

**INSTRUCTION AND  
MAINTENANCE MANUAL:**



**FM-STYLE PUMP**



**SANITARY CENTRIFUGAL PUMPS**



## DESCRIPTION

This manual contains installation, operation, assembly, disassembly and repair instructions for the Fristam “FM” style multi-stage pump. Please read this manual in its entirety before operating the pump.

The FM multi-stage pump is mounted to a heavy duty cast iron bearing block. This bearing block is coupled to a motor and mounted on a solid stainless steel adjustable baseplate.

The motors used on “FM” style pumps are standard NEMA totally enclosed fan cooled (TEFC) motors. Replacement motors are readily available from local motor distributors. IEC motors are also available.

The open design of the impeller eases cleaning. The close clearance between the impeller and the housing and cover give efficiencies similar to closed impellers.

Fristam pumps have an internal mechanical seal which allows the product pumped to cool, lubricate, and clean the front seal. Fristam does not recommend running this pump without product.

 **DANGER: 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.**

**Serial Number** \_\_\_\_\_

**Model Number** \_\_\_\_\_

**Tag Number** \_\_\_\_\_

**Seal Replacement Kit Number** \_\_\_\_\_

**Date of Manufacture** \_\_\_\_\_

**Approved by** \_\_\_\_\_

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## TECHNICAL INFORMATION

### SPECIFICATIONS

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Maximum Inlet Pressure .....	1000 PSI
Temperature Range .....	13°F - 300°F
Noise Level .....	60 - 85 dB(A)

### MATERIALS

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Product Wetted Steel Parts .....	AISI 316L
Casing Gasket .....	Viton (standard)
Other O-rings & Gaskets .....	Viton
Finish .....	32 Ra (standard)

### SHAFT SEALS

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Seal Types .....	Double Internal
Maximum Water Pressure (flushed seal) .....	5 PSI of water
Water Consumption (flushed seal) .....	12 gph
Stationary Seal Ring Material .....	Silicon Carbide
Rotating Seal Ring Material .....	Silicon Carbide
o-ring Material .....	Viton (standard)
o-ring Alternate Materials .....	BUNA-N, EPDM

### MOTOR INFORMATION

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Uses standard NEMA rigid base motors. Options include washdown, high efficiency, premium efficiency, explosion proof, chemical duty and IEC.

#### **Voltage and Frequency**

3 phase, 50 Hz, 208-220/330-415 VAC .....	3000 RPM
3 phase, 60 Hz, 208-230/460 VAC .....	3500 RPM
3 phase, 60 Hz, 575 VAC .....	3500 RPM

#### **Available Motor Sizes (Horsepower)**

10, 15, 20, 25, 30, 40, 50, 60, 75

## RECOMMENDED PREVENTIVE MAINTENANCE

### RECOMMENDED TORQUE VALUES

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Cover nuts (Star Nuts)	100-120 ft.-lbs
Impeller nut	100-120 ft.-lbs
Seal retaining ring bolts	5 ft.-lbs

### RECOMMENDED SEAL MAINTENANCE

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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

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

### BEARING BLOCK OIL RECOMMENDATIONS

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Fristam bearing block design features special bearings in an oil bath. Keep oil levels at the **center** of the sight glass.

Oil Manufacturer:	BenzOil
Type Used:	Petraulic 46
Oil Change Frequency:	3 Months or 2000 Hours
Oil Type Recommended:	Generic: ISO VG46 Viscosity Grade 230 SUS @ 100°F*

\*A lubricant of identical quality and viscosity from a different lubricant manufacturer may also be used.

**Note:** All bearing blocks built after January 1997, are shipped without oil in the bearing block. Oil is shipped in separate containers, and must be poured into the bearing block before start up.

## INSTALLTION

### UNPACKING EQUIPMENT

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Check the contents and all wrapping when unpacking the pump. Inspect carefully for any damage that may have occurred during shipping. Immediately report any damage to the carrier. Leave the caps over the pump inlet and outlet in place until you are ready to install the pump.

### LOCATION AND INSTALLATION

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Locate the pump as close as possible to the liquid source. Locate it also in a position where the suction piping can be short and direct with a minimum number of bends and fittings. It should also be readily accessible for inspection and cleaning.

### DESCRIPTION

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The Fristam “FM” multi stage pump has operating characteristics similar to standard single impeller centrifugal pumps. The unit is NOT self-priming. It requires a flooded suction.

### MAXIMUM OPERATING CONDITIONS FOR FM SERIES PUMPS

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System Pressure:	1000 PSI (68 Bar)
Capacity:	330 gpm (75 m /Hr.)
Discharge Pressure:	275 psi (19 Bar)
Power:	75HP

## PIPING GUIDELINES

### GENERAL

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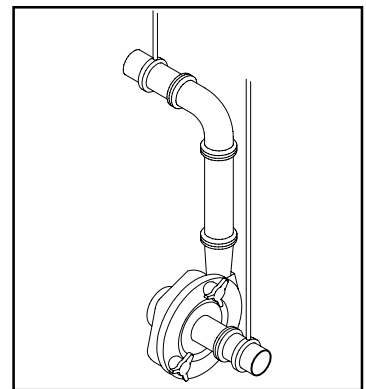
This section describes good piping practices to get maximum efficiency and service from your pump.

Support the piping independently at both the suction inlet and discharge outlet. Align the piping properly and do not put any strain on the pump casing (Figure 1).

### SUCTION PIPING

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The suction piping should be short and follow a direct route with a minimum number of elbows and fittings. Do not use elbows near the suction inlet. Friction will increase resulting in loss of NPSH. A minimum of the equivalent of the pipe diameter (inches) in feet of straight pipe should be between



*Figure 1: Support Piping At Suction And Discharge*

any elbow and the pump inlet (Figure 2). Example: A pipe diameter of 2-½ inches would require 2-½ feet of straight pipe between an elbow and the pump inlet. Excessive friction losses in the suction line could result in pump cavitation and poor performance. It could also cause excessive noise, vibration, damage to equipment, and possible damage to product.

Whenever practical, decrease the diameter of the piping to the suction inlet. Use an eccentric reducer instead of a straight concentric reducer to prevent air pockets from forming and impairing pump efficiency (Figure 3).

Horizontal suction pipe must have a gradual rise to the pump and must pass under other interfering piping (Figure 4). A high point in the suction line will form an air pocket and prevent proper pump operation. All joints in the suction line should be air tight to prevent air leakage which can reduce pump capacity and efficiency.

### DISCHARGE PIPING

Position of the pump discharge should be either vertical, top horizontal, or top 45°. The discharge piping should be short and direct with a minimum number of elbows and fittings. Do not use elbows at the discharge outlet since friction would increase, resulting in head loss.

It is also advisable to increase pipe diameter at the discharge outlet to lessen head loss. However, use of a larger discharge pipe than recommended will reduce total system head, and increase pump volume. This can cause pump vibration due to cavitation and possible damage to the motor due to overload. Use of a discharge pipe smaller than the pump discharge outlet increases total system head and decreases volume.

### LOCATING VALVES

In suction lift applications where lift is not very high, it may be desirable to install a foot valve. This will help priming and prevent draining the liquid back to the source.

Install a throttling valve in the discharge piping to provide a means of throttling pump volume.

Do not install a throttling valve in the suction pipe.

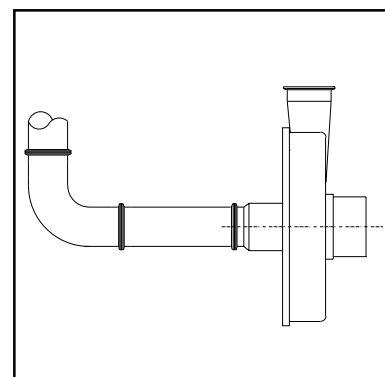


Figure 2: Allow Sufficient Distance Between Elbow and Suction Inlet

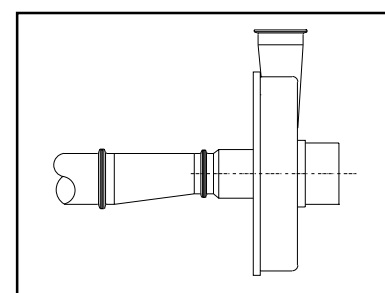


Figure 3: Use Eccentric Rather Than Concentric Reducer

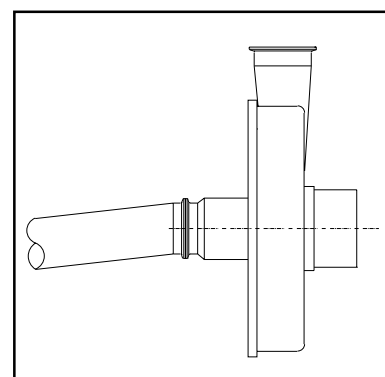


Figure 4: Suction Line Should Rise Gradually To Pump Inlet

## ELECTRICAL INSTALLATION

We use standard duty TEFC motors unless otherwise specified (for example, flameproof or explosion proof). Most are specially suitable for use in dairies, breweries, food and beverage processing plants, and in other locations where it is required to have protection against wet or damp conditions.

Have an electrician connect the motor using sound practice. Provide adequate protection.

**Please note: When checking the direction of rotation, the pump must be full of liquid. 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.**

The motor selected meets the requirements of the specified operating conditions. Changed 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 us with the full details.

We ship the pumps fully assembled.

## INSTALLATION OF SEAL FLUSH FOR DOUBLE MECHANICAL SEAL

Set up the seal flush for the double mechanical seal as shown (Figure 5). Excessive flow of water through the seal increases the pressure inside the seal. The maximum pressure inside the seal should not exceed 5 PSI. **Excessive flow/pressure through the seal flush will cause excessive wear and shorten seal life.** The seal flush should be 10-12 gph at 1-2 PSI.

A clean water flush is essential for correct operation of the seal.

Where temperatures are likely to fall below 0°C, use a mixture of one part glycerine to three parts water as a flushing media.

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 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.

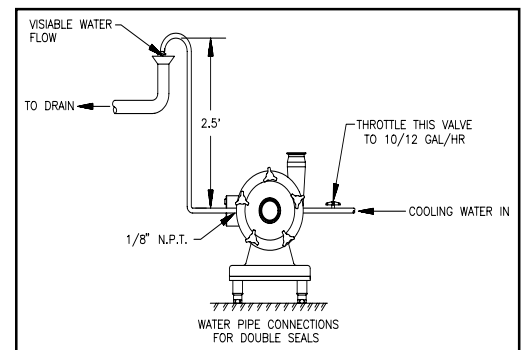


Figure 5: Water Flush For Double Seals

## START UP

Make sure pump duty is in accordance with pump rating on nameplate. Also, make sure that installed mechanical shaft seal is suitable for the product characteristics and temperature.

Check that pump and pipework are free of foreign materials, such as welding splatter. **DO NOT USE THE PUMP FOR FLUSHING THE SYSTEM.** Fill bearing block with oil, as directed on page 5, before starting the pump.

Take precautions to make sure that the discharge pressure presented to the pump does not fall to the point where it overloads the electric motor. Overload protection is recommended.

Install the electric motor in accordance with your country's electrical codes.

Make sure the direction of rotation is correct counter-clockwise as you face the inlet from the front. Incorrect rotation will damage the mechanical seal.

The mechanical shaft seal **must never run dry**. Even momentary pumping of motor to check rotation **must** be done with liquid in the pump.

## PUMP SHUT DOWN

Before shutting down the pump, drain the unit if there is any danger that the process fluid will harden, crystalize or freeze within the pump.

## SPARE PARTS

We back ALL FRISTAM pumps with a comprehensive, readily available spare parts stock. We recommend that you stock one set of gaskets and a mechanical seal for emergencies. In the event you need spare parts, please give your distributor the following information:

- 1) Pump model
- 2) Pump serial number

## SEAL 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.

### REQUIRED TOOLS

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- ◆ One pair of pliers or channel locks
- ◆ One set of feeler gauges
- ◆ One 7/16" wrench
- ◆ One 3/4" wrench
- ◆ One 15/16" socket wrench
- ◆ One set of impeller pullers (commonly available as tack pullers)
- ◆ One chain wrench
- ◆ Razor blade or knife blade
- ◆ 3/32" Allen wrench
- ◆ One 1" wrench
- ◆ Screwdriver

### PUMP HEAD DISASSEMBLY

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**Note:** the reference numbers listed in the text (#) refer to the assembly drawing on pages 12&13.



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

Loosen the cover nuts (2) with the 1" wrench. Remove the cover nuts, flat washers (3) (if supplied), cover (4) and cover gasket (6).

Loosen the four guard screws (51) securing the coupling guard (50) to the baseplate. Remove the coupling guard. While holding the chain wrench securely, turn the impeller nut (1) with the 15/16" socket wrench counter-clockwise until it threads off the pump shaft (34). Remove the impeller nut and impeller gasket (35).

#### SINGLE STAGE

For single stage pumps . . . the next step is to remove the impeller (10) and impeller key (11) from the pump shaft.

#### MULTI-STAGE

Or for multi-stage pumps . . . remove the impellers (7/10), diffusers (8), diffuser o-rings and impeller key (11). The impeller and the diffuser should be removed at the same time so that the diffuser does not drop onto the shaft (34). The number of impellers, diffusers and diffuser o-rings to remove will depend on the number of stages in your pump. Be careful not to damage the stage bushing (36) located in the diffuser when removing. Place the components in order as you remove them for ease of reassembly.

Remove the rotating seal assembly which includes: the impeller gasket (35), seal driver (37), rotating seal (39), seal spring (41) and rotating seal o-ring (38). To remove this assembly from the shaft, place the tack pullers on both sides of the assembly and pull toward the end of the pump shaft. Be careful not to drop this assembly as the seal face could be damaged.

Remove the o-ring and stainless gapping spacer (42) from the shaft (34). **IMPORTANT:** This gapping spacer is unique to this pump as it ensures the correct gap for the impellers as installed at the factory (Figure 8, page 15). **Do not discard.** If you are replacing the pump shaft on your FM pump, please contact the factory for proper gapping procedure.

To remove the stationary seal (44) and water seal (46), the pump housing needs to be removed from the bearing block. First remove the two water pipes (45) on either side of the pump housing using pliers or channel locks. Next remove the four pump housing bolts (13) and lock washers (12) which attach the pump housing (9) to the bearing block (24) using the 3/4" wrench. Carefully slide the pump housing off the end of the pump shaft, ensuring that the stationary seal (which is mounted inside the pump housing) does not contact the pump shaft. **Note: the stationary seal may be damaged if it makes hard contact with the pump shaft.**

Place the pump housing on its hub. Remove the stationary seal (44) by placing your fingers on the ID of the stationary seal and pulling it toward the front of the pump housing. The stationary seal o-ring (43) should come out with the stationary seal.

To remove the water seal, turn the housing over and place it on the housing studs. Remove the four retaining ring bolts (48) on the pump housing with the 7/16" wrench. Remove the retaining ring (47) and pry the water seal (46) out of the pump housing with the screwdriver.

Next clean off the water seal sleeve (16) on the pump shaft. Place a razor blade or knife blade on the water seal sleeve and rotate the pump shaft until all the rubber residue is removed. **Note:** Be careful not to scratch the water seal sleeve. The sleeve may also be cleaned up with water and a Scotch-Brite pad. If the water seal sleeve has significant wear, it can be moved so that the new water seal rides on a different spot on the sleeve.

To move the water seal sleeve, loosen the set screw (17) using the 3/32" Allen wrench. Move the water seal sleeve slightly (1/16"-1/8") on the pump shaft and re-tighten the set screw. If the water seal sleeve has significant wear it should be replaced along with the water seal o-ring (15) which is located inside the water seal sleeve.

Remove the seal driver o-ring (40) from the pump shaft. You are now ready to reassemble the pump head.

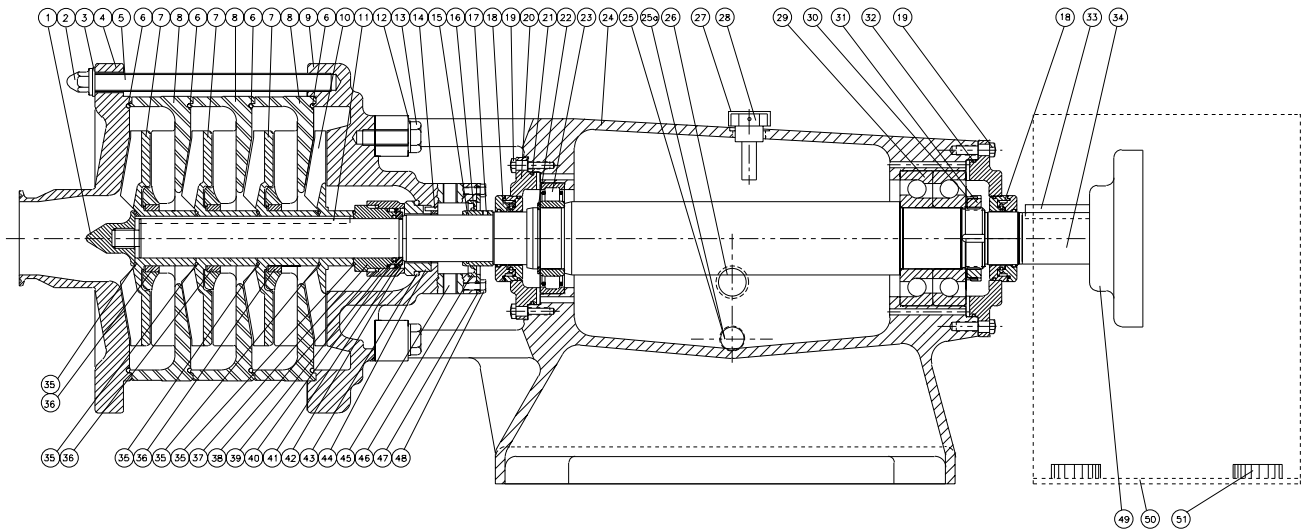
#### **PUMP HEAD ASSEMBLY**

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You are now ready to install the new seals into the pump (Figure 10, page 18). With the pump housing still sitting on the housing studs, carefully press the new water seal (46) into the pump housing. Replace the retaining ring (47) onto the hub of the pump housing and install the four retaining ring bolts (48). Tighten with the 7/16" wrench to 5 ft. lbs.

Next install the new stationary seal (44) and stationary seal o-ring (43) into the pump housing. Turn the pump housing over and place it on the retaining ring bolts (48). Generously lubricate the outside stationary seal o-ring with a food grade lubricant such as Haynes CIP lube and place it onto the stationary seal. Place the stationary seal and o-ring into the bottom of the pump housing. Align the notch in the stationary seal with the pin in the pump housing and press the stationary seal into the pump housing until it snaps into place.

You are now ready to install the pump housing (9). Carefully slide the pump housing over the pump shaft (34) and push it against the bearing block (24) ensuring that the stationary seal (which is mounted inside the pump housing) does not contact the pump shaft. **Note: the stationary seal may be damaged if it makes hard contact with the pump shaft.**



**FIGURE 6: FM MULTI-STAGE ASSEMBLY (4-STAGE ASSEMBLY)**

- |                             |                              |
|-----------------------------|------------------------------|
| 1. Impeller Nut             | 14. Pin                      |
| 2. Cover Nut                | 15. Water Seal o-ring        |
| 3. Flat Washer              | 16. Water Seal Sleeve        |
| 4. Pump Cover               | 17. Set Screw                |
| 5. Housing Stud             | 18. Labyrinth Seal           |
| 6. Cover Gasket             | 19. Bearing Cap Bolts        |
| 7. Impeller (w/backplate)   | 20. Front Bearing Cap        |
| 8. Diffuser                 | 21. Front Bearing Cap o-ring |
| 9. Pump Housing             | 22. Snap-Ring                |
| 10. Impeller (no backplate) | 23. Radial Bearing           |
| 11. Impeller Key            | 24. Bearing Block            |
| 12. Lock Washer             | 25. Drain Plug Nipple        |
| 13. Pump Housing Bolts      | 25-a. Drain Plug Cap         |

- |                             |                            |
|-----------------------------|----------------------------|
| 26. Sight Glass             | 39. Rotating Seal          |
| 27. Plastic Cap             | 40. Seal Driver o-ring     |
| 28. Breather Plug           | 41. Seal Spring            |
| 29. Thrust Bearings         | 42. Gapping Spacer         |
| 30. Bearing Lock Nut Washer | 43. Stationary Seal o-ring |
| 31. Bearing Lock Nut        | 44. Stationary Seal        |
| 32. Rear Bearing Cap o-ring | 45. Water Pipe             |
| 33. Coupling Key            | 46. Water Seal             |
| 34. Pump Shaft              | 47. Retaining Ring         |
| 35. Impeller Gasket         | 48. Retaining Ring Bolt    |
| 36. Stage Bushing           | 49. Coupling Flange        |
| 37. Seal Driver             | 50. Coupling Guard         |
| 38. Rotating Seal o-ring    | 51. Guard Screw            |

To reconnect the bearing block and pump housing install the four pump housing bolts (13) with lock washers (12). Tighten them with the 3/4" wrench to 50 ft-lbs.

Next install the gapping spacer (42) and the new o-ring. (**Note:** it is important, to use the same gapping spacer that was removed, as this is unique to your pump. The gap behind the impeller should be approximately 1.0 mm.) Lubricate the new o-ring with a food grade lubricant such as Haynes CIP lube and place it on the stainless gapping spacer. Slide the gapping spacer and o-ring on to the pump shaft (34).

Now install the new rotating seal assembly which includes: the impeller gasket (35), seal driver (37), rotating seal (39), seal spring (41) and rotating seal o-ring (38). First install the seal spring into the rotating seal between the pins and the front seal face. Next install the rotating seal o-ring into the rotating seal. Align the pins on the rotating seal with the grooves on the seal driver and press the two components together. Lubricate the impeller gasket (if it is not EPDM) with a food grade lubricant such as Haynes CIP-Lube and place it into the groove on the seal driver. Slide the rotating seal assembly onto the pump shaft so the face of the rotating seal meets the face of the stationary seal.

#### SINGLE STAGE

For single stage pumps . . . place the impeller key (11) into the shaft keyway and slide the impeller (10) onto the pump shaft.

#### MULTI-STAGE

For multi-stage pumps . . . replace the impeller without a backplate first (10), the additional impellers (7) diffusers (8), diffuser o-rings and impeller key (11). The impeller and the diffuser should be replaced at the same time so that the diffuser does not drop onto the shaft (34). The number of impellers, diffusers and diffuser o-rings to disassembly will depend on the number of stages in your pump. Be careful not to damage the stage bushing (36) located in the diffuser when replacing.

Locate the new impeller nut gasket and lubricate it (if it is not EPDM) with a food grade lubricant such as Haynes CIP-Lube and place it onto the impeller nut (1). Thread the impeller nut with gasket onto the pump shaft. Place the chain wrench on the pump shaft (34) near the coupling to keep the shaft from rotating while tightening the impeller nut with the 15/16" socket wrench. Tighten to 70-80 ft-lbs.

Place the new cover gasket (6) into the groove on the pump cover and install them onto the pump housing. Thread the cover nuts (2) and flat washers (3) onto the housing studs. Cross the cover nuts to approximately 100-120 ft lbs (Figure 7).

Remove the chain wrench and rotate the pump shaft to make sure that the impeller moves freely. If it does not, recheck your assembly to make sure that gaskets aren't pinched and everything is seated properly.

Replace the coupling guard and tighten the guard screws. Reconnect the suction and discharge piping.

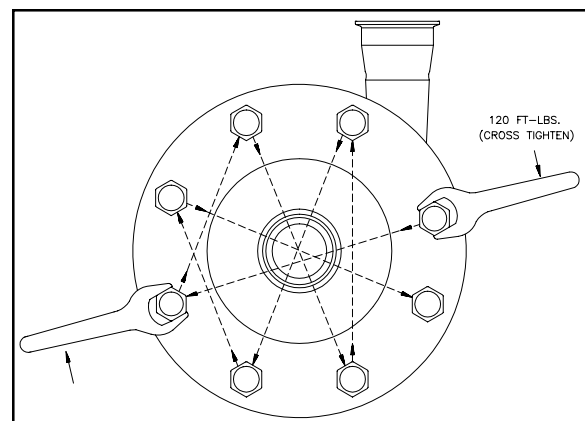


Figure 7: Tightening Of Cover nuts

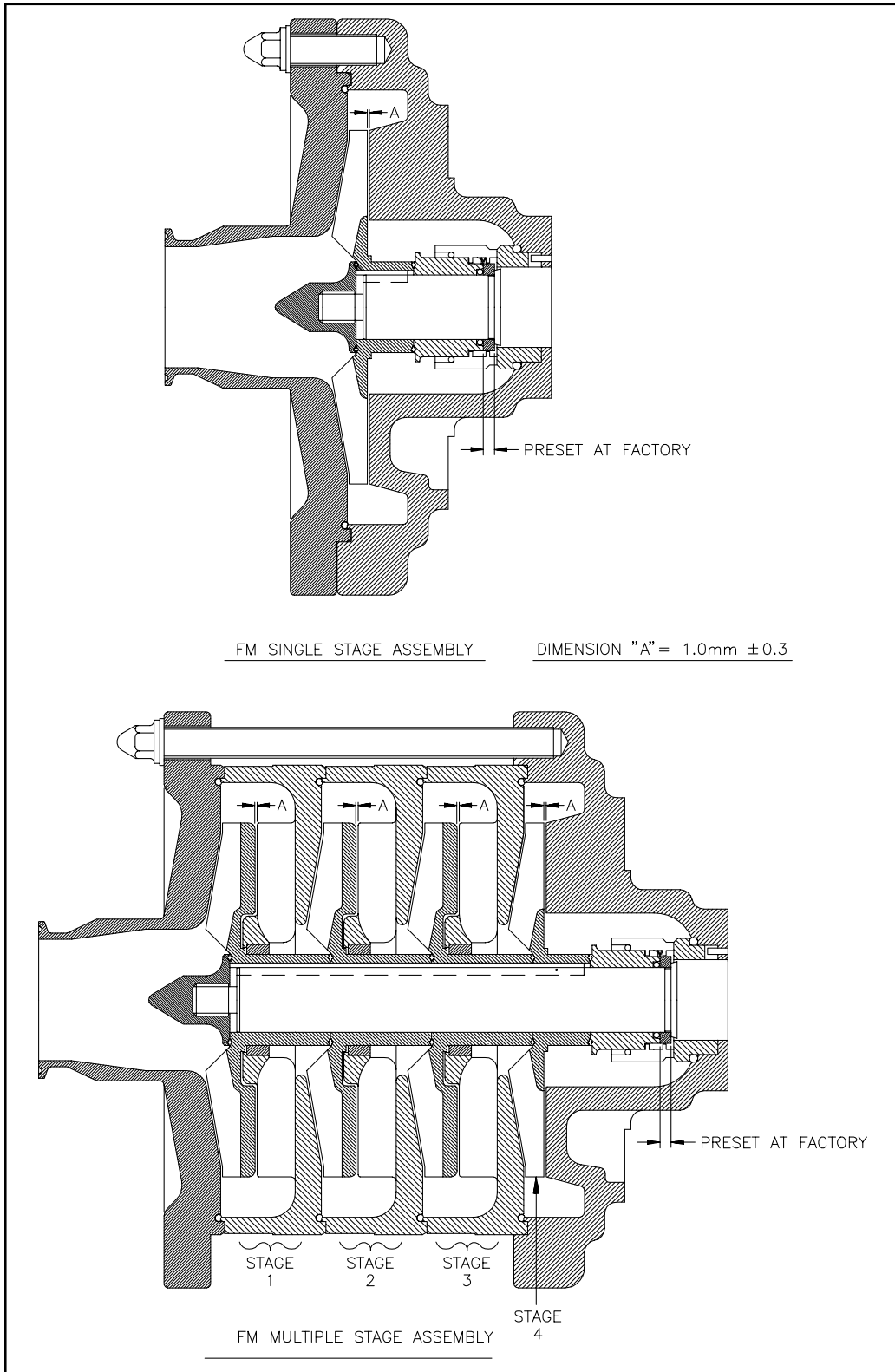


Figure 8: Gap Set At Factory

## SHAFT OR BEARING REPLACEMENT

### REQUIRED TOOLS

- ◆ One 1/2" wrench
- ◆ One 15/16" wrench
- ◆ Snap ring pliers
- ◆ One spanner wrench
- ◆ One pair of pliers or channel locks
- ◆ Shaft alignment tool
- ◆ One 3/32" Allen wrench
- ◆ One 3/16" Allen wrench
- ◆ One 5 lb. soft-faced hammer
- ◆ Screwdriver
- ◆ Shims

### BEARING BLOCK DISASSEMBLY

To replace the bearings or pump shaft in the bearing block first disassemble the pump head as described under pump head disassembly in the seal replacement section (pages 10-11).

Next drain the oil from the bearing block by removing the drain plug cap (25-a) with the pliers or channel locks. Unbolt the bearing block (24) from the baseplate by removing the bearing block mounting bolt with the 15/16" wrench. Slide the bearing block away from the motor and remove the rubber coupling sleeve. Loosen the set screws on the coupling flange (49) with the 3/16" Allen wrench and remove the coupling flange and coupling key (33) from the pump shaft.

If the water seal sleeve (16) is still on the pump shaft, remove it by loosening the set screw (17) with the 3/32" Allen wrench and sliding the sleeve off the shaft. Inspect the sleeve and the inside o-ring for damage or wear and replace if necessary.

Remove the front and rear bearing block caps by removing the bearing cap bolts (19) with the 1/2" wrench. Discard the used bearing cap O-rings (21).

Remove the snap ring (22) which secures the radial bearing (23) from the pump shaft with the snap-ring pliers. Tap the impeller end of the pump shaft with the soft-faced hammer to remove the shaft assembly from the bearing block (24). **SUPPORT THE SHAFT WHILE TAPPING SO THAT IT DOES NOT FALL AND BECOME DAMAGED.**

Stand the pump shaft on end (impeller end down) and slowly heat the inner race of the radial bearing with the flame torch until it drops off the pump shaft. Loosen the bearing lock nut (31) with the spanner wrench. Remove the bearing lock nut and lock nut washer (30) from the pump shaft. Press the thrust bearings (29) off the pump shaft using caution to prevent damaging the pump shaft in the process (Figure 9). Remove the radial bearing from the bearing block.

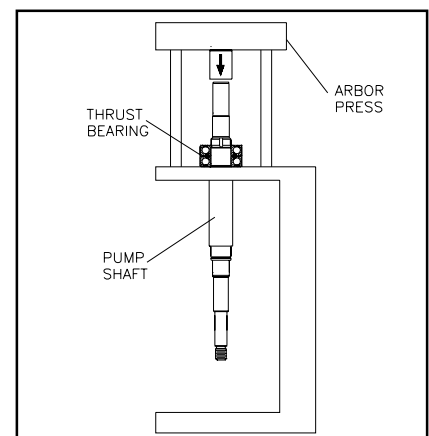


Figure 9: The thrust bearing must carefully be removed from the pump shaft.

### BEARING BLOCK ASSEMBLY

Replace the pump shaft (34) if necessary. Heat the new thrust bearings (29) on a bearing heater to 230°F (**DO NOT HEAT BEARING ABOVE 250°F OR BEARING DAMAGE MAY RESULT**) and slide onto the pump shaft in a back-to-back arrangement (see assembly drawing). Slide the bearings onto the pump shaft quickly as the bearings cool rapidly when they come in contact with the shaft. A light film of oil on the pump shaft may ease assembly. Replace the bearing lock nut washer (30) and lock nut (31).

**Note:** the tab on the bearing lock nut washer fits into the slot on the pump shaft. Tighten the bearing lock nut with the spanner wrench until the bearings do not wobble but still rotate freely. (**Do Not OVERTIGHTEN**)

Heat the inner race of the radial bearing to 230°F and slide it onto the pump shaft. Allow the shaft/bearing assembly to cool to room temperature while keeping the assembly covered to prevent dirt from getting into the bearings. Recheck tightness of the bearing lock nut (31) to ensure that the thrust bearings (29) are tight and still rotate freely. Bend one of the tabs on the bearing lock nut washer (30) into one of the slots of the bearing lock nut with a screwdriver. This keeps the bearing lock nut secure during pump operation.

Press the outer race of the new radial bearing into the bearing block (24). Now you are ready to install the pump shaft assembly into the bearing block. Slide the impeller end of the pump shaft into the motor end of the bearing block. Move the shaft forward until the thrust bearings (29) meet the bearing block. Now press or tap the outer race of the thrust bearings into the bearing block while supporting the impeller end of the shaft so that the inner race of the radial bearing (23) clears the rollers secured in the outer race. **DO NOT PRESS ON THE PUMP SHAFT OR THE INNER RACE OF THE THRUST BEARINGS OR BEARING DAMAGE MAY RESULT.** It may be easier to install the pump shaft assembly into the bearing block with the bearing block standing on end. Note that you need to allow for clearance for the impeller end of the pump shaft to protrude through the face of the bearing block. Replace the snap ring (22) for the radial bearing with the snap-ring pliers

With the pump shaft assembly installed, you are now ready to install the bearing caps (20). Inspect the labyrinth seals (18) and replace if damaged or worn. The labyrinth seals are press fit into the bearing caps. Press the old seals out and press the new labyrinth seals into the bearing cap, preferably with an Arbor press. Make sure the drain port on the labyrinth seals will be in the downward position when the bearing caps are mounted on the bearing block. **Note:** it is normal for some of the outer o-ring on the labyrinth seal to shear off when it is pressed into the bearing cap.

Generously lubricate the inside O-rings on the labyrinth seals with a food grade lubricant such as Haynes CIP-Lube and press the labyrinth seal/bearing cap assemblies onto the pump shaft. Replace the bearing cap bolts (19) and tighten with the 1/2" wrench to 10 ft-lbs. Replace the drain plug cap (25-a) and fill the bearing block with oil to the center of the sight glass (26). **SEE LUBRICATION RECOMMENDATIONS PAGE 5.**

Replace the coupling key (33) and the coupling flange (49). Tighten the set screws (17) on the coupling flange with the 3/16" Allen wrench.

#### PUMP/MOTOR SHAFT ALIGNMENT

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The bearing block can now be returned to the baseplate and aligned with the motor. Align the bearing block over the bearing block mounting holes in the baseplate and loosely thread the bearing block mounting bolts. Mount the shaft alignment tool between the pump and motor and align the shafts. **Note:** shims may be required under the mounting feet of the motor. The shafts should not have more than .020" parallel misalignment and .094" angular misalignment. Once the shafts are aligned, tighten the bearing block mounting bolts securely with the 15/16" wrench to 70-80 ft-lbs. Replace the rubber coupling sleeve and slide the two coupling flange halves together. Tighten the set screws on the coupling flange with the 3/16" Allen wrench. The pump head may now be assembled as described on pages 11 & 14.

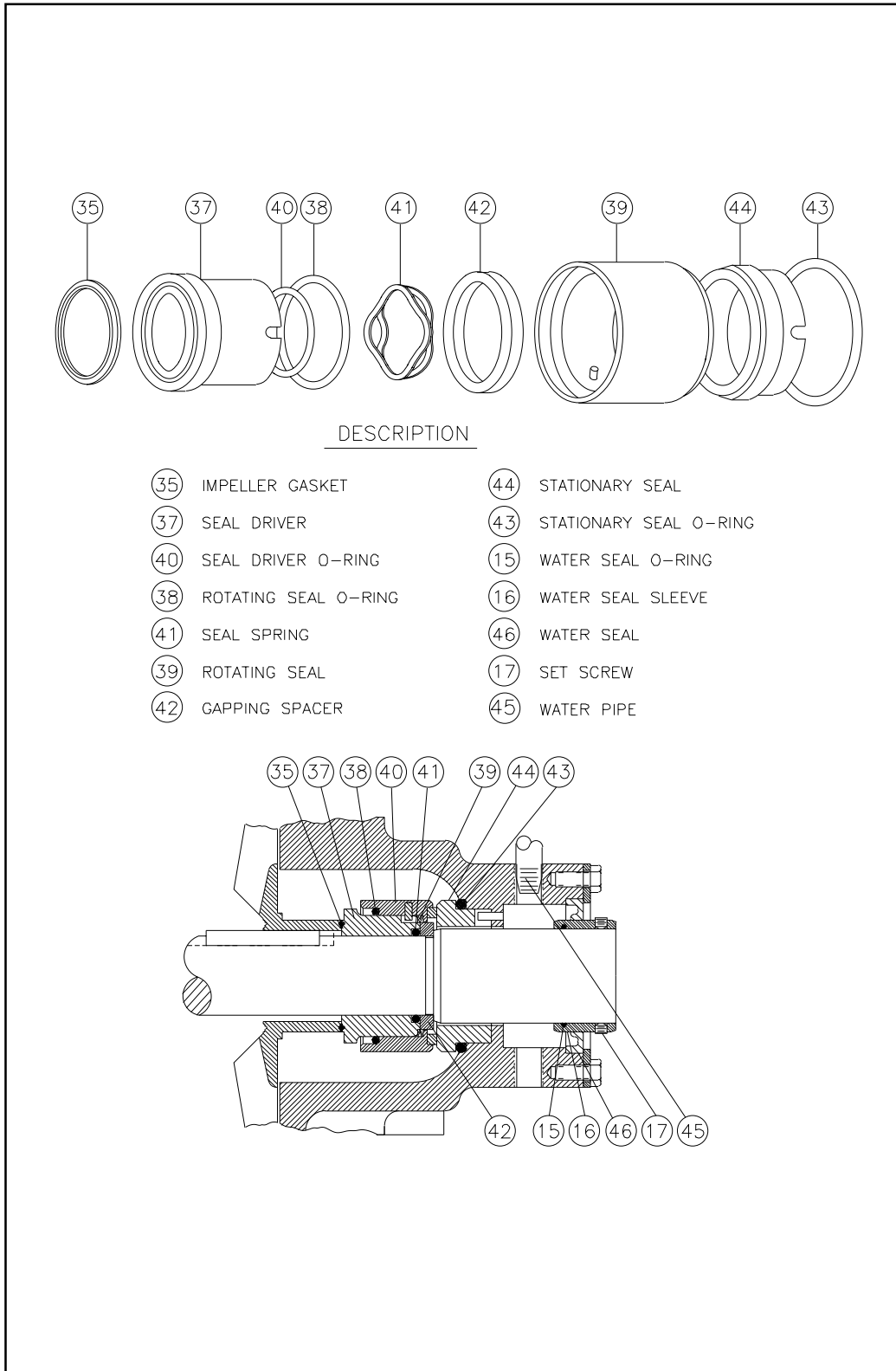


Figure 10: FM Seal Assembly

## TROUBLE SHOOTING

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, Inc. At 800-841-5001 or 608-831-5001.

<b>PROBLEM</b>	<b>POSSIBLE CAUSE OF TROUBLE</b>
	(see the following pages)
Pump does not deliver liquid	1, 2, 4, 8, 10, 11, 14, 16, 29, 30
Not enough capacity delivered	2, 3, 4, 5, 8, 11, 14, 16, 20, 21, 29
Pump loses prime after starting	2, 3, 4, 5
Pump requires too much power	9, 12, 13, 16, 19, 24
Leaking seal	7, 18, 23, 24, 25
Seal fails prematurely	6, 7, 18, 20, 23, 24, 25, 26, 27
Pump vibrates or is noisy	2, 12, 15, 16, 17, 18, 19, 20, 21, 26, 28, 29, 31, 32, 33
Motor bearings fail prematurely	15, 18, 20, 26, 28, 29, 31, 32
Pump overheats and seizes	1, 15, 19, 20, 26, 28
<b>POSSIBLE SUCTION PROBLEMS</b>	<b>POSSIBLE SOLUTIONS</b>
1. Pump inlet is not flooded	1a) Adjust piping so the pump inlet is flooded 1b) Install a foot valve to keep liquid in the suction piping
2. NPSHA is not sufficient	2a) Raise the level of liquid on the inlet side of the pump or lower the pump 2b) Use larger pipe on the inlet side of the pump 2c) Eliminate restrictions in suction line where possible 2d) Check inlet pipe for obstructions 2e) Shorten the inlet piping, move pump 2f) Lower the temperature of the liquid

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|--|--|
| 3. Too much air or gas in liquid               | 3a) Install air relief valve                                     |
|  | 3b) Turn pump head so discharge is at 45° angle                  |
| 4. Air pocket in suction line                  | 4. Adjust pipe to eliminate pocket                               |
| 5. Air entering the pump through the seal area | 5. Check seal for proper installation, replace seal if defective |
| 6. Seal flush water not on                     | 6. Turn on water to seal flush                                   |
| 7. Seal water flush pressure too high          | 7. Adjust water flow to seal flush to 10-12 gph at 1-2 psi       |

**POSSIBLE MECHANICAL PROBLEMS**

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|---|---|
| 8. Drive speed too low or too high                                | 8. Have a qualified person check that the power supplied matches the power of the drive |
| 9. Direction of shaft rotation is incorrect                       | 9. Reverse rotation   |
| 10. Total head of system is higher than design head of pump       | 10a) Check for restrictions in the piping   |
|   | 10b) Use larger diameter pipe   |
|   | 10c) Use a larger diameter impeller   |
|   | 10d) Check application with Fristam Pumps, Inc.   |
| 11. Total head of system is lower than pump design head           | 11a) Install throttling valve in discharge line   |
|   | 11b) Trim diameter impeller   |
|   | 11c) Check with Fristam Pumps, Inc.   |
| 12. Specific gravity of liquid greater than expected              | 12. Use larger motor, check application with Fristam Pumps, Inc.                        |
| 13. Viscosity of liquid is greater than expected                  | 13a) Increase piping diameter and eliminate restrictions                                |
|   | 13b) A larger drive or pump may be required, check application with Fristam Pumps, Inc. |
| 14. Operation is at a very low capacity for the pump model chosen | 14. Check application with Fristam Pumps, Inc.  |
| 15. Foreign matter in pump  | 15. Remove pump cover and clear foreign matter  |
| 16. Pump foundation not rigid                                     | 16. Provide firmer foundation for the pump  |
| 17. Bent shaft  | 17. Replace shaft (see pages 16-17 for directions)                                      |

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|--|--|
| 18. Impeller rubbing on pump housing or cover                                      | 18a) Check gap of the impeller   |
|  | 18b) Replace defective components  |
|  | 18c) Make sure impeller nut is tightened properly  |
| 19. Motor worn or damaged  | 19. Take motor to authorized service center  |
| 20. Pump damaged   | 20. Remove pump cover and inspect for damage. Replace defective parts                                  |
| 21. Cover gasket defective, permitting leakage                                     | 21. Replace cover gasket   |
| 22. Shaft worn or scored   | 22. Replace impeller shaft   |
| 23. Seal improperly installed  | 23. Check seal installation, replace defective components  |
| 24. Type of seal incorrect for operating conditions                                | 24. Replace seal with correct type of seal, check with your local representative or Fristam Pumps Inc. |
| 25. Impeller out of balance, causing vibration                                     | 25. Balance the impeller or contact Fristam  |
| 26. Dirt or grit in seal flush liquid leading to scoring of shaft or seal surfaces | 26. Use clean source of water for seal flush   |
| 27. Lack of lubrication in motor bearing   | 27. Lubricate motor bearings   |
| 28. Piping is obstructed   | 28. Remove obstruction in pipe, check for closed valve   |
| 29. Power is not being supplied  | 29. Have qualified person check electrical connections   |
| 30. Piping is being supported by the pump  | 30. Support the piping independently from the pump   |
| 31. Pump and motor shaft are not aligned   | 31. Realign  |
| 32. Bearing failure  | 32. Replace pump bearings  |



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