



## INSTRUCTION AND MAINTENANCE MANUAL:

### FM SINGLE STAGE CLOSE COUPLED - STYLE PUMP



**SANITARY CENTRIFUGAL PUMPS**

## DESCRIPTION

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

The motors used on “CCFM” 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**



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## TECHNICAL INFORMATION

### **SPECIFICATIONS**

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Maximum Inlet Pressure .....	1000 PSI
Temperature Range .....	-40°F - 400°F
Noise Level .....	60 - 85 dB(A)

### **MATERIALS OF CONSTRUCTION**

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Primary Product Contact Components.....	AISI 316
Casing Gasket .....	Viton (standard)
Also Available in.....	EPDM
Surface Finish for Product Contact Surfaces .....	32 Ra (standard)

### **SHAFT SEALS**

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Mechanical Seal Type .....	Double Mechanical
Water Flush Pressure.....	1-2 PSI
Water Consumption (seal flush).....	12 gph
Primary Stationary Seal Ring Material .....	Silicon Carbide
Primary Rotating Seal Ring Material.....	Silicon Carbide
Seal O-ring Material .....	Viton (standard)
Also Available in.....	BUNA-N, EPDM, other available upon request

### **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 .....	2900 RPM
3 phase, 60 Hz, 208-230/460 VAC .....	3500 RPM
3 phase, 60 Hz, 575 VAC .....	3500 RPM

#### **Motor Shaft**

Axial and Radial play  $\leq 0.002$ "

### **RECOMMENDED TORQUE VALUES**

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Impeller nut	40 ft.-lbs
Seal retaining ring bolts	5 ft.-lbs
Seal driver set screw	10 in.-lbs.
Housing bolt	50 ft.-lbs.
Cover nut	105 ft.-lbs.

### **IMPELLER GAP (IMPELLER TO HOUSING MEASUREMENT)**

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single or multistage pumps   .030" - .040" (.8 - 1.0 mm)

## RECOMMENDED PREVENTIVE MAINTENANCE

### 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 replacements.

### LUBRICATION RECOMMENDATIONS:

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Use a food grade lubricant on o-rings and gaskets unless otherwise specified. If using EPDM o-rings or gaskets, an oil-based lubricant can't be used.

### MOTOR LUBRICATION RECOMMENDATIONS:

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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 service conditions:*

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FRAME SIZE NEMA/(IEC)	MOTOR SPEED 3500 RPM
Over 210 to 280 (132 to 180) inclusive	9,500 hours

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

*Table 2: Service condition definitions:*

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SERVICE CONDITION	MAXIMUM AMBIENT TEMPERATURE	ATMOSPHERIC CONTAMINATION
Standard	104°F (40°C)	Clean, little corrosion.
Severe	122°F (50°C)	Moderate dirt, corrosion.
Extreme	> 122°F (> 50°C)	Severe, dirt, abrasive dust, corrosion.

*Table 3: Volume of grease to be added:*

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Frame Size NEMA/(IEC)	Grease Volume	
	IN. <sup>3</sup>	TSP
Over 210 to 280 (132 to 180) inclusive	1.2	3.9

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## INSTALLATION

### UNPACKING

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Before accepting a pump from a carrier, visually inspect the packaging for any damage.

Check the contents and all wrapping when unpacking the pump. Carefully inspect for any damage that may have occurred during shipping. Immediately report any damage to the carrier. Remove the coupling guard and protective cover from pump outlet. Place your ear near the pump outlet and turn the shaft by hand, a small amount of noise from the seals is normal. Metal-to-metal contact will be very noticeable. If you have metal-to-metal contact, shipping damage is likely. Leave the protective caps over the pump inlet and outlet connections until you are ready to install the pump.

### INSTALLING

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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.

We ship our pumps fully assembled.

### DESCRIPTION

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

### MAXIMUM OPERATING CONDITIONS FOR CCFM SERIES PUMPS

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System Pressure:	1000 PSI (69 Bar)
Capacity:	300 gpm (68 m <sup>3</sup> /Hr.)
Discharge Pressure:	1275 psi (88 Bar)
Power:	25 HP

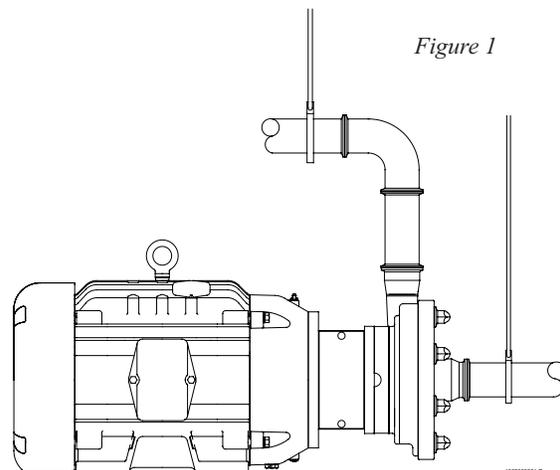
### PIPING GUIDELINES

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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.

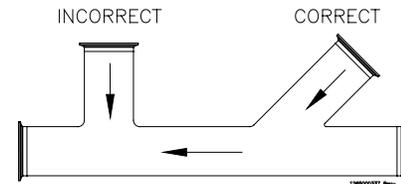
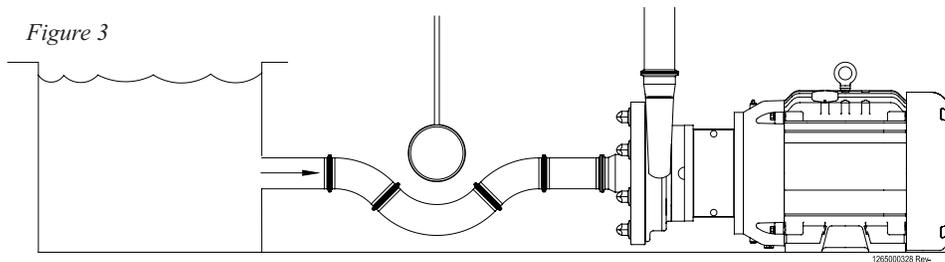
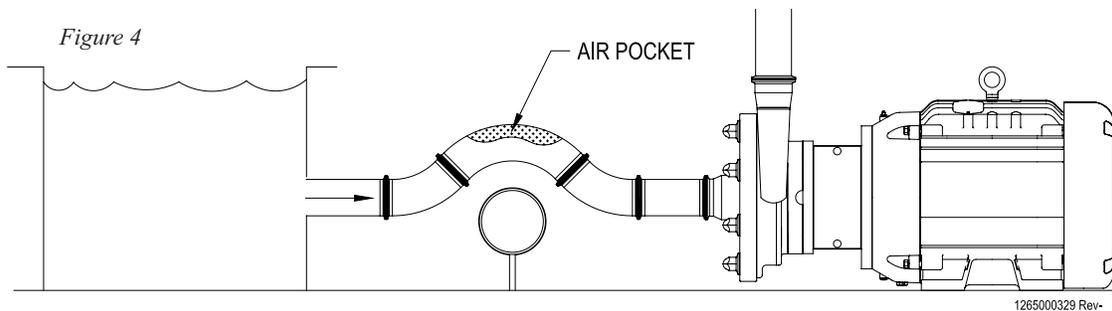


Figure 2

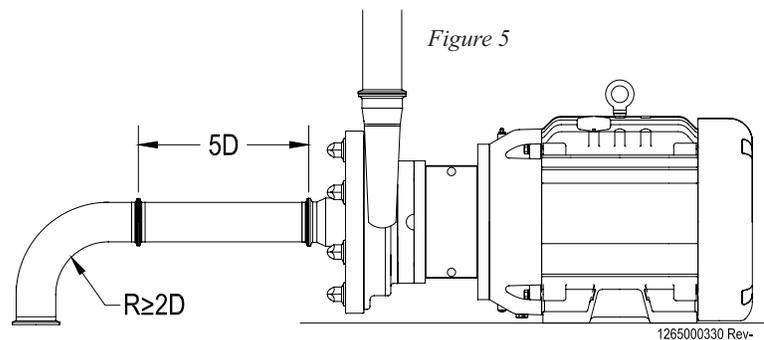


- Avoid sump areas where sediments may collect (**Figure 3**).



- 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**).



## ELECTRICAL INSTALLATION

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

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.**

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.

## PUMP OPERATIONS

### START-UP INSTRUCTIONS

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

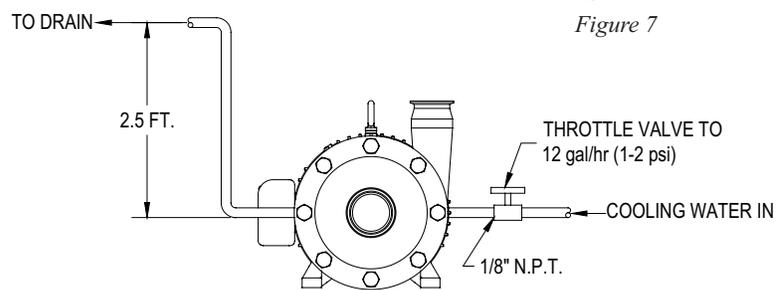
- Shut off the power supply to the pump.
- Close the shut-off valves in the suction and discharge piping.
- Drain and clean the pump as required.
- Protect the pump against dust, heat, moisture and impact damage.

## INSTALLATION OF SEAL FLUSH FOR DOUBLE MECHANICAL SEAL

Set up the seal flush for the double mechanical seal as shown in (Figure 7). **Use only about 12 gallons per hour of water at a pressure of 1-2 PSI.**

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.



WATER PIPE CONNECTIONS

## 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 1" wrench  
Soft-faced hammer  
FM wrench - 1 1/2" open end (provided by Fristam)  
Optional: One set of impeller pullers (commonly available as tack pullers)

### PUMP HEAD DISASSEMBLY

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

Disconnect the suction and discharge piping. Drain all fluids from the pump.

- a) Loosen the cover nuts (37) with the 1" wrench. Remove the cover nuts, flat washers (36) (if supplied), cover (23) and cover gasket (22).
- b) Loosen and remove the four guard screws (27).
- c) Remove the seal guard (28).
- d) Using the FM wrench on the shaft, turn the impeller nut (21) with the 15/16" socket wrench counter-clockwise until it threads off the pump shaft.
- e) Remove the impeller nut and impeller gasket (19).
- f) Remove impeller key (35) from the pump shaft.
- g) Remove the impeller (20) by pulling the impeller toward you. (If the impeller is difficult to pull off the shaft, wedge the tack pullers between the pump housing and the impeller and pry the impeller off the shaft.)
- h) Remove the rotating seal assembly which includes: the impeller gasket (19), seal driver (18), rotating seal (15), seal spring (16) and rotating seal o-ring (17). 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.
- i) Remove the o-ring (14) and stainless gapping spacer (13) from the shaft. **IMPORTANT:** This gapping spacer is unique to this pump as it ensures the correct gap for the impellers as installed at the factory (Figure 10, page 15). **Do not discard.** If you are replacing the pump shaft/motor on your CCFM pump, please contact the factory for proper gapping procedure.

- j) Remove the two water pipes (10) (if supplied) on either side of the pump housing using pliers or channel locks.
- k) Next remove the four pump housing bolts (26) and lock washers (24) which attach the pump housing (33) to the flange adapter (2) using the 3/4" wrench.
- l) Slide the pump housing off the end of the pump shaft.
- m) Place the pump housing on its hub.
- n) Remove the stationary seal (12) 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 (11) should come out with the stationary seal. Discard after removal.
- o) Turn the housing over and place it on the housing studs. Loosen and remove the four retaining ring bolts (8) on the pump housing with the 7/16" wrench. Remove the retaining ring (30), stationary water seal (31) and flat gasket (32) from the pump housing.
- p) Now remove the rotating water flush components for the pump shaft, which include: the rotating water seal ring (7), the rotating water seal o-ring (6), the water seal spring (5), and the water seal drive ring (4). The water seal driver (3) may be left on the pump shaft.

You are now ready to install the new seal and reassemble the pump head.

#### **PUMP HEAD ASSEMBLY**

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**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.

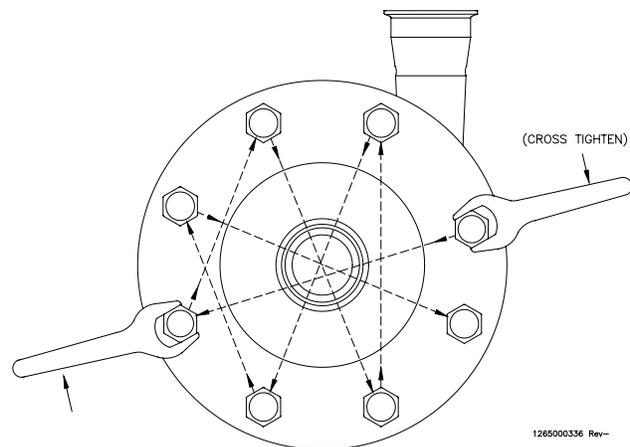
You are now ready to install the new seals into the pump (**Figure 9**, page 12).

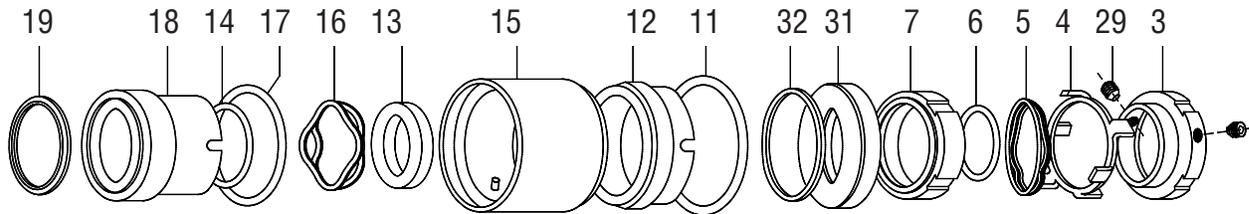
- a) Start the seal assembly by sliding the new water seal drive ring (4) onto the pump shaft with the shorter tabs facing the water seal driver (3). Align the tabs with the slots in the seal driver.
- b) Slide the new water seal spring (5) onto the pump shaft and position it against the water seal drive ring.
- c) Lubricate the new water seal o-ring (6) with a food grade lubricant. Place the o-ring inside the rotating water seal ring (7) and slide the assembly onto the pump shaft. Align the tabs in the water seal drive ring with the slots in the water seal ring.
- d) With the pump housing still sitting on the housing studs, place the new stationary seal flat gasket (32) and stationary water seal (31) into the pump housing.
- e) Replace the retaining ring (30) onto the hub of the pump housing and install the four retaining ring bolts (8). Tighten with the 7/16" wrench to the proper torque (see page 4).
- f) Turn the pump housing over and place it on its hub. Generously lubricate the outside stationary seal o-ring (11) with a food grade lubricant and place it onto the stationary seal (12). 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.
- g) Carefully slide the pump housing over the pump shaft and push it against the flange adapter (2) ensuring that the stationary seals (which are mounted in the pump housing) do not contact

the pump shaft. **Note: the stationary seals may be damaged if they make hard contact with the pump shaft.**

- h) Install the four pump housing bolts (25) with lock washers (24). Tighten them with the 3/4" wrench to the proper torque, see page 4.
- i) Lubricate the new seal driver o-ring (14) with a food grade lubricant and place it on the stainless gapping spacer. Slide the gapping spacer and o-ring on to the pump shaft. (**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 is listed on page 4.)
- j) Now install the new rotating seal assembly which includes: the impeller gasket (19), seal driver (18), rotating seal (15), seal spring (16) and rotating seal o-ring (17). 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 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.
- k) Place the impeller key (25) into the shaft keyway and slide the impeller (20) onto the pump shaft.
- l) Locate the new impeller nut gasket (19) and lubricate it (if it is not EPDM) with a food grade lubricant and place it onto the impeller nut (21). Thread the impeller nut with gasket onto the pump shaft. Hand tighten the impeller nut for now.
- m) Place the new cover gasket (22) into the groove on the pump cover and install them onto the pump housing. Thread the cover nuts (37) and flat washers (36) onto the housing studs. With a cross-tightening pattern, tighten the cover nuts to the proper torque, see page 4. (**Figure 8**).
- n) Place the 1 1/2" wrench on the pump shaft, to keep the shaft from rotating while tightening the impeller nut with an 15/16" socket wrench. Tighten the impeller nut to the proper torque, see page 4.
- o) Remove the 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 seal guard and guard screws.





### DESCRIPTION

- |                            |                               |
|----------------------------|-------------------------------|
| 19. Impeller gasket        | 32. Flat gasket               |
| 18. Seal driver            | 31. Stationary water seal     |
| 14. Seal driver o-ring     | 7. Rotating water seal ring   |
| 17. Rotating seal o-ring   | 6. Rotating water seal o-ring |
| 16. Seal spring            | 5. Water seal spring          |
| 13. Gapping spacer         | 4. Water seal drive ring      |
| 15. Rotating seal          | 29. Set screw                 |
| 12. Stationary seal        | 3. Water seal driver          |
| 11. Stationary seal o-ring |                               |

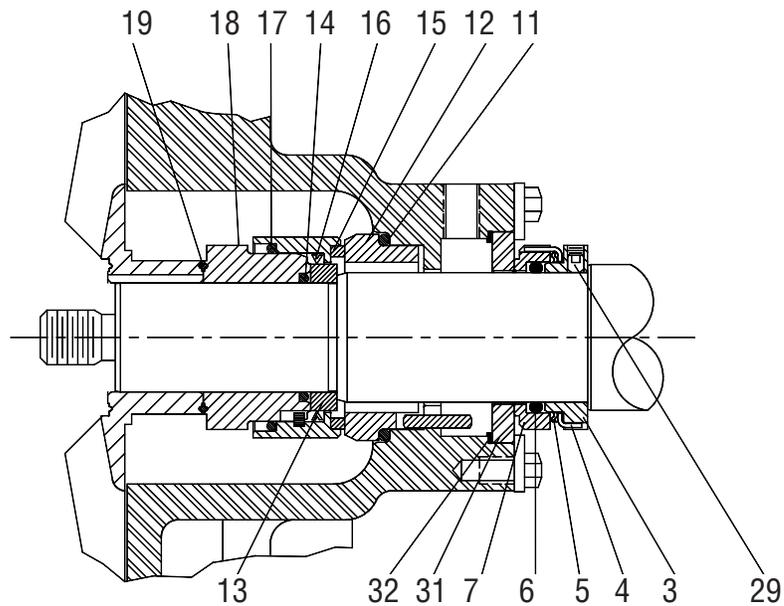


Figure 9: CCFM Seal Assembly

## 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.

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### REQUIRED TOOLS

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

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### PUMP DISASSEMBLY

Disassemble the pump head as described on pages 9-10.

- a) Loosen the four flange bolts (24) and washers (25) with the 3/4" wrench.
- b) Remove the flange support from the motor.

The CCFM motor and pump shaft are one unit.

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### PUMP ASSEMBLY

Place the flange support (2) on the new motor unit (1), replace the flange bolts (24) and washers (25) and tighten to the appropriate torque (see page 4).

Finish the pump assembly as described on pages 10-11.

### **CHECKING THE IMPELLER GAP**

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If you have changed the motor, the pump will need gapping.

In order to check the gap, place the gapping spacer (26), seal driver (31), impeller key (56), impeller gaskets (32) impeller (33) and impellers with backplates (37) and finally the impeller nut (38) with the impeller nut gasket (32) in place. Tighten the impeller nut to the proper torque, see page 5.

The gap is measured between the impeller (37) and pump housing (54) 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 4

If the gap isn't correct please contact Fristam Pumps for a new gapping spacer (26).

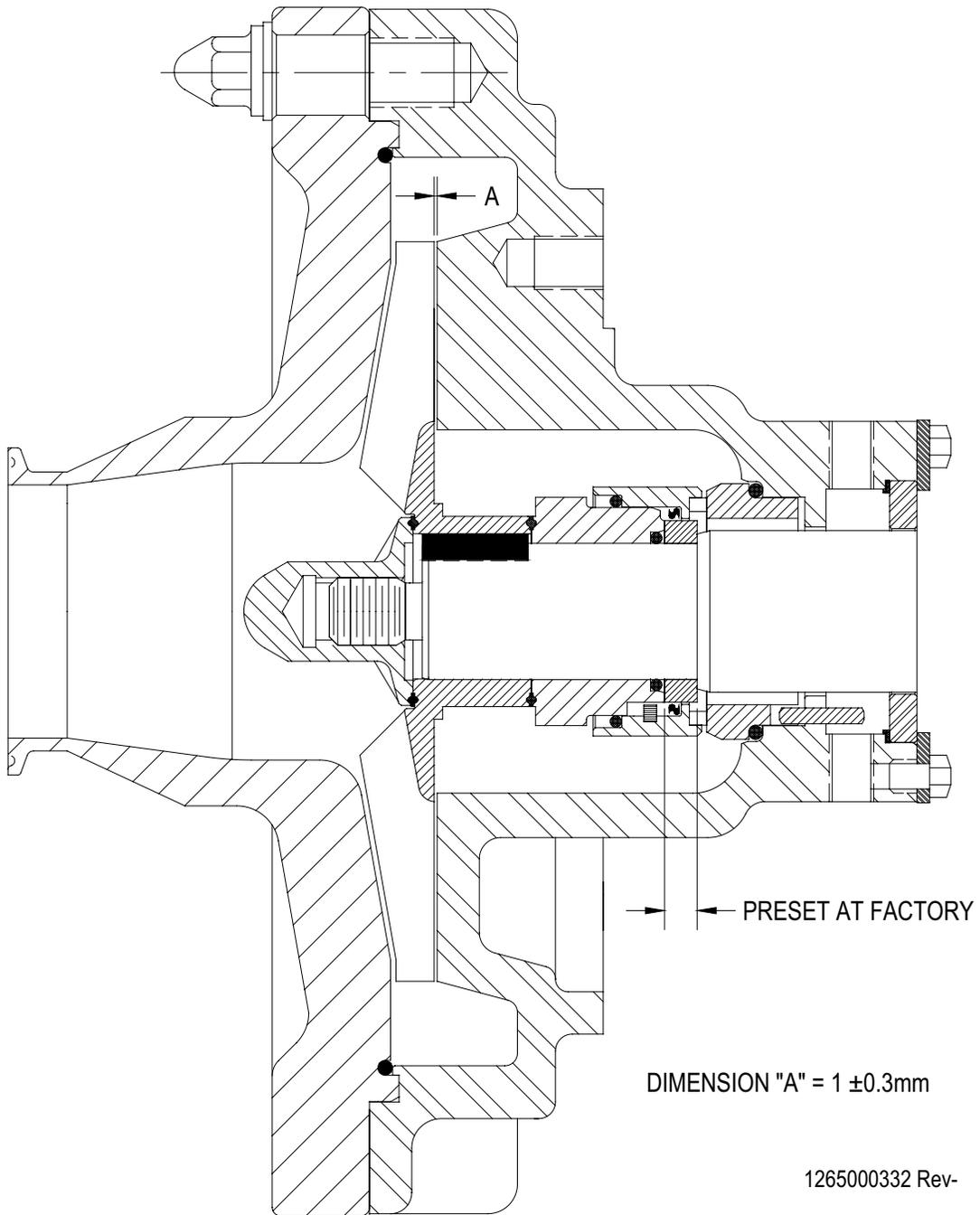
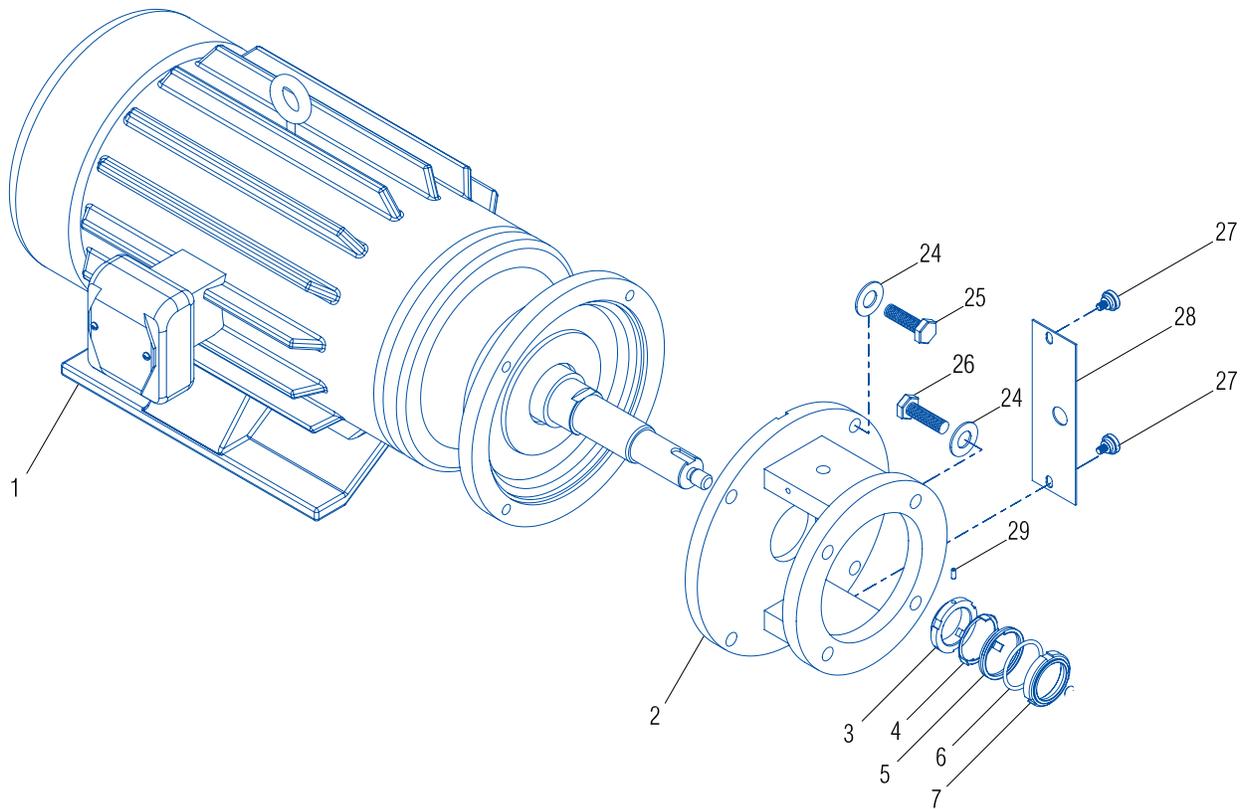
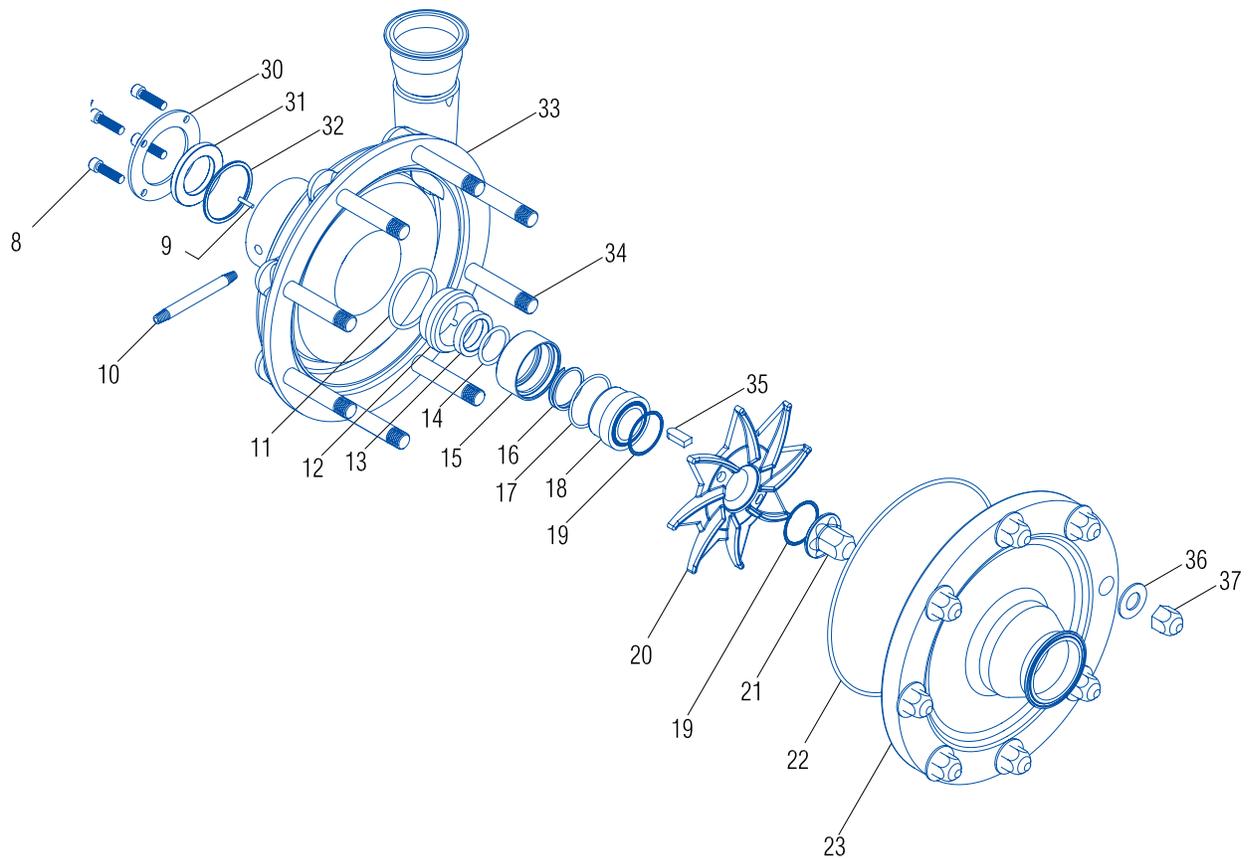


Figure 10: Gap Set At Factory



## CLOSE COUPLED FM ASSEMBLY EXPLODED VIEW

- |                               |                             |
|-------------------------------|-----------------------------|
| 1. Motor                      | 15. Rotating seal           |
| 2. Flange adapter             | 16. Seal spring             |
| 3. Water seal driver          | 17. Rotating seal o-ring    |
| 4. Water seal drive ring      | 18. Seal driver             |
| 5. Water seal spring          | 19. Impeller gasket         |
| 6. Rotating water seal o-ring | 20. Impeller (no backplate) |
| 7. Rotating water seal ring   | 21. Impeller nut            |
| 8. Retaining ring bolt        | 22. Cover gasket            |
| 9. Housing pin                | 23. Pump cover              |
| 10. Water pipe                | 24. Lock washer             |
| 11. Stationary seal o-ring    | 25. Flange bolt             |
| 12. Stationary seal           | 26. Housing bolt            |
| 13. Gapping spacer            | 27. Guard screw             |
| 14. Seal driver o-ring        | 28. Seal guard              |
|                               | 29. Set screw               |



- 30. Retaining ring
- 31. Stationary water seal
- 32. Flat gasket
- 33. Pump housing
- 34. Housing stud
- 35. Impeller key
- 36. Flat washer
- 37. Cover nut

## 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 at 800-841-5001 or 608-831-5001.

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
Discharge pressure insufficient	Direction of rotation incorrect	Reverse electrical phases to motor
	Motor speed too low Impeller diameter too small	
Capacity insufficient	Direction of rotation incorrect	Reverse electrical phases to motor
	Discharge pressure too high	Check for partly closed valves or blockages. If not, check pipework design
	Product viscosity Air leaks on suction side	Replace pipework gaskets and/or mechanical seal
Drive power too high	Product viscosity too high	Throttle pump discharge Check order and consult Fristam
	Discharge pressure insufficient	
	Impeller diameter too large	
Noisy operation	Cavitation due to insufficient NPSH	Frictional resistance in pipework too high or suction vessel level too low
	Impeller to housing contact	Reassembly pump or correct poor pipework installation
	Bearing failure	Replace motor bearings Consult Fristam

## **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.

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All claims must be in writing and mailed or delivered by purchaser within thirty (30) days after purchaser learns 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.

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