



Engineered For Lasting Performance®

INSTRUCTION AND MAINTENANCE MANUAL: FP AND FPX SERIES Pumps (Original Instructions)



SANITARY CENTRIFUGAL PUMPS

DESCRIPTION

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

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, and 3500 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 style pumps are standard NEMA totally enclosed fan cooled (TEFC) motors. They are C-face (except 320TSD, which are D flange - only available on FP series pumps). Replacement motors are readily available from local motor distributors.

SAFETY

This instruction and maintenance manual shall be read and completely understood prior to operation of the pump. The manual should be kept available at the pump installation location.

All applicable local/national regulation and laws shall be followed.

All work described herein may only be performed by qualified personnel.

Personal protective equipment (PPE) such as hearing protection may be required.

Despite inherent safe design measures some amount residual risk will remain. Throughout the manual these risks will be pointed out.



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)
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	Silicon Carbide
Rotating Seal Ring Material	Chrome Oxide coated Stainless Steel
Also available in	Silicon Carbide
Double Rotating Seal Material (FP only)	Ceramic
O-ring Material	Viton (standard)

RECOMMENDED TORQUE VALUES

Impeller nut	Models 700–3550	40 ft.-lbs.
	Models 1050, 1150 and 1160	90 ft.-lbs.
Shaft collar screw	56C–180TC motor frames	12 ft.-lbs.
	210TC–280TSC motor frames	24 ft.-lbs.
	280TC–320TD/TSD, 360TSC motor frames	43 ft.-lbs.
	56C - 140TC motor frames	20 ft.-lbs.
Motor bolts	180TC–280TSC motor frames	55 ft.-lbs.
	280TC–320TD/TSD, 360TSC motor frames	110 ft.-lbs.
	FPX 250TC	4.5 ft. lbs.
Seal retaining ring bolts	All models (except FPX 250TC)	10 ft.-lbs.
	FPX 250TC	4.5 ft. lbs.
Housing bolts (double flange)	All models	50 ft.-lbs.
Clamping bolt (single flange)	All models	55 ft. lbs.

MOTOR INFORMATION

Uses standard NEMA TEFC C-face motors (except D-flange motors for 320TSD). Options include wash-down, high efficiency, explosion proof, chemical duty and IEC.

VOLTAGE AND FREQUENCY

3 phase, 60 Hz, 208-230/460 VAC	1750/3500 RPM
3 phase, 60 Hz, 575 VAC.....	1750/3500 RPM
3 phase, 50 Hz, 208-220/380-415 VAC	1450/2900 RPM

SHAFT RUN-OUT TOLERANCE

All models	0.05 mm (0.002")
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IMPELLER GAPS	TO HOUSING	TO COVER
700, 710, 720, 740, 1732, 1740.....	0.5 mm (0.020")	0.5 mm (0.020")
352.....	0.5 mm (0.020")	1 mm (0.040")
353, 1050.....	1 mm (0.040")	0.5 mm (0.020")
354.....	1 mm (0.040")	1 mm (0.040")
345, 355.....	1.5 mm (0.060")	0.5 mm (0.020")
1150, 1160.....	1.5 mm (0.060")	2.0 mm (0.080")

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. If the impeller nut gasket fails, the threaded hole on the impeller nut and the threads on the end of the shaft will need to be cleaned. A wire brush is recommended for cleaning these threads.

PUMP SHAFT INSPECTION

Inspect the pump shaft and collar annually for wear. Inspect the shaft collar bolt(s) annually or more often in corrosive environments.

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.ts.

*Table 1: Motor Lubrication Intervals for Standard Conditions**

Frame Size: NEMA (IEC)	3500 RPM	1750 RPM
Up to 210 incl. (132 IEC)	5,500 hrs.	12,000 hrs.
Over 210 to 280 incl. (180 IEC)	3,600 hrs.	9,500 hrs.
Over 280 to 360 incl. (225 IEC)	2,200 hrs.	7,400 hrs.

*For severe conditions, multiply interval hours by 0.5; for extreme conditions, multiply interval hours by 0.1

Table 2: Service Conditions Definitions

Service Conditions	Max. 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 per Bearing

Frame Size NEMA (IEC)	Grease IN³	Volume TSP
Up to 210 incl. (132 IEC)	0.6	2.0
Over 210 to 280 incl. (180 IEC)	1.2	3.9
Over 280 to 360 incl. (225 IEC)	1.5	5.2

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.

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 (5-lb. 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 18-21.



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)

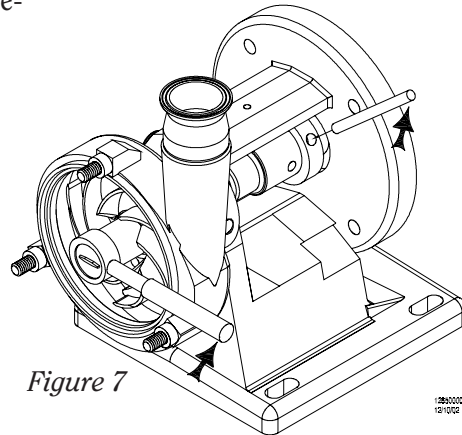


Figure 7

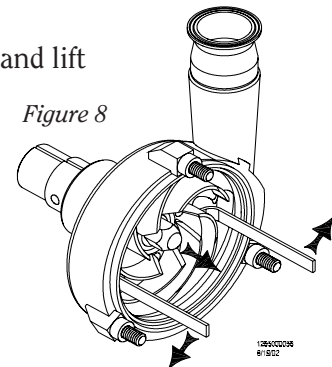


Figure 8

until the rotating seal face comes off the shaft (*Figure 10*). Discard the seal components after you remove them.

- j) **SINGLE FLANGE:** 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*).

DOUBLE FLANGE: Loosen and remove the four housing bolts that pass through the flange support and thread into the back of the pump housing with the 3/4" wrench. Slide the pump housing off the end of the pump shaft.

- 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 SPLIT 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 (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.

PUMP HEAD ASSEMBLY

(SEE SEAL ASSEMBLY DRAWINGS PAGES 10-13)

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.

Figure 9

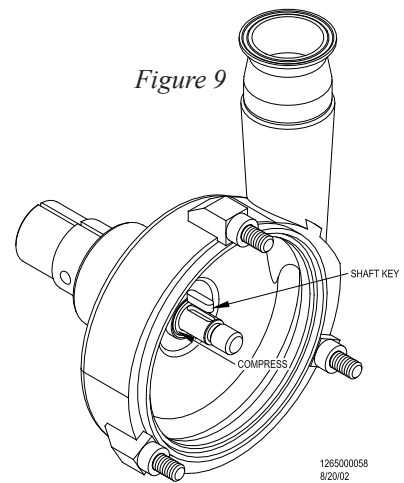
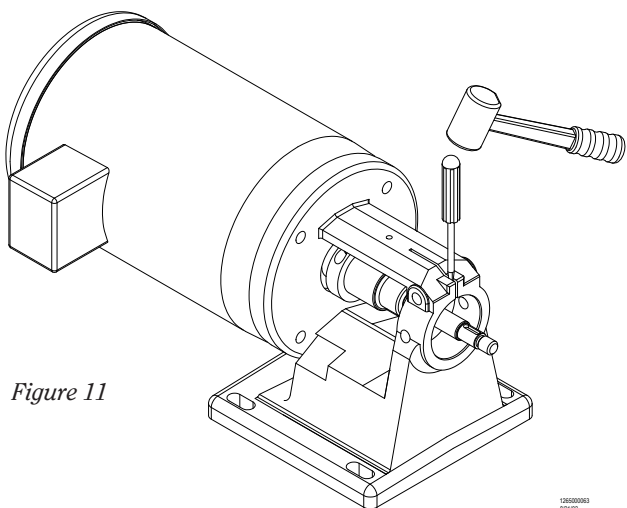
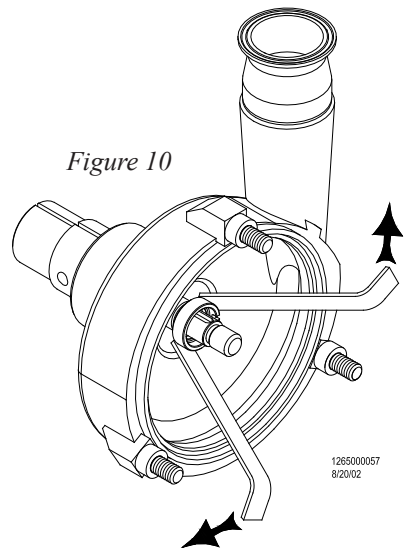


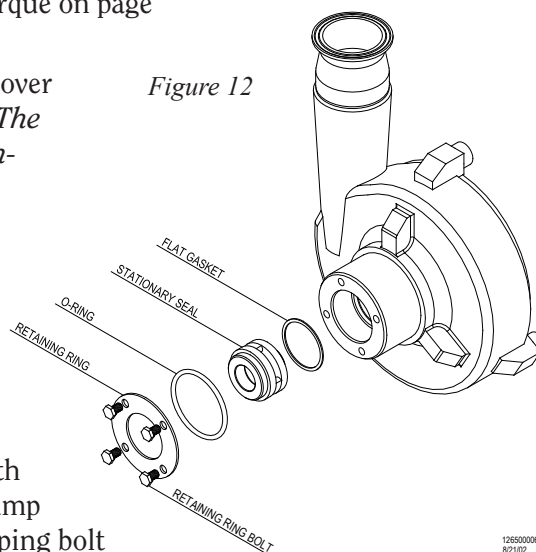
Figure 10



- 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) **SINGLE FLANGE:** 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. While holding the pump housing against the flange support, tighten the clamping bolt in the flange support.

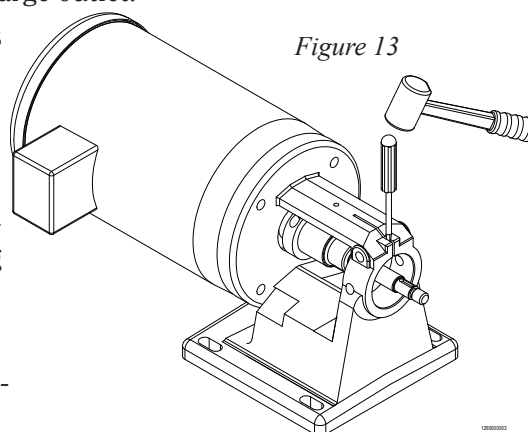
Figure 12



DOUBLE FLANGE: Carefully slide the pump housing (10) over the pump shaft (7) and back against the flange support (2). *Note: the stationary seal may be damaged if it makes hard contact with the pump shaft.* Install the housing bolts (29) and washers (30). Tighten to the proper torque listed on page 4. Install the seal water pipe (if supplied), by threading it into the housing and tighten with a pair of pliers. Align the discharge piping with the discharge outlet.

- 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.

Figure 13



- 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. *(Note: for frame sizes 254 and up, the larger end of the seal spring goes into the rotating seal Figure 14)*
- 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.

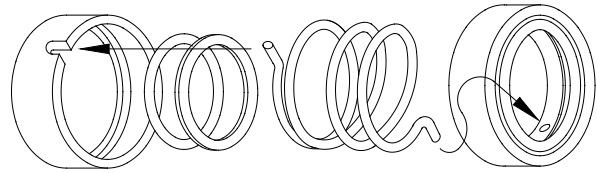
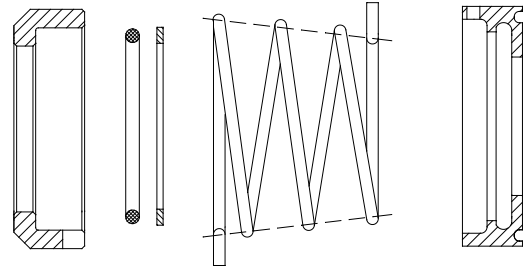


Figure 14

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.

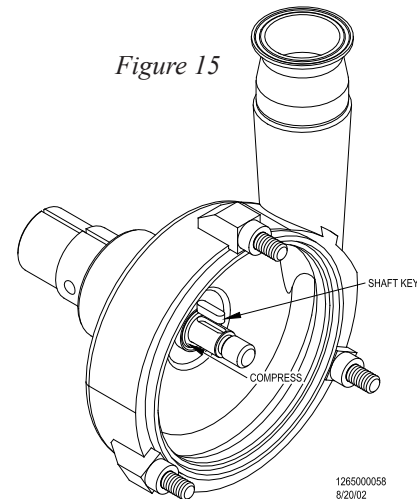
q) Generously lubricate the new impeller nut gasket with a food grade lubricant (if it is not EPDM) and place it onto the impeller nut.

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.

Figure 15

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 stamped 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.

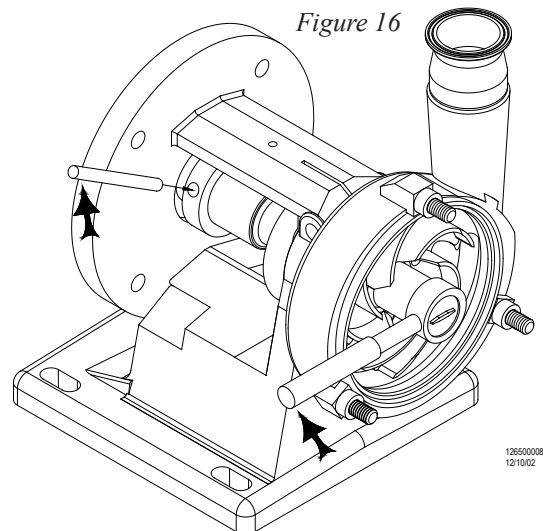
v) Now rotate the pump shaft to make sure that the impeller moves freely. If it does not, recheck your assembly to make sure that gaskets are not pinched and everything is seated properly.

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.

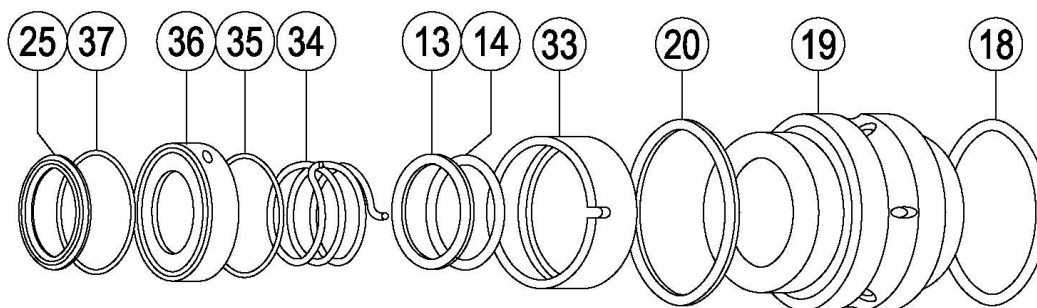
Figure 16

Reconnect the suction and discharge piping.

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

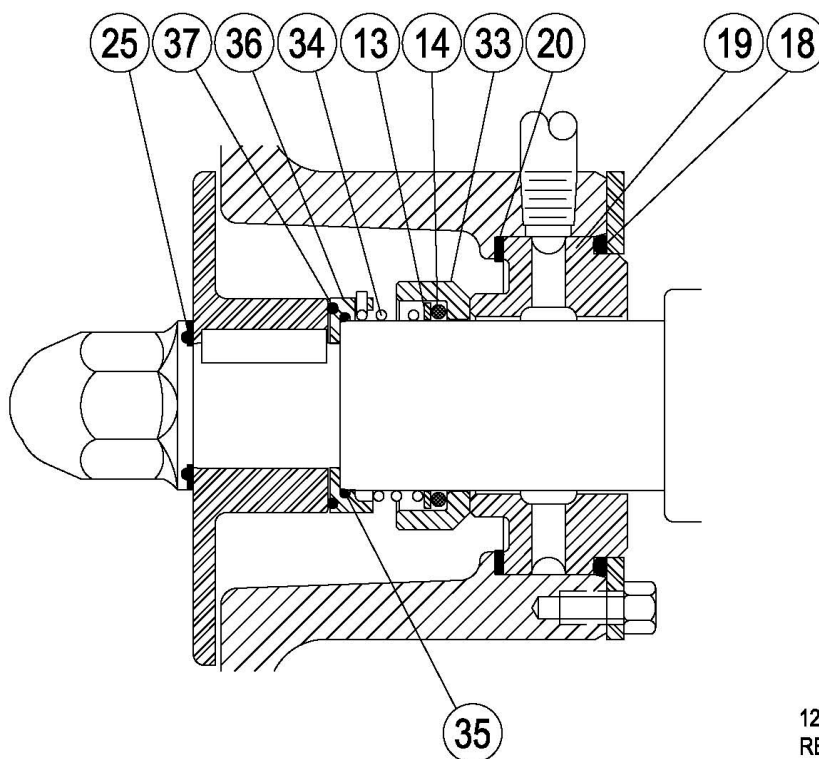


SINGLE SEAL ASSEMBLY



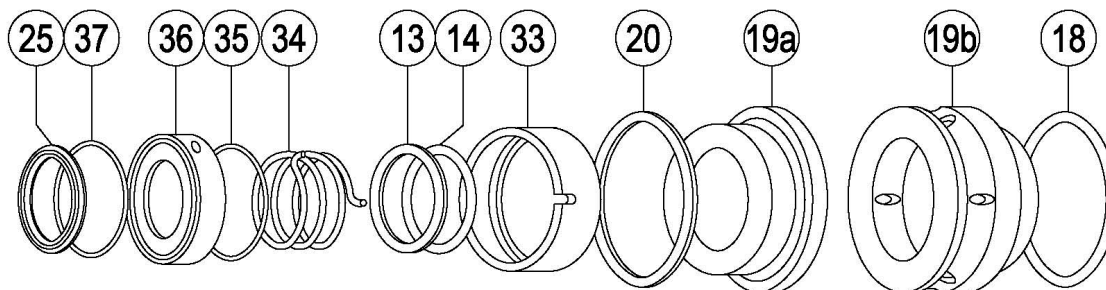
DESCRIPTION

- | | |
|---------------------------------|-----------------------------|
| (25) IMPELLER NUT GASKET | (14) ROTATING SEAL O-RING |
| (37) OUTSIDE SEAL DRIVER O-RING | (33) ROTATING SEAL |
| (36) FRONT SEAL DRIVER | (20) FLAT GASKET |
| (35) INSIDE SEAL DRIVER O-RING | (19) STATIONARY SEAL |
| (34) SEAL SPRING | (18) STATIONARY SEAL O-RING |
| (13) ROTATING SEAL WASHER | |



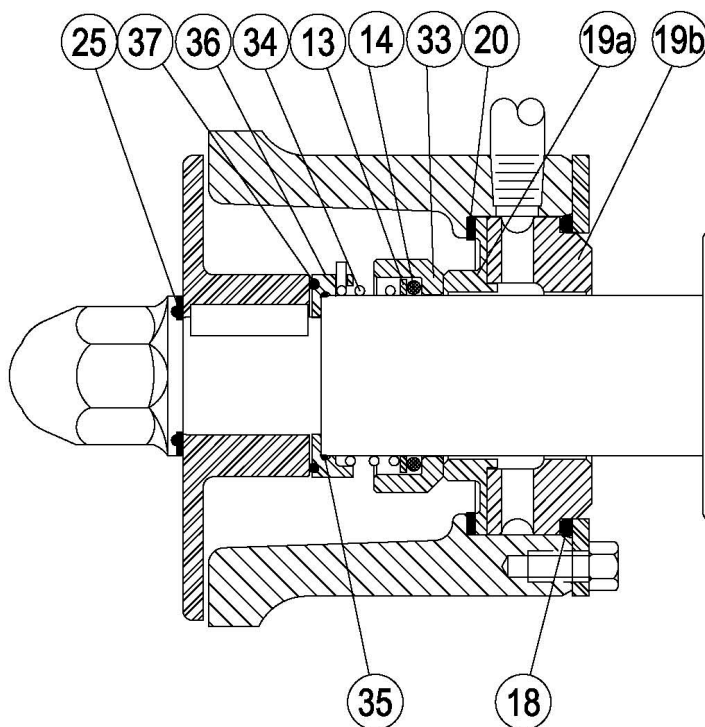
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SINGLE SEAL ASSEMBLY (SPLIT-CENTERED STYLE)



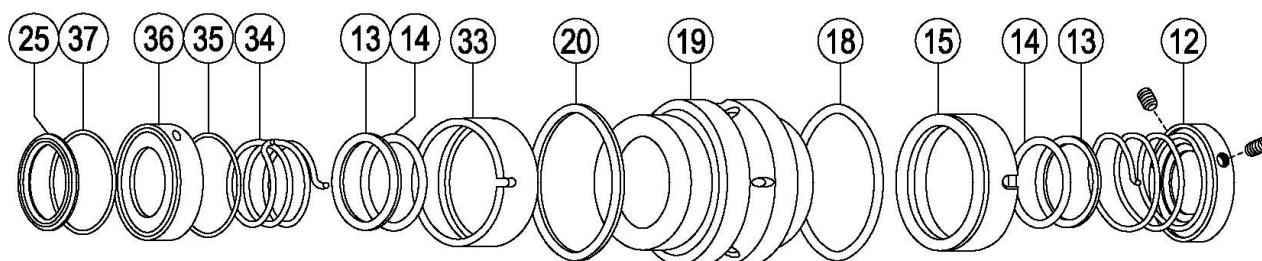
DESCRIPTION

- | | |
|-------------------------------|----------------------------------|
| 25 IMPELLER NUT GASKET | 14 ROTATING SEAL O-RING |
| 37 OUTSIDE SEAL DRIVER O-RING | 33 ROTATING SEAL |
| 36 FRONT SEAL DRIVER | 20 FLAT GASKET |
| 35 INSIDE SEAL DRIVER O-RING | 19a STATIONARY SEAL - FRONT HALF |
| 34 SEAL SPRING | 19b STATIONARY SEAL - REAR HALF |
| 13 ROTATING SEAL WASHER | 18 STATIONARY SEAL O-RING |



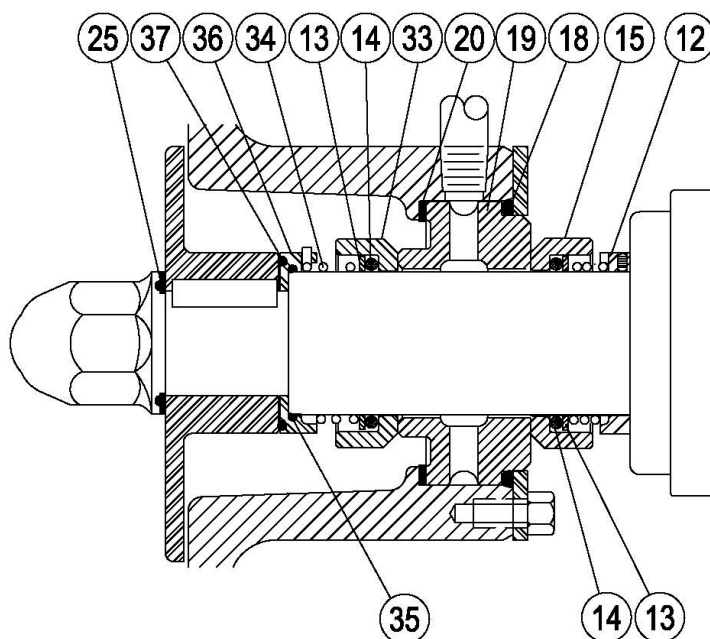
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DOUBLE SEAL ASSEMBLY

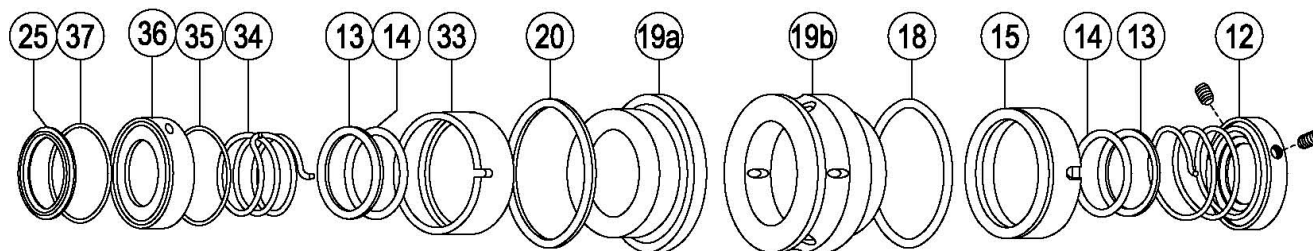


DESCRIPTION

- | | |
|-------------------------------|------------------------------|
| ②⑤ IMPELLER NUT GASKET | ③③ FRONT ROTATING SEAL |
| ③⑦ OUTSIDE SEAL DRIVER O-RING | ②① FLAT GASKET |
| ③⑥ FRONT SEAL DRIVER | ①⑨ STATIONARY SEAL |
| ③⑤ INSIDE SEAL DRIVER O-RING | ①⑧ STATIONARY SEAL O-RING |
| ③④ FRONT SEAL SPRING | ①⑤ REAR ROTATING SEAL |
| ①③ ROTATING SEAL WASHER | ①② REAR SEAL DRIVER & SPRING |
| ①④ ROTATING SEAL O-RING | |

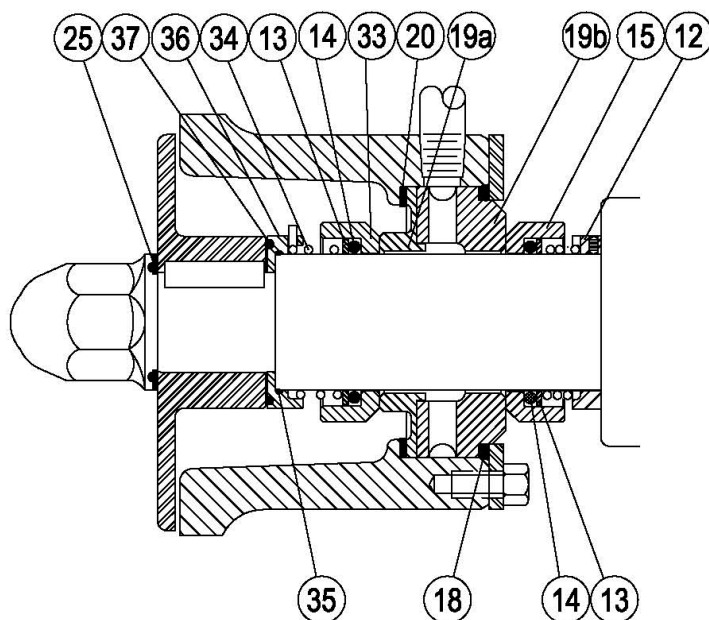


DOUBLE SEAL ASSEMBLY (SPLIT-CENTERED STYLE)



DESCRIPTION

- | | |
|---------------------------------|------------------------------------|
| (25) IMPELLER NUT GASKET | (33) FRONT ROTATING SEAL |
| (37) OUTSIDE SEAL DRIVER O-RING | (20) FLAT GASKET |
| (36) FRONT SEAL DRIVER | (19a) STATIONARY SEAL - FRONT HALF |
| (35) INSIDE SEAL DRIVER O-RING | (19b) STATIONARY SEAL - REAR HALF |
| (34) FRONT SEAL SPRING | (18) STATIONARY SEAL O-RING |
| (13) ROTATING SEAL WASHER | (15) REAR ROTATING SEAL |
| (14) ROTATING SEAL O-RING | (12) REAR SEAL DRIVER & SPRING |



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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:

9/16" wrench	(for 56C - 145TC motor frames)
3/4" wrench	(for 182 - 286TC motor frames)
Two 1-1/8" wrenches	(for 324 - 326TSD motor frames)
15/16" wrench	(for 324 - 365TSC 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 previously.

- a) Loosen the shaft collar screw on the shaft collar with an Allen wrench.
- 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.

MOTOR REPLACEMENT - REMOVAL

Loosen the motor bolts (28) with a wrench and remove the bolts and lock washers (27) that pass through the flange support (2) and thread into the C-face of the motor. For 324 and 326 TSD frame motors, use two wrenches to remove the bolts and lock washers that pass through the flange support and thread into the D-face motor.

Remove the flange support (2) from the motor (1). Take care to support the weight of the motor as you remove the flange support. Stand the motor on the fan guard if possible.

MOTOR REPLACEMENT - ASSEMBLY TO THE FLANGE SUPPORT

If you have replaced the motor, clean off the motor face of the flange support (2). Place the flange support on the new motor, replace the motor bolts (28) and lock washers (27). Tighten the motor bolts to the appropriate torque (see page 5).

For motor frame sizes up to and including 286 TC: The four hex bolts (28) with lock washers (27) are placed through the holes in the flange support then threaded into the tapped holes on the C-face of the motor.

For 324 and 326 TSD motors: The four hex bolts (28) are placed through the holes on the flange support and motor then fasten with a lock washer (27) and nut (38) .

Tighten the motor bolts to the proper torque (see page 4).

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) Do not tighten the shaft collar screw yet. You must first set the impeller gap.

SETTING THE IMPELLER GAP

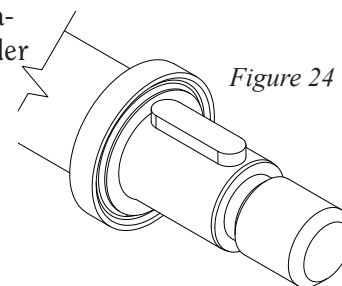
If you have removed the pump shaft from the motor shaft for any reason (such as replacing the shaft or motor), you must re-set the gap.

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 pages 4-5.

- a) **SINGLE FLANGE:** 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. Tighten the clamping bolt in the flange support. Note: make sure the housing is level or in line with the piping.

DOUBLE FLANGE: place the original housing shim, if supplied, with the pump and the pump housing (less the stationary seal) on the flange support. Bolt the housing in place.

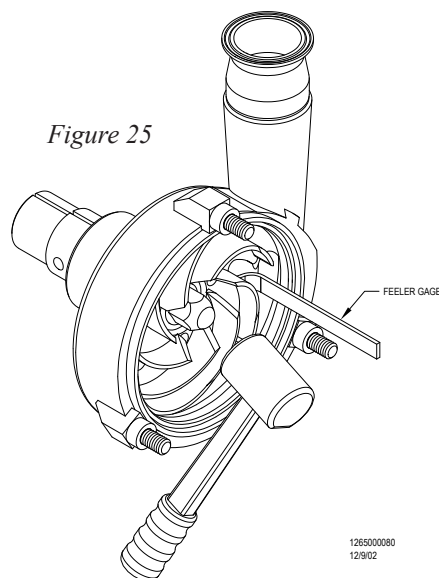
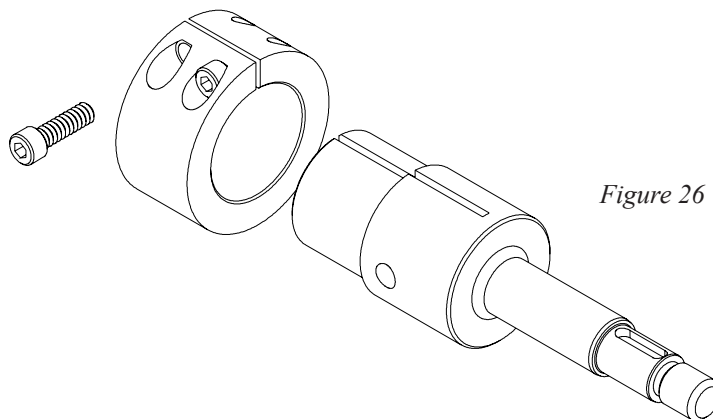
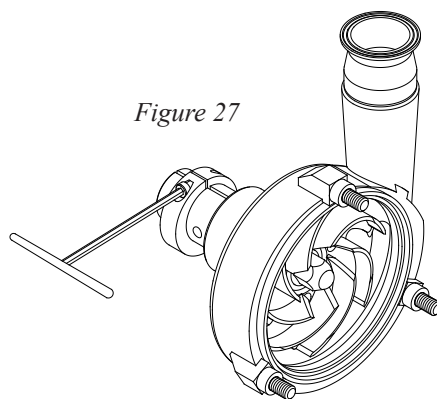
- b) Place the front seal driver and the impeller key onto the shaft (*Figure 24*).
- c) Place the impeller onto the shaft. Thread the impeller nut onto the shaft and tighten.



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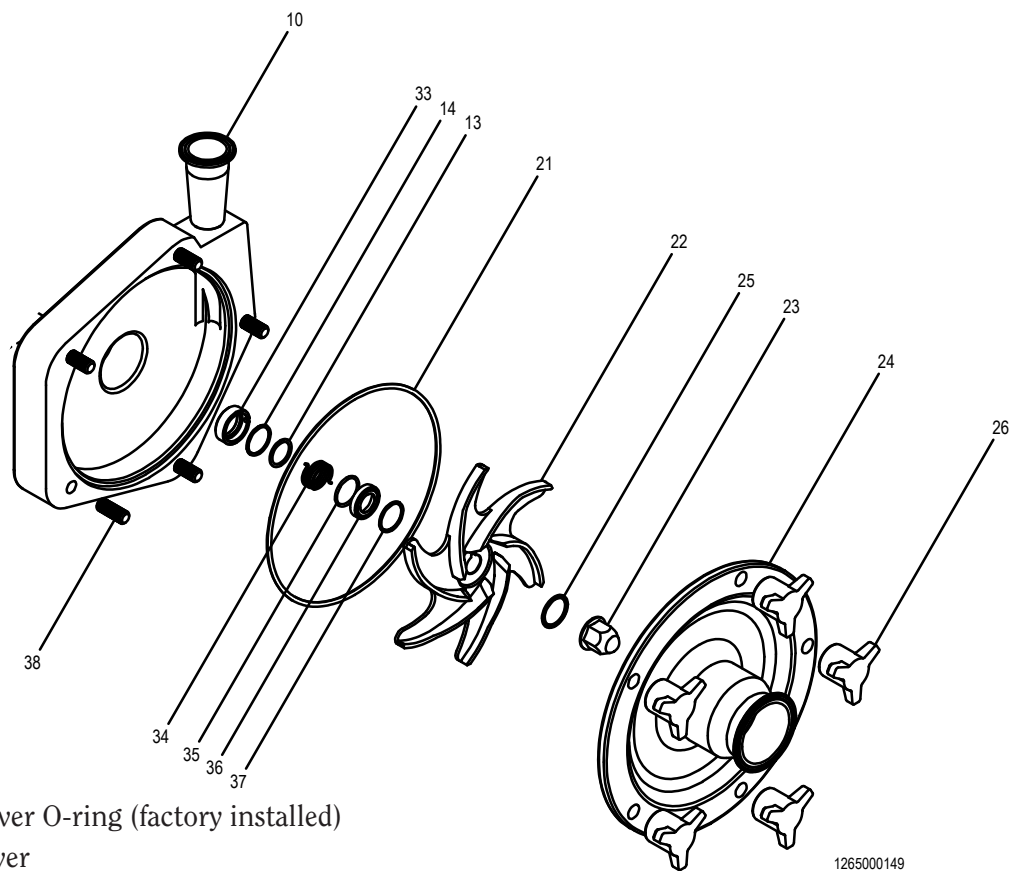
- d) With the shaft collar still loose, push the shaft slightly forward to leave room to adjust the gap.
- e) Place the correct feeler gauge behind two blades of the impeller.
- f) Using a soft-faced hammer, tap on the front of the impeller nut until the impeller is snug against the feeler gauge (*Figure 25*).
- g) Be sure to align the slot of the clamping ring directly over the slot on the shaft (*Figure 26*) and tighten the shaft collar screw on the shaft collar to the proper torque (*Figure 27*).
- h) Remove the feeler gauge.
- i) Check the gap by placing the correct feeler gauge behind each blade of the impeller to ensure the gap on each blade is correct.

Now you are ready to assemble the pump head as described previously.

Figure 25*Figure 26**Figure 27*

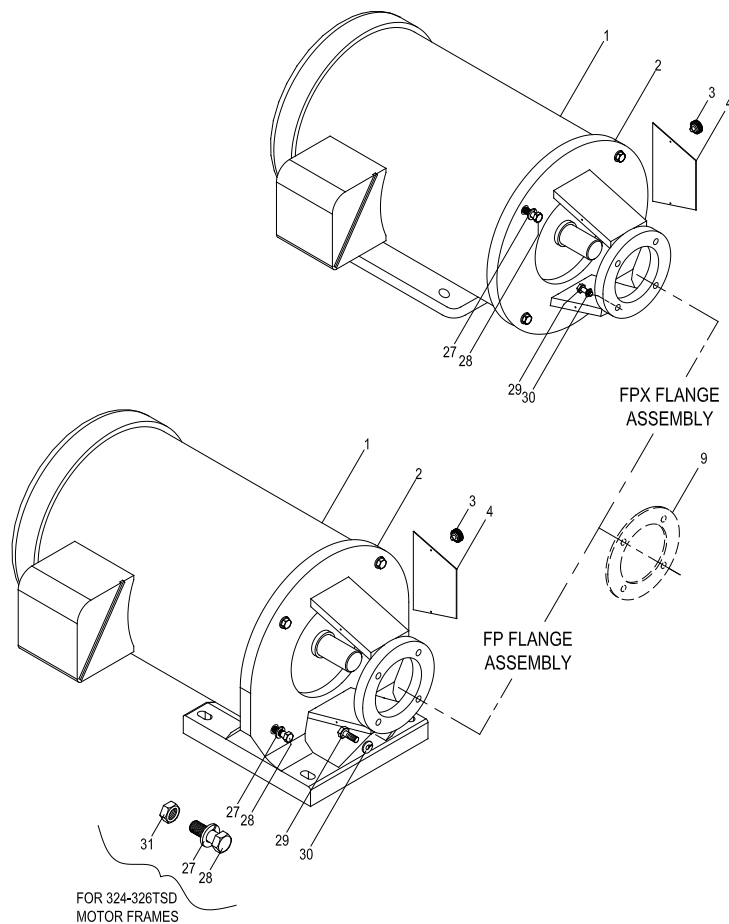


- | | | | |
|-----|-----------------------------|-----|-------------------------|
| 1. | Motor | 17. | Retaining Ring |
| 2. | Flange Support | 18. | Stationary Seal O-ring |
| 3. | Guard Nut | 19. | Stationary Seal |
| 4. | Shaft Guard | 20. | Flat Gasket |
| 5. | Shaft Collar Screw | 21. | Cover Gasket |
| 6. | Shaft Collar | 22. | Impeller |
| 7. | Pump Shaft | 23. | Impeller Nut |
| 8. | Impeller Key | 24. | Pump Cover |
| 10. | Pump Housing | 25. | Impeller Nut Gasket |
| 11. | Set Screws | 26. | Cover Nuts |
| 12. | Rear Seal Driver and Spring | 27. | Motor Bolt Lock Washer |
| 13. | Rotating Seal Washer | 28. | Motor Mounting Bolts |
| 14. | Rotating Seal O-ring | 32. | Water Piping (optional) |
| 15. | Rear Rotating Seal | 33. | Front Rotating Seal |
| 16. | Retaining Ring Bolts | 34. | Seal Spring |



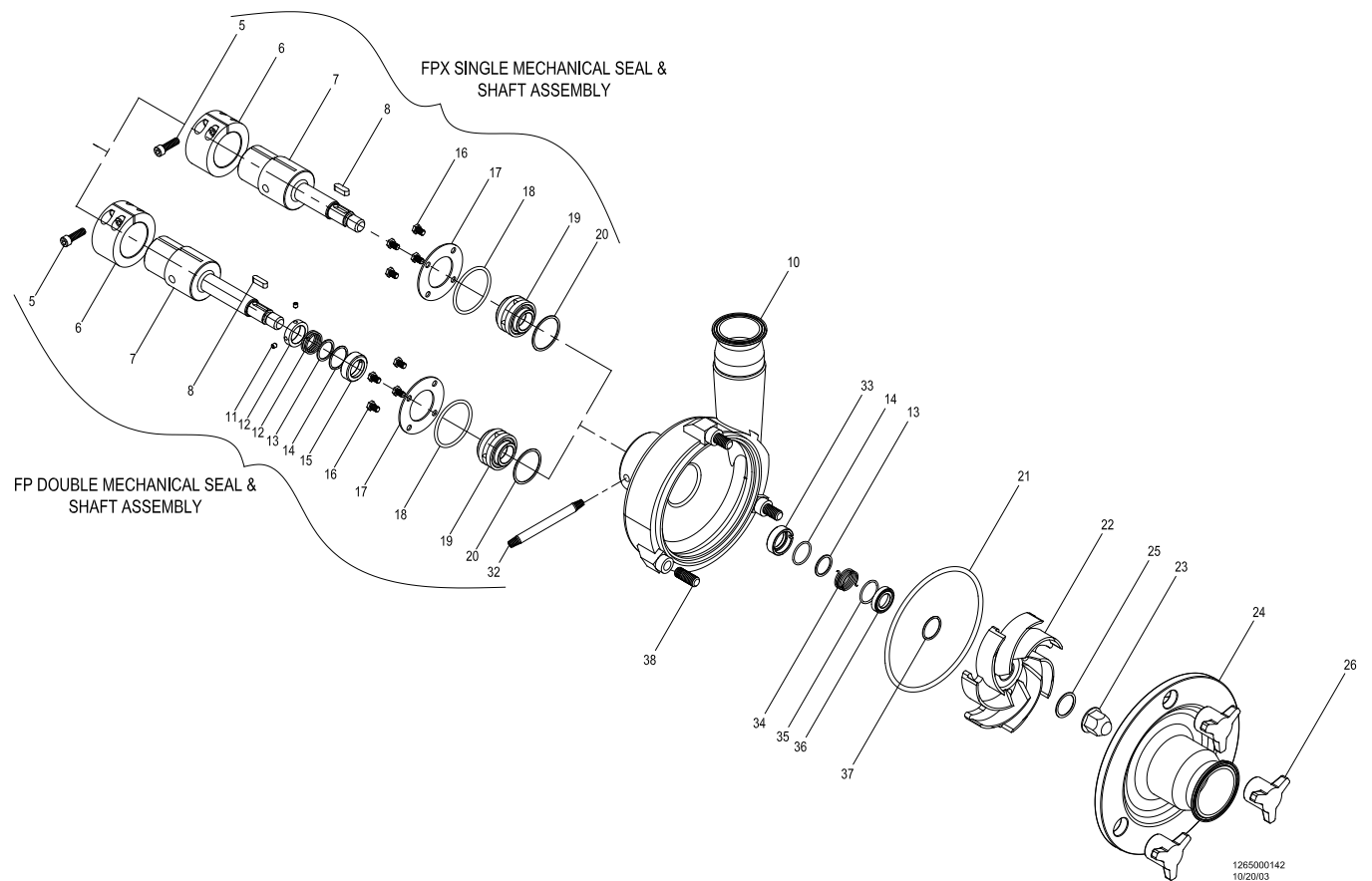
- 35. Inside Seal Driver O-ring (factory installed)
- 36. Front Seal Driver
- 37. Outside Seal Driver O-ring
- 38. Housing Studs
- 39. Clamping Bolt
- 40. Clamping Bolt Nut

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FP & FPX DOUBLE FLANGE ASSEMBLY

- | | |
|---------------------------------|---------------------------------|
| 1. Motor | 18. Stationary Seal O-ring |
| 2. Flange Support | 19. Stationary Seal |
| 3. Guard Nuts | 20. Stationary Seal Flat Gasket |
| 4. Shaft Guards | 21. Cover Gasket |
| 5. Shaft Collar Screw | 22. Impeller |
| 6. Shaft Collar | 23. Impeller Nut |
| 7. Shaft | 24. Pump Cover |
| 8. Impeller key | 25. Impeller Nut Gasket |
| 9. Shim (for some frame sizes) | 26. Cover Nuts |
| 10. Pump Housing | 27. Motor Bolt Lock Washer |
| 11. Set Screw | 28. Motor Bolts |
| 12. Rear Seal Driver and Spring | 29. Housing Bolts |
| 13. Seal Washer | 30. Housing Lock Washer |
| 14. Seal O-ring | 31. Motor Bolt Nut |
| 15. Rear Rotating Seal | 32. Water Piping (optional) |
| 16. Retaining Ring Bolts | 33. Front Rotating Seal |
| 17. Retaining Ring | 34. Seal Spring |



- 35. Inside Seal Driver O-ring (factory installed)
- 36. Seal Driver
- 37. Outside Seal Driver O-ring
- 38. Housing Stud

SPARE PARTS

Use of replacement parts that are not approved by Fristam Pump can lead to serious personal injury and material damage. If you have any questions regarding approved replacement parts, please contact Fristam.

TRANSPORTATION

Transportation may only be performed by trained personnel. The pump may be moved using approved lifting devices suitable for the weight/size of the pump. Improper securing the pump may result in injury from falling, tipping, or unsecured parts. Dimensional information is available for download at www.fristam.com/usa. Weight information is based on motor selection, and is available upon request.

NOISE REDUCTION

Operating the pump within its intended design range will aid in reducing the noise to acceptable levels.

- Avoid excessively low or very high flow rates.
- Avoid cavitation of the pump.
- Maintain good piping practices (see below).

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*).

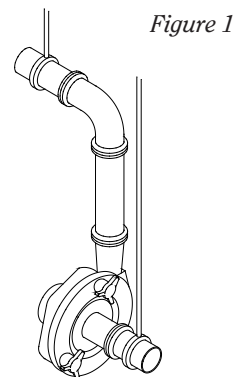


Figure 1

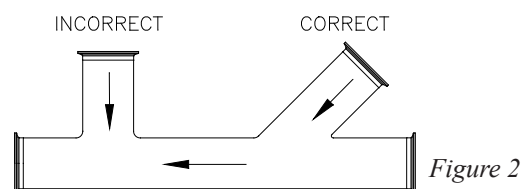


Figure 2

- 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.

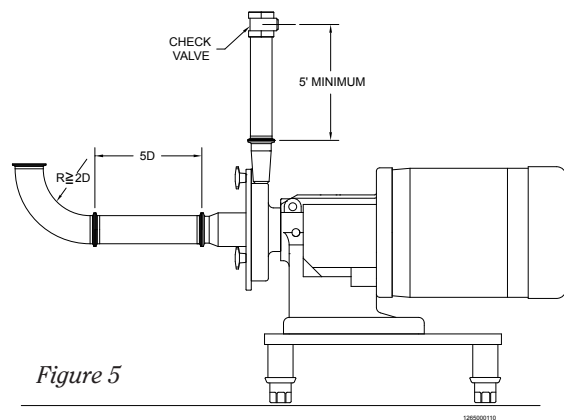
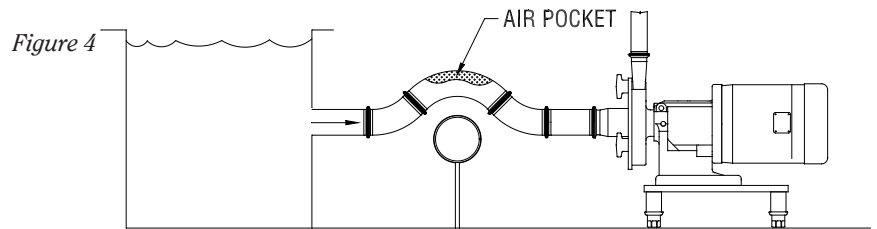
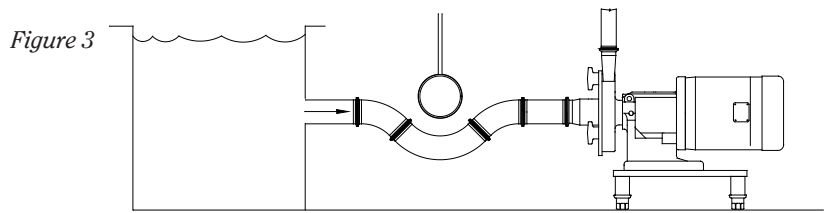
- Avoid sump areas where sediments may collect (*Figure 3*).

- 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

INTENDED USE

The standard FP/FPX centrifugal pump versions are designed for use in hygienic applications. Each pump is specified according to customer specifications, including performance and materials of construction. The pump may only be used for the application it was specified for.

General Specifications:

- Motor sizes up to 75 HP
- Flow rate up to 900 GPM
- Viscosity up to 1200 CPS
- Inlet pressure up to 150 psi
- Discharge pressure up to 450 ft. head / 195 psi

IMPROPER USE

The standard FP/FPX centrifugal pump versions may not be used in explosive atmospheres. Special explosion-proof versions may be available. Please consult Fristam for more information.

Pumping media other than those specified can cause serious damage to the pump and/or personnel. Any modifications to the pump or its use are only permissible with the explicit consent of Fristam.

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.

CLEANING

SIP PROCESS

FP/FPX series pumps should only be used for SIP (Sterilization In Place) process with the prior approval of Fristam. Suitability may depend on selected elastomers and/or process temperatures.

CIP PROCESS

FP/FPX series pumps are suitable for the CIP (Cleaning In Place) process. The following is a general example of the CIP process:

- Preliminary flush with water
- Caustic flush (NaOH, ~1-2%)
- Intermediate flush with water
- Acid flush (HNO₃, ~1%)
- Final flush with water

The pump's differential pressure should be sufficient to achieve adequate flow rates for proper cleaning. The result of the CIP process is dependent on many factors (temperature, time, chemical compositions/concentrations, speed, differential pressure, e.g.). Therefore, it is recommended that the cleaning cycle is validated prior to being put into service.

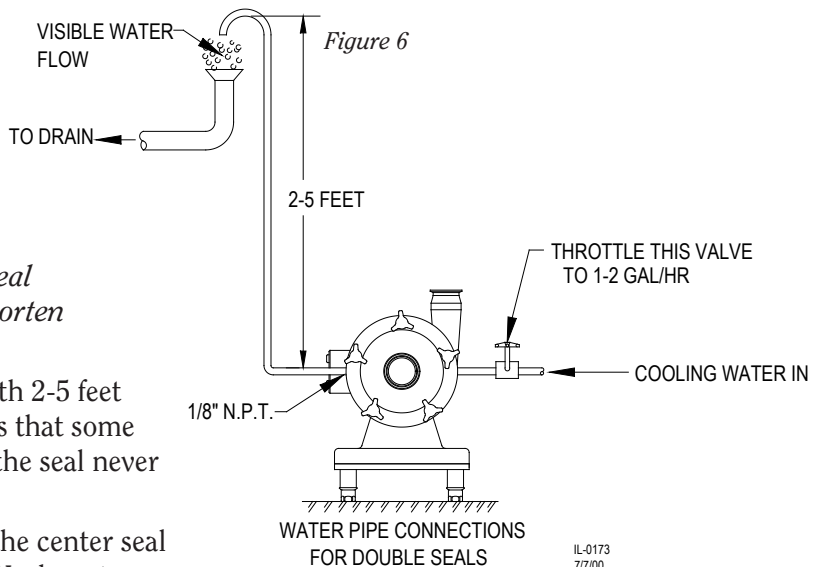
INSTALLATION OF WATER FLUSH FOR DOUBLE MECHANICAL SEAL

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.

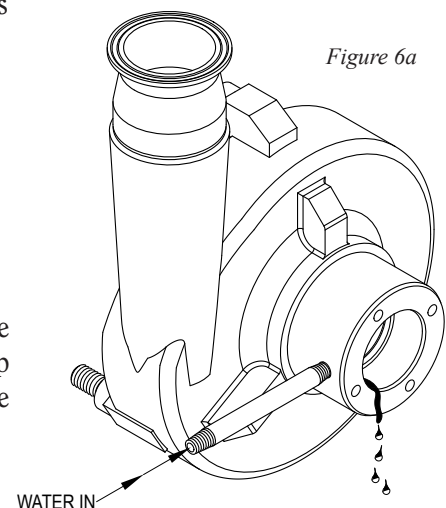
It is desirable to have the flush water on the outlet side visible. This allows an easy check to see that the flush water is on and also if the seal is functioning properly. In a malfunctioning seal the flush water will disappear, become discolored, or show an unusual increase in flow. If these conditions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



INSTALLATION OF WATER CASCADE

Note: Not all FP/FPX pumps require a water cascade on the seal. 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*).

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.

PROBLEM	POSSIBLE CAUSE OF TROUBLE
	(each number is defined on pages 25-26)
Pump does not deliver liquid	1, 2, 3, 4, 6, 14, 16, 17, 22, 23, 40
Not enough capacity delivered	2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 16, 17, 20, 22, 23, 27, 28, 40
Not enough pressure developed	5, 6, 7, 8, 14, 16, 17, 20, 22, 27, 28, 40
Pump loses prime after starting	2, 3, 5, 6, 7, 8
Pump requires too much power	15, 17, 18, 19, 20, 23, 24, 25, 26, 27, 30, 31, 34
Seal leaks	13, 25, 30, 31, 32, 36
Seal has short life	11, 12, 13, 25, 27, 30, 31, 32, 33, 34, 35, 36
Pump vibrates or is noisy	2, 3, 4, 9, 10, 21, 23, 24, 25, 26, 27, 28, 33, 34, 35, 37, 38, 39, 40
Motor bearings have short life	25, 26, 27, 33, 34, 35, 37, 38, 39
Pump overheats and seizes	1, 4, 21, 22, 26, 27, 33, 34, 35, 37, 38, 39, 40
Pump leaks from cover	29

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

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

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.
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 | 23. Remove pump cover and clear foreign matter |
| 24. Foundations not rigid | 24. Provide firmer foundation for the pump |
| 25. Shaft bent | 25. Replace shaft |
| 26. Impeller rubbing on pump housing | 26. Re-establish gap of the impeller, replace impeller if defective, make sure impeller nut is tightened properly |
| 27. Motor bearings worn | 27. Replace motor bearings |
| 28. Impeller damage | 28. Replace impeller |
| 29. Cover gasket defective permitting leakage | 29. Replace cover gasket |
| 30. Shaft or shaft collar worn or scored | 30. Replace pump shaft and/or collar |
| 31. Seal improperly installed | 31. Install seal correctly, replace seal if defective |
| 32. Type of seal incorrect for operating conditions | 32. Replace seal with correct type of seal, check with your local representative |
| 33. Pump shaft running off center because of worn bearings or misalignment | 33. Check motor bearings and replace if defective |
| 34. Impeller out of balance causing vibration | 34. Balance the impeller |
| 35. Motor front bearing not locked | 35. Contact motor manufacturer for locking shim or to replace motor with a motor with locked front bearing |
| 36. Dirt or grit in sealing liquid, leading to scoring of shaft or seal surface | 36. Use clean source of water for seal flush |
| 37. Lack of lubrication in motor bearing | 37. Lubricate motor bearings |
| 38. Improper installation of antifriction bearings (damage during assembly, incorrect assembly of stacked bearings, use of unmatched bearings as a pair, etc.) | 38. Reinstall bearings correctly |
| 39. Dirt in bearings | 39. Clean bearings, replace if defective |
| 40. Piping is obstructed | 40. Remove obstruction in pipe, check for closed valve |

PUMP MAINTENANCE RECORD

[illegible]

PUMP MAINTENANCE RECORD

[illegible]

EC DECLARATION OF CONFORMITY

The manufacturer: Fristam Pumps
 2410 Parview Road
 Middleton, WI 53562
 USA

herby declares that the following product (pump with motor):

- Centrifugal pump types: FPR, FPX, FP, FZX, FM, FPH/FPHP, FS
- Positive displacement pump types: FKL conforms to the requirements of the **Machinery Directive (2006/42/EC)**.

The machine also complies with all requirements of the **Low Voltage Directive (2006/95/EC)** and the **EMC Directive (2004/108/EC)**.

The following harmonized standards have been applied:

- DIN EN 809 Pumps and pump units for liquids – Common safety requirements
- DIN EN 12100 Safety of machinery – General principles for design – Risk assessment and risk reduction

Authorized person responsible for the compilation of the technical file:



Duane Ehlke / Vice President of Operations
2410 Parview Road
Middleton, WI 53562

Date: 2014-5-9

EG DECLARATION OF INCORPORATION

The manufacturer: Fristam Pumps
 2410 Parview Road
 Middleton, WI 53562
 USA

herby declares that the following product (pump without motor):

- Centrifugal pump types: FPR, FPX, FP, FZX, FM, FPH/FPHP, FS
- Positive displacement pump types: FKL are partly completed machines in accordance with the **Machinery Directive (2006/42/EC) Annex II B**.

The above mentioned products meet the relevant general health and safety requirements laid down in Annex I of the above Directive.

The above named partly completed machines must not be put into service until the final machinery into which they are to be incorporated has been declared in conformity with the provisions of the **Machinery Directive (2006/42/EC)**.

The above products comply with the following standards:

- DIN EN 809 Pumps and pump units for liquids – Common safety requirements
- DIN EN 12100 Safety of machinery – General principles for design – Risk assessment and risk reduction

On request, the manufacturer shall forward the special documentation of the partly completed machine in electronic format to the relevant state authorities. The special technical documentation relating to the machine according to Annex VII B has been compiled.

Authorized person responsible for the compilation of the technical file:



Duane Ehlke / Vice President of Operations
2410 Parview Road
Middleton, WI 53562

Date: 2014-5-9

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.



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Part # 1050000272
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