



Imo Industries Inc.

INSTRUCTIONS AND PARTS LIST

SERIES C324A ROTOR SIZES 325-412

This manual now is
identified as part no.
SRM00045

WARNING

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

Instructions C324A-C(R-2)

MANUFACTURING FACILITIES

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FOREWORD

This instruction manual covers IMO Series C324A, rotor sizes 325, 350, 375, 412, pumps. Because of the large number of operating conditions, it is necessary to have a variety of construction and material combinations to meet job requirements. The model of each pump is identified on the pump nameplate.

NOTE

This manual identifies pump types and sealing designs by figure numbers only. For maintenance, disassembly and re-assembly procedures, ensure that the specific pump type is identified with correct Figure Number(s). Refer to Table 1 and Figures 9 through 15 for proper identification of specific models.

Series C324A pumps are upgraded versions of the basic A324A and B324A designs. One of the product refinements of the C324A Series, rotor sizes 325 through 412, is the tapered design of the power rotor shaft. Initial designator A and B pump types are equipped with either a straight or 1° tapered power rotor. More recent C designator pumps are equipped with a 3/4-inch per foot taper on the power rotor shaft for ease of connecting and disconnecting coupling hubs. Table 1 identifies A and B pump type designators with corresponding C pump type designators. Definitions of model designators are given in Figure 1.

DESCRIPTION

The 324A series 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. A slight modification to the basic design permits vertical mounting.

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. On 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
ROTOR SIZES 325, 350, 375 AND 412

INITIAL DESIGNATORS			PUMP FIG. NO.	SEALING DESIGN FIG. NO.	SEAL SEAT DESIGN FIG. NO.
A, B, C, D, E, AB or SB	CB, CC, CD, CE, CAB or CSB	C324A			
A324A	CB324A	C324APF	9	9	
A324AA	CB324AA'	C324AHF	9	3 (2)	11 or 12 (3)
B324AA	CB324AA	C324AHF	9	3 (2)	11 or 12 (3)
B324AA	CB324AA	C324AHF	9	6 (2)	10 (3)
A324AS	CB324AS	C324ABF	9	4 (2)	11 or 12
A324AV	CB324AV	C324AX (4)	9	9	
A324A	CB324AW	C324AEF	9	9	
B324A	CB324AW	C324AEF	9	9	
B324AW	CB324AW	C324AEF	9	9	
A324AX	CB324AX (4)	C324AXS (4)	9	9	
A324AAX	CB324AAS	C324AHFS	9	3 (2)	11 or 12 (3)
A324AAX	CB324AAS	C324AHFS	9	6 (2)	10
A324ASX	CB324AAS	C324AHFS	9	3 (2)	11 or 12 (3)
A324ASX	CB324AAS	C324AHFS	9	6 (2)	10
A324ASX	CB324AGS	C324ARTFS	9	5	10
A324ASX	CB324ASS	C324ABFS	9	4 (2)	11 or 12 (3)
A324ASX	CB324ASX (4)	C324AX (4)	9	4 (2)	11 or 12 (3)
B324AWX	CB324AWS	C324AEFS	9	9	
A324AAXT	CB324AAST	C324AHTFS	9	3 (2)	11 or 12 (3)
A324AAXT	CB324AAST	C324AHTFS	9	6 (2)	10
B324AAXT	CB324AAST	C324AHTFS	9	3 (2)	11 or 12 (3)
B324AAST	CB324AAST	C324AHFFS	9	6 (2)	10
A324ASXT	CB324ASST	C324ABTFS	9	4 (2)	12
B324ASST	CB324ASST	C324ABTFS	9	4 (2)	12
A324ASXU	CB324ASSU	C324AX (4)	9	4 (2)	
B324AZST	CB324AZST	C324AHTFS	9	7	10
B324AZX	CB324AZST	C324AHTFS	9	7	10
C324A	CC324A	C324AX (4)	9		
	CC324AASX (4)	C324AXS (4)	9	3 (2)	12
	CC324AASX (4)	C324AXS (4)	9	6 (2)	10
A324A	CD324AX (4)	C324AX (4)	9	9	
E324AS	CE324AS	C324AX (4)	9	9	
	CAB324A	C324APFJ	13	13	
	CAB324AA	C324AHFJ	13	3 (2)	11 or 12 (3)
	CAB324AA	C324AHFJ	13	6 (2)	10
	CAB324AS	C324ABFJ	13	4 (2)	11 or 12 (3)
A324AX	CAB324AX (4)	C324APFJ	13	13	
A324AAX	CAB324AAS	C324AHFJ	13	3 (2)	11 or 12 (3)
A324AAx	CAB324AAS	C324AHFJ	13	6 (2)	10
AB324AAX	CAB324AAS	C324AHFJ	13	3 (2)	11 or 12 (3)
AB324AAX	CAB324AAS	C324AHFJ	13	6 (2)	10
A324ASX	CAB324AFS	C324AXS (4)	13	13	
AB324AWX	CAB324AWS	C324AEFS	13	13	
A324AX	CAB324AWS	C324AEFS	13	13	
B324AAXT	CAB324AAST	C324AHTFS	13	3 (2)	12
B324AAXT	CAB324AAST	C324AHTFS	13	6 (2)	10
	CAB324ASST	C324ABTFS	13	4 (2)	12
A324AAX	CAB324AASX (4)	C324AXS (4)	13	3 (2)	12
A324AAX	CAB324AASX (4)	C324AXS (4)	13	6 (2)	10
	CSB324A	C324APFY	13	14	
	CSB324AA	C324AHFY	13	3 (2)	11 or 12 (3)
	CSB324AA	C324AHFY	13	6 (2)	10
	CSB324AS	C324ABFY	13	4 (2)	11 or 12 (3)
	CSB324AX (4)	C324AEFY	13	13	
	CSB324AAS	C324AHFY	13	3 (2)	11 or 12 (3)
	CSB324AAS	C324AHFY	13	6 (2)	10
	CSB324AFS	C324AXS (4)	13	15	15
B324AX	CSB324AWS	C324AEFY	13	13	
SB324AWS	CSB324AWS	C324AEFY	13	13	
D324AWX	CSB324AWS	C324AEFY	13	13	
	CSB324AAS	C324AHTFY	13	3 (2)	12
	CSB324AAS	C324AHTFY	13	6 (2)	10
	CSB324ASST	C324ABTFY	13	4 (2)	12

- (1) Pump model precedes rotor size. Example CAB324AAS-325
- (2) Figures 9 and 13 pumps can be equipped with a variety of mechanical seals as illustrated in Figures 10, 11, 12 and 15.
- (3) Mechanical seals, Figures 3 and 4, can be equipped with either seal seat as illustrated in Figures 11 and 12.
- (4) Special pump designs, denoted by X in model designators, have Bill of Material suffix (three or four digits) following rotor size designator.

ORDERING INSTRUCTIONS

All correspondence pertaining to renewal parts for Series 324A pumps 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 pump 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 E	0-500°F.
	Type B	0-160°F.
	Type H	0-250°F.

DRIVE: Direct only

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

PRESSURE: 500 PSIG

SUCTION: 25 PSIG Maximum

DISASSEMBLY AND ASSEMBLY PROCEDURES

UNIT REMOVAL

STEP 1. Deenergize electrical system and attach a "WARNING" Out-of-Service Tag.

STEP 2. Disconnect pump piping and drain pump.

STEP 3. Shut, lock and tag Out-of-Service the suction and discharge valves. Remove tubing (037) from pump. NOTE: Tube (037) is equipped with a check valve (040) that must be replaced in its original installed position.

STEP 4. Disconnect coupling and remove pump from mounting.

STEP 5. Locate pump in clean working area for disassembly.

DISASSEMBLY PROCEDURES

SPECIAL NOTE

Disassembly and assembly procedures are given for pump types and sealing designs by Figure Numbers only. Ensure that pump type is identified by proper Figure(s) for correct disassembly and assembly procedures. Refer to Table 1 for identification of pump types and applicable Figure Number(s).

STEP 1. *All Pumps:* Remove checknut (042), setscrew (043), key (055) and coupling hub from power rotor (013).

STEP 2. *Figures 9 and 13 Only:* Remove nut (004), bolt (003) and drip cup (032).

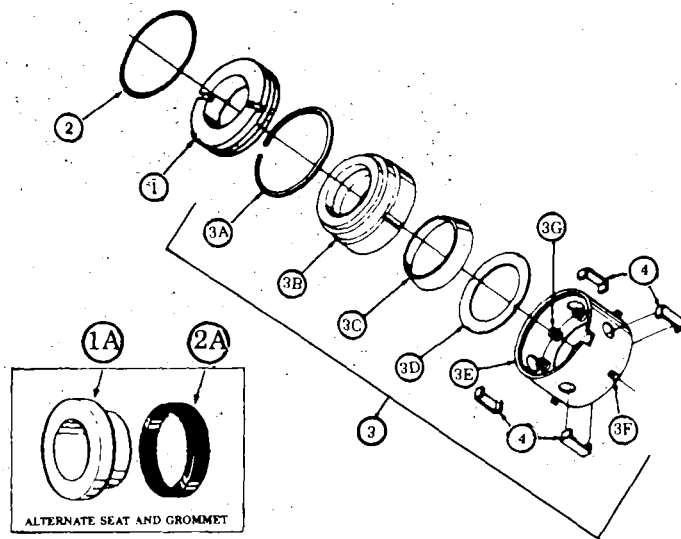
STEP 3. *Figure 14 Only:* Remove nuts (029), bolts (099) and drip cup (032) when supplied with welded packing box cover.

STEP 4. Remove packing or mechanical seal as follows:

Figures 9 and 13: Remove nuts (029) and washers (030) from gland bolts (028). Remove capscrews (027) and slide packing glands (084 and 085) from power rotor (013). Turn gland bolts (028) away from power rotor. Using a "packing puller" or a sharp pointed brass or copper rod, remove packing rings (025).

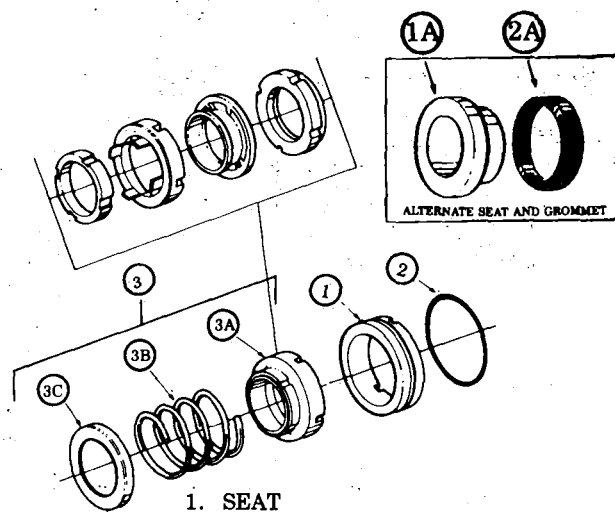
Figure 14: Remove nuts (029) and washers (030) from packing cover threaded studs (099). Remove capscrews (027) and slide packing glands (084 and 085) from power rotor (013). Using a "packing puller" or a sharp pointed brass or copper rod, remove packing rings (025).

Figures 10, 11, 12, and 15: Remove bolts (057), seal cover sub-assembly (056) and gasket (058). Removal of seal cover includes removal of seal seat and O-ring (Figures 10, 12 and 15) or seal seat and grommet (Figure 11). Remove seal seat and O-ring (1 and 2, Figure 3, 4, 5, 6 or 7) or seal seat and grommet (1A and 2A, Figure 3 or 4) from seal cover (056). Remove mechanical seal from power rotor (013). If seal has setscrews, loosen setscrews to remove seal. Slide shim (062) and spacer (061), where applicable with mechanical seal, from power rotor (013).



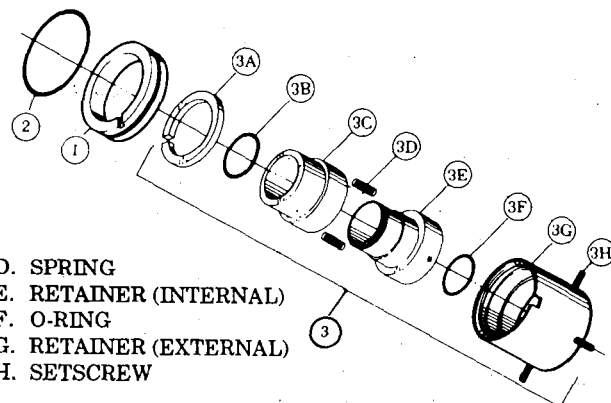
- | | |
|----------------------|--------------------|
| 1. SEAT | 3C. CHEMLON RING |
| 1A. ALTERNATE SEAT | 3D. DISC |
| 2. O-RING | 3E. RETAINER |
| 2A. GROMMET | 3F. SETSCREW |
| 3. ROTATING ASSEMBLY | 3G. SPRING |
| 3A. SNAP RING | 4. RETAINING CLIPS |
| 3B. WASHER | |

FIGURE 3. Crane Type 9 Mechanical Seal.



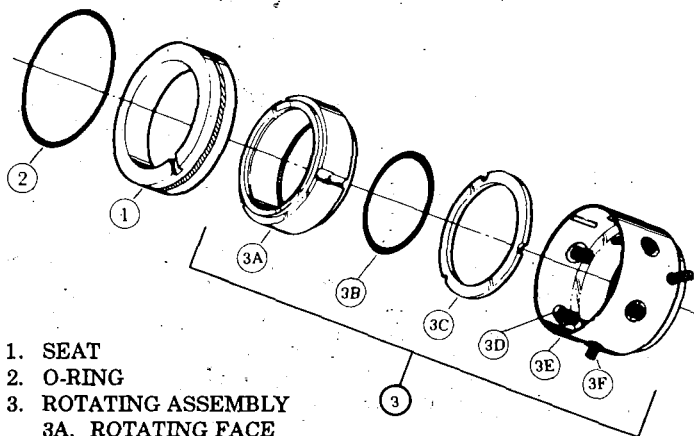
- | | |
|-----------------------------|----------------------|
| 1. SEAT | 1A. ALTERNATE SEAT |
| 2. O-RING | 2A. GROMMET |
| 3. ROTATING ASSEMBLY | 3. ROTATING ASSEMBLY |
| 3A. WASHER BELLOWS ASSEMBLY | 3B. SPRING |
| 3C. SPRING HOLDER | |

FIGURE 4. Crane Type 21 Mechanical Seal



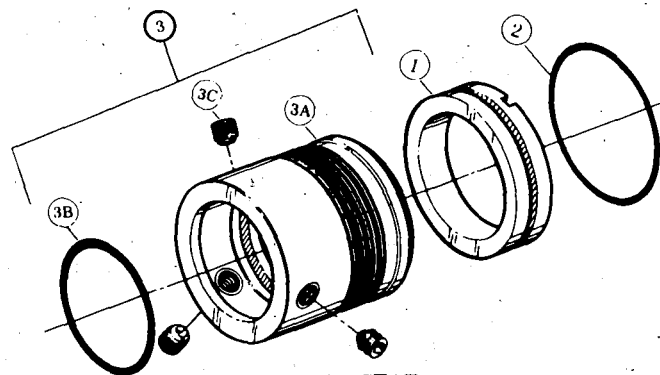
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|----------------------|-------------------------|
| 1. SEAT | 3D. SPRING |
| 2. O-RING | 3E. RETAINER (INTERNAL) |
| 3. ROTATING ASSEMBLY | 3F. O-RING |
| 3A. SNAP RING | 3G. RETAINER (EXTERNAL) |
| 3B. O-RING | 3H. SETSCREW |
| 3C. WASHER | |

FIGURE 5. Crane Type 8B3 Mechanical Seal



- | |
|----------------------|
| 1. SEAT |
| 2. O-RING |
| 3. ROTATING ASSEMBLY |
| 3A. ROTATING FACE |
| 3B. GASKET |
| 3C. RETAINING RING |
| 3D. SPRING HOLDER |
| 3E. SETSCREW |
| 3F. SPRING |

FIGURE 6. Borg Warner Type Q Mechanical Seal



- | |
|----------------------|
| 1. SEAT |
| 2. O-RING |
| 3. ROTATING ASSEMBLY |
| 3A. BELLOWS ASSEMBLY |
| 3B. O-RING |
| 3C. SETSCREW |

FIGURE 7. Borg Warner Type BX Mechanical Seal

STEP 5. Remove Packing Box Cover or Inboard Cover as follows:

Figures 9 and 13: Remove bolts (002), packing box cover (017) and gasket (005). Removal of packing box cover includes removal of washer (031), check valve (040), plug (068) and inboard bearing sub-assembly (018). Remove washer (031) and bearing (094) with spring pin (012) from cover (017). Unless check valve (040) must be replaced, no further disassembly of cover (017) is necessary.

Figure 14: Remove bolts (092) and slide packing box cover (017) from power rotor (013). Remove gasket (005) from case (001). Removal of packing box cover includes removal of washer (031), plugs (039 and 068) and check valve (040), and inboard bearing sub-assembly (018). Remove washer (031) and bearing with spring pin (018) from cover (017). Unless check valve must be replaced, no further disassembly of cover (017) is necessary.

Figures 10, 11, 12, and 15: Remove bolts (002) and slide inboard cover (065) from power rotor (013). Remove gasket (005) from case (001). Removal of inboard cover includes removal of check valve (040), plug (068) and inboard bearing sub-assembly (018). Remove inboard bearing (094) with spring pin (012) from inboard cover (065). Unless check valve (040) must be replaced, no further disassembly of cover (065) is necessary.

NOTE: Disassembly procedures Step 6 through Step 11 are for all pumps.

STEP 6. Remove inboard collar (022) with key (021) from power rotor (013).

STEP 7. Remove outboard cover bolts (002) and slide outboard cover (015) off power rotor (013). Remove gasket (005) from case (001). Removal of outboard cover (015) includes removal of outboard bearing sub-assembly (016). Remove outboard bearing (093) with spring pin (012) from cover (015).

STEP 8. Remove outboard collar (019) with key (021) and shim (020) from power rotor (013).

STEP 9. Grasp power rotor (013) and pull idlers (014) and power rotor (013) from inboard end of pump. **NOTE:** As rotors slide from housings, wrap rotors with a sling to prevent accidental dropping and to assist in holding rotors in mesh for ease of removal.

STEP 10. Remove plug (009) from case (001). Stop pins (011) are match marked with case during assembly for proper position and alignment. If new housings are required, new stop pins must be used for correct fitting. Ensure that stop pins are properly marked for installation. Install a 3/16-16-inch bolt in each stop pin (011) and remove stop pins. Tag each stop pin to identify installed position.

STEP 11. Slide housings (010) from case (001). Removal of housings (010) includes removal of adjustable screws (008) and jam nut (007). Unless new housings are required, adjusting screws (008) and jam nut (007) should not be removed from housings. Slide spacer (024) from case (001).

ASSEMBLY PROCEDURES

SPECIAL 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 seals when these parts are disturbed from their previously installed positions. Wipe all parts with light lubricating oil prior to assembly. Refer to Table 1 to identify correct Figure Number(s) for pump types. Assembly procedures are given for pump types and sealing designs by Figure Number(s) only.

STEP 1. *All Pumps:* Wipe spacer (024) with oil and slide spacer (024) into pump case (001). Align one open port of spacer (024) with outlet opening of pump case.

STEP 2. *All Pumps:* Wipe inboard housing (010) with oil. Align stop pin slot and slide housing (010) in inboard end of case (001) until housing (010) contacts spacer (024). With housing stop pin slot aligned with case stop pin slot, install stop pin (011) and plug (009) in inboard end of pump. Wipe outboard housing (010) with oil and install outboard housing in outboard end of pump as outlined above. Install stop pin (011) and plug (009) in outboard end of pump. NOTE: If new housings are installed, new stop pins must be fitted and installed to ensure proper housing alignment. To fit new stop pins, file or grind one or both flat surfaces of stop pins until pin fits snugly into housing slot. DO NOT over grind flat surfaces. If stop pins do not fit snugly to housing, housing may rotate out of position during operation, causing damage to rotor assembly.

NOTE: To ensure proper housing alignment, slide idlers (014) into idler bores of housings (010) and slide idlers back and forth to check for binding, indicating misalignment of housings. Remove idlers when housing alignment is verified.

STEP 3. *All Pumps:* Place bluing or fuse wire on faces of adjusting screws (008) for verification of proper adjustment of screws (008) as outlined in Step 6.

STEP 4. *All Pumps:* Align spring pins (012) in outboard bearing sub-assembly (016) with spring pin slots in outboard cover (015) and install outboard bearing (093) in outboard cover (015). Install gasket (005) and assembled outboard cover (015) with bolts (002). Torque bolts to necessary value as outlined in Table 2.

**TABLE 2
TORQUE VALUES**

PART	ROTOR SIZE	TORQUE VALUE
002	325-350	225 lbs. ft. (\pm 15 lbs. ft.)
	375-412	160 lbs. ft. (\pm 10 lbs. ft.)
057	325-350	45 lbs. ft. (\pm 5 lbs. ft.)
	375-412	40 lbs. ft. (\pm 5 lbs. ft.)
092	325-350	225 lbs. ft. (\pm 15 lbs. ft.)
	375-412	160 lbs. ft. (\pm 10 lbs. ft.)

STEP 5. Install Packing Box Cover or Inboard Cover as follows:

NOTE: If check valve (040) was removed during disassembly, install check valve in packing box cover (017, Figures 9, 13 and 14) or inboard cover (065, Figures 10, 11, 12, and 15).

Figures 9, 13 and 14: Coat inboard bearing (094) with oil; align spring pins (012) of inboard bearing (094) with slots in packing box cover (017) and install inboard bearing sub-assembly (018) in packing box cover (017). Install gasket (005) on case (001).

Figures 9 and 13: Attach assembled packing box cover (017) to case (001) using bolts (002). Torque bolts (002) to proper value as given in Table 2.

Figure 14: Attach assembled packing box cover (017) to case (001) using bolts (092). Torque bolts (092) to proper value listed in Table 2.

Figures 10, 11, 12 and 15: Coat inboard bearing (094) with oil; align spring pins (012) of inboard bearing (094) with slots in inboard cover (065) and install inboard bearing sub-assembly (018) in inboard cover (065). Install gasket (005) and assembled inboard cover (065) to case (001) using bolts (002). Torque bolts (002) to proper value listed in Table 2.

STEP 6. All Pumps: Adjust screws (008) on inboard and outboard ends of housings as outlined in Figure 8. Correct adjustment should be verified for inboard end before adjusting screws on outboard end. Remove inboard cover (017, Figures 9, 13 and 14) or (065, Figures 10, 11, 12 and 15) and verify adjusting screws (008) contact on inboard bearing (018). Adjust screws (008) as necessary for required contact. Ensure jam nuts (007) are locked tight. Install inboard cover as outlined in Step 3. Torque bolts (002) to proper value listed in Table 2. With proper adjustment verified for inboard end adjusting screws (008), perform procedure outlined for adjusting screws on outboard end of pump, Figure 8. Remove outboard cover (015) and check for contact between outboard bearing (016) and screws (008). Adjust screws (008) as necessary. Ensure jam nuts (007) are tight. Outboard cover (015) will be replaced in Step 9. **CAUTION:** Do not exceed 0.003-inch pressure on adjusting screws (008) to avoid distortion of rotor housing bores.

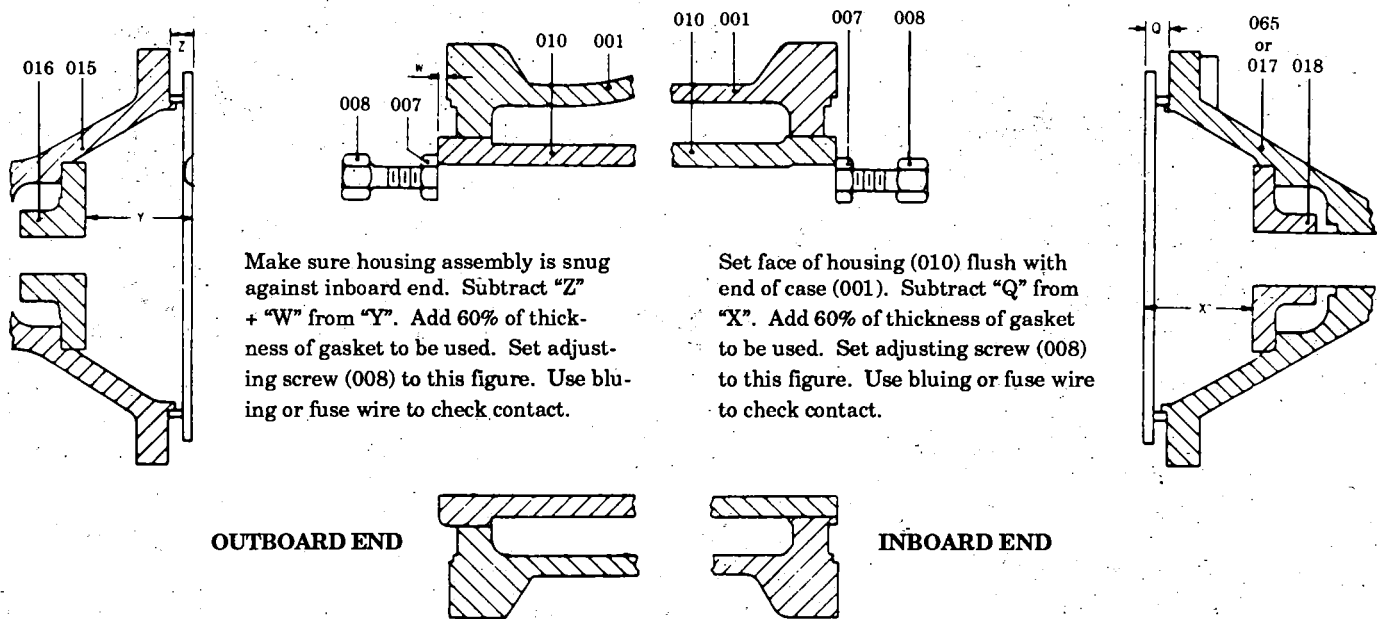


FIGURE 8. Setting of Housing Adjusting Screws

STEP 7. All Pumps: Place key (021) in inboard key slot of power rotor (013). Align inboard collar (022) with key (021) and slide collar (022) on power rotor (013). Slide shim (020) on outboard end of power rotor (013). Place key (021) in power rotor outboard end key slot. Align outboard collar (019) with key (021) and slide collar (019) on power rotor.

STEP 8. All Pumps: Mesh threads of idlers (014) with threads of assembled power rotor (013) and slide rotor assembly (013 and 014) into housing (010) rotor bores from outboard end of pump.

STEP 9. All Pumps: Install assembled outboard cover (015) and gasket (005) on case (001) using bolts (002). Torque bolts (002) to necessary value as given in Table 2.

STEP 10. All Pumps: Mount a dial indicator on inboard cover to measure end clearance (axial movement) of power rotor (013). Axial movement should be 1/16-inch (+ 1/64-inch, -0) for packing pumps (Figures 9, 13 and 14), 0.030-inch (+ 0.005-inch, -0) (Figures 10, 11, 12 and 15) or 0.010-inch (+ 0.005-inch, -0) (Figure 10 with Borg Warner BX Seal). If end clearance must be adjusted, remove assembled outboard cover (015), outboard collar (019) and key (021). Add or remove layers of shim (020) to obtain desired end clearance. Replace key (021), outboard collar (019) and assembled outboard cover (015). Torque outboard cover bolts (002) to required values given in Table 2.

STEP 11. Install Packing or Mechanical Seal as follows:

Figures 9, 13 and 14: Slide washer (031) in packing box cover (017). Install five new rings of packing (025) in gland sub-assembly (026). Set each packing ring individually and firmly in place, starting with one ring of hard packing, followed with one ring of soft packing, etc., ending with one ring of hard packing.

Figures 9 and 13: Slide packing gland sub-assembly (026) on power rotor (013). Install capscrews (027) in gland (084 and 085). Turn gland bolts (028) parallel with power rotor (013) and slide packing gland sub-assembly (026) to packing bore of power rotor (013). Slide washers (030) on gland bolts (028) and install nuts (029) on bolts (028). Tighten gland bolts (028) evenly and hand tight.

Figure 14. Slide packing gland sub-assembly (026) on power rotor (013), aligned to receive threaded studs (199) of packing box cover (017). Packing gland sub-assembly (026) should be positioned in packing bore of power rotor (013). Install washers (030) and nuts (029) on threaded studs (199). Tighten nuts (029) evenly and hand tight.

NOTE: If plugs (068, Figures 9 and 13) or (039, Figure 14) were removed during disassembly, install plugs.

CAUTION: When pump is operating adjust gland nuts (029) to allow packing gland seepage of approximately 8 drops per minute for rotor lubrication. **DO NOT** overtighten packing, or damage will occur to power rotor.

Figures 11 and 12 (with Figures 3 or 4) and Figure 15: Install gasket (058) and seal cover (056) on inboard cover (065) using bolts (057). Torque bolts (057) to required value given in Table 2. Pull power rotor in axial direction until inboard collar (022) is in contact with inboard bearing (018). Mark power rotor shaft at point where it begins to extend through seal cover (056) to use as reference point for setting operating length of mechanical seal. Remove bolts (057), seal cover (056) and gasket (058). Slide spacer (061) and shim on power rotor (013) until spacer is in contact with step-cut shoulder of power rotor. Measure distance from power rotor scribe mark to nearest surface of spacer (061). Identify measured distance as "X" to be used in determining seal working length. Determine seal working length of mechanical seal from Table 3 and identify length as distance "S". Install O-ring (2, Figures 3 and 4) on seal seat (1, Figures 3 and 4) or grommet (2A, Figures 3 and 4) on seal seat (1A, Figures 3 and 4). Slide assembled seal seat in seal cover sub-assembly (065).

NOTE: O-ring (Figure 15) may be located on seal seat or in seal cover (056, Figure 15).

Measure thickness of power rotor bore of seal cover (056) including mechanical seal thickness and identify measured thickness as distance "Y." Determine required thickness of shim (062) by adding seal working length "S" to thickness of seal cover bore "Y" and subtracting the total from power rotor length "X."

$$\text{SHIM THICKNESS (062)} = X - (Y + S)$$

Add or subtract layers of shim (062) until required thickness is obtained for proper seal working length. Slide shim (062) on power rotor (013).

**TABLE 3
MECHANICAL SEAL WORKING LENGTH**

SEAL FIG. NO.	SEAL SEAT FIG. NO.	ROTOR SIZE	SEAL WORKING LENGTH
3	11 or 12	325/350	1 3/8 (+0,-1/64 inch) 375/412 1 11/16 (+0,-1/64 inch)
4	11 or 12	325/350 375/412	1 1/2 (+0,-1/64 inch) 1 11/16 (+0,-1/64 inch)
5	10	375/41	2 1/8 (+0,-1/64 inch)
6	12	325/350 375/412	1 11/16 (+0,-1/64 inch) 1 3/4 (+0,-1/64 inch)
7	10	375/412	1 21/32 (± 1/32 inch)
15	15	325/350	1 13/32 (+0,-1/64 inch)

Figure 10 (with Figures 5 or 6): Install gasket (058) and seal cover (056) on inboard cover (065) using bolts (057). Torque bolts (057) to required value given in Table 2. Pull power rotor in axial direction until inboard collar (022) is in contact with inboard bearing (018). Scribe power rotor shaft at point where it begins to extend through seal cover (056) to use as a reference point in setting operating length of mechanical seal. Remove bolts (057), seal cover (056) and gasket (058). Install O-ring (2, Figure 5 or 6) on seal seat (1, Figure 5 or 6).

Slide assembled seal seat in seal cover (056). Measure distance of seal cover from face of cover to face of seal seat which rides against rotating parts of seal. Identify distance of measured seal cover as distance "X". Determine seal working length from Table 3 and identify distance as "Y". Add distance "X" and "Y" and identify total as "Z". From scribe mark on power rotor where it protrudes from seal cover, measure distance "Z" toward center of pump. Lightly scribe power rotor at this point to indicate where rear of rotating parts of the mechanical seal should be installed.

Figure 10 (with Figure 7): Install gasket (058) and seal cover (056) on inboard cover (065) using bolts (057). Torque bolts (057) to required value from Table 2. Pull power rotor in axial direction until inboard collar (022) is in contact with inboard bearing (018). Scribe power rotor shaft at point where it begins to protrude through seal cover (56) to use as a reference point in setting operating length of mechanical seal. Remove bolts (057), seal cover (056) and gasket (058). Install O-ring (2, Figure 7) on seal seat (1, Figure 7) and slide seal seat into seal cover (056). Measure distance of seal cover from face of cover to face of seal seat which rides against rotating parts of seal, and identify distance as "A." Place rotating parts of seal (3, Figure 7) on flat surface and measure free length of seal, and identify length as distance "B". Subtract .080-inch (± .010-inch) from distance "B," and identify result as distance "C". Add distance "A" and "C," and identify resulting distance as "X." From scribe mark on power rotor where it extends through seal cover (56), measure distance "X" toward center of pump, and lightly scribe power rotor to indicate where rear of rotating elements of mechanical seal should be installed.

Crane 9 Mechanical Seal (Figure 3): Slide mechanical seal rotating assembly (3) on power rotor (013) until retainer (3E) rests next to shim (062). Remove and discard retaining clips (4). Slide seal until full contact exists between seal retainer (3E) and shim (062). Tighten setscrews (3F).

Crane 21 Mechanical Seal (Figure 4): Slide mechanical seal rotating assembly (3) on power rotor (013) with spring holder (3C) next to shim (062).

Crane 8B3 (Figure 5), Borg Warner Q (Figure 6) and Borg Warner BX (Figure 7) Mechanical Seals: Slide mechanical seal rotating assembly (3) on power rotor (013) with face of rotating assembly positioned at scribe mark on power rotor. (Position of scribe mark determined in Step 11, Figure 10 with Figures 5, 6 or 7.) Tighten setscrews.

Seal Seal (Figure 15). Slide mechanical seal (059) rotating assembly on power rotor (013) with drive collar of mechanical seal next to shim (062) and tighten setscrews.

STEP 12. *Figures 10, 11, 12 and 15:* Install gasket (058) and seal cover sub-assembly (056) using bolts (057). Torque bolts (057) to necessary value listed in Table 2.

STEP 13. *Figures 9 and 13 Only:* Install drip cup (032) with bolt (003) and nut (004).

STEP 14. *Figure 14 Only:* Install drip cup (032) with bolts (099) and nuts (029) when drip cup is supplied with welded packing box cover.

STEP 15. *All Pumps:* Install key (055) in key slot of power rotor and slide coupling hub on power rotor (013). Install setscrew (043) and checknut (042).

UNIT ASSEMBLY

STEP 1. Mount pump on base plate and follow mounting instructions in the CA-1 Manual.

STEP 2. Install tubing (037). Connect pump piping and install all drain plugs.

STEP 3. Open suction and discharge valves. Remove "Out-of-Service" Tags and locks. Rotate pump shaft by hand to fill pump with fluid and expel all air.

STEP 4. Energize electrical system.

STEP 5. Adjust flow control needle valve (038) as required to ensure proper cooling of packing/seal chamber.

TABLE 4
LIST OF MATERIAL FOR FIGURES 9 THROUGH 15

ITEM	PART DESCRIPTION	ITEM	PART DESCRIPTION	ITEM	PART DESCRIPTION
001	Case	023	No Flare Connector (2)	056	Seal Cover Sub-Assy. (Includes Items 070 and 097)
002	Bolt (24)	024	Ring Spacer	057	Bolt (8)
003	Bolt	025 (1)	Packing	058 (1)	Gasket
004	Nut	026	Gland Sub-Assy. (Includes Items 027, 084 and 085)	059 (1)	Seal
005 (1)	Gasket (2)	027	Capscrew (2) (Part of Item 026)	061 (2)	Spacer
006	Nipple	028	Gland Bolt (2)	062 (2)	Shim (3)
007 (2)	Jam Nut (4)	029	Nut (2)	065	Inboard Cover
008 (2)	Adjustable Screw (4)	030	Washer (2)	066	No Flare Elbow
009	Plug (2)	031	Washer	068	Plug
010 (2)	Housing (2)	032	Drip Cup	070	Spring Pin (Part of Item 056)
011 (2)	Stop Pin (2)	033	Plug	080	Valve (Part of Item 038)
012	Spring Pin (*Part of Item 016 and 018)	034	Name Plate	081	Elastic Nut (Part of Item 038)
013 (2)	Power Rotor	035	Name Plate	082	Solid Pin (part of Item 038)
014 (2)	Idler (2)	036	Name Plate	083	Drive Screw (3)
015	Outboard Cover	037	Tubing	084	Gland (Part of Item 026)
016 (2)	Outboard Bearing Sub-Assy. (Includes Items 012 and 093)	038	Needle Valve Sub-Assy. (Includes Items 080, 081, 082, and 090)	085	Gland (Part of Item 026)
017	Packing Box Cover	039	Plug (2)	090	Body (Part of Item 038)
018 (2)	Inboard Bearing Sub-Assy. (Includes Items 012 and 094)	040 (2)	Check Valve or Relief Valve	092	Bolt
019 (2)	Outboard Collar or Thrust Collar	041	Plug	093	Outboard Bearing (Part of Item 016)
020 (2)	Shim (3)	042	Check Nut	094	Inboard Bearing (Part of Item 018)
021 (2)	Woodruff Key (2)	043	Setscrew	096	Threaded Cap (4)
022 (2)	Inboard Collar or Thrust Collar	045	Drive Screw (4)	097	Seal Cover (Part of Item 056)
		046	Spring Pin	098	Packing Box Cover
		055	Key	099	Bolt (2)
				199	Continuous Threaded Stud

(1) Minor Repair Kit items.

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

FIGURE 12.
VIEW OF INBOARD END COVER
SEAL WITH O-RING BEAT.

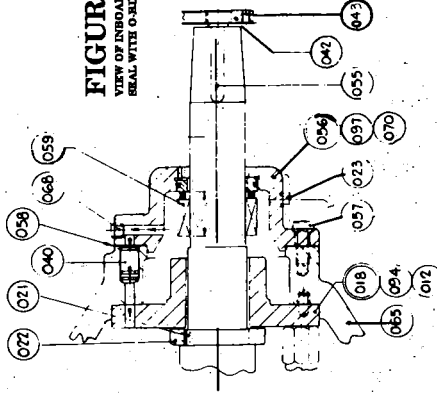


FIGURE 11.
VIEW OF INBOARD END
COVER SEAL WITH O-RING BEAT

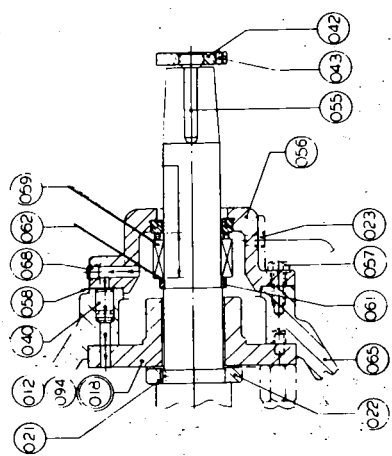
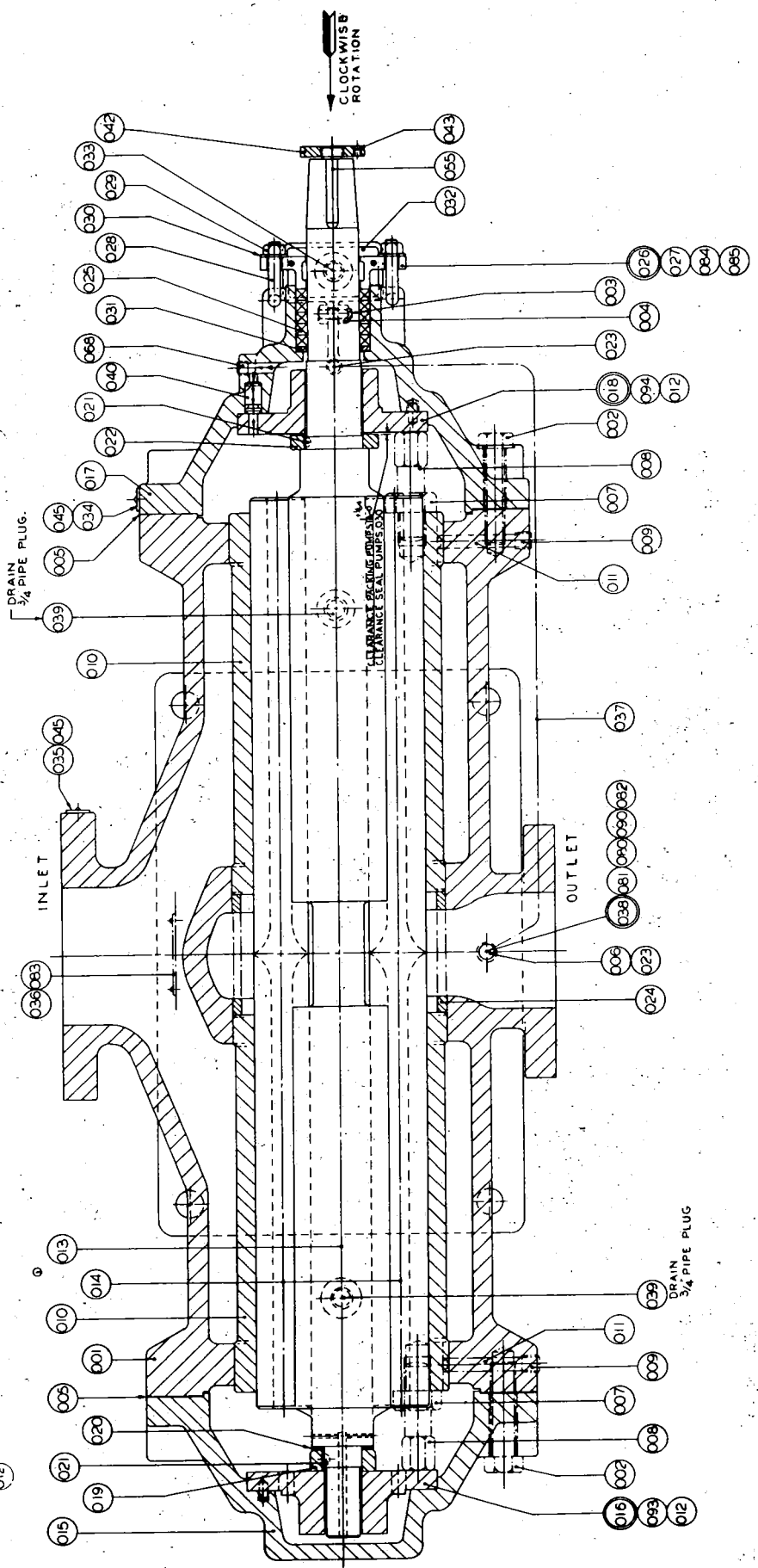
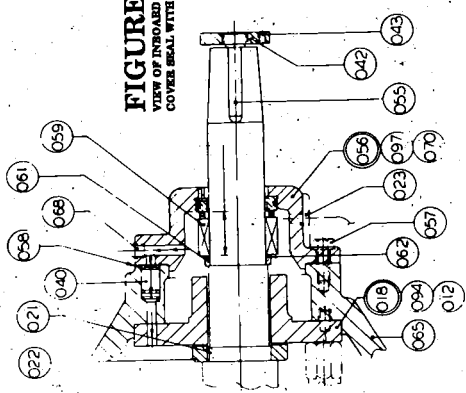


FIGURE 10.
VIEW OF INBOARD END
COVER SEAL WITH O-RING BEAT



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 Division 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. The IMO Pump Division, 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 Division 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.