND H.D. COOLING—TRUCK MODELS



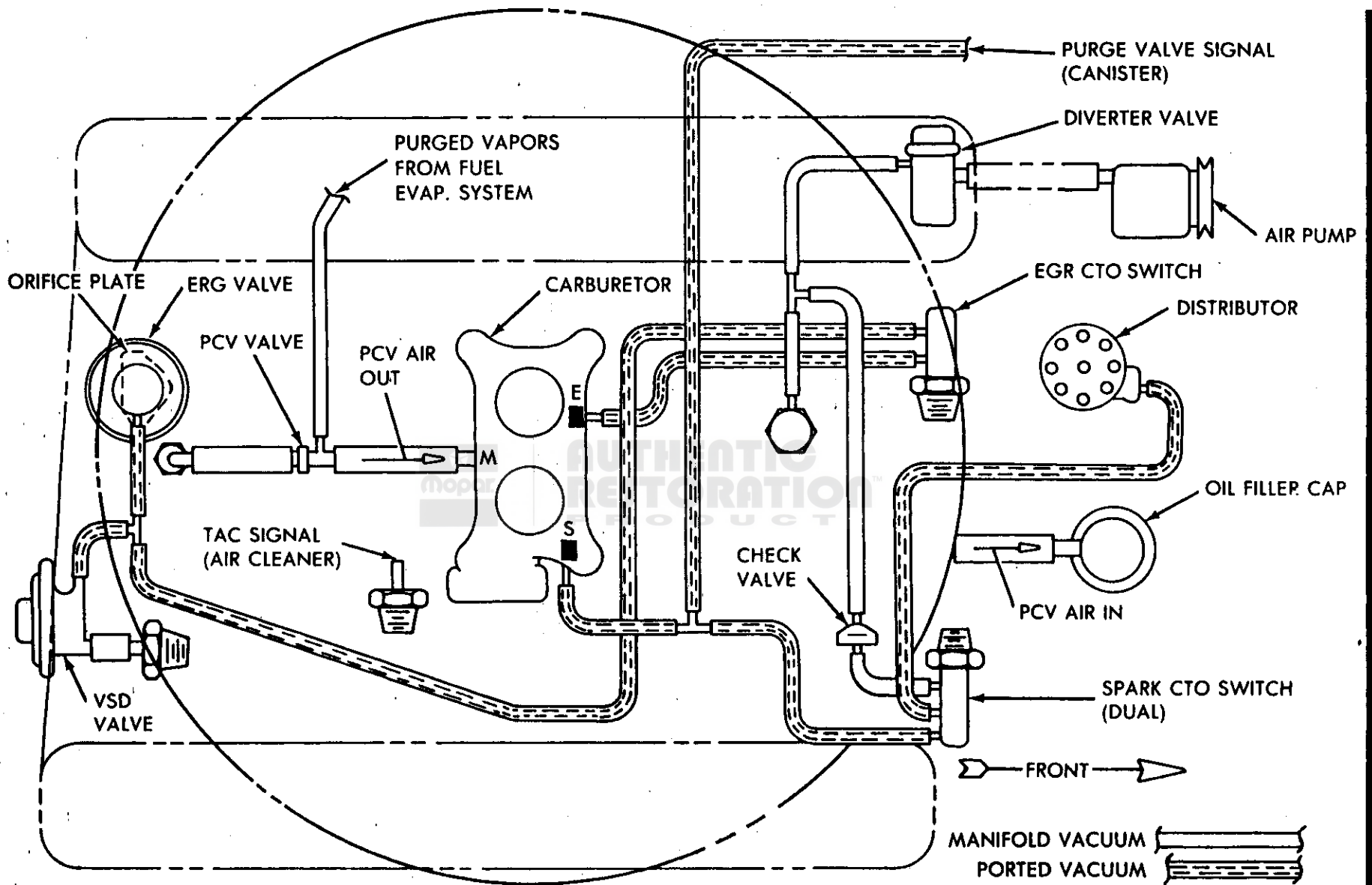
CALIFORNIA 360 CID ENGINE WITH AUTO. TRANS.—CHEROKEE-WAGONEER MODELS

90191T





CALIFORNIA 360 CID ENGINE WITH AUTO TRANS.—TRUCK MODELS



CALIFORNIA 360 CID ENGINE WITH AUTO. TRANS. AND H.D. COOLING—TRUCK MODELS

90192B





## Component Grid Locator

### CJ Models

NOMENCLATURE	LOCATION
Accessory Feed	C-8
Air Conditioner Compressor, 8-Cylinder	B-3
Alternator, 8-Cylinder	B-2
Alternator, 6-Cylinder	D-3
Anti-Diesel Solenoid, 8-Cylinder	A-4
Anti-Diesel Solenoid, 6-Cylinder	D-4
Back-up Lamp, Right Side	C-11
Back-up Lamp, Left Side	D-11
Back-up Light Switch Manual Transmission	C-4
Back-up Light Switch Manual Transmission	E-2
Battery, 8-Cylinder	A-4
Battery, 6-Cylinder	C-4
Body, 8-Cylinder	A-4
Body, 6-Cylinder	C-4
Brake Failure Switch	E-3
Brake Warning Lamp	C-7
Capacitor Jumper, 8-Cylinder	A-3
Capacitor Jumper, 6-Cylinder	C-2
Chassis, 8-Cylinder	A-4
Chassis, 6-Cylinder	C-4
Cigar Lighter Feed	D-9
Coil, 8-Cylinder	A-2
Coil, 6-Cylinder	C-2
Dimmer Switch	D-6
Distributor, 8-Cylinder	A-2
Distributor, 6-Cylinder	C-3
Electric Choke	A-6
Fuel Gauge	B-8
Fuel Sender	D-9
Ground Air Lamp Feed	A-7
Ground Defogger Lamp Feed	A-7
Ground Fan Lamp Feed	A-8
Ground Temperature Lamp Feed	A-7
Headlamp, Right Side	B-1
Headlamp, Left Side	D-1
Heater Motor, 8-Cylinder	B-3
Heater Motor, 6-Cylinder	D-3
Heater Switch	B-5
High Beam Indicator	D-5
Horn	E-4
Horn Relay	D-7
Ignition Switch	C-8
Kickdown & Quadra-Trac, 6-Cylinder	E-3
Left Turn Indicator & Hazard Lamp	D-8
Low Beam Lamp	D-6

NOMENCLATURE	LOCATION
Marker & Reflector, Right Side	A-2
Marker & Reflector, Left Side	E-2
Marker & Reflector, Right Side	B-10
Marker & Reflector, Left Side	E-10
Module Assembly Ignition, 8-Cylinder	B-2
Module Assembly Ignition, 6-Cylinder	D-3
Neutral Safety Switch	C-8
Oil Lamp Gauge	B-7
Oil Pressure Sender, 8-Cylinder	B-3
Oil Pressure Sender, 6-Cylinder	C-4
Oil Pressure Switch	A-6
Panel Lamp	A-7
Panel Lamp	B-7
Park & Signal Lamp, Right Side	A-1
Park & Signal Lamp, Left Side	D-1
Parking Brake	C-7
Quadra-Trac Lamp	B-7
Resistor Heater Blower Motor	B-6
Splice, 8-Cylinder	B-4
Splice, 6-Cylinder	A-1
Splice, 6-Cylinder	C-4
Splice, 6-Cylinder	A-1
Splice, 6-Cylinder	C-2
Splice, 6-Cylinder	C-3
Splice	B-6
Splice	C-6
Splice	C-6
Splice	C-7
Splice	C-7
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Temperature Sender, 8-Cylinder	A-4
Temperature Sender, 6-Cylinder	C-4
Transmission Kickdown Switch	E-6
Turn Signal Switch	D-7
Voltmeter Gauge	B-7
Windshield Wiper & Washer Lamp	D-8
Windshield Wiper Motor	C-9
Windshield Wiper & Washer Switch	D-8

## Component Grid Locator

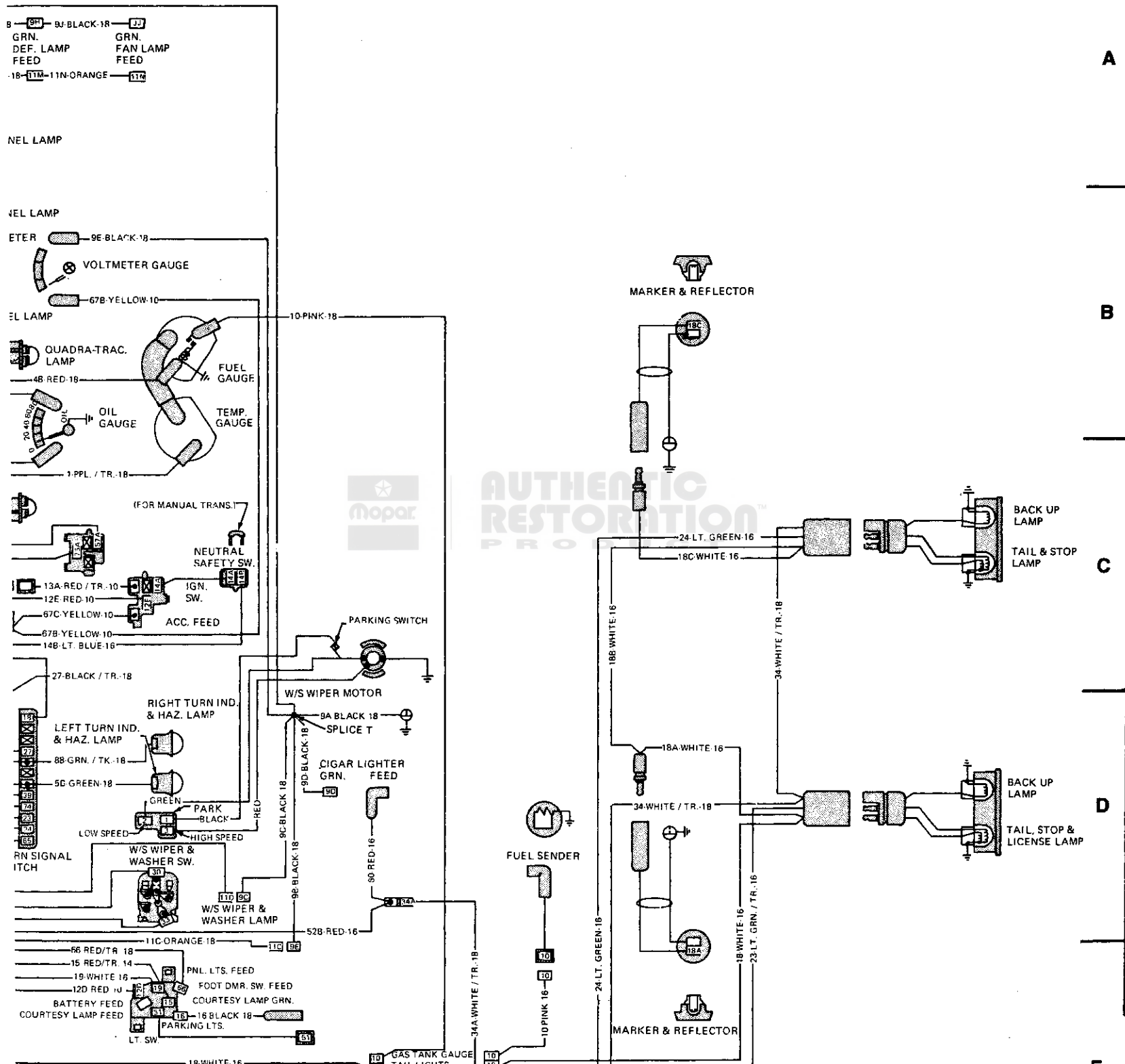
### Cherokee - Wagoneer - Truck

## Wiring Diagram

### CJ Models

NOMENCLATURE	LOCATION
Air Conditioner Compressor, 6-Cylinder	D-4
Air Conditioner Compressor, 8-Cylinder	A-4
Alternator, 6-Cylinder	D-3
Alternator, 8-Cylinder	A-2
Anti-Diesel Solenoid, 8-Cylinder	B-3
Ash Tray Lamp Feed	C-7
Back-up Switch	B-7
Back-up Lamp, Left Side	C-11
Back-up Lamp, Right Side	C-11
Back-up Lamp	G-12
Back-up Light Switch	D-11
Back-up Switch	B-7
Battery, 6-Cylinder	C-4
Battery, 8-Cylinder	A-4
Body, 6-Cylinder	C-4
Body, 8-Cylinder	A-4
Brake Warning	E-9
Capacitor Jumper, 6-Cylinder	C-2
Capacitor Jumper, 8-Cylinder	A-3
Chassis, 6-Cylinder	C-4
Chassis, 8-Cylinder	A-4
Cigar Lighter	A-7
Clock	C-9
Clock Lamp	C-7
Cluster Connection	B-7
Cluster Connection	C-3
Coil, 6-Cylinder	C-2
Coil, 8-Cylinder	A-3
Courtesy Lamp	A-9
Distributor, 6-Cylinder	C-3
Distributor, 8-Cylinder	B-2
Dome & Courtesy Light Ground	D-9
Dome & Courtesy Light Ground	E-9
Dome Lamp	D-9
Door Fan	A-10
Door Fan	A-11
Door Fan	B-10
Door Switch	E-10
Electric Choke, 8-Cylinder	B-3
Frame Harness	E-5
Fuel Sender	E-9
Glove Box Lamp Feed	A-9
Headlamp, Left Side	D-1
Headlamp, Right Side	B-1
Heater Blower Motor, 8-Cylinder	C-3
Heater Control Switch	C-9
Heater Ground	C-9
Heater Lamps	C-7
Horn Relay	D-7

NOMENCLATURE
Ignition Switch, Left Side
Ignition Switch, Right Side
Kickdown & Quadra-Trac
Light Switch
License Lamp
License Lamp
License Lamp
Marker & Reflector
Marker & Reflector
Marker & Reflector
Marker & Reflector Lamp, Left Side
Marker & Reflector Lamp, Right Side
Module Assembly Ignition, 6-Cylinder
Module Assembly Ignition, 8-Cylinder
Neutral Safety Switch
Oil Pressure, 6-Cylinder
Oil Pressure, 8-Cylinder
Park & Signal Lamp, Left Side
Park & Signal Lamp, Right Side
Parking Brake Warning Switch
Seat Belt Buzzer
Seat Belt Lamp
Seat Belt Timer
Starter Solenoid, 6-Cylinder
Starter Solenoid, 8-Cylinder
Starting Motor, 6-Cylinder
Starting Motor, 8-Cylinder
Stop Light Switch
Stop Light Switch & Cruise Control
Tail & Stop Lamp
Tail & Stop Lamp
Tailgate Switch
Tail, Stop & Back-up Lamp
Tail, Stop & Back-up Lamp
Tail, Stop & Marker Lamp
Tail, Stop & Marker Lamp
Temperature Sender, 6-Cylinder
Temperature Sender, 8-Cylinder
Transmission Kickdown Switch
Turn Signal Switch
Washer Bottle, 6-Cylinder
Windshield Wiper Motor, 6-Cylinder
Windshield Wiper Motor, 8-Cylinder
Windshield Wiper Switch



A

B

C

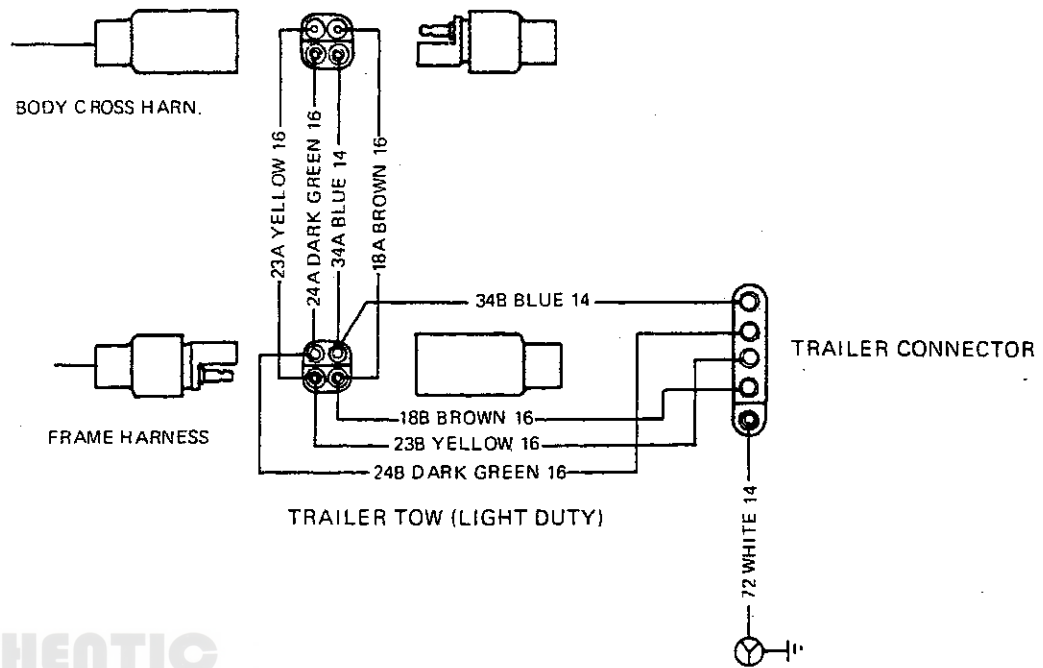
D



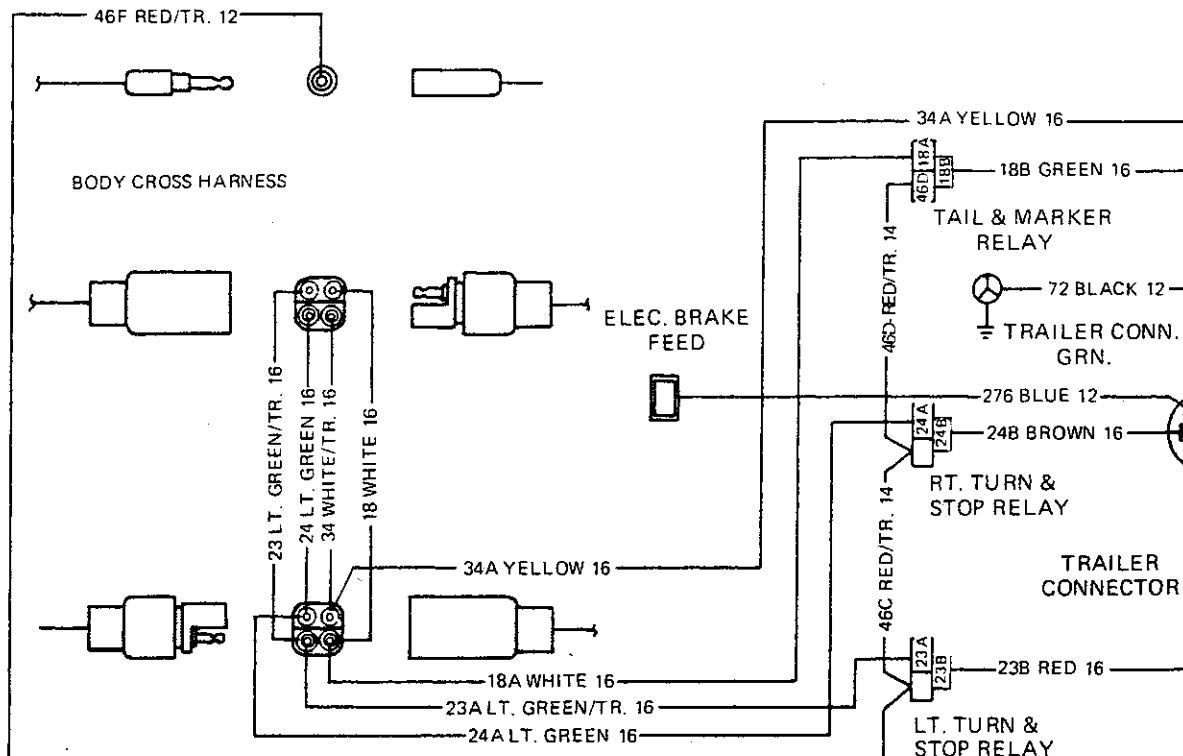


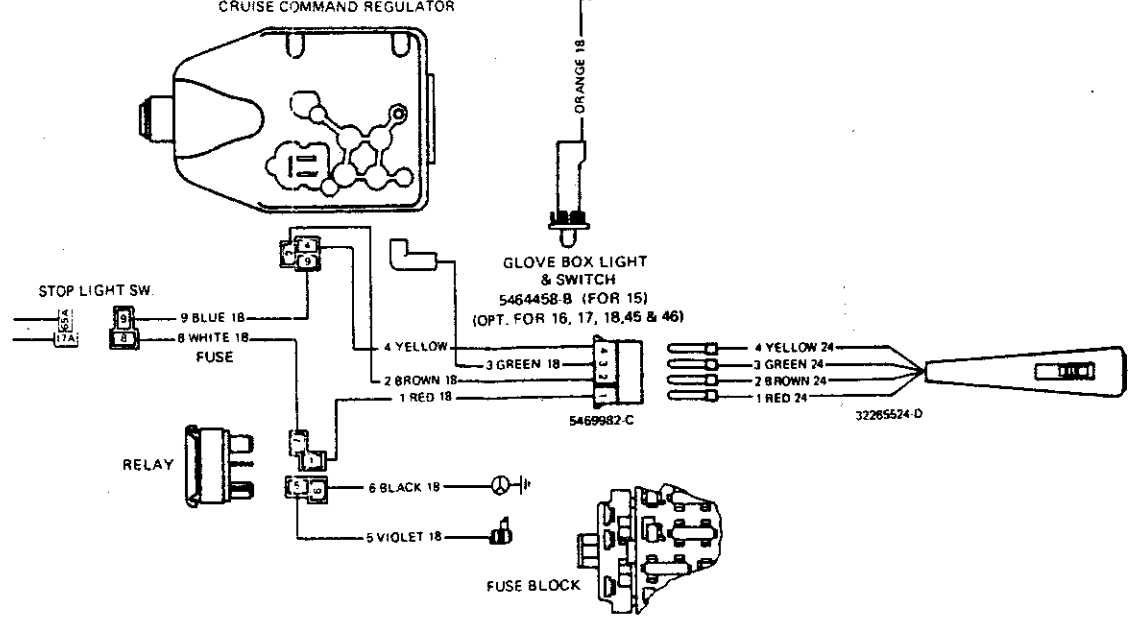




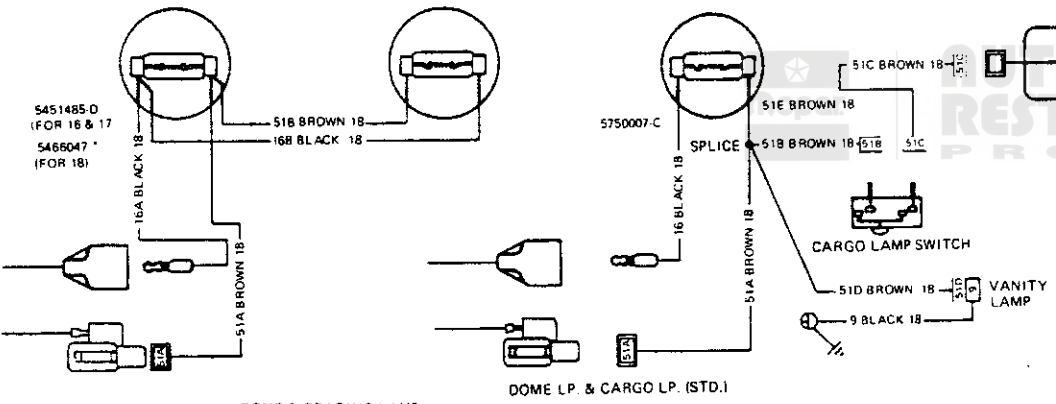


**AUTHENTIC RESTORATION PRODUCT**

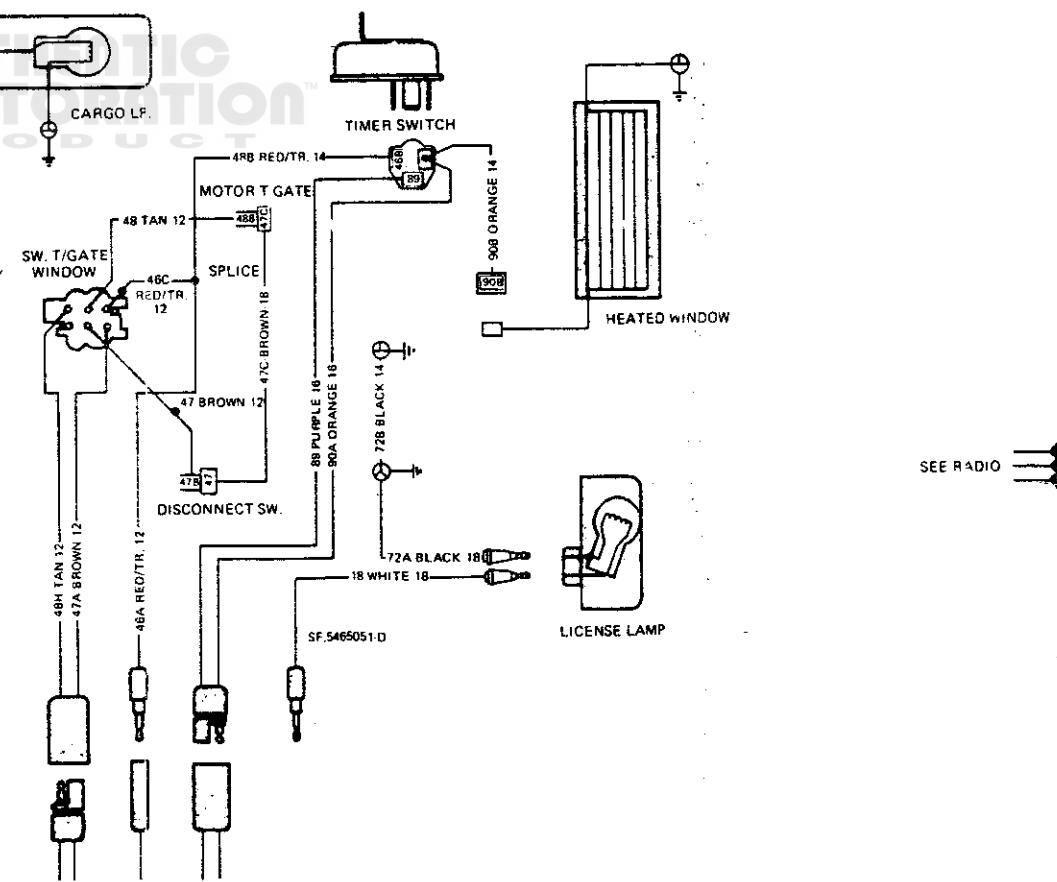
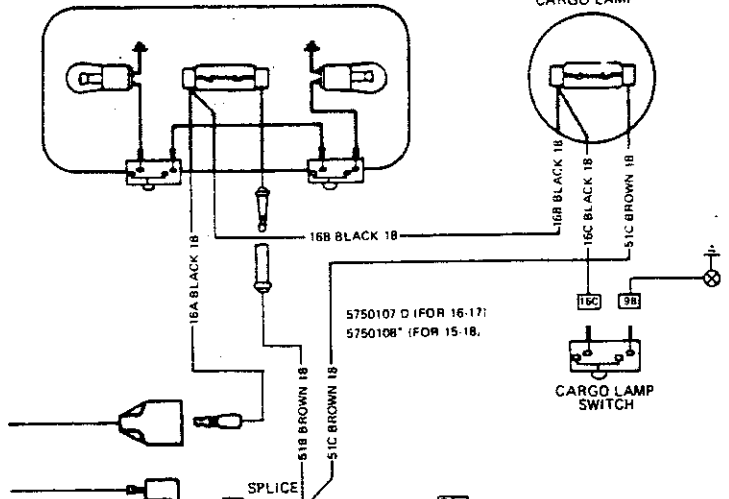




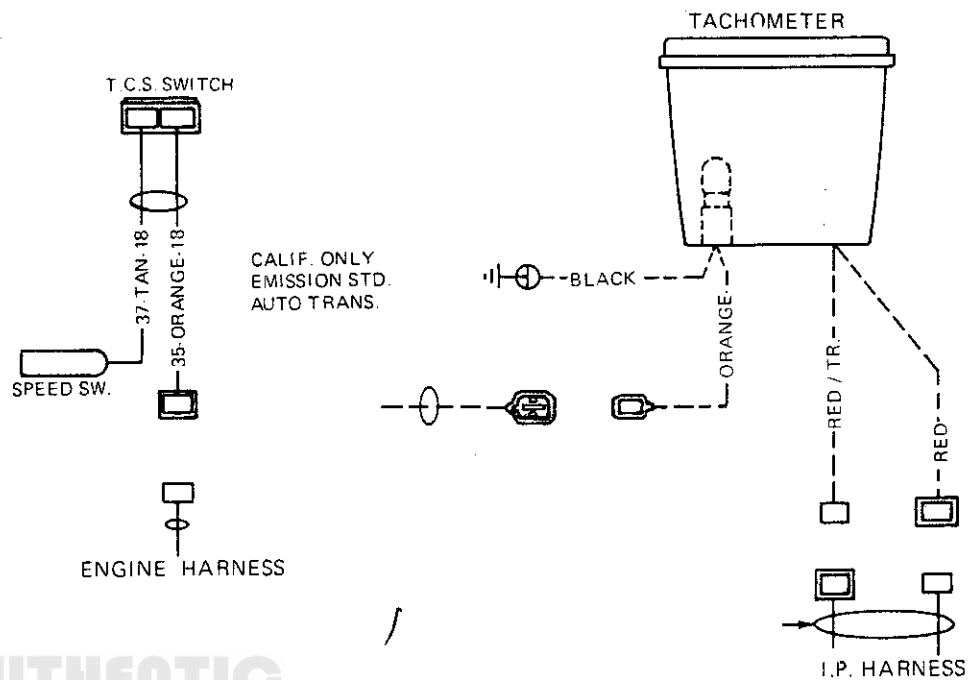
**DOME LT, CARGO LT. & SW. (OPT. FOR 25, 45 & 46)**



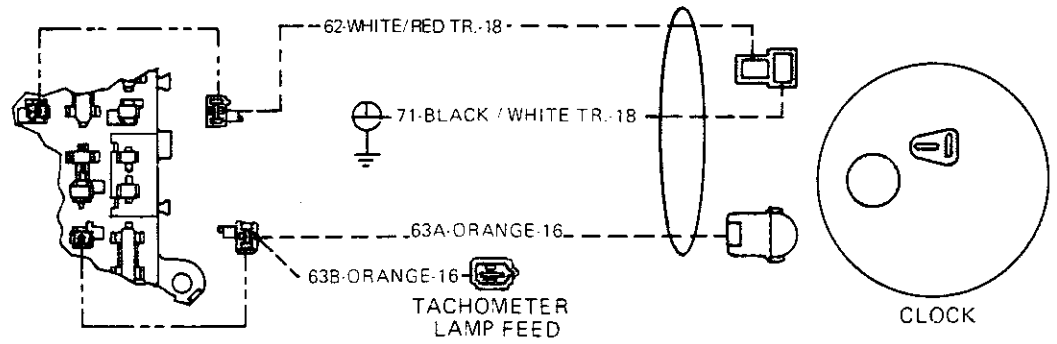
**DOME & READING LAMP**



Accessories



AUTHENTIC RESTORATION PRODUCT



TO I.P. HARNESS LIGHT SW.

