INSTRUCTION AND MAINTENANCE MANUAL:

FP AND FPX Single Flange Style Pump

(for FP pumps with motors frame sizes 56C thru 215TC
and FPX pumps with motor frame sizes to 256TC)
DESCRIPTION

This manual contains installation, operation, assembly, disassembly and repair instructions for the Fristam FP and FPX single flange centrifugal pump.

The heavy-duty FP pump is flange mounted on a cast flange support. This flange support provides an extremely sturdy method of coupling the pump head and the motor. It absorbs vibrations and noise. The flange support also fastens the pump to the floor (or adjustable base). The FP series is available with either a single or double mechanical seal.

The general purpose FPX pump is mounted on a close coupled-style flange support. The FPX series is only available with a single mechanical seal.

There are two general styles of pump heads in “F” type Fristam pumps. The 700 and 1700 series are non-volute style pumps. The 1050, 1150, 3400, 3500 and 4000 series are volute style. In general, maintenance procedures for both series are the same. Any variations will be clearly noted.

The motors used on both the FP and FPX pumps are standard NEMA totally enclosed fan cooled (TEFC) motors. They are C-face and have a locked front bearing. These motors do not require feet. Replacement motors are readily available from local motor distributors.

CAUTION: Begin all pump maintenance operations by disconnecting the energy source to the pump. Observe all lock out/tag out procedures as outlined by ANSI Z244.1-1982 and OSHA 1910.147 to prevent accidental start-up and injury.
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TECHNICAL INFORMATION

SPECIFICATIONS

Maximum Inlet Pressure .................................................................................................................... 150 PSI
Temperature Range .................................................................................................................. -40°F - 400°F
Noise Level ................................................................................................................................. 60 - 85 dB(A)

MATERIALS OF CONSTRUCTION

Primary Product Contact Components ......................................................................................... AISI 316L
Cover Gasket ........................................................................................................................ BUNA (standard)
Also available in others available upon request
Surface Finish for Product Contact Surfaces .......................................................... 32 Ra (standard) - other finishes available

SHAFT SEALS

FP Mechanical Seal Type ............................................................................................................. Single or Double Internal
Seal Flush Water Pressure (double seal only) .............................................................................. 5 Max. PSI
Seal Water Consumption (double seal only) ................................................................................ 1-2 gph
FPX Mechanical Seal Type ................................................................................................ Single Internal
Stationary Seal Ring Material ........................................................................................... Carbon (standard)
Also available in Silicone Carbide
Rotating Seal Ring Material .................................................. Chrome Oxide coated Stainless Steel
Also available in Silicon Carbide
O-ring Material ..................................................................................................................... Viton (standard)
Also available in others available upon request

RECOMMENDED TORQUE VALUES

<table>
<thead>
<tr>
<th>Component</th>
<th>Torque Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impeller nut</td>
<td>40 ft. lb.</td>
</tr>
<tr>
<td>Housing clamping bolt</td>
<td>55 ft. lb.</td>
</tr>
<tr>
<td>Motor bolts</td>
<td>20 ft.-lb.</td>
</tr>
<tr>
<td>(for 56C - 145TC motor frames)</td>
<td></td>
</tr>
<tr>
<td>Motor bolts</td>
<td>55 ft.-lb.</td>
</tr>
<tr>
<td>(for 182TC - 256TC motor frames)</td>
<td></td>
</tr>
<tr>
<td>Seal retaining ring bolts</td>
<td>4.5 ft. lb.</td>
</tr>
<tr>
<td>Shaft collar screw</td>
<td>6 ft.-lb.</td>
</tr>
<tr>
<td>(for 56TC - 184 TC motor frames)</td>
<td></td>
</tr>
<tr>
<td>Shaft collar screw</td>
<td>15 ft.-lb.</td>
</tr>
<tr>
<td>(for 213TC - 256TC motor frames)</td>
<td></td>
</tr>
</tbody>
</table>

MOTOR INFORMATION

Uses standard NEMA TEFC C-face motors. Options include washdown, high efficiency, explosion proof, chemical duty and IEC. The TIR of the motor shaft should be 0.002” or less.

VOLTAGE AND FREQUENCY

<table>
<thead>
<tr>
<th>Voltage and Frequency</th>
<th>RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 phase, 60 Hz, 208-230/460 VAC</td>
<td>1750/3500 RPM</td>
</tr>
<tr>
<td>3 phase, 60 Hz, 575 VAC</td>
<td>1750/3500 RPM</td>
</tr>
<tr>
<td>3 phase, 50 Hz, 208-220/380-415 VAC</td>
<td>1450/2900 RPM</td>
</tr>
</tbody>
</table>
**Recommended Preventive Maintenance**

**Recommended Seal Maintenance**

Visually inspect mechanical seal daily for leakage.
Replace mechanical seal annually under normal duty.
Replace mechanical seal as often as required under heavy duty.

**Elastomer Inspection**

Inspect all elastomers when performing pump maintenance. We recommend replacing elastomers (o-rings and gaskets) during seal, pump shaft and/or motor replacement.

**Motor Lubrication Recommendations**

Use a high grade ball and roller bearing grease. Recommendations for standard service conditions include *Shell Dolium R* or *Chevron SRI*. (See Tables 1-3 for more details.)

*Table 1: Motor Lubrication Intervals for Standard Conditions*

<table>
<thead>
<tr>
<th>NEMA/(IEC) Frame Size</th>
<th>Rated Speed - RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 210 incl. (132 IEC)</td>
<td>5,500 hrs. 12,000 hrs.</td>
</tr>
<tr>
<td>Over 210 to 280 incl. (180 IEC)</td>
<td>3,600 hrs. 9,500 hrs.</td>
</tr>
</tbody>
</table>

For severe service conditions, multiply interval hours by .5
For extreme service conditions, multiply interval hours by .1

*Table 2: Service Condition Definitions*

<table>
<thead>
<tr>
<th>Service Conditions</th>
<th>Maximum Abient Temperature</th>
<th>Atmospheric Contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>104°F (40°C)</td>
<td>Clean, little corrosion</td>
</tr>
<tr>
<td>Severe</td>
<td>122°F (50°C)</td>
<td>Moderate dirt, corrosion</td>
</tr>
<tr>
<td>Extreme</td>
<td>&gt;122°F (&gt;50°C)</td>
<td>Severe, dirt abrasive dust, corrosion</td>
</tr>
</tbody>
</table>

*Table 3: Volume of Grease to be Added per Bearing*

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>Grease Volume</th>
<th>Volume TSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEMA/(IEC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 210 incl. (132 IEC)</td>
<td>0.6</td>
<td>2.0</td>
</tr>
<tr>
<td>Over 210 to 280 incl. (180 IEC)</td>
<td>1.2</td>
<td>3.9</td>
</tr>
</tbody>
</table>
**SEAL REPLACEMENT (633 & 735 SEAL SIZES)**

Begin all pump maintenance by disconnecting the energy source to the pump. Observe all lock out/tag out procedures as outlines by ANSI Z244.1-1982 and OSHA 1910.147 to prevent accidental start-up and injury.

**TOOLS FOR SEAL REPLACEMENT**

- 15/16” socket
- Two 3/4” wrenches
- 7/16” wrench
- 3/32” Allen wrench
- 3/8” diameter steel rod
- Pliers (channel locks)
- Screwdriver (flat blade)
- Soft-faced hammer (5lb. dead-blow)
- Food grade lubricant
- Optional tool: One pair of impeller pullers (can be purchased through Fristam)

**PUMP HEAD DISASSEMBLY**

*Note: the reference numbers listed in the text (#) refer to the assembly drawing on pages 18-19.*

**WARNING** Disconnect the suction and discharge piping from the pump. Drain all fluid from the pump prior to disassembly.

a) Loosen the cover nuts (26) with the soft-faced hammer and remove.

b) Remove the pump cover (24) and the cover gasket (21).

c) Remove the seal water pipes (on pumps with a double mechanical seal or water cascade option) by turning them counter-clockwise with the pliers.

d) Loosen and remove the guard screw (3). Next remove the shaft guard (35).

e) Place the 3/8” diameter rod in the pump shaft hole. Allow the rod to rest against the pump flange support (2) to prevent the shaft from rotating while loosening the impeller nut (23) with the 15/16” socket wrench (*Figure 7*). Remove the impeller nut and the impeller nut gasket (25).

f) Remove the impeller (22) from the pump shaft (7) by grasping an impeller blade in each hand and pulling the impeller toward you. If the impeller is difficult to pull off the shaft, wedge the impeller pullers between the pump housing (10) and the back of the impeller and pry off the impeller (*Figure 8*).
g) Compress the seal spring (34) by pushing on the front seal driver (36) and lift out the impeller key (8) (Figure 9). (You may find it easier to rotate the keyway to bottom of the shaft, compress the seal spring, and let the key drop out.)

h) Next remove the front seal driver and seal spring by pulling them off the pump shaft and discard them.

i) Remove the rotating seal, seal washer and o-ring by gently placing the flat ends of two impeller pullers on either side of the rotating seal and carefully pull (wiggling the seal ring side-to-side should aid removal) until the rotating seal face comes off the shaft (Figure 10). Discard the seal components after you remove them.

j) Loosen the housing clamping bolt with the two 3/4” wrenches until it is loose in the flange support. (Note: the clamping bolt does not have to be removed.) Now slide the pump housing off the end of the pump shaft. If the pump housing does not come out of the flange support easily, widen the flange support by driving a screwdriver into the slot on top (Figure 11).

k) Place the pump housing face down on the housing studs.

l) Loosen the retaining ring bolts with the 7/16” wrench and remove them from the hub of the pump housing.

m) Remove the retaining ring.

n) Place a finger through the stationary seal, pull it out of the seal cavity and discard. If the stationary seal has been in the pump for an extended period, it may be necessary to softly tap it out from the opposite end using a rubber mallet. If you have a Silicon Carbide Stationary Seal design - two pieces will be removed.

o) Check for the flat gasket in the bottom of the seal cavity. Remove this gasket, discard and clean the seal cavity if necessary.

**ADDITIONAL DISASSEMBLY FOR DOUBLE MECHANICAL SEALS ONLY (FP SERIES ONLY)**

To remove the rear seal components (only pumps with double seal), carefully slide the rear rotating seal, seal washer, the seal o-ring off the pump shaft and discard. Use the 3/32” Allen wrench to remove the rear seal driver and spring off the pump shaft and discard.
NOTE: when installing the new seal components make sure that you use all of the components supplied with the replacement seal kit. Using some of the old components may reduce seal life.

For double mechanical seals only (FP Series only), first install the rear seal components. Note: this includes the seal washer, the seal o-ring, the rear rotating seal and the rear seal driver and spring.

You are now ready to install the stationary seal into the pump.

a) To install the stationary seal into the hub of the pump housing, place the pump housing on a clean surface with the hub side up. Inspect the hub area to ensure that it is clean.

b) Place the flat gasket into the hub of the pump housing. Make sure that it is all the way to the bottom and is seated evenly.

c) Install the stationary seal into the housing hub with the smaller face entering the hub first.

For the Silicon Carbide Stationary Seal design (Figures 18 and 21) - install the front half of the stationary seal into the housing hub with the smaller face side first. Then install the rear half of the stationary seal.

d) Install the stationary seal o-ring (do not lubricate this o-ring) onto the back of the stationary seal. Improper fit may cause leakage or seal damage.

e) Place the retaining ring on the housing hub, aligning the holes in the retaining ring with the holes in the hub.

f) Thread the four retaining ring bolts through the holes in the stationary seal retaining ring and into the housing hub. Alternately tighten the bolts so the retaining ring secures evenly. Uneven tightening could result in seal damage. Check for proper torque on page 5.

g) Carefully slide the pump housing over the pump shaft and back against the flange support. The stationary seal may be damaged if it makes hard contact with the pump shaft. If the pump housing does not slide into the flange support easily, widen the flange support by driving a screwdriver into the slot on top (Figure 13). Slide the pump housing all the way into the flange support until the shoulder of the housing is against the flange support. Remove the screwdriver. If the pump has a double mechanical seal or water cascade option, make sure that the water pipe holes in the pump housing are aligned with the holes in the flange support.

h) Install the seal water pipes (for double mechanical seals or water cascade option), by threading them into the housing and tighten with the pliers.

i) You are now ready to install the rotating seal assembly.

First lubricate the seal o-ring with a food grade lubricant (unless the o-ring material is EPDM, then only water should be used for lubrication). Place the seal o-ring inside the rotating seal.

j) Now place the seal washer into the rotating seal.
k) Next install the one end of the seal spring into the rotating seal making sure that the tab of the spring is in the slot on the rotating seal.

l) Finally, install the tab on the other end of the seal spring into the hole on the front seal driver (Figure 14). The rotating seal assembly is now ready to be installed onto the pump shaft. (Note: for pumps with a 735 seal, the larger end of the seal spring goes into the rotating seal.)

m) Rotate the pump shaft so the keyway is on top. Now slide the rotating seal assembly which includes: the rotating seal, the seal o-ring, the seal washer, the seal spring and the seal driver onto the pump shaft.

n) Lubricate the outside o-ring with a food grade lubricant, if it is not EPDM, and install it in the groove on the front of the seal spring and driver assembly.

o) Compress the spring assembly with two fingers and install the impeller key into the keyway on the pump shaft (Figure 15).

p) Slide the impeller onto the pump shaft. The slot in the impeller hub will slide over the impeller key.

q) Generously lubricate the new impeller nut gasket with a food grade lubricant (if it is not EPDM) and place it onto the impeller nut.

r) Thread the impeller nut with the gasket in place onto the pump shaft.

s) Place the 5/16" diameter rod in the pump shaft hole. Allow the rod to rest against the pump flange support to keep the shaft from rotating while tightening the impeller nut with the 15/16" socket wrench (Figure 16). Tighten to the proper torque listed on page 5.

t) Now install the new cover gasket onto the pump cover. When placing the cover gasket into the pump cover, gently stretch the gasket into position. Do not roll the gasket into position. With the cover gasket in position, place the pump cover onto the front of the pump. (Note: the pump serial number is embossed into the ‘top’ of the pump cover.)

u) Thread the cover nuts onto the housing studs. Make sure the cover o-ring is properly seated in the cover to ensure that it will not get pinched when tightening the cover nuts. Tighten the cover nuts by tapping on them with the soft-faced hammer.

v) Now rotate the pump shaft to make sure that the impeller moves freely. If it does not, recheck your assembly to make sure that gaskets are not pinched and everything is seated properly.
Listen to the pump as you turn the shaft. A small amount of noise from the seals is normal, but if there is metal-to-metal contact, the sound will be noticeable. If there is metal-to-metal contact, check the impeller gap. Regap the impeller if necessary. See page 16 for directions. Replace the shaft guard and secure with the guard screws.

Reconnect the suction and discharge piping.

**WARNING:** Mechanical seals must never run dry, even momentarily. Seal damage will result.

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*Figure 17: Single Seal Assembly with optional water cascade (seal sizes 633 & 735)*

![Diagram of Single Seal Assembly with optional water cascade](image-url)
Figure 18: Single Silicon Carbide Stationary Seal Assembly (seal sizes 633 & 735)

DESCRIPTION

- IMPELLER NUT GASKET (25)
- OUTSIDE SEAL DRIVER O-RING (37)
- FRONT SEAL DRIVER (36)
- INSIDE SEAL DRIVER O-RING (35)
- SEAL SPRING (34)
- ROTATING SEAL WASHER (13)
- ROTATING SEAL O-RING (14)
- ROTATING SEAL (33)
- FLAT GASKET (20)
- STATIONARY SEAL - FRONT HALF (19a)
- STATIONARY SEAL - REAR HALF (19b)
- STATIONARY SEAL O-RING (18)
Figure 19: Tapered Single Seal Assembly (seal sizes 633 & 735)

**DESCRIPTION**

- **25** ImPELLer NUT Gasket
- **37** OUTSIDE SEAL DRIVER O-RING
- **36** FRONT SEAL DRIVER
- **35** INSIDE SEAL DRIVER O-RING
- **34** SEAL SPRING
- **13** ROTATING SEAL WASHER
- **14** ROTATING SEAL O-RING
- **33** ROTATING SEAL
- **20** FLAT GASKET
- **19** TAPERED STATIONARY SEAL
- **18** STATIONARY SEAL O-RING
Figure 20: Double Seal Assembly (FP seal sizes 633 & 735)

DESCRIPTION

25 IMPELLER NUT GASKET
37 OUTSIDE SEAL DRIVER O-RING
36 FRONT SEAL DRIVER
35 INSIDE SEAL DRIVER O-RING
34 FRONT SEAL SPRING
13 ROTATING SEAL WASHER
14 ROTATING SEAL O-RING
33 FRONT ROTATING SEAL
20 FLAT GASKET
19 STATIONARY SEAL
18 STATIONARY SEAL O-RING
15 REAR ROTATING SEAL
12 REAR SEAL DRIVER & SPRING
Figure 21: Double Silicon Carbide Stationary Seal Assembly (FP seal sizes 633 & 735)
PUMP SHAFT AND/OR MOTOR REPLACEMENT

Begin all pump maintenance by disconnecting the energy source to the pump. Observe all lock out/tag out procedures as outlined by ANSI Z244.1-1982 and OSHA 1910.147 to prevent accidental start-up and injury.

TOOLS FOR PUMP SHAFT AND/OR MOTOR REPLACEMENT:

One 9/16” wrench (for 56C - 145TC motor frames)
One 3/4” wrench (for 182TC or 215TC motor frames)
Soft-faced hammer
One set of feeler gauges
3/16” Allen wrench socket (for 56C – 180TC shaft collars)
1/4” Allen wrench socket (for 210TC – 250TC shaft collars)
5/16” Allen wrench socket (for 280TC – 360TSC shaft collars)

PUMP DISASSEMBLY

Disassemble the pump as described on pages 6-7.

a) Loosen the shaft collar screw on the shaft collar with the 3/16” or 1/4” or 5/16” Allen wrench (depending on the motor frame size, see above).
b) Pull the pump shaft off the motor shaft. If necessary, rotate the pump shaft and tap with the soft-faced mallet to loosen the pump shaft from the motor shaft.

If the pump shaft does not pull off the motor shaft, the pump housing and impeller can be reinstalled to aid in removal (Figure 22). To do this, first ensure that the stationary seal is not in the pump housing. Next install the pump housing onto the flange support. DO NOT TIGHTEN THE FLANGE CLAMPING BOLT. Install the impeller onto the pump shaft and place a clean cloth or brass shim between the impeller and pump housing to prevent the impeller from scratching the pump housing during the shaft removal process. Thread the impeller nut and impeller nut gasket onto the shaft and tighten by hand. Now pull on the pump housing to loosen the pump shaft from the motor shaft. Tapping on the back of the pump housing with the soft-faced mallet may be required.

![Figure 22]
**ADDITIONAL INSTRUCTIONS FOR MOTOR REPLACEMENT**

Loosen the four motor bolts (28) and remove the motor bolts and lock washers. (Use the 9/16” wrench for 56C – 145TC motor frames and 3/4” wrench for 182TC - 256TC motor frames.)

Remove the flange support from the motor. Take care to support the weight of the motor as you remove the flange support. Stand the motor on the fan guard if possible.

**ASSEMBLING THE MOTOR TO THE FLANGE SUPPORT**

If you have replaced the motor, clean off the motor face of the flange support. Place the flange support onto the new motor and replace the motor bolts and lock washers. Tighten the motor bolts to the torque indicated on page 5.

**ASSEMBLING THE PUMP SHAFT ONTO THE MOTOR SHAFT**

Note: when replacing the shaft, replace the shaft collar at the same time.

a) Slide the new shaft collar onto the pump shaft, do not tighten the shaft collar screw at this time.
   Note: align the slot of the clamping ring directly over the slot on the shaft.

b) Slide the pump shaft and shaft collar onto the motor shaft with the hole in the pump shaft aligned with the key in the motor shaft.

c) Tighten the shaft collar screw (*Figure 23*).

**SETTING THE IMPELLER GAP**

If you have removed the pump shaft from the motor shaft for any reason (such as replacing the shaft or motor), you must re-set the gap.

The gap is measured between the impeller and pump housing using feeler gauges. (Note: Due to polishing and balancing the impeller, the gap behind each impeller blade may vary. The gap should be checked behind each blade and the smallest value should be used as your gap setting.) The correct gap dimensions are listed on page 5.

a) Assemble the pump housing (without the stationary seal) onto the flange support. Make sure that the shoulder of the pump housing bottoms out against the flange support.

b) Tighten the clamping bolt in the flange support. Note: make sure the housing is level or in line with the piping.

c) Place the front seal driver (*Figure 24*) onto the pump shaft.

d) Place the impeller key and impeller onto the shaft. Thread the impeller nut onto the shaft and tighten.

e) Check the gap by placing the correct feeler gauge (see chart) behind each blade of the impeller.
f) *Align the slot of the shaft collar (6) directly over one of the slots on the shaft (Figure 26).*

g) Using a soft-faced hammer, tap on the front of the impeller nut (*Figure 25*) until the impeller is snug against the feeler gauge.

h) Tighten the shaft collar screw in the shaft collar (6) to the proper torque, see page 5 (*Figure 26*).

i) Remove the feeler gauge.

Check the gap behind each blade of the impeller to see if the gap on each blade is correct, see the chart on the previous page for correct gap. Check to be sure that the pump shaft assembly is tight enough. Using a soft-faced mallet, tap sharply several times on the impeller nut. Using a feeler gauge, check to see that the gap has not changed. If the gap has changed, reset the gap and check it again.

Now remove the impeller nut, impeller, impeller key, front seal driver and pump housing. You are ready to check the run-out of the pump shaft.

If the gap does not fall within tolerance, call Fristam Pumps.

Now you are ready to assemble the pump head as described on pages 8-10.
**Figure 29: FP & FPX Single Flange Assembly**

1. Motor
2. Flange Support
3. Guard Nut
4. Shaft Guard
5. Shaft Collar Screw
6. Shaft Collar
7. Pump Shaft
8. Impeller Key
9. Pump Housing
10. Set Screws
11. Rear Seal Driver and Spring
12. Rotating Seal Washer
13. Rotating Seal O-ring
14. Rear Rotating Seal
15. Retaining Ring Bolts
16. Retaining Ring
17. Stationary Seal O-ring
18. Stationary Seal
19. Stationary Seal
20. Flat Gasket
21. Cover Gasket
22. Impeller
23. Impeller Nut
24. Pump Cover
25. Impeller Nut Gasket
26. Cover Nuts
27. Lock Washer
28. Motor Mounting Bolts
29. Water Piping (optional)
30. Front Rotating Seal
31. Seal Spring
35. Inside Seal Driver O-ring (factory installed)
36. Front Seal Driver
37. Outside Seal Driver O-ring
38. Housing studs
39. Clamping Bolt
40. Clamping Bolt Nut
INSTALLATION

UNPACKING
Check the contents and all wrapping when unpacking the pump. Inspect the pump carefully for any damage that may have occurred during shipping. Immediately report any damage to the carrier. Remove the shaft guard and rotate the pump shaft by hand to make sure the impeller rotates freely. Keep the protective caps over the pump inlet and outlet in place until you are ready to install the pump.

INSTALLING
Prior to actually installing the pump, ensure that:

- the pump will be readily accessible for maintenance, inspection and cleaning.
- adequate ventilation is provided for motor cooling.
- the drive and motor type is suitable for the environment where it is to be operated. Pumps intended for use in hazardous environments e.g., explosive, corrosive, etc., must use a motor and drive with the appropriate enclosure characteristics. Failure to use an appropriate motor type may result in serious damage and/or injury.

PIPING GUIDELINES
This section describes good piping practices to obtain maximum efficiency and service life from your pump.

Maximum performance and trouble-free operation require adherence to good piping practices.

- Ensuring proper piping support and alignment at both the suction inlet and discharge outlet can help prevent serious damage to the pump housing (Figure 1).
- Avoid abrupt transitions in the piping system (Figure 2).
- Avoid throttling valves in the suction piping.
- Keep suction lines as short and direct as possible.
- Ensure that the NPSH available in the system is greater than NPSH required by the pump.
- Avoid sump areas where sediments may collect (Figure 3).
- Avoid the formation of air pockets in the piping (Figure 4).

- Avoid abrupt closure of shut-off valves, this may cause hydraulic shock which can cause severe damage to the pump and system.

- Avoid elbows in the suction line if possible. When necessary they should be located 5 pipe diameters away from the pump inlet, and have a bend radius greater than 2 pipe diameters (Figure 5).

- Check valves in discharge line should be a minimum of 5 ft. away from the pump outlet (Figure 5).

**ELECTRICAL INSTALLATION**

We use standard duty TEFC motors unless otherwise specified. Many motor options are available: wash-down, flameproof, explosion proof, hostile duty or chemical duty.

The motor selected should meet the requirements of the specified operating conditions. A change in conditions (for example, higher viscosity, higher specific gravity, lower head losses) can overload the motor. When changing operating conditions or whenever there is any doubt, please contact Fristam Pumps, Inc., for technical assistance.

Have an electrician connect the motor using sound electrical practices. Provide adequate protection. Pumps fitted with mechanical seals must not run dry, not even momentarily. *Determine the direction of rotation by watching the motor fan, which must turn clockwise.*

**PUMP OPERATIONS**

**START-UP INSTRUCTIONS**

- Remove any foreign matter that may have entered the pump.

- Turn shaft by hand to make sure seals do not stick together otherwise, if motor is bumped in wrong direction it may unwind the seal spring.

- Do not use the pump to flush the system!

Check pump for proper rotation as indicated on the pump. *Proper motor direction is clockwise when looking at the fan end of the motor.* (NOTE: When checking the direction of rotation, the pump must be full of liquid.)

- Never run the pump dry, even momentarily. Seal damage can result.
**SHUT-DOWN INSTRUCTIONS**

- Shut off the power supply to the pump.
- Close the shut-off valves in the suction and discharge piping.
- Drain and clean the pump.
- Protect the pump against dust, heat, moisture and impact damage.

**INSTALLATION OF WATER FLUSH FOR DOUBLE MECHANICAL SEAL**

Set up the water flush for the double mechanical seal as shown (Figure 6). Use only between 1-2 gallons per hour of water at a maximum pressure of 5 PSI. Excessive flow of water through the seal increases the pressure inside the seal. **Note:** maximum pressure inside the seal is 5 PSI. Excessive flow/pressure through the seal flush will cause excessive wear and shorten seal life.

Pipe the exit side of the water flush with 2-5 feet physical height of tubing. This ensures that some water is always in the center seal and the seal never runs dry.

It is possible to inject steam through the center seal (within the pressure requirements). We do not recommend using steam alone for the cooling/lubricating of the seal.

It is desirable to have the flush water on the outlet side visible. This allows an easy check to see that the flush water is on and also if the seal is functioning properly. In a malfunctioning seal the flush water will disappear, become discolored, or show an unusual increase in flow. If these conditions exist, check the seal and replace if necessary.

**INSTALLATION OF WATER CASCADE**

The water cascade (if supplied) is piped through the hub of the pump housing and into the stationary seal. Since there is no rear seal, the flush water will exit through the rear of the seal area (Figure 6a).

Not all FPX pumps require a water cascade on the seal.

Use about 1-2 gallons per hour of water at a maximum pressure inside the seal of 5 psi.
**Troubleshooting**

Fristam pumps are relatively maintenance free, however, in the event that a problem does arise, the troubleshooting chart below should help you with most of your pump related problems. If a motor problem arises please contact your local motor repair representative.

This troubleshooting chart has been prepared assuming that the pump installed is suitable for the application. Symptoms of cavitation can result when a pump is not properly applied. Examples of these symptoms are noisy operation, insufficient discharge, and vibration. If these conditions are present, check the system and re-evaluate the application. If you need assistance, contact Fristam Pumps at 1-800-841-5001 or 608-831-5001.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause of Trouble</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump does not deliver liquid</td>
<td>1, 2, 3, 4, 6, 14, 16, 17, 22, 23, 40</td>
</tr>
<tr>
<td>Not enough capacity delivered</td>
<td>2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 16, 17, 20, 22, 23, 27, 28, 40</td>
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<tr>
<td>Not enough pressure developed</td>
<td>5, 6, 7, 8, 14, 16, 17, 20, 22, 27, 28, 40</td>
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<tr>
<td>Pump loses prime after starting</td>
<td>2, 3, 5, 6, 7, 8</td>
</tr>
<tr>
<td>Pump requires too much power</td>
<td>15, 17, 18, 19, 20, 23, 24, 25, 26, 27, 30, 31, 34</td>
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<tr>
<td>Seal leaks</td>
<td>13, 25, 30, 31, 32, 36</td>
</tr>
<tr>
<td>Seal has short life</td>
<td>11, 12, 13, 25, 27, 30, 31, 32, 33, 34, 35, 36</td>
</tr>
<tr>
<td>Pump vibrates or is noisy</td>
<td>2, 3, 4, 9, 10, 21, 23, 24, 25, 26, 27, 28, 33, 34, 35, 37, 38, 39, 40</td>
</tr>
<tr>
<td>Motor bearings have short life</td>
<td>25, 26, 27, 33, 34, 35, 37, 38, 39</td>
</tr>
<tr>
<td>Pump overheats and seize</td>
<td>1, 4, 21, 22, 26, 27, 33, 34, 35, 37, 38, 39, 40</td>
</tr>
<tr>
<td>Pump leaks from cover</td>
<td>29</td>
</tr>
</tbody>
</table>
**Suction Problems**

1. Pump not primed
2. Pump or suction pipe not completely filled with liquid
3. Suction lift too high
4. Insufficient difference between suction pressure and vapor pressure (cavitation)
5. Too much air or gas in liquid
6. Air pocket in suction line
7. Air leaks into suction line
8. Air leaks into pump through seal
9. Foot valve too small
10. Foot valve partially clogged
11. Seal flush water not on
12. Water seal pipe plugged
13. Seal water flush pressure too high

**Possible Solutions**

1a) Adjust piping so that pump is flooded
1b) Install a foot valve to keep liquid in the pump
2. Adjust piping so that suction pipe is filled with liquid
3. Raise the level of the liquid, lower the level of the pump
4. Use larger pipe on the inlet side of the pump, raise the level of liquid above the pump center line, lower the temperature of the liquid, eliminate fittings in suction line if possible, check inlet pipe for obstructions
5. Install air relief valve, turn pump head so discharge is at 45 degree angle
6. Adjust pipe to eliminate pocket
7. Find and fix air leak
8. Check seal for proper installation, replace seal if defective
9. Replace with larger foot valve
10. Clear obstruction from foot valve
11. Turn on water to seal flush
12. Clear obstruction from seal water pipe
13. Adjust water flow to seal flush to 1-2 gph at a maximum of 5 psi.

**Mechanical Problems**

14. Speed too low
15. Speed too high
16. Direction of rotation incorrect
17. Total head of system higher than design head of pump
18. Total head of system lower than pump design head
19. Specific gravity of liquid greater than expected
20. Viscosity of liquid greater than expected
21. Operation at very low capacity
22. Parallel operation of pumps unsuitable for such operation

14. Check electrical connections, consult motor manufacturer
15. Check electrical connections, consult motor manufacturer
16. On a three-phase motor, switch any two of the three leads
17. Check for restrictions in the pipe, use larger diameter pipe, use larger diameter impeller, check application with Fristam Pumps
18. Install throttling valve in line, use smaller diameter pipe, use smaller diameter impeller, check with Fristam Pumps.
19. Use larger motor, check application with Fristam Pumps.
20. Use larger motor, use larger diameter pipe, check application with Fristam Pumps.
21. Install throttling valve
22. Replace parallel pumps with a single larger pump
23. Foreign matter in impeller
24. Foundations not rigid
25. Shaft bent
26. Impeller rubbing on pump housing
27. Motor bearings worn
28. Impeller damage
29. Cover gasket defective permitting leakage
30. Shaft or shaft collar worn or scored
31. Seal improperly installed
32. Type of seal incorrect for operating conditions
33. Pump shaft running off center because of worn bearings or misalignment
34. Impeller out of balance causing vibration
35. Motor front bearing not locked
36. Dirt or grit in sealing liquid, leading to scoring of shaft or seal surface
37. Lack of lubrication in motor bearing
38. Improper installation of antifriction bearings (damage during assembly, incorrect assembly of stacked bearings, use of unmatched bearings as a pair, etc.)
39. Dirt in bearings
40. Piping is obstructed

23. Remove pump cover and clear foreign matter
24. Provide firmer foundation for the pump
25. Replace shaft
26. Re-establish gap of the impeller, replace impeller if defective, make sure impeller nut is tightened properly
27. Replace motor bearings
28. Replace impeller
29. Replace cover gasket
30. Replace cover gasket and/or collar
31. Install seal correctly, replace seal if defective
32. Replace seal with correct type of seal, check with your local representative
33. Check motor bearings and replace if defective
34. Balance the impeller
35. Contact motor manufacturer for locking shim or to replace motor with a motor with locked front bearing
36. Use clean source of water for seal flush
37. Lubricate motor bearings
38. Reinstall bearings correctly
39. Clean bearings, replace if defective
40. Remove obstruction in pipe, check for closed valve
## Pump Maintenance Record

<table>
<thead>
<tr>
<th>Date</th>
<th>Service Performed</th>
<th>By</th>
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<tbody>
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**Notice of Terms, Warranty Provisions Including Disclaimers, Claims and Limitation of Liability**

Prices and all terms and conditions of sale are established in current price sheets and are subject to change without notice. All orders are subject to acceptance by Fristam Pumps USA, Limited Partnership.

Each Fristam Pumps item is warranted to be free from manufacturing defects for a period of one (1) year from the date of shipment, providing it has been used as recommended and in accordance with recognized piping practice, and providing it has not been worn out due to severe service, such as encountered under extremely corrosive or abrasive conditions.

This warranty is expressly in lieu of any other warranties expressed or implied, including but not limited to, any implied warranty of merchantability or fitness for particular purpose. All other warranties whatsoever, expressed or implied by law or otherwise, are hereby excluded.

All claims must be in writing and must be mailed or delivered by purchaser within thirty (30) days after purchaser learns of the facts upon which such claim is based. Any claim not made in writing and within the time period specified above shall be deemed waived.

Purchaser’s sole and exclusive remedy and Fristam Pumps maximum liability for claims arising hereunder or for negligence for any and all losses and damages resulting from any cause shall be either the repair or replacement of defective items or, at Fristam Pumps’ option, the refund of the purchase price for such items. In no event, including in the case of a claim for negligence, shall Fristam Pumps be liable for incidental or consequential damages, including loss of profits.

No person, including any representative employee or agent of Fristam Pumps is authorized to assume on behalf of Fristam Pumps any liability or responsibility in addition to or different from that described in this provision. Any and all representations, promises, warranties or statements that are in addition to or different from the terms of this provision are of no force or effect.

If any provision of this Notice is held to be invalid, such provision shall be severed and the remaining provisions shall continue to be in force.