

SECTION 3B3

POWER STEERING

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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DESCRIPTION

Vehicles covered by this manual are equipped with power steering as standard equipment.

An integral steering gear is used. In an integral steering gear, the power cylinder and control valve are integrated into the steering gear. No separate power cylinder is necessary.

A vane-type hydraulic pump with remote reservoir is used. The hydraulic pump is gear driven.

The power steering fluid reservoir is equipped with a screen and fluid filter to help keep the system fluid clean.

DIAGNOSIS OF POWER STEERING SYSTEM

| PROBLEM | POSSIBLE CAUSE | CORRECTION |
|---|---|---|
| Objectionable "Hiss" | <p>Noisy relief valve. There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. Hiss is a high frequency noise similar to that experienced while slowly closing a water tap. The noise is present in every valve and results from high-velocity fluid passing through valve orifice edges. There is no relationship between this noise and performance of the steering. "Hiss" may be experienced when the steering wheel is at the end of travel or when slowly turning at standstill.</p> | <p>Do not replace valve unless "hiss" is extremely objectionable. A replacement valve will also exhibit slight noise and is not always a cure for the objection.</p> |
| Rattle or Chuckle Noise in Steering Gear | <ol style="list-style-type: none"> 1. Gear loose on frame. 2. Steering linkage looseness. 3. Pressure hose touching other parts of truck. 4. Loose pitman shaft over center adjustment. 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. 5. Loose pitman arm. | <ol style="list-style-type: none"> 1. Check gear mounting. Torque bolts to specifications. 2. Check linkage pivot points for wear. Replace if necessary. 3. Adjust hose position. Do not bend tubing by hand. 4. Adjust. 5. Torque pitman arm nut. |
| Groan Noise in Steering Pump | <ol style="list-style-type: none"> 1. Low oil level. 2. Air in the oil. Poor pressure hose connection. | <ol style="list-style-type: none"> 1. Fill reservoir to proper level. 2. Torque connector. Bleed system. |
| Rattle or Knock Noise in Steering Pump | <p>Loose pump gear nut.</p> | <p>Torque nut.</p> |
| Rattle Noise in Steering Pump | <ol style="list-style-type: none"> 1. Vanes not installed properly. 2. Vanes sticking in rotor slots. | <ol style="list-style-type: none"> 1. Install properly. 2. Repair or replace. |
| Swish Noise in Steering Pump | <p>Defective flow control valve.</p> | <p>Repair or replace.</p> |
| Whine Noise in Steering Pump | <p>Pump shaft bearing scored.</p> | <p>Replace housing and shaft. Flush and bleed system.</p> |
| Growl Noise in Steering Pump | <p>Excessive back pressure in hoses or steering gear caused by restriction.</p> | <p>Locate restriction and correct. Replace part if necessary.</p> |

DIAGNOSIS OF POWER STEERING SYSTEM (CONT.)

| PROBLEM | POSSIBLE CAUSE | CORRECTION |
|---|--|---|
| Growl Noise in Steering Pump (Particularly Noticeable at Standstill Parking) | <ol style="list-style-type: none"> 1. Scored pressure plates, thrust plate or rotor. 2. Extreme wear of cam ring. | <ol style="list-style-type: none"> 1. Replace parts and flush system. 2. Replace parts. |
| Excessive Play or Looseness in Steering System (Steering Wanders) | <ol style="list-style-type: none"> 1. Front wheel bearings loosely adjusted. 2. Worn coupling or steering shaft U-joints. 3. Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms, or steering linkage ball studs. 4. Steering gear worm bearing loosely adjusted. 5. Excessive pitman shaft to ball nut lash in steering gear. 6. Toe-in out of adjustment or worn drag link or tie rod sockets. 7. Steering system out of alignment. 8. Tires badly worn, edge of tires are rounded off. 9. Lack of lubrication in linkage and kingpins. 10. Air in system. 11. Steering gear mounting loose. | <ol style="list-style-type: none"> 1. Adjust bearings or replace with new parts as necessary. 2. Replace. 3. Torque to proper specifications. 4. Adjust preload. 5. Adjust preload. 6. Replace tie rod ends if worn. Adjust to correct toe-in, and inspect steering arm and tie rod for a bent condition. 7. Align steering complete, caster, camber, and toe-in. Inspect spring components for condition and wear. Repair or replace as required. 8. Install new tires, and check alignment; abnormal tire wear indicates improper alignment. 9. Free up and lubricate any components that are frozen and will not take lubrication. 10. Add oil to pump reservoir and bleed. Check hose connectors and proper torque. 11. Tighten attaching bolts to specified torque. |
| Vibration and Shimmy | <ol style="list-style-type: none"> 1. Seal damage and leakage resulting in loss of lubricant, corrosion and excessive wear. 2. Tires, wheels, or brake drums out of balance. | <ol style="list-style-type: none"> 1. Replace damaged parts as necessary. 2. Balance tires and wheels, preferably with on-vehicle type balancer, as this method balances entire wheel and drum assembly. |

DIAGNOSIS OF POWER STEERING SYSTEM (CONT.)

| PROBLEM | POSSIBLE CAUSE | CORRECTION |
|--|---|--|
| Vibration and shimmy (cont.) | <ol style="list-style-type: none"> 3. Bent wheel or out of round tire. Wheel nuts torqued unevenly. 4. Loose steering linkage components. 5. Wheel loose on hub. 6. Driveline universal joints rough, or defective. This condition may be confused with steering vibration. 7. Engine misses or is out of balance, this may also be confused with steering shimmy. 8. Faulty shock absorbers. | <ol style="list-style-type: none"> 3. Replace wheel, and remount tire, or repair. 4. Adjust, torque, and repair linkage as necessary. 5. Inspect wheel bolt holes for damage, and replace wheel or torque nuts. 6. Repair driveline. 7. Correct miss in engine, or repair out of balance condition, clutch, pressure plate, or harmonic balancer, etc. 8. Replace shock absorbers. |
| Hard Steering Excessive Effort Required at Steering Wheel | <ol style="list-style-type: none"> 1. Low or uneven tire pressure. 2. Steering linkage kingpins or ball joints need lubrication. 3. Tight or frozen drag link or tie rod. 4. Steering gear to column misalignment. 5. Steering gear preload too tight. 6. Front wheel alignment incorrect. 7. Steering gear selector shaft adjusted too tight. 8. Frozen or tight shaft bearings. 9. Lower U-joint flange rubbing against adjuster. 10. Tight or binding conditions in steering column. | <ol style="list-style-type: none"> 1. Inflate to specified pressures. 2. Lubricate, and free up kingpins or ball joints. Make certain all fittings take lubricant properly. 3. Lube or replace as necessary. 4. Align column. 5. Adjust preload. 6. Check alignment and correct as necessary. 7. Adjust selector shaft. 8. Replace bearings. 9. Loosen bolt, assembly and torque properly. 10. Adjust steering column. |
| Pump Inoperative, Poor, or no Assist (Hard Steering) | <ol style="list-style-type: none"> 1. Low oil level. 2. Air in the oil. 3. Defective hoses or steering gear. 4. Flow control valve stuck. 5. Loose nut in end of flow control valve. 6. Pressure plate not flat against ring. 7. Extreme wear of pump ring. 8. Scored pressure plate, thrust plate. 9. Vanes not installed properly. 10. Vanes sticking in rotor slots. 11. Faulty flow control valve assembly. | <ol style="list-style-type: none"> 1. Fill reservoir to proper level. 2. Locate source of air leak and correct. 3. Repair or replace. 4. Repair or replace. 5. Torque nut not specifications. 6. Repair or replace. 7. Repair or replace. 8. Repair or replace. 9. Repair or replace. 10. Repair or replace. 11. Repair or replace. |

DIAGNOSIS OF POWER STEERING SYSTEM (CONT.)

| PROBLEM | POSSIBLE CAUSE | CORRECTION |
|--|--|---|
| Momentary Increase in Effort when Turning Wheel Fast to Right or Left | <ol style="list-style-type: none"> 1. Low oil level in pump. 2. High internal leakage in hydraulic pump. 3. High internal leakage in steering gear. | <ol style="list-style-type: none"> 1. Add power steering fluid as required. 2. Check pump pressure. (See pump pressure test.) 3. Repair source of leak. |
| Steering Wheel Surges or Jerks when Turning with Engine Running Especially During Parking | <ol style="list-style-type: none"> 1. Low oil level. 2. Insufficient pump pressure. 3. Defective gear relief valve. 4. Sticky flow control valve. | <ol style="list-style-type: none"> 1. Fill as required. 2. Check pump pressure. (See pump pressure test.) Replace relief valve if defective. 3. Replace gear relief valve. 4. Repair or replace. |
| Steering Pulls to Left or Right | <ol style="list-style-type: none"> 1. Camber or caster incorrectly adjusted. Steering will generally pull to side of axle having greatest positive camber. 2. Low air pressure in right or left tire. Steering will pull to side having low air pressure. 3. Axle loose and shifted at spring U-bolts. 4. Rear axle loose at spring. U-bolt if shifted at one side will cause steering to pull. 5. Unbalanced steering gear control or spool valve. If this is caused, steering effort will be very light in direction of lead and heavy in opposite direction. | <ol style="list-style-type: none"> 1. Adjust camber and caster. 2. Inflate tire to correct pressure, check for air leak and repair as required. 3. Align axle, and torque U-bolt nuts. Inspect for damaged parts. Replace if required. 4. Align rear axle and replace defective parts, if any. Torque U-bolts to specifications. 5. Replace valve. |
| Poor Return of Steering Wheel | <ol style="list-style-type: none"> 1. Lack of lubrication in linkage. 2. Steering gear to column misalignment. 3. Tires not properly inflated. 4. Improper front wheel alignment. 5. Steering linkage binding. 6. Steering wheel rubbing against directional signal housing. (Turn steering wheel and listen for internal rubbing in column.) 7. Tight steering shaft bearings. 8. Sticky or plugged valve spool. 9. Steering gear out of adjustment. 10. Tight kingpin bushings. 11. Lower U-joint flange rubbing against steering gear adjuster plug. | <ol style="list-style-type: none"> 1. Lube linkage. 2. Align steering column. 3. Inflate to specified pressure. 4. Check and adjust as necessary. 5. Replace pivots as required. 6. Adjust steering jacket. 7. Replace bearings. 8. Repair or replace valve. 9. Check adjustment. Adjust as required. 10. Lubricate or replace as required. 11. Loosen pinch bolt and assembly properly. |

DIAGNOSIS OF POWER STEERING SYSTEM (CONT.)

| PROBLEM | POSSIBLE CAUSE | CORRECTION |
|---|---|---|
| Snapping or Chucking in Steering Column or Wheel | <ol style="list-style-type: none"> 1. Loose steering gear at frame. 2. Worn steering shaft universal joints. 3. Worn steering linkage components will telescope through steering system and be felt in steering wheel. 4. Steering gear incorrectly adjusted. | <ol style="list-style-type: none"> 1. Torque mounting bolts to specifications. 2. Replace and repair joints as necessary. 3. Adjust, torque, and repair components. 4. Adjust steering gear. |
| Excessive Road Shock | <ol style="list-style-type: none"> 1. Tire pressure too high. 2. Wheel bearings adjusted too loose. 3. Camber adjustment incorrect. 4. Weak or broken front spring. 5. Defective shock absorbers. 6. Loose suspension components. | <ol style="list-style-type: none"> 1. Deflate to correct pressure. 2. Adjust bearings. 3. Adjust camber to specifications. 4. Replace spring. 5. Replace shock absorbers. 6. Inspect, adjust or repair, and replace as necessary. |

POWER STEERING SYSTEM TEST

Hydraulic System Test

This test requires the Power Steering Analyzer J-26487-A, or equivalent, along with Adapter Kit J-35719. The analyzer consists of a 0–3000 psi pressure gage, a gate valve, and a 0–10 gpm flow meter (figure 1).

1. Be sure the system reservoir has the right kind of fluid and is filled to the mark on the dipstick. Tests should be done with the system at normal operating temperature.
2. Install the analyzer (1) in the pressure line (3) between the pump and the steering gear (2) using Adapter Kit J-35719. The gate valve should be fully open.
 - a. Trace the pressure line from the pump to the steering gear.
 - b. Disconnect the pressure line at the steering gear. Place a container under the steering gear to catch fluid when disconnecting hoses. Clean the surfaces around fittings before removing them.
 - c. Thread the adapter from the adapter kit into the steering gear. Thread the other adapter onto the pressure line.
 - d. Connect the analyzer to the adapters.
3. If the analyzer has never been used, it will be necessary to bleed the hydraulic system to remove all air, as directed later in this section.

The analyzer gate valve must be open. If the analyzer has been used before, bleeding will probably not be necessary. This is because the power steering fluid is kept in the analyzer by the quick disconnect couplings once it has been used.

4. Run the engine at idle speed with the gate valve open for a few minutes to bleed the system of any air that may still be in it.
5. Check the pressure gage reading with the engine idling. The gage should read about 70 psi. If the reading is greater than this, the control valve, fluid filter, or hydraulic lines are restricted or plugged.
6. Increase engine speed to 2000 rpm.

NOTICE: Do not keep the gate valve closed longer than 10 seconds. To do so may damage the hydraulic pump.

NOTICE: A malfunctioning pressure relief valve may not properly relieve pump pressures. Constantly watch the pressure gage while closing the gate valve. If pressure rises rapidly, or appears uncontrolled, do not completely close the gate valve, as excessive pressure buildup may cause hose rupture or pump damage.

7. Gradually close the gate valve and read the pressure gage. IMMEDIATELY OPEN THE GATE VALVE.

The gage should read 1493 psi. A higher reading indicates a faulty relief valve in the hydraulic pump. A lower reading indicates a worn or malfunctioning hydraulic pump.

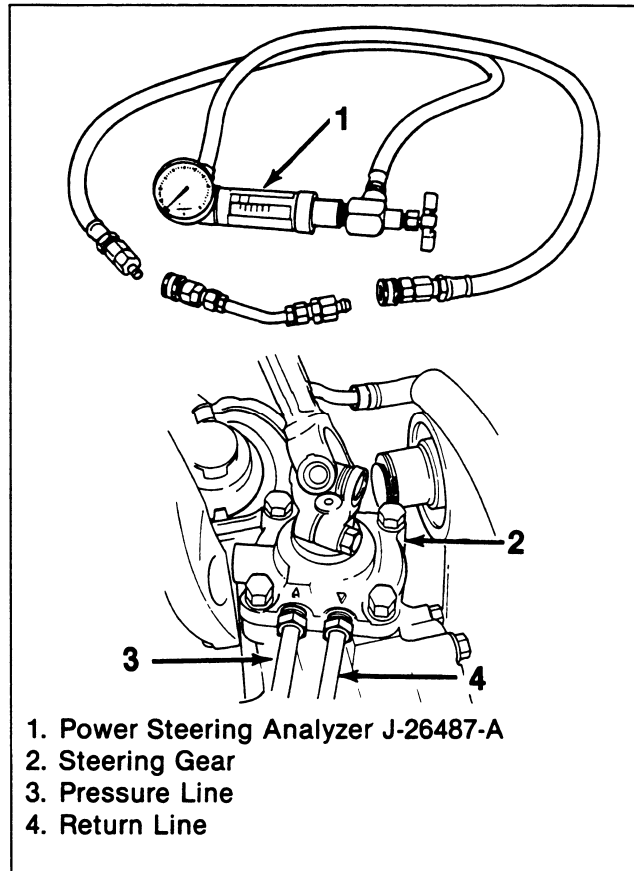


Figure 1. Steering Gear Analyzer and Connections

POWER STEERING SYSTEM ON-VEHICLE SERVICE

MAINTENANCE

The hydraulic system should be kept clean. At regular intervals the power steering fluid level in the reservoir should be checked and fluid added when required. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B) of this manual for the type of fluid to be used, and intervals for filling.

The power steering fluid and filter should be changed at regular intervals. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B) for service intervals.

Correct any hose contact with other parts of the vehicle that could cause chafing or wear.

Power steering hoses and lines must not be twisted, kinked, or tightly bent.

Because of the power assist from the power steering system, it is more difficult to detect defects in the steering system. Therefore, periodic maintenance is very important on a vehicle having power steering.

If the system contains some dirt, flush it, as

detailed in "Bleeding the Hydraulic System" later in this section. If it is exceptionally dirty, both the pump and the gear must be completely disassembled before further usage.

All tubes, hoses, and fittings should be inspected for leakage at regular intervals. All fittings must be tight. Be sure clips, clamps supporting tubes and hoses are in place and properly secured.

POWER STEERING FLUID AND FILTER SERVICE

1. Remove the vent cap (1), fill cap (2) and seal (O-ring) (3) (figure 2).
2. Remove the filter(5).
3. Clean the filter (5) in clean solvent. Then blow filter dry with compressed air.
4. Raise the front of the vehicle until the front tires are off the floor. Block the frame with safety stands.

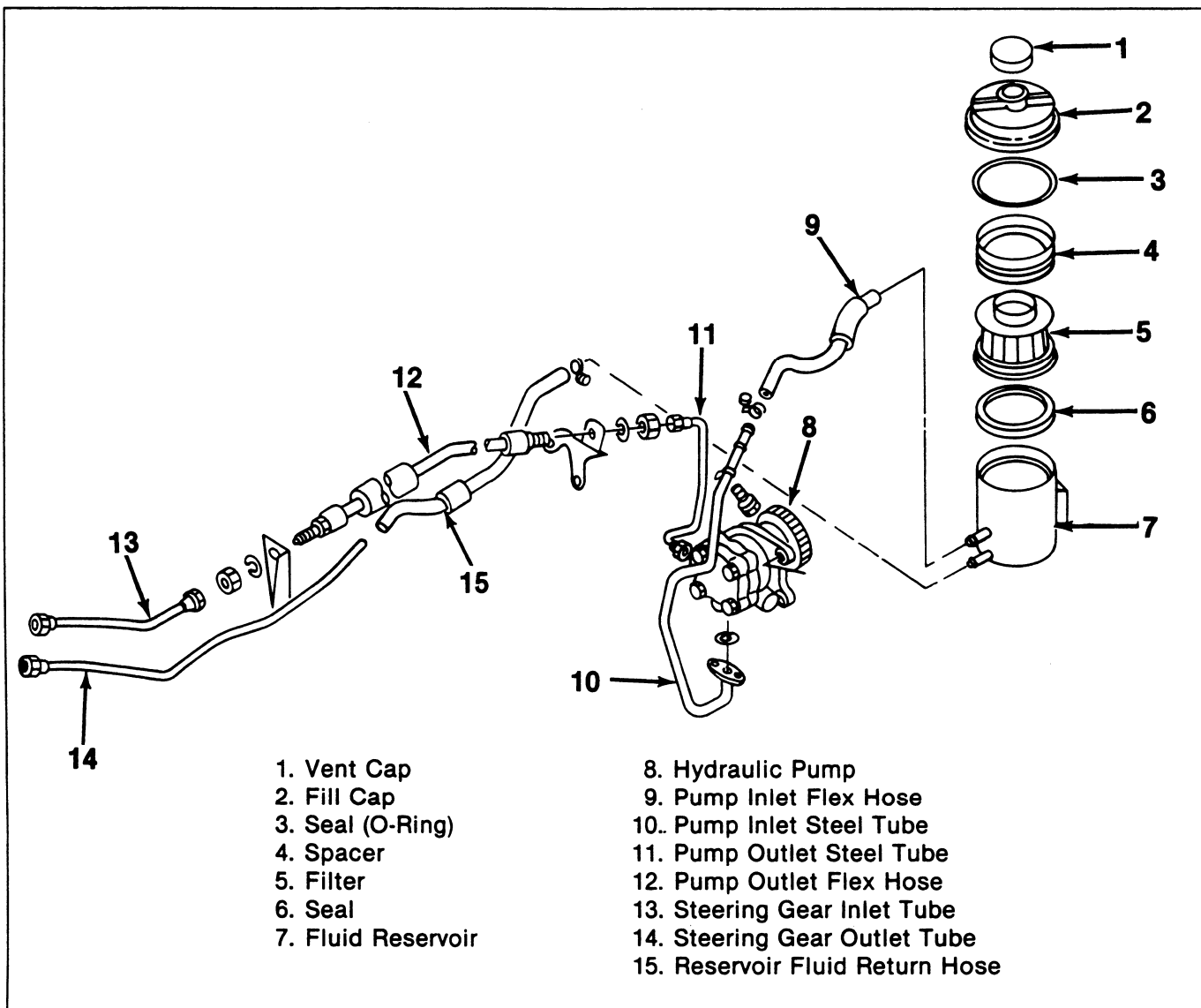


Figure 2. Power Steering Fluid Reservoir

5. Disconnect the reservoir fluid return hose (15) from the steering gear outlet tube (14). Direct both the hose and tube into a container. Drain the fluid reservoir (7).
6. Turn the steering wheel several times from lock to lock to pump the fluid from the steering gear. **DO NOT START THE ENGINE.**
7. Connect the reservoir fluid return hose (15) to the steering gear outlet tube (14).
8. Install the filter (5), seal (6), spacer (4) and seal (O-ring) (3).
9. Fill and bleed the hydraulic system, as outlined later in this section.
10. Install the vent cap (1) and fill cap (2).

straight ahead position.

- Provide a pan for power steering fluid to drain into, when hydraulic lines are disconnected.

Remove or Disconnect (Figure 3)

1. Pitman arm (16) as outlined in STEERING LINKAGE (SEC. 3B1) in this manual.
2. U-joint bolt (17).
3. Put reference marks on the U-joint (18) and input shaft (19). Then remove steering shaft U-joint from the steering gear input shaft.
4. Hydraulic lines (20) from the steering gear (23).
5. Nuts (21) and bolts (22).
6. Steering gear (23).

STEERING GEAR REPLACEMENT

- Place the steering wheel and front wheels in the

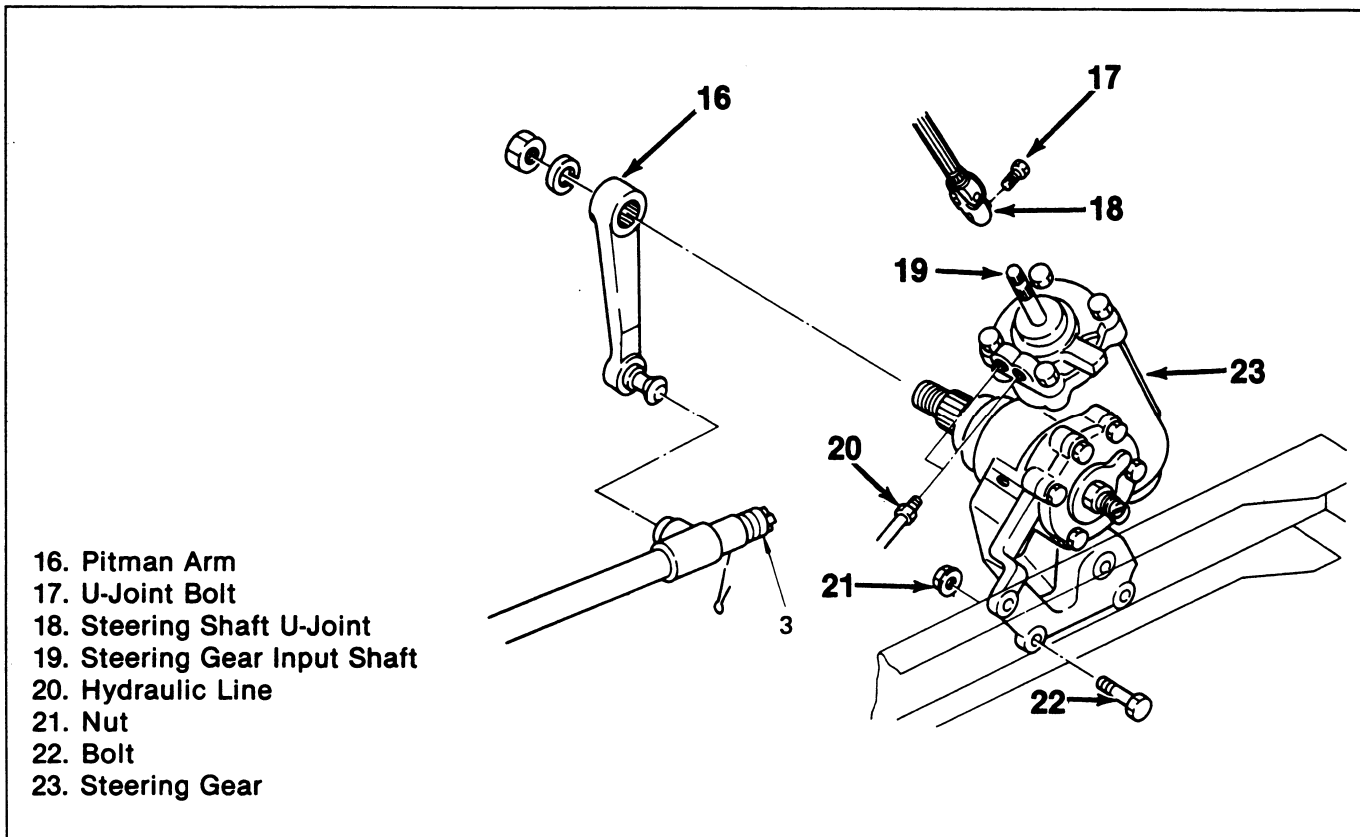


Figure 3. Steering Gear Removal - Installation

Install or Connect (Figure 3)

NOTICE: See "NOTICE" on page 3B3-1 of this section for steps 2 and 5.

1. Steering gear (23) to the frame.
2. Bolts (22) and nuts (21).

Tighten

- Steering gear bolts (22) to 102 N·m (75 lb·ft).
3. Hydraulic lines (20) to the steering gear (23).
 4. Steering shaft U-joint (18) to the steering gear input shaft (19). Be sure to align the reference marks.
- Check to be sure the steering wheel is in the straight ahead position.
5. U-joint bolt (17).

Tighten

- U-joint bolt (17) to 38 N·m (28 lb·ft).
6. Pitman arm (8) to the sector shaft. Refer to STEERING LINKAGE (SEC. 3B1) in this manual.
- Bleed the hydraulic system as outlined in this section.

STEERING GEAR ADJUSTMENT

Refer to "Power Steering Gear Unit Repair" in this section.

HYDRAULIC PUMP REPLACEMENT

Remove or Disconnect (Figure 4)

1. Pump bolts (24) and pump inlet tube (10).
2. Pump outlet steel tube (11).
3. Steering gear bolts (25).
4. Hydraulic pump (8).
5. Seal (O-ring) (26) and (27) and discard.

Install or Connect (Figure 4)

1. New seal (O-ring) (26) to the hydraulic pump (8).
2. Hydraulic pump (8) to the engine front cover.
3. Steering gear pump bolts (25).
4. Pump outlet steel tube (11).
5. Pump inlet steel tube (10), seal (O-ring) (27) and inlet tube bolts (24).

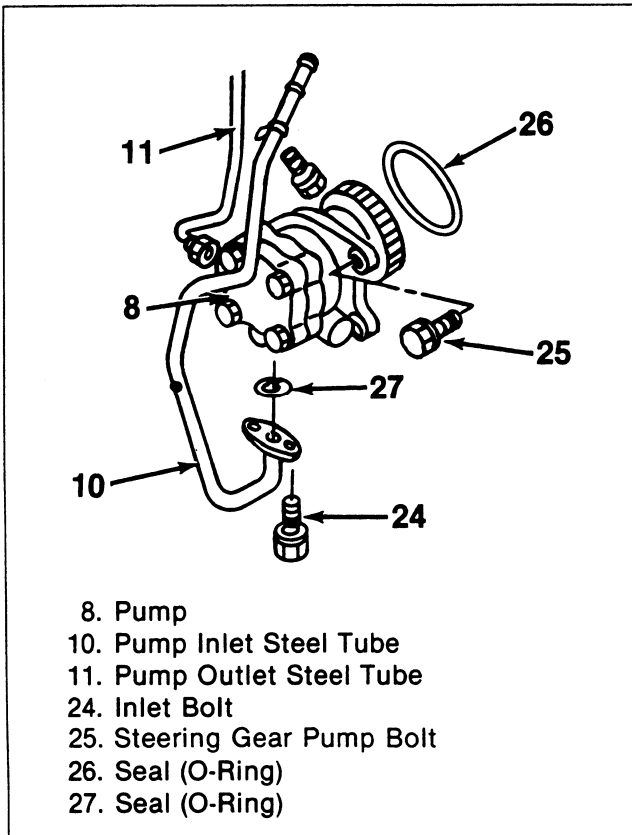


Figure 4. Power Steering Pump Removal or Installation

6. Fill the hydraulic system with DEXRON® or DEXRON® II. Bleed the system as outlined later in this section.

BLEEDING THE HYDRAULIC SYSTEM

Important

- Use only DEXRON® or DEXRON® II automatic transmission fluid as described in MAINTENANCE AND LUBRICATION (SEC. 0B) in this section.

1. Raise the vehicle until the front wheels are off the floor. Block the frame.
2. Fill the reservoir with the proper fluid.
3. With the engine stopped, turn the steering wheel slowly from lock to lock in both directions. Add fluid as necessary.
4. Start the engine and let it idle for two to three minutes.
5. With the engine idling, turn the steering wheel slowly from lock to lock in both directions several times. Add fluid as needed.
6. Repeat step 5 until the fluid level stabilizes and air bubbles no longer appear in the reservoir.
7. Stop the engine and fill the reservoir to the proper level.

8. Lower the vehicle.

HYDRAULIC SYSTEM FLUSHING

Refer to figure 2.

1. Raise the front of vehicle off ground until the wheels are free to turn.
2. Disconnect the return hose (15) at the fluid reservoir (7). Direct the hose into a drain pan.
3. Plug the return hose connector on the fluid reservoir (7).
4. Remove the fill cap (2). Have an assistant ready to keep the fluid reservoir (7) full of fluid. Refer to MAINTENANCE AND LUBRICATION (SEC.0B) for fluid specifications.
5. Start the engine and run it at idle. Turn the steering wheel from lock to lock.

NOTICE: DO NOT hold the steering wheel at a lock or fluid flow will stop and the pump will be in the relief pressure mode. A sudden overflow from the reservoir may also develop if the steering wheel is held at a lock.

6. Continue the process until all foreign material has cleared from draining fluid. If foreign material is still evident, the individual components must be flushed out as outlined in the following steps.
7. Stop the engine.
8. Remove all hydraulic lines and hoses. Drain all the lines and blow clear of fluid. Flush the lines with new power steering fluid, drain, and blow clear.
9. Disconnect the lines from the hydraulic pump (8), (10) and (11). Drain the pump and then cap or plug the line connections. Fill with new power steering fluid. Drain and check the fluid for foreign material. Repeat the process as necessary.
10. Install all lines, hoses, and components (if removed) on vehicle. Fill the system with new power steering fluid and bleed the system as described in "Bleeding the Hydraulic System" previously in this section. Operate the engine for approximately 15 minutes.
11. Repeat steps 1 through 6. Check the draining fluid for foreign material. If the fluid shows foreign material, drain the system, refill, bleed system, run engine and recheck for foreign material.
 If foreign material is still evident, replace all lines and repair or replace all hydraulic components.
 Do not reuse any drained power steering fluid
12. After the flushing operation, clean the power steering fluid filter (5) as outlined previously.

POWER STEERING GEAR UNIT REPAIR

Power steering gear components are a combination of many machined, polished surfaces with very fine tolerances.

When these components are serviced, care and cleanliness are important. The workbench, hands, tools, and component parts must be kept clean at all times. The entry of even small amounts of dirt into the component may cause an unsatisfactory repair and possible damage to the component. The dirt may also be carried by the power steering fluid to other components in the power steering system, causing damage to other components as well.

Throughout this section, it should be understood

that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Components should be cleaned in a clean, approved solvent that will not damage the rubber parts.

In some instances, "automatic transmission fluid" will be specified to lubricate parts upon assembly. In these cases, use automatic transmission fluid as specified in MAINTENANCE AND LUBRICATION (SEC. 0B) in this manual.

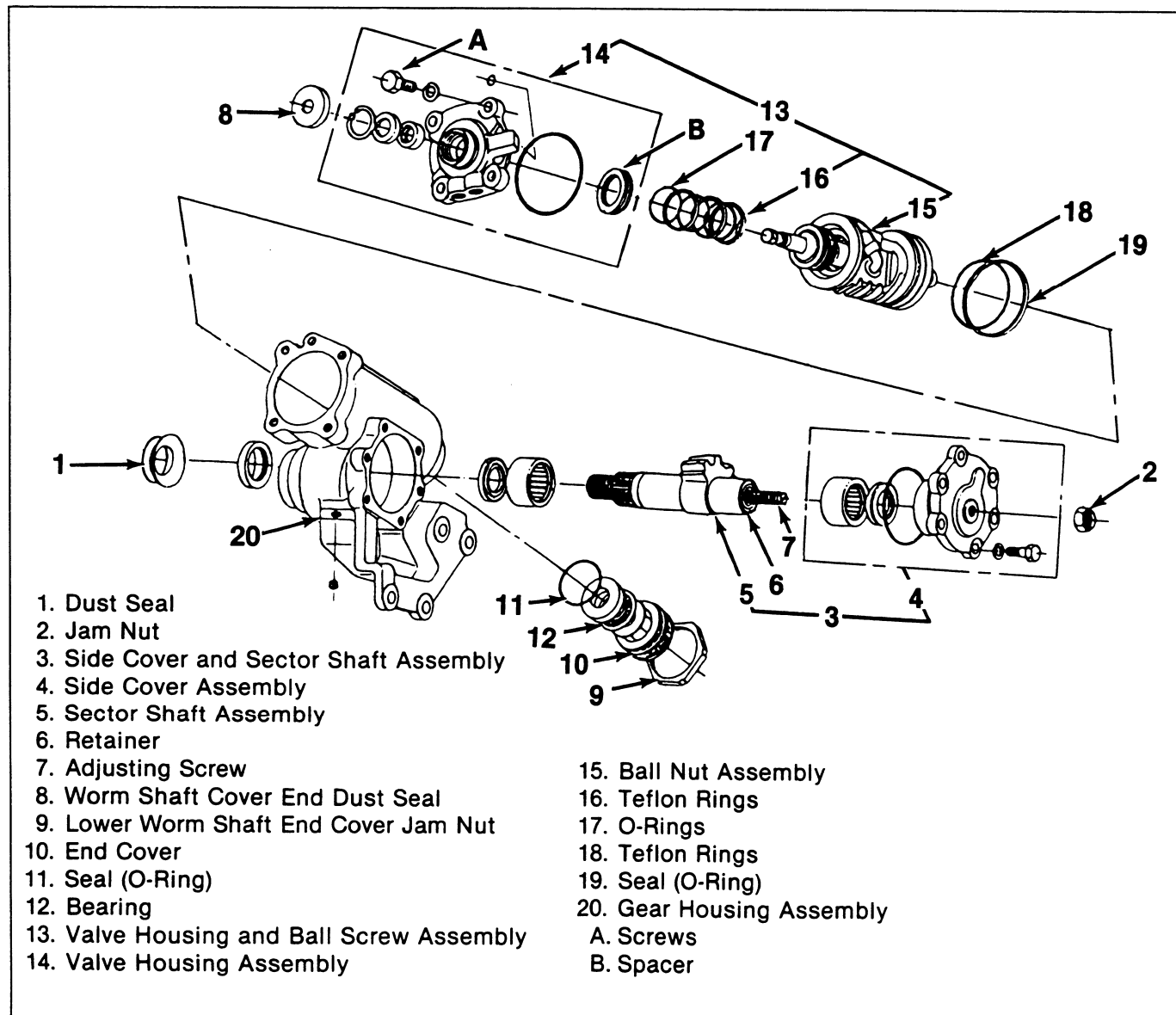


Figure 5. Steering Gear Major Components

NOTICE: When repairing a power steering gear or pump, if broken components or foreign material are encountered, the remaining components of the entire hydraulic system should be disassembled, inspected, cleaned, and flushed before servicing is completed or serious damage to the system may result.

REMOVAL OF MAJOR SUB-ASSEMBLIES FROM POWER STEERING GEAR UNIT

Remove or Disconnect

- Steering gear, as outlined previously in this section.

Clean

- Exterior of steering gear with solvent.

Disassemble (Figures 5 through 12)

- Dust seal (1).
- Jam nut (2).
- Side cover and sector shaft assembly (3) from the rest of the unit.
 - Align the sector shaft major components (5) to a neutral position by turning the input shaft of the steering gear to lock and backing off approximately 2.5 turns.

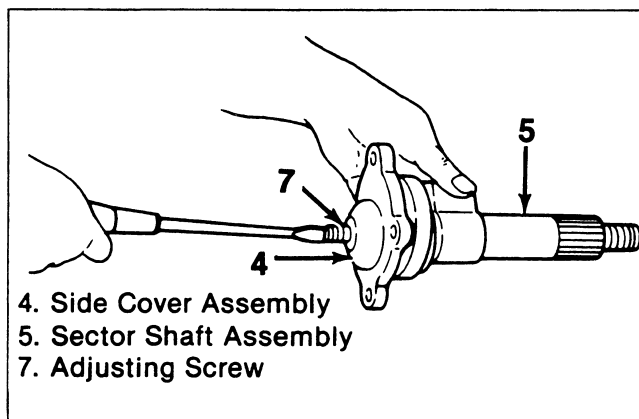


Figure 7. Sector Shaft Assembly/Disassembly

- Sector shaft assembly (5) from side cover assembly (4) by turning the adjusting screw (7) clockwise (figure 7).
- Screw retainer (6) (figure 8).
 - Flatten out staked portion of the screw retainer (6) and remove retainer (figure 8).
 - A tool (A) must be fabricated to remove and install the retainer (figure 8).
 - Obtain a nut that will fit into the hex cutout in the screw retainer. Weld or braze the nut to a suitable deep-well socket. Drill the nut out, if necessary, so the tool will fit over the sector shaft adjusting screw (7) (figure 8).

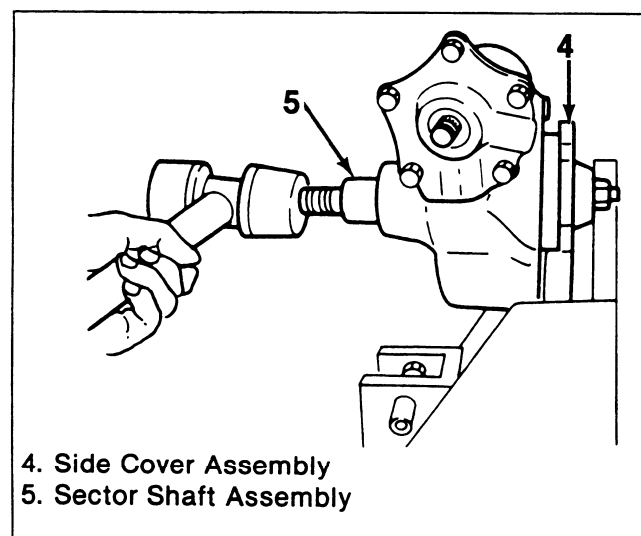


Figure 6. Sector Shaft and Cover Removal

- Turn the adjusting screw (7) counterclockwise slightly. Then remove the bolts from the side cover assembly (4).
- Then remove the side cover assembly (4) and sector shaft assembly (5) by tapping on the end of the sector shaft with a plastic hammer (figure 6).

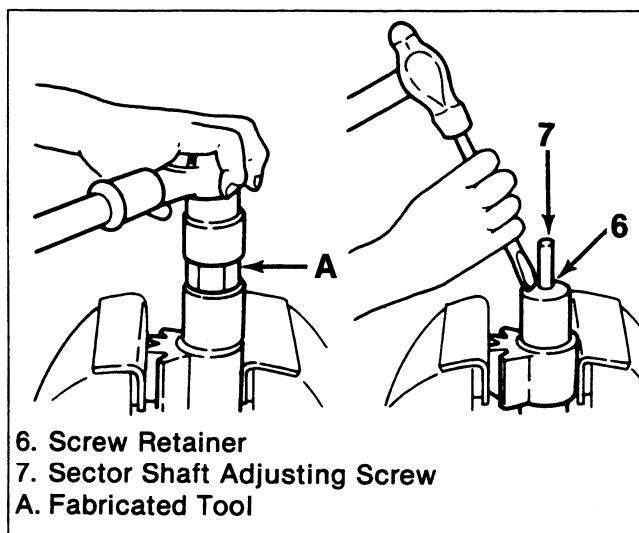


Figure 8. Sector Shaft Retainer Removal

- Sector shaft adjusting screw (7) (figure 8).
- Worm shaft cover end dust seal (8) (figure 5).
- Lower worm shaft end cover jam nut (9) (figure 5).
- End cover (10) with a spanner wrench (figure 5).
- Seal (O-ring) (11) (figure 5).
- Bearing (12) (figure 5).
- Screws (A) retaining valve housing and ball

screw assembly (13) to gear housing assembly (20) (figure 5).

13. Valve housing and ball screw assembly (13) (figure 5).

Important

- Always keep the valve housing and ball screw assembly (13) in a horizontal position and avoid holding it vertically, or ball nut will slide out (figure 9).
- Remove this assembly from the housing by tapping on the end of the ball screw assembly with a plastic hammer (figure 9).

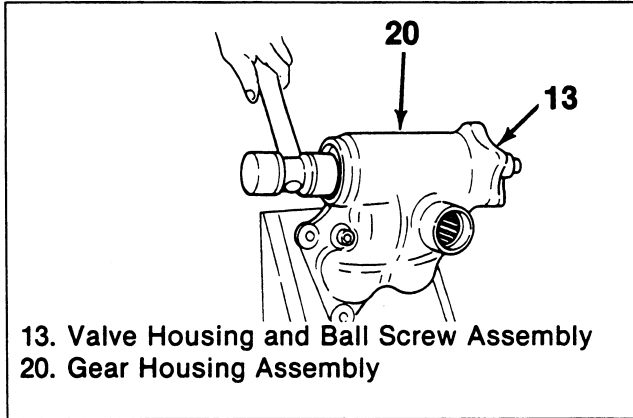


Figure 9. Ball Nut and Screw Removal

Side Cover Disassembly (Figure 10)

- Remove the seal (O-ring) (22), the needle bearing (24), and the seal (23) from the side cover (21).

Valve Housing Disassembly (Figure 11)

- Remove the snap ring (25), oil seal (26), needle bearing (27), and seal (O-ring) (29) from the valve housing (28).

Gear Housing Disassembly (Figure 12)

- Remove the outer sector shaft seal (30), the needle bearing (31), and the inner seal (32), from the gear housing (33) (figure 12).

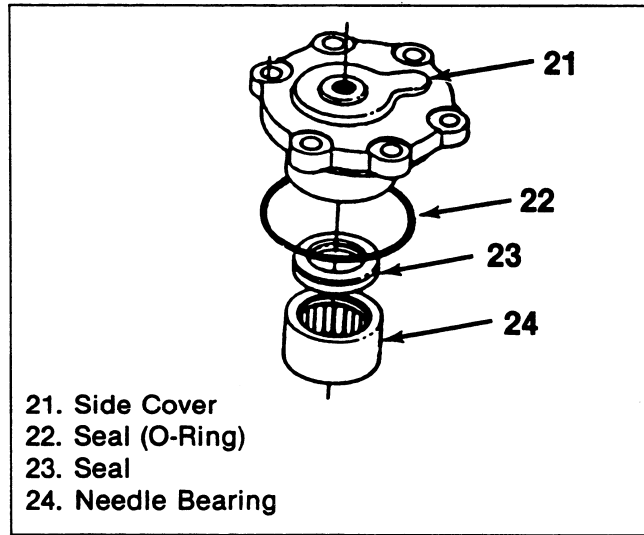


Figure 10. Sector Shaft Side Cover

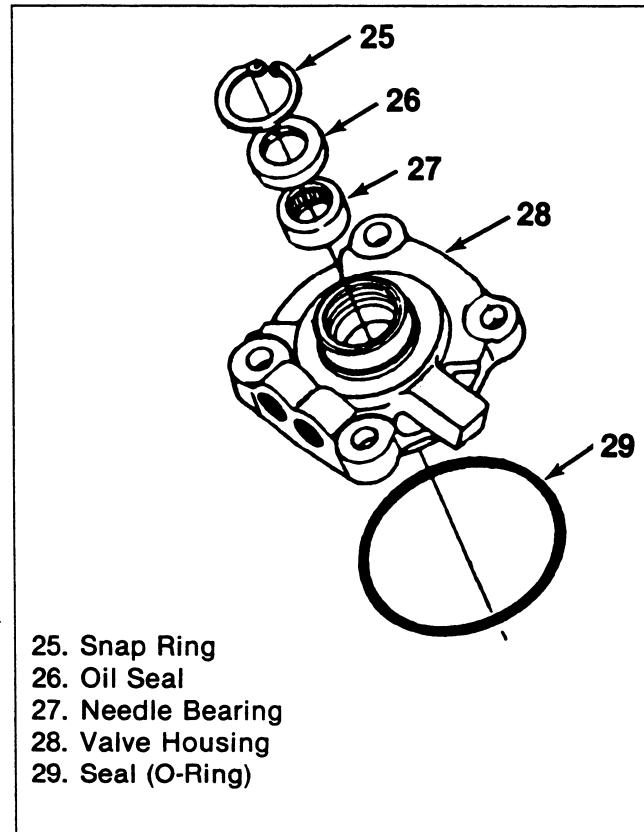
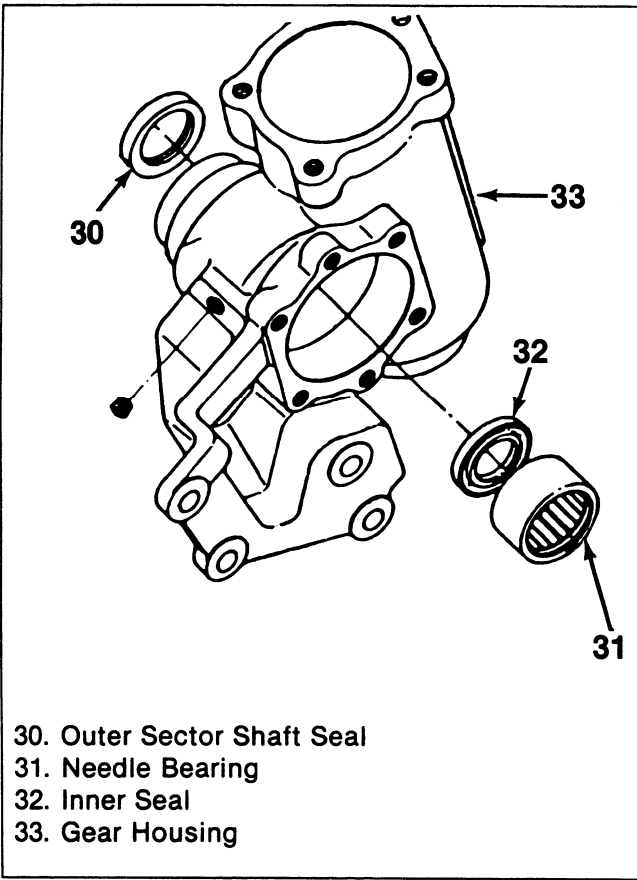


Figure 11. Control Valve Housing



- 30. Outer Sector Shaft Seal
- 31. Needle Bearing
- 32. Inner Seal
- 33. Gear Housing

Figure 12. Steering Gear Housing

CLEANING, INSPECTION AND REPAIR

Clean

- All parts in clean solvent. Blow parts dry with compressed air.

Inspect

Make necessary corrections or parts replacement if worn, damaged or any other abnormal conditions are found through inspection. Inspect the following parts for wear, damage or other abnormal conditions.

- Housing.
- Sector shaft.
- Needle roller bearing.
- Ball screw assembly
- Oil seal, dust cover, inner seal, seal (O-ring) and snap ring.

Ball Nut Rotation

Hold the worm shaft vertically and see if the ball nut rotates smoothly. If lowering of the ball nut with its own weight is not smooth, check the worm shaft for bending and ball groove for burrs, dents and the presence of foreign matter.

Important

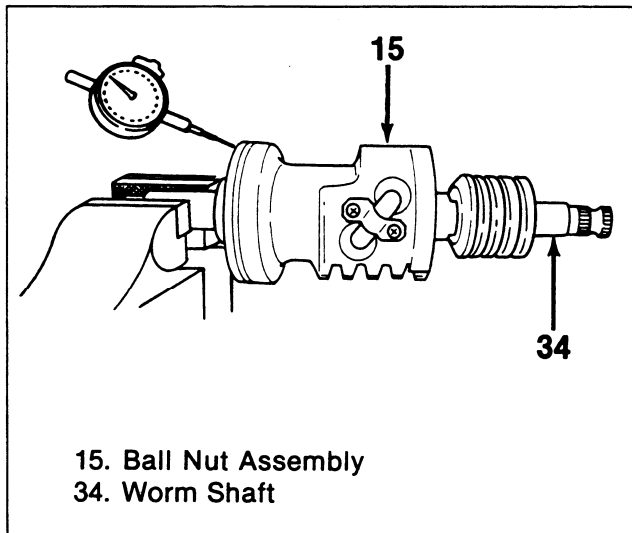
- When making a test on the ball screw assembly, exercise care not to strike the ball nut against the end of the worm shaft, or damage to the ball tubes will result.

Ball Nut Assembly

- Ball nut assembly and control valve assembly include precision-finished parts of selective fitting.
- Always keep the ball nut assembly in a horizontal position and avoid holding it vertically, or ball nut will slide out.
- If any defects exist in the ball nut or in the control valve, the assemblies should be replaced with new parts.

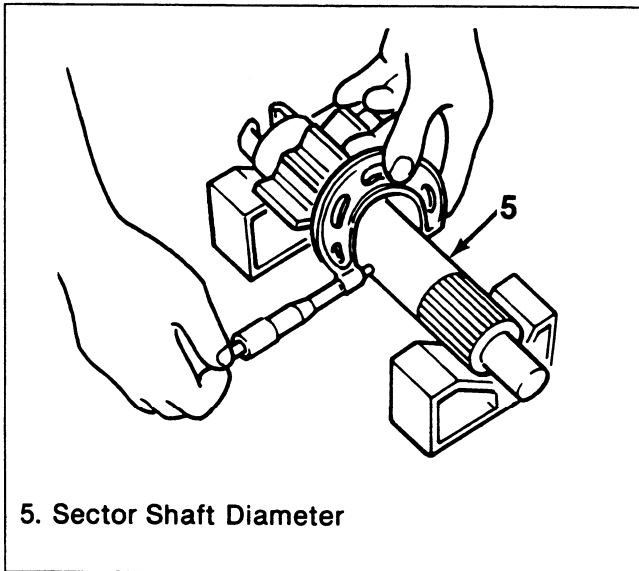
Measure (Figures 5, 13, 14 and 15)

- Ball nut piston axial play. Use a dial indicator to check the axial play as shown in figure 13. If play exceeds 0.2 mm (0.008 in), replace the worm/ball nut piston assembly. The ball nut assembly (15), worm shaft (34), and balls are selectively fitted and are not available separately.
- Ball nut assembly (15) to gear housing assembly (20) bore clearance (figure 5). Measure the ball nut piston diameter, using a micrometer. Measure the housing bore inside diameter, using an inside micrometer. Subtract the ball nut piston diameter from the housing bore inside diameter to obtain the clearance. The production clearance is 0.1 mm (0.004 in). Replace the piston and/or housing if clearance exceeds specification.



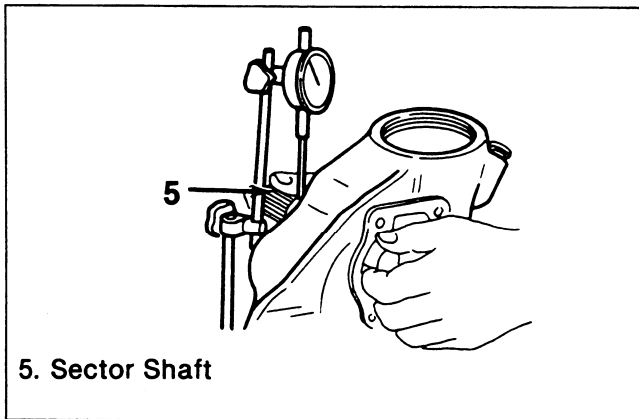
- 15. Ball Nut Assembly
- 34. Worm Shaft

Figure 13. Measuring Ball Nut Axial Play



5. Sector Shaft Diameter

Figure 14. Measuring Sector Shaft



5. Sector Shaft

Figure 15. Measuring Sector Shaft to Bearing Clearance

Ball nut assembly

 **Assemble (Figure 5)**

1. New teflon ring (18) to ball nut assembly (15).
2. New seal (O-ring) (19) to ball nut assembly (15).
3. New teflon rings (16) and new seals (O-rings) (17) to ball nut assembly (15).
4. Keep ball nut assembly (15) clean until ready to assemble into gear housing assembly (20).

Housing Assembly

 **Assemble (Figure 12)**

1. Inner seal (32) into sector shaft bore.
2. Needle bearing (31) into sector shaft bore.
3. Outer sector shaft seal (30) into outer housing seal bore.

Sector Shaft Assembly

 **Inspect (Figure 5)**

1. Seal mating surfaces for nicks or damage.
2. Gear teeth for wear or damage.
3. Adjusting screw (7) for thread damage. The adjusting screw must turn smoothly in the sector shaft assembly(5), and not be excessively loose.
Replace, if necessary, as outlined later.
4. Splines and threads for damage.

 **Measure (Figures 5, 14 and 15)**

- Sector shaft outside diameter(5) with micrometer (figure 14). The standard diameter is 38.082 mm (1.50 in). Replace the sector shaft if the diameter is less than 38.0 mm (1.496 in).
- Sector shaft (5) to needle bearing clearance (figure 15).
- Install a dial indicator as shown in figure 15.
- Measure the clearance. If more than 0.2 mm (0.008 in), replace the sector shaft and/or bearing as needed.

 **Assemble (Figure 8)**

- Discard used retainer and install a new one. Use tool (A) fabricated during disassembly. Install and fully tighten the screw retainer (6) and back off 180 °. Retighten to a torque 39 N·m (29 lb·ft) and back off 20 degrees. Check that the sector shaft adjusting screw (7) turns smoothly.
- Stake the screw retainer (6) in position.

Side Cover Assembly

 **Inspect (Figure 10)**

- Side cover (21) for cracks or damage to the sealing surface.

 **Assemble (Figure 10)**

1. Seal (23) into side cover (21).
2. Press needle bearing (24) into side cover (21).
3. Seal (O-ring) (22) onto side cover (21).

Sector Shaft to Side Cover

- Fit the sector shaft into the side cover (figure 7).

 **Adjust (Figure 7)**

Turn the adjusting screw (7) counterclockwise until the end of the sector shaft assembly (5), bottoms in the side cover assembly (4) then turn one full turn clockwise.

Valve Housing Assembly

Inspect (Figure 11)

- For internal scoring and worn grooves.
- Valve housing (28) for cracks.
- Snap ring groove to be square.

Assemble (Figure 11)

1. Press needle bearing (27) into valve housing (28).
2. Press oil seal (26) into valve housing (28) with lip facing bearing.
3. Snap ring (25) in groove.
4. Seal (O-ring) (29) onto valve housing (28).

ASSEMBLING MAJOR SUB-ASSEMBLIES INTO POWER STEERING GEAR UNIT

Assemble (Figures 5, 16, 17, 18 and 19)

NOTICE: See “NOTICE” on Page 3B3-1 of this section for steps 3, 5, 7, 8 and 12.

- Install gear housing (20) in a vise, clamped-by the mounting flange with the ball nut bore horizontal.
- Lubricate the ball nut assembly (15) with automatic transmission fluid (figure 5).
 1. Spacer(B) on the splined end of the input shaft.
 2. Ball nut assembly (15) fully into the gear housing assembly bore (20) (figure 5).
 - Lubricate the valve housing assembly (14) bearing and seal with automatic transmission fluid (figure 5).
 3. Valve housing assembly (14) onto the gear housing assembly (20) (figure 5).

Tighten

- Valve housing bolts to 86 N·m (64 lb·ft).
4. Seal (O-ring) (11) on the lower worm shaft end cover (10) (figure 5).
 - Lubricate the bearing (12) with automatic transmission fluid and install them onto the worm shaft of the ball nut assembly (15) (figure 5).
 5. End cover (10) with spanner wrench J-35767 (C) (figure 16).

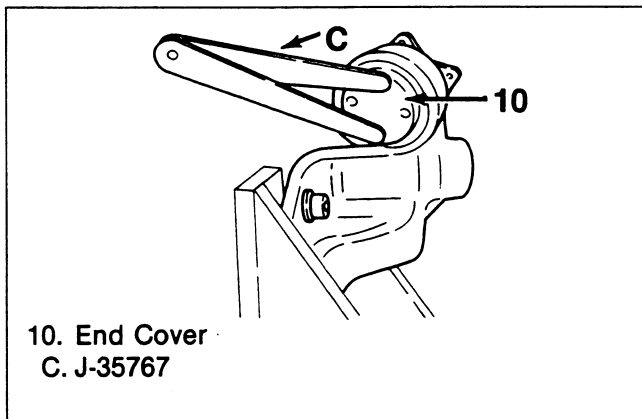


Figure 16. End Cover Installation

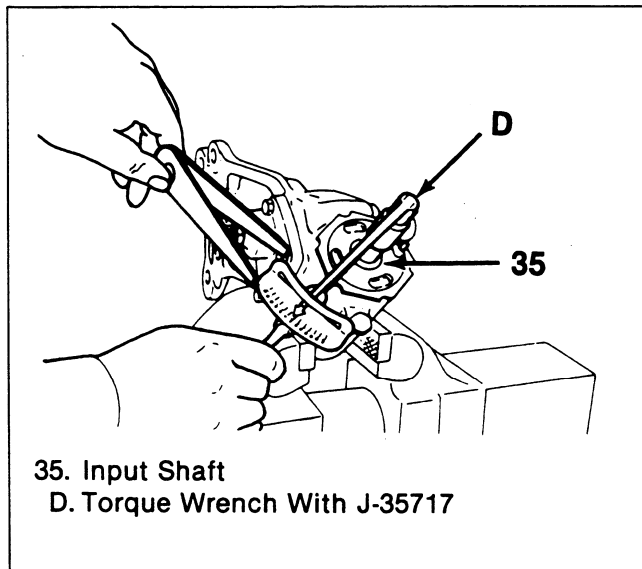


Figure 17. Setting Preload on Ball Nut Assembly

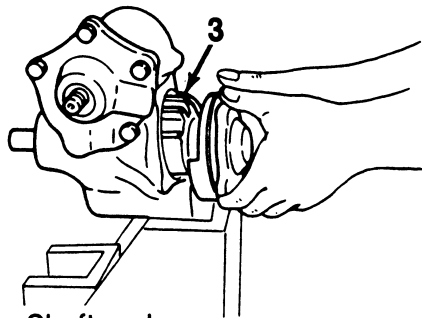
Measure

- Place torque wrench (D) and socket J-35717 on the input shaft (35) (figure 17).
- Tighten the end cover with J-35767 until a starting torque reading of 0.4 N·m (0.3 lb·in) is observed on the input shaft.

6. End cover jam nut.

Tighten

- Jam nut to 196 N·m (145 lb·ft).
 - Recheck the starting torque and readjust if necessary.
7. Center the ball nut teeth in the sector shaft opening.
 8. Lubricate the sector shaft and install it and the side cover assembly in the housing bore (figure 18), aligning the center tooth of the sector shaft with the center tooth of the ball nut.



3. Sector Shaft and Side Cover Assembly

Figure 18. Installing Sector Shaft

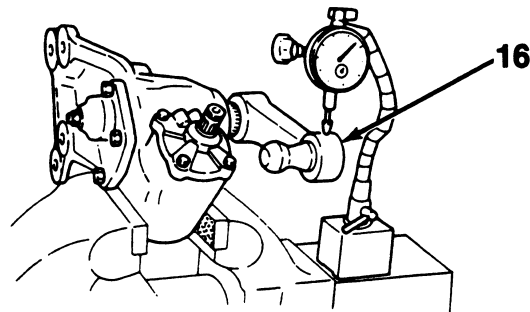
Tighten

- Side cover bolts to 47 N·m (35 lb·ft).

9. Pitman arm onto the sector shaft until no looseness or play exists between the arm and shaft.

Adjust

- 1) Center the sector and ball nut teeth in the gear housing by turning the input shaft to the limit of travel in each direction. Count the turns from end to end. Then turn the input shaft one half that number of turns from one end.
- 2) Set a dial indicator to read pitman arm (16) movement (figure 19).



16. Pitman Arm

Figure 19. Measuring Sector Shaft Backlash

- 3) Turn the sector shaft adjusting screw until a maximum of 0.33 mm (0.013 in) movement of the pitman arm exists when measured at the end of the arm.

10. Jam nut (2) on end of adjuster screw (7) (figure 5).

Tighten

- Jam nut to 68 N·m (50 lb·ft).

Inspect

- Recheck the total starting torque of the input shaft (figure 17). When the unit is fully assembled, the specification is 0.7 N·m (0.5 lb·in).

HYDRAULIC PUMP UNIT REPAIR

Power steering components are a combination of many machined, polished surfaces with very fine tolerances.

When these components are serviced, care and cleanliness are important. The workbench, hands, tools, and component parts must be kept clean at all times. The entry of even small amounts of dirt into the component may cause an unsatisfactory repair and possible damage to the component. The dirt may also be carried by the power steering fluid to other components in the power steering system, causing damage to other components as well.

NOTICE: When repairing a power steering gear or pump, if broken components of foreign material are encountered, the remaining components of the entire hydraulic system should be disassembled, inspected, cleaned, and flushed before servicing is completed or serious damage

to the system may result.

Remove or Disconnect

- Hydraulic pump, as outlined previously.

Clean

- Exterior of hydraulic pump.

Disassemble (Figures 20, 21, 22 and 23)

1. Elbow (1), and seal (O-ring) (2) (figure 20).
2. Connector (3), seal (O-rings) (4), flow control valve assembly (5), and spring (6) (figure 20).

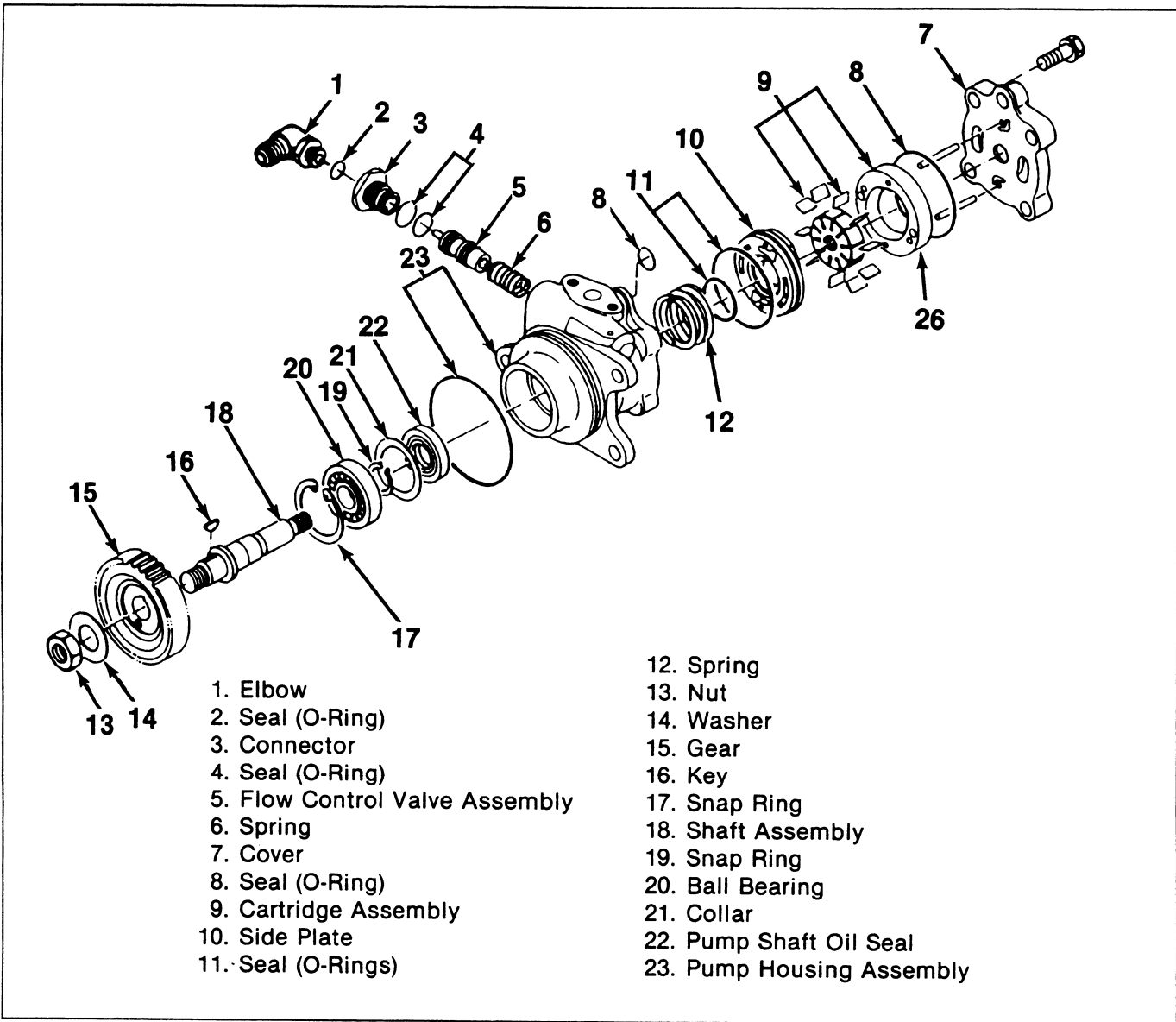


Figure 20. Power Steering Oil Pump

- 3. Cover (7), seal (O-ring) (8), cartridge assembly (9), side plate (10), seal (O-rings) (11), and the spring (12) (figure 20).
- 4. Nut (13), washer (14) and gear (15) (figure 20).
- 5. Key (16), snap ring (17) and the shaft assembly (18) (figure 20).
 - Use a mallet to remove the shaft assembly from the housing (figure 21).
- 6. Snap ring (19), and ball bearing (20). A press and rod will be necessary to remove the ball bearing from the shaft (figures 20 and 22).
 - Use a brass drift (C) to remove the oil seal from the housing (23) (figure 23).

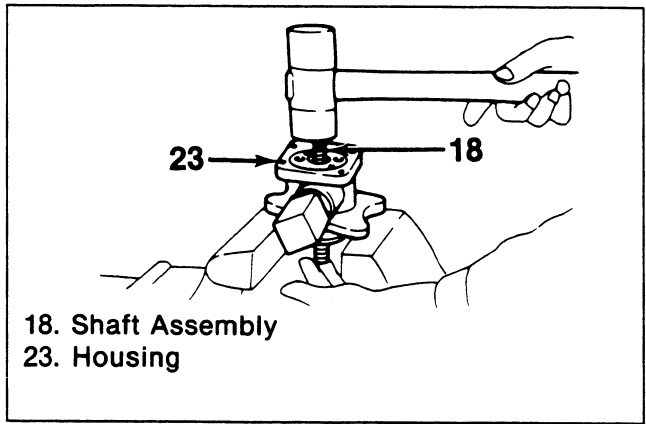
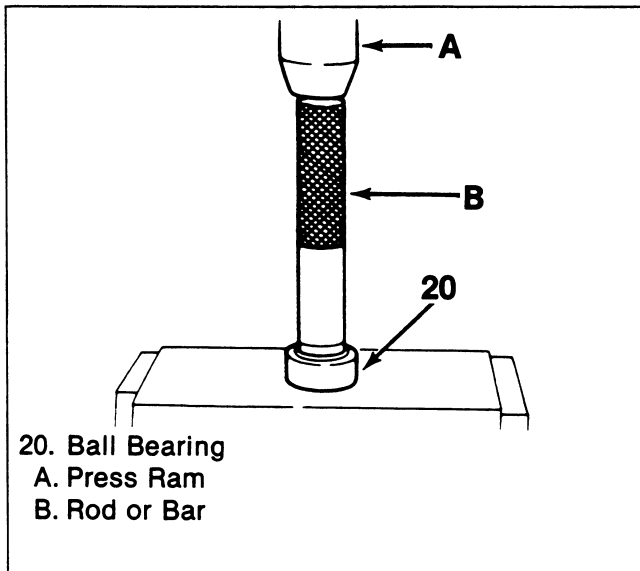
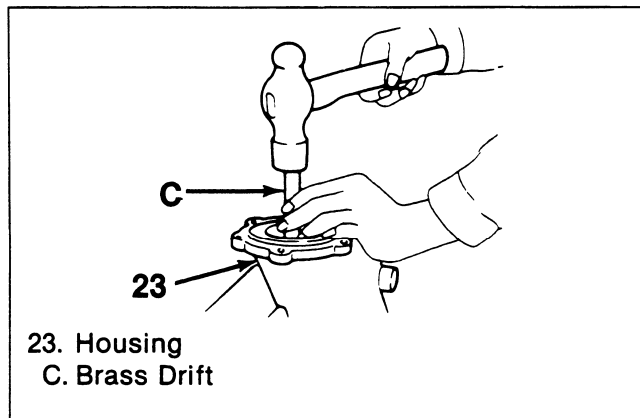


Figure 21. Removing Power Steering Pump Shaft Assembly From Housing



20. Ball Bearing
A. Press Ram
B. Rod or Bar

Figure 22. Removing Pump Shaft Bearing



23. Housing
C. Brass Drift

Figure 23. Removing Oil Seal from Pump Housing

Clean

- All parts in a suitable solvent and blow dry with compressed air. Be sure to use clean solvent to clean internal parts.

Inspect (Figure 20)

- Cartridge assembly (9).
 - Vane tips of cartridge assembly for wear.
 - Vanes for scoring or wear.
 - Inner surface of the ring for scoring, wear, damage, etc.
 - Fit of the vanes in the rotor. The vanes must fit properly in the rotor slots, without sticking or excessive play. Also check for burrs in the rotor slots, and excessive wear at the thrust faces.
 - If heavy wear is present, or if parts are damaged, replace the entire cartridge

assembly (9).

- Side plate (10) for wear at the thrust faces. Replace if excessive wear is evident.
- Ball bearing (20). If the bearing is rough or loose, replace it as outlined later in this section.
- Seal contact area of the shaft assembly (18). If fretting or roughness is present, replace the shaft.
- Gear (15) for rough or chipped teeth.
- Flow control valve assembly (5) for scoring or burrs. Also, inspect the flow control valve bore in the pump housing (23) for burrs.

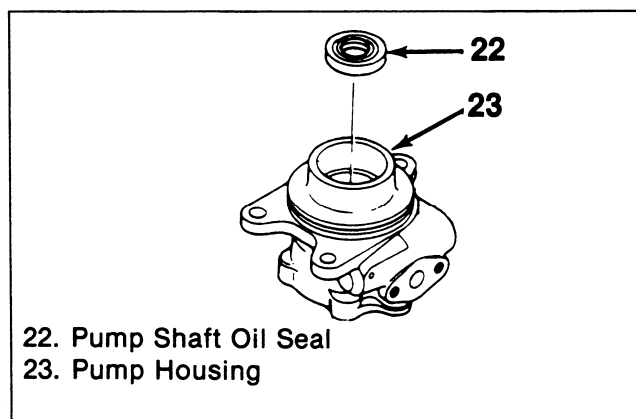
Assemble (Figures 20, 24, 25 and 26)

NOTICE: See 'NOTICE' on page 3B3-1 of this section for steps 7, 10 and 11.

1. Pump shaft oil seal (22) into the pump housing (23) using a proper size rod and press or hammer (figure 24).
2. Collar (21) into the pump housing (23) (figure 20).
3. Press the shaft assembly (18) into the ball bearing (20) (figure 25).
4. Snap ring (19) (figure 20).
5. Shaft assembly (18) into the pump housing assembly (23) (figure 20).
6. Snap ring (17) into the pump housing assembly (23) (figure 20).
7. Key (16), gear (15), washer (14), and nut (13) onto the shaft assembly (18). The long hub of the gear faces the pump housing assembly (figure 20).

Tighten

- Hold the gear (15) and torque the nut (13) to 88 N·m (65 lb-ft).



22. Pump Shaft Oil Seal
23. Pump Housing

Figure 24. Installing Seal into Housing

8. Vanes (25) in the rotor (24) with the flat edge (E) facing inward (figure 26).
9. Vanes (25) and rotor (24) into the cam ring. Any stamped marks on the cam ring or rotor face the

housing.

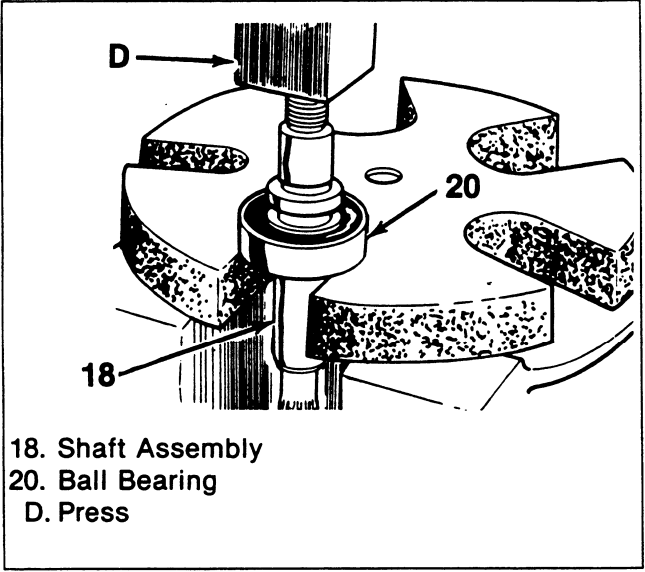


Figure 25. Installing Shaft into Bearing

10. Spring (12), seal (O-rings) (11), side plate (10), cartridge assembly (9), seal (O-ring) (8), and cover (7) to the pump housing assembly (23) (figure 20).

 Tighten

- Cover bolts to 35 N·m (26 lb·ft).

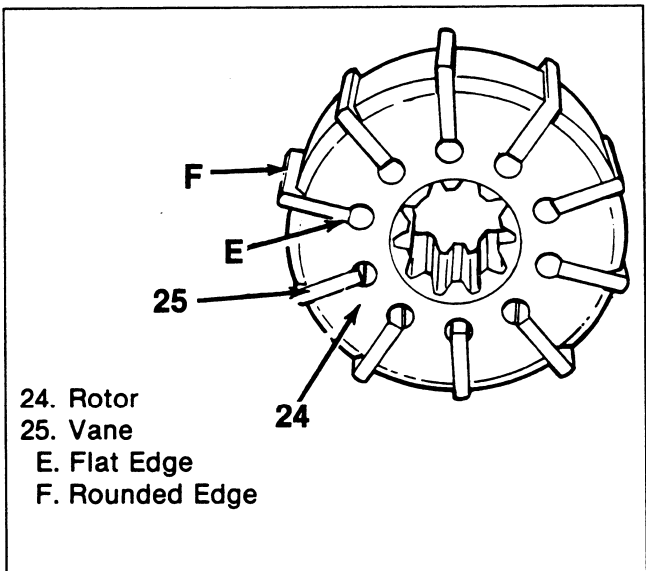


Figure 26. Installing the Vanes

11. Spring (6), flow control valve assembly (5), seal (O-rings) (4), connector (3), seal (O-ring) (2), and elbow (1).

 Tighten

- Connector to 77 N·m (57 lb·ft).
- Elbow (1) to 73 N·m (54 lb·ft).

SPECIFICATIONS

| | |
|---|----------------------|
| Ball Nut Piston Axial Play | 0.2 mm (0.008 in) |
| Ball Nut Piston to Housing Bore Clearance | 0.1 mm (0.004 in) |
| Sector Shaft Diameter | 38.000 mm (1.496 in) |
| Sector Shaft to Needle Bearing Clearance | 0.2 mm (0.008 in) |
| Backlash (Measured at End of Pitman Arm)..... | 0.33 mm (0.013 in) |
| Starting Torque of Input Shaft | 0.4 N·m (0.3 lb-in) |
| Final Starting Torque of Input Shaft | 0.7 N·m (0.5 lb-in) |

FASTENER TORQUES

| | |
|--|---------------------|
| Steering Gear to Frame Rail Bolts | 102 N·m (75 lb-ft) |
| Steering Shaft U-Joint Clamp Bolt | 38 N·m (28 lb-ft) |
| Sector Screw Retainer | |
| (1) Fully Tighten Retainer and Loosen 180°. | |
| (2) Torque to 39 N·m (29 lb-ft). | |
| (3) Loosen 20 degrees. | |
| Steering Gear Valve Housing Bolts..... | 86 N·m (64 lb-ft) |
| End Cover Jam Nut..... | 196 N·m (145 lb-ft) |
| Steering Gear Side Cover Bolts | 47 N·m (35 lb-ft) |
| Sector Adjusting Screw Jam Nut..... | 68 N·m (50 lb-ft) |
| Steering Gear Fluid Tube Nuts | 45 N·m (33 lb-ft) |
| Pump Gear Nut | 88 N·m (65 lb-ft) |
| Power Steering Pump End Cover to Pump Housing Bolts..... | 35 N·m (26 lb-ft) |
| Pump Flow Control Valve Connector | 77 N·m (57 lb-ft) |
| Pump Elbow Fitting to Connector..... | 73 N·m (54 lb-ft) |

SPECIAL TOOLS

| | |
|-----------|-------------------------------|
| J-35719 | Adapter Kit |
| J-35717 | Steering Shaft Socket |
| J-26487-A | Power Steering Analyzer |
| J-35767 | Power Steering Locknut Wrench |