



IMO®

## INSTRUCTIONS AND PARTS LIST

### Series C324A DOUBLE EXTENDED POWER ROTOR

**WARNING**

READ CA-1 AND THIS INSTRUCTION BOOK BEFORE  
INSTALLATION, OPERATION, OR MAINTENANCE

### Instructions C324A-D (R-1)

This manual now is  
identified as part no.  
SRM00042

This instruction manual covers Imo Series C324A pumps with double extended power rotor shafts in rotor sizes 162, 187, 231, 250, 275 and 300. It is necessary to have a variety of construction and material combinations due to the large number of operating conditions. The model of each pump is identified on the pump nameplate.

#### NOTE

This manual identifies pump types by figure numbers only. For maintenance, disassembly and reassembly procedures, ensure that the specific pump type is identified with correct Figure Number(s). Refer to Table 1 and Figures 6 through 10 for proper identification of specific models.

Series C324A pumps are upgraded versions of the basic A324A and B324A designs. Table 1 identifies A and B pump type designators with corresponding CB and C324A pump type designators. Note that the double extended power rotor shaft denotes special design in all C324A models. Definitions of model designators are given in Figure 1.

The 324A series with double extended power rotors are positive-displacement, rotary, screw-type pumps. Fluid entering the suction inlet divides and flows to the end of the rotors. At rotor ends, fluid enters the rotor set, and the smooth intermeshing of these rotors propels the fluid axially in a smooth flow, without churning, pocketing or pulsation to the central discharge chamber. The fluid entering from both ends keeps the rotors in axial hydraulic balance. The moving parts are lubricated by the fluid being pumped.

The basic C324A series pumps are supplied with an iron case and covers with packing. For special applications, pumps are supplied with a steel case and covers and/or with a steam jacketed case. Special high temperature packing or mechanical seals are used for high temperature applications.

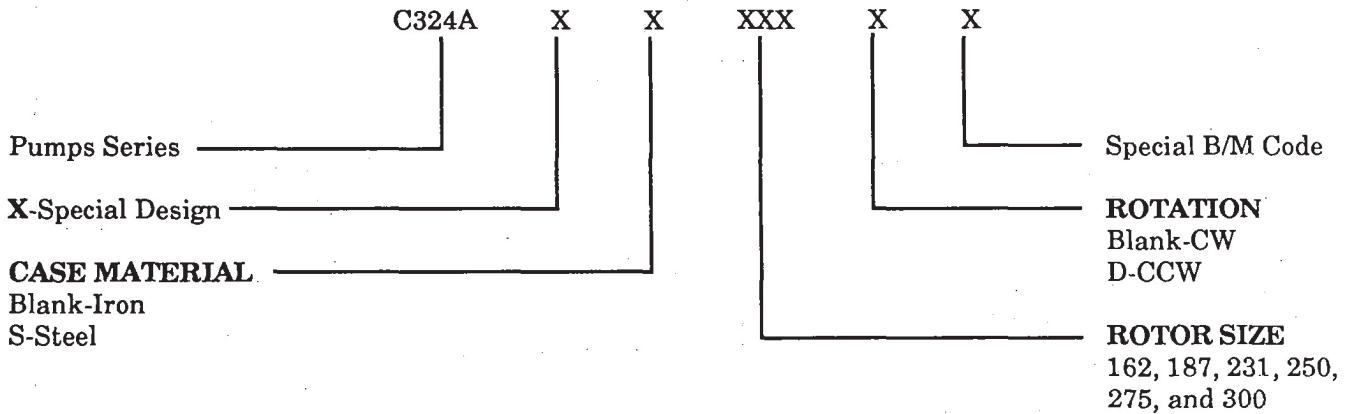
Each model of this series is equipped with a seal piping connection between pump discharge and seal housing or packing gland. When the pump is operated with a suction lift, liquid under pressure is delivered to the pump-side of either the packing or mechanical seal, depending on pump type. In packing type pumps, air is prevented from leaking into the pump by a slow-flowing liquid seal. Flow control is regulated by a needle valve. The needle valve opening should be great enough to allow a slow leak of liquid past the packing while the pump is in operation and is pre-set for normal conditions before being shipped. As a precaution, the valve is slotted to avoid full closure.

SERIES 324A-424A INSTRUCTION MANUALS	
ROTOR SIZE	INSTRUCTIONS
162-250	324A-424A-A
275-300	324A-B
325-412	324A-C
Double Extended	324A-D

**TABLE 1**  
**324A PUMP TYPES WITH DOUBLE EXTENDED POWER ROTOR**  
**ROTOR SIZES 162 THROUGH 300**

INITIAL DESIGNATORS			PUMP FIG. NO.	SEALING DESIGN FIG. NO.	SEAL SEAT DESIGN FIG. NO.
A or B	CB	C324A (4)			
A324AX	CB324AD	C324AX	6	6	
A324AAX	CB324AAD	C324AX	7	3	7 or 8 (3)
B324ACD	CB324ACD	C324AX	10	3	10
B324ATD	CB324ACD	C324AX	9	3	9
A324ASX	CB324ASD	C324AX	7	4	7 or 8 (2)
A324AAX	CB324AADS	C324AXS	7	3	7 or 8 (3)
B324ABDT	CB324ABDT	C324AX	10	4	10
A324ASX	CB324ASDS	C324AXS	7	4	7 or 8 (3)
B324ASDS	CB324ASDS	C324AXS	7	4	7 or 8 (3)

- (1) Pump model precedes rotor size. EXAMPLE: CB324AD-162.
- (2) Figure 7 pumps can be equipped with either Figure 3 or 4 seals.
- (3) Mechanical seal, Figures 3 and 4, can be equipped with either seal seat as illustrated in Figures 7 and 8.
- (4) C324A pumps with double extended power rotors are special design pumps, denoted by X in model designators. A bill of material suffix follows rotor size designator.



**FIGURE 1. Definition for Model Designators for C324A Pumps with Double Extended Power Rotors**

### ORDERING INSTRUCTIONS

All correspondence pertaining to renewal parts for Series 324A pumps with double extended power rotors must refer to this instruction book number and should be addressed to the nearest IMO Pump Division Sales office or representative listed in CA-1 Manual.

The following directions should be followed for renewal part orders:

- 1 - Give the number of this instruction book.
- 2 - Give the pump type and serial number of the pump for which part(s) is ordered.
- 3 - Give the figure number(s) on which the pump type and sealing design part(s) are shown.

### STRUCTURAL LIMITS

Operating conditions such as speed, fluid viscosity, inlet pressure, temperature, filtration, duty cycle, mounting, drive type, etc. are interrelated. Due to variable conditions, specific application limitations may vary from structural limitations. **This equipment must not be operated without verification that operating requirements are within published capabilities as shown in the appropriate pump data manuals** (available from local IMO Pump Division offices and representatives listed in Manual CA-1).

Under no circumstances are the following structural limitations to be exceeded.

**MAXIMUM SPEED:** Contact the IMO Pump Division for rating tables. For residual, crude oil and other fluids known to contain fine abrasives, pump speed should not exceed 1800 RPM.

**VISCOSITY:** 8.0 cst (50 SSU) Minimum. Consult factory for lighter viscosities.

Maximum for type B - 3000 SSU. For viscosities above 3000 SSU use packed pumps or type H. Contact the IMO Pump Division for minimum allowable operating viscosity at specific speeds and pressures. Do not use packed pump for viscosity below 100 SSU.

**TEMPERATURE:** Type P 0-250°F.  
 Type B 0-160°F.  
 Type H 0-250°F.

**PRESSURE:** 500 PSIG

**SUCTION:** 50 PSIG MAXIMUM

**FILTRATION:** Light fluids—60 mesh  
 Heavy fluids—1/8 to 3/16-inch

**DRIVE:** Direct Only

## DISASSEMBLY AND ASSEMBLY PROCEDURES FOR FIGURE 6 AND 7 PUMPS

### DISASSEMBLY

**STEP 1.** Remove pump from driver couplings and mounting bracket. Remove coupling hubs and keys (029). Remove tube (037) from pump. **NOTE:** Tube (037) is equipped with check valves (039) that must be replaced in their original installed position.

**STEP 2. Figure 6 only:** Remove nuts (006), bolts (005) and drip cups (003) from pump (inboard and outboard ends).

**STEP 3.** Remove packing or mechanical seal as follows:

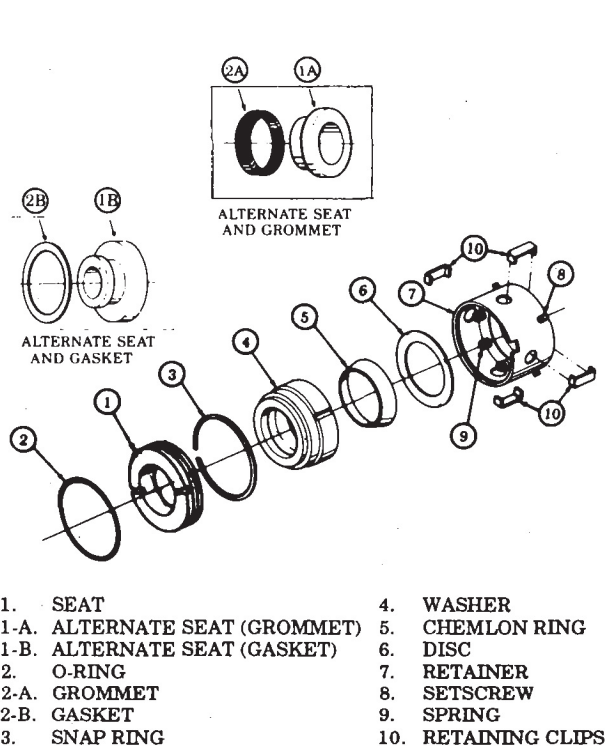
*Figure 6:* Remove packing nuts (022) and washers (021) from gland bolts (020). Slide packing gland (028) off power rotor (013). Swing gland bolts (020) away from power rotor (013). Remove packing (027), using either a "packing puller" or sharp pointed brass or copper rod.

*Figure 7:* Remove bolts (046), seal cover (045) and gasket (044). **NOTE:** Mechanical seal seat will be removed with seal cover (045). Remove mechanical seal seat with O-ring or seal seat with brommet (Figure 8) from seal cover (045). Remove O-ring (2) from seat (1) (Figure 3 or 4) or grommet (2A) from seat (1A) (Figure 3 or 4). Remove mechanical seal rotating parts (3 through 9, Figure 3) or (3 through 5, Figure 4), shim (043) and spacer (042) from power rotor (013).

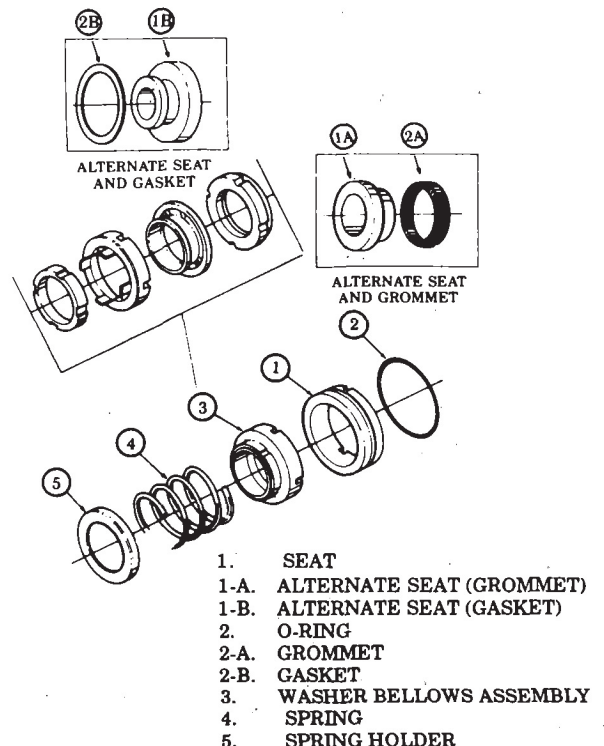
**NOTE:** Step 3 should be followed on both inboard and outboard ends of pump.

**STEP 4.** Remove bolts (002) and slide inboard cover (017) off power rotor (013). Remove gasket (004) from pump case (001).

**STEP 5.** Remove bolts (002) and outboard cover (015). Remove gasket (004) from pump case (001).



**FIGURE 3. Crane Type 9 Mechanical Seal.**



**FIGURE 4. Crane Type 21 Mechanical Seal.**

*Figure 6:* Removal of inboard cover (017) and outboard cover (015) includes removal of bushings (018), stop pins (023), washers (024), check valves (039), bushings (040), and plugs (041). Slide washer (024) from inboard cover (017) and outboard cover (015). Remove stop pins (023) and slide bushing (018) from inboard cover (017) and outboard cover (015). No additional disassembly of inboard cover or outboard cover is required unless check valves (039) must be replaced. Remove bushing (040) to remove check valve (039).

*Figure 7:* Removal of inboard cover (017) and outboard cover (015) includes removal of bushings (018), stop pins (023), plugs (041) and check valves (039). Remove stop pins (023) and slide bushing (018) from inboard cover (017) and outboard cover (015). No further disassembly of inboard cover or outboard cover is required unless check valves (039) must be replaced.

**STEP 6.** Grasp power rotor (013) and pull idlers (014) and power rotor (013) from inboard end of pump case. **NOTE:** As the rotor assembly slides from housings, wrap the rotors with a sling to prevent accidental dropping or to assist in holding the rotors in mesh for easy removal.

**STEP 7.** Remove inboard collar (016) and key (026) from power rotor (013). Remove outboard collar (048), key (026) and shim (036) from power rotor (013).

**STEP 8.** Remove plugs (007) from case (001). Stop pins (011) are match-marked with case (001) to identify correct installed location and position. If stop pins are to be replaced or if marks are not visible, make new markings before removal of pins. If new housings are required, new stop pins will be required for correct fitting. Install a 3/16-inch-16 bolt in each stop pin and remove stop pins (011). Tag each stop pin with installed location.

**STEP 9.** Slide housings (010) from case (001). Slide spacer ring (012) from case (001). **NOTE:** Adjusting screws (019) and jam nuts (025) should not be removed from housings (010) unless new housings are required.

## **ASSEMBLY**

**NOTE:** Prior to assembly of pump, all parts should be cleaned and inspected for burrs or nicks. Replace all worn or damaged parts. The IMO Pump Division recommends automatic replacement of gaskets, packing, or mechanical seal when these parts are disturbed from their previously installed position. Wipe all parts with light lubricating oil prior to assembly.

**STEP 1.** Wipe spacer ring (012) with oil and slide spacer (012) into pump case (001). Align one open port of spacer ring (012) with outlet opening of case.

**STEP 2.** Wipe housings (010) with oil, align stop pin slots and slide housings (010) into case (001). To assist in properly aligning housings (010), slide idlers (014) into idler bores and slide back and forth until idlers slide freely. When housings are properly aligned, install stop pins (011) and plugs (007). Remove idlers (014).

**NOTE:** If new housings are installed, new stop pins (011) must be field fitted and installed. To fit new stop pins, file or grind one or both flat surfaces of stop pins until pin fits rightly into housing slot. Do not over grind flat surfaces. If stop pins are not snugly fitted to housings, housing may rotate out of position during operation and damage rotors.

**STEP 3.** Coat bushing (018) with oil. Align bushing slot to receive stop pin (023) and slide bushing (018) in inboard cover (017) bushing bore. Install stop pin (023) in inboard cover (017) and bushing (018). **NOTE:** If check valve (039) was removed, install check valve (039, Figure 7) or check valve with bushing (039 and 040, Figure 6) in inboard cover (017).

**STEP 4.** Install gasket (004) and assembled inboard cover (017) on inboard end of case (001) using bolts (002). Torque bolts (002) to 85 lbs. ft. ( $\pm$  5 lbs. ft.) for rotor sizes 162 and 187 or 170 lbs. ft. ( $\pm$  10 lbs. ft.) for rotor sizes 231 and 250.

**STEP 5.** Push outboard housing (010) toward inboard end of pump until inboard housing (010) contacts lugs on inboard cover (017). Measure distance from outboard cover (015) flange face down to adjusting screw machined pad of outboard cover (015) by placing a straight edge across outboard cover flange face and measuring to machined pad. Measure gasket (004) thickness and add 60% of this measurement to outboard cover machined pad depth measurement. Adjust adjusting screws (019) until the heads of screws (019) extend from housing a distance equal to the total measurement of outboard cover machined pad depth plus 60% of gasket measurement. Tighten jam nuts (025). Wipe blueing on heads of adjusting screws (019). Install gasket (004) and unassembled outboard cover (015) using bolts (002). Torque bolts to approximately 50 lbs. ft. Remove outboard cover (015) and check for contact of adjusting screws on machined pad of cover. Adjust screws (019) until contact is achieved between adjusting screws (019) and machined pad of outboard cover (015). **CAUTION:** Do not exceed 0.003-inch pressure on adjusting screws (019) to avoid distortion of rotor housing bores.

**STEP 6.** Wipe power rotor (013), keys (026) and collars (016 and 048) with oil. Place key (026) in inboard key slot of power rotor (013). Align collar (016) with key (026) and slide collar (016) on power rotor (013). Slide shim (036) on outboard end of power rotor (013). Place key (026) in outboard end key slot. Align outboard collar (048) with key (026) and slide collar (048) on power rotor (013).

**STEP 7.** Coat assembled power rotor (013) and idlers (014) with oil. Slide rotor assembly, power rotor (013) and idlers (014), in pump from outboard end. Power rotor and idlers should be in mesh for ease of insertion into rotor bores.

**STEP 8.** Install gasket (004) and outboard cover (015) to case (001) using bolts (002). Torque bolts (002) to 85 lbs. ft. ( $\pm 5$  lbs. ft.) for rotor sizes 162 and 187 or 170 lbs. ft. ( $\pm 10$  lbs. ft.) for rotor sizes 231 and 250.

**STEP 9.** Mount a dial indicator on inboard cover to measure power rotor (013) end clearance (axial movement). Axial movement should be 0.030-inch (+ 0.005, -0-inch). If end clearance must be adjusted, remove outboard cover (015), gasket (004), collar (048), key (026) and shim (036). Add or remove layers of shim (036) to obtain desired clearance. Slide shim (036) on power rotor (013). Repalce key (026) in key slot, align collar (048) with key (026), and slide collar (048) on power rotor (013).

**STEP 10.** Coat bushing (018) with oil. Align bushing slot to receive stop pin (023), and slide bushing (018) in outboard cover (015) bushing bore. Install stop pin (023) in outboard cover (015) and bushing (018). **NOTE:** If check valve (039) was removed, install check valve (039, Figure 7) or check valve with bushing (039 and 040, Figure 6) in outboard cover (015).

**STEP 11.** Install gasket (004) and assembled outboard cover (015) to case (001, using bolts (002). Torque bolts (002) to 85 lbs. ft. ( $\pm 5$  lbs. ft.) for rotor sizes 162 and 187 or 170 lbs. ft. ( $\pm 10$  lbs. ft.) for rotor sizes 231 and 250.

**STEP 12.** Install packing or mechanical seal.

*Figure 6.* Slide washer (024) on power rotor (013) and into inboard cover (017). Install packing rings (027) in packing bore. Set each packing ring individually and firmly in place, with the joints of the rings staggered. Slide packing gland (028) on power rotor (013) and turn gland bolts (020) parallel with power rotor. Slide gland (028) to packing bore. Slide washers (021) on gland bolts (020) and install nuts (022). Tighten gland nuts (022) evenly and hand tight. **NOTE:** If plug (041) was removed, install plug (041).

*Figure 7.* Install gasket (044) and seal cover (045) on inboard cover (017) using bolts (046). Torque bolts (046) to 20 lbs. ft. ( $\pm 2$  lbs. ft.). Pull power rotor in axial direction until collar (016) contacts bushing (018). Lightly scribe power rotor (013) where it starts to protrude through seal cover (045). Remove bolts (046), seal cover (045) and gasket (044). Slide spacer (042) on power rotor (013) until it rests on step-cut shoulder of power rotor. Measure distance from scribe mark on power rotor to nearest face of spacer (042). Identify this measured distance as "X" to be used in adjusting seal working length. Determine required working length of mechanical seal from Special Note below.

## SPECIAL NOTE

Mechanical seal working length for rotor sizes 162 and 187 is 1-1/16-inch (+0, -1/64-inch). Mechanical seal working length for rotor sizes 231 and 250 is 1-1/8-inch (+0, -1/64-inch). Determine necessary seal working length per rotor size and identify length as "S".

Install O-ring (2, Figure 3 or 4) on seal seat (1, Figure 3 or 4), or grommet (2A, Figure 3 or 4) on seal seat (1A, Figure 3 or 4). Slide assembled seal seat in seal cover (045). Measure thickness of power rotor bore of seal cover (045) including mechanical seal thickness and identify measured distance as "Y". Determine required thickness of shim (043) by adding seal working length "S" to thickness of seal cover bore "Y" and subtracting the total from power rotor length "X".

$$\text{SHIM THICKNESS (043)} = X - (Y + S)$$

Add or subtract layers of shim (043) until required thickness is obtained for proper seal working length. Slide shim (043) on power rotor (013). Install mechanical seal rotating parts as follows:

*Crane 9 Mechanical seal (Figure 3):* Slide mechanical seal rotating parts (3 through 10) on power rotor (013) until retainer (7) contacts shim (043). Remove and discard retaining clips (10). Slide seal on power rotor until contact is made between seal retainer (7) and shim (043). Tighten setscrews (8).

*Crane 21 Mechanical Seal (Figure 4):* Slide mechanical seal rotating parts (3 through 5) on power rotor (013) with spring holder (5) next to shim (043).

STEP 13. Install gasket (044) and seal cover (045) using bolts (046). Torque bolts (046) to 20 lbs. ft. ( $\pm 2$  lbs. ft.).

STEP 14. Repeat Steps 12 and 13 for outboard end of pump to install packing or mechanical seal.

STEP 15. *Figure 6 Only:* Install drip cups (003) using bolts (005) and nuts (006) on inboard and outboard ends of pump.

STEP 16. Install tubing (037), key (029) and pump coupling hub. Install pump on foundation and align pump driver as described in CA-1 Manual. Connect coupling hubs. Connect all piping to pump.

NOTE: (*Figure 6*) When starting pumps, adjust packing bolts to allow seepage of approximately 8 drops per minute. DO NOT over tighten packing to avoid distortion of power rotor. Seepage from packing gland provides cooling and lubrication for packing.

## DISASSEMBLY AND ASSEMBLY PROCEDURES FOR FIGURE 9 PUMPS

### DISASSEMBLY

NOTE: Due to the double extended power rotor design, terminology for Figure 10 pump disassembly and assembly procedures refer to "clamped end" and "unclamped end" of pump rather than inboard and outboard ends. The outer race of the ball bearing on the clamped end is held in place by a retaining ring and a bearing retainer. The bearing at the unclamped end has neither of these two parts and is free to float.

STEP 1. Disconnect all piping. Disconnect pump from each coupling and mounting. Remove coupling hubs and keys (022). Move pump to a clean area suitable for disassembly.

NOTE: Steps 2 through 5 are for the clamped end of pump.



STEP 2. Remove bearing nuts (016), bearing washer (015) and spacer (028) from power rotor (013). Remove bolts (019) and bearing retainer (018) from bearing housing (008).

STEP 3. Insert two (2) 1/2 X 1-1/2-inch jacking bolts in bearing housing (008). Tighten jacking bolts evenly to remove bearing housing and ball bearing (014). Remove jacking bolts from bearing housing (008). Remove ball bearing (014) and spiral ring (009) from bearing housing (008). Remove truarc ring (012) from rotor (013).

STEP 4. Remove bolts (002), cover (017) and gasket (004) from pump case (001). Remove seal cover and gasket from cover (017).

STEP 5. Loosen setscrews and slide mechanical seal (006) rotating parts off power rotor (013).

NOTE: Steps 6 through 9 are for disassembly of unclamped end of pump.

STEP 6. Remove bearing nuts (016), bearing washer (015) and spacer (028) from power rotor (013).

STEP 7. Remove bolts (020). Insert two (2) jacking bolts in bearing housing and remove and disassemble bearing housing as described in Step 3.

STEP 8. Remove mechanical seal (006), bolts (002), cover (017) and gasket (004). Remove mechanical seal seat (1B, Figure 3) and gasket (2B, Figure 3) from cover (017).

STEP 9. Remove shim (021) from power rotor (013).

STEP 10. Grasp power rotor (013) and pull idlers (027) and power rotor (013) from clamped end of pump case. NOTE: As rotor assembly slides from housings, wrap the rotors with a sling to prevent accidental dropping or to assist in holding the rotors in mesh for easy removal.

STEP 11. Remove plugs (007) from case (001). Stop pins (011) are match-marked with case (001) to identify correct installed location and position. If stop pins are to be replaced, or if marks are not visible, make new markings before removal of pins. If new housings are required, new stop pins must be installed for correct fitting. Install a 3/8-inch-16 bolt in each stop pin and remove stop pins (011). Tag each stop pin with installed location.

STEP 12. Slide housings (010) from case (001). Remove spiral rings (003) from housings (010).

## ASSEMBLY

NOTE: Prior to assembly of pump, all parts should be cleaned and inspected for nicks and burrs. Replace all worn or damaged parts. The IMO Pump Division recommends automatic replacement of gaskets, mechanical seals, and ball bearings when these parts are disturbed from their previously installed position. Wipe all parts with light lubricating oil prior to assembly.

STEP 1. Wipe housings with oil. Install spiral rings (003) in both housings (010). Align stop pin slots and slide housings (010) into case (001), one from each end, until spiral ring (003) contacts case (001). To assist in properly aligning housings (010), slide idlers (027) into idler bores and slide idlers back and forth to check for binding, indicating misalignment of housings. Install stop pins (011) and plugs (007). Remove idlers (027).

NOTE: If new housings (010) are installed, new stop pins (011) must be field fitted and installed. To fit new stop pins, file or grind one or both flat surfaces of stop pin until pin fits rightly into housing slot. Do not over grind flat surfaces. If stop pins are not snugly fitted to housings, housing may rotate out of position during operation and damage rotors.

STEP 2. Mesh threads of idlers (027) with threads of power rotor (013) and slide rotor assembly into housing rotor bores from unclamped end of pump.

NOTE: Assembly clamped end of pump first since working length is pre-determined. Steps 3 through 6 are for the clamped end of the pump.

STEP 3. Slide mechanical seal rotating parts (3 through 10, Figure 3) on power rotor (013) until retainer (7, Figure 3) contacts step-cut shoulder of power rotor. Remove and discard retaining clips (10, Figure 3). Position seal on power rotor at marked areas for setscrews and tighten setscrews.

STEP 4. Install gasket (004) and cover (017) using bolts (002). Install gasket (2B, Figure 3), furnished with seal in cover (017). Slide seal seat (1B, Figure 3) on power rotor next to gasket in cover (017). Slide truarc ring (012) on power rotor and position truarc ring in power rotor groove.

STEP 5. Install spiral ring (009) in bearing housing (008) and slide bearing housing (008) into cover (017) bore. Install ball bearing (014) in bearing housing (008). NOTE: If it is necessary to tap ball bearing for installation in housing, tap only on inner race of bearing.

STEP 6. Install bearing retainer on bearing housing using bolts (019). Slide spacer (028) on power rotor (013) next to ball bearing (014). Install bearing washers (015) and bearing nuts (016). Bend down one tab of washer (015) into corresponding groove on bearing nut (016) and torque bearing nuts to 20 lbs. ft. (+5, -0 lbs. ft.).

NOTE: Steps 7 through 12 are for assembly of unclamped end of pump.

STEP 7. Prior to installation of mechanical seal (006), seal working length must be verified and required shim thickness must be determined. Install gasket (004) and cover (017) with bolts (002). Scribe power rotor lightly where rotor begins to protrude through cover (017). Remove cover (017) and gasket (004). Measure distance from scribe mark on power rotor to step cut shoulder of power rotor and identify distance as "X". Measure cover (017) from face of seal seat bore to face of cover, and identify distance as "A". Measure thickness of seal seat (1B, Figure 3) by measuring from face which fits into bore of cover (017) to outer face which sits next to rotating parts of seal and identify distance as "B". Seal working length is 1-3/8-inch ( $\pm 1/64$ -inch) and should be identified as distance "C". Add distance "A" and "B"; subtract 0.006 for compression of seal gasket and add distance "C". Identify resulting distance as "Y".

$$(A + B) - 0.006 + C = Y$$

Determine shim thickness by subtracting distance "Y" from distance "X". Add or remove layers of shim to obtain desired thickness.

$$\text{SHIM THICKNESS (021)} = X - Y$$

STEP 8. Slide desired thickness of shim (021) on power rotor (013) next to step-cut shoulder of rotor.

STEP 9. Assemble mechanical seal rotating parts on power rotor as outlined in Step 3 for clamped end of pump. NOTE: Seal retainer (7, Figure 3) will be next to shim (021) rather than the step-cut shoulder of power rotor (013).

STEP 10. Install gasket (004) and cover (017) with bolts (002). Slide gasket furnished with mechanical seal in cover (017) seal seat bore. Install seal seat in cover (017) seal seat bore. Slide truarc ring (012) in ring groove of power rotor (013).

STEP 11. Slide bearing housing (008) into cover (017) housing bore and install bolts (020) in bearing housing (008). Install ball bearing (014) in bearing housing (008). NOTE: If bearing does not slide easily onto power rotor and it is necessary to tap the ball bearing for installation, tap only on inner race of bearing.

STEP 12. Install spacer (028) on power rotor next to ball bearing (014). Install bearing washers (015) and bearing nuts (016). Bend down one tab of washer (015) into corresponding groove of nut (016). Torque bearing nuts to 20 lbs. ft. ( $\pm 5$ , -0 lbs. ft.).

STEP 13. Install keys (022), coupling hubs, and pump piping.

## **DISASSEMBLY AND ASSEMBLY PROCEDURES FOR FIGURE 10 PUMPS**

### **DISASSEMBLY**

NOTE: Due to the double extended power rotor design, terminology for Figure 10 pumps disassembly and assembly procedures refer to "clamped end" and "unclamped end" of pump rather than inboard and outboard ends. The outer race of the ball bearing on the clamped end is held in place by a retaining ring and a bearing retainer. The bearing at the unclamped end has neither of these two parts and is free to float.

STEP 1. Disconnect all piping. Disconnect pump from each coupling and mounting. Remove coupling hubs and keys (022). Move pump to a clean area suitable for disassembly.

NOTE: Steps 2 through 5 are for disassembly of clamped end of pump.

STEP 2. Remove bolts (028), bearing retainer (020) and bearing nut (019).

STEP 3. Remove capscrews (021) from bearing housing (016). Insert two 1/2 X 1-1/2 inch jacking bolts in bearing housing (016), and tighten jacking bolts evenly to remove bearing housing and ball bearing (018). Remove jacking bolts from bearing housing (016). Remove ball bearing (018) and spiral ring (027) from bearing housing (016). Remove support washer (029) and truarc ring (017) from power rotor (011).

STEP 4. Remove bolts (002), cover (010) and gasket (013) from pump case (001). Remove seal seat and gasket from cover (017). NOTE: Crane Type 21 mechanical seals with O-ring seat (1 and 2, Figure 4) can be used on Figure 10 pumps. When using this seal seat arrangement, a seal seat adapter and gasket are installed to provide a clamped seat arrangement for the mechanical seal.

STEP 5. Remove seal (015) rotating parts from power rotor (011).

NOTE: Steps 6 through 8 are for disassembly of unclamped end of pump.

STEP 6. Remove bearing nut (019) and capscrews (021). Use jacking bolts and remove bearing housing (016) and ball bearing (018) as outlined in Step 3. Remove ball bearing (018) from bearing housing (016).

STEP 7. Remove bolts (002), cover (010) and gasket (013) from pump case (001). Remove seal seat and gasket from cover (010). Remove support washer (029) and truarc ring (017) from power rotor (011).

STEP 8. Remove mechanical seal (015) rotating parts from power rotor (011). Remove shim (014) from power rotor (011).

STEP 9. Grasp power rotor (011) and pull power rotor (011) and idlers (012) as an assembly from clamped end of case. NOTE: As rotor assembly slides from housings, wrap rotors with a sling to prevent accidental dropping and to assist in holding rotors in mesh for easy removal.

STEP 10. Remove plugs (009) from case (001). Stop pins (008) are match-marked with case (001) to identify correct installed location and position. If new housings are required, new stop pins must be installed for correct fitting. If stop pins are to be replaced, or if marks are not visible, make new markings before removal of pins. Install a 3/8-inch -16 bolt in each stop pin and remove stop pins (008). Tag each stop pin with installed location.

STEP 11. Slide housings (005) from case (001). Slide spacer ring (004) from case (001). Unless housings (005) are to be replaced, do not remove capscrews (006) from housings.

### ASSEMBLY

NOTE: Prior to assembly of pump, all parts should be cleaned and inspected for nicks and burrs. Replace all worn or damaged parts. The IMO Pump Division recommends automatic replacement of gaskets, mechanical seals and ball bearings when these parts are disturbed from their previously installed position. Wipe all parts with light lubricating oil prior to assembly.

STEP 1. Wipe spacer ring (004) and housings (005) with oil. Slide spacer ring (004) into case (001). Align one open port of ring (004) with outlet opening of case. Align stop pin slots of case (001) and housing (005) and install one housing (005) at each end of pump. To assist in properly aligning housings, slide idlers (012) into idler bores and slide idlers back and forth to check for binding, indicating misalignment of housings. With housings (005) properly aligned, install stop pins (008) and plugs (009). Remove idlers.

NOTE: If new housings (005) were installed, new stop pins (008) must be field fitted and installed. To fit new stop pins, file or grind one or both flat surfaces of stop pin until stop pin fits snugly into housing slot. Do not over grind flat surfaces. If stop pins are not tightly fitted to housings, housings may rotate out of position during operation and damage rotors.

STEP 2. Place blueing on capscrews (006) in housings (005). Install gaskets (013) and covers (010) on both ends of pump case (001) with bolts (002). Torque bolts (002) to 75 lbs. ft. ( $\pm 5$  lbs. ft.). Adjust capscrews (006) on ends of both housings as outlined in Figure 5. Correct adjustment should be verified for clamped end of pump before adjusting capscrews on unclamped end. Remove cover (010) to check for contact and adjust capscrews (006) as necessary. Lock tight nuts (007). When capscrews (006) are properly adjusted on clamped end of pump, make sure housings are snugly against clamped end cover (010) and adjust capscrews (006) on unclamped end of pump as necessary. Ensure nuts (007) are locked tight when adjustment is complete. Remove cover (010) and gasket (013) from both ends of pump.

CAUTION: Do not exceed 0.001" pressure on capscrews (006) to avoid distortion of rotor housing bores.

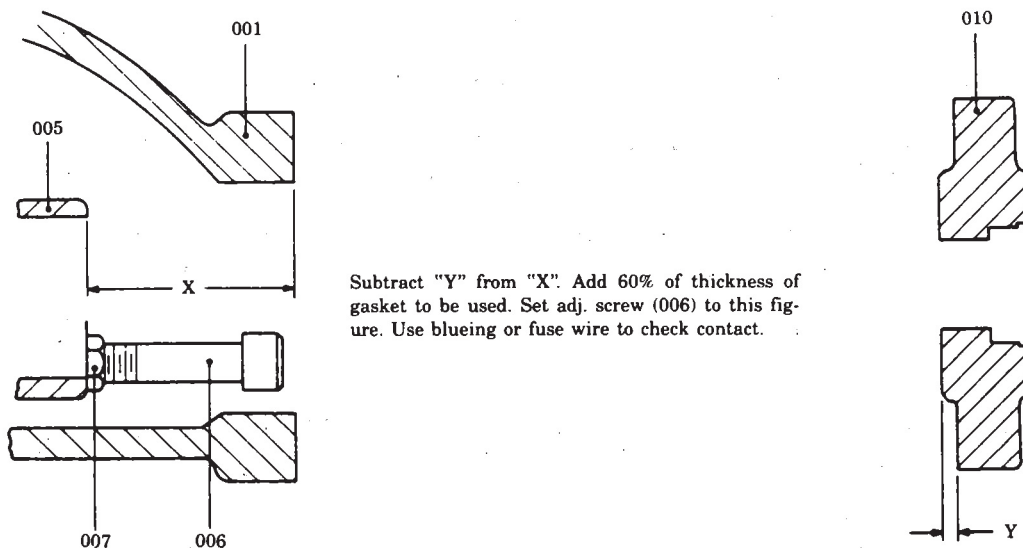


FIGURE 5. SETTING OF HOUSING ADJUSTING CAPSCREWS

STEP 3. Mesh threads of idlers (012) with threads of power rotor (011) and slide rotor assembly into housing rotor bores from unclamped end of pump.

NOTE: Assemble clamped end of pump first since working length of mechanical seal is pre-determined. Steps 4 through 8 are for the clamped end of pump.

STEP 4. Install mechanical seal as follows:

*Crane 9 Mechanical Seal (Figure 3):* Slide mechanical seal rotating parts (3 through 10) on power rotor (011) until retainer (7) contacts step-cut shoulder of power rotor. Remove and discard retaining clips (10). Position seal on power rotor at marked areas for setscrews and tighten setscrews (8).

*Crane 21 Mechanical Seal (Figure 4):* Slide mechanical seal rotating parts (3 through 5) on power rotor (011) with spring holder (5) next to step-cut shoulder of power rotor.

STEP 5. Install gasket (013) and cover (010) on case (001) using bolts (002). Torque bolts (002) to 75 lbs. ft. ( $\pm 5$  lbs. ft.). Install gasket (2B, Figure 3 or 4) in cover (010). Slide seal seat (1B, Figure 3 or 4) on power rotor into seal seat bore of cover (010).

NOTE: If using Crane 21 Mechanical seal with O-ring seat, install gasket in cover. Assemble seal seat adapter with seal seat and O-ring (1 and 2, Figure 4), and install seal seat adapter in cover (010).

STEP 6. Slide truarc ring (017) on power rotor (011) and install truarc ring (017) in ring groove of power rotor. Install support washer (029) on power rotor.

STEP 7. Install spiral ring (027) in bearing housing (016) and install bearing housing (016) on cover (010) using capscrews (021). Torque capscrews (021) to 45 lbs. ft. ( $\pm 5$  lbs. ft.). Install ball bearing (018) in bearing housing (016). NOTE: If it is necessary to tap ball bearing for installation into housing, tap only on inner race of bearing.

STEP 8. Install bearing retainer on bearing housing using bolts (028). Torque bolts (028) to 15 lbs. ft. ( $\pm 3$  lbs. ft.). Install bearing nut (019) and torque nut (019) to 50 lbs. ft. ( $\pm 5$  lbs. ft.).

NOTE: Steps 9 through 15 are for assembly of unclamped end of pump.

STEP 9. Prior to installation of mechanical seal (015), seal working length and required shim thickness must be determined. Install gasket (013) and cover (010) with bolts (002). Torque bolts (002) to 75 lbs. ft. ( $\pm 5$  lbs. ft.). Scribe power rotor lightly where it begins to protrude through cover (010). Remove cover (010) and gasket (013). Measure distance from scribe mark on power rotor to step-cut shoulder of power rotor and identify distance as "X". Measure cover (010) from face of seal seat bore to face of cover, and identify distance as "A". Measure thickness of seal seat (1B, Figure 3 or 4) by measuring from face which fits into bore of cover (010) to outer face which sits next to rotating parts of seal and identify distance as "B". Seal working length is 1-3/8-inch ( $\pm 1/64$ -inch) and should be identified as distance "C". Add distance "A" and "B"; subtract 0.006 for compression of seal gasket; and add distance "C". Identify resulting distance as "Y".

$$(A + B) - 0.006 + C = Y$$

Determine shim thickness by subtracting distance "Y" from distance "X". Add or remove layers of shim to obtain desired thickness.

$$\text{SHIM THICKNESS (014)} = X - Y$$

**NOTE:** Seal working length for Crane 21 Mechanical Seal with seal seat adapter assembly is 1-1/2-inch ( $\pm 1/64$ -inch). See Note, Step 5.

**STEP 10.** Slide shim (014) on power rotor (011) next to step-cut shoulder of power rotor.

**STEP 11.** Assemble mechanical seal rotating parts on power rotor as outlined in Step 4 for clamped end of pump.  
**NOTE:** Seal retainer (7, Figure 3) or spring holder (5, Figure 4) will be contacting shim (021) rather than step-cut shoulder of power rotor.

**STEP 12.** Install gasket (013) and cover (010) with bolts (002). Torque bolts (002) to 75 lbs. ft. ( $\pm 5$  lbs. ft.). Install gasket (2B, Figure 3 or 4) and seal seat (1B, Figure 3 or 4) in seal seat bore of cover (010).

**NOTE:** If using Crane 21 Mechanical Seal with O-ring seat, install gasket in cover. Assemble seal seat adapter with seal seat and O-ring (1 and 2, Figure 4), and install seal seat adapter in cover (010).

**STEP 13.** Install truarc ring (017) in ring groove of power rotor (011). Slide support washer (029) on power rotor (011).

**STEP 14.** Install bearing housing (016) on cover (010) with capscrews (021). Torque capscrews (021) to 45 lbs. ft. ( $\pm 5$  lbs. ft.). Slide ball bearing (018) into bearing housing (016). **NOTE:** If it is necessary to tap on ball bearing for installation into housing (016), tap only on inner race of bearing.

**STEP 15.** Install bearing nut (019) and torque nut (019) to 50 lbs. ft. ( $\pm 5$  lbs. ft.).

**STEP 16.** Install keys (022), coupling hubs, and pump piping.

**STEP 17.** Adjust flow control needle valve (008) as required to insure proper cooling in the packing/seal chamber.

**TABLE 2  
LIST OF MATERIAL FOR FIGURES 6 AND 7**

ITEM	PART DESCRIPTION	ITEM	PART DESCRIPTION	ITEM	PART DESCRIPTION
001	Case	018 (2)	Bushing (2)	036 (2)	Shim
002	Bolt (16)	019 (2)	Adjustable Screw (2)	037	Tubing
003	Drip Cup (2)	020	Gland Bolt (4)	038	Nipple
004 (1)	Gasket (2)	021	Washer (4)	039 (2)	Check Valve (2)
005	Bolt (2)	022	Nut (4)	040	Bushing (2)
006	Nut (2)	023	Stop Pin (2)	041	Plug (2)
007	Plug (2)	024	Washer (2)	042 (2)	Spacer (2)
008	Needle Valve Sub-Assembly	025 (2)	Jam Nut (2)	043 (1)	Shim (2)
009	Plug (2)	026 (2)	Woodruff Key	044 (1)	Gasket (2)
010 (2)	Housing	027 (1)	Packing (2)	045	Cover (2)
011 (2)	Stop Pin (2)	028	Gland (2)	046	Bolt (8)
012	Spacer Ring	029	Key (2)	047 (1)	Seal (2)
013 (2)	Power Rotor	030	Name Plate	048 (2)	Collar
014 (2)	Idler (2)	031	Name Plate	049	Close Nipple
015	Outboard Cover	032	Name Plate	050	Flush Bushing
016 (2)	Collar	033	Drive Screw (4)	051	Spring Pin
017	Packing Box Cover or Inboard Cover	034	Drive Screw (3)	053	No Flare Tee
		035	No Flare Connector (2)		

(1) Minor Repair Kit items.  
(2) Major repair kit items. (Items marked (1) are included in major repair kit.)  
Quantities are one except when noted in parentheses after part description.

**TABLE 3  
LIST OF MATERIAL FOR FIGURE 9**

ITEM	PART DESCRIPTION	ITEM	PART DESCRIPTION	ITEM	PART DESCRIPTION
001	Case	011 (2)	Stop Pin (2)	021 (2)	Shim (2)
002	Bolt (16)	012 (1)	Truarc Ring (2)	022	Key (2)
003 (2)	Spiral Ring (2)	013 (2)	Power Rotor	023	Name Plate
004 (1)	Gasket (2)	014 (1)	Ball Bearing (2)	024	Name Plate
005	Plug	015 (2)	Bearing Washer (2)	025	Name Plate
006 (1)	Seal (2)	016 (2)	Bearing Nut (2)	026	Drive Screw (4)
007	Plug (2)	017	Cover (2)	027 (2)	Idler (2)
008	Bearing Housing (2)	018	Retainer	028	Spacer (2)
009 (2)	Spiral Ring	019	Bolt (4)	030	Drive Screw (3)
010 (2)	Housing (2)	020	Bolt (4)		

(1) Minor Repair Kit items.  
(2) Major Repair Kit Items. (Items marked (1) also included in Major Repair Kit.)  
Quantities are one (1) except when noted in parentheses after part description.

**TABLE 4  
LIST OF MATERIAL FOR FIGURE 10**

ITEM	PART DESCRIPTION	ITEM	PART DESCRIPTION	ITEM	PART DESCRIPTION
001	Case	012 (2)	Idler (2)	022	Key (2)
002	Bolt (16)	013 (1)	Gasket (2)	023	Name Plate
003	Plug	014 (1)	Shim (3)	024	Name Plate
004	Ring	015 (1)	Seal (2)	025	Name Plate
005 (2)	Housing (2)	016	Bearing Housing (2)	026	Drive Screw (4)
006 (2)	Capscrew (4)	017 (1)	Truarc Ring (2)	027 (2)	Spiral Ring
007 (2)	Nut (4)	018 (1)	Ball Bearing (2)	028	Bolt (4)
008 (2)	Stop Pin (2)	019 (2)	Bearing Nut (2)	029	Support Washer (2)
009	Plug (2)	020	Retainer	030	Drive Screw (3)
010	Cover (2)	021	Capscrew (8)	035	Plug
011 (2)	Power Rotor				

(1) Minor Repair Kit items.  
(2) Major Repair Kit Items. (Items marked (1) also included in Major Repair Kit.)  
Quantities are one (1) except when noted in parentheses after part description.

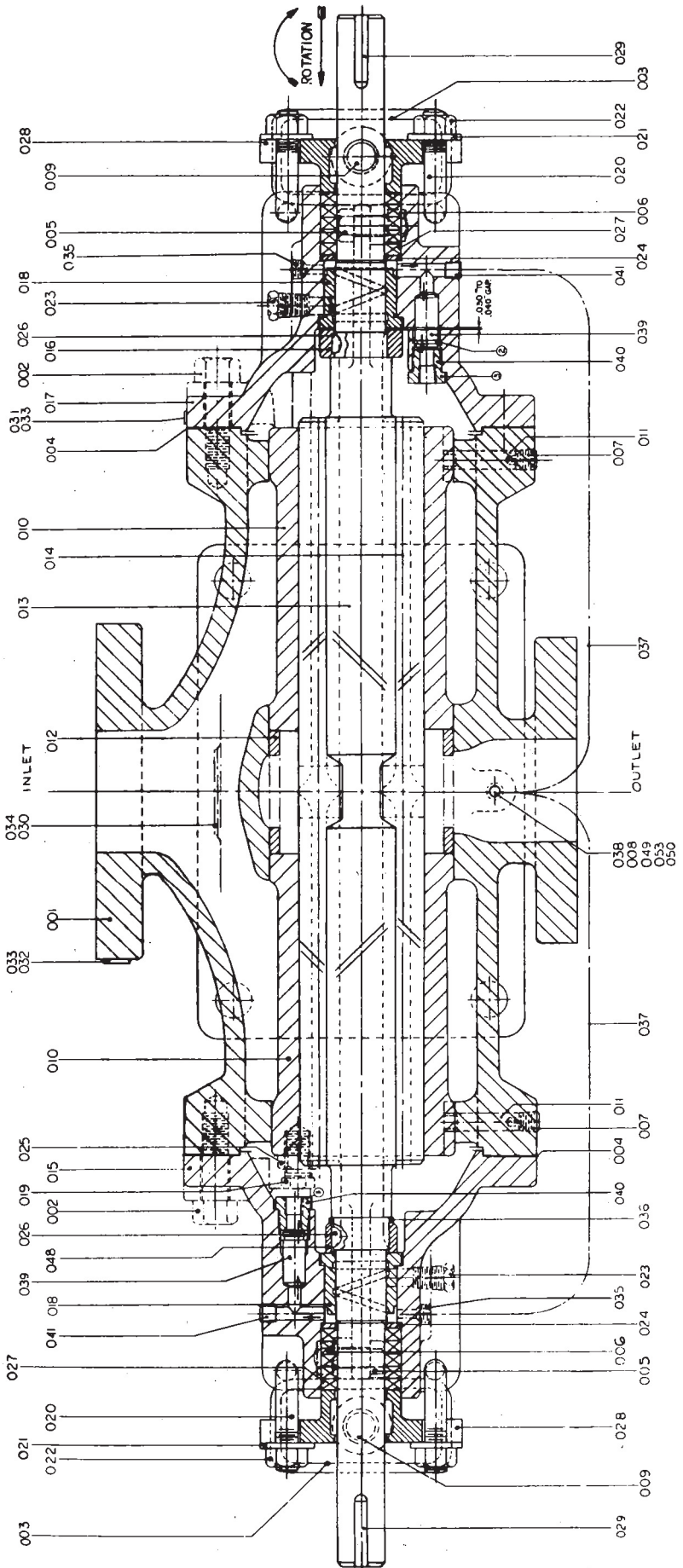
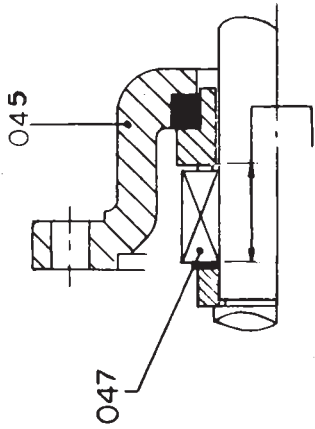
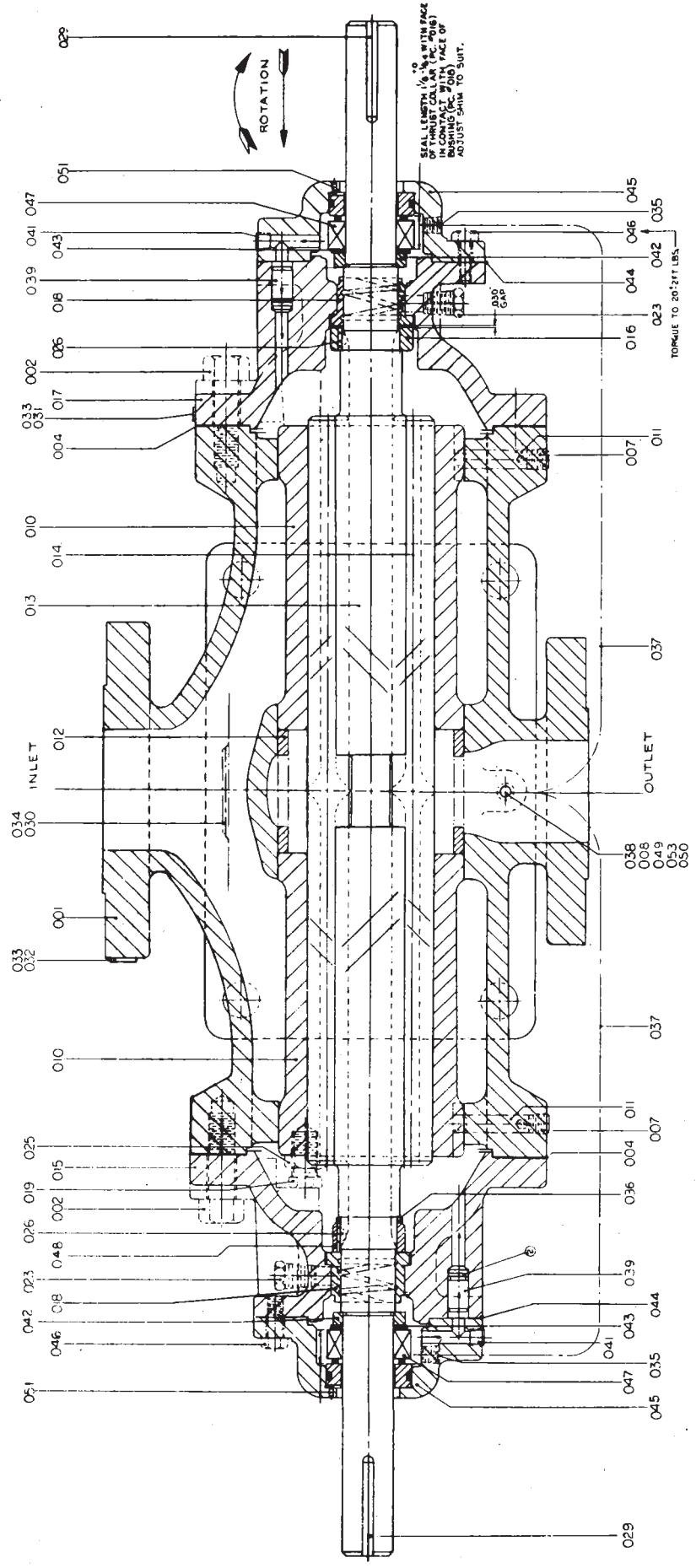


FIGURE 6

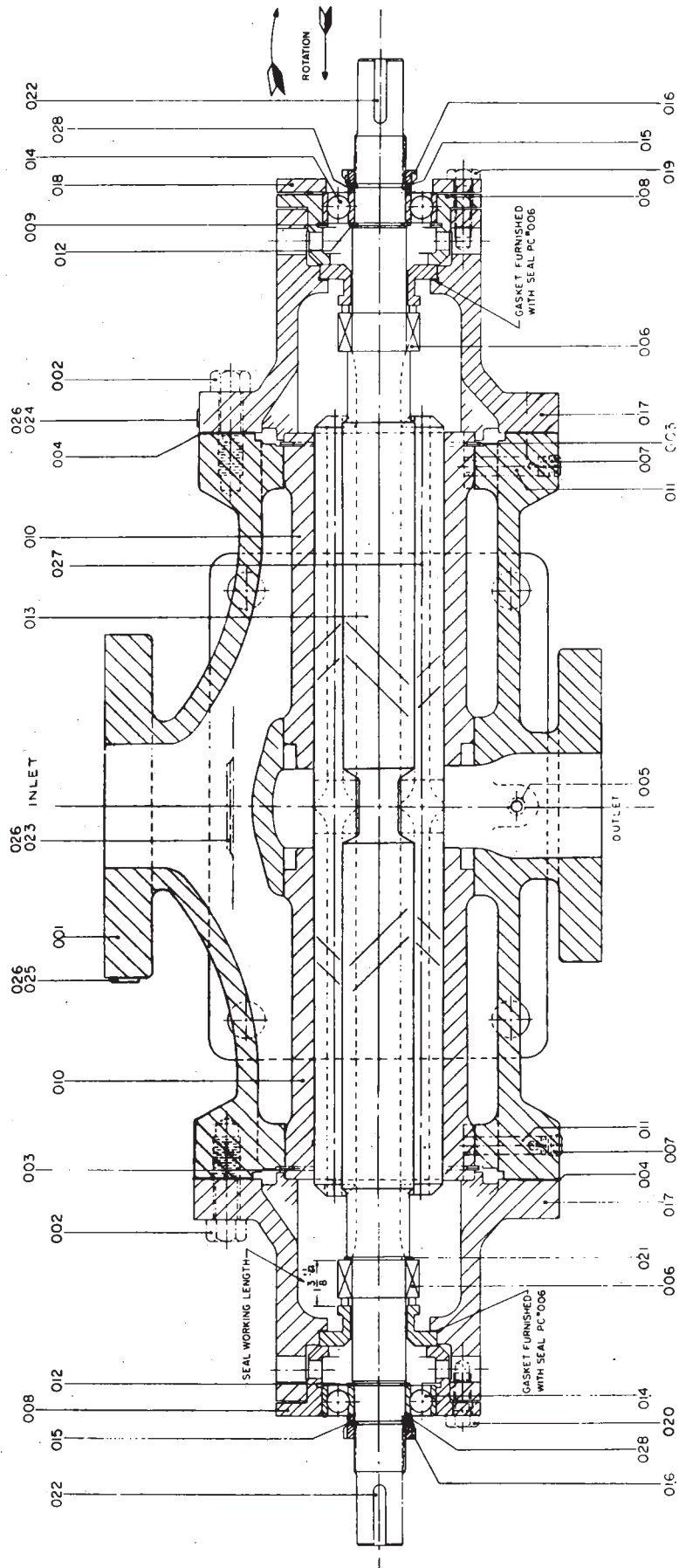




**FIGURE 8** VIEW OF END COVER SEAL WITH SQUARE RING SEAT.



**FIGURE 7**



**FIGURE 9**

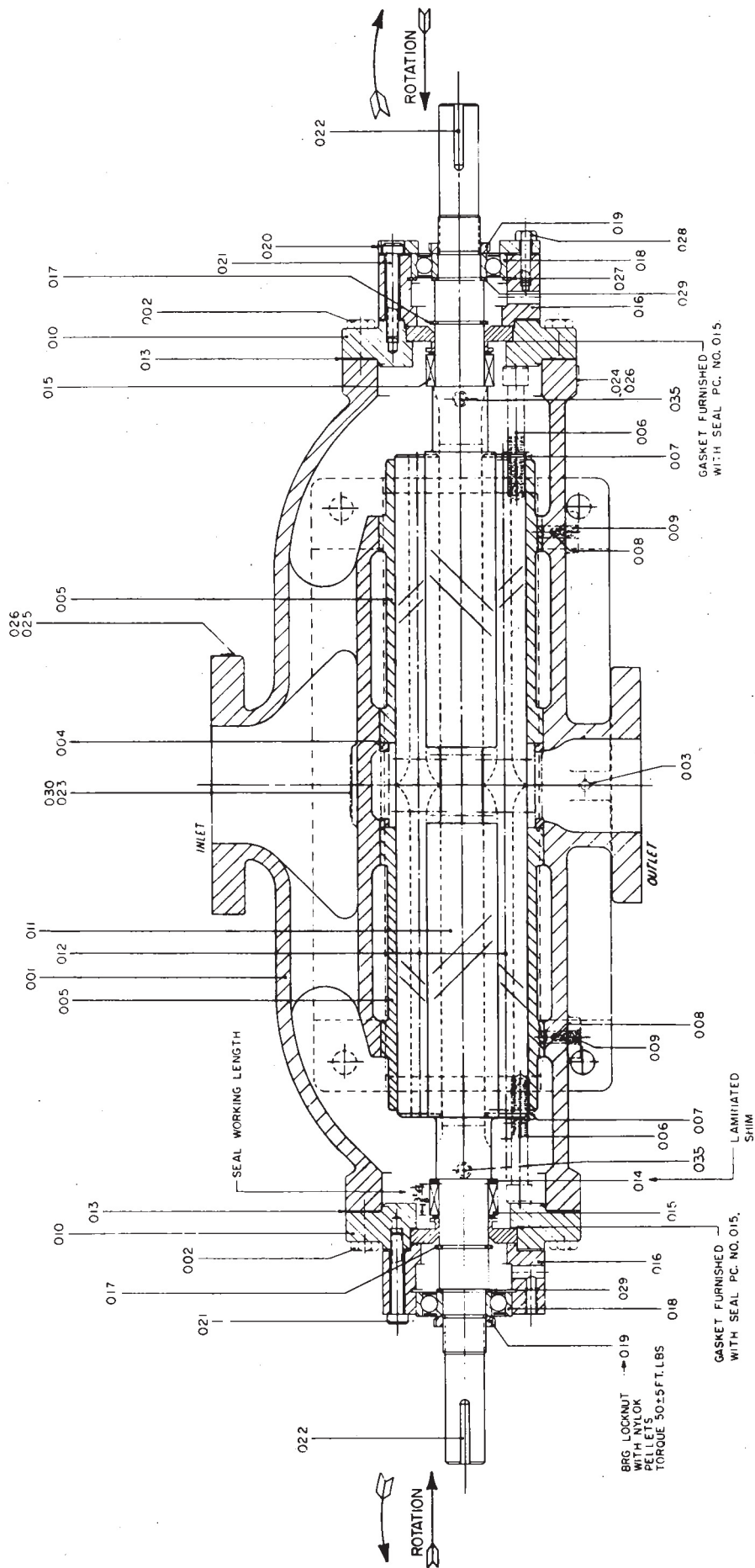
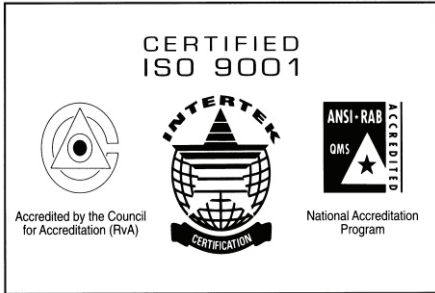


FIGURE 10

The instructions given herein cover generally the operation and maintenance of subject equipment. Should any questions arise which may not be answered specifically by these instructions, they should be referred to the Imo Pump for further detailed information and technical assistance.

This manual cannot possibly cover every situation connected with the operation, adjustment, inspection, test, overhaul and maintenance of the equipment furnished. Every effort is made to prepare the text of the manual so that engineering and design data is transformed into the most easily understood wording. Imo Pump, in furnishing this equipment and this manual, must presume that the operating and maintenance personnel assigned thereto have sufficient technical knowledge and experience to apply sound safety and operational practices which may not be otherwise covered herein.

In applications where the Imo Pump furnished equipment is to be integrated with a process or other machinery, these instructions should be thoroughly reviewed to determine the proper integration of the equipment into the overall plant operational procedures.



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