

# INSTRUCTION, INSTALLATION, MAINTENANCE AND REPAIR MANUAL

## MODELS 411, 412 AND 413

### SPLIT CASE PUMPS

# 6

#### **IMPORTANT NOTE TO INSTALLER:**

This manual contains important information about the installation, operation and safe use of this product. This information should be given to the owner/operator of this equipment.

#### **ATTENTION: SAFETY WARNINGS:**

Read and understand all warnings before installation or servicing pump.

#### **Warning: California Proposition 65 Warning:**

This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

#### **OPERATIONAL LIMITS: \***

Maximum Operating Pressure: 250 psi

Maximum Operating Temperature: 275°F (135°C)

\* See ASTM A126/ANSI B16.1 for pressure/temperature ratings of flanges.

#### **ELECTRICAL SAFETY:**

#### **Warning: Electrical Shock Hazard**

All electrical connections are to be made by a qualified electrician in accordance with all codes and ordinances. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning: Electrical Overload Hazard**

Ensure all motors have properly sized overload protection. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning: Sudden Start-up Hazard**

Disconnect and lock out power source before servicing. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **HIGH TEMPERATURE SAFETY:**

#### **Warning: Hot Surface Hazard**

If pumping hot water, ensure guards or proper insulation is installed to protect against skin contact to hot piping or pump components. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning: Spraying Water Hazard**

When servicing pump, replace all gaskets and seals. Do not reuse old gaskets or seals. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **HIGH PRESSURE SAFETY:**

#### **Warning: High Pressure Hazard**

The pump is rated at a maximum of 175 psi at 150°F. Do not exceed this pressure. Install properly sized pressure relief valves in system. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning: Expansion Hazard**

Water expands when heated. Install properly sized thermal expansion tanks and relief valves. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **INSTALLATION**

**GENERAL.** The life of your Aurora® pump can be extended considerably by carefully following the installation instructions contained herein. Each step of the pump installation instructions plays a vital part in assuring long life, efficient operation and reduced maintenance, from the initial location of the pump through prestarting directions.

**UNPACKING YOUR PUMP.** The crate containing your pump should be opened immediately upon receipt from the factory, and the pump generally inspected for damage and shortage of parts. Particular attention should be given to the discharge and suction nozzle threads or flanges. Any damage or shortage of parts should be reported to the carrier immediately.

**PLANNING THE PUMP LOCATION.** You probably have spent considerable time planning where your pump will be located. However, you may have overlooked some factor that may affect pump operation or efficiency.

The pump should be located as close to the liquid source as possible so that the suction line can be short and direct. It should be located in a clean, open area, where it is easily accessible for inspection, disassembly and repair. Pumps installed in dark, dirty areas or in cramped locations are often neglected, which can result in premature failure of both the pump and the driver.

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**FOUNDATION.** The foundation for your pump must be sufficiently rigid to absorb any vibration and stress encountered during pump operation. A raised foundation of concrete is preferable for most floor mounted pumps. The raised foundation assures a satisfactory base, protects against flooding, simplifies moisture drainage, and facilitates keeping the area clean.

Your pump should be firmly bolted to the foundation, whether it is a raised concrete base, steelwork wall, or structural member. The mounting bolts or lag screws should be accurately located per the applicable Aurora® dimension sheet. Refer to Fig. 1.

**LEVELING THE PUMP.** Leveling the pump will require enough shims to support the baseplate near the foundation bolts and at any points of the baseplate carrying a substantial weight load. The shims should be large enough to allow a gap of 3/4" to 1-1/2" between the baseplate and foundation for grouting.

**INITIAL ALIGNMENT OF THE FLEXIBLE COUPLING.** The pump and driver were accurately aligned at the factory. However, it is impossible to maintain this alignment during shipping and handling. Therefore it will be necessary for you to realign the pump and driver. Flexible couplings are not universal joints. They should not be used to compensate for misalignment of the pump and motor shafts. Their function is to transmit power from the driver to the pump while compensating for thermal expansion and shaft end movement. The coupling faces should be far enough apart so that they do not make contact when the motor shaft is forced to the limit of the bearing clearance toward the pump shaft.

In order to properly align the coupling, you will need a taper gauge or set of feeler gauges and a straight edge.

There are two types of misalignment encountered with flexible couplings: angular misalignment, in which the shafts are not parallel, and parallel misalignment where the shafts are parallel but not on the same axis.

To check angular alignment, insert a feeler gauge or taper gauge at any four places 90° apart around the coupling halves. Insert shims under the driver feet until the same reading is obtained at all four checkpoints. The pump and driver will then be in angular alignment.

To check parallel alignment, a straight edge should be held against the edges of the coupling halves at any four places 90° apart around the coupling. The straight edge should be parallel to the pump and driver shafts at all times. Insert shims until the straight edge lies flat against both coupling halves at all four checkpoints. The pump and driver will then be in proper parallel alignment. Refer to Fig. 2.

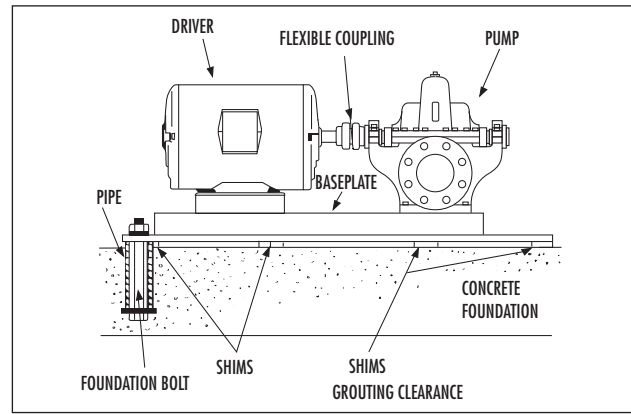


Figure 1. Foundation for frame mounted pumps.

**SUCTION PIPING.** The suction piping should be short, but no less than ten pipe diameters in length, and direct with as few elbows and fittings as possible to keep head loss, from friction, at a minimum. However, the suction pipe should provide a minimum uninterrupted length, equal to ten pipe diameters, to the pump suction flange. A horizontal suction line should have a gradual rise to the pump and pass under any interfering piping.

The suction pipe diameter should be at least the same diameter as the suction nozzle on the pump, and preferably larger. Use of a smaller diameter pipe will result in loss of head due to friction. All joints must be tight to maintain prime on the pump.

**REDUCERS.** Eccentric reducers should be installed directly at the suction nozzle, with the taper at the bottom to prevent air pockets from forming. Straight taper reducers should never be used in a horizontal suction line because of the air pocket that is formed at the leg of the reducer and the pipe. Refer to Fig. 3.

**ELBOWS.** Long radius elbows should be used in place of standard elbows wherever possible because of their superior flow characteristics. For instance, head loss in a standard four inch elbow is equivalent to the head loss in a piece of pipe 11 feet long, while the head loss in a long radius elbow is approximately half as much. Elbows should not be used at the suction nozzle, but if it is unavoidable, they should be installed in a vertical position. Elbows installed in any position at the suction nozzle have a tendency to distribute the liquid unevenly in the impeller chamber, causing a reduction in capacity, and creating an undesirable thrust condition. Refer to Fig. 4.

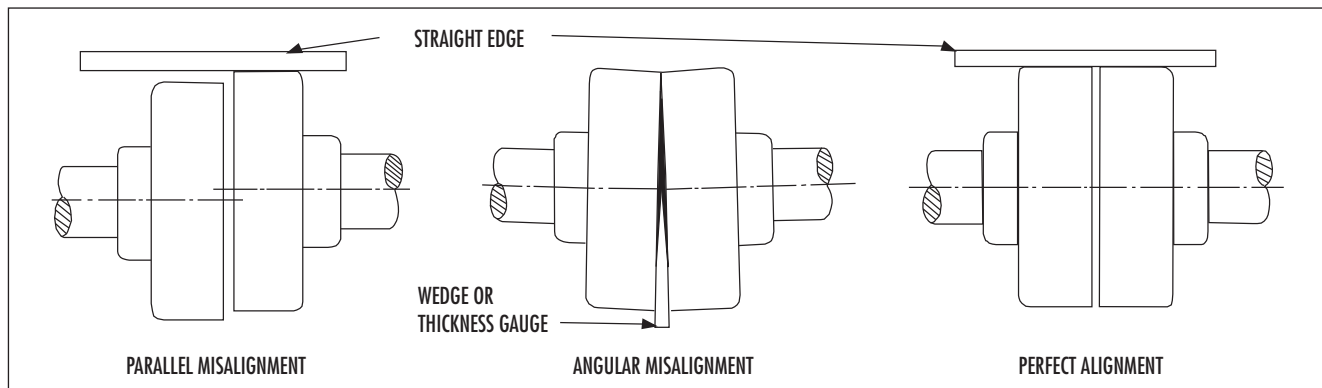


Figure 2. Flexible coupling alignment.

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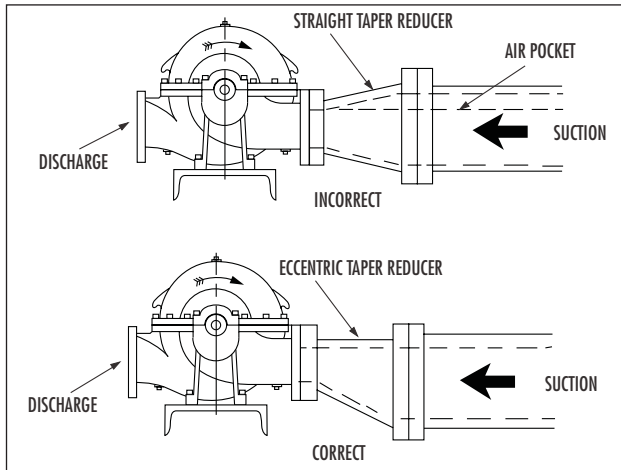


Figure 3. Installation of tapered reducers.

**GROUTING THE INSTALLATION.** Grouting the baseplate prevents lateral movement of the baseplate and improves the vibration absorbing characteristics of the foundation by increasing its mass. A wooden dam should be constructed around the baseplate to contain the grout while it is being poured. The dam can be built tight against the baseplate or slightly removed from it as desired.

The entire baseplate should be completely filled with a non-shrinkable type grout. The grout should be puddled frequently to remove any air bubbles from the grout.

**DISCHARGE PIPING.** Discharge piping should also be short and direct as possible, with few elbows and fittings, to reduce head loss from friction.

**PIPE.** The discharge pipe diameter should be the same as, or larger than, the discharge nozzle diameter. The size of discharge pipe to be used is dependent upon the application.

**DISCHARGE VALVES.** The discharge piping should include a check valve and a gate valve. The check valve should be located between the gate valve and the pump. If an increaser is used in the discharge piping, the increaser should be installed between the pump nozzle and the check valve. The check valve protects against a reverse flow of the liquid if the driver fails. Refer to Fig. 5.

The gate valve is used in the priming operation, as a throttling valve to control pump volume and to shut down the pump for inspection and maintenance.

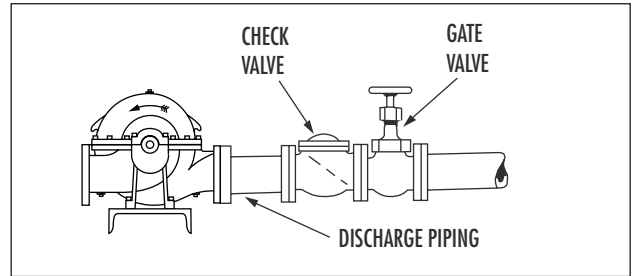


Figure 5. Gate valve and check valve.

**ELECTRICAL WIRING.** Normally, your pump will be supplied with an attached drive motor. The motor should be wired in accordance with the wiring diagram found on the motor nameplate. Be sure the voltage, frequency and phase of your power supply corresponds with the nameplate data. It is advisable to provide a separate switch and overload protection for your pump motor to protect against power failure in some other area. Conversely, if the pump motor develops electrical problems, it will be isolated from other equipment.

**PRESTARTING INSTRUCTION.** The coupling halves should be connected. Prior to connection, however, the drive motor should be started to make sure the direction of rotation is the same as the direction indicated by the arrow on the pump casing.

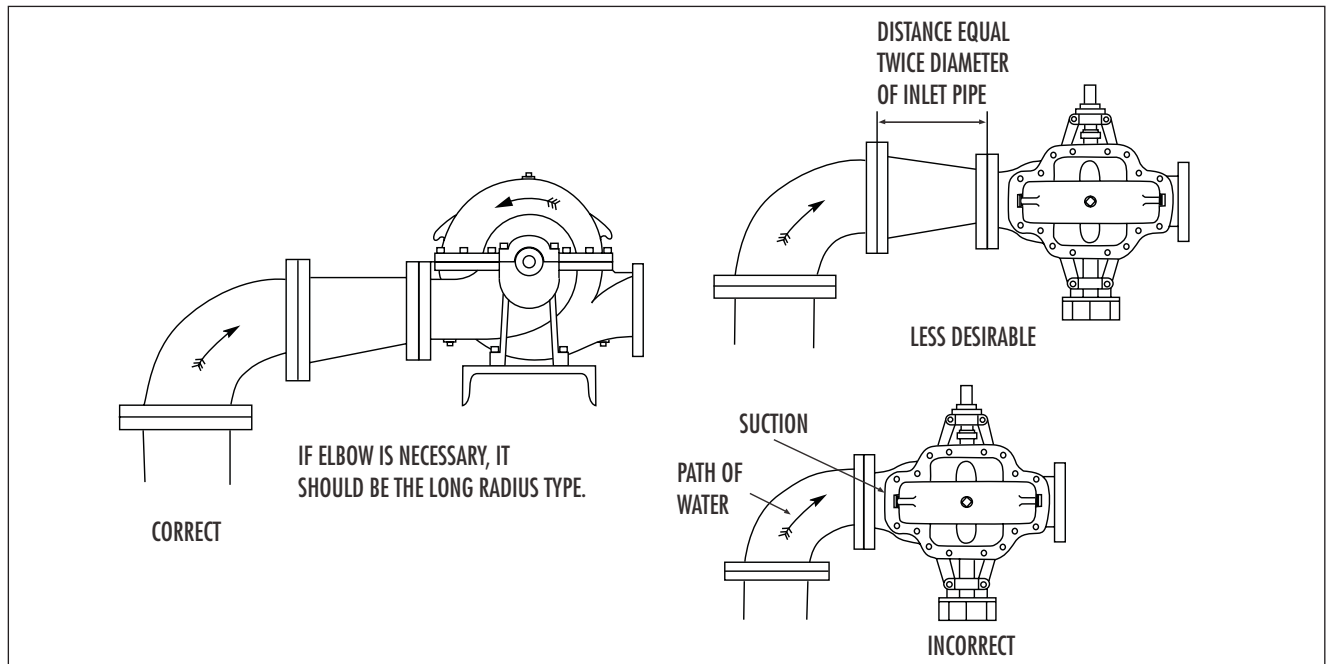


Figure 4. Installation of elbows.

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### CAUTION

Do not operate the pump without liquid. Pump seals or packing depend on the liquid being pumped for lubrication.

Be sure the pump is primed and that no air exists in the suction pipe and pump casing.

#### MAINTENANCE

Your Aurora® pump requires no maintenance other than periodic inspection, lubrication and occasional cleaning. The intent of inspection is to prevent breakdown, thus obtaining optimum service life. The motor may require lubrication. The motor manufacturer's recommendation should be followed. For all of the split case pump models, regreasable bearings are standard. Oil lubrication is optional on the 431B pumps.

Regreasable bearings will require periodic lubrication and can be accomplished by using the zerk or lubrication fittings in the cartridge cap. Lubricate the bearings at regular intervals using a grease of high quality. Aurora recommends Chevron SRI No. 2 grease with a polyurea thickener. However, most major brands of Grade No. 2 ball bearing grease are satisfactory for pumps operating in both wet and dry locations. Mixing of different brands of grease should be avoided due to possible chemical reactions between the brands which could damage the bearings. Accordingly, avoid grease of vegetable or animal base which can develop acids, as well as grease containing rosin, graphite, talc and other impurities. Under no circumstances should grease be reused.

Overlubrication should be avoided as it may result in overheating and possible bearing failure. Under normal application, adequate lubrication is assured if the amount of grease is maintained at 1/3 to 1/2 the capacity of the bearing and adjacent space surrounding it.

In dry locations, each bearing will need lubrication at least every 4,000 hours of running time or every 6 to 12 months, whichever is more frequent. In wet locations the bearings should be lubricated at least after every 2,000 hours of running time or every 4 to 6 months, whichever is more frequent. A unit is considered to be installed in a wet location if the pump and motor are exposed to dripping water, to the weather, or to heavy condensation such as is found in unheated and poorly ventilated underground locations.

Oil lubricated bearings are optional on Model 431B pumps. A fixed oil level is maintained with the bearing cartridge by an oiler which allows visual indications of reserve oil.

At initial installation and before starting, a unit that has been shut down for repairs or for any extended length of time, run enough 10W-20 weight motor oil through the oiler to maintain a constant oil level to ensure that the bearing will never be without an oil supply. Oil will have to be added at intervals to maintain a constant level in the oiler. This interval can be determined only by experience.

Under working conditions, oil will break down and need to be replaced at regular intervals. The length of these intervals will depend on many factors. Under normal operation, in clean and dry locations, the oil should be changed about once a year. However, when the pump is exposed to dirt contamination, high temperatures (200°F or above) or a wet location, the oil may have to be changed every 2 to 3 months.

At times it may be necessary to clean the bearings due to accumulated dirt or deteriorated lubricants. This can be accomplished by flushing the bearing with a light oil heated 180 to 200°F while rotating it on a spindle. Wipe the bearing housing with a clean rag soaked in a cleaning solvent and flush all surfaces.

Dry bearing thoroughly before relubricating. Compressed air can be used to speed drying, but care should be taken not to let bearings rotate while being dried.

### CAUTION

Use normal fire caution procedures when using any petroleum cleaner.

The motor that drives your Aurora pump may or may not require lubrication. Consult the manufacturer's recommendations for proper maintenance instructions.

#### REPAIRS

The pump may be disassembled using the illustrations and text provided. Although complete disassembly is covered, it will seldom be necessary to completely disassemble your Aurora pump.

The illustrations accompanying the disassembly instructions show a Model 411 pump at various stages of disassembly. The illustrations are intended to aid in the correct identification of the parts mentioned in the text.

*Refer to Figure 6 that illustrates the various pump models described in this manual.*

Inspect removed parts at disassembly to determine if they can be reused. Cracked castings should never be reused. All optional packing and gaskets should be replaced at reassembly simply as a matter of economy. They are much less expensive to replace routinely than to replace singly as the need arises. In general it is economical to return to the manufacturer for repair to the motor and motor controller.

#### DISASSEMBLY

Disassemble only what is needed to make repairs or accomplish inspection. Proceed to disassemble the pump as follows:

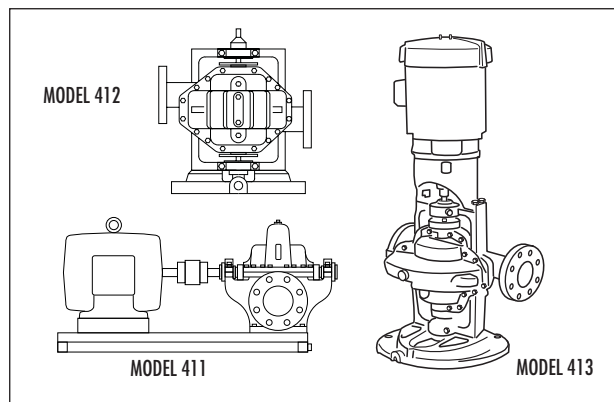


Figure 6. The models shown above are single stage pumps in various mounting configurations.

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1. Break electrical connections to motor or take other steps needed to prevent drive unit from being unintentionally energized during disassembly.
2. Close such valves or flow-control devices necessary to make certain flow of liquid will not take place during disassembly.

### NOTE

Discharge and suction piping need not be disturbed unless complete pump assembly is to be removed.

3. Drain liquid from pump by removing plugs (1 and 2). Disconnect any flushing, cooling, bypass lines that are connected to parts that will be removed.
4. Loosen and remove capscrews (6) securing casing half (8) to remainder of pump assembly.

### NOTE

If pump being disassembled is size 4 x 5 x 11 or larger, remove capscrews (7) also before attempting to separate casing halves.

5. Make certain all securing capscrews are removed, then carefully remove casing half (8) using hoist or crane with a sling attached around cast hooks on the casing and under the casing. Refer to Fig. 8.

## CAUTION

Use extreme care when casing comes loose that it does not drop out of sling as this would cause extensive damage to other components of pump.

6. Remove gasket (9) and scrape mating surfaces of casing halves to remove pieces of gasket that have adhered in separation. Take care not to scratch or mar mating surfaces.
7. On Models 411 and 413, loosen flexible coupling and slide the halves apart. On pump Model 412 remove flexible shafting.
8. Remove four capscrews (25) securing two bearing caps (26). Lift off bearing caps (26) and pins (27). Mark caps to ensure correct replacement and orientation on the respective bearing arms.
9. Loosen and remove four nuts (18), washers (19) and gland clamps (20), securing split halves of two packing glands (21). Remove four swing bolts (22).
10. Assuming that further work is required on shaft and impeller assembly, use properly secured rope and hoist or crane as required to lift it from casing half (69) single stage

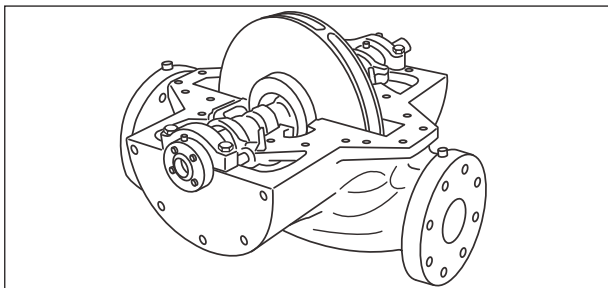


Figure 8. Casing half removed.

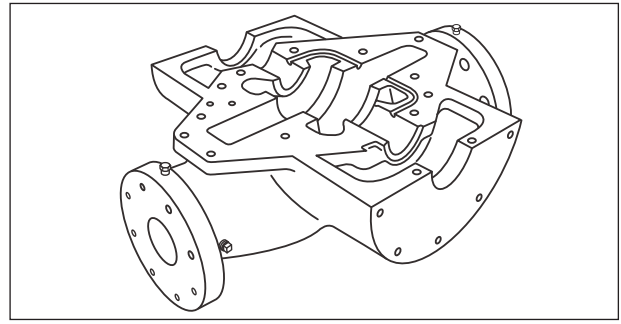


Figure 9. Rotating element removed from casing half.

and (74) two stage and place it on a suitable bench or work surface. Refer to Fig. 9.

## CAUTION

Take care not to dent or damage impeller and/or other parts. Use of a supporting cradle or work stand is recommended. Refer to Fig. 10.

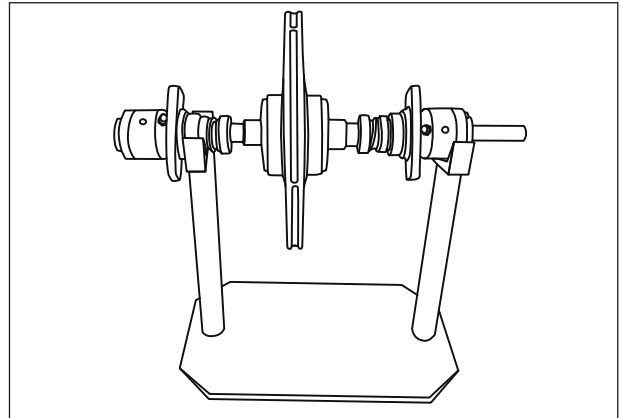


Figure 10. Element placed in a protective cradle for further disassembly.

### NOTE

Disassembly procedure from this point covers pumps having standard packing. If pump has mechanical seals, refer to specific instructions.

11. Remove and discard rings of packing (23). Replacement with new packing is recommended whenever pump is disassembled.
12. Slip off flexible coupling half or flexible shafting from shaft (65) single stage or (71) two stage, and remove key (24). If preferred, the key may be removed by carefully tapping it from outer end with a brass drift or similar nonmarring tool, using a small hammer.
13. Remove two casing wearing rings (28).
14. Remove zerks (10) and pipe plugs (12) from cartridge caps (32 and 42).
15. Loosen and remove four capscrews (31) from cartridge cap (32). The outboard shaft end protector (29) may be removed from its recess in the outboard cartridge cap if necessary. Remove retainer ring (35) with a pair of truarc pliers. On 431B pump, remove lock nut (77). Also remove gasket (34).

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### NOTE

If the unit has a tandem shaft, protector (29) is not used.

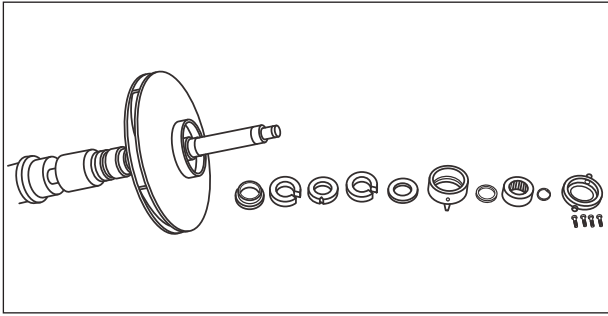


Figure 11. Outboard rotating element components removed, illustrating disassembly.

16. Outboard bearing (38) is press fitted onto shaft (65). To remove it, place a puller on bearing cartridge (36) and pull cartridge, grease seal (37) and bearing from shaft. The grease seal can be pressed from the bearing cartridge if it needs replacing, then slide slinger (39), lantern ring (52) and bushing (56) off shaft (65) single stage, (71) two stage. Refer to Fig. 11.
17. Removal of inboard bearing is basically the same as for outboard bearing. Remove capscrews (41) and slide slinger (40), cartridge cap (42), grease seal (43) and gasket (44) off shaft.
18. Pull or press off bearing cartridge (45), grease seal (46) and bearing (47). Remove slinger (48), lantern ring (52) and bushing (56) from shaft.
19. If pump has right-hand rotation, unscrew and remove outboard sleeve (57) first. Remove O-ring (62) single stage, (58) two stage. If pump has left-hand rotation, unscrew and remove inboard sleeve (64) single stage, (65) two stage first. Remove O-ring (58) single stage, (66) two stage. Refer to Fig. 12.

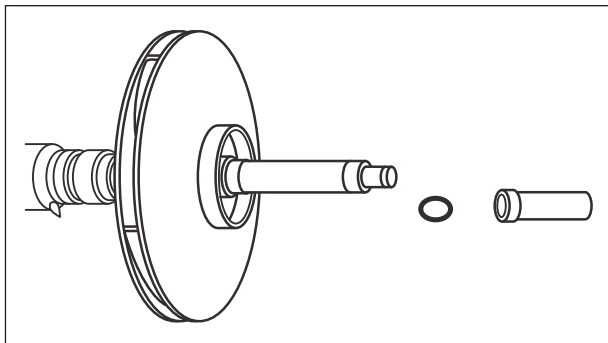


Figure 12. Sleeve and O-ring removed.

20. Key (63) holds impeller (59) and either sleeve (64) if pump is right-hand or sleeve (57) for a left-hand pump. These parts can be removed by pulling impeller from shaft (65) and removing key (63) from its position in keyway and sleeve. Unscrew and remove remaining sleeve and gasket.

21. Disassemble wearing ring(s) (61) (optional) from impeller (59) only if necessary. On power frames 5, 6B and 7, remove setscrews (78). Apply a puller and gradually withdraw wearing rings (61) from impeller (59). Wearing rings may have to be cut or trimmed off the impeller. If a lathe is used to trim rings off, use care not to clamp impeller too tight and cause distortion. Also use care not to remove any metal from impeller.
22. Remove locking and locating pins (66, 67 and 68) from casing half (69) only if replacement is necessary.
23. Nameplate and its securing screws should be removed only if replacement is necessary.
24. For pump Model 413 unscrew capscrews (75) to remove motor and motor bracket (74) from casing half (69). The motor can be separated from motor bracket by removing capscrews (73).

### DISASSEMBLY OF A PUMP WITH MECHANICAL SEALS

1. Perform disassembly procedure as previously given through step 8.
2. Loosen and remove four nuts (18) and washers (19) thus freeing swing bolts (22) to allow shaft and impeller assembly to be lifted from casing half (69) with sling and hoist or crane as described in paragraph 10.

### CAUTION

Use extreme care in moving assembly. Mechanical seal, seats and washers can be cracked by just sliding loose on shaft. To prevent this, wrap seal securely in a shop cloth or other protective covering.

3. With shaft and impeller assembly on a suitable bench, cradle, or work stand, loosen and remove pipe plug (12) from inboard cartridge cap (42). Remove grease zerk (10) and capscrews (41) and slide the cartridge cap with grease seal (43) off end of shaft (71). Remove gasket (44).
4. Pull or press bearing cartridge (45), grease seal (46) and bearing (47) off shaft. Remove slinger (48).
5. One piece gland (49) used with mechanical seal assembly can now be removed from shaft. O-ring (50) can be removed from seal gland if desired.

### CAUTION

Exercise great care in removing seal assembly (53) to keep from marring or otherwise damaging precision ground mating surfaces.

6. Scribe a mark on shaft sleeves for relocating seal collar on reassembly. Loosen setscrews (55), securing seal collars (54) to shaft sleeves and slide them off.
7. Proceed with further disassembly of outboard ball bearing and seal assembly using same basic procedure.
8. After removal of mechanical seals, proceed with balance of disassembly in the same manner as described for packing design.

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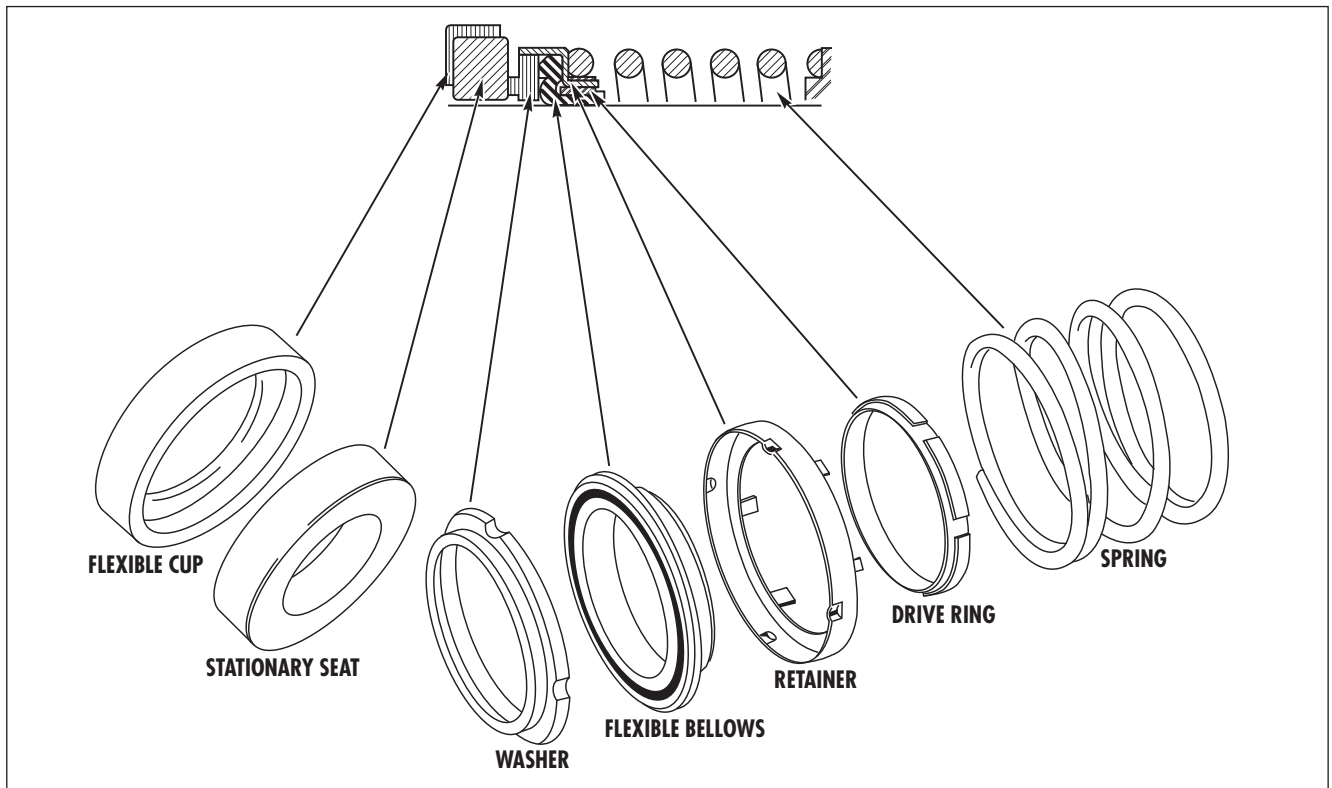


Figure 13. Mechanical seal.

REASSEMBLY

Reassembly will generally be in reverse order of disassembly. If disassembly was not completed, use only those steps related to your particular repair program.

1. Position locating pins (67) in lower casing (69), adding swing bolt pins (68), if used on your pump. Install wearing ring pins (66). Tap pins gently to seat them in place. If nameplate (71) was removed, install it with screws (70). Install O-ring (58) in shaft sleeve (64).
2. On a right-hand unit, thread inboard sleeve (64) onto shaft (65) distance A (refer to figure 14) based on pump size. On a left-hand unit, thread outboard sleeve (57) onto the shaft a distance A (refer to figure 15). When the sleeve is in position its keyway should align with keyway on shaft. Coat key and keyway with Loctite® Sealant Grade 242. Insert key (63) into keyways of shaft and sleeve. Tap it firmly in place.
3. Coat inside diameters of impeller wearing rings (61) (optional) with Loctite Sealant Grade 271 and press them over hubs of impeller (59). Do not attempt to hammer impeller wear rings into position, since they are a press fit. Use of an arbor press is preferred. However, placing a block of wood over the impeller wearing ring and pressing it in will work satisfactorily. For power frames 5, 6B and 7 only, two setscrews (78) will be installed by drilling into wearing rings and impeller. The opposite surface of the impeller should be protected from damage throughout the procedures by resting it against soft wood on the surface of work bench.

**CAUTION**

Impeller wearing rings must be given special care because they are press fit. Be sure rings are positioned squarely over hubs of impeller. A soft headed hammer may be used to gently tap impeller wearing rings into correct alignment before they are pressed into place.

4. Coat impeller (59) keyway with Loctite Sealant Grade 242 and slide onto shaft until it is firmly against the shaft sleeve. Place O-ring (58) in shaft sleeve (57) and thread shaft sleeve firmly against the impeller.

NOTE

When assembling rotating element of a 410 Series pump, it is important that the curve of the impeller blades is in agreement with pump rotation. Refer to impeller rotation sketches, Figs. 22-24.

**CAUTION**

Carefully check that proper shaft sleeve has been keyed into place for rotation of pump. If correct shaft sleeve is not keyed onto shaft, it can spin loose during operation of pump and cause excessive damage.

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Carefully check that the proper shaft sleeve has been keyed into place for rotation of pump. If correct shaft sleeve is not keyed onto shaft, it can spin loose during operation of pump and cause extensive damage.

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5. Install packing or mechanical seals and secure according to the following specific instructions:

### STANDARD PACKING

- A. Slide a bushing (56) onto each end of shaft. The larger diameter shoulder on these bushings must face away from impeller. Flat washer is standard on newer pumps.
- B. Pump sizes 2 x 2-1/2 x 9, 2 x 2-1/2 x 10 and 2 x 2-1/2 x 12 have one packing ring (23) in front of lantern ring (52). All other pump sizes have two packing rings in front of lantern ring. Stagger the joints in packing rings so pump will not leak excessively.

### MECHANICAL SEALS

#### A. Single Seal and Balanced Single Seals

- I. Slide one seal lock collar (54), with the step holding setscrews (55) facing the impeller, onto each end of the shaft. Position edge of collar on scribe mark made during disassembly and lock in place.
- II. Put a light coat of liquid dishwashing detergent on the shaft sleeve. Check rotating parts of seal to make sure they are clean. Spread a light coat of liquid detergent on inside diameters of flexible bellows and washers.
- III. Place the seal's spring, drive ring, retainer, flexible bellows and washer on the shaft sleeve in respective order. *Refer to Figure 13.*
- IV. Thoroughly inspect cavity of seal gland (49) for burrs or nicks which would damage seat of the seal. Apply a film of liquid detergent to seal seat and install it in seal gland cavity, taking care to seat it evenly and squarely.

#### NOTE

If it is not possible to insert the seat with fingers, place a cardboard protecting ring, furnished with seal, over lapped face of seat and press into place with a piece of tubing having end cut square. Tubing should be slightly larger than the diameter of the shaft. Remove cardboard after the seat is firmly in place.

## CAUTION

Never place a mechanical seal into service after it has been used without replacing or relapping stationary seat and washer faces.

- V. Place O-rings (50) around the seal glands and slide seal glands onto the ends of the shaft.
6. Place slinger (39) onto outboard end of the shaft.
  7. Press grease seal (37) into bearing cartridge (36). On 6B and 7 power frames replace snap ring (35A) on inboard

side of bearing. Place outboard double row ball bearing (38) in bearing cartridge and press these parts onto outboard end of the shaft. Snap retainer ring (35) in place to secure outboard bearing. Place gasket (34) and cartridge cap (32) in position and secure with capscrews (31).

#### NOTE

Both grease zerk holes in bearing cartridges and pipe plug holes in cartridge caps must be facing in opposite directions when assembled.

8. Protector (29) can be placed in cartridge cap or if unit has tandem shaft, press a grease seal into cartridge cap and slide a slinger onto shaft.
9. Place slinger (48) in inboard end of shaft.
10. Press grease seal (46) into bearing cartridge (45). Place inboard ball bearing (47) in bearing cartridge and press this assembly onto inboard end of shaft.
11. Press grease seal (43) into cartridge cap (42). Position gasket (44) and cartridge cap against bearing cartridge and secure it in place with capscrews (41). Be sure to align grease zerk holes and pipe plug hole on opposite sides.
12. Place slinger (40) onto shaft. Place grease zerks (10) in bearing cartridges and pipe plugs (12) in bearing caps.
13. Slide casing wearing rings (28) over impeller hub or optional wearing rings and set rotating element into casing half (69) single stage, (74) two stage. Make certain that drill holes in bottom surface casing wearing rings are located over pins (66) single stage, (69) two stage. The drill hole in casing bushing (61) is over pin (63) previously set in casing half (74).
14. Install key (24) in motor end of shaft (69) single stage, (71) two stage. Check positioning and alignment of packing rings or seal components, install swing bolts (22) and split gland halves (21) if pump has packing. Position clamps (20), washers (19) and nuts (18), securing loosely in place. Swing bolts (22) are set over pins on smaller units. On larger units, swing bolts are held in place by capscrews (7) after casing half (8) is in position.
15. Place pins (27) into bearing cartridges. Place bearing caps (26) in position and secure with capscrews (25).
16. Position new casing gaskets (9) on lower casing half. Set casing half (8) in place. Secure it to lower casing half with capscrews (6). Pins (67) single stage, (72) two stage are used as a means of locating the position of casing halves.
17. On larger pumps, thread in capscrews (7), making sure they are placed through eye of swing bolts (22).
18. Place drain plugs (1) and (2) back in casing halves.
19. On pump Model 413, set the motor on motor bracket (74) single stage, (80) two stage and fasten them together with capscrews and nuts. Slide flexible coupling halves onto pump and motor shafts. Attach motor bracket to casing with capscrews. Connect flexible coupling halves.



## MODELS 411-412-413

20. On pump Model 412, attach flexible shafting. Ideal joint operating angle is 1° to 5° on pump Model 411. If lower casing was removed from the base, see section on Installation for proper methods of realigning pump to motor and piping.
21. Replace any flushing, cooling, bypass or drain lines that were removed from the pump. Connect electricity back to the motor.

### STARTING PUMP AFTER REASSEMBLY

Do not start pump until all air and vapor have been bled, making sure that there is liquid in pump to provide necessary lubrication.

#### NOTE

Do not overtighten standard packing assembly before returning unit to operation. Jog the pump to check for proper rotation. Then allow pump to run for a short time, gradually tightening nuts (18) until dripping has been reduced to its normal level.

MODELS 411-412-413

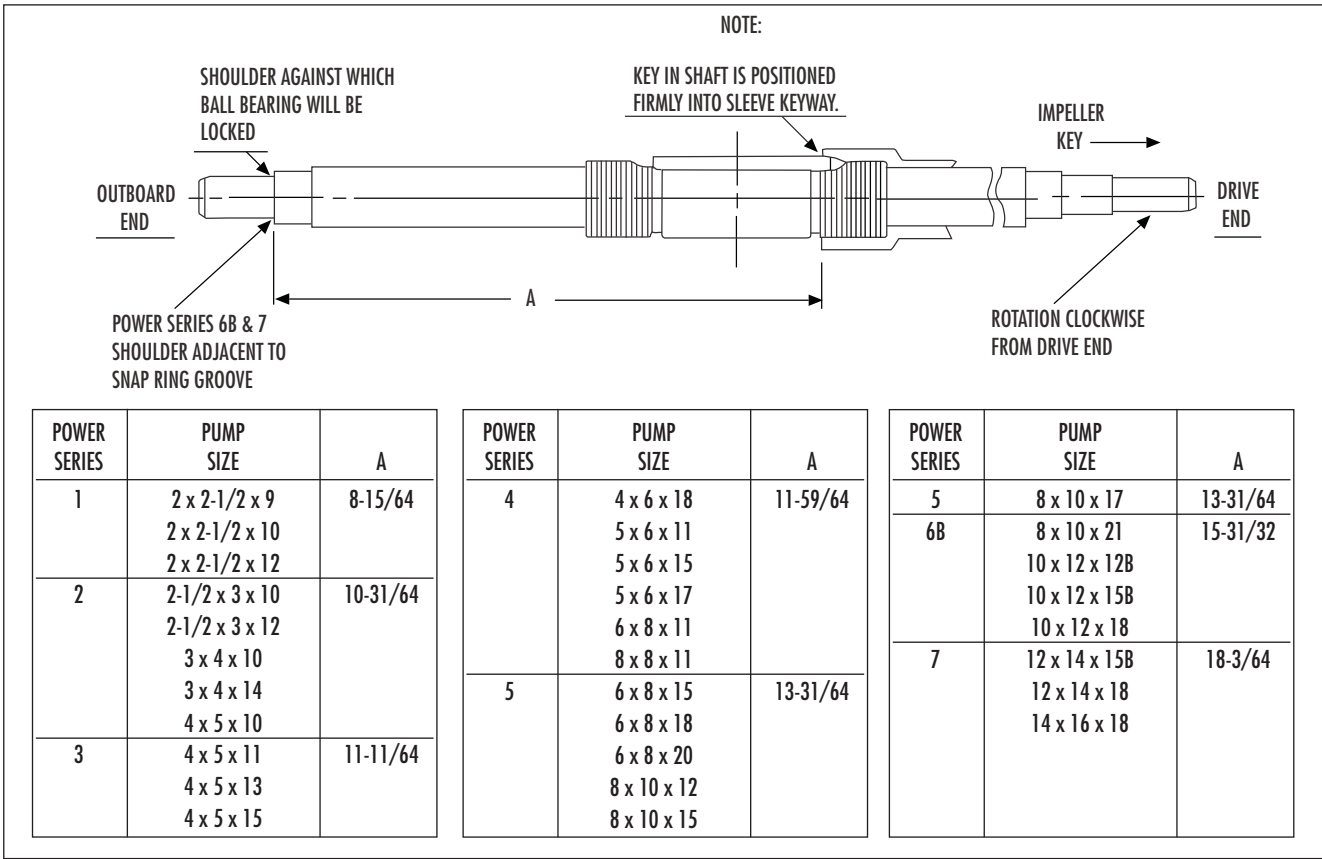


Figure 14. Locating shaft sleeve on shaft, **Right-hand Rotation.**

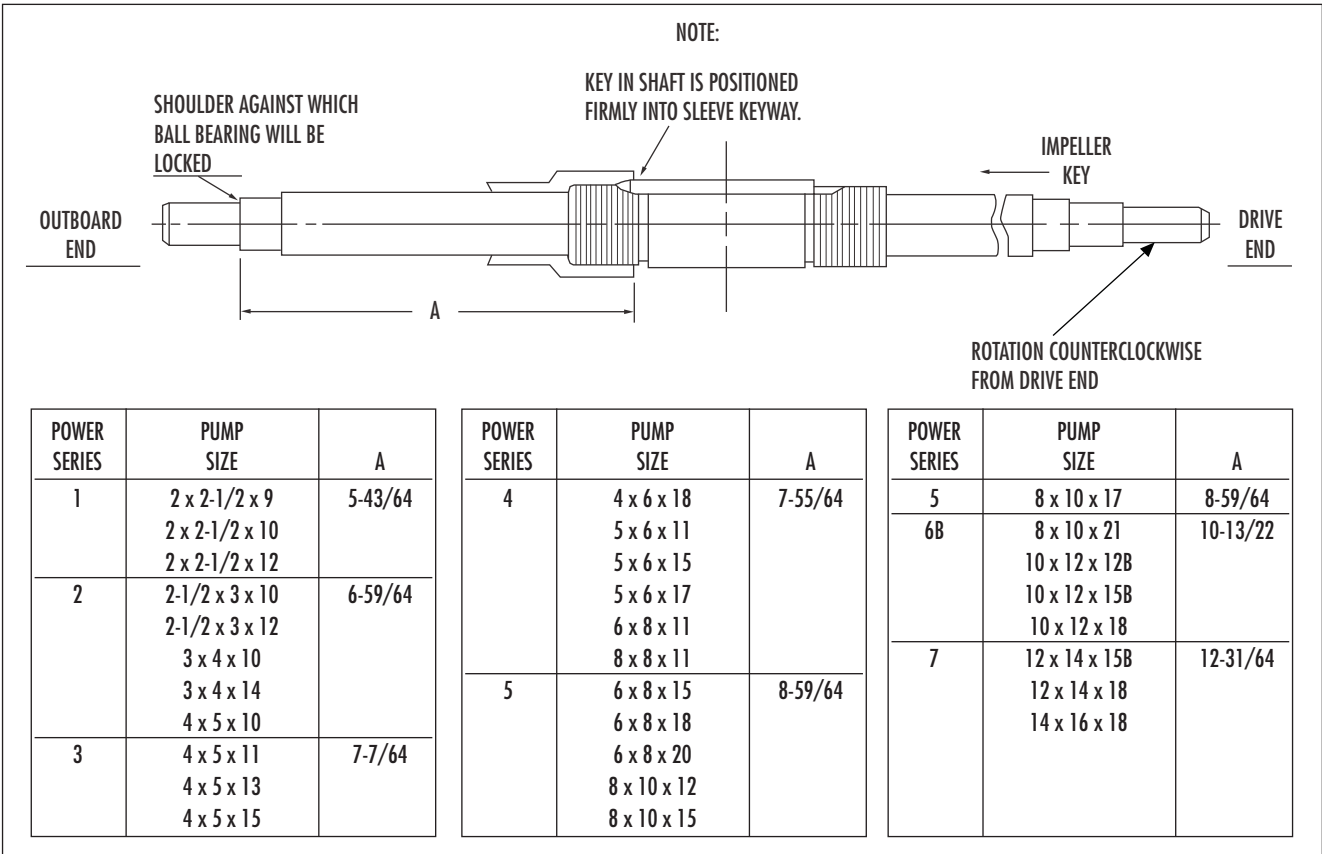


Figure 15. Locating shaft sleeve on shaft, **Left-hand Rotation.**

**MODELS 411-412-413**

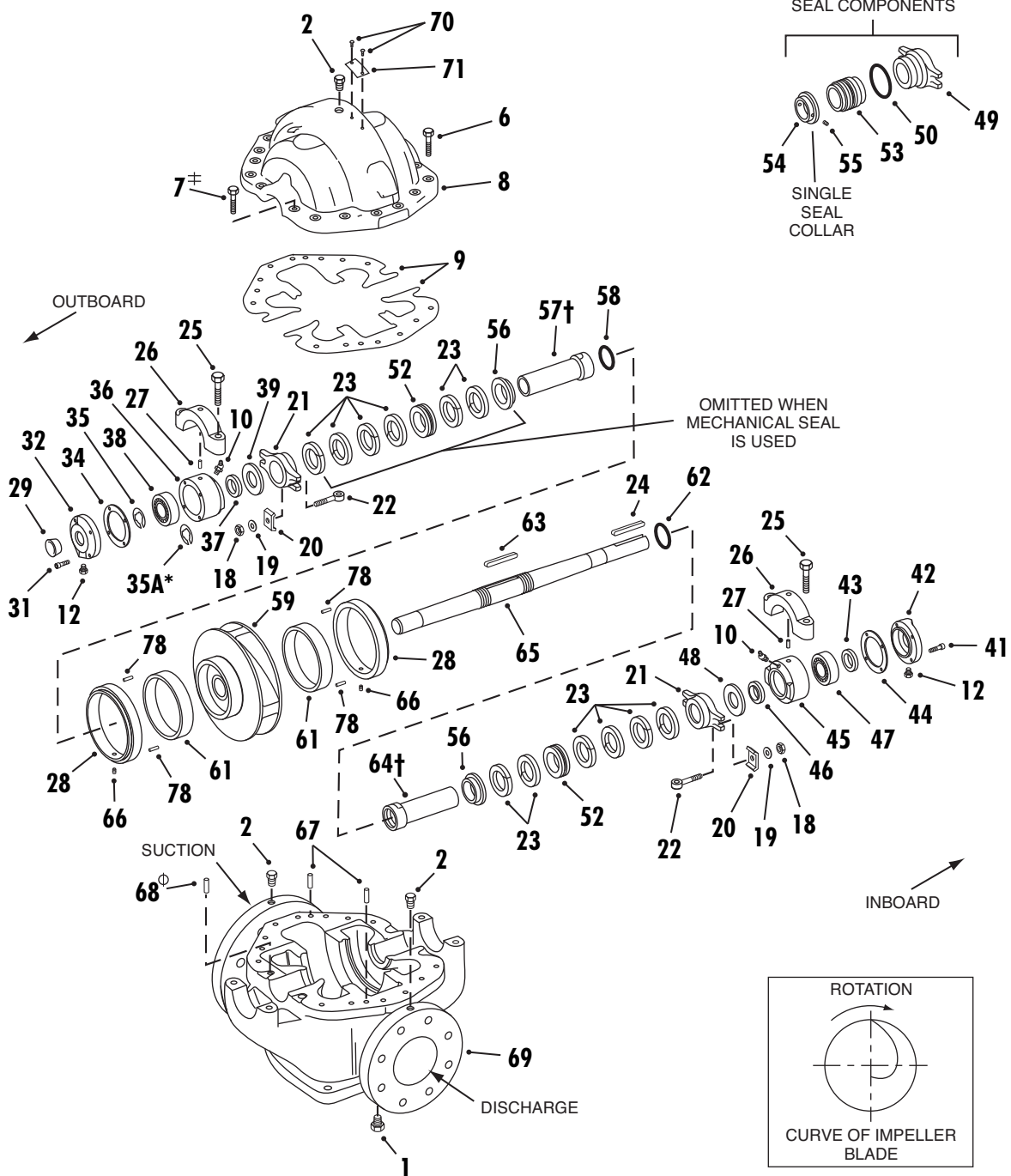
MODEL 411 LIST OF PARTS (See Figure 21)			
1. Plug	26. Bearing Cap	43. Grease Seal	59. Impeller
2. Plug	27. Pin	44. Gasket	61. Wearing Ring
6. Capscrew	28. Wearing Ring	45. Cartridge	62. O-ring
7. Capscrew	29. Protector	46. Grease Seal	63. Key
8. Casing	31. Capscrew	47. Bearing	64. Sleeve
9. Gasket	32. Cartridge Cap	48. Slinger	65. Shaft
10. Grease Fitting	34. Gasket	49. Gland	66. Pin
12. Plug	35. Retaining Ring	50. O-ring	67. Pin
18. Nut	35A. Retaining Ring	51. O-ring	68. Pin
19. Washer	36. Cartridge	52. Lantern Ring	69. Casing
20. Clamp	37. Grease Seal	53. Seal	70. Drive Screw
21. Gland Half	38. Bearing	54. Collar	71. Nameplate
22. Swing Bolt	39. Slinger	55. Setscrew	78. Setscrew
23. Packing	40. Slinger	56. Bushing	
24. Key	41. Capscrew	57. Sleeve	
25. Capscrew	42. Cartridge Cap	58. O-ring	

MODEL 412 LIST OF PARTS (See Figure 22)			
1. Plug	26. Bearing Cap	43. Grease Seal	59. Impeller
2. Plug	27. Pin	44. Gasket	61. Wearing Ring
6. Capscrew	28. Wearing Ring	45. Cartridge	62. Gasket
7. Capscrew	29. Protector	46. Grease Seal	63. Key
8. Casing	31. Capscrew	47. Bearing	64. Sleeve
9. Gasket	32. Cartridge Cap	48. Slinger	65. Shaft
10. Grease Fitting	34. Gasket	49. Gland	66. Pin
12. Plug	35. Retaining Ring	50. O-ring	67. Pin
18. Nut	35A. Retaining Ring	51. O-ring	68. Pin
19. Washer	36. Cartridge	52. Lantern Ring	69. Casing
20. Clamp	37. Grease Seal	53. Seal	70. Drive Screw
21. Gland Half	38. Bearing	54. Collar	71. Nameplate
22. Swing Bolt	39. Slinger	55. Setscrew	76. Capscrew
23. Packing	40. Slinger	56. Bushing	77. Base
24. Key	41. Capscrew	57. Sleeve	78. Setscrew
25. Capscrew	42. Cartridge Cap	58. Gasket	

MODEL 413 LIST OF PARTS (See Figure 23)			
1. Plug	27. Pin	45. Cartridge	63. Key
2. Plug	28. Wearing Ring	46. Grease Seal	64. Sleeve
6. Capscrew	29. Protector	47. Bearing	65. Shaft
7. Capscrew	31. Capscrew	48. Slinger	66. Pin
8. Casing	32. Cartridge Cap	49. Gland	67. Pin
9. Gasket	34. Gasket	50. O-ring	68. Pin
10. Grease Fitting	35. Retaining Ring	51. O-ring	69. Casing
12. Plug	35A. Retaining Ring	52. Lantern Ring	70. Drive Screw
18. Nut	36. Cartridge	53. Seal	71. Nameplate
19. Washer	37. Grease Seal	54. Collar	73. Capscrew
20. Clamp	38. Bearing	55. Setscrew	74. Bracket
21. Gland Half	39. Slinger	56. Bushing	75. Capscrew
22. Swing Bolt	40. Slinger	57. Sleeve	76. Capscrew
23. Packing	41. Capscrew	58. Gasket	77. Base
24. Key	42. Cartridge Cap	59. Impeller	78. Setscrew
25. Capscrew	43. Grease Seal	61. Wearing Ring	
26. Bearing Cap	44. Gasket	62. Gasket	

Figure 20.

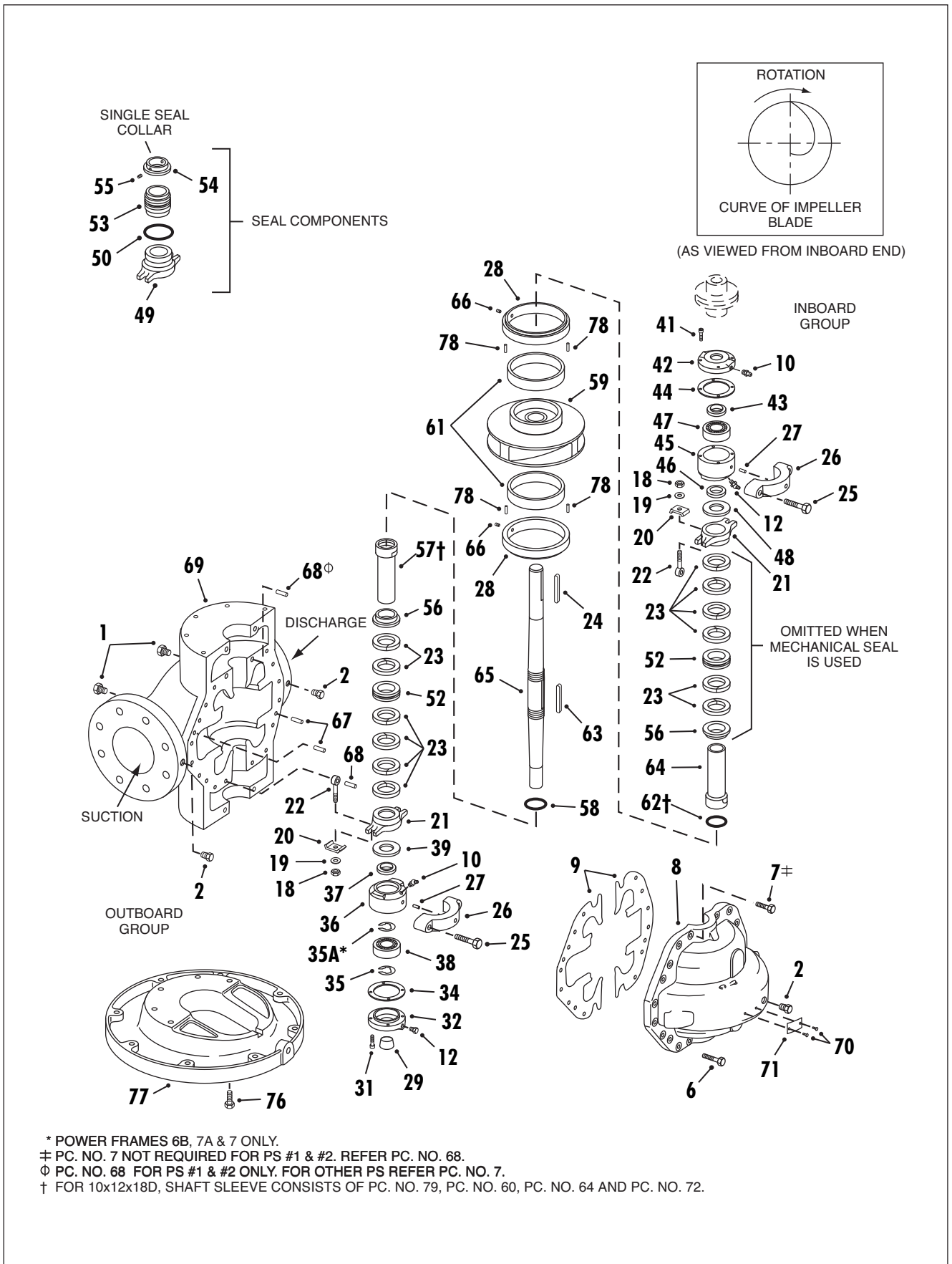
MODEL 411



\* POWER FRAMES 6B, 7A & 7 ONLY.  
 ± PC. NO. 7 NOT REQUIRED FOR PS #1 & #2. REFER PC. NO. 68.  
 Φ PC. NO. 68 FOR PS #1 & #2 ONLY. FOR OTHER PS REFER PC. NO. 7.  
 † FOR 10x12x18D, SHAFT SLEEVE CONSISTS OF PC. NO. 79, PC. NO. 60, PC. NO. 64 AND PC. NO. 72.

Figure 21. Model 411 exploded view.

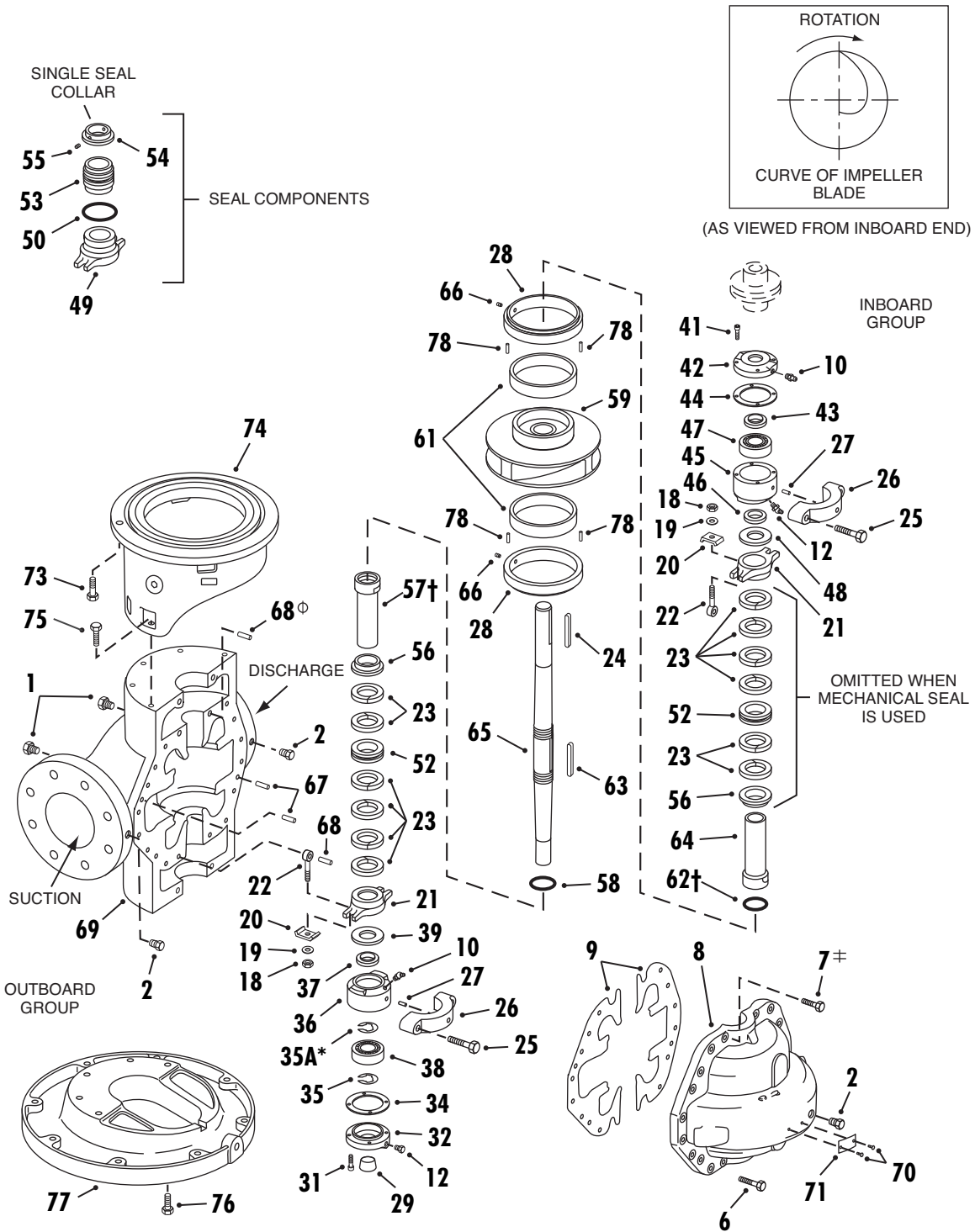
MODEL 412



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 ‡ PC. NO. 7 NOT REQUIRED FOR PS #1 & #2. REFER PC. NO. 68.  
 ◊ PC. NO. 68 FOR PS #1 & #2 ONLY. FOR OTHER PS REFER PC. NO. 7.  
 † FOR 10x12x18D, SHAFT SLEEVE CONSISTS OF PC. NO. 79, PC. NO. 60, PC. NO. 64 AND PC. NO. 72.

Figure 22. Model 412 exploded view.

MODEL 413



\* POWER FRAMES 6B, 7A & 7 ONLY.

± PC. NO. 7 NOT REQUIRED FOR PS #1 & #2. REFER PC. NO. 68.

Φ PC. NO. 68 FOR PS #1 & #2 ONLY. FOR OTHER PS REFER PC. NO. 7.

† FOR 10x12x18D, SHAFT SLEEVE CONSISTS OF PC. NO. 79, PC. NO. 60, PC. NO. 64 AND PC. NO. 72.

Figure 23. Model 413 exploded view.

## **NOTE**

**When ordering spare parts, always include the pump type, size, serial number and the piece number from the exploded view in this manual.**

**Order all parts from your local authorized distributor or the factory at Aurora, Illinois.**

**NOTE:**

***For "NSF 50"  
units that  
require a  
strainer, the  
strainer must  
be "NSF"  
listed!***

**NOTE:**

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