

# SERVICE MANUAL

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# SERVICE MANUAL

## **1-1. INTRODUCTION**

#### 1-2. GENERAL

The Moyno Tri-Phaze<sup>®</sup> System is the culmination of over 60 years of experience in manufacturing and marketing fluids handling equipment. This system includes a special Moyno<sup>®</sup> Pump, a drive, a variable frequency drive, and instrumentation. The rugged pump is based on the Moyno<sup>®</sup> 2000 Pump design which has been engineered to be the most reliable product ever sold under the Moyno name. It has been painstakenly tested to assure consistent performance in the most difficult applications.

The variable frequency drive should have a 115 VAC control interface and a 4 to 20 ma input speed isolator module to accept a suction pressure signal. This permits the pump speed to be automatically varied in response to variable well or satellite conditions.

#### 1-3. NAMEPLATE DATA

The pump nameplate, located on the bearing housing, contains important information relating to the operation and servicing of the pump. This information includes the direction of rotation arrow and the pump model and serial numbers (see Figure 1-1). The pump model number and serial number must be used for reference when ordering spare parts.

**1-4. Pump Rotation.** The direction of rotation is indicated by a rotation arrow on the nameplate. Rotation of Moyno pumps is clockwise, when viewed from the driven end of the pump.

## 2-1. INSTALLATION

#### 2-2. GENERAL

Moyno pumps are lubricated and tested at the factory prior to shipment and require minimum pre-start up maintenance. Packing, however, is not lubricated at the factory.

Accessibility to the pump and adequate clearance should be a prime consideration in any installation. Enough space should surround the unit so that maintenance can be carried out with ease.

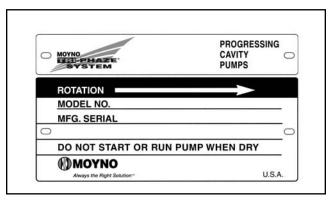


Figure 1-1. Typical nameplate showing rotation arrow, model and manufacturing serial numbers.

#### 2-3. PIPING

**2-4. Suction Piping** should be as short as possible and is normally the same size as the suction flange. However, actual wellhead or satellite conditions may warrant a different pipe size. It is recommended the pump be installed with a bypass loop around the pump to the discharge piping. This bypass loop will facilitate bringing the Tri-Phaze System online, and can also be used to permit the well or satellite to remain in operation when the pump is being serviced.

**2-5.** Suction Housing Rotation to any position 360° about the centerline of the pump is possible. To rotate, loosen the hex head bolts holding the clamp ring to the bearing housing. Remove the packing gland halves and the packing studs. Loosen the stator support caps and rotate the suction housing, stator and discharge flange together. Replace the packing gland studs in the threaded hole provided.

CAUTION: Rotating the suction flange by any other method may tear the stator gaskets causing a leak. Once the gaskets have been compressed, it is virtually impossible to rotate any one of the two compressing surfaces without tearing the gasket.

**2-6. Discharge Piping** diameter should generally be as large as the pump ports unless fluid conditions indicate otherwise.

An easily removable section of piping one-to-two times longer than the connecting rod should be mated to the discharge port. This will allow the stator to be removed without having to disassemble the complete pump.

#### 2-7. FOUNDATION

Each unit is mounted on a strong, fabricated steel base plate. Skid mounted units may be furnished where applicable, but for most installations the base plate should be mounted on a concrete foundation. The foundation should be approximately 4" to 8" longer and wider than the base for which it is built (see Figure 2-1). Anchor bolts for the base plate should be located in the foundation.

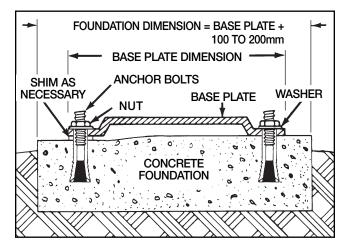


Figure 2-1. Typical Foundation Example

Check the base plate surface with a carpenter's level and place shims under the base plate at the places necessary to make it level. Then check the pump, drive shaft and the pump ports to ensure that they are level. Complete base mounted units supplied by Moyno including pump and drive are leveled with respect to the base at the factory. Shifting may occur during shipment. The pump and drive should be realigned. Care should be exercised to ensure that all components are level and mounted in a direct line.

For maximum rigidity and lower noise levels, the base plate should be grouted to the foundation after the anchor bolts have been evenly tightened. A good grade of nonshrink grout is recommended. The spaces between the base plate and the foundation around the shims should also be filled with grout. Allow the grout to dry according to manufacturer's instructions. Then fully tighten the anchor bolts.

#### 2-8. SHAFT ALIGNMENT

Although the base-mounted units supplied by Moyno are leveled with respect to the base before shipment, most of the larger pump and drive units are shipped with the flexible coupling disconnected.

After the base has been bolted down to the foundation, check the following conditions:

**2-9.** On Coupling Connected Units, be sure that the pump and drive shafts are realigned before the coupling is connected. Care should be exercised to ensure that all components are level and mounted in a direct line.

Check gap between coupling halves (refer to coupling manufacturers recommendations). Adjustment can usually be accomplished by loosening the mounting bolts on either the pump or driver and moving the loosened component into alignment with the fixed component. On couplings with equal diameter hubs, it may be possible to lay a straight edge axially across the coupling halves to check alignment.

**2-10. On Belt Drive Units**, check to ensure that sheaves or sprockets are in alignment. Check belts for proper tension. Tension requirements will vary with the type of belt, center distances, and belt speeds. Consult the belt manufacturer for specific recommendation.

#### 2-11. PACKING LUBRICATION

The packing is grease lubricated through a grease fitting in the stuffing box.

Packing is not grease lubricated at the factory prior to shipping.

If a mechanical seal is used, consult the seal manufacturer's instructions for seal flush requirements.

## **3-1. OPERATION**

#### 3-2. INITIAL CHECK

Before putting the pump into operation, the following items should be checked to ensure that each piece of equipment is installed correctly:

- Pump, driver, coupling or sheave alignment.
- Electrical connections.
- Gauges and other instruments.
- Pump rotation. Rotation is indicated on the nameplate on the bearing housing.
- All valves should be open on both suction and discharge sides of pump. See START-UP.
- VFD should be in manual mode.

# CAUTION: This is a positive displacement pump. Do not operate it against a closed valve.

#### 3-3. START-UP

#### CAUTION: DRY OPERATION MAY DAMAGE PUMP COM-PONENTS! Never allow the pump to operate without fluid as dry operation will cause premature wear and possible damage of the stator. The stator is lubricated by the fluid which is being pumped.

1. Before operating the pump for the first time, fill the pump suction with fluid. The fluid will lubricate the stator for the initial start-up. If the installation has a by-pass line as recommended and fluid is bypassing the pump, the suction and discharge valves can be slowly opened allowing fluid to flow to the pump.

2. Once the suction and discharge valves have been opened and fluid is in the pump, check for the direction of rotation by momentarily starting and stopping the drive and observing the pump shaft rotation. Rotation should be clockwise when viewing the pump from the drive shaft end. 3. If applicable, turn on the mechanical seal flush system. On packed pumps ensure the packing has been lubricated with a suitable grease and the packing gland adjusting nuts are a little more than finger tight.

4. With VFD in manual mode, start the pump at a slow operating speed. Over time, slowly increase the pump speed until the pump suction pressure has been decreased to the desired pressure. Slowly close the valve in the by-pass piping while observing the pump suction pressure. If the pump suction pressure increases above the desired pressure, then the pump speed should be increased as needed. Once the system has stabilized the VFD can be switched to automatic mode and the pump speed will be varied as needed to maintain the desired suction pressure.

#### 3-4 PACKING LEAKAGE

A packed stuffing box is designed to control leakage, not stop it completely. Leakage is generally necessary to reduce friction and dissipate heat. The amount of leakage necessary will depend on the fluid pumped, the installation, and pump speed and type. Refer to Section 4-3 for packing adjustment.

Moyno pumps have been designed for minimum stuffing box leakage when properly maintained. If leakage cannot be tolerated, then a mechanical seal should be used.

## **4-1. MAINTENANCE**

Note: In this section, the first reference to each pump part will be followed by a number or a letter in parentheses (). These numbers and letters are those used to identify the pump parts and hardware items in the Exploded View (see Figure 4-7).

#### 4-2. GENERAL

The Moyno pump has been designed for a minimum of maintenance, the extent of which is routine adjustment and lubrication of packing. The pump is one of the easiest to work on, in that the main elements are very accessible and require few tools to disassemble.

#### 4-3. PACKING ADJUSTMENT

Packing gland nuts should be evenly adjusted so they are little more than finger tight (see Figure 4-1). Overtightening of the packing gland may result in premature packing failure and possible damage to the shaft and gland.

When packing is new, frequent minor adjustments during the first few hours of operation are recommended in order to compress and seat each ring of packing evenly.

1. Upon initial start-up of the pump, adjust the gland nuts for a leakage rate of 1-2 drops per second until the packing has seated and adjusted to the operating temperature (approximately 10-15 minutes).

2. If leakage is excessive after 15 minutes of operation, tighten the gland nuts until a desired leakage rate is obtained.

CAUTION: Do not tighten until zero leakage is obtained. Over-tightening of the packing gland may result in accelerated wear on the packing and damage to the shaft. In those situations where no packing leakage can be tolerated, consult your Moyno Tri-Phaze System Authorized Service Representative.

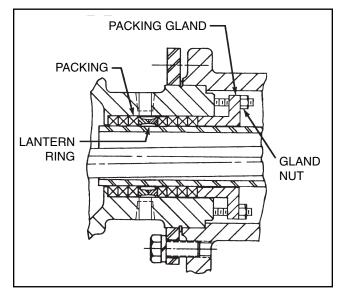


Figure 4-1. Cross Section of Stuffing Box

#### 4-4. PACKING REPLACEMENT

When leakage can no longer be regulated by tightening the gland nuts, remove and replace the packing. Replace as follows:

1. Remove packing gland nuts (F), and slide gland (21) and slinger ring (20) back along drive shaft (14).

2. Remove packing gland studs.

3. Use a pair of packing extractors (see Figure 4-2) to remove four packing rings (22), lantern ring halves (23) and three additional packing rings (22).



#### Figure 4-2. Packing Removal Tool

3. Inspect surface of drive shaft for wear or grooves. If shaft is worn through the chrome plating into the base metal, or is badly scored or grooved, it should be replaced.

4. If the drive shaft is not worn, install three rings of packing, the lantern ring halves, and four more rings of packing; lubricating them before installation with a good grade of packing grease. Be sure to stagger the packing ring joints at 90° increments (see Section 4-26).

CAUTION: Always use a proper packing tamper tool to install packing. Do not use a pointed or sharp tool, as damage to the packing material or drive shaft could result. To assure proper shaft lubrication, never use a one-piece spiral wrap packing.

5. Replace packing gland (21) and secure with packing gland nuts (see Figure 4-1).

6. Adjust packing per Section 4-3.

#### 4-5. LUBRICATION

**4-6. Bearings.** The bearings are lubricated at the factory and will only need to be relubricated when the shaft/bearing assembly is removed from the pump.

**4-7.** Gear Joints. Both gear joints are packed with lubricant during assembly, and will only need to be relubricated when gear joints are disassembled.

#### 4-8. DISASSEMBLY

- CAUTION: Be aware that although the pump is isolated from the pipeline by valves there could still be fluid under high pressure in the pump. Therefore, after closing the suction and discharge valves, carefully remove the suction housing drain plug and loosen the discharge flange connection to relieve any of the pressure in the pump before proceeding with disassembly of the pump.
- Note: The following instructions cover ONE procedure for disassembling all pump components. Major pump components can be disassembled in various ways since specific installation location limitations will determine method of component removal.

#### 4-9. Disconnect Pump

1. Flush the pump (preferably with clean water) to remove the pumpage from the unit.

- 2. Shut off pump.
- 3. Close suction and discharge valves.
- 4. Disconnect power source.
- 5. Drain any fluid in the pump by removing the drain plug.

#### 4-10. Packing Removal

- 1. Shut off the pump.
- 2. Complete Section 4-9, steps 3 6.

3. Remove gland adjustment nuts (F), gland studs (H) and gland halves (21) from stuffing box.

4. Remove packing rings (22). This is best done by using flexible packing extractors (see Figure 4-2). Use two extractors simultaneously on opposite sides of each ring. Pull evenly.

5. Remove lantern rings (23) in similar fashion. Twist split rings to remove from shaft.

6. Remove additional packing rings.

#### 4-11. Stator Removal

1. Complete Section 4-9.

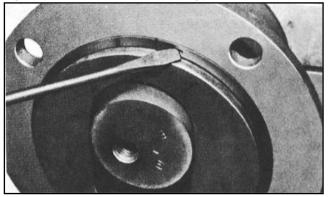
2. Remove section of discharge pipe attached to discharge flange (37).

3. Remove discharge flange by unbolting from stator clamp ring (36B) and remove stator gasket (34). Remove stator retaining ring (35) and stator clamp ring from stator (30).

Note: Omit above step 3 when using alternate methods 1 or 2 (see Page 5) to separate rotor and stator.

4. Remove top half of stator support (31).

5. Unbolt stator clamp ring (36A) from suction housing (29). Pull stator off rotor. Remove stator gasket (34). Use a screwdriver tip to carefully remove stator retaining ring (35) (see Figure 4-3). Remove stator clamp ring from stator (30).



#### Figure 4-3. Typical Retaining Ring Removal

Note: On multiple stage pumps, or when cleaning, checking or changing stator (30), rotor (40) and/or gear joint assembly, one of the following procedures is suggested.

Method 1. Use winch-type device anchored directly opposite stator end. Attach cable to discharge flange (37) to pull stator (30) off rotor (40).

Method 2. Remove stator (30), rotor (40) and connecting rod (38) as a single unit. (see Section 4-13.) Place the stator (30) in an upright position on the discharge flange (37). Remove rotor (40) and connecting rod (38) from the stator (30). It may be necessary to use a chain or sling with a lifting device. Anchor discharge flange (37) securely to the floor before lifting.

Method 3. Hold stator (30) with pipe or strap wrench and turn drive shaft head (4) clockwise to unscrew stator (30) from rotor (40).

6. Check rotor (40) and stator (30) for wear. See Sections 4-21 and 4-22 for instructions.

#### 4-12. Drive End Gear Joint Removal

1. Complete Section 4-9.

2. Remove drive coupling or V-belts and pulley from drive shaft head (4).

3. Remove vent plugs (C) from drive shaft head (4) and drive shaft (14). Remove set screw (D) from drive shaft (14). Remove six socket head screws (E) from drive shaft head (4) and remove drive shaft head. Remove primary thrust plate (6) from drive shaft head and remove two keys (7).

4. Remove lock nut (9) from end of connecting rod (38). Remove ring gear (8), gear ball (10), secondary thrust plate (11), seal support (12), and gear joint seal (13).

Note: It is recommended that each time the drive end gear joint is disassembled, the drive shaft O-ring (5) and gear joint seal (13) should be replaced.

#### 4-13. Rotor and Connecting Rod Removal

1. Complete Sections 4-9, 4-11 and 4-12.

2. Pull the rotor/connecting rod assembly from the pump. Remove the vent plug (C) and set screw (S) from the gear joint shell (39).

3. Remove six socket head screws (T) from head ring (42) and remove head ring and O-ring (41). Slide connecting rod/gear joint assembly off rotor head. Remove gear joint keys (7) and primary thrust plate (6) from rotor (40).

4. Slide gear joint shell (39) off gear ball/connecting rod assembly. Slide ring gear (8) off gear ball (10).

5. Clamp connecting rod (38) in vice or hold with pipe wrench and remove lock nut (9). Remove gear ball (10), secondary thrust plate (11), seal support (12), and gear joint seal (13) from connecting rod.

Note: It is recommended that each time the rotor end gear joint is disassembled, the rotor head O-ring (41) and gear joint seal (13) should be replaced.

#### 4-14. Drive Shaft and Bearings Removal

- Note: If the space immediately in front of the pump is unobstructed for a distance equal to the length of the drive shaft, follow steps 1 through 3.
  - 1. Complete Sections 4-9 and 4-12.

2. Remove six hex head screws (A) from bearing cover plate (2). Slide bearing cover plate (2) with radial grease seal (1) and O-ring (3) off drive shaft.

3. Pull drive shaft/bearing assembly out of bearing housing, taking steps to support the weight of the assembly as the bearings clear the housing. Remove grease seal (19) from the bearing housing.

Note: If the space in front of the pump is obstructed, and the obstruction is not easily moveable, follow steps 4 through 6.

4. Complete Sections 4-10 and 4-11, and pull the rotor/ connecting rod assembly from the pump.

5. Remove the four cap screws (0) from the clamp ring (28), and the four cap screws fastening the bearing housing (26) to the base. Slide the bearing housing/shaft assembly out of the suction housing until the quill clears the stuffing box. Assembly may now be turned or removed to an area where sufficient space is available to permit removal of the shaft/ bearing assembly.

#### CAUTION: The bearings are pressed on the shaft during assembly. Care must be taken during disassembly to avoid damaging the bearings or shaft.

6. Remove bearing lock screw (17) from bearing nut (18). Using suitable spanner wrench or soft punch and hammer, thread lock nut off drive shaft. Do not use a pipe wrench to remove the lock nut.

7. Remove both halves of bearing spacer (16) from shaft, and using suitable bearing press and adapters, press bearings off shaft.

#### 4-15. CLEANING

Clean all parts in a suitable cleaning solvent being careful to observe all safety precautions regarding the use of solvent.

#### 4-16. INSPECTION

**4-17. Bearings.** After cleaning, rotate bearings very slowly under hand pressure to feel for smoothness and even action. Never spin a dry bearing. Check for cracks, galling, pitting, burrs, etc. Replace bearing if there is any doubt concerning complete serviceability.

**4-18.** Drive Shaft. Inspect drive shaft (14) for scoring, burrs, cracks, etc. Replace as necessary.

**4-19. Seals.** It is sound practice to always replace grease seals (1 and 19) whenever drive shaft and tapered roller bearings are removed. Apply Locktite 690 to outside diameter of both grease seals.

**4-20. Packing.** It is sound practice to always replace packing (22) whenever the pump bearing housing is disassembled.

**4-21. Rotor.** Check for excessive wear of rotor (40).

**4-22.** Stator. A worn stator may appear pitted and gouged, or may appear smooth similar to when new. Performance is the best measure of rotor to stator fit. If unable to measure performance adequately, suspected stator wear can be evaluated by a Moyno Tri-Phaze® System sales or factory representative.

**4-23. All Other Parts.** Check for cracks, excessive wear, damage to threaded holes, burrs, etc. Replace as necessary. Replace O-rings and all gaskets at each disassembly and reassembly.

#### 4-24. ASSEMBLY

The Moyno pumps are reassembled in the reverse order of dismantling. The following suggestions are offered:

1. While pump is dismantled, check all gaskets, seals, packing, and O-rings. Replace all worn items. It is recommended that the gear joint seals (13), gear joint O-ring (41), and drive shaft O-ring (5) be replaced each time either of the gear joints is disassembled.

2. During the assembly process, cleanliness is important. To avoid premature failure, bearings and gear joint components must be handled with care and kept clean.

#### 4-25. Lubrication During Assembly

Note: The bearings are lubricated at the factory, and will only need to be relubricated when the shaft/bearing assembly is completely removed from pump.

**1. Bearings.** Pack bearings after installation on shaft (see Section 4-28). Lubricant should be packed around all of the rollers and should completely cover the faces of the races. The void inside the spacer between the bearings should be filled approximately half-way with lubricant.

2. Gear Joints. Both gear joints should be packed with lubricant during assembly (see Sections 4-30 and 4-32). DO NOT use zerk fittings to lubricate gear joints after assembly. The pipe plugs (C) in the drive shaft head, drive shaft, and gear joint shell are vent plugs and MUST BE REMOVED during assembly of the gear joints to allow excess lubricant to vent from the gear joints.

**3. Packing.** Lubricate packing rings during assembly. Additional grease can be added after assembly through the zerk fittings installed in the side of the stuffing box.

#### 4. Approved lubricants:

# CAUTION: Do not mix different brands of lubricants for the same application.

Area to Lubricate	Approved Lubricant or Equivalent
Bearings	Mobilux EP2 Grease
	(Mobil Chemical Co.)
Gear Joints	MPG-2 Multi-Purpose Grease
& Packing	(Dubois Chemical Div.)

#### 4-26. PACKING INSTALLATION

1. The standard packing set (22) consists of seven braided packing rings. Lantern ring halves (23) must be ordered separately.

2. Install packing and lantern ring halves into the stuffing box area of the suction housing (29) in the following sequence:

a. Wipe a film of lubricant on each packing ring and install three rings. Push each ring firmly in place.

Note: Install the packing rings with the splits staggered at 90 degrees to the adjacent ring of packing. On initial

assembly, one ring of packing may not fit in stuffing box. This final ring of packing should be installed after pump is started and packing is seated.

CAUTION: Always use a proper packing tamper tool to install packing. Do not use a pointed or sharp tool, as damage to the packing material or drive shaft could result. To assure proper shaft lubrication, never use a one-piece spiral wrap packing.

b. Install the two lantern ring halves with the flat side against the packing.

c. Install final four packing rings, firmly pushing each ring into place.

3. Install packing gland studs (H), packing gland halves (21), and gland adjusting nuts (F). Tighten nuts finger tight at this time.

**4-27. Bearing Housing/Suction Housing Assembly.** This procedure may be performed now or after the bearing/drive shaft assembly is installed in the bearing housing.

1. Place clamp ring (28) on suction housing (29) and install retaining ring (27) in groove on suction housing.

2. Slide turned diameter of suction housing into bore on end of bearing housing (26). Align holes in clamp ring (28) with four threaded holes in bearing housing (26) and thread four hex head screws (O) with lock washers into threaded holes. Tighten finger tight.

3. Rotate suction flange to desired position (if not already fastened to piping) and tighten four hex head screws (O).

#### 4-28. Bearing/Drive Shaft Assembly

1. Bearings must be pressed on the shaft in the following sequence: Larger units (5000 BFD models and larger) require heating of the bearings to 250°F before assembly.

a. Press bearing cone on shaft (14), making sure rollers face in proper direction to receive cup (step b). Cone should be pressed firmly against shoulder on shaft.

- b. Place cup on rollers.
- c. Place bearing spacer (16) halves on cup.
- d. Place second cup on spacers.

e. Press second bearing cone on shaft with rollers facing seat in cup. Cone should be pressed on until face of cone is flush or even with shoulder on shaft.

# CAUTION: Do not press second cone past shoulder on shaft.

2. Thread bearing nut (18) on shaft (14) and tighten until it rests against the shoulder on the drive shaft. Install brass tip set screw (17) in bearing nut and tighten.

Note: The tapered bearings are designed such that when properly installed there may be a very slight end play in the bearings (bearing spacer halves may slip freely out 3. Remove bearing spacer halves (16). Thoroughly pack lubricant around rollers and on bearing races. Install one half of bearing spacer. Fill area between bearings half-full of lubricant, and install other half of bearing spacer.

- Note: Assuming the bearings are not too hot, an alternate method of lubricating bearings is as follows: Pack the rollers of the first cone immediately after it is pressed on shaft. Lubricate race of first cup before it is installed. Place bearing spacer halves in place and fill it full of lubricant. Lubricate race of second bearing cup and place on spacer. Pack rollers of second cone with lubricant, and press on shaft until flush with shoulder.
- Note: If too much grease is packed into the bearings during assembly, it may seep from the grease seals during the first few hours of operation until the proper lubricant level is achieved. This lubricant should be wiped from the seal area, when the pump is not operating, to prevent contaminants from collecting in the seal area.

4. Install (light press) grease lip seals (1 and 19) into bearing cover plate (2) and bearing housing (26) with Locktite. The lip of the radial grease seal (1) should be facing outward with spring visible. The lip of the seal (19) should be facing the bearings. The lips of both seals should be wiped with grease.

5. Install drive shaft with bearings in bearing housing, being careful to avoid damaging the grease seal (19).

6. Place O-ring (3) on bearing cover plate and bolt bearing cover plate to bearing housing using six hex head screws (A) and lock washers. The six screws should be tightened evenly, and care should be taken to insure the O-ring becomes seated in the step in the bearing housing. When the bearing cover plate is fully secured to the bearing housing, a small gap of 0.010 to 0.020 inch will exist between the bearing cover plate and the bearing housing.

#### 4-29. Rotor/Stator Assembly

1. Slide head ring (42) over rotor (40) contour to the rotor head. The side of the head ring with the smallest diameter holes should be facing the rotor head.

Note: On some models the head ring is a two-piece component which eliminates this step.

2. Slide stator clamp rings (36) on both ends of the stator (30) and secure in position with retaining rings (35).

3. Coat the rotor (40) contour with waterless hand cleaner, glycol or other lubricant compatible with the stator elastomer. Insert rotor into stator so that rotor head is at the specified distance from the end of the stator (Dimension "A," Figure 4-4).

Note: Turning the rotor counterclockwise while inserting into stator will ease assembly.

#### 4-30. Rotor Gear Joint Assembly

1. Slip O-ring (41) over the rotor head and allow to hang loose with head ring. Insert primary thrust plate (6) into rotor head, flat side first. Thrust plate and rotor head surfaces must be flush to assure proper assembly and operation of the pump (see Figure 4-5).

2. Assemble the rotor end gear joint by first fitting a gear joint seal (13) onto the connecting rod assembly (38). The seal must be positioned so that the flat face of the seal neck fits into the seal retainer component of the connecting rod assembly. Apply a small coating of approved gear joint lubricant to the inside surfaces of the seal.

3. Apply a small amount of lubricant to the flat face of the seal support (12) and slide it onto the connecting rod so that the flat face and radius of the support is against the seal (13).

4. Grease the concave spherical surface of the rear thrust plate (11) and position thrust plate against the seal (13) with the lip on the outside diameter of the seal fitting the step on the back side of the thrust plate.

Model	A
Number(s)	(Inches)
3000	4.62"
5000, 7000	5.68"
9000, 11000-2	6.25"
11000-4, 12000	6.84"
15000, 29000	8.75"

Figure 4-4. Rotor Installation

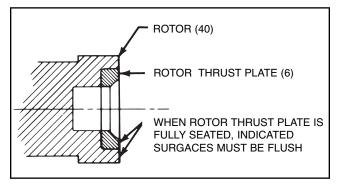


Figure 4-5. Rotor Thrust Plate Seating Detail

#### Page 8

5. Apply a film of grease to the splines on the inside of the gear ball (10). Install gear ball on connecting rod (38), with counterbored end (end without splines) first on connecting rod. Gear ball should slide freely against shoulder on connecting rod. Place lock nut (9) on connecting rod and tighten against gear ball. Apply grease to spherical surfaces and teeth of gear ball.

6. Apply grease to the teeth of the ring gear (8), and slide ring gear onto the gear ball. When ring gear is in place, keyways should be facing the lock nut end of connecting rod.

7. Apply a thin coating of grease to the spherical surface of the thrust plate (6) already installed in the rotor head. Fill the recessed area in the rotor head with grease.

8. Slide the gear joint shell (39) over the connecting rod and assembled gear joint components, being careful to seat the outside diameter of the gear joint seal (13) in the end of the gear joint shell (39). The two tapped holes in the gear joint shell should be in line with one of the keyways in the ring gear.

9. Place keys (7) in the keyways in the ring gear. Check to insure the tapped holes in the side of the gear joint shell are aligned with one of the keyways.

10. Align the keys in the ring gear with the keyways in the rotor head. Slide assembled gear joint shell onto the rotor head, checking to be sure the keys are properly engaged in the rotor head and ring gear. The shallow hole in the rotor head should be aligned with the first threaded hole in the outside of the gear joint shell. Thread the set screw (S) into the threaded hole in the shell until light contact is made with the hole in the rotor head.

11. Place O-ring (41) into step in gear joint shell. Align holes in head ring (42) with six threaded holes in end of gear joint shell and install stainless socket head screws (T). Tighten the six socket head screws evenly, checking to insure O-ring (41) remains in place. When tightened properly, a small gap of a few thousandths of an inch may exist between the shell (39) and head ring (42).

12. Excess grease in the assembly will be purged from the vent hole while the socket head screws are tightened. Tighten the set screw (S) in the shell. Move the free end of the connecting rod in a circular motion to assure that the joint is free and assembled properly. This will also help to purge excess grease from the assembly.

13. Install the stainless steel pipe plug (C) in the second hole in the shell and tighten.

#### 4-31. Rotor/Stator to Drive End Assembly

1. If not already in place, slip stator clamp rings (36) on both ends of stator (30), and install retaining rings (35) in grooves provided on both ends of stator.

2. Place stator gasket (34) in recess in end of suction housing.

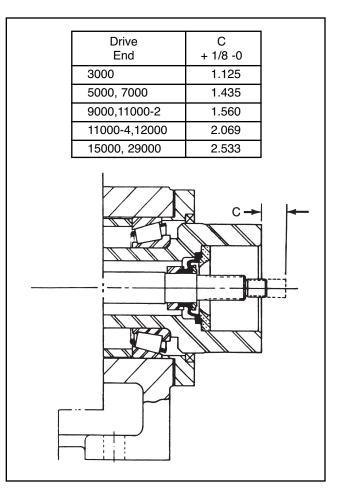


Figure 4-6. Gear Joint Installation

3. Move the rotor/stator/connecting rod assembly in position, and insert connecting rod through the suction housing and drive shaft. Align stator with bore in suction housing, and slide stator in place, checking to insure that stator gasket (34) remains properly positioned.

4. Check the dimension "C" between the end of the connecting rod and face of the drive shaft as shown in Figure 4-6. For proper assembly of the drive end gear joint, this dimension should be no less than that shown in column C, and should not exceed the amount in column C by more than 1/8 inch. Reposition rotor/stator assembly in or out of suction housing as required to achieve the proper dimension.

5. If the stator is firmly seated against stator gasket in suction housing recess, and connecting rod extends beyond face of drive shaft by specified amount, stator may be secured to suction housing. If the specified dimension cannot be maintained with stator firmly seated, do not perform the following step 6 until the drive end gear joint is properly assembled.

6. Align holes in clamp ring (36A) with threaded holes in suction housing, and thread four hex head screws (R) with lockwashers through holes in clamp ring into threaded holes in suction housing. Tighten hex head screws evenly.

#### 4-32. Drive End Gear Joint Assembly

1. Check to see that connecting rod extends beyond face of drive shaft by amount specified in column C of Figure 4-6 (see Section 4-31, step 4).

2. Fit the gear joint seal (13) on the connecting rod (38). Push the seal firmly in place on the connecting rod so that the neck on the seal seats in the recess in the seal retainer component of the connecting rod.

3. Apply a film of gear joint grease to the inside of the gear joint seal and to the flat face of the seal support (12). Slide the seal support (12) onto the connecting rod such that the flat face fits against the seal.

4. Apply a film of grease to the concave spherical surface of the secondary thrust plate (11), and slowly push the thrust plate into the drive shaft until it rests firmly against the seal.

5. Apply a film of grease to the gear ball (10) splines and spherical surfaces, and install gear ball on connecting rod, counterbored end first (end without spines). Gear ball should slide freely on rod until it contacts shoulder on rod. Install connecting rod lock nut (9) and tighten against gear ball. While tightening lock nut, prevent connecting rod from turning by carefully holding with pipe wrench or vise grips through inspection ports in suction housing.

6. Apply liberal amount of grease to gear ball teeth and ring gear (8) teeth, and slide ring gear into the drive shaft assembly. Keyways in ring gear should be facing out, and one of the keyways should be aligned with drilled and tapped holes in outside diameter of drive shaft.

7. Place keys (7) in keyways of the ring gear. A small amount of grease may be used to hold the keys in place. The flat face of the ring gear should be approximately flush with the face of the drive shaft.

8. Place primary thrust plate (6) in drive shaft head (4), aligning slot in outside diameter of thrust plate with pin in drive shaft head. When the thrust plate is properly seated, the face of the thrust plate should be flush with the face of the drive shaft head.

9. Lubricate the spherical surface of the thrust plate and fill the recess in the drive shaft head with grease.

10. Place O-ring (5) in the groove on drive shaft head (4). Align the keyways in the drive shaft head with the keys in the ring gear, and insert the head into the drive shaft assembly.

Note: If the threaded holes in the drive shaft do not align with the holes in the drive shaft head, a strap wrench or pipe wrench may be used to turn the drive shaft slightly.

11. Thread the six socket head screws (E) through the drive shaft head into the drive shaft. Tighten them evenly until face of drive shaft head is tight against face of drive shaft. Excess grease in the gear joint assembly will be purged from the holes in the drive shaft and drive shaft head.

Note: If the standard socket head screws are not long enough initially to engage the threads in the drive shaft, two longer screws may be used 180 degrees apart to pull the drive shaft head close enough to the drive shaft to engage the standard screws.

12. After the six socket head screws (E) are secured and the grease has been purged from the assembly, install the pipe plugs (C) in the drive shaft head and drive shaft. Also install the locking set screw (D) in the drive shaft in the threaded hole nearest the bearing housing.

13. If the stator was not previously tightened to the suction housing (Section 4-31, step 5), it should be tightened at this time.

#### 4-33. Stator Support/Discharge Assembly

1. Place top of stator support(s) (31) over stator and fasten to bottom half of stator supports using hex head screws (L).

2. Place stator gasket (34) in recess in discharge flange (37) and position discharge flange on end of stator. Align holes in stator clamp ring (36B) with threaded holes in discharge flange, and install and tighten hex head screws (M).

#### 4-34. Final Assembly

1. Install inspection plates (32) to suction housing (29) with gaskets (33), using hex head screws (P) and lockwashers.

2. Install pipe plugs (Q and J) and zerk fittings (K) in appropriate threaded holes in suction housing. Install pipe plugs (N) in threaded holes in bearing housing, or attach drain lines if preferred.

3. Connect power source. Open suction and discharge valves, and start pump.

#### 4-35. Packing Adjustment

For packing adjustment, refer to Section 4-3.

#### 4-36. STORAGE

**4-37.** Short-Term Storage. Storage of 6 months or less will not damage the pump. However, to insure the best possible protection, the following is advised:

1. Store pump inside whenever possible or cover with some type of protective covering. Do not allow moisture to collect around pump.

2. Remove drain plug to allow the pump body to drain and dry completely.

3. Loosen the packing gland and inject a liberal amount of grease into the stuffing box. Tighten the gland nuts only hand tight. Page 10

4. See drive manufacturer's instructions for motor and/or drive storage.

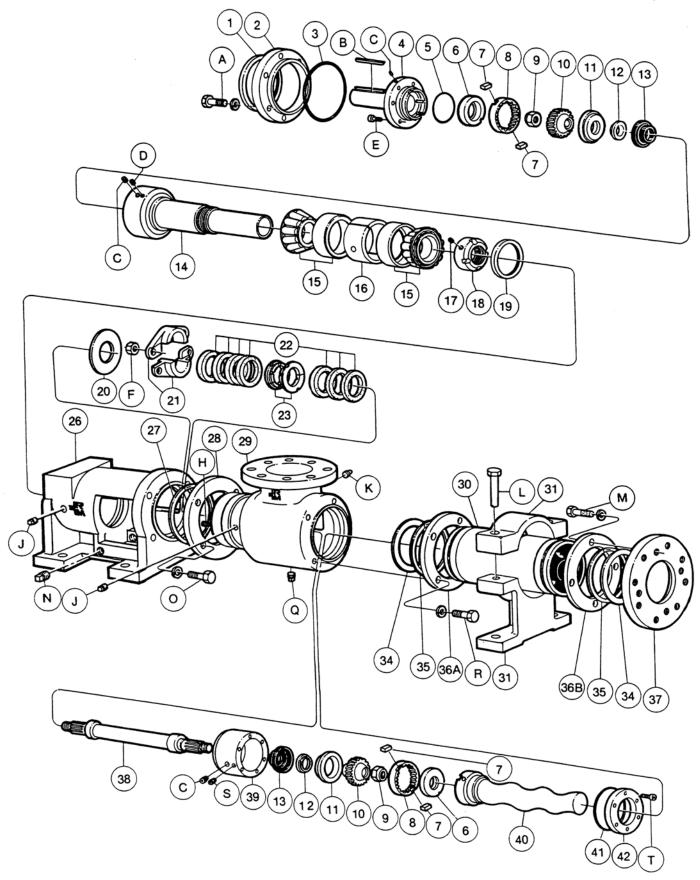
5. See OPERATION Sections 3-1 through 3-4 before start-up. Be sure all lubricants are in good condition.

**4-38.** Long-Term Storage. If pump is to be in storage for more than 6 months, perform the above short-term storage procedures plus the following:

1. Occasionally rotate the pump manually a few revolutions to avoid a "set" condition of rotor in stator elastomer. This will prevent hard starting and excessive torque requirements when pump is again put into operation.

2. Apply rust inhibitor to all unpainted cast iron and machined carbon steel surfaces.

3. Remove drive belts if applicable.



### 4-39. PARTS LIST

			DRIVE	END SIZE		
REF. NO.		3000	5000 7000	9000 11000-2	11000-4 12000	15000 29000
1	Radial Grease Seal	PF0611	PG0611	PH0611	PJ0611	PK0611
2	Bearing Cover Plate	PF0341	PG0341	PH0341	PJ0341	PK0341
3	O-Ring	BJ112Q	BK110Q	PH110Q	BH114Q	PK110Q
4	Drive Shaft Head	PF0971	PG0971	PH0971	PJ0971	PK0971
5	O-Ring Shaft Head	BE113Q	BG114Q	BH111Q	TJ111Q	BK114Q
6	Primary Thrust Plate	PF0981	PG0981	PH0981	PJ0981	PK0981
7	Key	RF0761	RG0761	RH0761	RJ0761	RK0761
8	Ring Gear	AF0952	AG0952	AH0952	AJ0952	AK0952
9	Lock Nut	RF0581	RG0581	RH0581	RJ0581	RK0581
10	Gear Ball	AF0951	AG0951	AH0951	AJ0951	AK0951
	Gear Joint Kit (See Note C)	KPF951	KPG951	KPH951	KPJ951	KPK951
11	Secondary Thrust Plate	PF0982	PG0982	PH0982	PJ0982	PK0982
12	Seal Support	PF0891	PG0891	PH0891	PJ0891	PK0891
13	Gear Joint Seal	PF087Q	PG087Q	PH087Q	PJ087Q	PK087Q
	Gear Joint Seal Kit (See Note D)	KPF87Q	KPG87Q	KPH87Q	KPJ87Q	KPK87Q
14	Drive Shaft	T30261	T50261	T90261	T11261	T15261
15	Tapered Roller Bearing	PF0311	PG0311	PH0311	PJ0311	PK0311
	Bearing Kit (See Note B)	KPF291	KPG291	KPH291	KPJ291	KPK291
16	Bearing Spacer	PF0331	PG0331	PH0331	PJ0331	PK0331
17	Bearing Lock Plug	PI0762	PI0762	PI0762	PI0762	PI0762
18	Bearing Lock Nut	PF0581	PG0581	PH0581	PJ0581	PK0581
19	Thrust Grease Seal	XK0621	PG0621	PH0621	Al4611	PK0621
20	Slinger Ring	PF0771	PG0771	PH0771	PJ0771	PK0771
21	Packing Gland Half	PF041S	PG041S	PH041S	PJ041S	PK041S
22	Packing	T30423	T50423	T90423	T11423	T15423
23	Lantern Ring Half	PF0571	PG0571	PH0571	PJ0571	PK0571
26	Bearing Housing	PF0051	PG0051	PH0051	PJ0051	PK0051
27	Retaining Ring		PG0085	AH0085	PJ0085	PK0085
28	Clamp Ring	AG0932	PG0932	AH0932	PJ0932	PK0932
29	Suction Housing	T30021	T50021	T90021	T11021	T15021
30	Stator (See Note A)		sing Pump Mode			
31	Stator Support	BF0381	BG0381	BH0381	BJ0381	BK0381
34	Stator Gasket	BF085Q	BG085Q	BH085Q	BJ085Q	BK085Q
35	Retaining Ring	AF0085	AG0085	AH0085	AJ0085	AK0084
36A	Stator Clamp Ring Clip	AF0932	AG0932	AH0932	AH0932	AK0932
36B	Stator Clamp Ring	AF0993	AG0993	AH0993	AH0993	WK0932
37	Discharge Flange	BF0127	BG0127	BH0127	BJ0127	WK0126
38	Connecting Rod	PF0256	PG0256	PH0256	PJ0256	PK0256
39	Gear Joint Shell	PF0916	PG0916	PH0916	PJ0916	PK0916
40	Rotor (See Note A)		sing Pump Mode			
41	O-Ring	PF113Q	PG113Q	PH113Q	PJ113Q	PK113Q
42	Head Ring (See Note E)	PF0335	PG0335	PH0335	PJ0335	PH0335

Note B: Bearing Kit includes items 1, 15(2),19

Note C: Gear Joint Kit includes items 6, 7(2), 8, 10, 11, 12

Note D: Gear Joint Seal Kit includes items 5, 13, 41

Note E: Model 11000-2 Head Ring part number is PH034S

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