

POWER STEERING GEAR AND PUMP

2L

SECTION INDEX

	Page		Page
General Information	2L-1	Power Steering Pump	2L-37
Power Steering Gear	2L-19	Tools	2L-45

GENERAL INFORMATION

	Page		Page
Description and Operation	2L-1	Periodic Maintenance	2L-15
General	2L-1	Service Diagnosis	2L-6
Hydraulic Pressure Test	2L-15	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 and Scrambler 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 and Scrambler 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.*

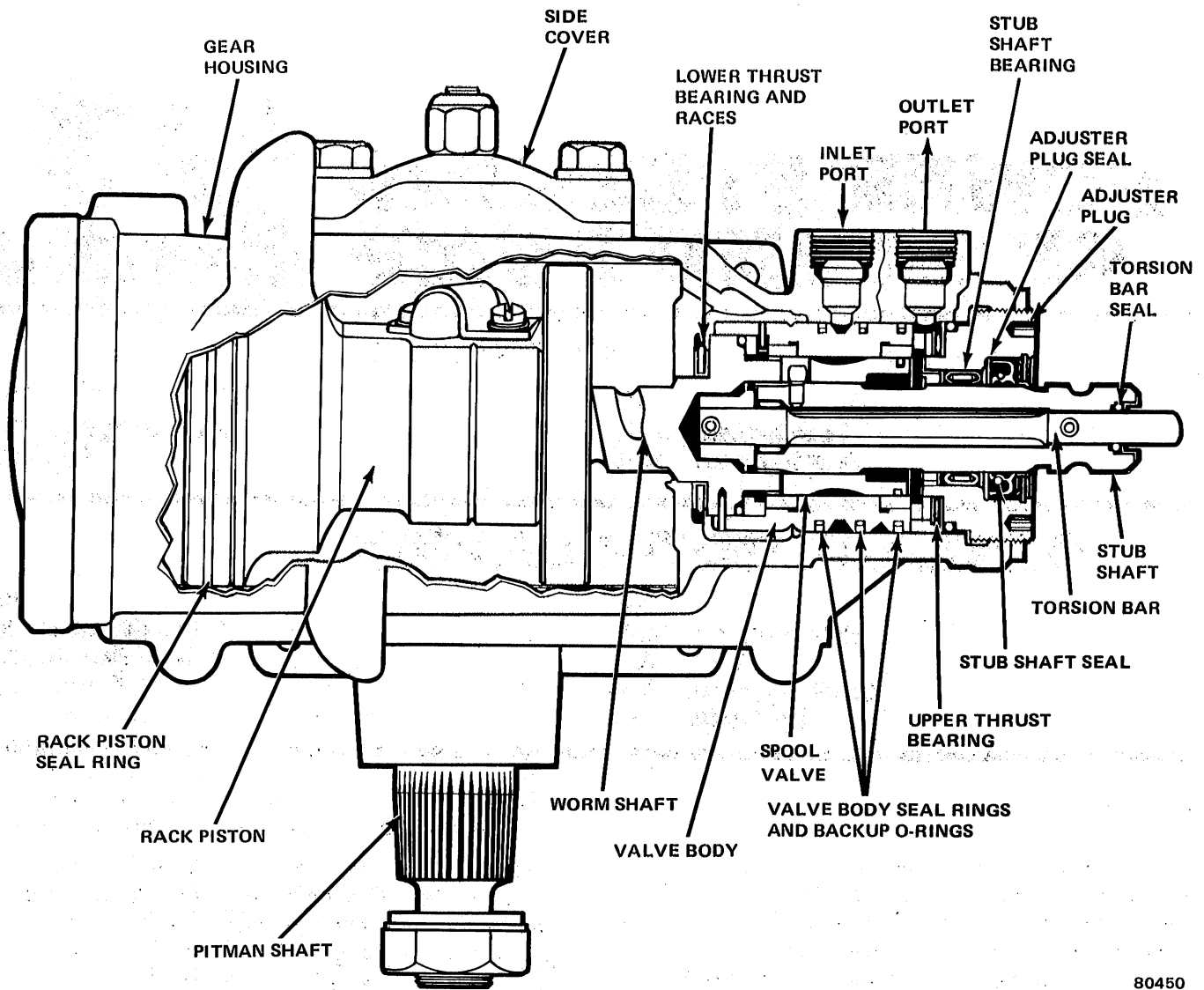
DESCRIPTION AND OPERATION

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 and Scrambler 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



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Fig. 2L-1 Power Steering Gear

prevent loss of thrust bearing preload. The adjuster plug provides initial worm bearing preload and service adjustment.

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

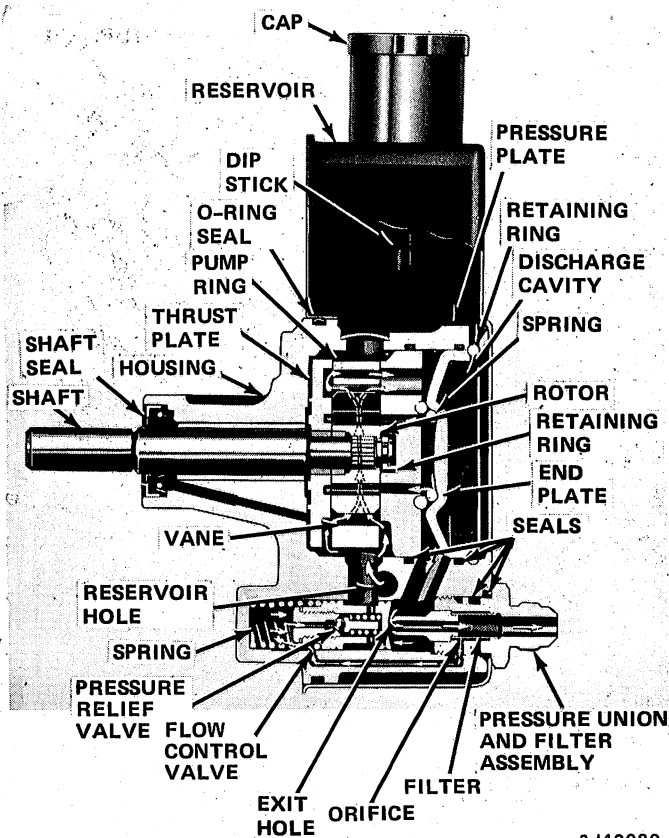


Fig. 2L-2 Power Steering Pump

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).

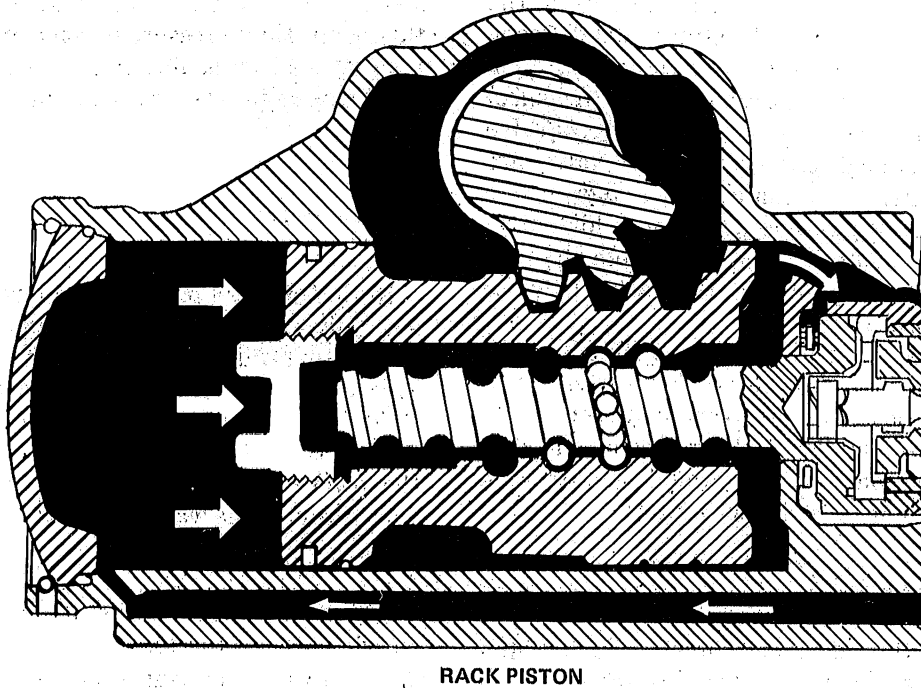
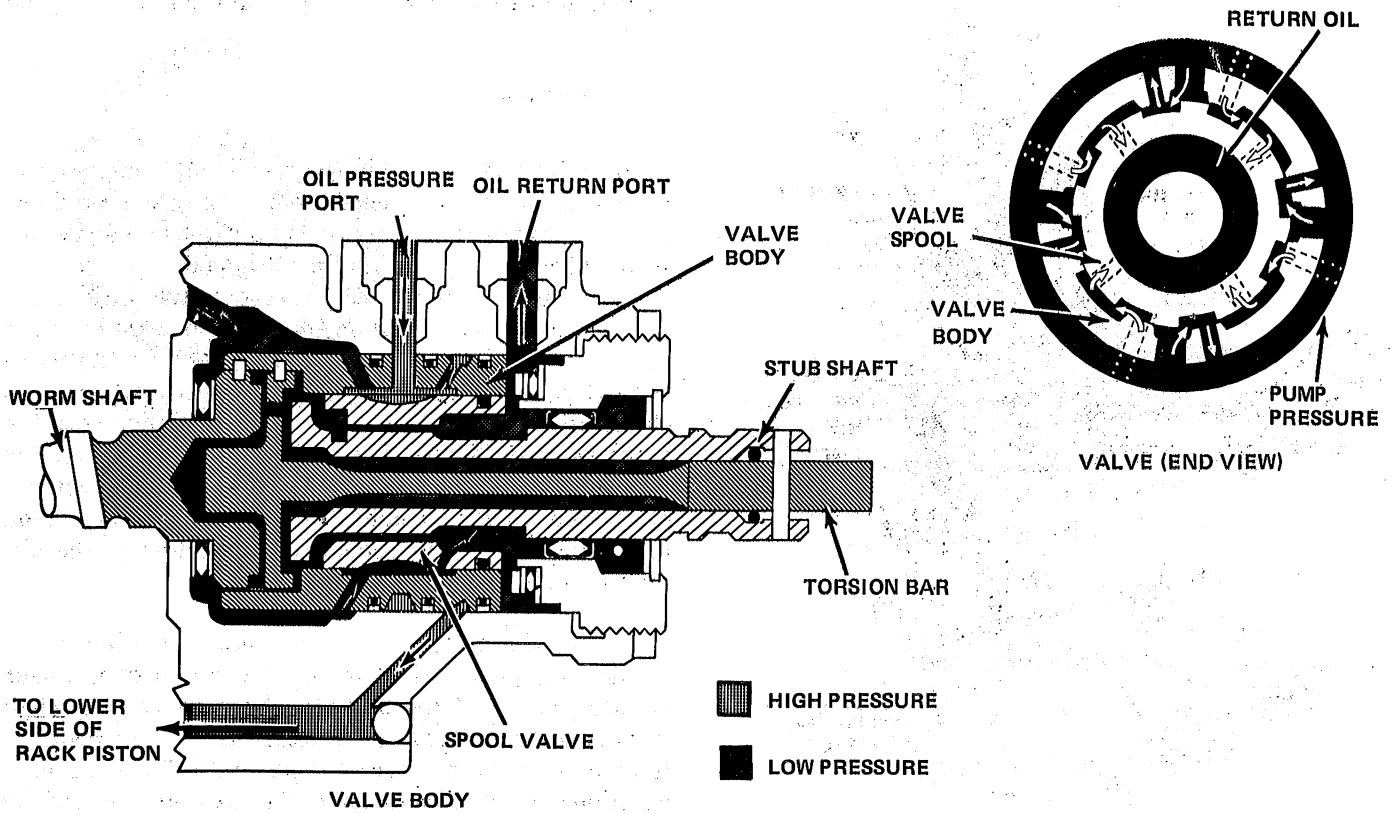
As the valve body directs fluid against the lower end of the rack piston, fluid in the upper end of the gear simultaneously flows back to the reservoir through valve body return grooves. When front wheel resistance to turning effort increases, torsion bar deflection causes additional spool valve rotation. 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.



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Fig. 2L-3 Fluid Flow—Right Turn Position

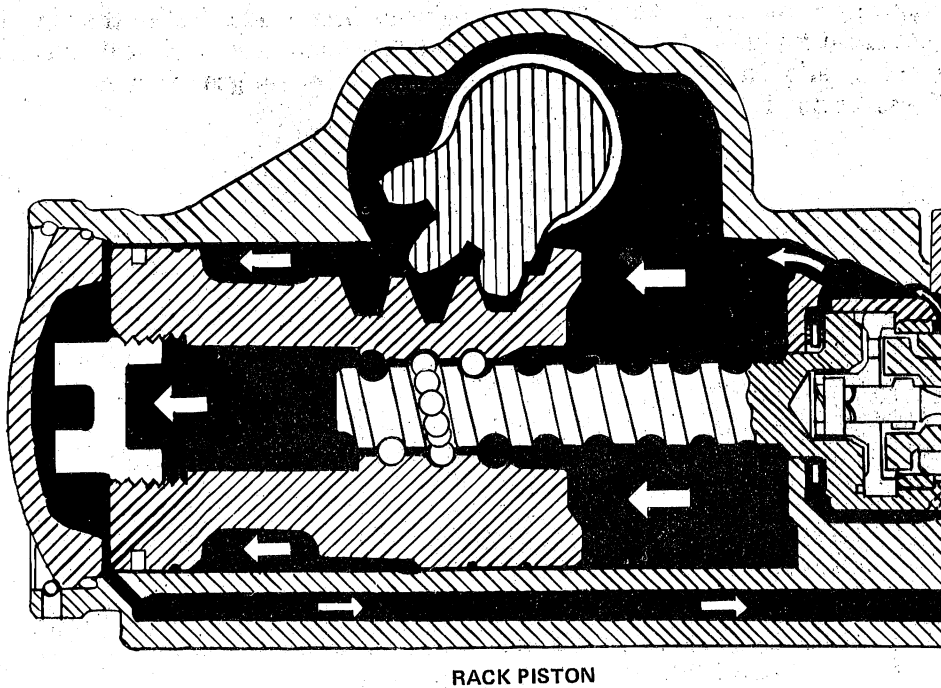
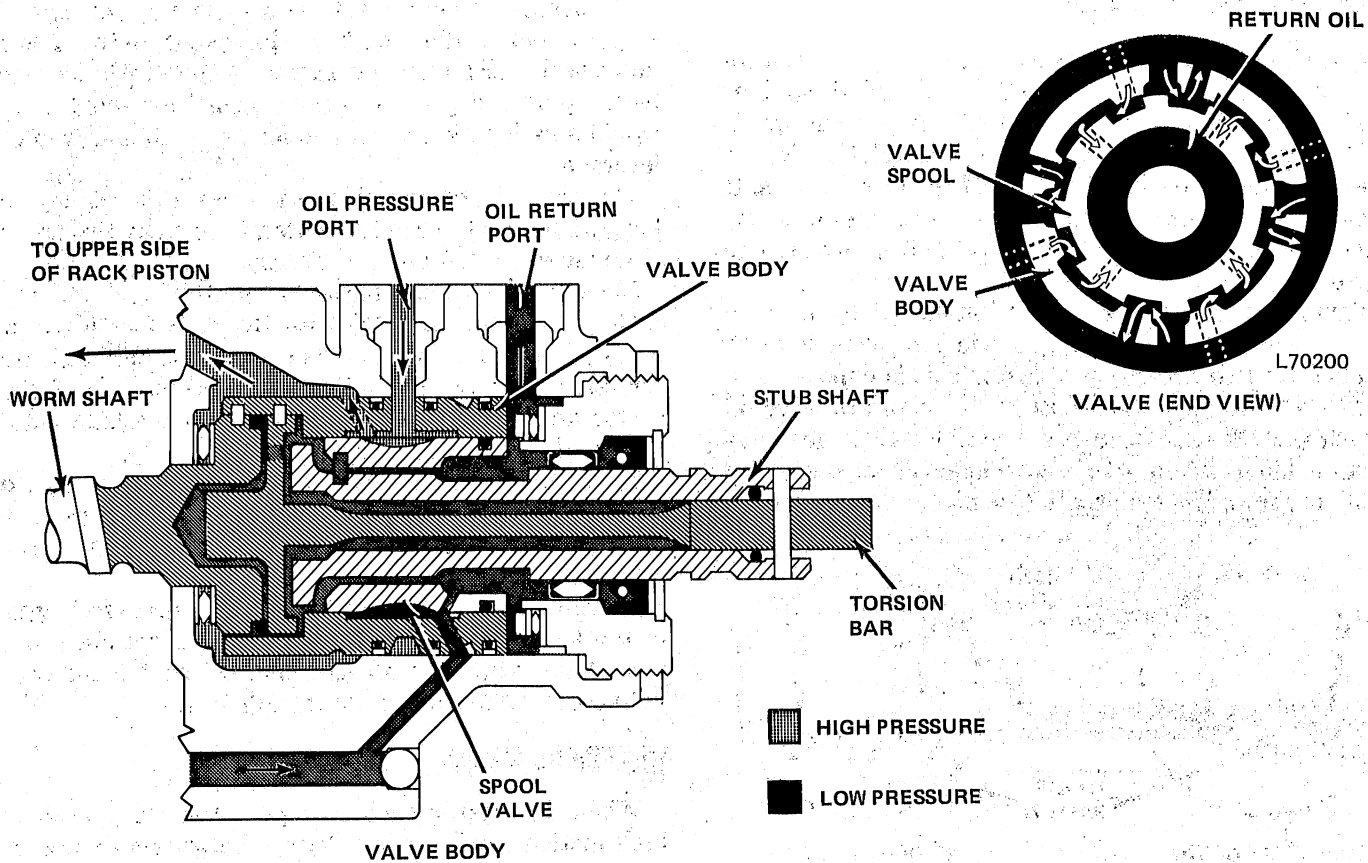


Fig. 2L-4 Fluid Flow—Left Turn Position

Variable Ratio Power Steering

A variable ratio power steering gear is used on Cherokee, Wagoneer and Truck models. CJ and Scrambler 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).

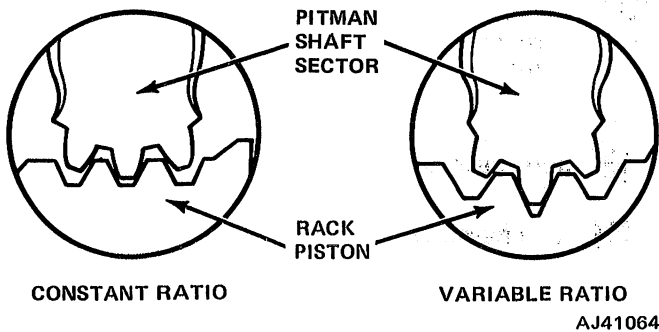


Fig. 2L-5 Rack and Sector Comparison

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.

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
RATTLE OR CHUCKLE NOISE IN STEERING GEAR (CONTINUED)	(2) Steering linkage looseness. (3) Pressure hose touching other parts of vehicle. (4) Insufficient pitman shaft spool over center drag torque. NOTE: A slight rattle may occur on turns because of increased clearance off the "high point." This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.	(2) Check linkage pivot points for wear. Replace if necessary. (3) Adjust hose position. Do not bend tubing by hand. (4) Adjust to specifications.
SQUAWK NOISE IN STEERING GEAR WHEN TURNING OR RECOVERING FROM A TURN	(1) Damper O-ring on valve cut.	(1) Replace damper O-ring.
CHIRP NOISE IN STEERING PUMP	(1) Loose or damaged belt.	(1) Adjust belt tension or replace belt.
BELT SQUEAL (PARTICULARLY NOTICEABLE AT FULL WHEEL TRAVEL AND STAND STILL PARKING)	(1) Loose or damaged belt.	(1) Adjust belt tension or replace belt.
GROWL NOISE IN STEERING PUMP	(1) Excessive back pressure in hoses or steering gear caused by restriction.	(1) Locate restriction and correct. Replace part if necessary.
GROWL NOISE IN STEERING PUMP (PARTICULARLY NOTICEABLE AT STAND STILL PARKING)	(1) Scored pressure plates, thrust plate or rotor. (2) Extreme wear of cam ring.	(1) Replace parts and flush system. (2) Replace parts.
GROAN NOISE IN STEERING PUMP	(1) Low oil level. (2) Air in the oil or loose pressure hose connection.	(1) Fill reservoir to proper level. (2) Tighten connector to specified torque. Bleed system by operating steering from right to left-full turn.
RATTLE NOISE IN STEERING PUMP	(1) Vanes not installed properly. (2) Vanes sticking in rotor slots.	(1) Install properly. (2) Free up by removing burrs, varnish, or dirt.

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.	(1) Inflate to specified pressure.
	(2) Lack of lubrication in linkage and ball studs.	(2) Lube linkage and ball studs.
	(3) Lower coupling flange rubbing against steering gear adjuster plug.	(3) Loosen pinch bolt and assemble properly.
	(4) Improper front wheel alignment	(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.
	(11) Return hose kinked.	(11) Replace hose.
VEHICLE LEADS TO ONE SIDE OR THE OTHER (KEEP IN MIND ROAD CONDITION AND WIND. TEST VEHICLE IN BOTH DIRECTIONS ON FLAT ROAD)	(1) Incorrect tire pressure.	(1) Check and adjust.
	(2) Front end misaligned.	(2) Adjust to specifications.
	(3) Unbalanced steering gear valve.	(3) Replace valve.
MOMENTARY INCREASE IN EFFORT WHEN TURNING WHEEL FAST TO RIGHT OR LEFT	(1) Low oil level in pump.	(1) Add power steering fluid as required.
	(2) Pump belt slipping.	(2) Tighten or replace belt.
	(3) High internal leakage.	(3) Check pump pressure. (See pressure test)

Service Diagnosis—Steering Gear and Pump (Continued)

Condition	Possible Cause	Correction
STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING ESPECIALLY DURING PARKING	(1) Low oil level. (2) Loose pump belt. (3) Insufficient pump pressure.	(1) Fill as required. (2) Adjust tension to specification. (3) Check pump pressure. (See pressure test). Replace relief valve if defective.
LOOSE STEERING	(4) Flow control valve sticking. (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.	(4) Inspect for varnish or damage, replace if necessary. (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.
HARD STEERING OR LACK OF ASSIST	(1) Loose pump belt. (2) Low oil level in pump reservoir. NOTE: 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.	(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 pressure test tool J-21567 is required.

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>FOAMING AERATED POWER STEERING FLUID, LOW FLUID LEVEL AND POSSIBLE LOW PRESSURE</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>LOW PRESSURE DUE TO STEERING PUMP</p>	<p>(1) Flow control valve stuck or inoperative. (2) Pressure plate not flat against cam ring. (3) Extreme wear of cam ring. (4) Scored pressure plate, thrust plate, or rotor. (5) Vanes not installed properly. (6) Vanes sticking in rotor slots. (7) Cracked or broken thrust or pressure plate.</p>	<p>(1) Remove burrs or dirt or replace. Flush system. (2) Correct. (3) Replace parts. Flush system. (4) Replace parts. Flush system. (5) Install properly. (6) Freeup by removing burrs, varnish, or dirt. (7) Replace part.</p>
<p>LOW PRESSURE DUE TO STEERING GEAR</p>	<p>(1) Pressure loss in cylinder due to worn piston ring or badly worn housing bore. (2) Leakage at valve rings, valve body-to-worm seal.</p>	<p>(1) Remove gear for disassembly and inspection of ring and housing bore. (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 inaccurate 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.

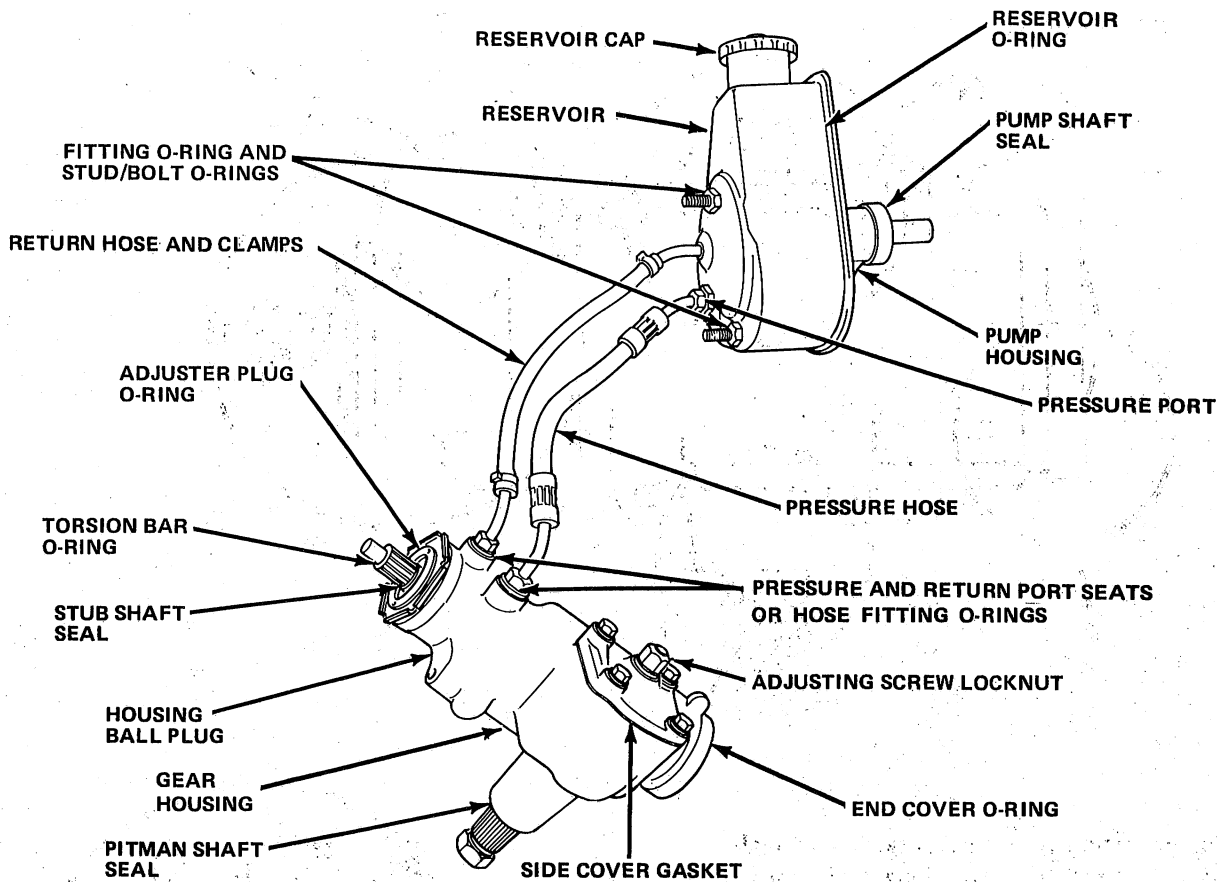
(5) Check and tighten all hose connections at gear and pump. Do not exceed 30 foot-pounds (41 N•m) torque at any fitting.

(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.



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Fig. 2L-6 Power Steering System Leak Points

(1) If leak occurs from hose or hose fittings, replace hose and O-ring if equipped with metric thread fittings. If leak continues to occur at gear housing pressure or return port and hose or O-ring has been replaced, replace hose connector seats in gear housing or hose and O-ring if equipped with metric thread fittings.

CAUTION: Some steering gear units may have metric thread pressure and return port and hose fittings that use an O-ring instead of connector seats (fig. 2L-7).

(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, seat plug in housing using blunt punch. Spray ball area with Loctite Solvent 7559, or equivalent.

Dry area using compressed air. Cover ball with Loctite Sealant 290, or equivalent. Allow sealant to cure for approximately two hours before installing 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.

NOTE: The locknut has a left-hand thread.

(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. If pump has metric thread union fitting, replace O-ring or hose and O-ring if damaged.

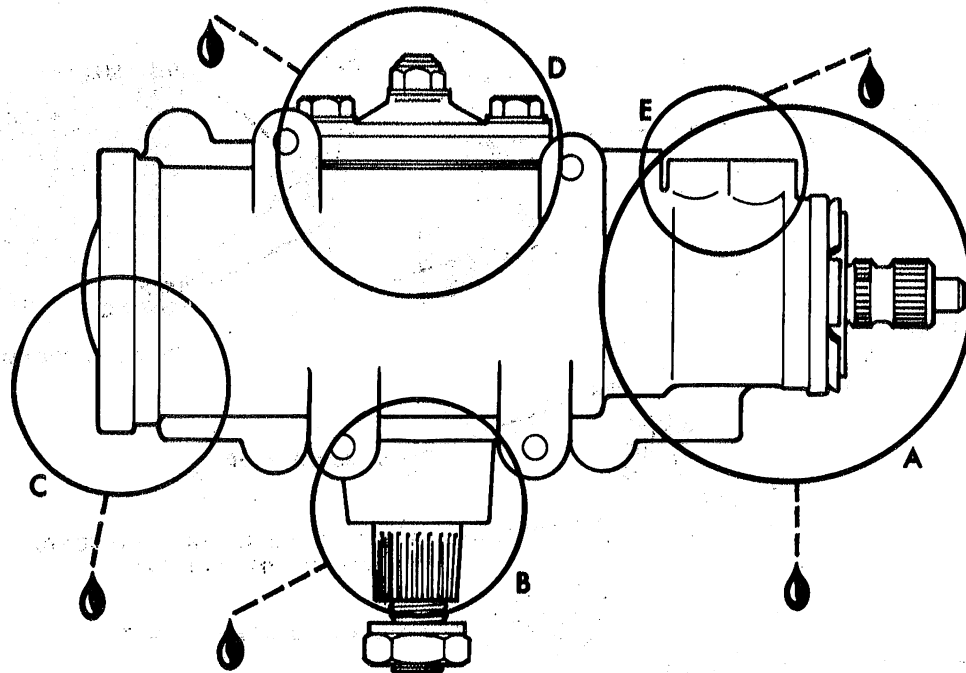
(2) If leak occurred between pump union fitting and pump body, replace pump union fitting O-rings.

(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.

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 blunt punch. Spray ball area with Loctite solvent 75559 or equivalent, Dry ball area with compressed air. Apply Loctite sealant 290, or equivalent to ball area. Allow sealant to cure for approximately two hours before installing housing.

Replace both pitman shaft seals.

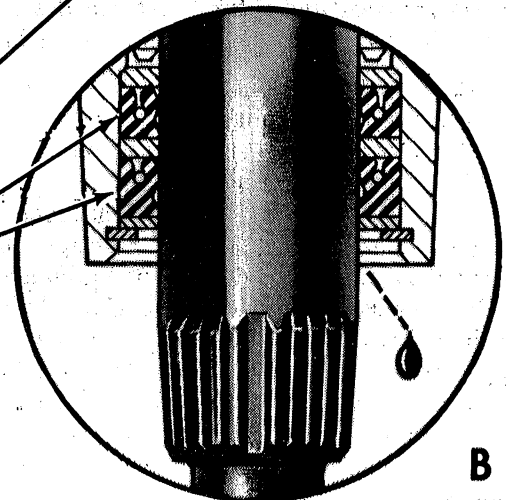
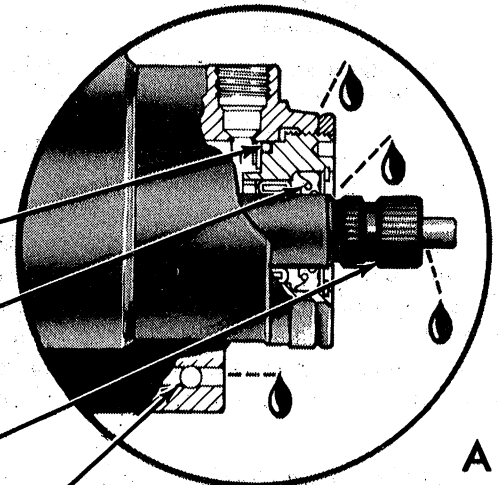
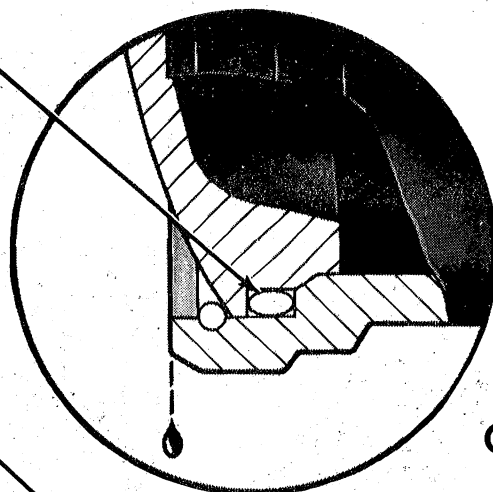


Fig. 2L-7 Steering Gear Leak Diagnosis and Corrective Action (View A)

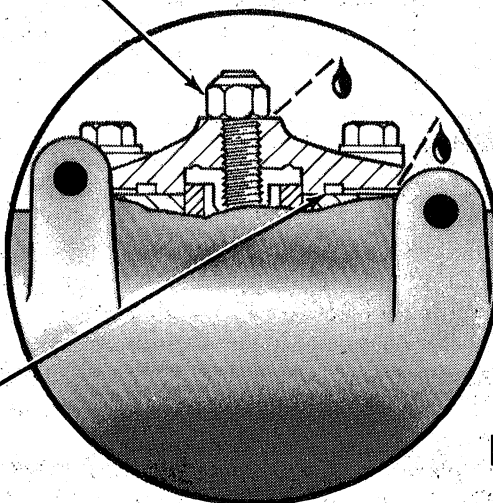
Corrective Action (cont.)

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.

CAUTION: Some steering gear units may be equipped with metric thread hose fittings that use O-ring seals. Replace the seal if it leaks or replace the hose and seal if the fitting is damaged.

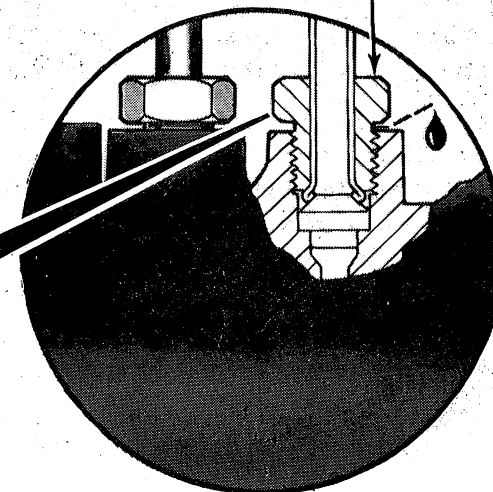
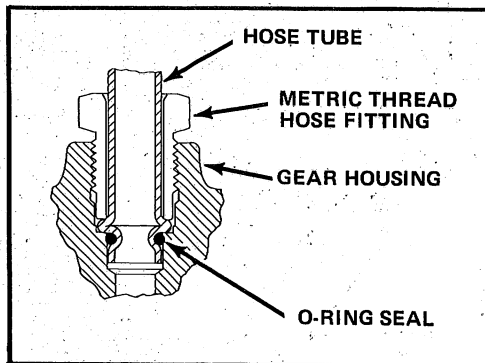
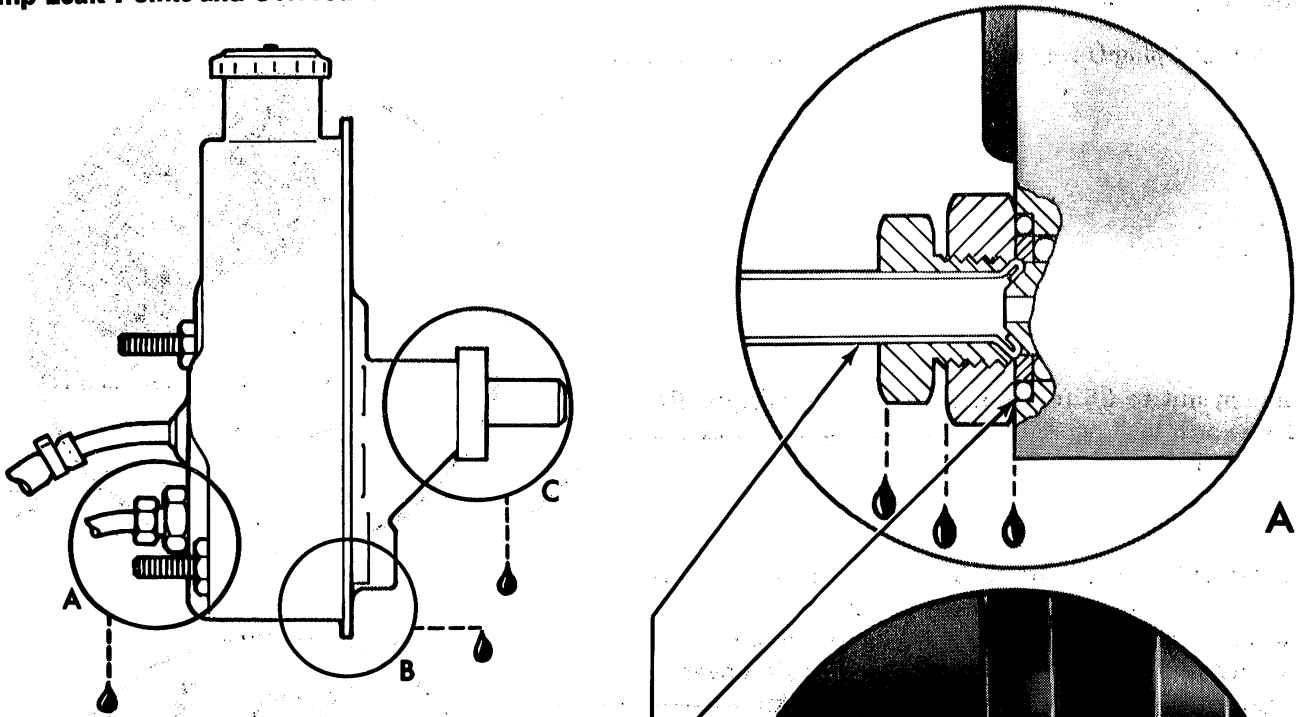


Fig. 2L-7 Steering Gear Leak Diagnosis and Corrective Action (View B)

Pump Leak Points and Corrective Action



Corrective Action

If leak persists after tightening fitting nut to specified torque:

- a. Loosen nut and rotate tubing to reseat. Tighten nut again and recheck. If leak persists, replace connector seats and hose or O-ring.
- b. Remove hose and check sealing face for cracks. If flare is cracked, replace hose. If not cracked, replace connector seats.
- c. 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.

CAUTION: Some pumps may have a metric thread pressure part fitting that uses an O-ring seal (2L-7 view B).

Tighten fitting to specified torque. If leak persists, Replace both O-ring seals.

Replace reservoir O-ring.

Replace pump shaft seal.

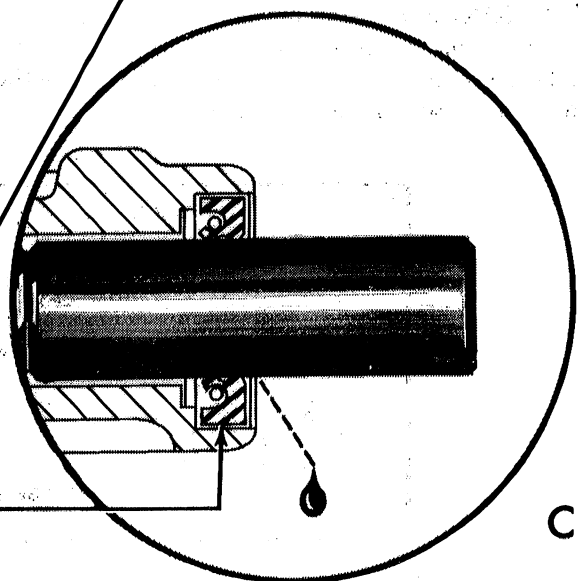
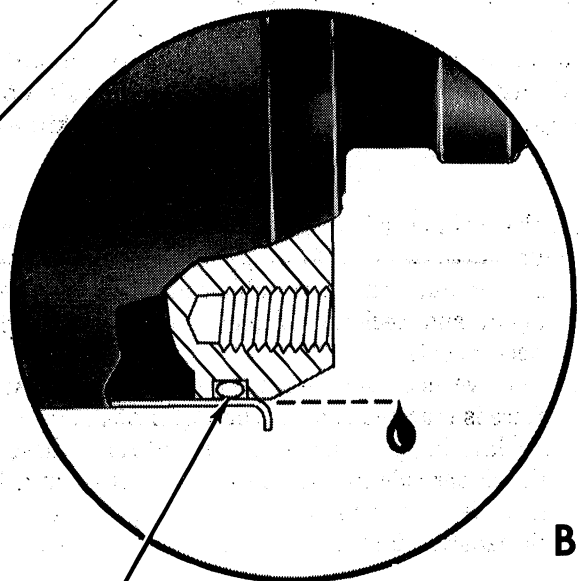
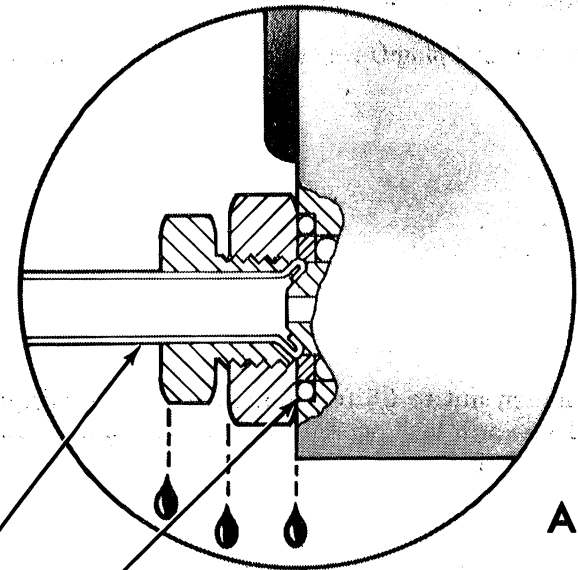


Fig. 2L-8 Power Steering Pump Leak Diagnosis and Corrective Action

(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.

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.

CAUTION: *Some steering gear and pump units have metric thread fittings and hose fittings which use an O-ring seal (fig. 2L-7, View B). In order to use gauge J-21567, hose fitting adapters J-5176-50, must be installed on the existing gauge hoses before using the test gauge.*

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. Install hose fitting adapters J-5176-50 if gear and pump have metric thread fittings.

(7) Connect test gauge hose to pump. Refer to Pump Diagnosis Charts.

(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 to 125 psi (552 to 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 to 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 and Scrambler models, maximum pump output pressures should be in 1000 to 1100 psi (6 895 to 7 584 kPa) range and not vary by more than 50 psi (345 kPa). On all other models, pressures should be in 1400 to 1500 psi (9 653 to 10 342 kPa) range and also not vary by more than 50 psi (345 kPa).

For example if recorded pressures on CJ and Scrambler models were 1050-1060-1070 psi (7 240-7 309-7 378 kPa), or 1450-1480-1470 psi (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 to 1100 psi (6 895 to 7 584 kPa) on CJ and Scrambler models, or 1400 to 1500 psi (9 653 to 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 five 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.

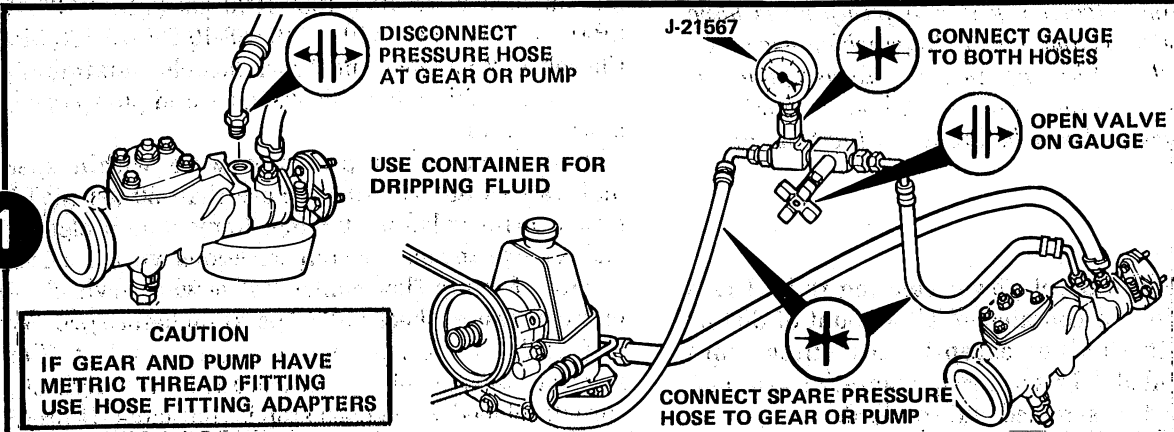
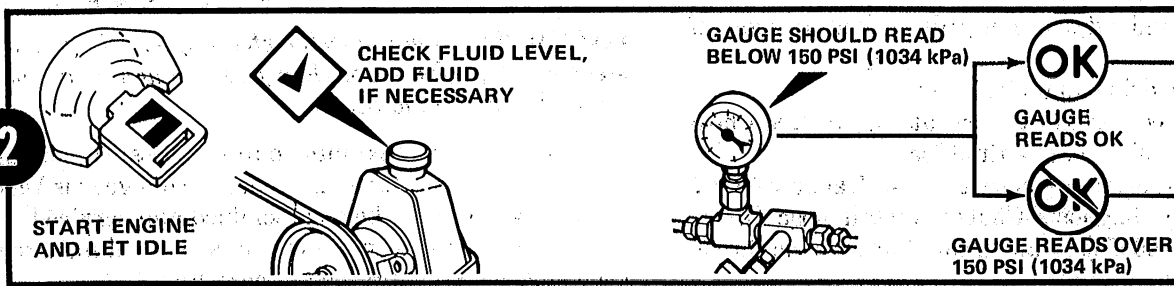
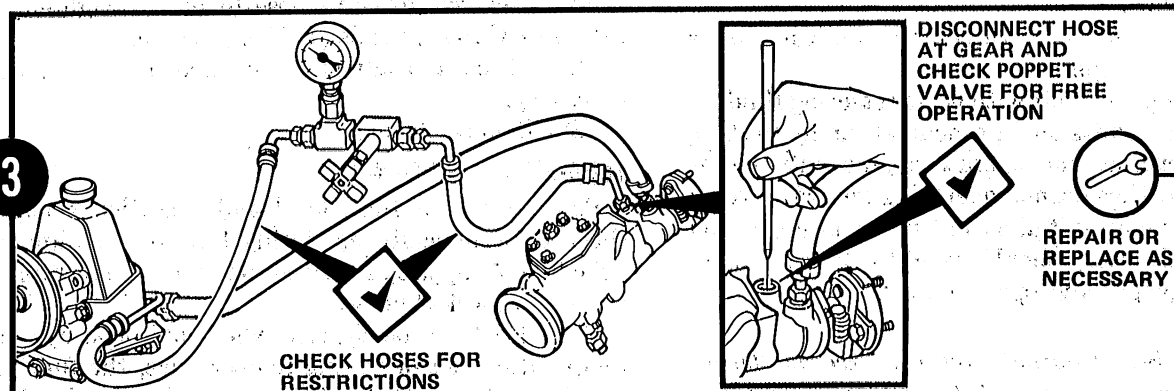
Fluid level can be checked when cold or at operating temperature. At operating temperature, the fluid level should be at the FULL HOT mark on the dipstick. When cold it should be at the FULL COLD mark. If the fluid

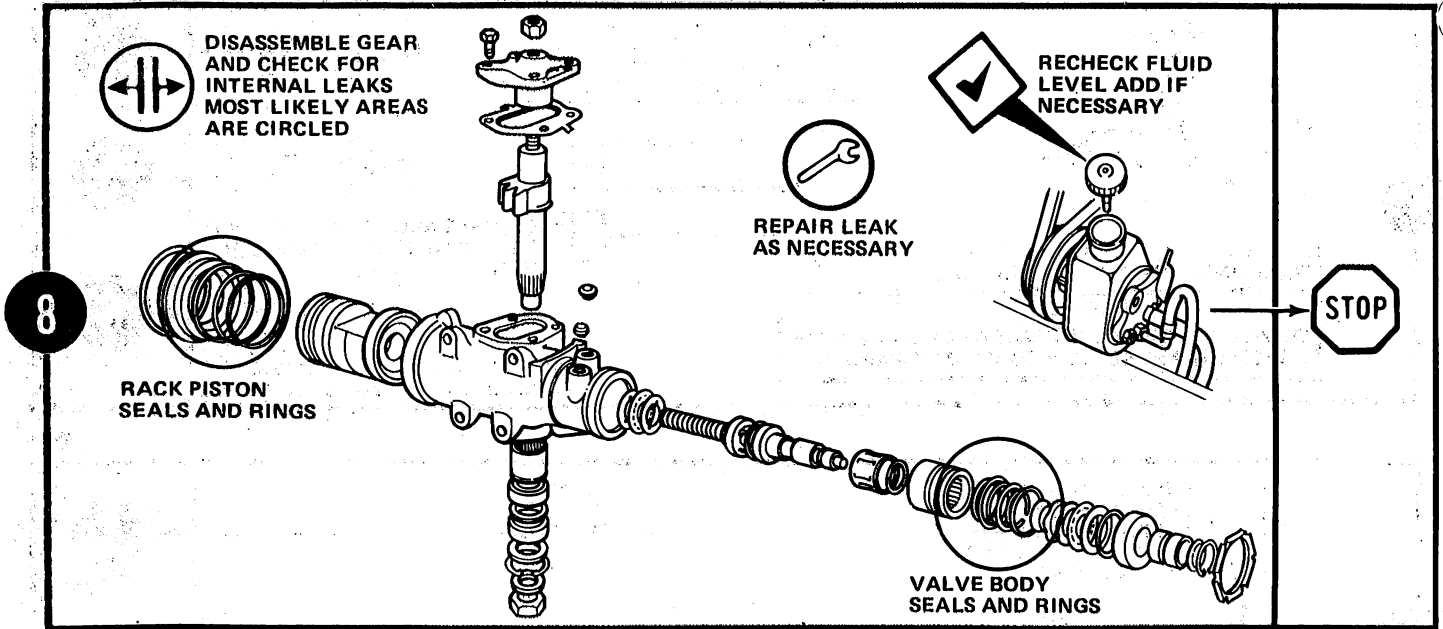
level is low, add fluid as necessary and check for leaks. If the reservoir is overfilled, drain fluid to correct level.

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.

POWER STEERING SYSTEM HYDRAULIC PRESSURE TEST PROCEDURE

STEP	SEQUENCE	RESULT
1	 <p>DISCONNECT PRESSURE HOSE AT GEAR OR PUMP</p> <p>USE CONTAINER FOR DRIPPING FLUID</p> <p>CAUTION IF GEAR AND PUMP HAVE METRIC THREAD FITTING USE HOSE FITTING ADAPTERS</p> <p>J-21567</p> <p>CONNECT GAUGE TO BOTH HOSES</p> <p>OPEN VALVE ON GAUGE</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>REPAIR OR REPLACE AS NECESSARY</p>	4



80084C

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 (Now 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
- Valve Body Three-way, open center, rotary-type.

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 (49-State)	125-155	90-115	556-589	400-512
Power Steering Pump (California)	180-200	140-160	800-890	623-712

*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
General	2L-19	Steering Gear Disassembly	2L-22
In-Vehicle Service	2L-19	Steering Gear Installation	2L-22
Specifications	2L-36	Steering Gear Removal	2L-21
Steering Gear Assembly and Adjustment	2L-32	Steering Gear Subassembly Overhaul	2L-24

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 close tolerance 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.

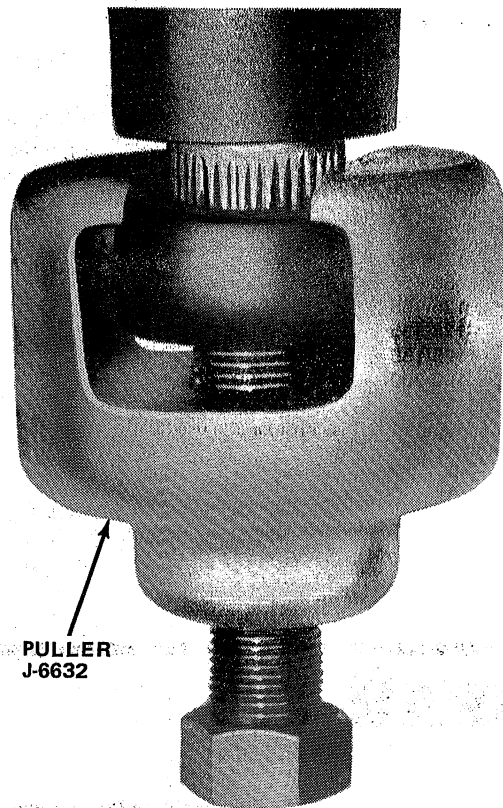
Conditions such as shimmy and hard or loose steering may be caused by wheels and tires or worn or damaged front suspension components. These items should be checked before attempting power steering gear repairs.

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).



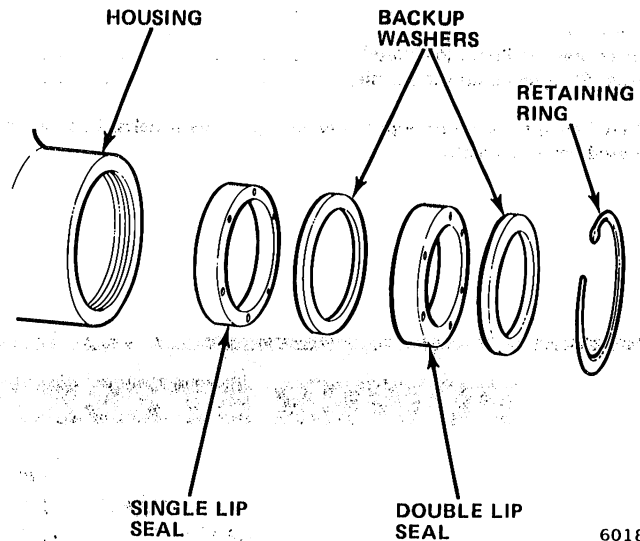
PULLER
J-6632

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Fig. 2L-9 Pitman Arm Removal

(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.



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Fig. 2L-10 Pitman Shaft Seals and Backup Washers

- (3) Position drain pan under gear.
- (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.

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 or 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).

- (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 and Scrambler 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.

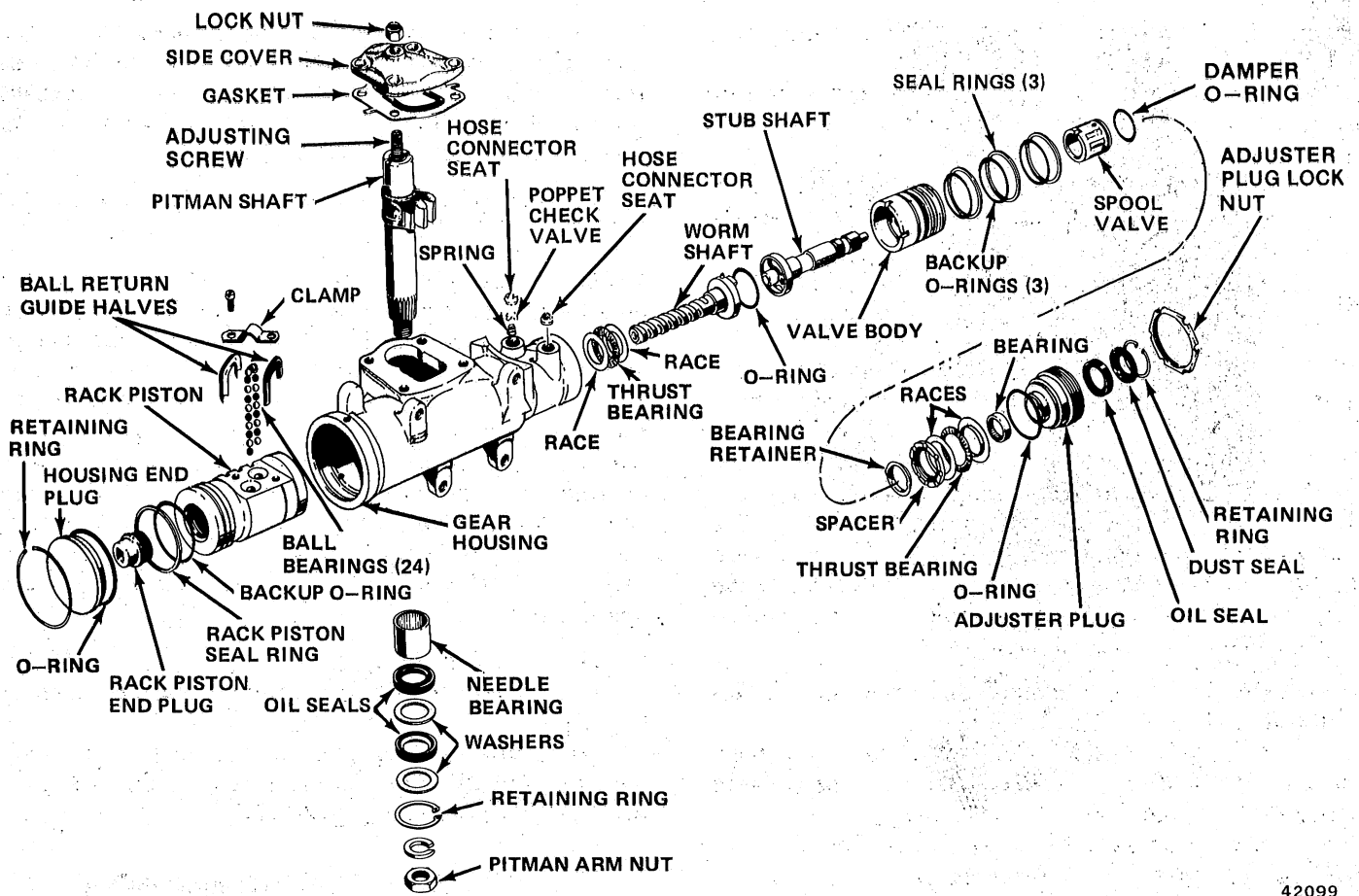


Fig. 2L-11 Power Steering Gear Assembly

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(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). It is necessary to remove the gear to perform seal replacement.

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.

(3) On CJ and Scrambler models, remove clamp bolt and nut attaching intermediate shaft coupling to steering gear stub shaft and disconnect intermediate shaft.

(4) Paint alignment marks on pitman shaft and pitman arm for assembly reference.

(5) Remove and discard pitman arm nut and lockwasher.

(6) Remove pitman arm using Tool J-6632 (fig. 2L-9).

(7) On Cherokee, Wagoneer and Truck models, remove steering gear-to-frame mounting bolts and remove gear.

(8) On CJ and Scrambler models, remove gear as follows:

(a) Raise left side of vehicle slightly to relieve tension on left front spring and place support stand under frame.

(b) Remove three lower steering gear mounting bracket-to-frame bolts.

(c) Remove two upper steering gear mounting bracket-to-crossmember bolts and remove steering gear and mounting brackets as assembly.

(d) Remove mounting bracket-to-gear attaching bolts and remove upper and lower mounting brackets from steering gear.

STEERING GEAR INSTALLATION

NOTE: Proper retention of the steering gear is important. Some of the following procedural steps in gear installation require the application of Loctite or equivalent material to attaching bolt threads. Wherever indicated, use Jeep Adhesive Sealant or Loctite 271 Adhesive/Sealant, or equivalent. When applying this material, clean all bolt threads thoroughly to remove dirt and grease and apply the material liberally to the bolt threads no more than five minutes before installation.

(1) On Cherokee, Wagoneer and Truck models, install gear as follows:

(a) Align and install flexible coupling on steering gear stub shaft and install clamp bolt. Tighten clamp bolt to 30 foot-pounds (41 N•m) torque.

(b) Apply Loctite or equivalent material to steering gear-to-frame mounting bolts.

(c) Position steering gear on frame and install gear mounting bolts. Tighten mounting bolts to 70 foot-pounds (95 N•m) torque.

(2) On CJ and Scrambler models, install gear as follows:

(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 crossmember 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.

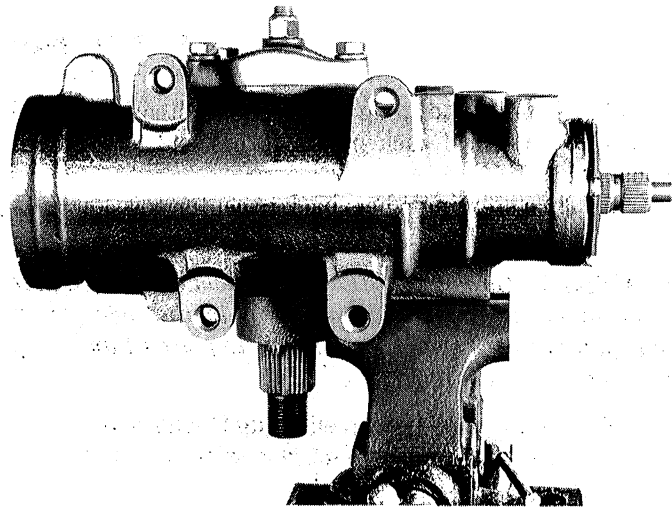
STEERING GEAR DISASSEMBLY

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 problems after assembly. Clean the gear exterior thoroughly 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).



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Fig. 2L-12 Mounting Steering Gear in Vise

(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).

(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.



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Fig. 2L-13 End Plug Retaining Ring Removal

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.

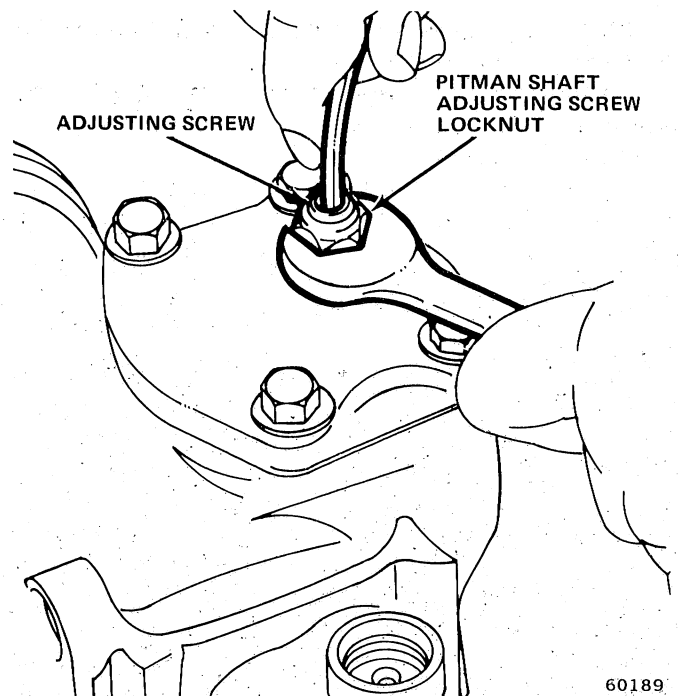
- (6) Remove and discard O-ring seal from housing end plug.
- (7) Turn stub shaft 1/2 turn clockwise.
- (8) Unseat rack piston end plug by tapping it with plastic mallet.
- (9) Remove rack piston end plug.

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).

NOTE: The locknut has left-hand threads.

- (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.

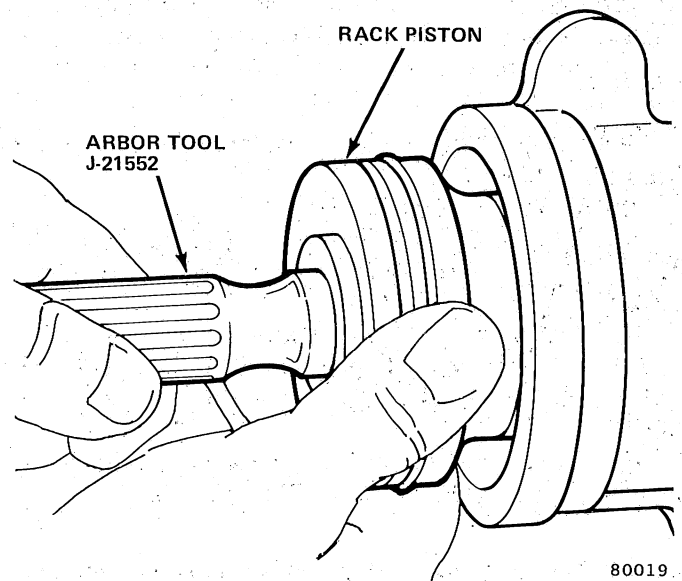


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Fig. 2L-14 Adjuster Screw Locknut Removal/Installation

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.
 - (c) Remove rack piston and arbor tool as assembly (fig. 2L-15).



80019

Fig. 2L-15 Rack Piston Removal/Installation

(16) Remove adjuster plug locknut using brass drift and hammer.

(17) Remove adjuster plug using Spanner Tool J-7624 (fig. 2L-16).

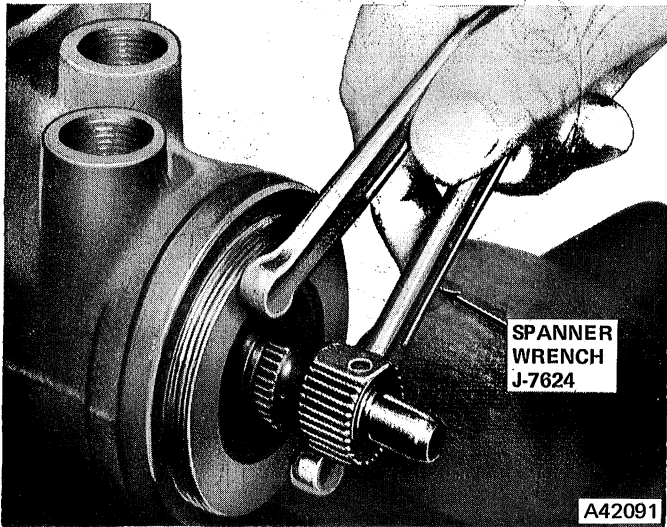


Fig. 2L-16 Adjuster Plug Removal

(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.

(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.

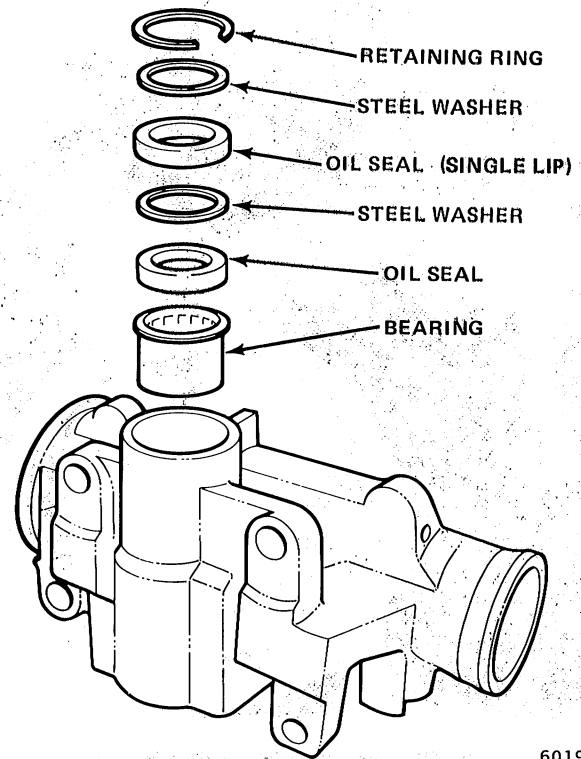


Fig. 2L-17 Pitman Shaft Bearing and Seals

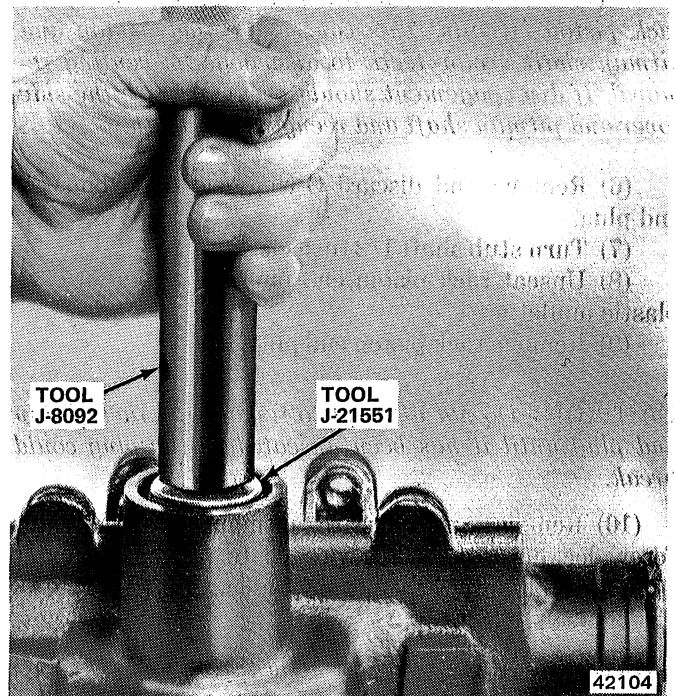


Fig. 2L-18 Pitman Shaft Bearing Removal/Installation

Cleaning and Inspection

Clean all components thoroughly with solvent and dry using compressed air or lint free paper towels or shop cloths.

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, if equipped, 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. Seat the ball using a blunt punch. Spray the ball area with Loctite Solvent 7559, or equivalent, and dry the area with compressed air. Cover the ball area and ball with Loctite Sealant 290. Allow the sealant to cure for approximately two hours before installing or assembling the gear.

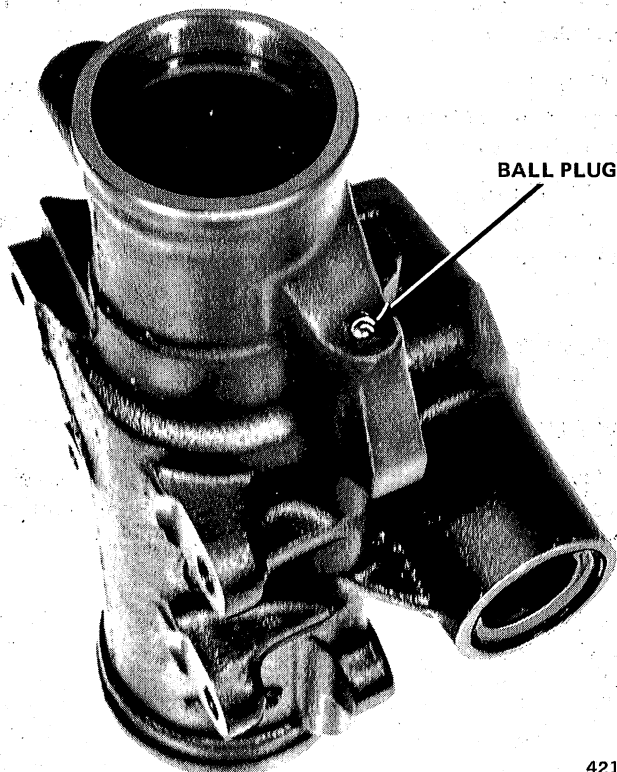


Fig. 2L-19 Housing Ball Plug Location

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: Some steering gear units have metric thread fittings and hose fittings which use O-ring seals instead of connector seats (fig. 2L-7, View B).

CAUTION: If the gear has connector seats, 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.

(2) Thread connector seats to depth of 2-3 threads (only) using 5/16-18 tap (fig. 2L-20).

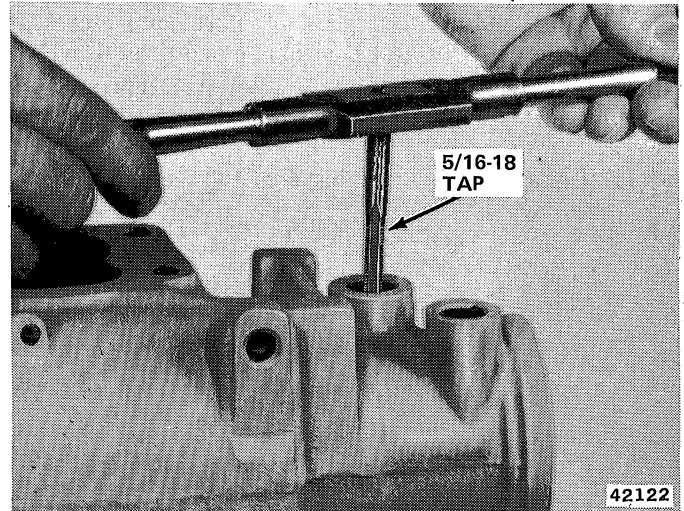


Fig. 2L-20 Threading Hose Connector Seats
(Gears with Non-Metric Fittings Only)

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, nut and flat washer and thread bolt into connector seat (fig. 2L-21).

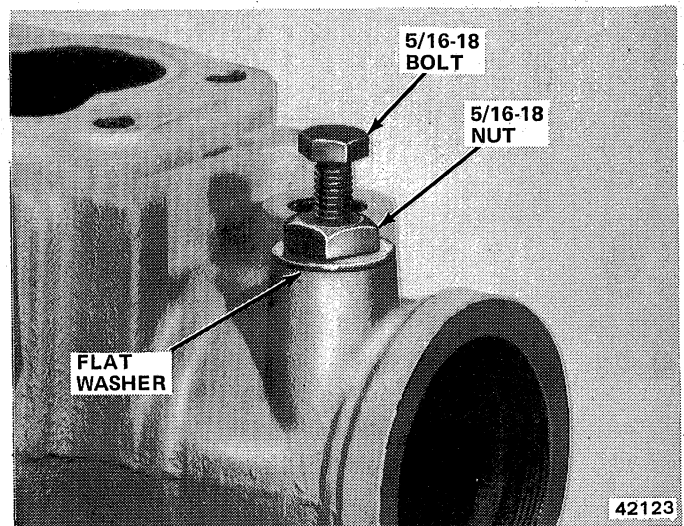


Fig. 2L-21 Hose Connector Seat Removal
(Gears with Non-Metric Fittings Only)

- (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 reuseable.
- (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).

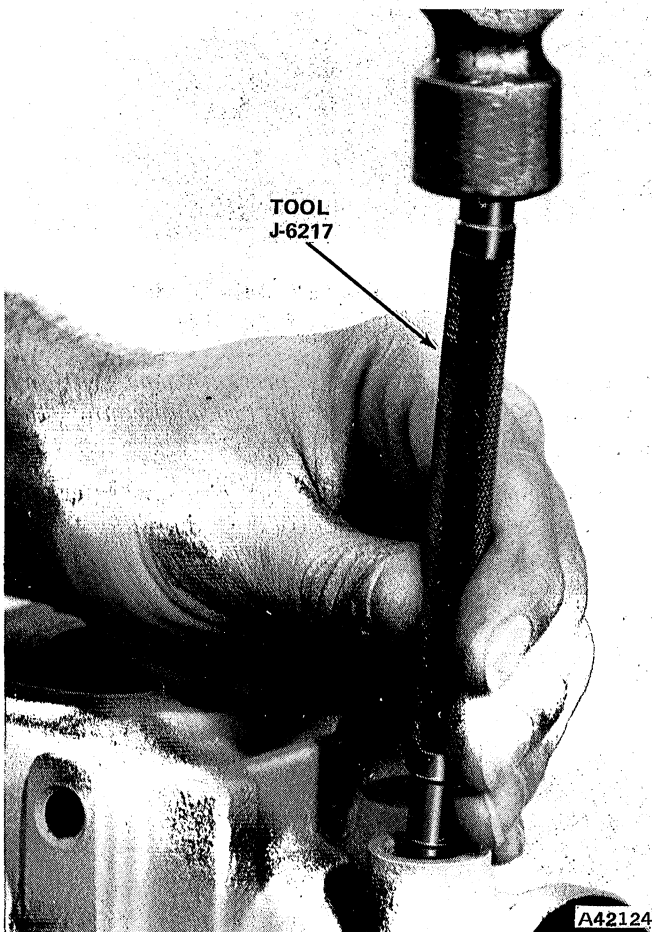


Fig. 2L-22 Hose Connector Seat Installation
(Gears with Non-Metric Fittings Only)

- (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.

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.

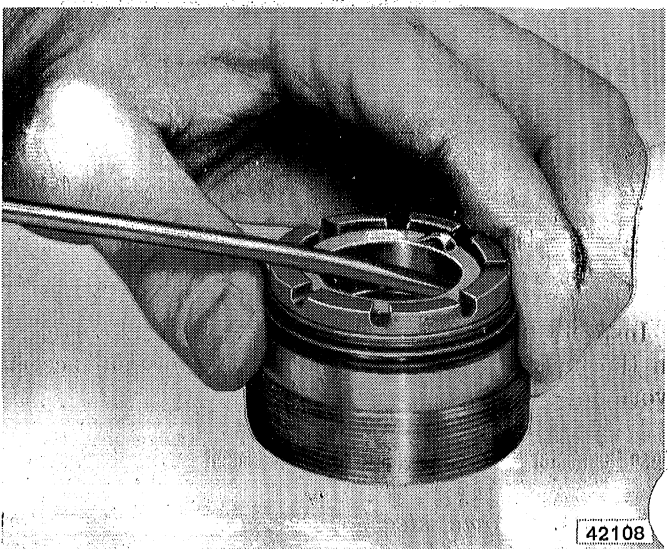
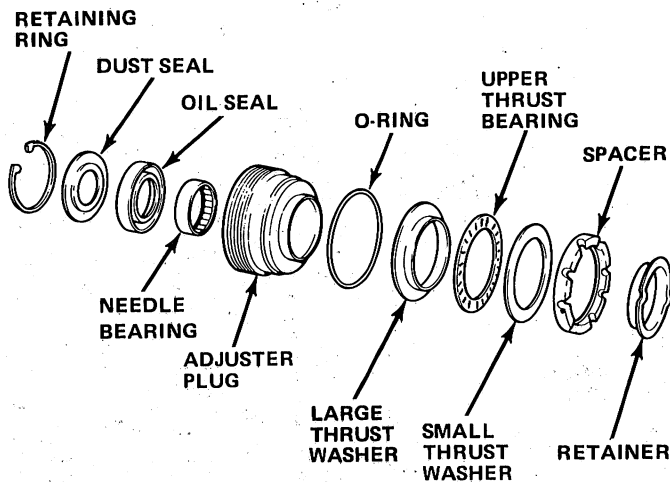


Fig. 2L-23 Thrust Bearing Retainer Removal

(2) Remove thrust bearing spacer, thrust bearing, and thrust bearing races (fig. 2L-24).



60192

Fig. 2L-24 Adjuster Plug Components

(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.

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.

(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 deep enough to provide clearance for dust seal and retaining ring.

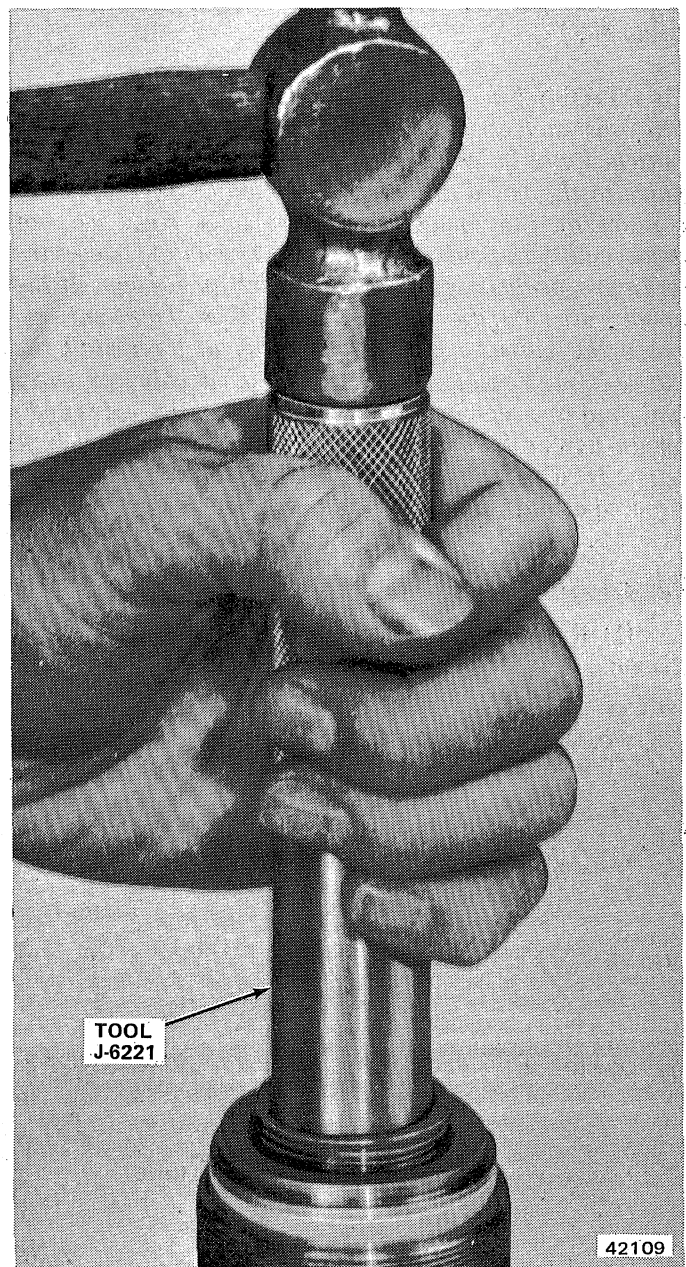


Fig. 2L-25 Adjuster Plug Needle Bearing Removal/Installation

(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.

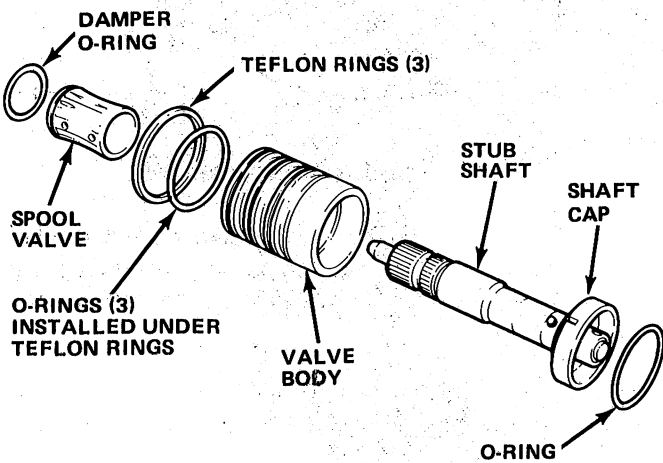
NOTE: The radial location of the spacer notches are not important. However, do not damage the notches during retainer installation.

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 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-26).



60194

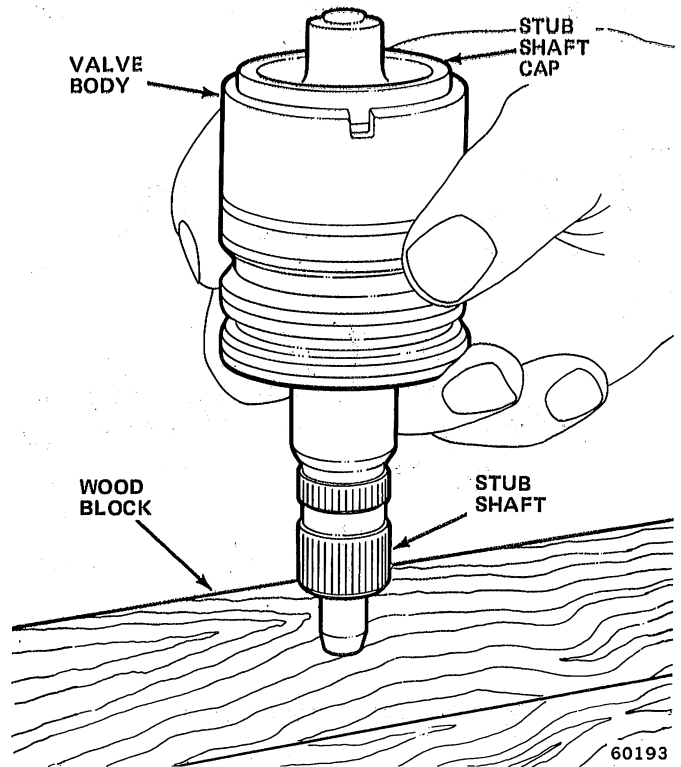
Fig. 2L-26 Valve Body Components

(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-27).

(3) Pull stub shaft outward until shaft cap clears valve body by approximately 1/4 inch (6 mm).

CAUTION: Do not pull the stub shaft out of the valve body any farther than 1/4 inch (6 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-28).



60193

Fig. 2L-27 Separating Stub Shaft and Valve Body

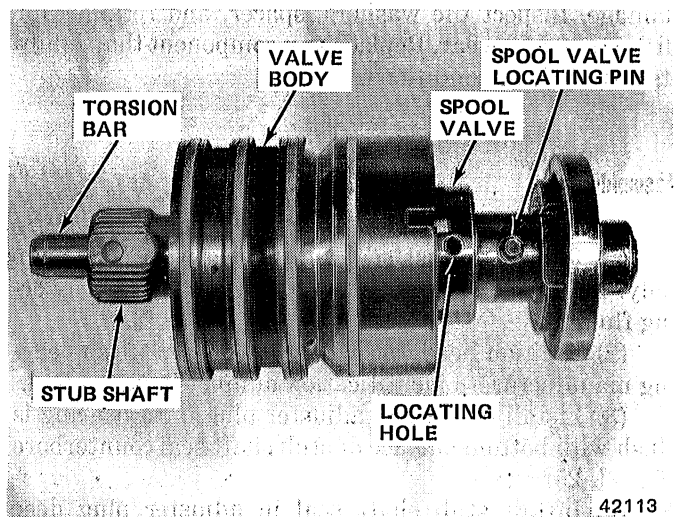
(5) Remove spool valve from valve body using a push and turn motion. If spool valve becomes cocked, carefully realign valve and try removal again. Do not force spool valve out.

(6) Remove and discard spool valve damper O-ring.

(7) Cut and remove valve body seal rings and backup O-rings (fig. 2L-26). Discard all rings.

Cleaning and Inspection

Wash the valve body components in clean solvent and



42113

Fig. 2L-28 Valve Body and Spool Valve Disassembly

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-29). Replace the entire valve body as an assembly if this notch is damaged or excessively worn.

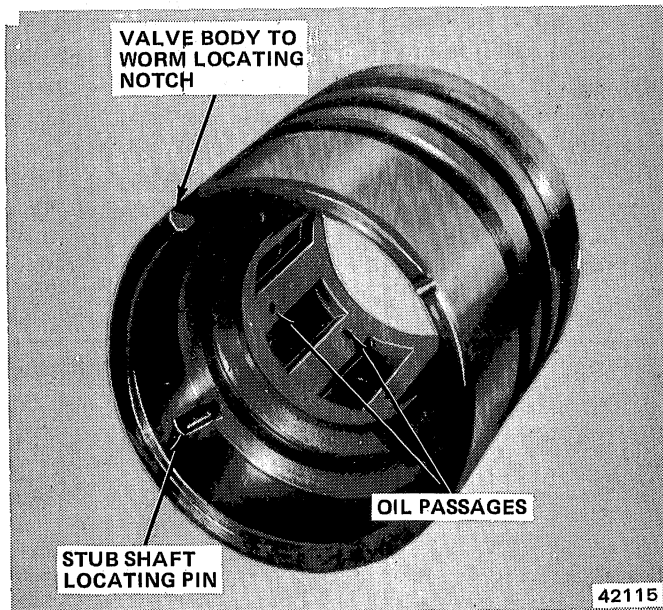


Fig. 2L-29 Valve Body

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-30). Take care to avoid damaging seal rings during installation.

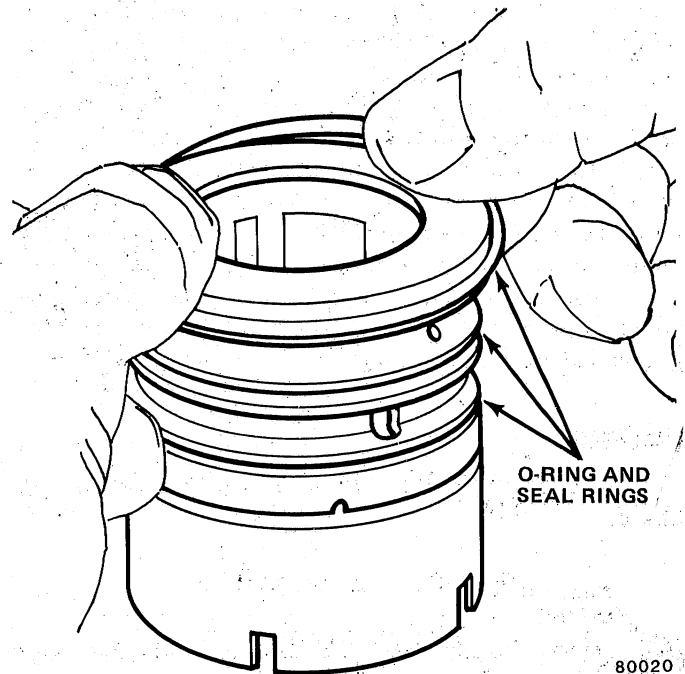


Fig. 2L-30 Valve Body Seal Ring Installation

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.

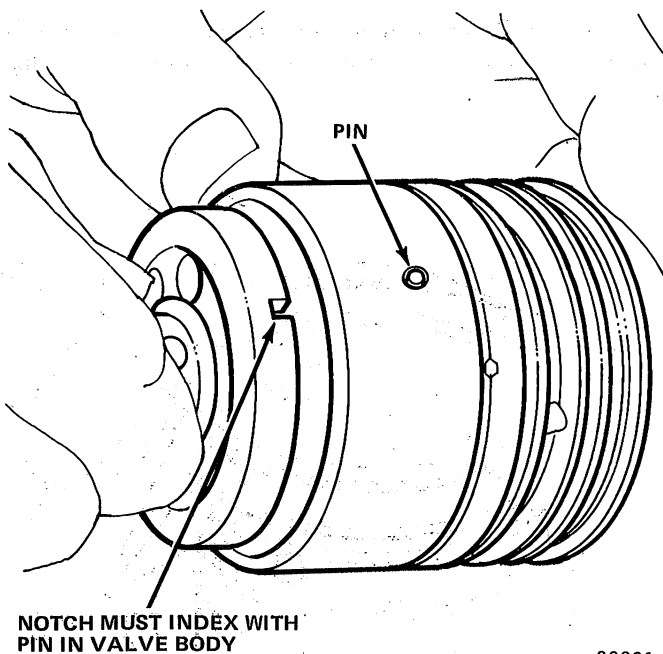
(6) Push spool valve through valve body until spool valve locating pin hole is visible at opposite end of valve body and spool valve is flush with notched end of valve body.

(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-28).

(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-31).

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.



80021

Fig. 2L-31 Stub Shaft Installation

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-32). 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-32). If either of these surfaces are damaged, replace the shaft.

Rack Piston and Wormshaft

Disassembly

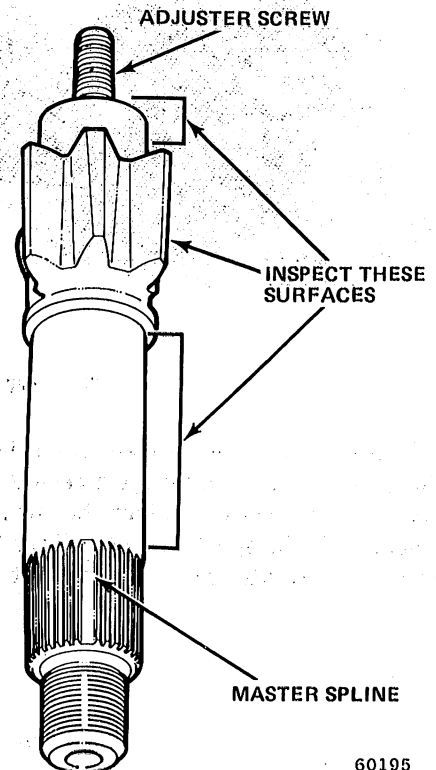
- (1) Remove wormshaft, lower thrust bearing, and bearing races from rack piston.
- (2) Cut and remove seal ring and backup O-ring from rack piston. Discard seal ring and O-ring.
- (3) Remove ball return guide clamp attaching screws and remove return guide clamp.
- (4) Place rack piston on clean cloth 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.



60195

Fig. 2L-32 Pitman Shaft Inspection

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-33).

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.

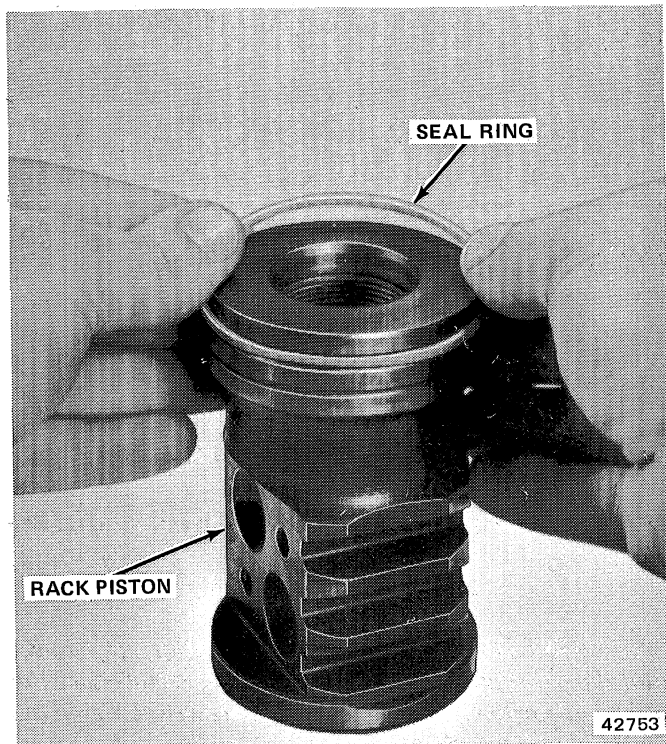


Fig. 2L-33 Rack Piston Seal Ring Installation

- (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-34).

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.

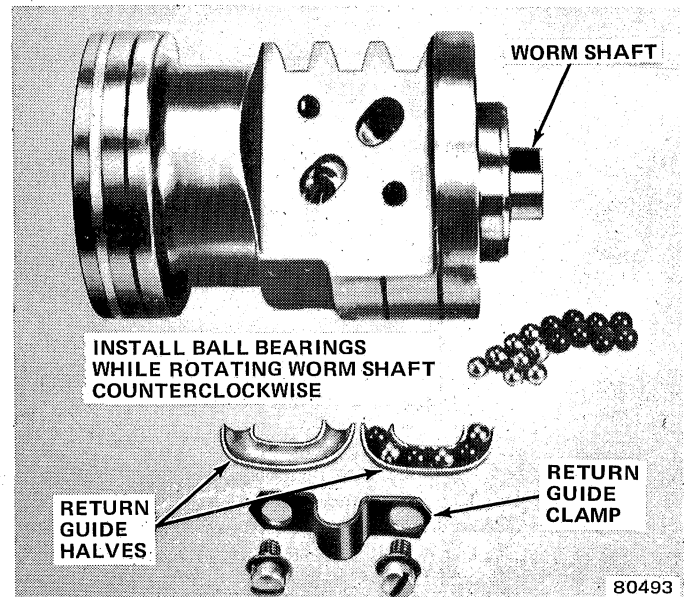


Fig. 2L-34 Rack Piston Ball Bearing Installation

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.

(7) Fill one ball return guide half with petroleum jelly and install six remaining ball bearings in guide (fig. 2L-34). 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.

(12) Position assembled rack piston and arbor tool on end and support assembly on wood blocks until ready to install in housing (fig. 2L-35).

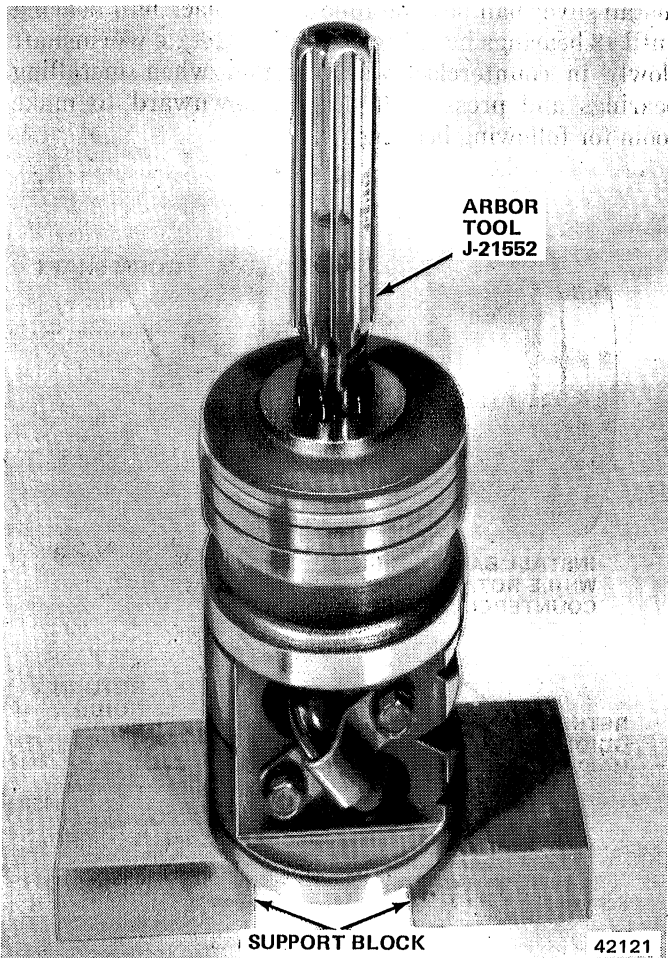


Fig. 2L-35 Arbor Tool Installed in Rack Piston

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-36). 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-37).

(6) Install assembled valve body and wormshaft in housing. Be sure wormshaft locating pin is still fully

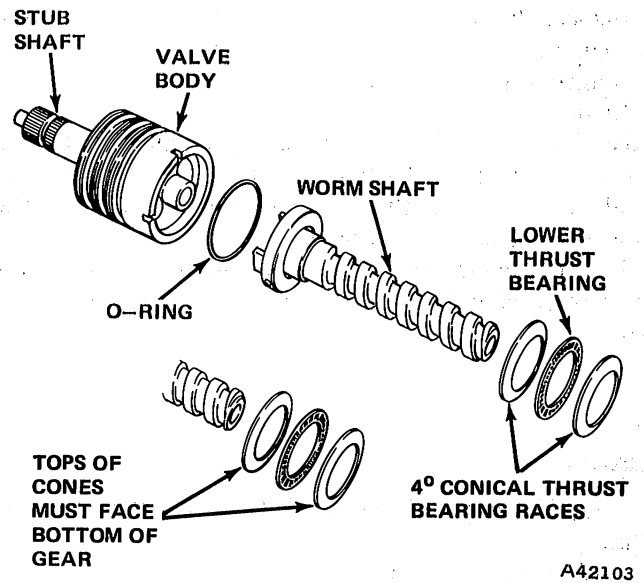


Fig. 2L-36 Wormshaft and Valve Body Assembly

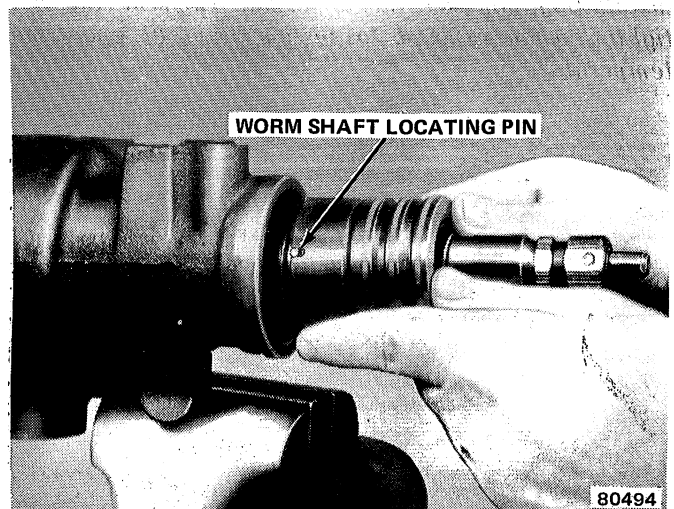


Fig. 2L-37 Valve Body-Wormshaft Installation

engaged in valve body notch before installing (fig. 2L-37).

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-37). 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-38). If the port is not visible, the valve body and wormshaft are misaligned or the thrust bearing and races are improperly installed.

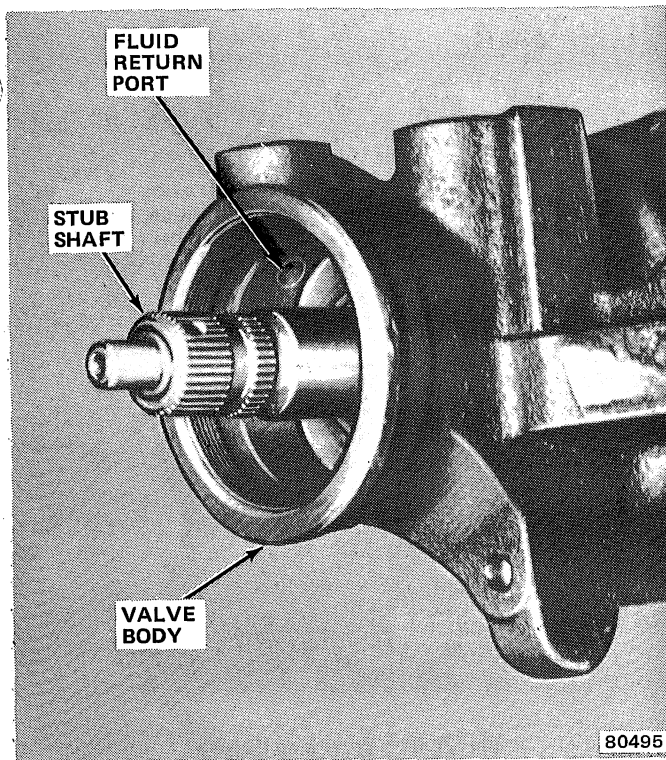


Fig. 2L-38 Seating Valve Body

(7) Place Seal Protector Tool J-29810 over end of stub shaft and install adjuster plug in housing (fig. 2L-39). Tighten adjuster plug to 20 foot-pounds (27 N•m) torque.

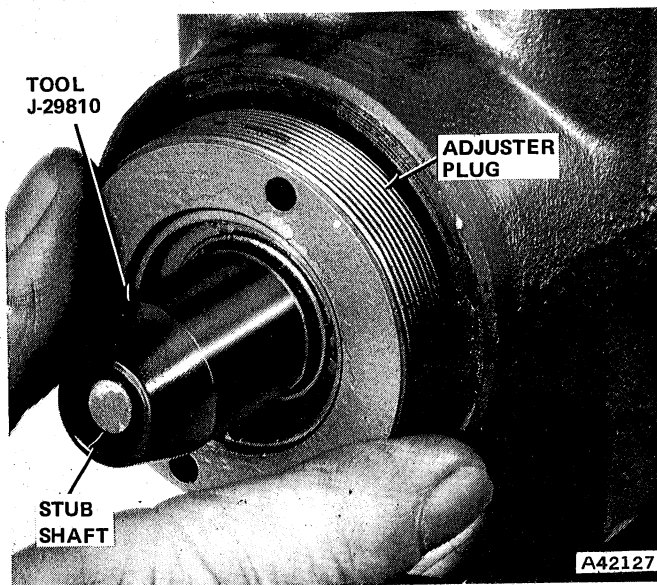


Fig. 2L-39 Adjuster Plug Installation

- (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.

NOTE: *The locknut has left-hand threads.*

(19) Install end plug in rack piston and tighten plug to 75 foot-pounds (102 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.

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-40).

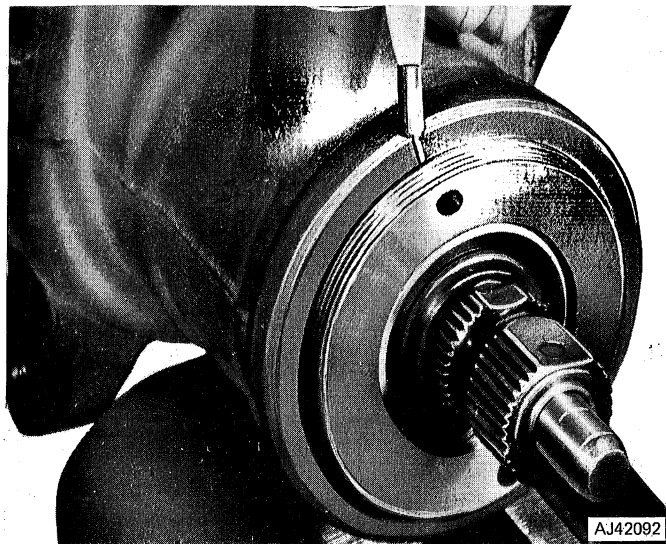


Fig. 2L-40 Marking Housing

(3) Measure back (counterclockwise) 1/2 inch (13 mm) from first index mark and remark housing (fig. 2L-41).

(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-42).

(8) Measure torque required to turn stub shaft. Take reading with beam of torque wrench at or near vertical position while turning stub shaft at an even rate (fig. 2L-42).

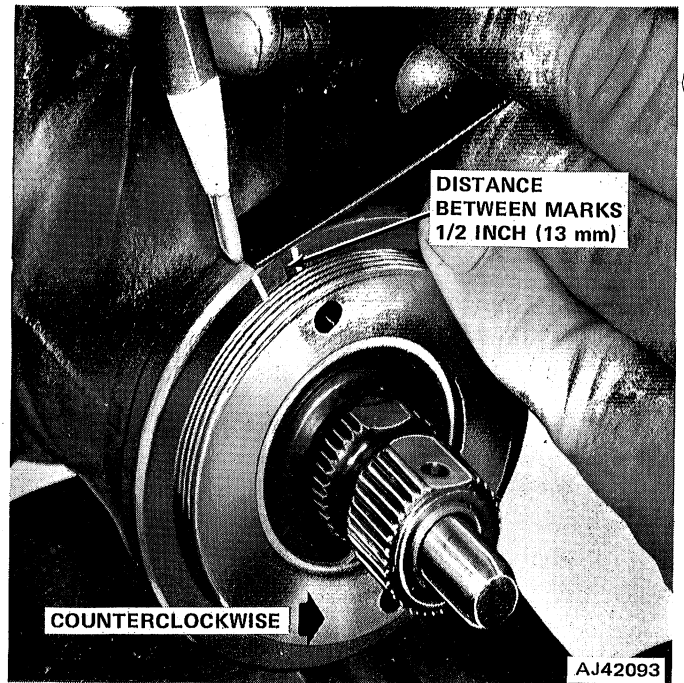


Fig. 2L-41 Remarking Housing

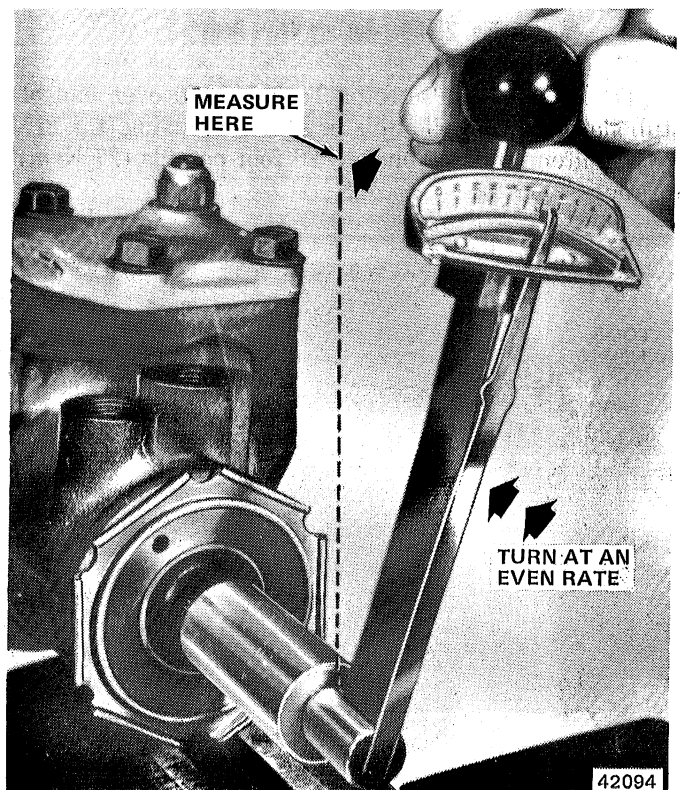


Fig. 2L-42 Measuring Wormshaft Bearing Preload

(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.

Pitman Shaft Overcenter Drag Torque

(1) Loosen adjuster screw locknut. Turn pitman shaft adjuster screw counterclockwise until screw is fully extended; then turn screw back one full turn in clockwise direction.

(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-43). In addition, the master spline on the pitman shaft should be in line with the adjuster screw (fig. 2L-44).

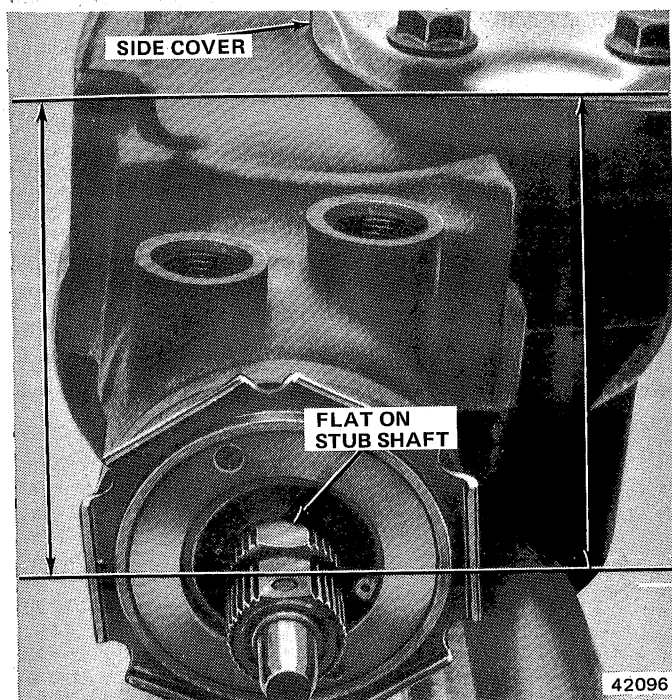


Fig. 2L-43 Stub Shaft Position with Gear Centered

(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-45).

(5) Rotate torque wrench 45 degrees each side of center and record highest drag torque measured on or near center (fig. 2L-45). Record drag torque reading.

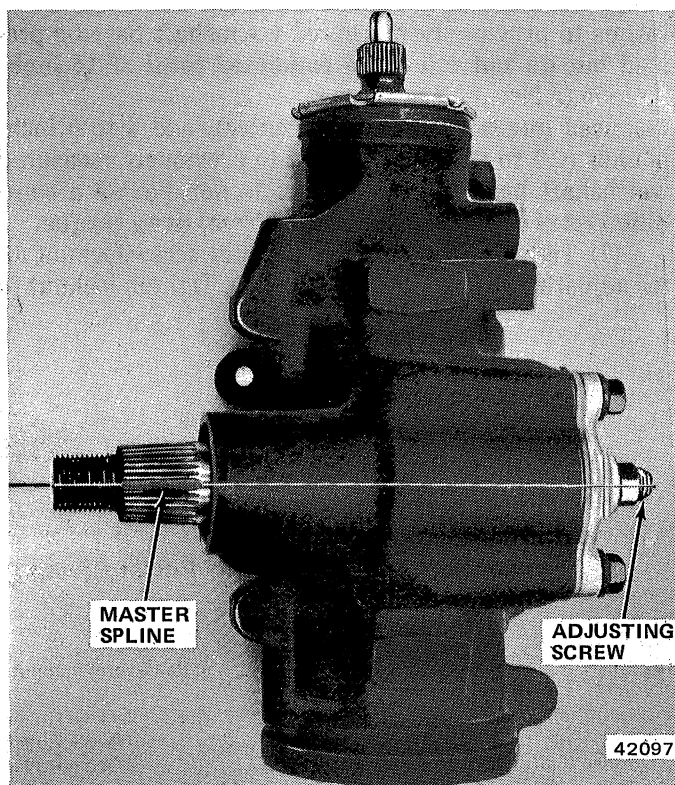


Fig. 2L-44 Pitman Shaft Master Spline Position with Gear Centered

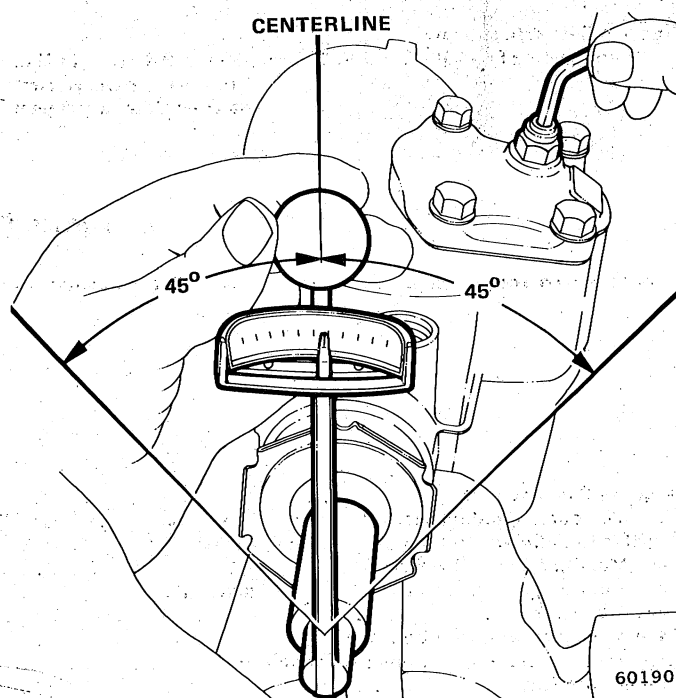


Fig. 2L-45 Measuring Pitman Shaft Overcenter Drag Torque

(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

20 foot-pounds (27 N•m) torque. Use hex wrench to prevent adjuster from turning while tightening adjuster 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.
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.
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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-Scrambler	17.5:1 constant ratio
Cke-Wag-Trk	13/16:1 variable ratio
Valve Body	Three-way, open center, rotary-type.

80499

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-tightened 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-Scrambler)	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-Scrambler)	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-Scrambler)	70	60-80	95	81-108
Pitman Arm Nut	185	170-210	251	230-285
Pitman Shaft Adjuster Screw Locknut	20	18-22	27	24-30
Return Guide Clamp Bolt	6	4-10	8	5-14
Rack-Piston End Plug	75	72-77	102	98-104
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
Fluid Level and Initial Operation	2L-39
In-Vehicle Service	2L-37
Pump Assembly	2L-41
Pump Disassembly	2L-40

	Page
Pump Installation	2L-40
Pump Removal	2L-40
Specifications	2L-44

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-46).

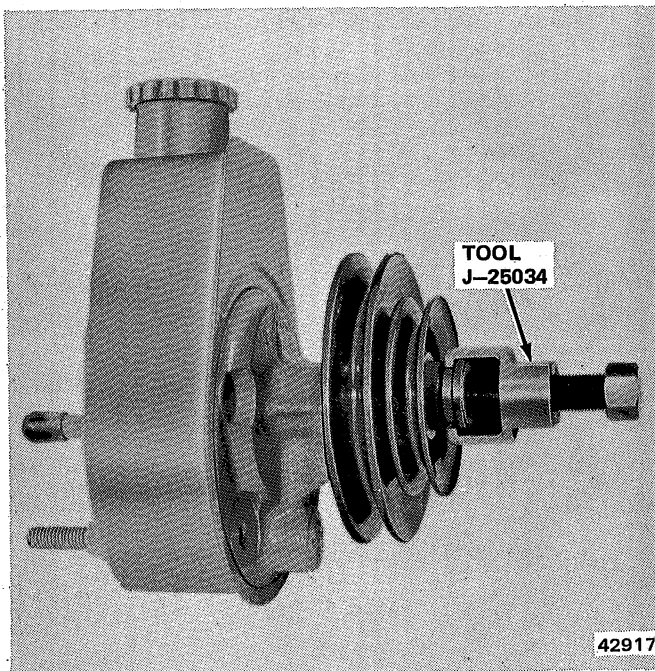


Fig. 2L-46 Pump Pulley Removal

(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-47).

(b) Cut metal body of shaft seal using sharp chisel and pry seal out of pump body using screwdriver (fig. 2L-47). Do not scratch or nick pump shaft or seal bore during seal removal.

(4) Remove any small nicks, scratches, or corrosion from pump shaft with crocus cloth.

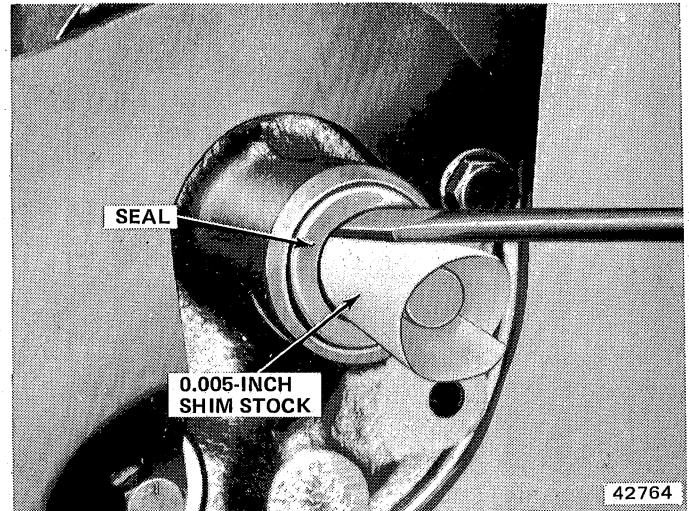


Fig. 2L-47 Pump Shaft Seal Removal

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-48).

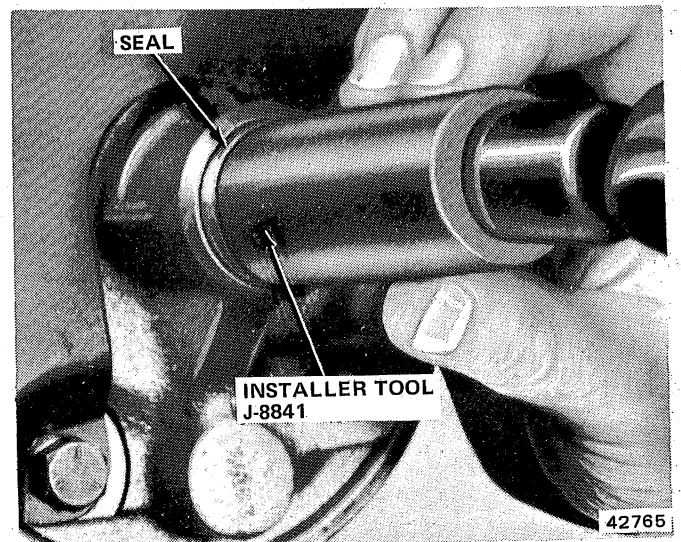


Fig. 2L-48 Pump Shaft Seal Installation

(4) Install pump pulley using Tool J-25033 (fig. 2L-49).

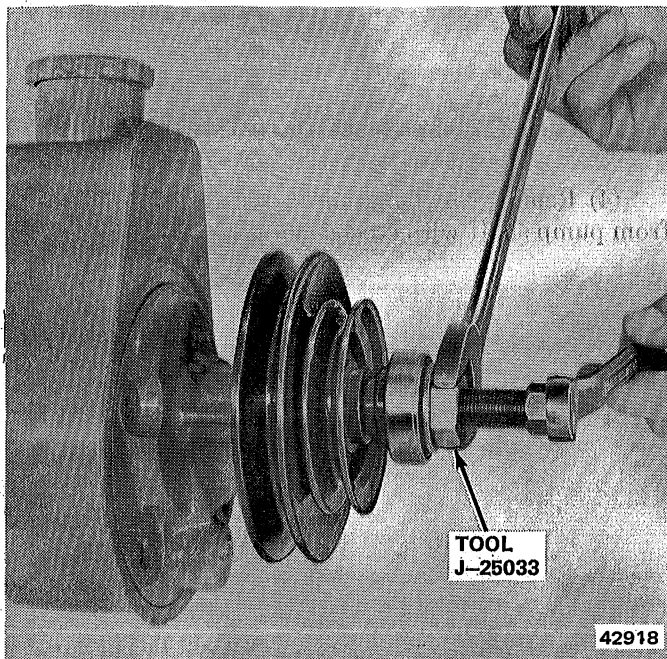


Fig. 2L-49 Pump Pulley Installation

(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

CAUTION: *The power steering pump on all vehicles built for sale in California is driven by a Serpentine drive belt. The pump should not be moved in an attempt to adjust the belt. Refer to Chapter 1C for belt adjustment instructions.*

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.

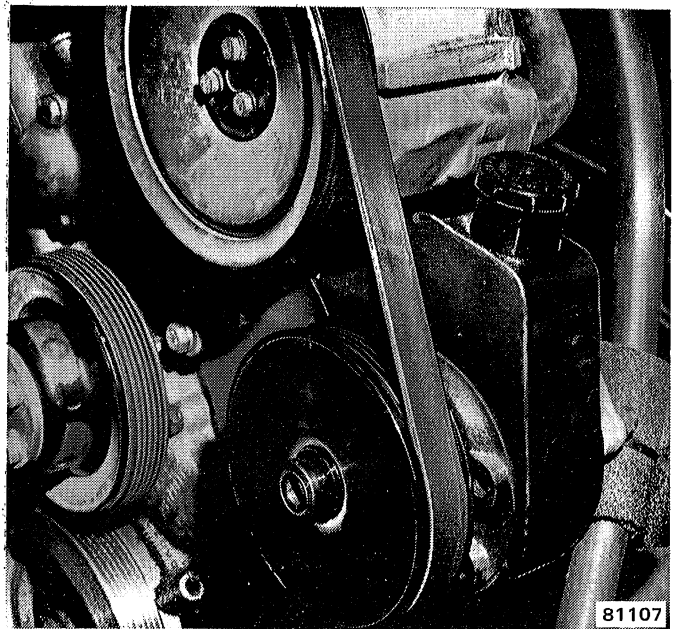


Fig. 2L-50 Power Steering Pump Belt Drive (California Only)

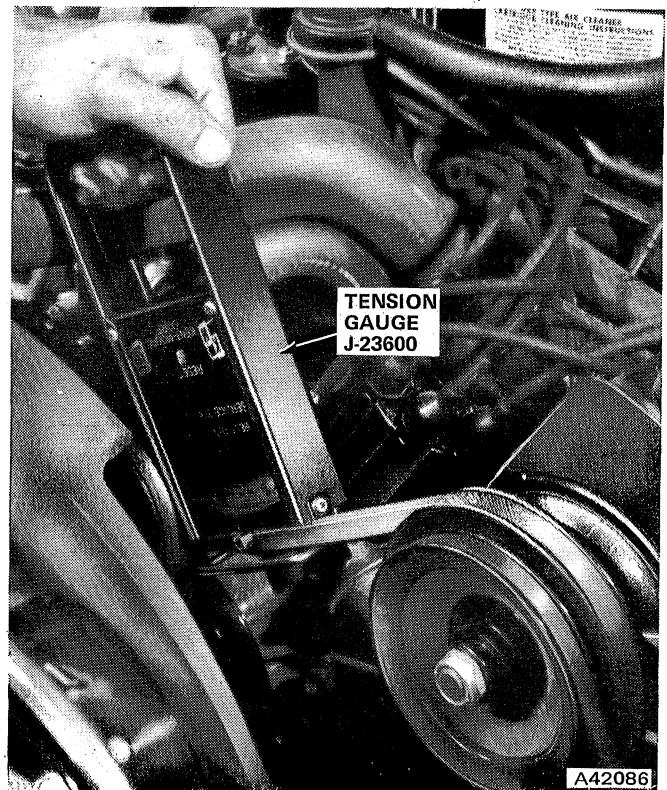


Fig. 2L-51 Checking Belt Tension

(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.

NOTE: Some power steering pump units may have a metric thread pressure port fitting. This fitting is designed for use with a pressure hose that uses an O-ring seal (fig. 2L-7, View B).

- (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) If pump pressure hose has metric fitting that uses an O-ring seal, check seal condition before connecting hose to pump. Replace seal if damaged or worn.

(6) Connect pressure hose to pump. Tighten hose fitting to 35 foot-pounds (47 N•m) torque.

(7) Fill pump reservoir with power steering fluid.

(8) Start engine and check for leaks. Repair any leaks as necessary.

(9) Bleed air from power steering system. Refer to Fluid Level and Initial Operation.

(10) Remove drain pan.

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

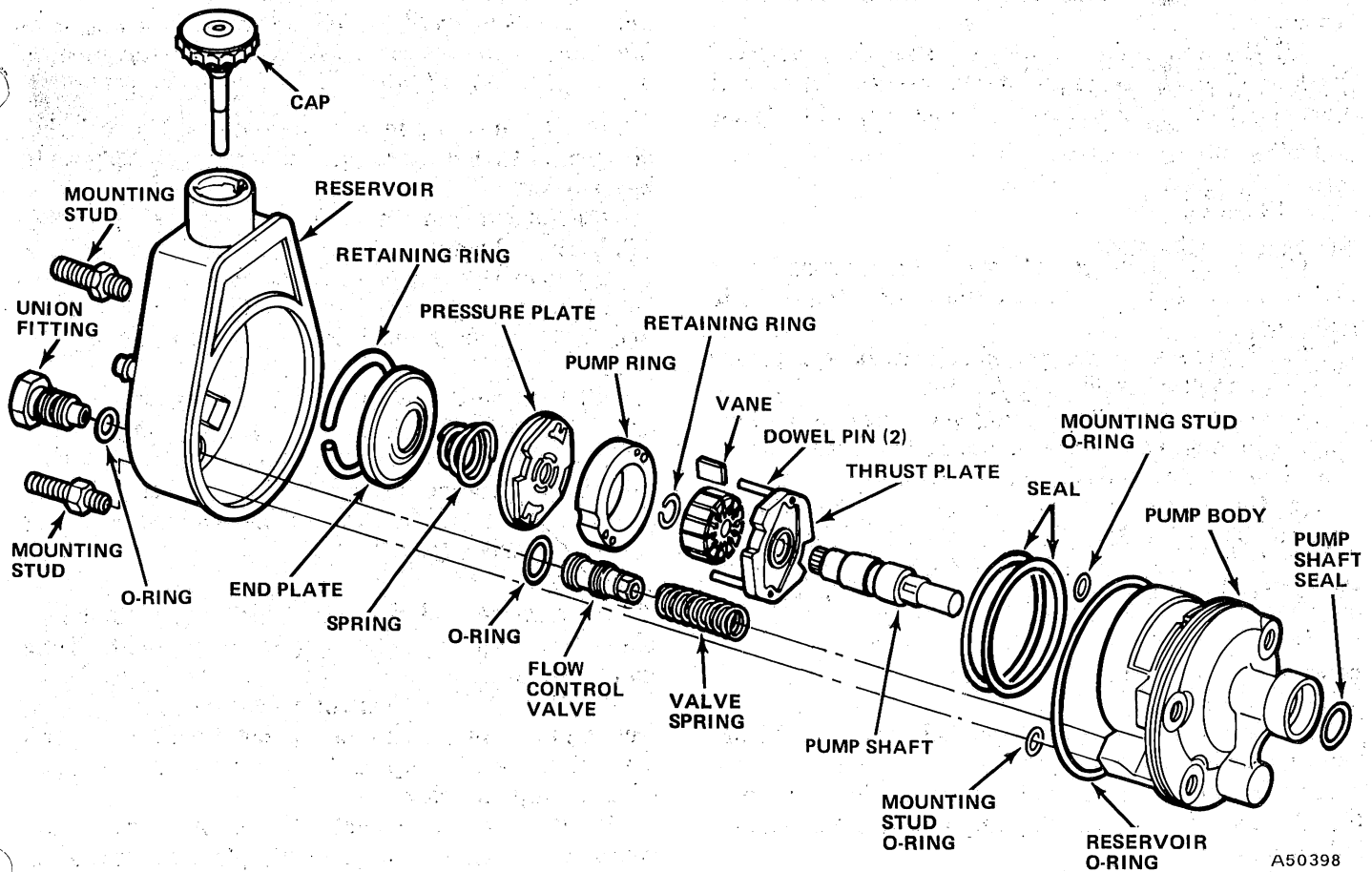


Fig. 2L-52 Power Steering Pump

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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 FULL 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 to 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.
- (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-46).

CAUTION: *Inspect the exposed surface of the pump shaft. Remove all traces of corrosion or nicks and scratches with crocus cloth before disassembling the pump. This will avoid damaging the pump bushing during disassembly—which might necessitate replacement of the entire pump body.*

(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.

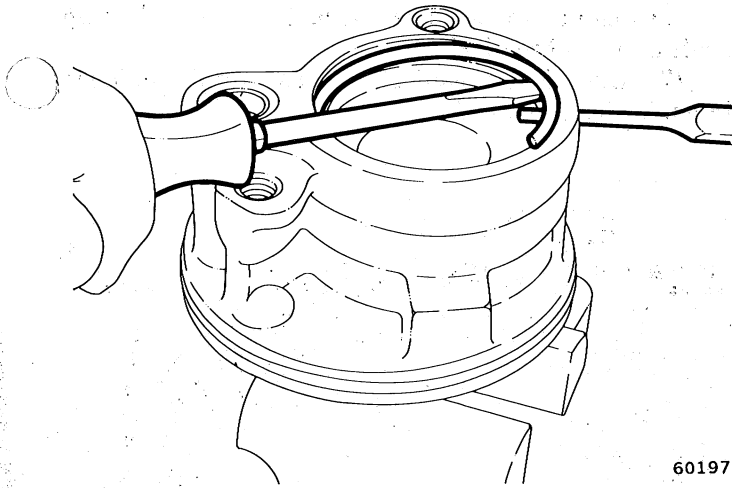
(8) Remove mounting stud O-rings from counterbores in pump body (fig. 2L-52). Discard O-rings.

(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.

(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).



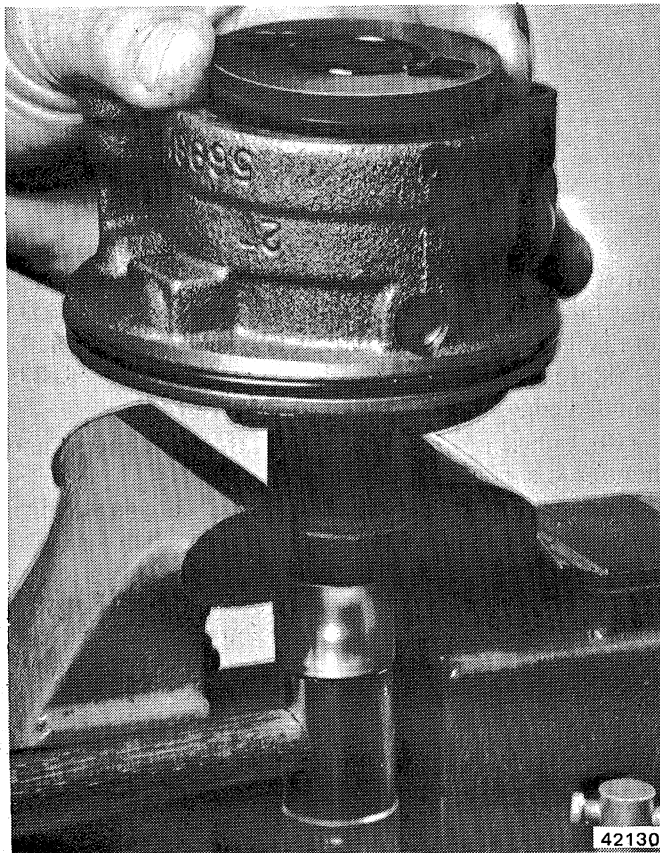
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Fig. 2L-53 End Plate Retaining Ring Removal

(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.



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Fig. 2L-54 Pump Shaft Assembly Removal

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 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).

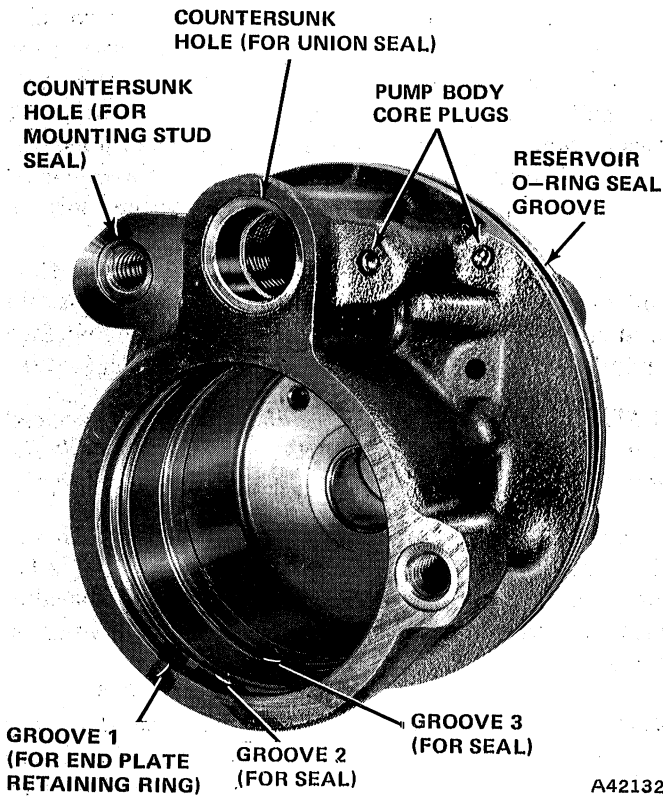


Fig. 2L-55 Pump O-Ring Seal Locations

- (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).

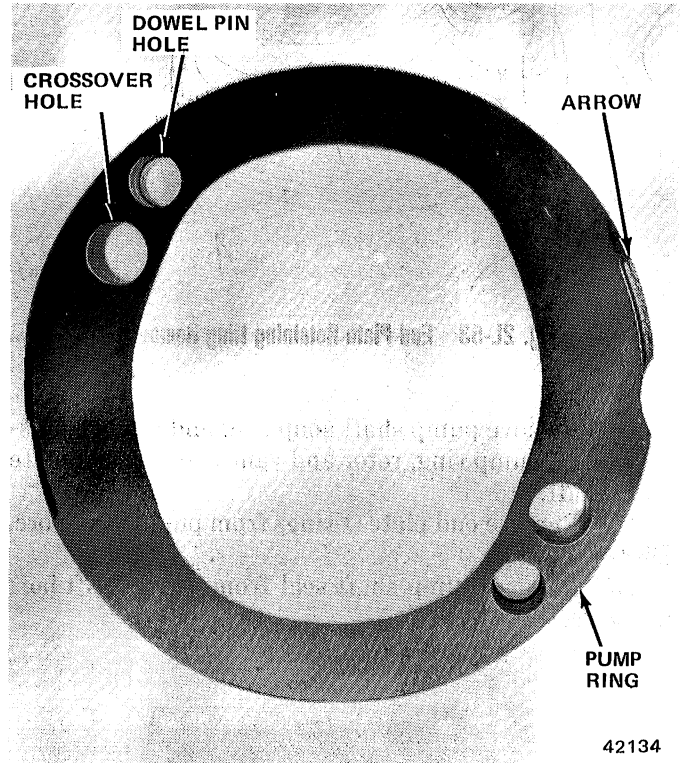


Fig. 2L-57 Pump Ring Dowel Hole Locations

- (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.

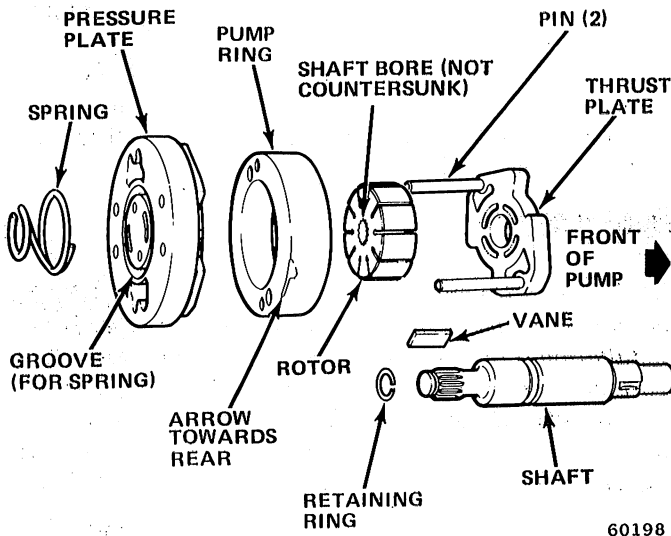


Fig. 2L-56 Pump Shaft Assembly Sequence

- (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).



Fig. 2L-58 Pump Ring Installation

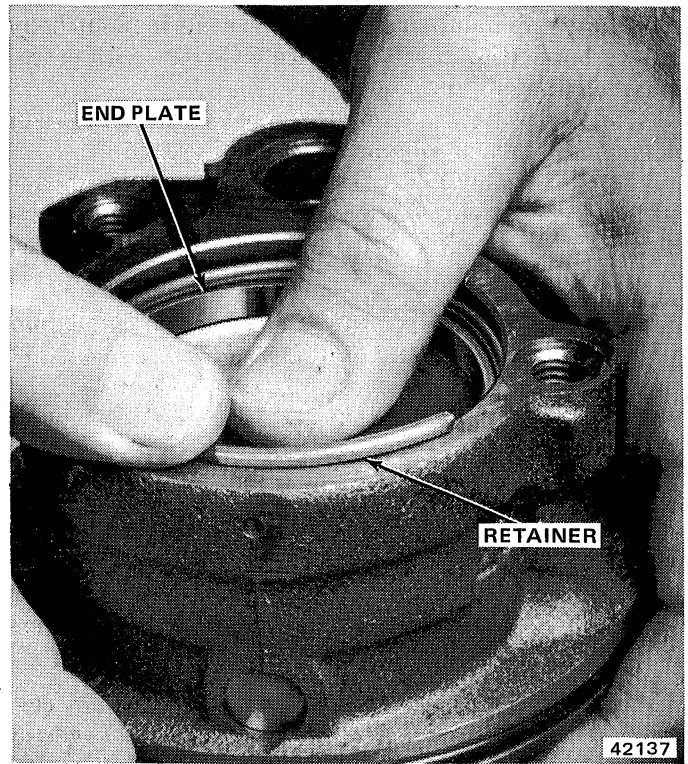


Fig. 2L-60 End Plate and Retaining Ring Installation

(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 spring-end first.

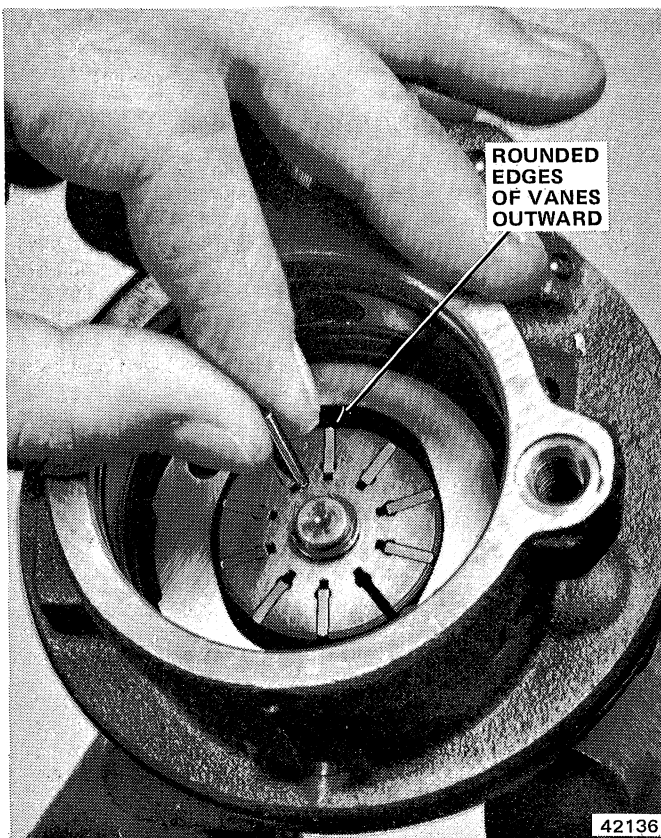


Fig. 2L-59 Rotor Vane Installation



Fig. 2L-61 Flow Control Valve and Spring Installation

(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 O-ring with petroleum jelly and install O-ring on fitting.

(23) Install pump union fitting in flow control valve bore and tighten fitting to 35 foot-pounds (47 N•m) torque.

CAUTION: *Some pump units have metric thread union fittings which are designed for use with metric hose fittings that use an O-ring seal (fig. 2L-7, View B). If the union is to be replaced, be sure to install the correct thread-type fitting.*

(24) Install pump pulley using Tool J-25033 (fig. 2L-49).

(25) Install pump. Refer to Pump Installation.

(26) Fill pump reservoir and bleed air from system. Refer to Fluid Level and Initial Operation.

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-Scrambler	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*	USA (ft-lbs)	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-tightened 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.

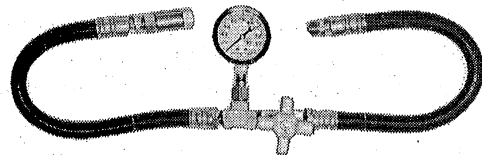
Tools



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-21554
ADJUSTER PLUG
SEAL
INSTALLER



J-6221
ADJUSTER PLUG
BEARING REMOVER
AND 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

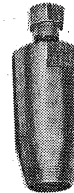


J-7624
SPANNER
WRENCH

80501



J-25034
REMOVER



J-8842
SEAL REMOVER



J-25033
INSTALLER

