

General Information

The TRW PS Series power steering pump supplies fluid for the operation of the power steering gear. See **Fig. 1**.

flow returns to normal, flowing from the inlet port to the outlet port and then into the power steering system.

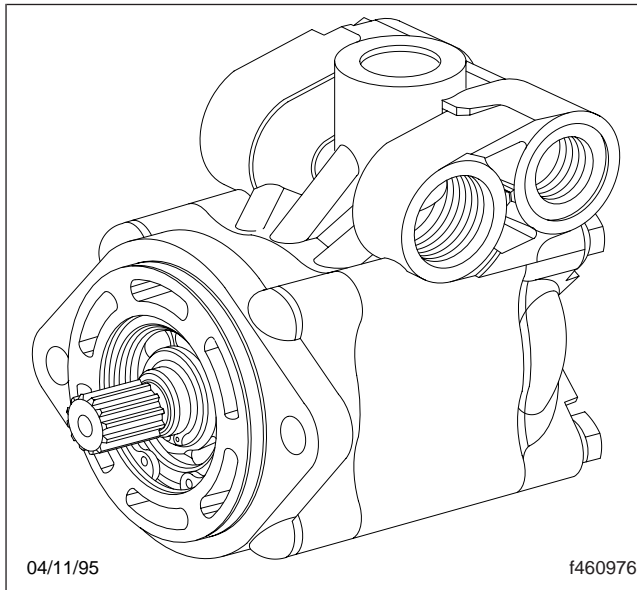


Fig. 1, TRW PS Series Power Steering Pump

The main parts of the power steering pump are the housing, input shaft, cam ring, rotor, vanes, control valve, and cover assembly.

Principles of Operation

The input shaft, powered by the adaptor gear in the engine gear case, or by the crankshaft pulley, turns the rotor, which is inside the cam ring. As the rotor turns, centrifugal force pushes the vanes out toward the surface of the cam ring. As fluid enters the cam ring through the inlet port, the rotor vanes force it out through the outlet port, and into the system. The fluid operates the steering gear. Eventually the fluid returns to the power steering reservoir, and then back to the power steering pump.

If the system pressure gets too high, a relief valve inside the control valve is forced off its seat, shunting fluid into a relief passage connected to the inlet port. The fluid then recirculates inside the pump instead of going to the outlet port. When the system pressure drops to the correct level, the relief valve seats, closing off the relief passage to the inlet port. The fluid

Steering Pump Removal and Installation

Removal

1. Apply the parking brake, chock the tires.
2. Clean all outside dirt from around the fittings and hose connections.
3. Put a container under the pump, then disconnect the hoses from the fittings on the pump. Plug the hoses and cap the fittings to keep out dirt and to prevent fluid from leaking.
4. Remove the mounting capscrews and lockwashers that attach the pump to the engine accessory drive mounting flange. See [Fig. 1](#). Hold the pump as you remove the second mounting bolt.

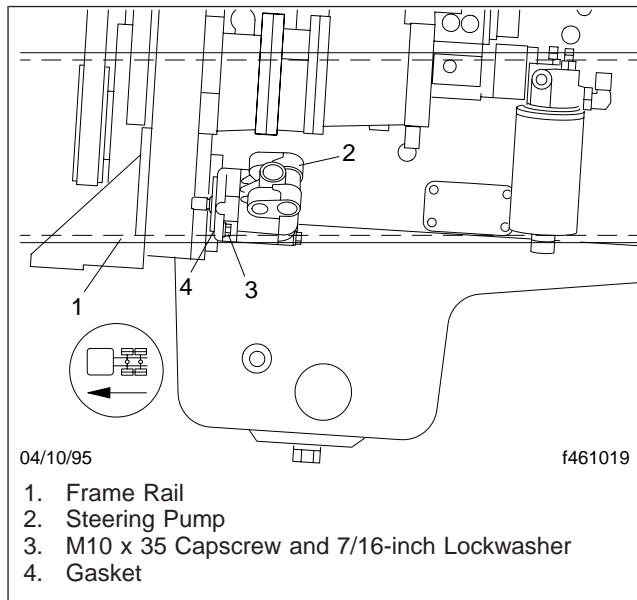


Fig. 1, TRW PS Series Power Steering Pump Mounting

5. Pull the pump straight out from the engine. Keep it level to avoid spilling fluid.
 6. Turn the pump upside down over a container and let the fluid drain out.
 7. Discard the gasket from the pump mounting flange.
2. Install the new gasket on the pump mounting flange, then place the pump on the engine's accessory drive mounting flange.
 3. Install the lockwashers and capscrews, and tighten them 35 lbf-ft (46 N-m).
 4. Connect the inlet hose (from the power steering reservoir) to the inlet port. Tighten it 26 lbf-ft (35 N-m).
 5. Connect the outlet hose (from the power steering gear) to the outlet port.
 6. Bleed the power steering system.
 - 6.1 Check the fluid level in the power steering reservoir and if needed, fill it to the correct level. For the approved steering system fluid, see [Specifications, 400](#).
 - 6.2 Start the engine and let it idle for several minutes.
 - 6.3 Turn the wheels to a full-left and full-right turn. Repeat three times.
 - 6.4 Check the fluid level in the power steering reservoir. Add fluid as necessary to the full line on the reservoir dipstick.
 - 6.5 Shut down the engine.
 7. Remove the chocks.

Installation

1. Using engine oil, lightly lubricate a new gasket and the pump shaft.

Steering Pump Disassembly, Inspection, and Assembly



CAUTION

Be careful when working on the pump housing; it is aluminum, and can be easily damaged. When putting the pump in a vise, pad the vise jaws and clamp only the cover; tighten the vise just enough to hold the pump.

Disassembly

NOTE: Prepare for fluid drainage before disassembling the pump.

1. Remove the power steering pump from the engine, following the instructions in [Subject 100](#).
2. Carefully remove the end plug from the pump housing. See [Fig. 1](#) and [Fig. 2](#). Remove the spring, if it didn't come out with the end plug. See [Fig. 3](#).
3. Remove and discard the O-ring from the plug.
IMPORTANT: TRW does not recommend disassembly of the control valve spool assembly.
4. Remove the control valve spool assembly by hand, or by pushing it with a small rod. See [Fig. 4](#). Don't push on the small screen in the relief valve seat assembly.
5. Using a solvent-proof marker, make a mark across the housing and the cover. See [Fig. 5](#). Remove the four screws and washers that hold the housing and the cover together. See [Fig. 6](#). Using a twisting motion, separate the housing from the cover.
6. Remove the spring. See [Fig. 7](#).
7. Using a solvent-proof marker, draw a line across the top plate and the bottom plate. See [Fig. 8](#).
8. Holding the cam ring in place, remove the top plate. See [Fig. 9](#). Remove and discard the O-ring and backup O-ring.
9. Holding the bottom plate in place, remove the cam ring. Note and record whether the dots near the locating pin holes on the cam ring are up or down. See [Fig. 10](#).
10. Look for wear on the outside edge of the vanes. Note and record the direction of the wear for assembly. Carefully remove the rotor and vanes, as the vanes will slip from their slots in the rotor. See [Fig. 11](#).

11. Remove the locating pins. See [Fig. 12](#). Make marks on the outside of the cover (not on the sealing surface) to note from which holes the locating pins were removed.
12. Remove the bottom plate. See [Fig. 13](#).
13. Turn the cover over and remove the large retaining ring. See [Fig. 14](#).
14. Press out the input shaft and ball bearing assembly. See [Fig. 15](#).
15. Remove the spacer from the cover. See [Fig. 16](#).
16. Using care not to damage the bore, remove the shaft seal. See [Fig. 17](#).

Inspection

1. Clean all the parts, using a solvent compatible with the steering system hydraulic fluid. Then, using filtered compressed air, dry all the parts.
NOTE: Replace any parts that are damaged or worn.
2. Inspect the housing for cracks, stripped threads, a damaged valve bore, and damaged sealing areas. See [Fig. 18](#).
3. Inspect the cover for nicks in the O-ring seal grooves. Make sure that the seal drain hole is open, and that the seal bore is free of nicks and other damage. See [Fig. 19](#).
Make sure that the surface on which the bottom plate rests is flat and free of nicks and other damage.
4. Check that the needles roll freely in the needle bearing. If needed, replace the needle bearing, as follows.

- 4.1 Place the cover in a press with the flange side down. Using an 11/16-inch socket, press the needle bearing out of the cover. See [Fig. 20](#).



CAUTION

Make sure that the press is clean and free of debris. Debris could damage the face of the cover, which will affect pump operation.

- 4.2 Put the cover in a clean press with the flange side up. Make sure that the lettered

Steering Pump Disassembly, Inspection, and Assembly

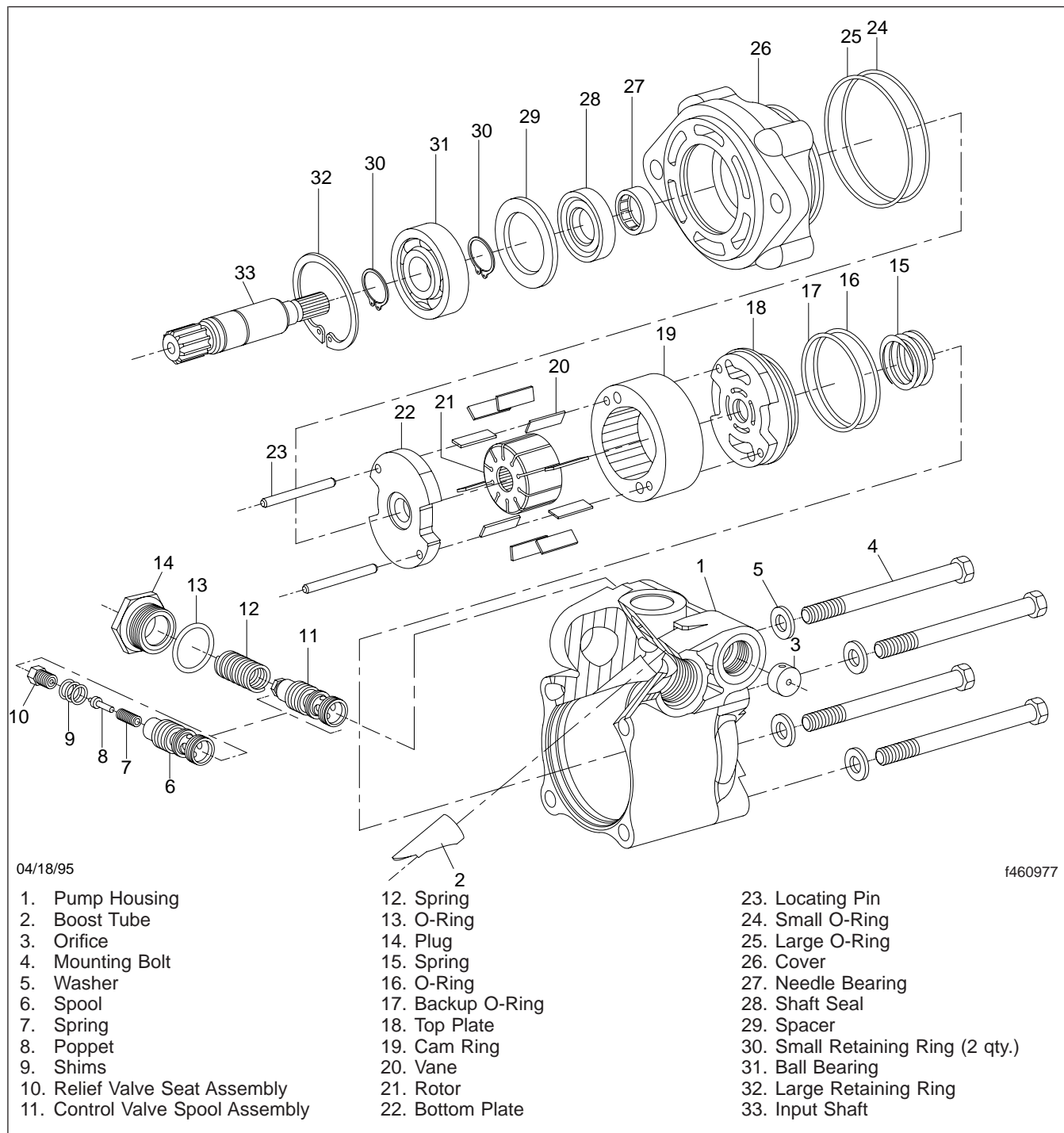


Fig. 1, Steering Pump, Exploded View

Steering Pump Disassembly, Inspection, and Assembly

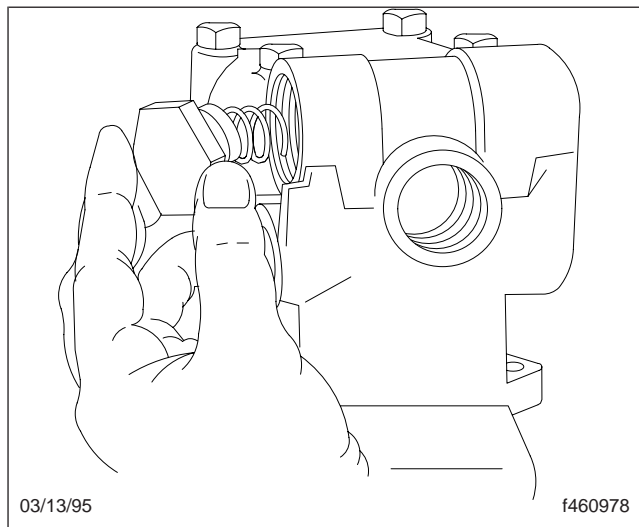


Fig. 2, Removing the End Plug

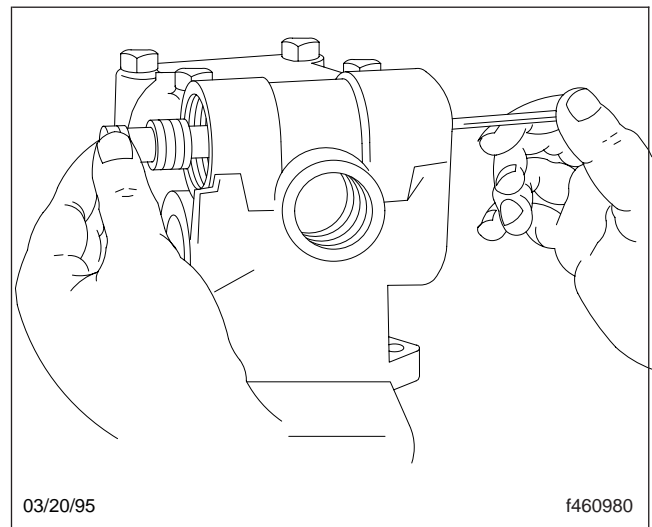


Fig. 4, Removing the Control Valve Assembly

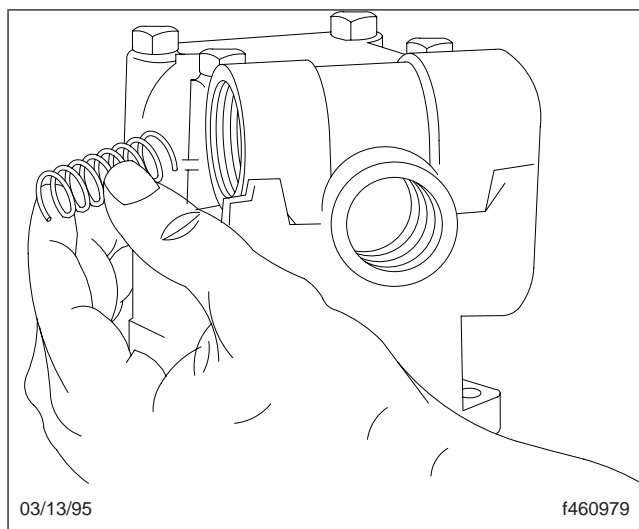


Fig. 3, Removing the Spring

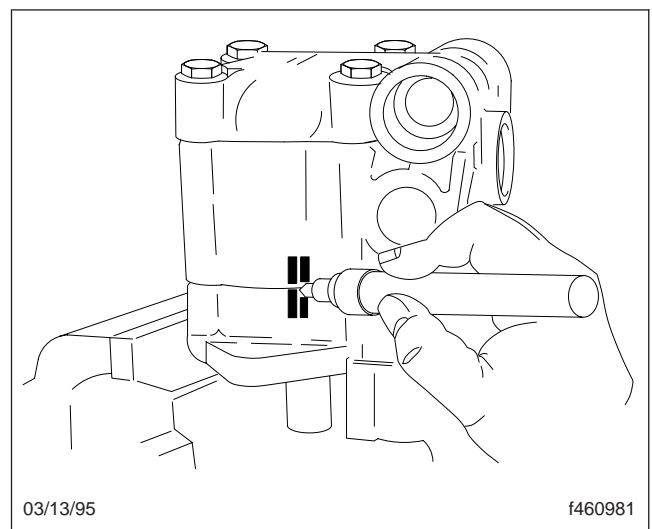


Fig. 5, Marking the Housing and the Cover

- side of the needle bearing is facing toward the press.
- 4.3 Using a 7/8-inch deep socket, press the new needle bearing into the cover until it is flush with the inside surface of the cover. See [Fig. 21](#).
 5. Inspect the top plate for seal area nicks, and abnormal wear or erosion. A polished pattern from the rotor and vanes is normal; grooves you can feel with your fingernail are not normal.

6. Look for abnormal wear, erosion, or surface damage on the inside of the cam ring.
7. Check the vanes on the rotor for damage or too much play in the rotor slots. See [Fig. 22](#). If you can move the vanes from side-to-side in the slots, replace the whole rotor assembly.

NOTE: If the vanes are removed, make sure they are installed with the rounded edge out.

8. Check the bottom plate for abnormal wear patterns.

Steering Pump Disassembly, Inspection, and Assembly

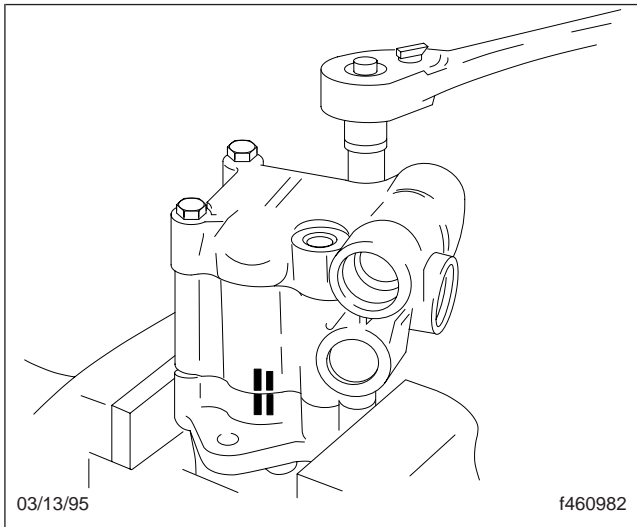


Fig. 6, Removing the Screws and Washers

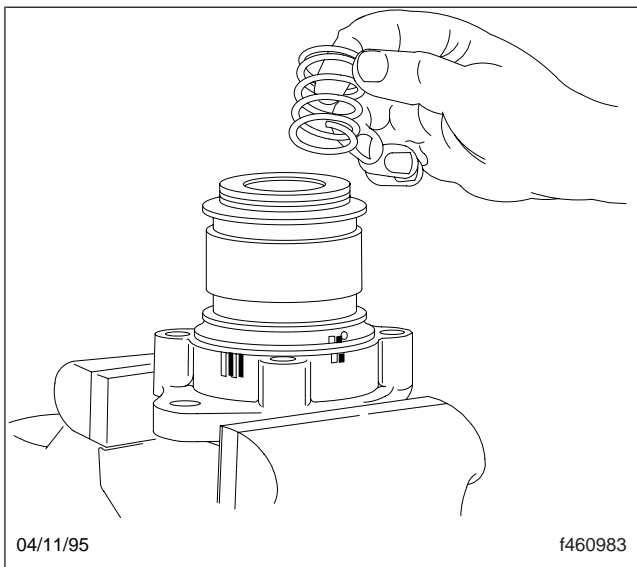


Fig. 7, Removing the Spring

9. Check the input shaft for damaged splines and abnormal wear grooves around the seal area. See [Fig. 23](#). If there are grooves that can be detected with your fingernail, replace the input shaft, as follows.

- 9.1 Remove the retaining ring (engine drive end) from the shaft. See [Fig. 24](#).

Remove the woodruff key, if equipped.

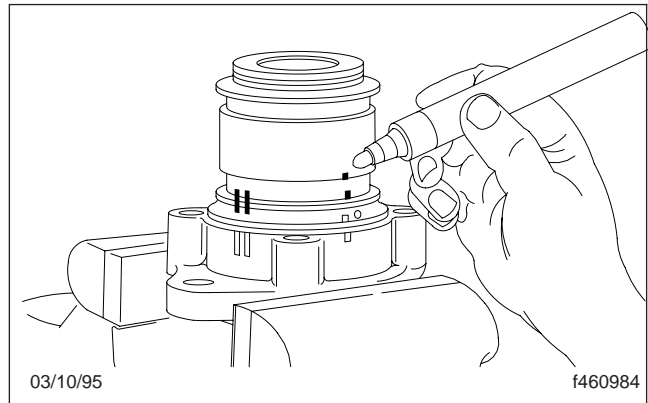


Fig. 8, Marking the Top Plate and the Bottom Plate

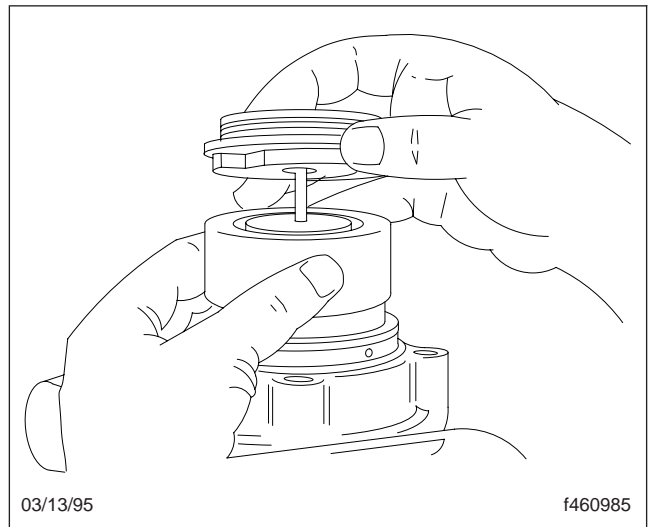


Fig. 9, Removing the Top Plate

- 9.2 Applying pressure to the engine drive end of the input shaft, press the input shaft from the ball bearing. See [Fig. 25](#).
- 9.3 Press the new input shaft (from the small splined end) into the ball bearing until the shaft bottoms out on the retaining ring. See [Fig. 26](#).
- 9.4 Install the retaining ring on the input shaft with the sheared edge pointing away from the bearing. Make sure that the retaining ring is properly seated.

IMPORTANT: TRW does not recommend disassembly of the control valve spool assembly.

Steering Pump Disassembly, Inspection, and Assembly

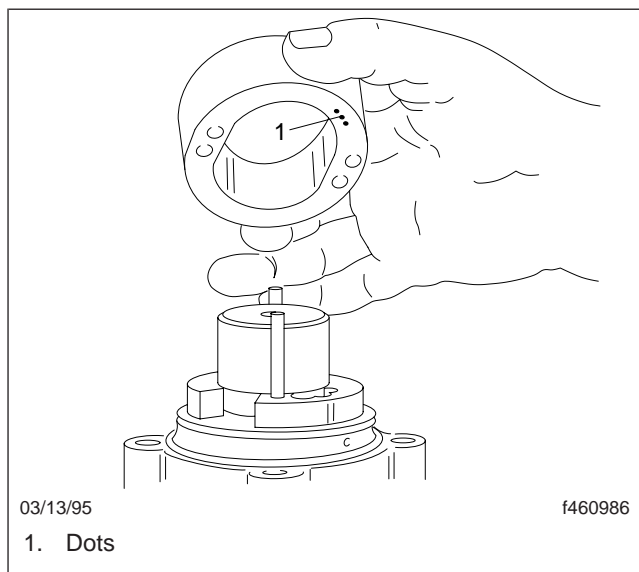


Fig. 10, Checking Whether the Dots are Up or Down.

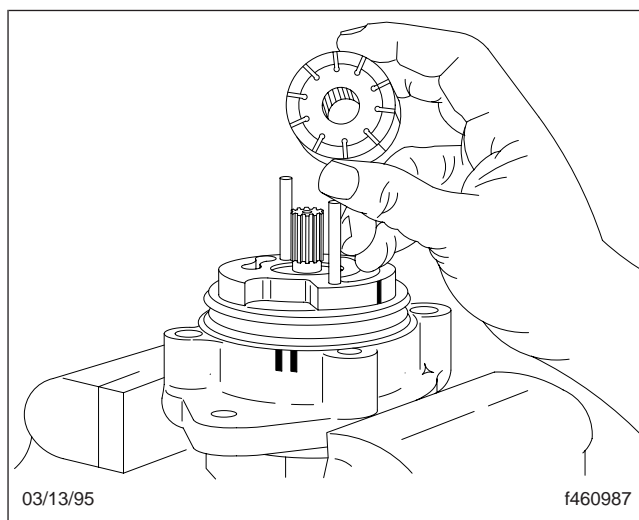


Fig. 11, Removing the Rotor and Vanes

10. Check the control valve spool assembly for wear or chipping. If needed, back-flush with air and solvent. Check the assembly for nicks or burrs.

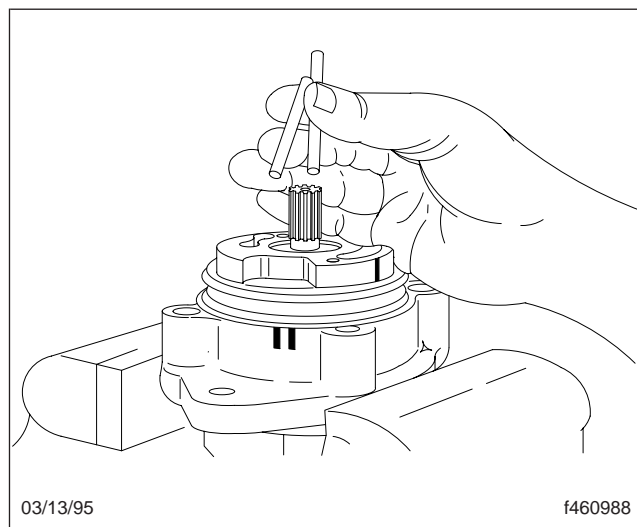


Fig. 12, Removing the Locating Pins

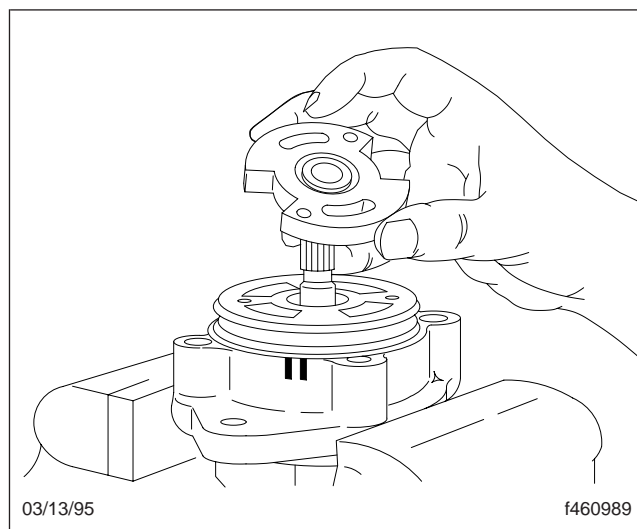


Fig. 13, Removing the Bottom Plate

Assembly

CAUTION

Make sure that the press is clean and free of debris. Debris could damage the face of the cover, which will affect pump operation.

1. Coat the outside surface of the shaft seal with a petroleum-based chassis grease. With the lettered side facing toward the needle bearing, press the seal into the cover. See [Fig. 27](#). The

Steering Pump Disassembly, Inspection, and Assembly

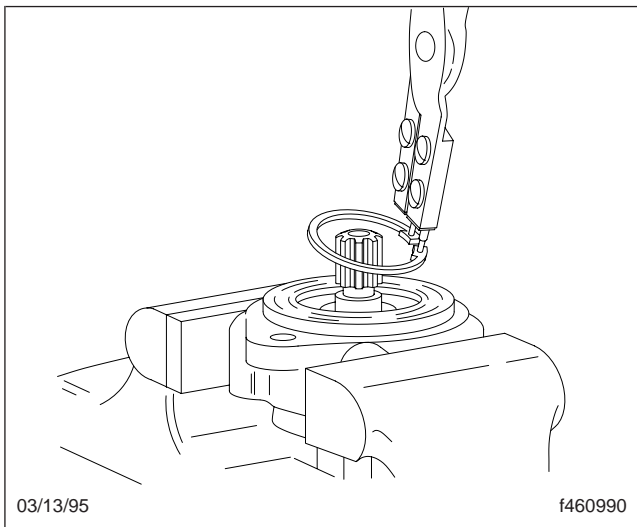


Fig. 14, Removing the Large Retaining Ring

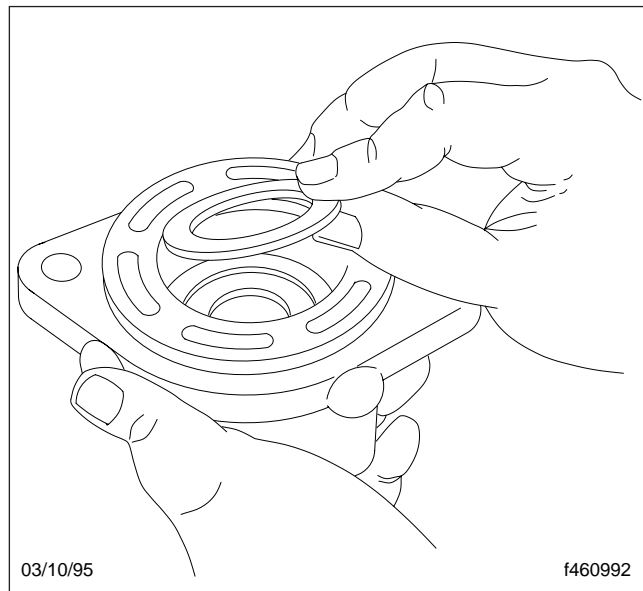


Fig. 16, Removing the Spacer

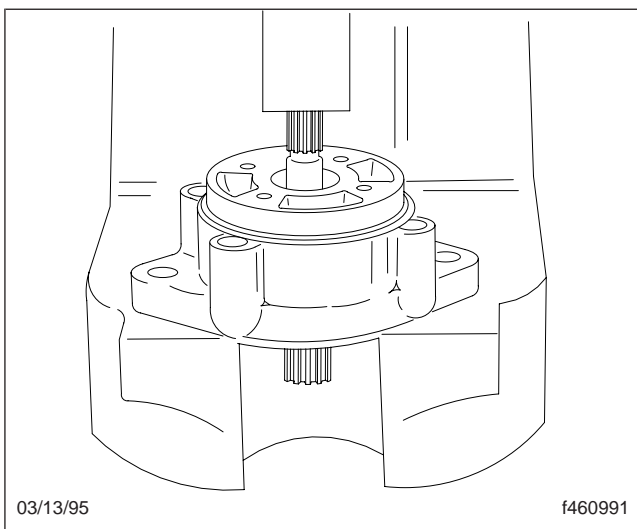


Fig. 15, Pressing out the Input Shaft and Ball Bearing Assembly

installed seal should be flush with, or just below, the sealing surface on the cover.

2. Grease the inside surface of the shaft seal using a petroleum-based chassis grease.
3. Install the spacer. See [Fig. 16](#). Make sure that it lies flat.

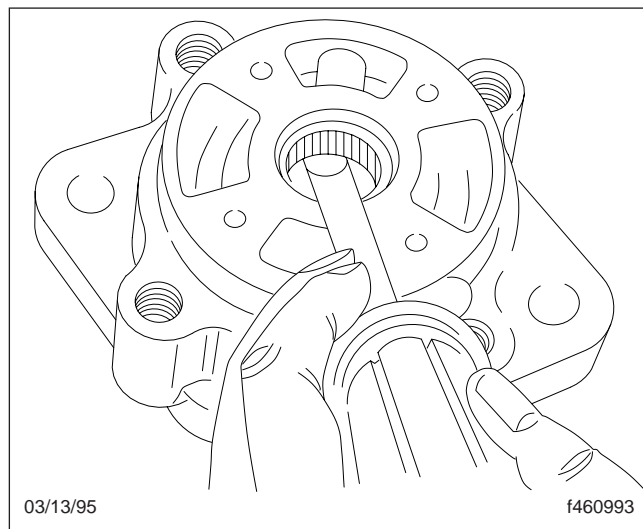


Fig. 17, Removing the Shaft Seal



CAUTION

Do not allow the splines to contact the shaft seal. The splines could damage the shaft seal.

4. Insert the input shaft (small splined end first) into the cover. Don't allow the splines to contact the shaft seal. Insert the shaft into the seal by hand until the ball bearing contacts the cover.

Steering Pump Disassembly, Inspection, and Assembly

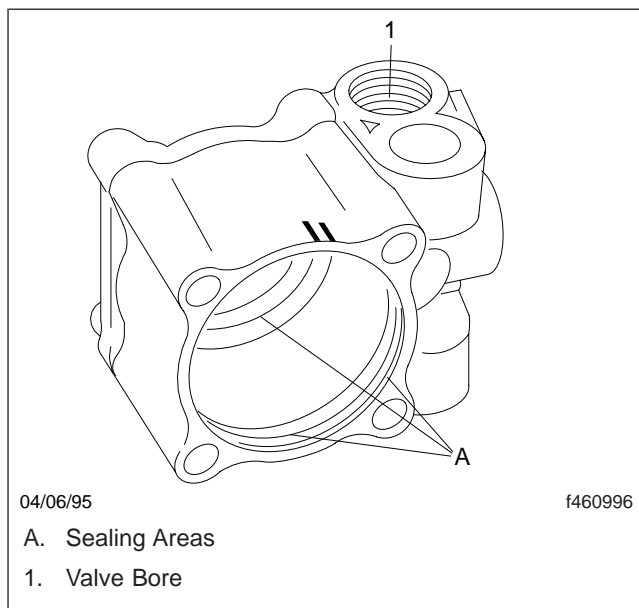


Fig. 18, Housing Inspection Areas

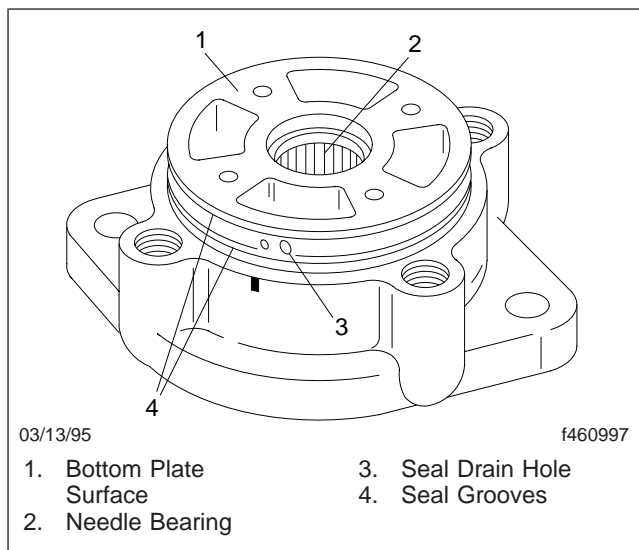


Fig. 19, Cover Inspection Areas

Using a 7/8-inch socket, press the shaft and bearing into the cover. See Fig. 28.

**CAUTION**

When placing the cover in a padded vise, do not use excessive clamping force. This could damage the cover.

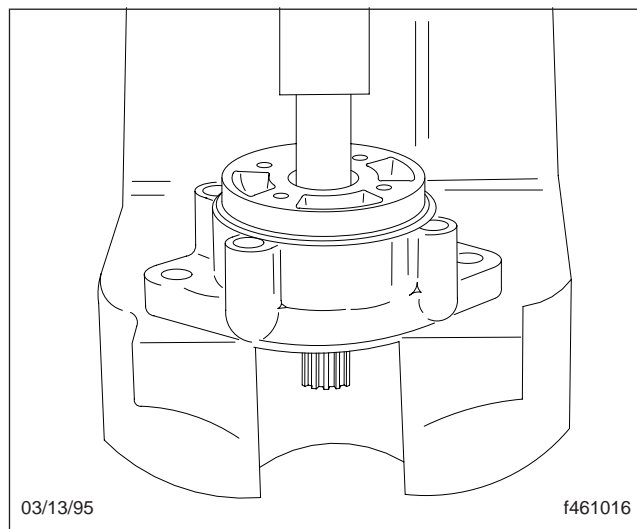


Fig. 20, Pressing the Needle Bearing out of the Cover

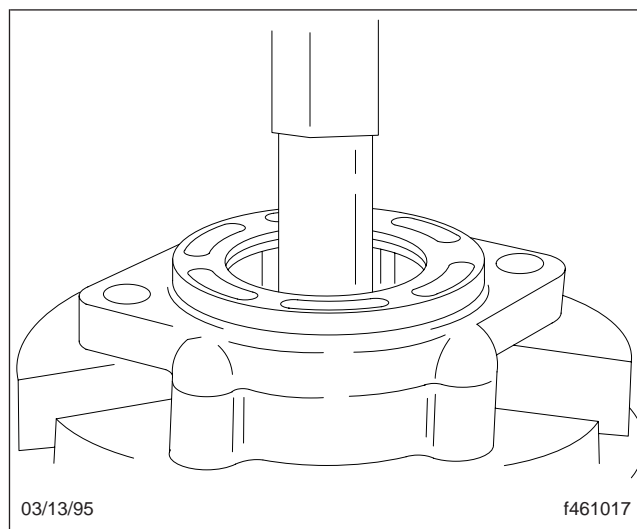


Fig. 21, Pressing a New Needle Bearing into the Cover

5. Place the cover in a padded vise and install the large retaining ring with the sheared edge out. Turn the cover assembly over.
6. Install the new large and small O-rings in the cover. Make sure that they are seated properly. See Fig. 29.
7. Using the marks made during disassembly as a guide, install the locating pins.

Steering Pump Disassembly, Inspection, and Assembly

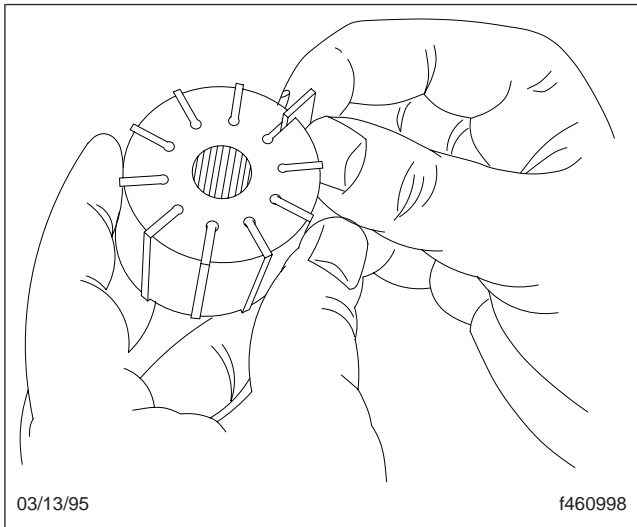


Fig. 22, Checking the Vanes

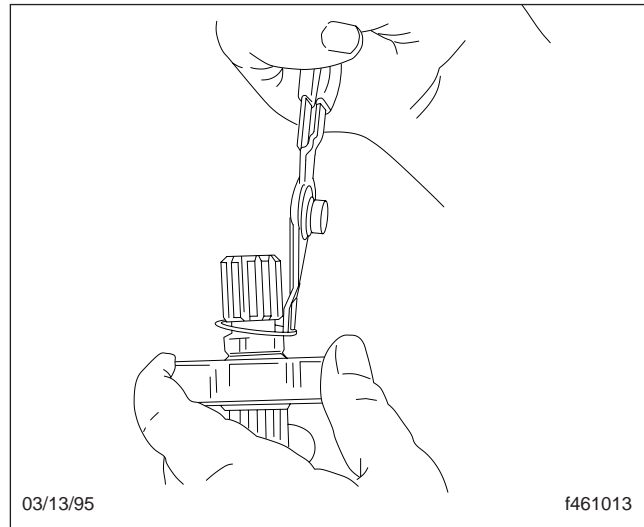


Fig. 24, Removing the Retaining Ring

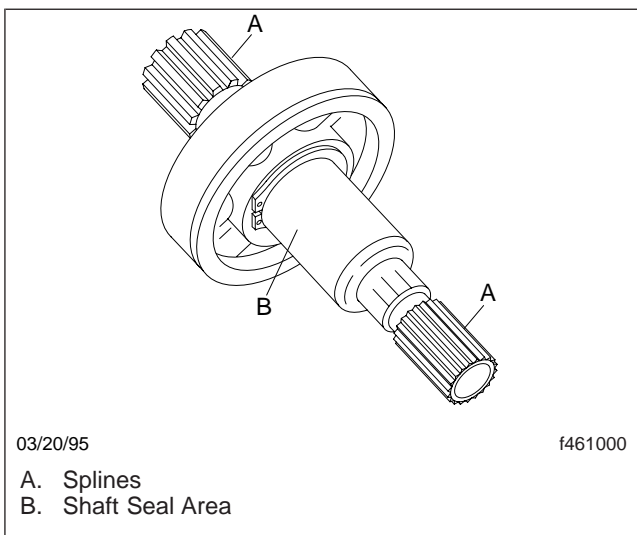


Fig. 23, Checking the Input Shaft

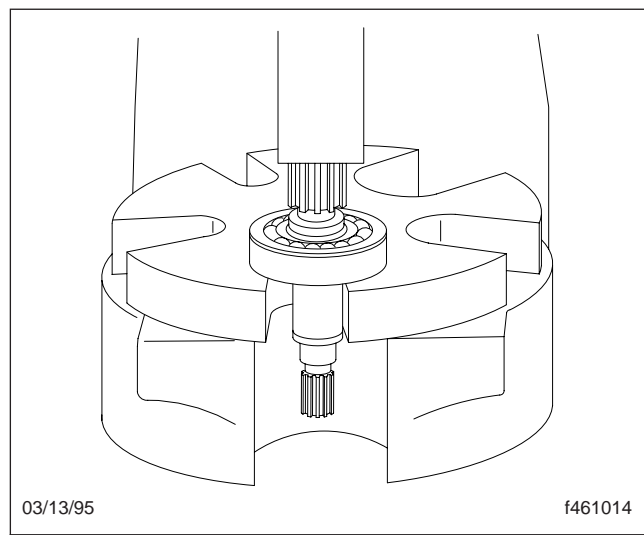


Fig. 25, Pressing the Input Shaft

IMPORTANT: In one of the four cutouts in the cover there is a bar. When installed, the bottom plate must cover this bar.

8. Install the bottom plate with the pockets facing up. See [Fig. 30](#). Make sure that the marks made during disassembly are aligned.
9. Install the cam ring with the dots facing up or down as noted during disassembly. Make sure that the cam ring is flush with the bottom plate's large outside diameter, and that the marks made during disassembly are aligned. [Fig. 31](#).

10. Install the rotor and vanes. Make sure that the squared edge on each vane points toward the center of the rotor. See [Fig. 32](#).
11. Install the top plate with the pin holes down. Make sure that the locating pins are engaged in the pin holes, not the pockets. See [Fig. 33](#).

Make sure that the top plate is flush with the cam, and that the marks made during disassembly are aligned.

Steering Pump Disassembly, Inspection, and Assembly

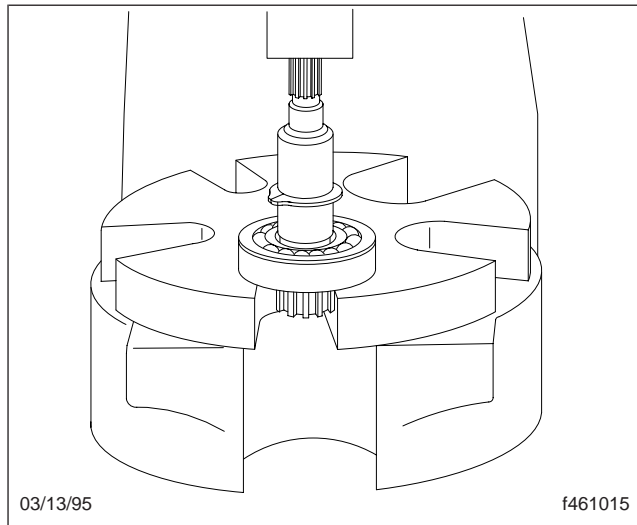


Fig. 26, Pressing the New Input Shaft

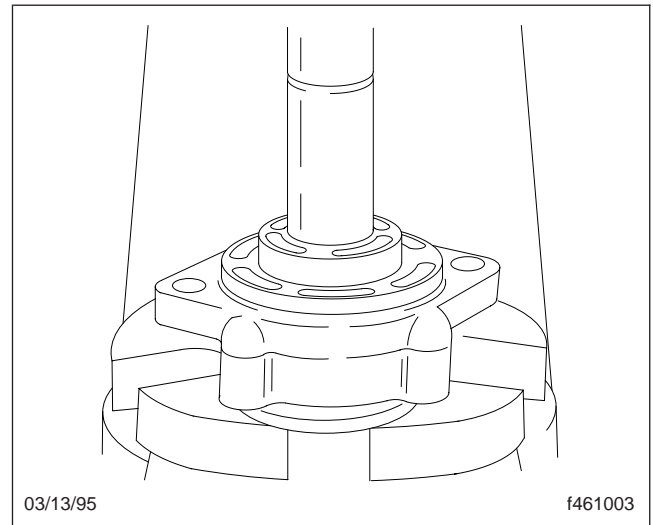


Fig. 28, Pressing the Shaft and Bearing into the Cover

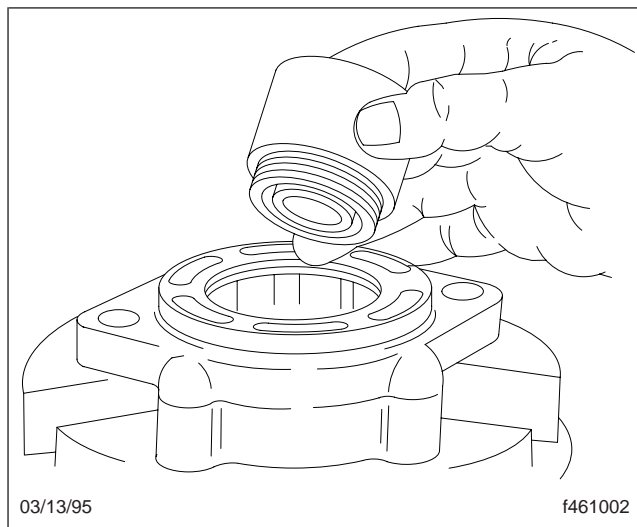


Fig. 27, Installing the Seal in the Cover

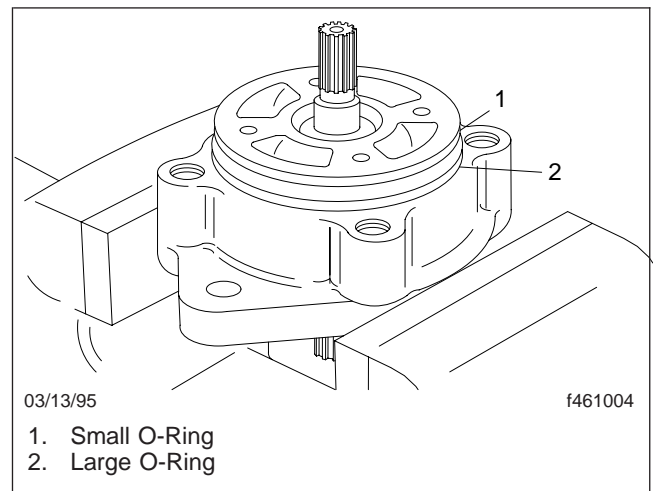


Fig. 29, Installing the O-Rings

NOTE: The backup O-ring will fit tighter on the top plate after loosely wrapping (no twisting) it around two fingers, then allowing it to unwrap.

12. Install the backup O-ring on the top plate. Seat the O-ring at the bottom of the groove.
13. Install a new O-ring (without allowing it to roll) on the top plate. Seat the O-ring at the top of the groove.
14. Grease both the O-ring and the backup O-ring. See [Fig. 34](#).

CAUTION

The housing may have sharp edges. Use care to not cut your finger when applying grease to the housing.

15. Grease the sealing areas of the housing. See [Fig. 35](#).
16. Place the spring on the top plate.
17. Place the housing over the cover assembly. Make sure that the marks made during disassembly are aligned. See [Fig. 36](#).

Steering Pump Disassembly, Inspection, and Assembly

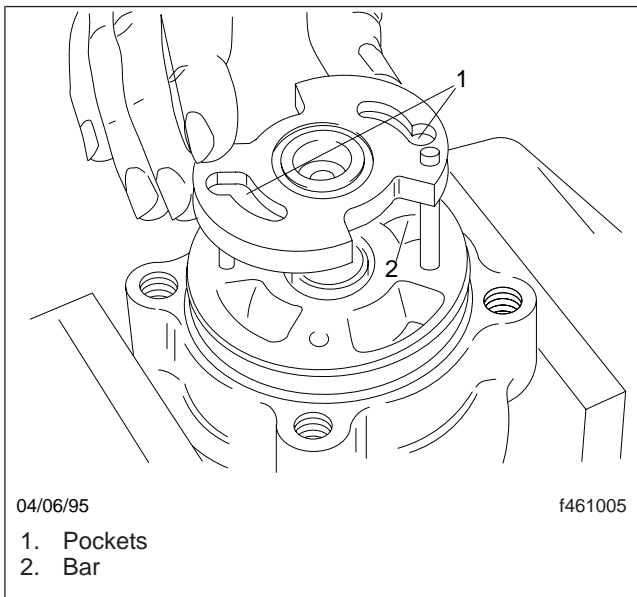


Fig. 30, Installing the Bottom Plate

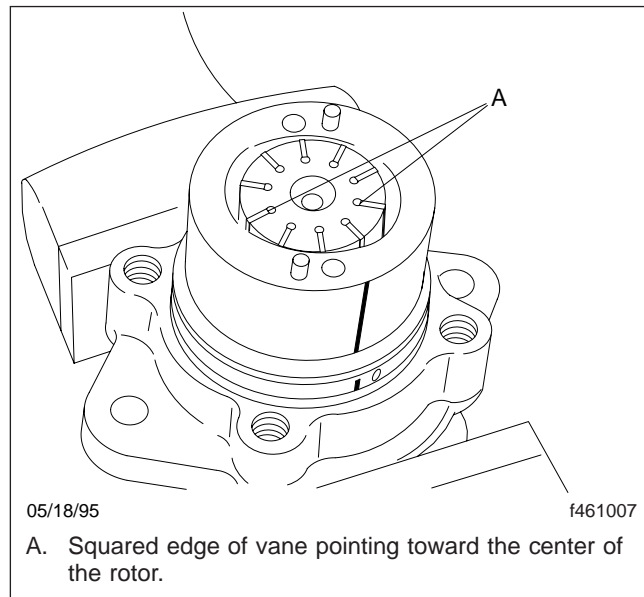


Fig. 32, Installing the Rotor and the Vanes

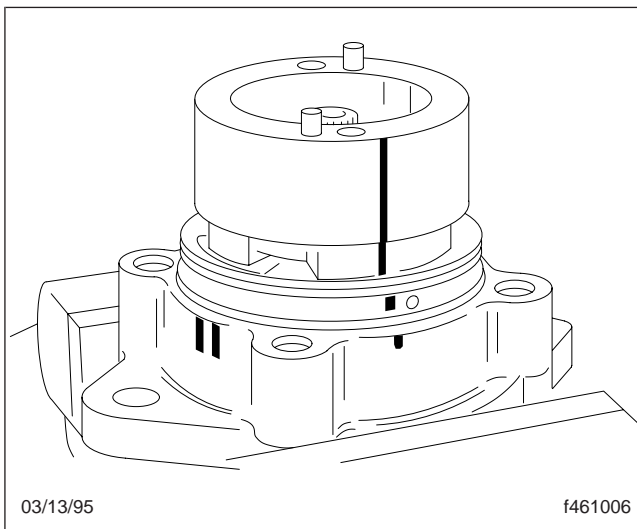


Fig. 31, Installing the Cam Ring

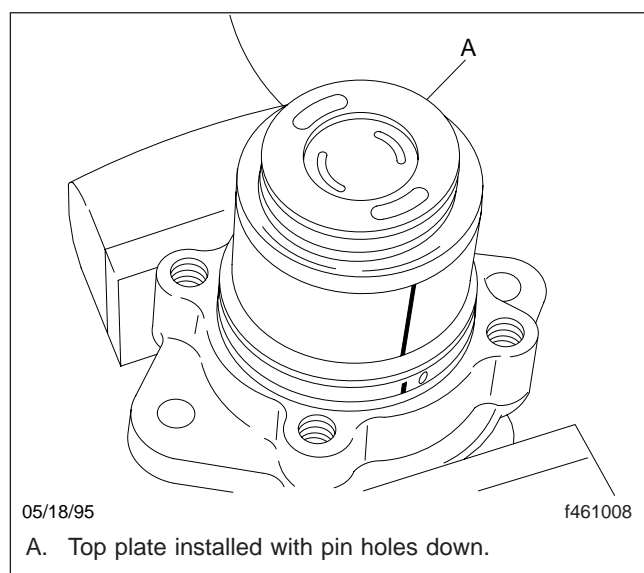


Fig. 33, Installing the Top Plate



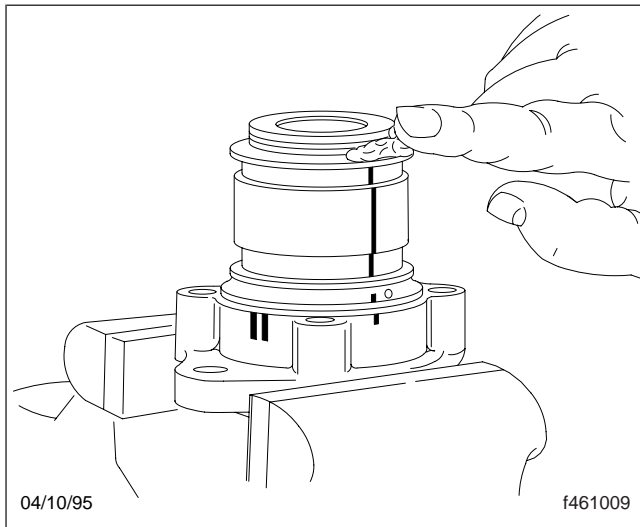
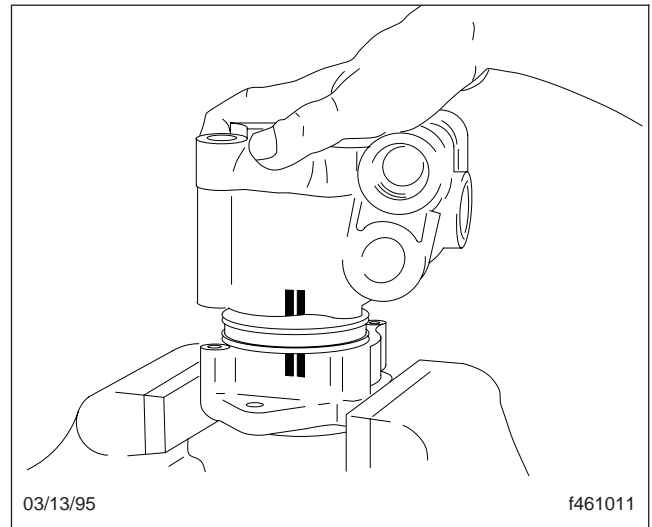
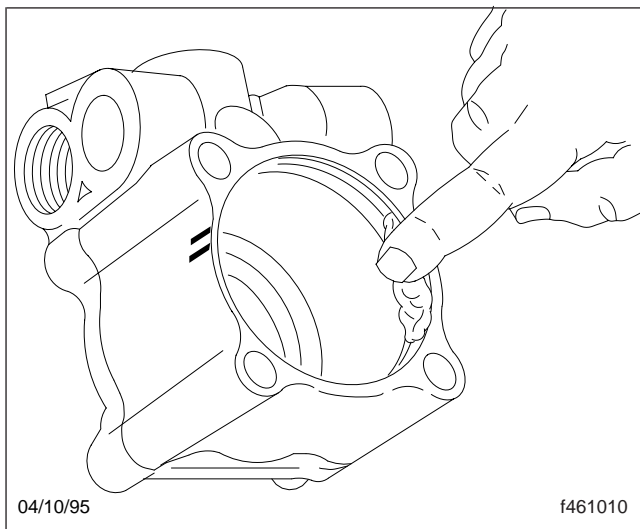
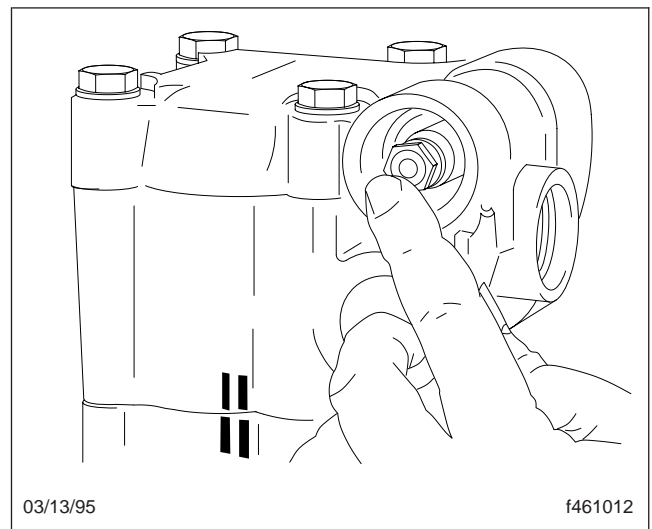
CAUTION

Evenly thread the mounting bolts into the cover. If not evenly threaded into the cover, damage could occur to the seals, top plate, or housing.

18. Install the mounting bolts and washers. Evenly thread all four bolts into the cover. Alternately tighten the bolts 30 lbf·ft (41 N·m).

19. Screw the relief valve seat assembly into the control valve spool assembly. Tighten the assembly 87 lbf·in (982 N·cm).

NOTE: Placing the spool assembly in a collet will assist the tightening procedure.

Steering Pump Disassembly, Inspection, and Assembly**Fig. 34, Greasing the O-Rings****Fig. 36, Installing the Housing****Fig. 35, Greasing the Sealing Areas****Fig. 37, Installing the Valve Spool Assembly**

20. Insert the valve spool assembly (screen end last) into the housing. Make sure that the spool slides freely in the housing. See [Fig. 37](#).
21. Install the spring in the housing.
22. Install a new O-ring on the end plug.
23. Lightly grease the O-ring and the end plug threads. Install the end plug and tighten 30 lbf-ft (41 N·m).
24. Install the woodruff key into the new input shaft (if removed during the input shaft replacement).

25. Turn the pump by hand and make sure that it turns freely.
26. Install the power steering pump on the engine, following the instructions in [Subject 100](#).

Problem—The Power Steering Pump Doesn't Deliver Fluid

Problem—The Power Steering Pump Doesn't Deliver Fluid	
Possible Cause	Remedy
The pump input shaft is broken, or not engaging.	Remove the pump. Repair or replace parts as needed.
The control valve is stuck open.	Remove and disassemble the pump. Clean the control valve in a solvent. Install the control valve, then check for any binding in its bore. If the control valve binds or feels gritty when you move it, replace the pump.
One or more rotor vanes is stuck.	Remove and disassemble the pump. Check the rotor and vanes for dirt or damage. If damaged, replace the pump. If dirty, clean the rotor and vanes in a solvent, then assemble the parts and check for free vane movement. If the problem persists, replace the pump.
Incorrect steering system hydraulic fluid is used.	Check for the type of fluid used. If it's incorrect, drain, flush, and fill the system with the correct fluid.
The pump intake port is blocked.	Drain and flush the system. Fill the system with clean fluid.
The air vent in the power steering reservoir is clogged.	Remove the filter cap from the reservoir, then clean the air slot.
A power steering inlet hose is kinked or blocked.	Repair or replace the hose.

Problem—The Power Steering Pump Is Making Noise

Problem—The Power Steering Pump Is Making Noise	
Possible Cause	Remedy
The intake line is plugged.	Drain the system. Clear the intake line if needed.
There is an air leak at the pump connections, the fittings, the reservoir connections, or the shaft seal.	Check all the connections by pouring steering system hydraulic fluid over them, then listen for a reduction in sound. Tighten all the connections as needed. If the problem persists, remove the pump, then disassemble it and replace the shaft seal.
The pump input shaft is misaligned.	Remove and disassemble the pump. Replace the shaft seal and bearing.

Fastener Torques	
Description	Torque: lbf·ft (N·m)
Pump Mounting Hexbolts	35 (47)
Pump Housing-to-Cover Assembly Bolts	30 (41)
Pump End-Plug	30 (41)
Pump Inlet Connection	26 (35)

Table 1, Fastener Torques

Approved Steering System Hydraulic Fluid	
Lubricant Type	Recommended Lubricant
Automatic Transmission Fluid *	Dexron VI®

* Do not mix engine oil with automatic transmission fluid (ATF). Use the same lubricant for parts as is used in the power steering system.

Table 2, Approved Steering System Hydraulic Fluid

