
Liquiflo

E Q U I P M E N T C O M P A N Y

INSTALLATION and MAINTENANCE MANUAL

3 and H-SERIES

ROTOGEAR™ SEALED PUMPS



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Document No.: 3.20.073

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GENERAL INSTRUCTIONS

This Manual covers the “3” and “H” series Sealed pumps.

Upon receipt of your Liquiflo pump verify:

- A) The equipment has not been damaged in transit.
- B) The pump model number and serial number are stamped on the pump's rear housing.

RECORD

Model:_____ **Serial No.**_____

NOTE: By adding a K prior to the pump's model number a repair kit can be obtained which consists of the following parts: drive and idler gears, drive and idler shafts, retaining rings, wear plates, keys, housing and bearing lock pins, o-rings and bearings.

SYMBOL EXPLANATION

- A) Work Safety Symbol



This symbol indicates remarks applicable to operational safety, where risks for health and life of personnel may be posed. All cautions should be passed on to other users.

- B) Attention Symbol

ATTENTION

Special attention must be paid in order to maintain a correct operating procedure and to avoid damage to the pump and/or other plant equipment.

INSTALLATION OF PUMP AND MOTOR ASSEMBLY

ATTENTION

All items included in this section.

The following should be observed for proper installation of the pump.

- A) Pump should be accessible for servicing and inspection.
- B) The foundation area should be rigid and level for maintaining pump alignment.
- C) The inlet should be as close to the liquid source as practical and preferably below it.
- D) Piping should be supported. **Do not use** the pump as a pipe hanger.
- E) Install valves and unions to isolate the pump during maintenance.

- F) Suction and discharge piping should be the same size or larger than the inlet and outlet ports.
- G) Clean piping as necessary to remove dirt, grit, weld slag, etc.
- H) If the Liquiflo pump was delivered as a complete assembly, it was properly aligned at the factory. Alignment should be checked by taking measurements at the coupling. Flexible couplings are not intended to compensate for misalignment. Therefore, both angularity and parallelism should be checked and corrected. If these are off, by more than 0.015 inches (0.4 mm), the assembly should be realigned.
- I) For further instructions on mounting or installing your pump, refer to the Hydraulics Institute Handbook.
- J) A positive displacement pump should have a pressure relief valve installed in the discharge line.
- K) Maximum particle size capable of being passed by the pump is 37 microns. A filter of at least 400 U.S. Mesh should be installed in the suction line. 312, H12 and 314 particle size is 60 microns with a filter mesh of 230 U.S. Concentration of solids, exceeding 1% is not recommended as wear rates will increase to unacceptable levels.



START UP

Insure motor is locked out, prior to rotating pump by hand.

- A) Turn the pump by hand to insure that it turns freely.
- B) Jog the motor to check the rotation. As viewed from the pump end a clockwise rotation of the motor will result in fluid discharge to the left. Counterclockwise rotation will result in fluid discharge to the right. The 312, 314 and the H series are opposite.
- C) The pump should be operated with at least a 20-psi (1.4 bar) differential pressure.
- D) The pump is capable of pulling a dry lift, but it is still recommended to prime the pump prior to start up.
- E) **Do not** operate the pump without fluid in it for more than 30 seconds.

SPECIAL PRECAUTIONS FOR VARIOUS SEALS

- A) If packing was specified for the stuffing box the following should be observed.

1) A packed pump can be run with grease, an external flush, or nothing at all. If grease is used, it should be compatible with the fluid being pumped (i.e. non-soluble and non-reactive). Inject grease into the fitting after removing the drain plug on the opposite side. This greasing should be repeated periodically. If nothing is used, there must be some leakage out of the pump so the packing is well lubricated.

NOTE: Replace drain plug after greasing.

2) Don't over tighten the packing screws. You will burn the packing and damage the shaft. Packed boxes should leak at a rate of 8 to 10 drops per minute. Tighten the gland screws 1/4 turn at a time to allow the leakage rate to stabilize. Repeat until a rate of 8-10 drops per minute is stable.

ATTENTION

Do not wear loose clothing around rotating objects.

B) If the pump is equipped with a double mechanical seal, a lubrication loop to pressurize the seal chamber is required. The seal chamber should be kept at approximately 5 to 20 psi (.3 to 1.4 bar) higher than the discharge pressure. In addition, the flow rate through the seal chamber should be approximately 1/8 GPM, for fluids with specific heat values other than 1.0 (i.e. water) the flow rate should be adjusted.



Insure coupling guard is replaced prior to starting.

ATTENTION

REMOVAL FROM SYSTEM

When the pump is handling flammable, toxic or hazardous fluid, flush the pump prior to removal from the piping system. Prior to flushing and disassembly consult the Material Safety Data Sheet (MSDS) for the pumped fluid to ensure procedures and precautions as specified are adhered to. Exercise extreme care to avoid contact with the fluid.

ATTENTION

Insure that the motor is locked out.

MAINTENANCE AND REPAIR

The pump has internal bearings and wear plates, which require replacement over time.

ATTENTION

Insure the pump's motor switch is in the "*off*" position and locked out.

The balance of the manual describes the maintenance procedures for the specific type of seal involved.

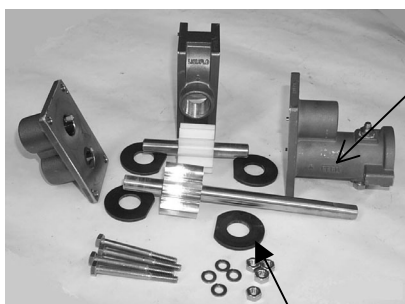
Maintenance for a sealed gear pump is minimal. Periodic lubrication of the packing and tightening of the gland screws and fluid in the double seal loop are the major maintenance items. When the gland screws cannot stop the packing from leaking excessively, or the mechanical seal starts to leak, or a decrease in head is observed, repair is necessary.

PUMP DISASSEMBLY

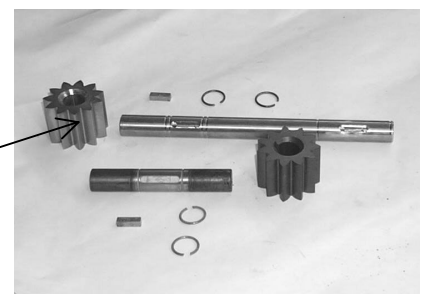
- 1) Remove the coupling guard and disconnect the flexible coupling.
- 2) Disconnect the pump's center housing (21) from the piping and remove the pump.
- 3) Remove the gland screws (16), lock washers (19) and the gland (17).

Note: For the 312, H12 and 314 go to step 12.

- 4)
 - (A) Refer to section (A) for removal of the packing.
 - (B) Refer to section (B) for removal of the lip seal.
 - (C) Refer to section (C) for removal of a single seal.
 - (D) Refer to section (D) for removal of an external seal.
 - (E) Refer to section (E) for removal of a double seal.
- 5) Remove the four housing bolts (4), housing nuts (10) and lock washers (15) which secure the front housing (8) and rear housing (2) to the center housing (21).



Front Housing



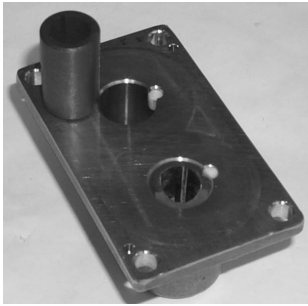
Gear

- 6) Remove the wear plates (7) and housing o-ring (5).
- 7) Remove the drive and idler shaft assemblies.
- 8) Remove the gears (22) and (6) from the shaft by removing the retaining rings (14). Remove retaining rings by inserting a pointed tool in the split and prying off.

NOTE: Exercise care during removal as not to damage the grooves.

- 9) Remove the keys (23A) and (23B).
- 10) Remove the bearings (3) and the bearing lock pins (13) from the front and rear housings. Removal is generally accomplished by destroying the bearing.

NOTE: When removing the bearings be careful not to damage the bearing bores.



- 11) Remove any burrs on shafts and bearing bores by polishing prior to reassembling pump.

NOTE: This is important to insure the proper fit of parts and the prevention of leaks.

Caution: Do not reuse O-rings, bearings and retaining rings. When tightening the center housing bolts use a star pattern torque sequence on the fasteners to insure even compression on the O-ring's surface. Repeat this process several times waiting between re-tightening. This is necessary as the Teflon® will cold flow.

| Bolt Size | Torque in-lbs (NM) |
|-------------|--------------------|
| 10-32 UNF | 28 (3.2) |
| 1/4-20 UNC | 60 (6.7) |
| 5/16-18 UNC | 90 (10) |

312, H12 and 314 Continued from Step 2

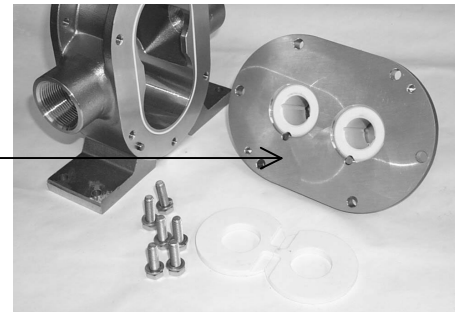
Caution: The 312, H12 and 314 pumps weigh approximately 55 and 70 lbs (25 and 32 kg), respectively.

- 12) Remove the six housing screws (4) and lockwashers (15) that secure the front housing (8) to the center housing (21).



Front Housing

Rear Housing



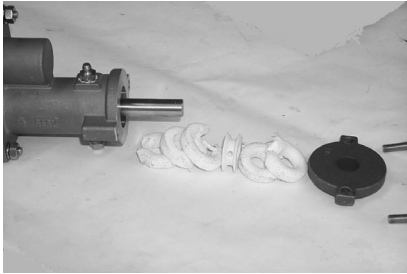
- 13) Go to step listed above 6 through 9 listed above.

- 14) Remove the six housing screws (4) and lockwashers (15) securing the rear housing (2) to the center housing (21).
- 15) Go to steps 10 and 11 listed above.

Section (A) Packed Stuffing Box

If the packing leaks excessively, it will have to be replaced.

- 1) The use of a packing puller will help facilitate the removal of the packing. Remove old packing (18) and lantern ring (11).



- 2) Insert three rings of packing into the stuffing box staggering the split by at least 90 to 120 degrees.
- 3) Insert lantern ring.
- 4) Insert two more rings (three more for the 312, 314 and H12) of packing staggering as described above.

- 5) Install split gland and gland screws.

ATTENTION

Do not over tighten the gland screws as the packing should leak at a rate of 8 to 10 drops per minute.

Section (B) Lip Seal

If the lip seal leaks excessively it needs to be replaced.

- 1) Remove the lip seal (11) from the front housing.
- 2) Install a new lip seal.

NOTE: If the drive shaft exhibits excessive wear the shaft must be replaced.

- 3) Install gland, gland screws and lock washers. Tighten gland screws to 90 in-lbs (10NM).

ATTENTION

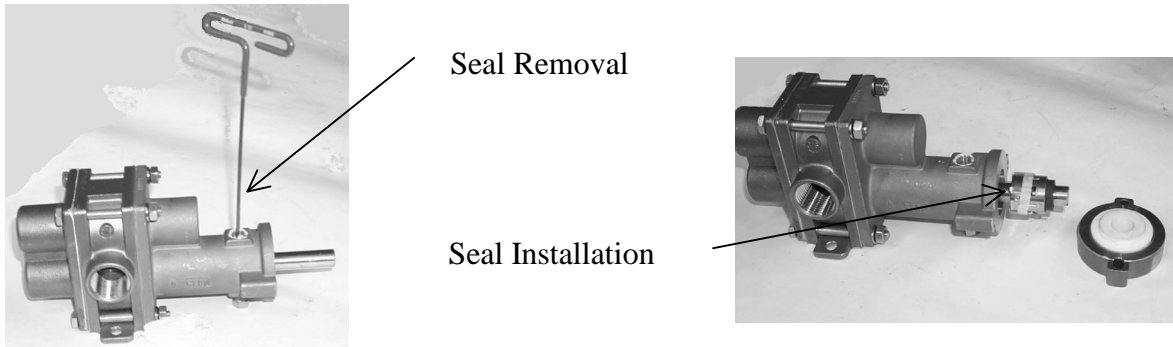
Applicable to all Mechanical Seals

- A) If the mechanical seal leaks excessively it needs to be replaced.
- B) Do not scratch or handle the lapped face of the seal.

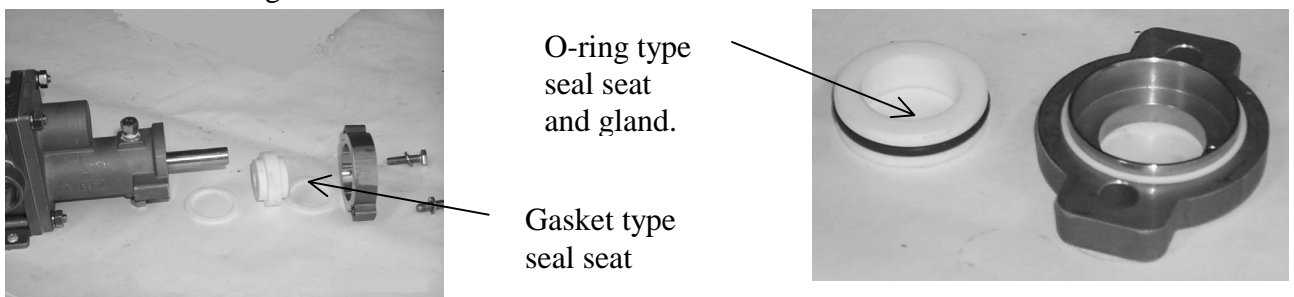
- C) Remove all burrs and setscrew marks from drive shaft.
- D) Do not remove the seal unless a new replacement seal is available; because the seal's wedge will be damaged upon removal.
- E) Do not reuse O-rings.

Section (C) Single Internal Mechanical Seal

- 1) Remove the mechanical seal (11) from the front housing first by removing the 1/8 inch NPT plug (9) and then loosening the four setscrews which are accessible through the 1/8 inch NPT opening by rotating the pump shaft.
- 2) Remove the seal seat (24) and the seal seat gaskets or O-rings (18) from the gland.



- 3) Put new seal seat gaskets or O-ring on the seal seat and install into gland.
- 4) Install the mechanical seal (face side out), with retaining clips still on; onto the drive shaft being careful not to damage the seal's wedge. Then remove the retaining clips. Slide the seal into the seal chamber centering the set screws in the 1/8 inch NPT opening.
- 5) Using gland plate (with seat installed) press seal into seal chamber until a gap of .09 inches (2.3 mm) exists between the gland plate and the front housing. Then tighten the setscrews accessible through the 1/8 inch NPT opening. Rotate shaft and tighten the remaining three set screws.



- 6) Install gland screws and lock washers and tighten to 90 in-lbs (10 NM).

- 7) Coat the 1/8 inch NPT plugs (if applicable) with a suitable pipe sealant, install into the front housing and tighten.

Section (D) External Mechanical Seal

Note: Mechanical seal must be removed first to provide access to the gland plate. The 312 and 314 have no gland plate.

- 1) Remove the mechanical seal (11) from the drive shaft by loosening the four set screws.

Note: For the 312 and 314 refer to Steps 2 through 6 listed below under Double Mechanical Seal and Step 8 in this Section.

- 2) Remove the gland screws (16), lock washers (19) and gland (17).
- 3) Remove the seal seat (25) and the two seal seat gaskets (18).
- 4) Install new seal seat gaskets on the seal seat.
- 5) Install gland, gland screws and lock washers.
- 6) Install the mechanical seal with retaining clips onto the drive shaft being careful not to damage the seal's wedge. Then remove the retaining clips. Slide the seal up to the seal seat.
- 7) Compress the mechanical seal by .09 inches (2.3 mm) and then tighten the four setscrews.

Section (E) Double Mechanical Seal

- 1) To remove the mechanical seal (11) from the front housing, first remove the 1/8 inch NPT plug (9) and then loosen the four setscrews which are accessible through the 1/8 inch NPT opening by rotating the pump shaft.

NOTE: For further seal removal the pump must be disassembled.

- 2) Refer to paragraph (5) through (7) in the pump disassembly section.
- 3) Remove the seal seat (inner) (26) and o-ring (25) from the front housing by pressing it out.



- 4) Install a new o-ring on the seal seat (inner).

- 5) Press assembly into the front housing.
- 6) Install the mechanical seal with retaining clips onto the drive shaft being careful not to damage the seal's wedge on the keyway. Then remove the retaining clips. Slide the seal into the seal chamber.
- 4) Remove the drive side seal seat (24) and the seal seat gaskets (18) or O-rings from the gland.
- 5) Install new seal seat gaskets or O-rings on the seal seat and install into gland.
- 6) Install gland, gland screws and lock washers. Tighten gland screws to 90 in-lbs (10 NM).
- 7) Using an Allen (Hex) Key slide seal retainer (metal cartridge) to position set screws centrally within the 1/8 inch NPT openings. Rotate shaft and tighten all four (4) set screws.

Trouble Shooting Guide

| Problem | Possible Cause | Remedy |
|--|-------------------------------|---|
| No Discharge | Pump not primed | Verify suction pipe is submerged Increase suction pressure Open suction valve |
| | Wrong direction of rotation | Reverse motor leads Reverse suction and discharge piping |
| | Valves closed | Verify valves are open |
| | Bypass valve open | System pressure higher than relief setting Close bypass valve |
| | Air leak in suction | Tighten connections Apply sealant to all threads Verify suction pipe is submerged |
| | Clogged strainer | Clean strainer |
| | Pump worn | Rebuild pump |
| | Magnetic coupling broken free | Stop pump. Wait till there is no rotation restart pump |
| Insufficient Discharge | Inlet pressure to low | Increase suction pressure Verify suction piping is not to long. Fully open any suction valves |
| | Clogged strainer | Clean strainer |
| | Speed to low | Increase driver speed if possible A larger size pump may be needed. |
| | Bypass valve open | System pressure higher than relief setting Close bypass valve |
| | Pump worn | Rebuild pump |
| Loss of suction after satisfactory operation | Increase in fluid viscosity | Heat fluid to reduce viscosity Decrease pump speed |
| | Air leaks in suction line | Tighten connections Apply sealant to all threads Verify suction pipe is submerged |

| Problem | Possible Cause | Remedy |
|-----------------------------|--|---|
| Excessive power consumption | Fluid viscosity higher than specified | Heat fluid to reduce viscosity Decrease pump speed Increase driver horsepower |
| | Gear clearances insufficient for viscosity | Purchase gears trimmed for the correct viscosity |
| | Differential pressure greater than specified | Increase pipe diameter |
| Rapid pump wear | Abrasives in fluid | Install suction strainer |
| | Corrosion wear | Materials of construction not acceptable for fluid being pumped |
| | Extended dry running | Install power sensor to stop pump |
| | Discharge pressure too high | Increase pipe diameter Decrease pipe run |
| | Misalignment | Align pump and motor |

Liquiflo

EQUIPMENT COMPANY

INSTALLATION and MAINTENANCE MANUAL

3 and H-MC SERIES

ROTOGEAR™ SEALLESS PUMPS

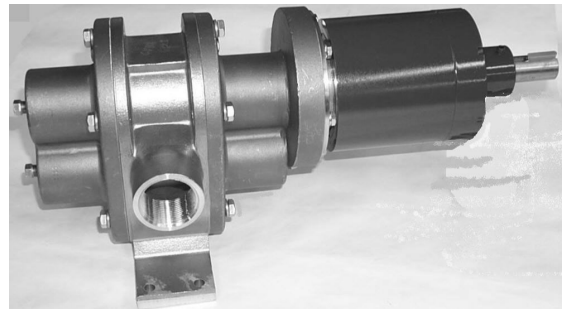
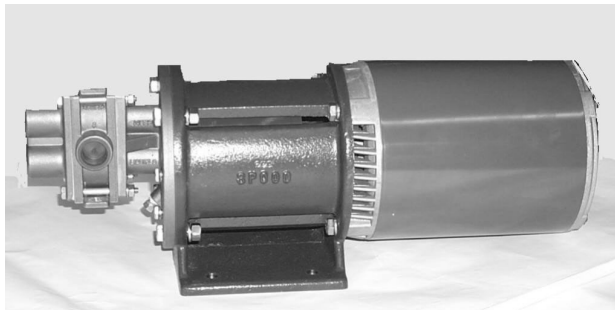


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Document No.: 3.20.074

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GENERAL INSTRUCTIONS

This Manual covers the “3” and “H” series Mag drive pumps.

Upon receipt of your Liquiflo pump verify:

- A) The equipment has not been damaged in transit.
- B) The pump model number and serial number are stamped on the pump's rear housing.

RECORD

Model:_____ **Serial No.**_____

NOTE: By adding a **K** prior to the pump's model number a repair kit can be obtained which consists of the following parts: drive and idler gears, drive and idler shafts, retaining rings, wear plates, keys, housing and bearing lock pins, o-rings and bearings.

SYMBOL EXPLANATION

- A) Work Safety Symbol



This symbol indicates remarks applicable to operational safety, where risks for health and life of personnel may be posed. All cautions should be passed on to other users.

- B) Attention Symbol

ATTENTION

Special attention must be paid in order to maintain a correct operating procedure and to avoid damage to the pump and/or other plant equipment.

INSTALLATION OF PUMP AND MOTOR ASSEMBLY

ATTENTION

All items included in this section.

The following should be observed for proper installation of the pump.

- A) Pump should be accessible for servicing and inspection.
- B) The foundation area should be rigid and level for maintaining pump alignment.
- C) The inlet should be as close to the liquid source as practical and preferably below it.
- D) Piping should be supported. **Do not use** the pump as a pipe hanger.
- E) Install valves and unions to isolate the pump during maintenance.

- F) Suction and discharge piping should be the same size or larger than the inlet and outlet ports.
- G) Clean piping as necessary to remove dirt, grit, weld slag, etc.
- H) If the Liquiflo pump was delivered as a complete assembly, it was properly aligned at the factory. Alignment should be checked by taking measurements at the coupling. Flexible couplings are not intended to compensate for misalignment. Therefore, both angularity and parallelism should be checked and corrected. If these are off, by more than 0.015 inches (0.4 mm), the assembly should be realigned.
- I) For further instructions on mounting or installing your pump, refer to the Hydraulics Institute Handbook.
- J) A positive displacement pump should have a pressure relief valve installed in the discharge line.
- K) Maximum particle size capable of being passed by the pump is 37 microns. A filter of at least 400 U.S. Mesh should be installed in the suction line. 312, H12 and 314 particle size is 60 microns with a filter mesh of 230 U.S.. Concentration of solids, exceeding 1% is not recommended as wear rates will increase to unacceptable levels.



START UP

Insure motor is locked out, prior to rotating pump by hand.

- A) Turn the pump by hand to insure that it turns freely.
- B) Jog the motor to check the rotation. As viewed from the pump end a clockwise rotation of the motor will result in fluid discharge to the left. Counterclockwise rotation will result in fluid discharge to the right. The 312, H12 and 314 are opposite.
- C) The pump should be operated with at least a 20-psi (1.4 bar) differential pressure.
- D) The pump is capable of pulling a dry lift, but it is still recommended to prime the pump prior to start up.
- E) **Do not** operate the pump without fluid in it for more than 30 seconds.

ATTENTION**REMOVAL FROM SYSTEM**

When the pump is handling flammable, toxic or hazardous fluid, flush the pump prior to removal from the piping system. Prior to flushing and disassembly consult the Material Safety Data Sheet (MSDS) for the pumped fluid to ensure procedures and precautions as specified are adhered to. Exercise extreme care to avoid contact with the fluid.

ATTENTION

Insure that the motor is locked out.

MAINTENANCE AND REPAIR

The pump has internal bearings and wear plates, which require replacement over time.

The selection of a seal-less pump may have been due to a concern for leakage of hazardous liquids. When performing maintenance on this pump, cautionary steps should be taken to ensure proper drainage or cleansing of the liquid inside the pump prior to disassembly.

WORK SAFETY

Magnetic drive pumps contain strong magnets, which pose health risks. Based on this the following must be observed.



- A) Individuals with cardiac pacemakers should avoid repairs on these units.
- B) Individuals with internal wound clips, metallic wiring, or other metallic prosthetic devices should avoid repairs on these units.
- C) Strong magnetic field can cause tools and parts to slam together; injuring hands and fingers.

Keep magnets away from credit cards, computers, computer discs and watches.

MAINTENANCE

Flush the pump and drain the containment can by removing the 1/8-inch NPT pipe plug from the front housing.

ATTENTION

Insure the pump's motor switch is in the "*off*" position and locked out.

DISASSEMBLY

- 1) Remove the coupling guard and disconnect the flexible coupling if necessary.
- 2) Disconnect the piping from the pump's center housing (21).

NOTE: For the 312, H12 and 314 go to step 17.

- 3) Remove the four front housing bolts (27), housing nuts (26) and the lock washers (31), which secure the front housing to the pedestal (16).



Cartridge

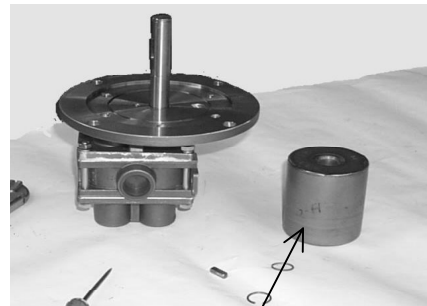
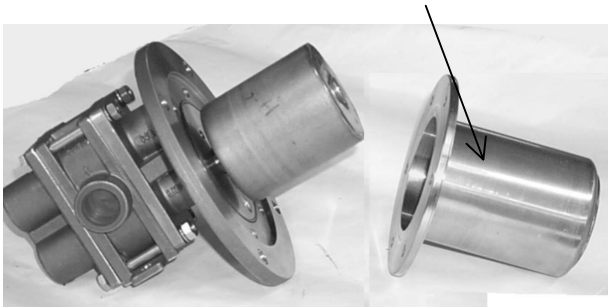
Pedestal



- 4) Remove the pump's cartridge from the pedestal by pulling the cartridge straight out.

NOTE: Force must be applied to overcome the magnetic field.

- 5) Remove the six containment can screws (18) and lock washers (32) which secure the front housing to the containment can (12).
- 6) Separate the containment can from the front housing.

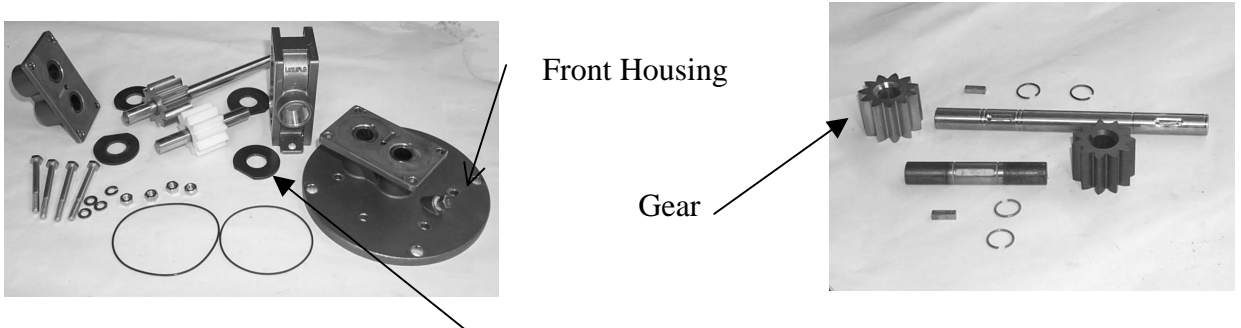


Inner Magnet

- 7) Discard the o-ring (19).
- 8) Remove the inner magnet assembly (11) from the drive shaft (20) by removing the retaining ring (28). Remove retaining rings by inserting a pointed tool in the split and prying off.

NOTE: Exercise care during removal as not to damage the grooves.

- 9) Remove the inner magnet and key (13).
- 10) Remove the four housing bolts (4), nuts (30) and lock washers (29) that secure the front and rear housing (2) to the center housing (21).



- 11) Remove the o-rings (5) and wear plates (7).
- 12) Remove the drive and idler shaft assemblies.
- 13) Remove the gears (22) and (6) from the shaft by removing the retaining rings (28).
- 14) Remove the keys (23A) and (23B).
- 15) Remove the bearings (3), (24) and the bearing lock pins (25) from the front and rear housings. Removal is generally accomplished by destroying the bearing.
NOTE: When removing the bearings be careful not to damage the bearing bores.



- 16) Remove any burrs on shafts and bearing bores by polishing prior to reassembling pump.

NOTE: This is important to insure the proper fit of parts and the prevention of leaks.

Caution: Do not reuse O-rings, bearings and retaining rings. When tightening the housing bolts use a star pattern torque sequence on the fasteners to insure even compression on the O-ring's surface. Repeat this process several times waiting between re-tightening. This is necessary as the Teflon® will cold flow.

| Bolt Size | Torque in-lbs (NM) |
|-------------|--------------------|
| 10-32 UNF | 28 (3.2) |
| 1/4-20 UNC | 60 (6.7) |
| 1/4-28 UNF* | 70 (8) |
| 5/16-18 UNC | 90 (10) |

*For containment can screws.

312, H12 and 314 Continued from Step 2

Caution: The 312, H12 and 314 pumps weigh approximately 70 and 90 lbs. (32 and 41 kg), respectively.

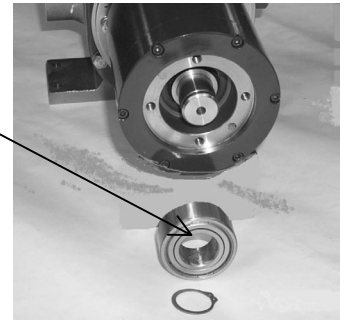
- 17) Remove the coupling hub, keys (31) and stub shaft (16) by loosening the setscrews (17).
- 18) Remove the stub holder (32) by removing the holder screws (15).

Note: If the stub holder is difficult to remove there are two, 1/4 -20 UNC tapped holes for jacking screws.



Stub
Holder

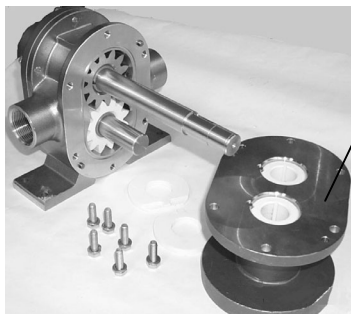
Ball Bearing



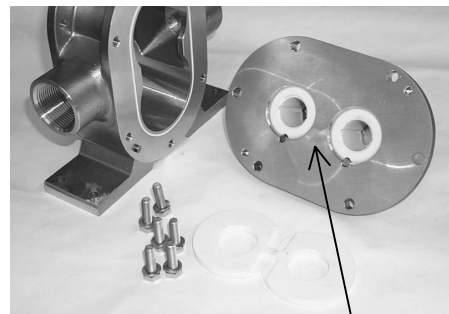
- 18) Remove the external snap ring (27) and ball bearing.

The magnetic couplings supplied with these units are extremely powerful. Never place your fingers so that a rapid pull from the magnets will place your fingers between two hard surfaces.

- 19) Using tool Pt.No. S314016 (available from Liquiflo), fasten hub to the outer magnet assembly using .25-20 UNC by 1.5 inch long screws and turn threaded rod clockwise to remove the outer magnet assembly.
- 20) Go to steps 6 through 9 listed above.
- 21) Remove the six housing screws (4) and lockwashers (30) that secure the front housing (8) to the center housing (21).



Front Housing



Rear Housing

- 22) Go to step listed above 11 through 14 listed above.
- 23) Remove the six housing screws (4) and lockwashers (30) securing the rear housing (2) to the center housing (21).
- 24) Go to steps 15 and 16 listed above.

OUTER MAGNET REMOVAL

- 1) Remove the pedestal (16) from the power frame, C-face adapter or motor by removing the four screws (15).



- 2) Remove the pedestal.
- 3) Loosen the two setscrews (17) which hold the hub (33) onto the motor shaft.
- 4) Remove the outer magnet assembly.
- 5) For re-assembly apply a small amount of anti-seize to the motor shaft.
- 6) Install outer magnet assembly onto motor shaft.
- 7) Position the outer magnet as follows:
 - a) For 56C-face motors, the end of the motor shaft must be flush with the inner surface of the hub. 143/145TC shafts should protrude 1/16 in. (1.6 mm)
 - b) For IEC motors (metric bore) the outer magnet's hub is positioned via a snap ring installed in the hub. Install hub until it bottoms out against the snap ring.

Trouble Shooting Guide

| Problem | Possible Cause | Remedy |
|--|-------------------------------|---|
| No Discharge | Pump not primed | Verify suction pipe is submerged Increase suction pressure Open suction valve |
| | Wrong direction of rotation | Reverse motor leads Reverse suction and discharge piping |
| | Valves closed | Verify valves are open |
| | Bypass valve open | System pressure higher than relief setting Close bypass valve |
| | Air leak in suction | Tighten connections Apply sealant to all threads Verify suction pipe is submerged |
| | Clogged strainer | Clean strainer |
| | Pump worn | Rebuild pump |
| | Magnetic coupling broken free | Stop pump. Wait till there is no rotation restart pump |
| Insufficient Discharge | Inlet pressure to low | Increase suction pressure Verify suction piping is not to long. Fully open any suction valves |
| | Clogged strainer | Clean strainer |
| | Speed to low | Increase driver speed if possible A larger size pump may be needed. |
| | Bypass valve open | System pressure higher than relief setting Close bypass valve |
| | Pump worn | Rebuild pump |
| Loss of suction after satisfactory operation | Increase in fluid viscosity | Heat fluid to reduce viscosity Decrease pump speed |
| | Air leaks in suction line | Tighten connections Apply sealant to all threads Verify suction pipe is submerged |

| Problem | Possible Cause | Remedy |
|-----------------------------|--|---|
| Excessive power consumption | Fluid viscosity higher than specified | Heat fluid to reduce viscosity Decrease pump speed Increase driver horsepower |
| | Gear clearances insufficient for viscosity | Purchase gears trimmed for the correct viscosity |
| | Differential pressure greater than specified | Increase pipe diameter |
| Rapid pump wear | Abrasives in fluid | Install suction strainer |
| | Corrosion wear | Materials of construction not acceptable for fluid being pumped |
| | Extended dry running | Install power sensor to stop pump |
| | Discharge pressure too high | Increase pipe diameter Decrease pipe run |
| | Misalignment | Align pump and motor |