SERFILCO

Series ‘FE3’ Magnetic Coupled Pumps

Operation & Service Guide

Refer to Bulletin P-520

O-4060

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Model Number and Serial Number

Record the model number and serial number below for future reference. This is important information when ordering replacement parts or when technical assistance is required. The numbers are found on a label located on the motor adapter.

MODEL NUMBER_____

SERIAL NUMBER _____

IMPORTANT NOTICE

U.S. Export Administration Regulations, pursuant to ECCN 2B350, prohibit the export or re-export to certain enumerated countries of sealless centrifugal pumps in which all wetted materials are constructed from fluoropolymers without first applying for and obtaining a license from the U.S. Bureau of Industry and Security (BIS). This affects all magnetic-drive pumps constructed from PVDF or lined with ETFE. Please contact the BIS (www.bis.doc.gov) with questions regarding the Regulations or a list of the countries to which they apply.

Chemical Reaction Disclaimer

The user must exercise primary responsibility in selecting the product's materials of construction, which are compatible with the fluid(s) that come(s) in contact with the product. The user may consult Serfilco, Ltd. or a distributor agent to seek a recommendation of the product's material of construction that offers the optimum available chemical compatibility.

However neither manufacturer nor agent shall be liable for product damage or failure, injuries, or any other damage or loss arising out of a reaction, interaction or any chemical effect that occurs between the materials of the product's construction and fluids that come into contact with the product's components.

Safety Precautions

⚠ **WARNING:** READ THIS MANUAL COMPLETELY BEFORE INSTALLING AND OPERATING THIS UNIT. FAILURE TO FOLLOW THESE PRECAUTIONS CAN RESULT IN SERIOUS INJURY OR DEATH.

⚠ **WARNING: Magnetic field hazard.** This pump contains powerful magnets. Exposed magnets (pump not connected to motor) produce powerful magnetic fields. Individuals with cardiac pacemakers, implanted defibrillators, other electronic medical devices, metallic prosthetic heart valves, internal wound clips (from surgery), metallic prosthetic devices or sickle cell anemia must not handle or be in the proximity of the magnets contained inside the pump. Consult a health care provider for specific recommendations before working with this pump.

⚠ **WARNING: Magnetic force hazard.** This pump should only be disassembled and assembled using the recommended procedures. The magnetic attraction is powerful enough to rapidly pull the motor end and the wet end together. Do not place fingers between the mating surfaces of the motor and wet ends to avoid injuries. Keep the drive magnet and impeller assembly away from metal chips or particles, items with magnetic stripes like credit cards and magnetic computer media such as floppy discs and hard drives.

⚠ **WARNING: Guidelines for pumping flammable or combustible liquids.** Follow these guidelines when pumping flammable or combustible liquids with a FE3 Series pump:

1. You must use a PVDF pump. PVDF has conductive carbon fibers added which allow it to be grounded when installed in a properly grounded piping system or when a properly installed grounding strap is attached to a housing bolt. If PVDF is not compatible with the liquid, you should then consider an ETFE lined UC Series mag-drive pump.

2. You must select the non-sparking (Ns) bronze bump ring option. The non-sparking ring is pressed into the clamp ring or motor adapter and prevents sparking should the motor bearings fail and the outer mag drive assembly runs out of round.

3. Select explosion-proof motor or provide your own explosion-proof motor.

Follow these guidelines when pumping non-flammable or non-combustible liquids in a hazardous area with a FE3 Series pump:

1. You must select the non- sparking (Ns) bronze bump ring option. The non-sparking ring is pressed into the clamp ring or motor adapter and prevents sparking should the motor bearings fail and the outer mag drive assembly runs out of round.

2. Select explosion-proof motor or provide your own explosion-proof motor.

⚠ **WARNING: Hot surface**s. This pump is capable of handling liquids with temperatures as high as 220º F (104ºC). This may cause the outer areas of the pump to become hot as well and could cause burns.

⚠ **WARNING**: R**otating Parts**. This pump has components that rotate while in operation. Follow local safety standards for locking out the motor from the power supply during maintenance or service.

⚠ **WARNING**: **Chemical Hazard**. This pump is used for transferring many types of potentially dangerous chemicals. Always wear protective clothing, eye protection and follow standard safety procedures when handling corrosive or personally harmful materials. Proper procedures should be followed for draining and decontaminating the pump before disassembly and inspection of the pump. There may be small quantities of chemicals present during inspection.

⚠ **WARNING:** Never run pump at less than minimum flow or with the discharge valve closed. This could lead to pump failure.

⚠ **WARNING:** The pump and associated components are heavy. Failure to properly support the pump during lifting and movement could result in serious injury or damage to the pump and components.

⚠ **CAUTION:** This pump should never be started without liquid in the casing. If the pump has a PTFE, ceramic or silicon carbide bushing, IT CANNOT BE RUN DRY WITHOUT CAUSING DAMAGE TO THE PUMP. It is recommended that run dry protection be used. Optional electronic power monitors are available to help protect against run dry. However, the pump can operate without liquid in the housing if the pump has a carbon bushing. The exact length of time the pump can operate dry with a carbon bushing varies with operating conditions and environment.

⚠ **CAUTION:** Never start or operate with a closed suction valve.

⚠ **WARNING:** Operation without priming or against a closed discharge valve can result in high temperatures that can result in injury or damage to pump components.

⚠ **CAUTION:** Always provide adequate NPSHa (net positive suction head available). It is recommended to provide at least 2 feet (61cm) above the NPSHr (net positive suction head required).

⚠ **CAUTION**: If pump is used on variable speed drive, do not exceed the frequency for which the pump was designed (for example, if the pump is a 50 Hz model, do not exceed 50 Hz).

Safety Precautions for ATEX Pumps

⚠ **CAUTION:** Proper O-ring material must be chosen for the fluid being pumped. Improper material selection could lead to swelling and be a possible source of leaks. This is the responsibility of the end user.

⚠ **WARNING:** The pump must be checked for leaks on a regular basis. If leaks are noticed, the pump must be repaired or replaced immediately.

⚠ **WARNING:** The pump must be cleaned on a regular basis to avoid dust buildup greater than 5 mm.

⚠ **WARNING:** ATEX pumps must use a power monitor, flow switch, pressure switch or similar device to help protect against running dry, closed discharge valve and decoupling. Any of these conditions could lead to a rise in surface temperature of the pump.

Temperature Classification

The surface temperature of FE3 Series pumps depends upon the temperature of the fluid that is being pumped. The following chart lists different fluid temperatures and the corresponding pump surface temperature.

Fluid Temperature	Maxim Surface Temperature	Temperature Class	Maximum Allowable Surface Temperature
85° F (36° C)	136° F (58° C)	T6	85° C
170° F (77° C)	178° F (81° C)	T5	100° C
220° F (104° C)	203° F (95° C)	T4	135° C

FE3 Capabilities

Maximum Working Pressure: 90psi (6.2 bar)

Maximum Temperature: Polypropylene -180º F (82º C); PVDF – 220º F (104º C)

NOTE: Maximum temperature is application dependent. Consult a chemical resistance guide or the chemical manufacturer for chemical compatibility and temperature limits.

Solids: Maximum particle size is 100 microns for slurries and 1/64" (.4 mm) for occasional solids. Maximum hardness is 80 HS. Maximum concentration is 10% by weight.

NOTE: If solids are being pumped, it is recommended that the pump have silicon carbide components for best results. Pumping solids may lead to increased wear.

Minimum Allowable Flow Rate - Do not allow the flow rate to drop below 10 gallons per minute (2.3 m3/hr).

Maximum Noise Level: 80 dBA

Maximum Allowable Motor Power
Do not exceed 7.5 kW (10 horsepower) for 50 Hz, 2900 rpm applications. For 60 Hz, 3450 rpm applications, the pump is capable of starting a 15 horsepower motor but is limited to a maximum of 13 horsepower (9.7 kW) while running. Use the information in the chart below to determine the maximum specific gravity capabilities by impeller trim for non-overloading applications. The use of a power monitor is strongly recommended for 60 Hz applications above 10 horsepower (7.5 kW).

Maximum Specific Gravity for Non-Overloading Applications

3450 rpm (60Hz)	
Closed Impeller Diameter	**Maximum Specific Gravity**
7.25" (184.2 mm)	1.0
7" (177.8 mm)	1.1
6.5" (165.1 mm)	1.5
6" (152.4 mm)	1.8
5.5" (139.7 mm)	1.8
5" (127.0 mm)	1.8
4.5" (114.0mm)	1.8

2900 rpm (50 Hz)	
Closed Impeller Diameter	**Maximum Specific Gravity**
184.2 mm (7.25")	1.35
177.8 mm (7")	1.6
165.1 mm (6.5")	1.8
152.4 mm (6")	1.8
139.7 mm (5.5")	1.8
127.0 mm (5")	1.8

3450 rpm (60Hz)	
Open Impeller Diameter	**Maximum Specific Gravity**
6" (152.4 mm)	1.5
5.5" (139.7 mm)	1.8
5" (127.0 mm)	1.8
4.5" (114.0 mm)	1.8

2900 rpm (50Hz)	
Open Impeller Diameter	**Maximum Specific Gravity**
181.0 mm (7.13")	1.35
177.8 mm (7")	1.5
165.1 mm (6.5")	1.75
152.4 mm (6")	1.8
139.7 mm (5.5")	1.8

Unpacking and Inspection
Unpack the pump and examine for any signs of shipping damage. If damage is detected, save the packaging and notify the carrier immediately.

Section I - Assembly

Tools Required:
3/8" Allen wrench or ballpoint hex socket, 3/16" Allen wrench, 19mm hex socket, metric socket set (for pumps with IEC outer drives)

Pumps with Motors
Proceed to "Installation" Section

Pumps without Motors
NOTE: All motors must have motor feet

1. Remove the pump, drive magnet assembly and hardware package from the carton. For 184TC motors proceed to step 3.

⚠ **Caution:** Keep away from metallic particles, tools and electronics. Drive magnets MUST be free of metal chips.

⚠ **Warning:** Keep the drive magnet away from the open end of motor adapter and barrier. Strong magnetic attraction could allow the drive hub to enter the motor adapter resulting in injury or damage.

2. **For 213/215 NEMA motors only**
   Install the O-ring in the groove in the motor adapter. Use small amount of petroleum jelly (or silicone grease on EPDM O-rings) to help hold the O-ring in place. Install the larger female rabbet portion of the motor adapter flange on the motor face. Align the holes in the adapter with the holes in the motor face. See figure 1.

   For 90, 100/112, & 132 with B5 flange motors
   Install flange on motor with the side with pockets (depressions) towards the motor face. Align (4) holes in the adapter with the holes in the motor face. Install (4) customer supplied bolts, lock washers and flat washers through the motor adapter into the motor face.

   For 90 and 132 with B14 flange & 145TC motors
   Install flange on motor with pockets (depressions) side towards the motor face. Align (4) holes in the adapter with the holes in the motor face. Install (4) bolts, lock washers and flat washers through the motor adapter into the motor face. See figure 1.

   For 100/112 with B14 flange motors
   Install flange on motor with pockets (depressions) towards the pump motor adapter. Align (4) holes in the adapter with the holes in the motor face. Install (4) bolts, lock washers and flat washers through the motor adapter into the motor face.

Flange hole thread size:
90 B5 = M10 x 1.5
100/112 B5 = M12 X 1.75

Torque bolts to the following:
90/100/112 B14 frame (M8) = 130 in-lb. (14.7 N-m)
132 B14 (M10) frame (M10) = 240 in-lb. (27.1 N-m)
90 frame B5 (M10) = 240 in-lb. (27.1 N-m)
100/112/132 B5 (M12) = 480 in-lb. (54.3 N-m)

Figure 1

3. Coat the motor shaft with anti-seize compound. Insert key supplied with motor into keyway on motor shaft.

   NOTE: Make sure the motor shaft is clean and free of burrs. The outer drive is precision machined and has a bore tolerance of +.0005/-0 inch

4. Slide the outer drive magnet assembly onto the motor shaft until the motor shaft contacts the snap ring in the bore of the drive. Figures 2 and 3.

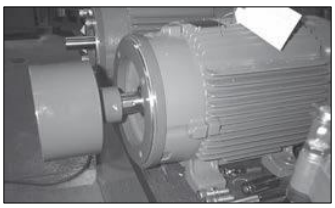

Figure 2

Figure 3

⚠ **WARNING:** Be careful, magnets will try to attract tools.

Metric Motors: Secure the drive to the motor shaft using bolt, lock washer and flat washer. Thread the bolt into the end of the motor shaft (while holding the outer drive to prevent it from turning). See figure 4.
Tighten the bolt to the following:

- 90 frame (M8) = 130 in-lb. (14.7 N-m)
- 100/112 frame (M10) = 240 in-lb. (27.1 N-m)
- 132 frame (M12) = 480 in-lb. (54.3 N-m)

NEMA Motors: Install set screws into threaded holes on the side of the outer drive magnet assembly. Using a 3/16" Allen wrench, tighten to 228 in-lbs. (25.8 N-m).
See figure 5.

Figure 4

Figure 5

5. Install the pump end on the motor/drive magnet assembly.

   NOTE: If the pump has the optional O-ring sealing option (available on the 184 and 215 frame pumps only), install the O-ring in the groove in the motor adapter (motor end). Use small amount of petroleum jelly (or silicone grease on EPDM O-rings) to help hold the O-ring in place.

   Place the motor/drive on a flat surface with the drive and motor face hanging over the bench surface. Secure the motor to the bench.

   Firmly grab the pump and slide over the outer drive magnet until the motor adapter is seated in the rabbet of the motor (184TC) or the motor adapter flange. The last 4-5" (10-12cm) will have strong magnetic attraction between the pump and outer drive magnet. See figures 6 and 7.

   NOTE: the clearance between the motor adapter and drive magnet is tight (about .010"/.254 mm).

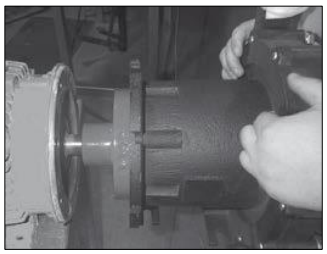

Figure 6

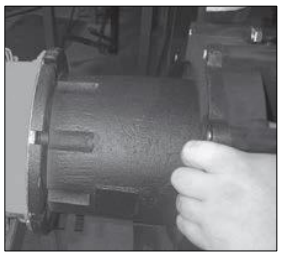

Figure 7

6. Secure the pump to the motor using (4) 1/2" socket head cap screws, lock washers and flat washers. Use 3/8" Allen wrench or 3/8" hex socket on universal joint.
   See figures 8 and 9.

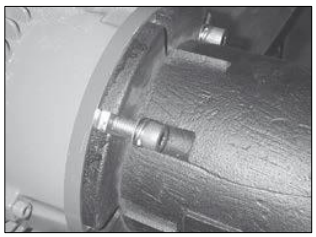

Figure 8

Figure 9

7. Rotate the motor fan to ensure that there is no binding in the pump.

8. Proceed to Installation Section.

Section II - Installation

Mounting - Pump foot should be securely fastened to a solid foundation. If the pump was received with plastic shipping shims, these may be used as additional support for the motor feet.

⚠ **CAUTION:** The NPSH available to the pump must be greater than the NPSH required. NPSH available should be two feet (.6 meters) greater than NPSH required.

- Install the pump as close to the suction source as possible.

- Support the piping independently near the pump to eliminate any strain on the pump casing. In addition, the piping should be aligned to avoid placing stress on the pump casing.
- The suction side of the pump should be as straight and short as possible to minimize pipe friction.

- The suction line should not have any high spots. This can create air pockets that can reduce pump performance. The suction piping should be level or slope slightly upward to the pump.

- If flexible hose is preferred over pipe, use a reinforced hose rated for the proper temperature, pressure and is chemically resistant against the fluid being pumped.

- The suction valve must be completely open to avoid restricting the suction flow.

- When installing pumps with flanges, we recommend use of low seating stress gaskets such as Gore-Tex or Gylon (expanded PTFE)

Motor/Electrical

Install the motor according to NEC requirements and local electrical codes. The motor should have an overload protection circuit.

Wire the motor for clockwise rotation when facing the fan end of the motor.

⚠ **CAUTION**: Do not operate the pump to check rotation until the pump is full of liquid.

Check all electrical connections with the wiring diagram on the motor. Make sure the voltage, frequency, phase and amp draw comply with the supply circuit.

To verify correct rotation of the motor:

1. Install the pump into the system.
2. Fully open the suction and discharge valves.
3. Allow fluid to flow into the pump. Do not allow the pump to run dry (ceramic, PTFE and silicon carbide bushings can't be run dry without damage to pump components).
4. Jog the motor (allow it to run for 1-2 seconds) and observe the rotation of the motor fan. Refer to the directional arrow molded into the pump casing if necessary.

NOTE: A pump running backwards will pump but at a greatly reduced flow and pressure.

Section III - Start-up and Operation

Start-up and Operation

1. This pump must be filled from a flooded suction tank (gravity) or primed with liquid from an outside source. The FE3 is not self-priming

2. Open the inlet (suction) and discharge valves completely and allow the pump to fill with liquid.

3 Close the discharge valve.

4. Turn the pump on. Slowly open the discharge valve. Adjust the flow rate and pressure by regulating the discharge valve. Do not attempt to adjust the flow with the suction valve.

Shut-down

1. Use the following procedure to shut-down the pump.

2. Slowly close the discharge valve.

3. Turn off the motor.

4. Close the suction valve.

Flush Systems

⚠ **CAUTION:** Some fluids react with water; use compatible flushing fluid.

1. Turn off the pump.

2. Completely close the suction and discharge valves.

3. Connect flushing fluid supply to flush inlet valve.

4. Connect flushing fluid drain to flush drain valve.

5. Open flushing inlet and outlet valves. Flush system until the pump is clean.

Optional Drain Installation

1. Remove the impeller housing from the pump assembly.

2. Clamp the impeller housing to a drill press table.

3. Using a 7/16" drill and the molded boss as a guide, drill completely through the molded boss into the interior of the impeller housing.

⚠ **CAUTION:** Do not tap too deep or the impeller housing may be damaged.

4. Using a 1/4" NPT tap, tap the hole in the molded boss to the appropriate depth.

5. Install the drain plug or valve, being careful not to over-tighten.

Section IV - Maintenance

Recommended maintenance schedule

The recommended maintenance schedule depends upon the nature of the fluid being pumped and the specific application. If the pump is used on a clean fluid, it is recommended that the pump be removed from service and examined after six months of operation or after 2,000 hours of operation. If the pump is used on fluids with solids, high temperatures or other items that could cause accelerated wear, then this initial examination should be sooner.

After the initial examination of the internal components and wear items are measured, a specific maintenance schedule can be determined. For best results, it is recommended that the pump be removed from service annually for examination.

Disassembly

⚠ **Warning:** Rotating Parts. This pump has components that rotate while in operation. Follow local safety standards for locking out the motor from the power supply during maintenance or service.

⚠ **Warning:** Chemical Hazard. This pump is used for transferring many types of potentially dangerous chemicals. Always wear protective clothing, eye protection and follow standard safety procedures when handling corrosive or personally harmful materials. Proper procedures should be followed for draining and decontaminating the pump before disassembly and inspection of the pump. There may be small quantities of chemicals present during inspection.

⚠ **Warning:** Magnetic force hazard. This pump should only be disassembled and assembled using the recommended procedures. The magnetic attraction is powerful enough to rapidly pull the motor end and the wet end together. Do not place fingers between the mating surfaces of the motor and wet ends to avoid injuries. Keep the drive magnet and impeller assembly away from metal chips or particles.

Stop the pump, lock out the motor starter, close all the valves that are connected to the pump, and drain/decontaminate the pump.

⚠ **Warning:** The pump must be thoroughly flushed of any hazardous materials and all internal pressure relieved prior to opening the pump. Allow the pump to reach ambient temperatures prior to performing maintenance.

1. Secure the pump/motor to the bench with the adapter foot hanging over the edge. Remove (4) 1/2" socket head cap screws, lock washers and flat washers securing the pump to the motor. Use 3/8" Allen wrench or 3/8" hex socket on universal joint.

2. Firmly grab the motor adapter and pull straight out to dis-engage the motor and pump. See figure 10.

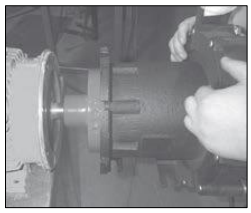

Figure 10

NOTE: If the pump has the optional O-ring sealing option (available on 184 and 215 frame pumps only), make sure O-ring does not fall out of the motor adapter (motor end).

3. Place pump on bench with housing facing up. Using a 19 mm socket, remove (10) M12 hex head cap screws, lock washers and flat washers. See figure 11.

4. Pull housing straight up to remove. Impeller shaft may be lodged in the front shaft support. Inspect housing for signs of wear or damage. Look for signs of rubbing, cracked thrust ring or damage to front shaft support. See figure 12.

5. Remove impeller/inner drive assembly.

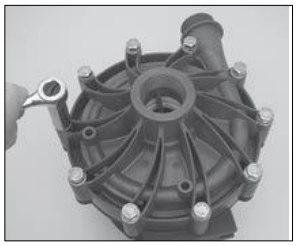

Figure 11

Figure 12

See figure 13. Inspect impeller and drive for signs of wear or damage. Look for signs of rubbing, damage and wear to the impeller and inner drive. Check the impeller thrust ring and bushing for wear. See figure14.

Figure 13

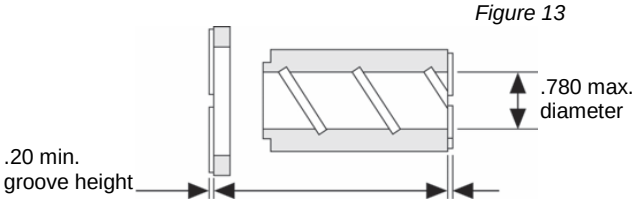

Figure 14

6. Remove the impeller shaft (item 5) from the barrier and check for signs of cracking, chipping, scoring or wear. See figure 15.

7. Remove the Barrier from the motor adapter (make sure the spindle has been removed). If necessary, gently tap on the backside of the barrier with a soft rod (wood, plastic, etc.). Inspect the inside and outside of the barrier for signs of rubbing. See figure 16.

Figure 15

Figure 16

8. Remove the O-ring from the barrier and inspect for chemical attack, swelling, brittleness, cuts, etc.

9. Visually inspect the outer drive for rubbing, damage, corrosion or loose magnets.

NOTE: Inspect the O-ring, for chemical attack, swelling, brittleness, cuts, etc. Both NEMA and IEC pumps have O-ring. If the pump has the optional O-ring sealing option (available on 184 and 215 frame pumps only), inspect O-ring.

Outer Drive Replacement

1. Remove the setscrews from the side of the drive (NEMA motors) or the bolt, lock washer and flat washers from the center of the drive (metric motors).

⚠ **Warning:** Be careful, tools will want to be attracted to the magnets.

2. Remove the drive magnet from the motor shaft by gently prying up from the bottom of the drive.

3. To reinstall the drive or a new drive follow the instructions from "Section I - Assembly, Pumps without Motor, Steps 3&4"

Thrust Ring Replacement

1. Thrust ring is held in-place with a snap fit ridge. Using a razor knife or side cutters, cut a notch out of the thrust ring. Pull ring up and out of the holder.
See figures 17 and 18.

2. To reinstall, align the two flats on the thrust ring with the flats in the bore of the impeller. Using a piece of wood press into place using an arbor press until the thrust ring is completely seated in the impeller.

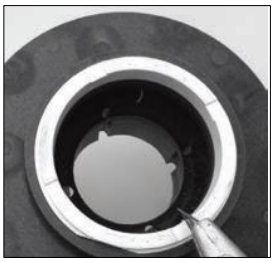

Figure 17

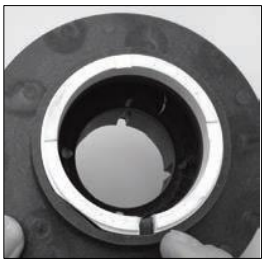

Figure 18

Bushing Replacement

1. To remove the bushing, place the impeller/inner drive assembly with the impeller facing up in an arbor press. If necessary support the bottom of the assembly with blocks to allow the bushing to fall out. Insert a 1" (25.4mm) diameter plastic or wooden shaft through the impeller and press bushing out. See figure 19.

2. To replace bushing, place the assembly on a flat surface with the impeller thrust ring face down. With the slotted face of the bushing facing the rear of the inner drive, align the flat in the bushing with the flat in the inner drive magnet. See figure 20. Gently push until bushing bottoms out.

Figure 19

Figure 20

Impeller Replacement

1. To remove the impeller from the inner drive magnet, gently pry off by hand or lightly tap the back of the impeller.

2. To install a new impeller, place the inner drive magnet assembly face up. Line up the patterns on the impeller with the ones on the inner drive magnet so they match and press into place by hand. An arbor press can also be used to press the impeller on the inner drive. Place a piece of wood over the top of the impeller thrust ring and push down on the impeller until it is completely seated in the inner drive.

Reassembly

1. Lubricate the O-ring with a chemically compatible lubricate and install in the groove in the motor.

2. Install the barrier into the motor adapter. Press firmly to ensure that the barrier is completely seated.

3. Install O-ring in groove in barrier.

4. Install impeller shaft into barrier by aligning flats on the shaft with the ones in the barrier. Make sure it is completely seated. See figure 21

Figure 21

5. Carefully install the impeller/inner drive assembly by sliding it over the impeller shaft in the barrier. It is normal for the impeller/inner drive to pop up a slight amount due to magnetic forces. See figures 22 and 23.

Figure 22

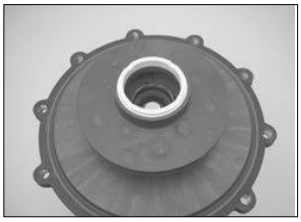

Figure 23

6. Install the impeller housing. Make sure the discharge is in the correct orientation in relation to the motor adapter pump foot. Align the shaft in the barrier with the front shaft support in the impeller housing. Press down to push the impeller/inner drive magnet assembly into position. Holding the impeller housing with one hand, install and finger-tighten two bolts lock washers and flat washers in opposite locations. See figure 24.

7. Install the remaining bolts, lock washers and flat washers finger tight.

8. Using a 19 mm socket, tighten all the bolts evenly using a star pattern. Tighten to 240 in-lb. (27.1 N-m)

Figure 24

9. Reinstall the pump on the motor/ drive magnet following instructions from "Section I – Assembly, Pumps without Motors, Steps 5 & 8".

Troubleshooting

General Notes:

- Do not pump liquids containing ferrous metal fines.
- If magnets decouple, stop pump immediately. Operating the pump with the magnets decoupled will eventually weaken the magnets.
- Contact our Technical Service Department If you have any questions regarding product operation or repair:

No or Insufficient Discharge

- Air leaks in suction piping
- Pump not primed
- System head higher than anticipated
- Closed valve
- Viscosity or specific gravity too high
- Motor too large for magnet coupling rating (magnets uncoupled)
- Suction lift too high or insufficient NPSH
- Clogged suction line or impeller vanes
- Motor rotation incorrect (correct rotation when viewed from the fan end is clockwise)

Insufficient Pressure

- Air or gas in liquid
- Impeller diameter too small
- System head lower than anticipated
- Motors speed insufficient (too low) or motor rotation incorrect (correct rotation when viewed from the fan end is clockwise)

Loss of Prime

- Leak in suction piping
- Foot valve or suction opening not submerged enough
- Foot valve too small or leaking
- Air or gas in liquid
- Foreign matter in impeller
- Leaking valve. Suction lift too high or insufficient NPSHa.

Excessive Power Consumption

- Head lower than rating
- Excessive flow
- Specific gravity or viscosity too high

Vibration/Noise

- Loose magnet
- Drive magnet rubbing
- Pump cavitating from improper suction or feed
- Motor or piping not properly secured
- Foreign object in impeller