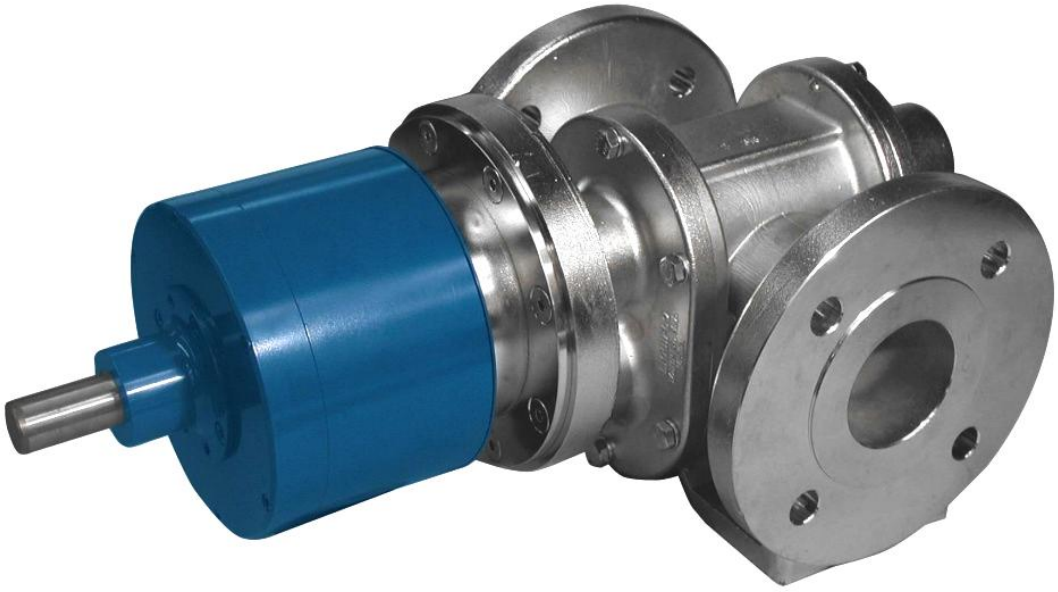
Liquiflo™
Chemical Processing Pumps

INSTALLATION, OPERATION & MAINTENANCE MANUAL

H-SERIES & 3-SERIES

MAGNETIC-DRIVE, LONG-COUPLED GEAR PUMPS



H-SERIES: Models H12R & H12F

3-SERIES: Models 312R, 312F & 314F

Document No.: 3.20.003

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Introduction

This manual provides instructions for the installation, operation and maintenance of the H-Series & 3-Series Magnetically-Coupled (MC) Gear Pumps, Models H12R, H12F, 312R, 312F & 314F, with Long-Coupled (LC) configuration. It is critical for any user to read and understand the information in this manual along with any documents this manual refers to prior to installation and start-up.

Liquiflo shall not be liable for damage or delays caused by a failure to follow the instructions for installation, operation and maintenance as outlined in this manual.

Thank you for purchasing a Liquiflo product.

LIQUIFLO STANDARD TERMS AND CONDITIONS APPLY UNLESS OTHERWISE SPECIFIED IN WRITING BY LIQUIFLO.

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Section 1: General Information

1.1 General Instructions

This manual covers the H-Series Mag-Drive, Long-Coupled Gear Pumps, Models H12R and H12F; and the 3-Series Mag-Drive, Long-Coupled Gear Pumps, Models 312R, 312F and 314F.

The materials of construction of the pump are selected based upon the chemical compatibility of the fluid being pumped. The user must verify that the materials are suitable for the surrounding atmosphere.

If the fluid is non-conductive, methods are available to mechanically ground the isolated shaft. This is only necessary if the surrounding atmosphere is extremely explosive or stray static charges are present.

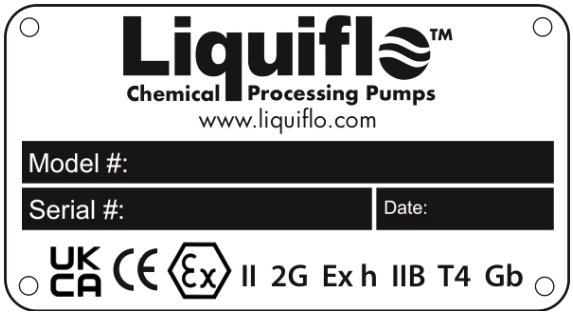
Upon receipt of your Liquiflo pump:

A) Verify that the equipment has not been damaged in transit.

B) Verify that the pump *Serial Number* is stamped on the pump's rear housing.

C) Verify that the *Liquiflo Stainless Steel Nameplate* is secured to the pump's housing:

D) For UKCA, CE and ATEX certification, verify that the following *Stainless Steel Tag* is attached to the pump:



Refer to **Appendix 8** for meaning of the Tag Certification Markings.

E) Record the following information for future reference:

Model Number:
Serial Number:
Date Received:
Pump Location:
Pump Service:

NOTE: By adding a **K** prior to the pump's Model Code, a **Repair Kit** can be obtained which consists of the following parts: drive and idler gears, drive and idler shafts, wear plates, bearings, retaining rings, keys, housing alignment pins, bearing lock pins and O-rings. (See **Appendix 3** for more information.)

1.2 Pump Specifications

Table 1A: Performance Specifications (English System Units)

Pump Series	Pump Model	Max Flow	Max Speed	Max ΔP	Max Viscosity (2)	NPSHR (3)	Dry Lift (4)	TD (5)
	Units:	GPM	RPM	PSI	cP	ft (a)	ft	Gal/Rev
H-Series	H12R	21.9	1150	225 (1)	100,000	5	15	.01907
	H12F	29.2	1150	225 (1)	100,000	5	17	.02543
3-Series	312R	21.9	1150	100	100,000	5	15	.01907
	312F	29.2	1150	100	100,000	5	17	.02543
	314F	58.4	1150	100	100,000	3	20	.05086

Table 1B: Performance Specifications (SI System Units)

Pump Series	Pump Model	Max Flow	Max Speed	Max ΔP	Max Viscosity (2)	NPSHR (3)	Dry Lift (4)	TD (5)
	Units:	LPM	RPM	bar	mPas	m (a)	m	L/Rev
H-Series	H12R	83.0	1150	15.5 (1)	100,000	1.5	4.5	.07219
	H12F	110	1150	15.5 (1)	100,000	1.5	5.2	.09626
3-Series	312R	83.0	1150	6.9	100,000	1.5	4.5	.07219
	312F	110	1150	6.9	100,000	1.5	5.2	.09626
	314F	220	1150	6.9	100,000	0.9	6.1	.19252

NOTES:

1 Max ΔP (Maximum Differential Pressure) is derated to 125 PSI (8.6 bar) for viscosities < 10 cP (mPas).

2 Fluid viscosities > 150 cP (mPas) should use pumps with trimmed gears to reduce power consumption and increase pump efficiency. High-viscosity fluids may require larger pumps with trimmed gears operating at lower speeds. Consult factory.

3 NPSHR (Net Positive Suction Head Required) is specified @ Max Speed and < 150 cP (mPas).

4 Dry Suction Lift is based on water @ room temperature and Max Speed with PEEK Gear(s) and Carbon Bearings. For other materials, priming of the suction line is required to prevent wear and possible damage to internal components.

5 TD (Theoretical Displacement) is based on new pump operating @ Max Speed and ΔP = 0.

Table 2: Absolute Temperature & Pressure Ratings

Pump Series	Pump Models	Minimum Operating Temperature		Maximum Operating Temperature (1)		Maximum Operating Pressure (2)	
	Units:	°F	°C	°F	°C	°F	°C
H-Series	H12R & H12F	-40	-40	500	260	270	18.6
3-Series	312R, 312F & 314F	-40	-40	500	260	270	18.6

NOTES:

1 Actual Maximum Operating Temperature depends on materials of construction. The actual maximum surface temperature depends not on the pump but primarily on the temperature of the fluid being pumped. Pump surfaces will be approximately 20°F (11°C) above the temperature of the process fluid.

2 For pumps with ANSI 150# RF Flanges, the Maximum Operating Pressure Rating of the flange is 275 PSIG within the temperature range of -20 to 100 °F. Above 100°F, derate by 0.3 PSIG/°F.

3 The pump is designed to handle fluid temperatures ranging from 32°F (0°C) to 104°F (40°C) with standard components. For temperatures outside this range, gears and bearings may require a trim to compensate for thermal expansion. Reference the pump model code to determine if the pump is trimmed.

4 The operating ambient temperature range depends not on the pump but on the motor, which is a function of motor design, enclosure, insulation class, loading, ventilation and other factors. Refer to motor manufacturer's specifications.

Table 3: Maximum Torque Specifications (in-lbs)

Gear Combination (1) or Magnetic Coupling	H-Series / 3-Series	H12R / 312R	H12F / 312F	314F
Double Metal Gears (2)		1150	1150	1200
Idler Gear PEEK (3)(5)		359	479	958
Idler Gear Ryton (5)		345	460	-
Idler Gear Kynar (5)		229	305	610
Idler Gear Teflon (4)(5)		94	126	-
Magnetic Coupling Size (6)	MCK	400		
	MCJ	800		

NOTES:

1 **Gear Maximum Use Temperatures:** Metal: 500°F; PEEK: 400°F; Ryton: 300°F; Kynar & Teflon: 230°F.

2 Torque limits for Double Metal Gears are based on the limiting torque-transmitting component of the pump (i.e., shafts, keys or gears). The recommended minimum fluid viscosity for double metal gears is 100 cP.

3 PEEK is suggested as the first choice for the idler gear material when the fluid viscosity is under 100 cP. PEEK is a high-performance Engineered Plastic that has substantially higher strength and wear resistance than Teflon and is corrosion-resistant to the majority or chemicals.

4 Teflon is the weakest material and should be considered for gears and bearings only when all other available materials are incompatible with the process fluid and when its torque, temperature and PV limits are not exceeded. Consult Liquiflo.

5 Torque ratings for plastic gears are specified @ Max Speed and 73°F (23°C). Plastic gears require torque derating at elevated temperatures.

6 Magnetic Couplings require torque derating at temperatures over 73°F (23°C). The required coupling size depends on the application's start-up torque, which is greater than the torque required at running conditions. If the coupling does not have sufficient strength at start-up, it will "decouple" and the pump will not operate.

Table 4: Pump Weights

H-Series / 3-Series	H12R / 312R	H12F / 312F	314F	Units
Weight, Long-Coupled *	70	70	85	lb
	32	32	39	kg

* Approximate weight of pump with flanged ports (excluding motor).

Table 5: Material Data

Component		Materials	
		H12R/H12F & 312-314	H14F
Pump Housing		316 Stainless Steel (CF8M) or Alloy-C (CX2MW/C-22)	316 Stainless Steel (CF8M)
Mounting Hardware		18-8 Stainless Steel	18-8 Stainless Steel
Mounting Bracket		Carbon Steel/Epoxy-Painted	Carbon Steel/Epoxy-Painted
Bearings		Carbon, Silicon Carbide (SiC), PEEK or Teflon (**Note 1**)	Carbon or Silicon Carbide (SiC) (**Note 1**)
Wear Plates		Carbon, Silicon Carbide (SiC), PEEK or Teflon (**Note 1**)	Carbon, Silicon Carbide (SiC), PEEK or Teflon (**Note 1**)
Gears		316 Stainless Steel, Alloy-C (C-276), PEEK, Ryton, Kynar or Teflon (**Note 1**)	316 Stainless Steel, PEEK or Kynar (**Note 1**)
Shafts	Base Metal	316 Stainless Steel or Alloy-C (**Note 2**)	316 Stainless Steel
	Coating	Uncoated, Chrome Oxide or Tungsten Carbide	Uncoated or Tungsten Carbide
Housing Pins, Bearing Pins, Retaining Rings & Keys		316 Stainless Steel or Alloy-C (**Note 2**)	316 Stainless Steel
O-rings		Teflon, Viton, EPDM, Buna-N, Kalrez or Silicone/PTFE Encapsulated	
Magnetic Coupling	Magnets	MCK & MCJ: Samarium Cobalt (SmCo)	
	Inner Magnet Casing	316 Stainless Steel or Alloy-C (**Note 2**)	
	Outer Magnet Casing	Carbon Steel/Epoxy-Painted	

NOTES:

1 **Standard Grades for Nonmetal Components:** Carbon (Graphitar 114 or equivalent); SiC (Alpha-sintered); PEEK (Bearing Grade 450FC30); Ryton (PPS, 25% Glass/15% PTFE-filled); Kynar (PVDF, Pure); Teflon (PTFE, 25% Glass-filled).

2 Material will match pump housing material. Alloy-C wrought parts are Grade C-276.

1.3 Model Coding

A **15-position Model Code** is used to completely describe a specific **mag-drive** pump. This code is required when ordering either a new pump or a repair kit or replacement parts for an existing pump. The tables below describe the Model Code and give specific examples:

Table 6A: Mag-Drive Pump Model Code Description & Example 1

Position #	Description	Pump Model Code Example 1: H12RS6P3B112006KS	
		Code	Selection
1	Pump Model (Size)	H12	Model H12R (H12 = Pump Size; R = Reduced Capacity)
2	Pump Model (Capacity)	R	
3	Basic Material & Port Type	S	316 SS Housing and Shafts & NPT Ports
4	Drive Gear	6	316 SS Drive Gear
5	Idler Gear	P	PEEK Idler Gear
6	Wear Plates	3	Teflon Wear Plates
7	Bearings	B	Silicon Carbide Bearings
8	Outer Magnet Shaft	1	7/8" Stub Shaft (Long-Coupled)
9	Bearing Flush	1	Bearing Flush Plugs
10	Shaft Coating	2	Tungsten Carbide (316 SS Base Metal)
11	O-rings	0	Teflon O-rings
12	Retaining Rings	0	316 SS Retaining Rings
13	Bearing Pins	6	316 SS Bearing Pins
14	Magnetic Coupling	K	MCK (400 in-lbs) Magnetic Coupling
15	Containment Can	S	Single-Wall Containment Can
Suffix	Trim Option		No Trim Option

Table 6B: Mag-Drive Pump Model Code Description & Example 2

Position #	Description	Pump Model Code Example 2: 314FC11EE120001JS-9T	
		Code	Selection
1	Pump Model (Size)	314	Model 314F (314 = Pump Size; F = Full Capacity)
2	Pump Model (Capacity)	F	
3	Basic Material & Port Type	C	Alloy-C Housing and Shafts & Flanged Ports
4	Drive Gear	1	Alloy-C Drive Gear
5	Idler Gear	1	Alloy-C Idler Gear
6	Wear Plates	E	Carbon-60 Wear Plates
7	Bearings	E	Carbon-60 Bearings
8	Outer Magnet Shaft	1	7/8" Stub Shaft (Long-Coupled)
9	Bearing Flush	2	Bearing Flush Plugs & Internal Bearing Flush
10	Shaft Coating	0	Uncoated (Bare Alloy-C Shafts)
11	O-rings	0	Teflon O-rings
12	Retaining Rings	0	Alloy-C Retaining Rings
13	Bearing Pins	1	Alloy-C Bearing Pins
14	Magnetic Coupling	J	MCJ (800 in-lbs) Magnetic Coupling
15	Containment Can	S	Single-Wall Containment Can
Suffix	Trim Option	-9T	Triple-Clearance Viscosity Trim

NOTE: See the Liquiflo Website (www.liquiflo.com) for complete Model Coding information.

1.4 General Operation

The successful and safe operation of a pump is not only dependent on the pump but also on each of the system components. It is therefore important to monitor the entire pumping system during operation and to perform the necessary maintenance to keep the system running smoothly.

A normally operating magnetic-drive gear pump will deliver a steady, pulse-less flow with no leakage, be relatively quiet and have a predictable flow rate based on the pump speed, fluid viscosity and differential pressure across the pump. Refer to the performance curves of the specific pump model being operated (see Liquiflo Product Catalog or website: www.liquiflo.com).

If a significant problem is observed during operation, the pump should be stopped so that corrective action can be taken. The observed problem could have several possible causes, and multiple remedies for each cause. For help with problem solving, refer to the Troubleshooting Guide given in **Appendix 7**.

1.5 Maintenance & Repair

The pump has internal sleeve bearings, wear plates, gears and shafts, which require replacement over time due to physical wear. The center housing of the pump may also incur physical wear and require replacement (see **Appendix 4**). O-rings and retaining rings should always be replaced when rebuilding the pump.

The main factors affecting the physical wear of the pump are operating speed, differential pressure, fluid viscosity, duty cycle, starting and stopping frequency, abrasives in the fluid and the wear properties of the materials. These factors can cause pump lifetimes to vary significantly from one application to another, making it difficult to predict when the pump will require maintenance. Therefore, the maintenance schedule for the pump is typically based on the maintenance history of the specific application. The main indicators that a pump may require maintenance are the following: (1) decreased flow rate or pressure, (2) fluid leakage, (3) unusual noise or vibrations and (4) increased power consumption.

Standard repair kits are available to facilitate repair of the pump (see **Appendix 3**). A repair kit includes all internal wear parts as well as O-rings, retaining rings, bearing lock pins, housing alignment pins and keys. The parts not included in a mag-drive pump repair kit are the housings (front, center and rear), magnets (inner and outer), containment can and hardware (bolts, nuts and lock-washers). Before performing maintenance on the pump, review the safety precautions and follow the included instructions.

1.6 Repair Kits & Replacement Parts

Repair kits and replacement parts for the pumps can be purchased from your local Liquiflo distributor. Refer to **Appendices 3 thru 6** for individual parts information.

1.7 Returned Merchandise Authorization (RMA)

If it is necessary to return the pump to the factory for service:

1) Contact your local Liquiflo distributor to discuss the return, obtain a Returned Merchandise Authorization Number (**RMA #**) and provide the distributor with the required information (see RMA Record below).

2) Clean and neutralize pump. Be sure no fluid remains in the containment can. **Liquiflo is not equipped to handle dangerous fluids.**

3) Package the pump carefully and include the **RMA #** in a visible location on the outside surface of the box. Always ship the outer magnet separately from the pump assembly. Shipping outer magnet over top of containment can will result in damage.

4) Ship pump to factory, freight prepaid.

Returned Merchandise Authorization (RMA) Record	
RMA #	(Supplied by Distributor)
Distributor Name	
Item(s) Returned	
Serial Number(s)	
Reasons for Return	
Fluid(s) Pumped	
Time in Service	

NOTE: Pump must be cleaned and neutralized prior to shipment to the factory.

Section 2: Safety Precautions

2.1 General Precautions

- **Always** lock out the power to the pump driver when performing maintenance on the pump
- **Always** lock out the suction and discharge valves when performing maintenance on the pump
- **Never** operate the pump with suction and/or discharge valves closed
- **Never** start the pump without making sure that the pump is primed
- **Never** use heat to disassemble the pump
- Decontaminate pump using procedures in accordance with federal, state, local and company environmental regulations
- Before performing maintenance on the pump, check with appropriate personnel to determine if skin, eye or lung protection is required and how best to flush the pump

Caution!
Failure to observe safety precautions can result in personal injury, equipment damage or malfunction.

2.2 Precautions for Magnetic-Drive Pumps

Magnetic-drive pumps contain strong magnets, which pose health risks. Therefore, the following precautions must be observed:

Caution!

- *Individuals with cardiac pacemakers should avoid repairs on these units*
- *Individuals with internal wound clips, metallic wiring, or other metallic prosthetic devices should avoid repairs on these units*
- ***Strong magnetic fields can cause tools and parts to slam together, injuring hands and fingers***

Strong magnets will attract iron, cast iron, carbon steel and some types of stainless steel. Keep magnets away from credit cards, computers, computer discs and watches.

Section 3: Pump & Motor Installation

3.1 Installation of Pump, Motor & Base

Refer to the Hydraulic Institute Standards for proper installation procedures of the base, pump and motor.

1) **The pump inlet should be as close to the liquid source as practical and preferably below it.** Even though gear pumps have self-priming and lift capability, many issues can be avoided with a flooded suction arrangement.

2) The pump models covered in this manual are designed to be *long-coupled* to a motor via a mechanical coupling. To prevent excessive radial loads from being applied to the pump – which can cause vibration and lead to premature pump failure – **the pump and motor shafts must be manually aligned.** (Note: If the pump was delivered as a complete long-coupled 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, if necessary, corrected. If these are off by more than 0.015 inches (0.4 mm), the assembly should be realigned.

3) The flexible insert of the mechanical coupling between the pump and motor **must be free to move axially** – a distance of 1/16 to 1/8 inches – to prevent axial loads from being applied to the pump.

4) After the pump and motor shafts have been properly aligned, install the coupling guard over the mechanical coupling and fasten to the base plate. (Note: If the pump was delivered as a complete long-coupled assembly, the coupling guard was properly installed at the factory.)

> ***Caution!***
> *Do not operate the pump without the Coupling Guard installed on the base plate.*

3.2 General Piping Requirements

Refer to the Hydraulic Institute Standards for piping guidelines.

1) All piping must be supported independently and must line up naturally with pump ports.

> ***Caution!***
> ***Do not use the pump to support the piping or allow the piping to apply stress to the pump ports.*** *This can distort the alignment of the pump housing with internal parts and lead to rapid wear or malfunction.*

2) Piping that handles both hot and cold liquids require proper installation of expansion loops and joints so that thermal expansion of the piping will not cause misalignment.

3) **Suction and discharge piping should be the same size or larger than the inlet and outlet ports.** This is especially important for viscous services when the pipe diameter has a large effect on friction losses and NPSH available. Piping runs should be designed to minimize friction losses.

4) The piping should be arranged to allow the pump to be flushed and drained prior to the removal of the pump for servicing. Valves and unions should be installed to allow the pump to be isolated for maintenance. Valves which open to the full pipe diameter, such as ball valves, should be used.

5) The piping system should be cleaned prior to installation of the pump.

3.3 Relief Valves

A positive displacement pump should have a pressure relief valve (PRV) installed in the discharge line. Operating a gear pump against a closed discharge valve will result in over-pressure and likely failure of the pump or system. Install the relief valve between the pump discharge port and the discharge isolation valve. Ideally, the relief valve should bypass the discharge line back to the supply tank. Where this is not feasible, piping the relief valve back to the suction side of the pump will prevent immediate pump failure from over-pressure. However, continuously running in this condition will cause heating of the fluid.

3.4 Strainers & Solids Handling

1) Liquiflo gear pumps have very close internal clearances and are designed to pump relatively clean fluids. The entrance of foreign material could cause damage or rapid wear to pump components. While occasional small particles may not be catastrophic to the pump, **the use of a strainer on the inlet will prevent large particulates from entering the pump**. Large particulates can become lodged into the roots of the gears, causing a sudden failure. If small, abrasive particles are present, they can get in between the shafts and bearings, which will accelerate or increase wear over an extended period of time. If the strainer clogs with material and is not properly maintained, the pump may be starved of liquid, causing a loss of flow and damaging the pump via dry-running.

2) The maximum particle size capable of being passed by the pumps is 60 microns. **Regardless of particle size, these pumps are intended for relatively clean liquids** where the general concentration of solids is limited to 1% by volume. Higher concentration may cause the wear rate to increase, resulting in a decrease in pump performance. In addition to solids concentration, the specific wear rate also depends on the size, shape and hardness of the particles, the operating speed and the materials used to construct the pump. Since wear rate is proportional to the square of the speed, slower operating speeds will substantially increase pump life.

3.5 Pressure Requirements

1) **The pump should be operated with at least 15 PSI (1 bar) differential pressure** to ensure that fluid is forced into the sleeve bearings, which are lubricated by the process fluid. If adequate discharge pressure is not available, a back pressure valve (BPV) can be used to generate sufficient pressure.

2) All pumps require sufficient NPSH (Net Positive Suction Head) to function properly. The NPSH available in the system is the difference between the available suction pressure at the pump inlet and the vapor pressure of the fluid (which depends on the fluid temperature). Each pump model has its own NSPH requirement (see Table 1A or 1B). **The NPSH available in the system must be greater than the NPSH required by the pump** or the pump will go into cavitation, resulting in decreased flow, increased vibration and noise emission, and potential damage to internal components.

3.6 Controlling the Flow

A gear pump is a positive displacement pump, and flow **cannot** be controlled by throttling the discharge valve. **Adjusting the motor speed** using a VFD (Variable Frequency Drive) is the most common method for controlling flow. Fluid viscosity and differential pressure will also have an effect on the flow rate.

3.7 Motor Selection

1) The motor frame size is part of the pump model coding and is selected at the time the pump is ordered. Brackets and outer magnet hubs are available to fit NEMA 182TC, 184TC, 213TC, 215TC, 254TC & 256TC and IEC 100, 112 & 132 (with B5 flange) motor frames. NEMA 254/256TC and IEC 132 B5 motor frames require an adapter plate to assemble the motor to the bracket (refer to **Appendix 1**). The adapter plate and bolts are provided when required.

2) The motor speed and power rating are usually determined at the time the pump is ordered to meet the specified conditions of service. The power requirement of the application depends on the flow rate, differential pressure and fluid viscosity. Up to 100 cP, the pump performance charts can be used to determine the brake horsepower (BHP) required for the application. Motor sizing and selection is further influenced by: constant torque ratios, coupling method, enclosure requirements and speed limits due to viscosity. For sizing of viscous fluid applications or for more assistance in general selection, contact the local distributor or Liquiflo.

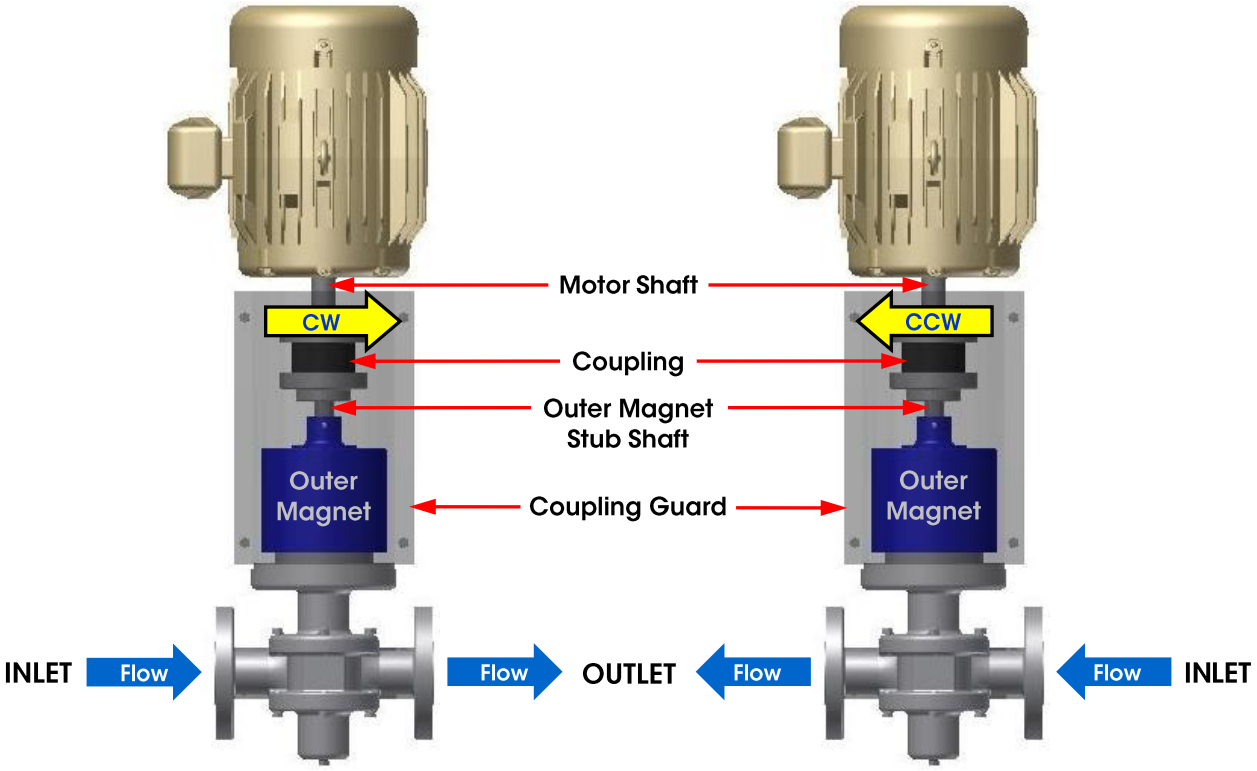
3.8 Motor Hook-Up

Please refer to the motor manufacturer's instructions.

3.9 Motor Direction

The motor shaft is mechanically coupled to the pump's outer magnet stub shaft, which is in turn magnetically coupled to the pump's internal drive shaft. All three shafts will turn in the same direction. Because the gear pump is bi-directional, the pump drive shaft can turn in either direction to produce flow in either direction. The direction of rotation of the motor shaft (same as that of the pump drive shaft) will determine which side of the pump is the inlet (suction side) and which side is the outlet (discharge side). For the pump models covered in this manual, the flow direction will be as shown below:

Top View of Mag-Drive Gear Pump Long-Coupled to Motor (with Transparent Coupling Guard)



Clockwise (CW) Rotation of Motor Shaft:

Fluid will enter the pump at the left side (inlet) and be discharged at the **right** side (outlet).

Counterclockwise (CCW) Rotation of Motor Shaft:

Fluid will enter the pump at the right side (inlet) and be discharged at the **left** side (outlet).

Section 4: Start-Up & Operation

4.1 Starting the Pump

1) Verify that the pump and motor are suitable for the conditions of service.

2) Verify that all suction and discharge **valves are open** before starting the pump.

3) **Prime the pump with fluid**.

NOTE: For a flooded suction, allow the fluid time to enter the pump before starting. Although the pump is capable of pulling a certain amount of dry lift, contact wear will occur during this period. For a suction lift, priming or wetting the internal parts greatly reduces wear, since the components are lubricated by the pumped fluid. Some material combinations, such as PEEK gears and Carbon wear plates and bearings, are much more forgiving to short periods of dry running. Prolonged dry running will cause rapid wear and damage to the bearings and shafts due to overheating and thermal expansion. In addition, the pump could overheat due to eddy currents induced in the containment can. **As a general rule, mag-drive pumps should not be run dry for more than 30 seconds**.

4) Jog the motor to check the direction of rotation (see page 12 for diagram).

5) Monitor the pump for several minutes to ensure proper operation.

Caution!
Do not run the pump dry for more than 30 seconds or damage to internal parts may result.

4.2 Operation & Troubleshooting

A normally operating magnetic-drive gear pump will deliver a steady, pulse-less flow with no leakage, be relatively quiet and have a predictable flow rate based on the pump speed, fluid viscosity and differential pressure across the pump. Refer to the performance curves of the specific pump model being operated (see Liquiflo Product Catalog or website: www.liquiflo.com).

During pump operation, inspect for: (1) Unusual noise, (2) Product leakage, (3) Expected suction and discharge pressures and (4) Expected flow rate based on pump speed, fluid viscosity and differential pressure. If any problems occur, stop the pump and take corrective action. Refer to the Troubleshooting Guide given in **Appendix 7**.

Section 5: Maintenance & Repair

The pump has internal bearings, wear plates, gears and shafts which require replacement over time due to physical wear. The center housing of the pump may also incur physical wear and require replacement (see **Appendix 4** for wear allowances). O-rings and retaining rings should always be replaced when rebuilding the pump.

5.1 Work Safety

Before performing maintenance, review the safety precautions given in **Section 2** (see page 9).

Caution!
The Magnetic Couplings used in these pumps are extremely powerful. Observe the precautions given in Section 2.2.

5.2 Removal from System

Before servicing, prepare the pump as follows:

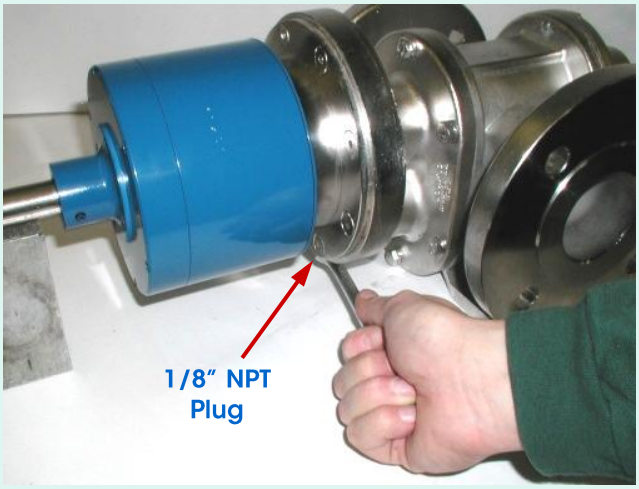
Caution!
If the pump was used on hazardous or toxic fluids, it must be flushed and decontaminated prior to removal from the system piping. Refer to the Material Safety Data Sheet (MSDS) for the liquid and follow all prescribed safety precautions and disposal procedures.

1. Flush the pump.
2. Stop the motor and lock out the electrical panel.
3. Close the suction and discharge isolation valves.
4. Disconnect the pump from the system piping.
5. Drain the containment can by removing the 1/8" NPT plug on the pump's front housing (see photo below).

Location & Removal of Drain Plug

The drain plug is located at the bottom of the pump's front housing. To drain the containment can, remove the **1/8" NPT plug**, as shown.

Caution!
Some trace fluid may remain in the pump and containment can even after draining.



5.3 PUMP DISASSEMBLY

Follow the procedure below and refer to the drawings in **Appendix 6.**

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1 Disconnect the pump from the base and move it to a clean work area. Disconnect the mechanical coupling from the stub shaft (16).

> ***Caution!***
> *The H12/312 and 314 pumps weigh 70 lbs (32 kg) and 85 lbs (39 kg), respectively.*

Removal of Outer Magnet:

2 **a.** Remove four screws (15) from the hub (33) of the outer magnet (10); then remove the hub.

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

---

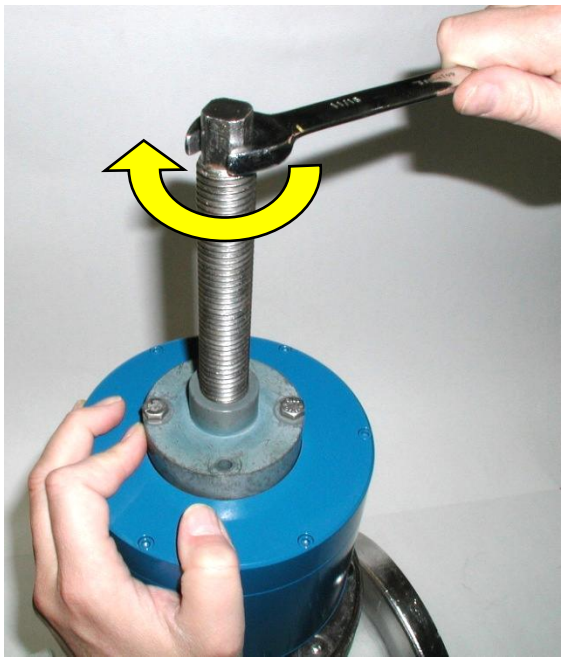
b. Remove the external snap ring (28) from the hub of the containment can (12), as shown.

NOTE: The tool shown below is recommended for removing the snap ring.

---

2 **c.** Bolt the **outer magnet tool** (P/N S314017, available from Liquiflo) onto bearing holder (30) using at least two 1/4-20 UNC x 1.5 inch long bolts. Turn the threaded rod clockwise to move the outer magnet (10) up and away from the inner magnet inside the containment can.

Outer Magnet Tool

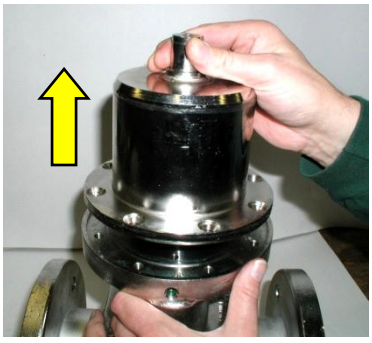


d. When the outer magnet (10) has been lifted far enough away from the pull of the inner magnet (11), remove the outer magnet by lifting it straight up.

Caution!
The magnetic couplings supplied with these units are extremely powerful. ***Do not place hands or fingers between the inner and outer magnets.*** *Once the outer magnet is removed, keep it in a safe location away from the inner magnet, tools and other metal objects.*

Removal of Containment Can:

3 Remove eight screws (18); then lift off the containment can (12) from the front housing (8). Discard the O-ring (19).



Removal of Inner Magnet:

4 **a.** Remove the inner magnet retaining ring (25) from the drive shaft (20).

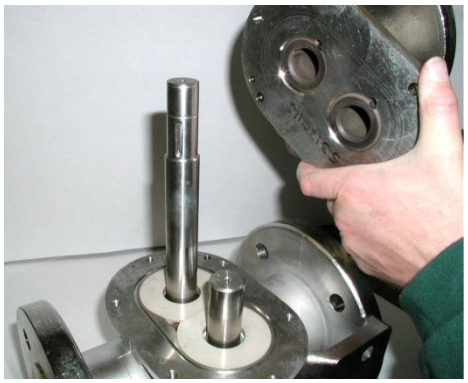
NOTE: Remove the retaining ring by inserting a pointed tool in the split and then prying it off, as shown.

b. Carefully lift off the inner magnet (11) and remove the key (13) from the drive shaft (20).

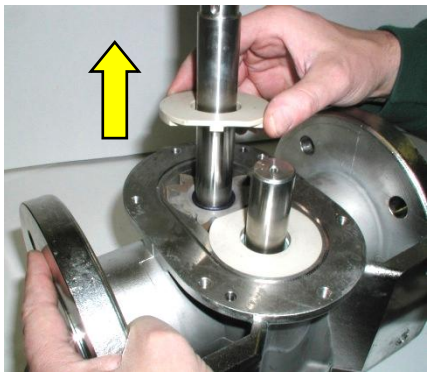
Caution!
Move the inner magnet to a safe location away from the outer magnet, tools and other metal objects.

5 Remove six housing bolts (4) and lock-washers (31) from the front housing (8).

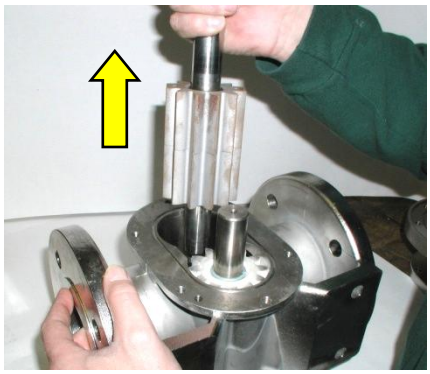
6 Separate the front housing (8) from the center housing (21).



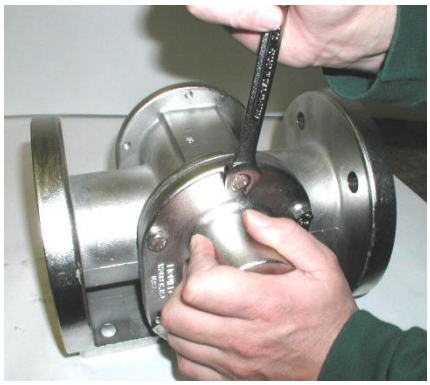
7 Remove two wear plates (7) from the center housing (21).



8 Remove the gear-shaft assemblies and the other two wear plates (7) from the center-rear housing.



9 Remove six housing bolts (4) and lock-washers (31) and then separate the rear housing (2) from the center housing (21).



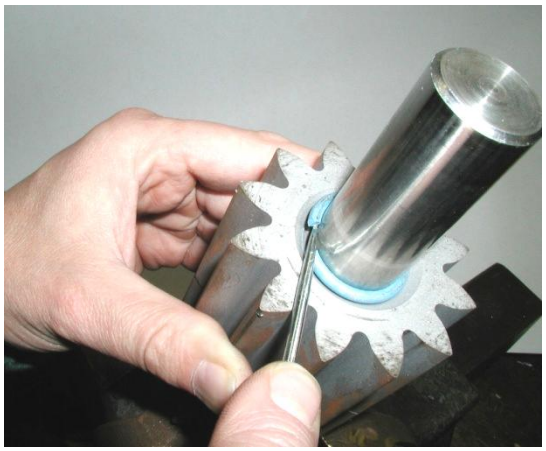
Removal of Bearings:

10 Remove the bearings (3) and bearing lock pins (26) from the front and rear housings.

NOTE: The bearings have a slip-fit design and can be extracted from the housings using a hooked tool, as shown.

Gear-Shaft Disassembly:

11 If necessary, disassemble the gear-shafts as follows:



a. Remove one retaining ring (29) from the shaft (1 or 20), as shown.

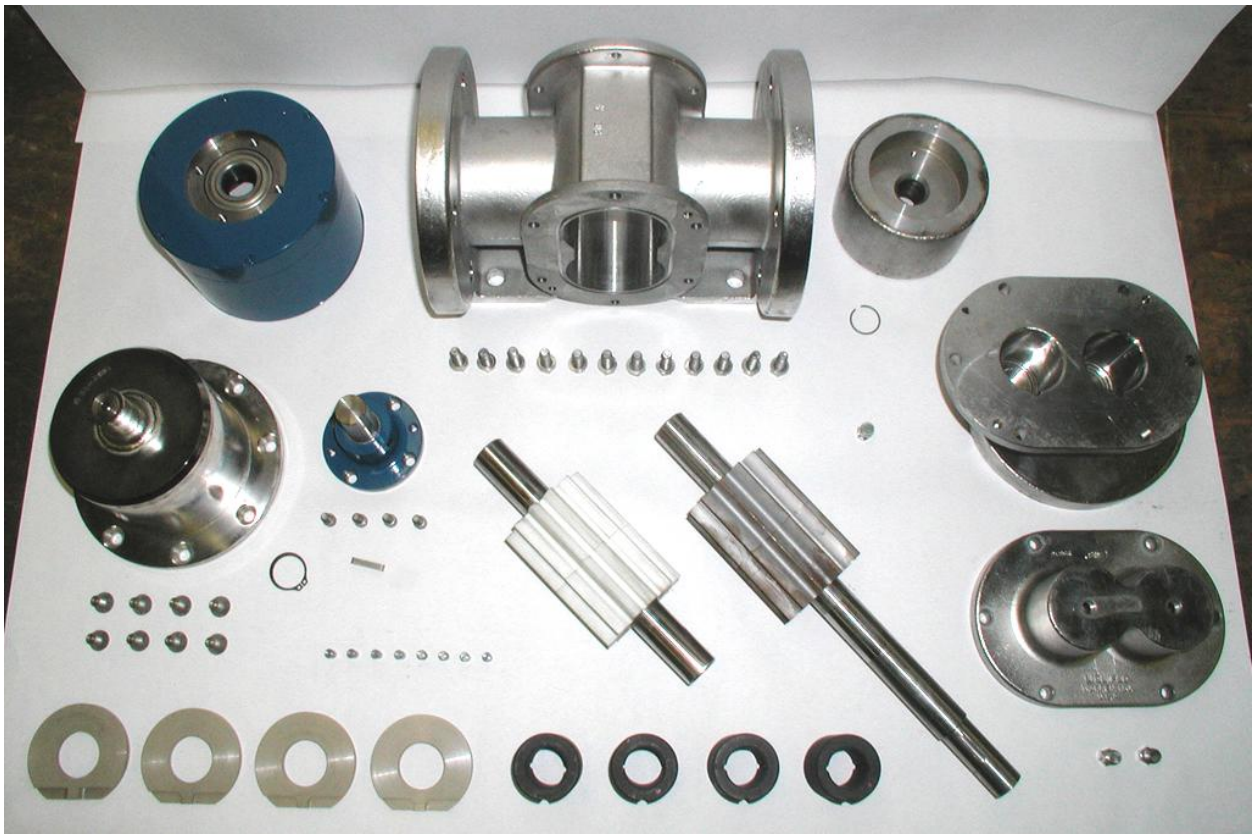
b. Remove the gear(s) (6 or 22) and key (24 or 23).

c. Remove the remaining retaining ring (29) from the shaft (1 or 20).

NOTE: Liquiflo Repair Kits include the gears and shafts preassembled, as shown in **Appendix 3**. If the replacement gears and shafts are not assembled, see **Appendix 5** for the assembly procedure.

NOTE: Model 314F pumps have two adjacent gears on a common shaft that are oriented with a single drive key (see Page 34). An earlier design used one key for each adjacent gear, or two keys per shaft.

The disassembled mag-drive pump is shown below:



END OF DISASSEMBLY PROCEDURE

5.4 PUMP ASSEMBLY

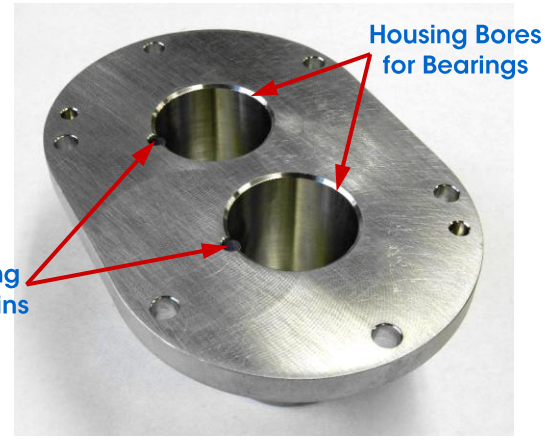
Follow the procedure below and refer to the drawings in **Appendix 6**.

Installation of Bearings into Front & Rear Housings:

1 Insert the bearing lock pins (26) into the front housing (8) and the rear housing (2).

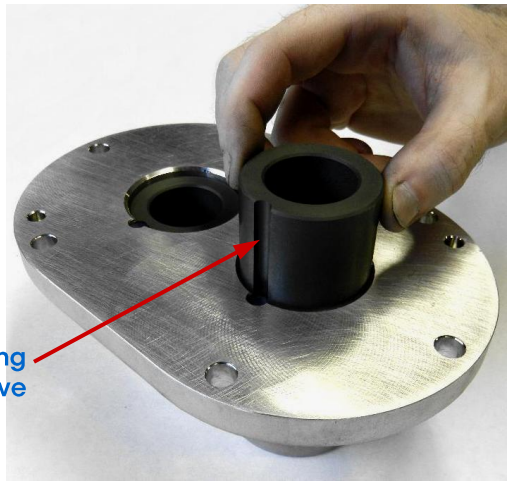
NOTE: The pins serve to prevent the bearings from rotating.

NOTE: A standard rear housing (i.e., not containing a bearing flush groove) is shown at right. Housings with the Internal Bearing Flush (IBF) option are described below.



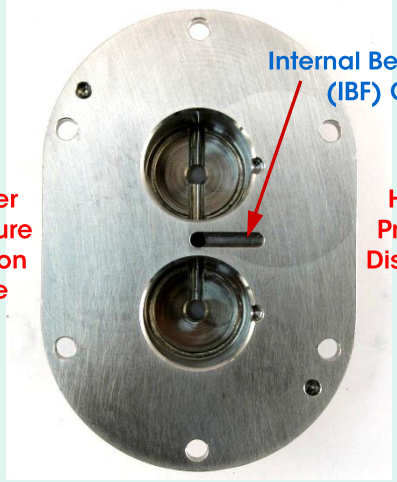
2 Insert the bearings (3) into the housing bores of the front and rear housings.

NOTE: Align the bearing grooves with the lock pins in the housings. The bearings have a slip-fit design and should slide easily into the housings.



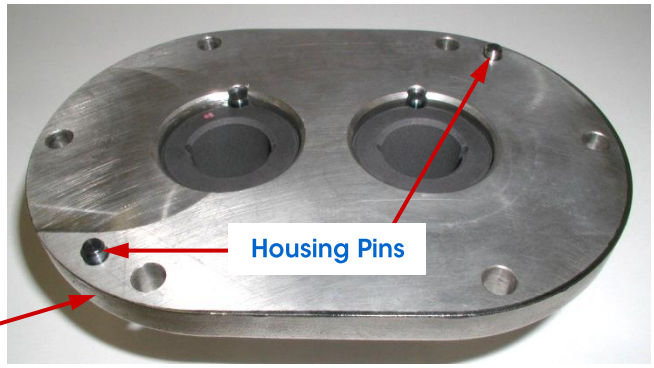
Internal Bearing Flush Option

Pumps ordered with the Internal Bearing Flush (IBF) option will have **modified front and rear housings**, as shown at right. The purpose of the IBF option is to more effectively lubricate and cool the bearings when pumping extremely thin or extremely thick liquids. When assembling the pump, the IBF grooves must be oriented on the higher pressure discharge side of the pump.



3 Insert two housing alignment pins (34) into the rear housing (2).

NOTE: The pins should have a slip fit into the housing. The pump will be assembled in a vertical orientation starting with the rear housing. The 1/8" NPT plugs should not be installed into the rear housing at this time. This will allow the rear housing to lie flat on the bench surface.



4 Install O-ring (5) into the racetrack shaped groove of the center housing (21).

Caution!
Do not reuse O-rings.

5 Place center housing (21) into position on top of the rear housing (2), as shown.

NOTE: Make certain the O-ring is facing down and the center housing seats properly over the alignment pins in the rear housing.

Installation of Wear Plates

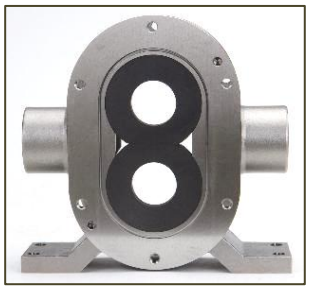
Standard Liquiflo wear plates are manufactured with cut-outs or grooves to provide liquid relief paths to reduce hydraulically-induced gear separation forces that exist during pump operation. These forces decrease pump life by placing significant loads on the shafts and bearings. To be effective, **the relief grooves must face toward the gears**.

NOTE: Failure to orient the wear plates properly will reduce the operating life of the pump.

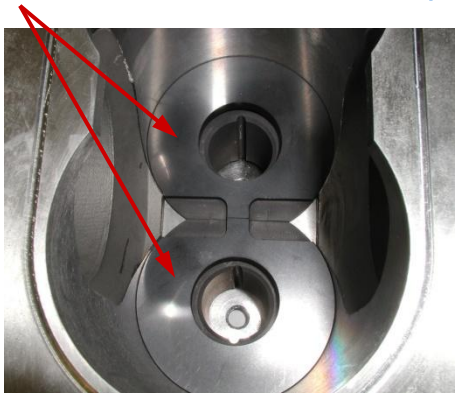
6 Place two wear plates (7) into position inside the housing bores, as shown.

NOTE: The wear plates must seat flush on the surface of the rear housing with the relief grooves facing up, as shown to the right. This will orient the grooves toward the gears.

NOTE: For these pump models, it may be easier to stand up the center housing and install the wear plates vertically on the end of the center housing, as shown at near right. The rear housing (with alignment pins) can then be installed to the center housing. Finally, the housing & wear plates assembly can be turned on its side so that the wear plate grooves are facing up, as shown at far right.



Wear Plates with Relief Grooves facing up



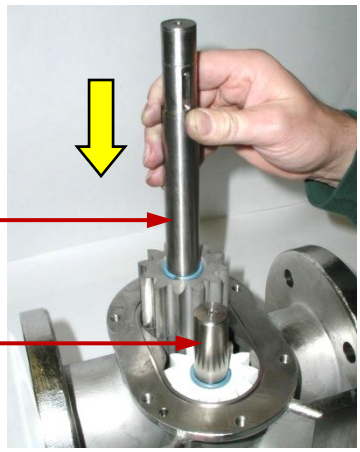
Installation of Gear-Shaft Assemblies:

7 Insert the gear-shaft assemblies into the housing, as shown.

NOTE: Liquiflo Repair Kits contain the gears and shafts preassembled, as shown to the right and in **Appendix 3**. If the replacement gears and shafts are not assembled, see **Appendix 5** for the assembly procedure.

Drive Gear-Shaft Assembly

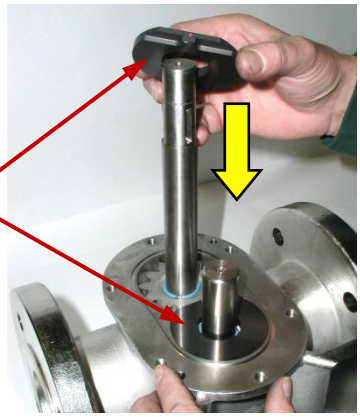
Idler Gear-Shaft Assembly



8 Place two wear plates (7) into position on top of the gears, as shown.

NOTE: For relieved wear plates, the cut-outs must face down, toward the gears.

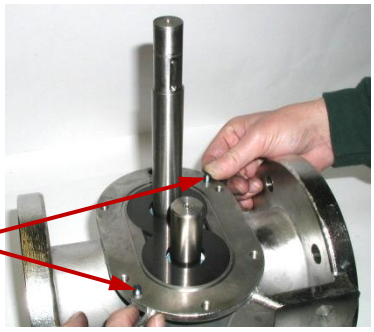
Wear Plates with Relief Grooves facing down



9 Insert two housing alignment pins (34) into the center housing (21), as shown.

NOTE: The pins should have a slip fit into the housing. The housing pins serve to accurately align the front, center and rear housings.

Housing Pins



10 Install O-ring (5) into the racetrack shaped groove of the center housing (21).

> ***Caution!***
> *Do not reuse O-rings.*

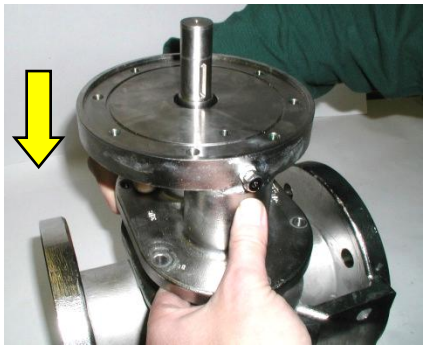
Installation of Drain Plug:

11 Install one 1/8" NPT plug (9) into the front housing (8), as shown

NOTE: Prior to installation, apply Teflon tape or pipe lubricant to the threads of the plug, to prevent leakage and galling.

---

12 Carefully place the front housing (8) into position on top of the center housing (21).



NOTE: Hold the bearings in place to ensure they will not slide out of the front housing. Make certain the front housing seats properly over the alignment pins in the center housing.

---

13 Install twelve bolts (4) with lock-washers (31) to attach the front, center and rear housings together; then tighten the bolts.

NOTE: Apply anti-seize compound to the bolts. Refer to **Appendix 1** for the torque specifications of the fasteners. When tightening the housing bolts, use a star pattern torque sequence on the fasteners to ensure even compression on the O-ring's surface. With Teflon (PTFE) O-rings, repeat this process several times, waiting between retightening. This is necessary because Teflon will cold flow and require a certain amount of time to properly seat. Continue the process until the bolts no longer require retightening.

---

14 Install containment can O-ring (19) into the circular groove on the front housing (8).

> ***Caution!***
> *Do not reuse O-rings.*

Installation of Inner Magnet:

15 **a.** Install the inner magnet key (13); then slide the inner magnet (11) on the drive shaft (20) with orientation as shown.

---

b. Check the gears and shafts for free rotation by turning the inner magnet by hand.

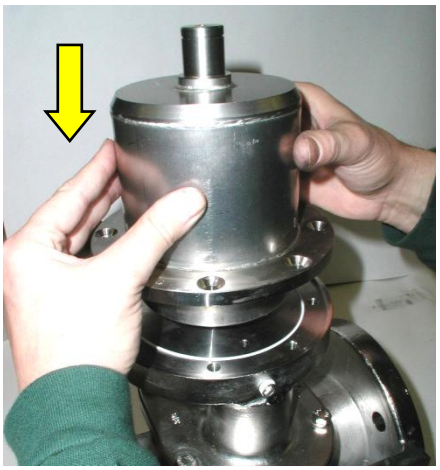
---

c. Install the retaining ring (25) to lock the inner magnet on the drive shaft.

Inner Magnet Retaining Ring

Installation of Containment Can:

16 **a.** Place the containment can (12) in position on the front housing (8).

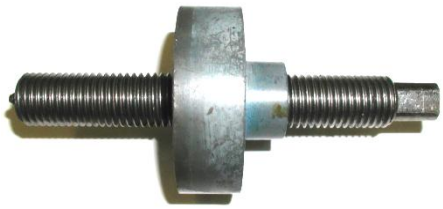


b. Attach the containment can to the front housing using eight screws (18).

NOTE: Apply anti-seize compound to the screws. Refer to **Appendix 1** for the torque specifications of the fasteners. When tightening the containment can screws, use a star pattern torque sequence on the fasteners to ensure even compression on the O-ring's surface. With Teflon (PTFE) O-rings, repeat this process several times, waiting between retightening. This is necessary because Teflon will cold flow and require a certain amount of time to properly seat. Continue the process until the bolts no longer require retightening.

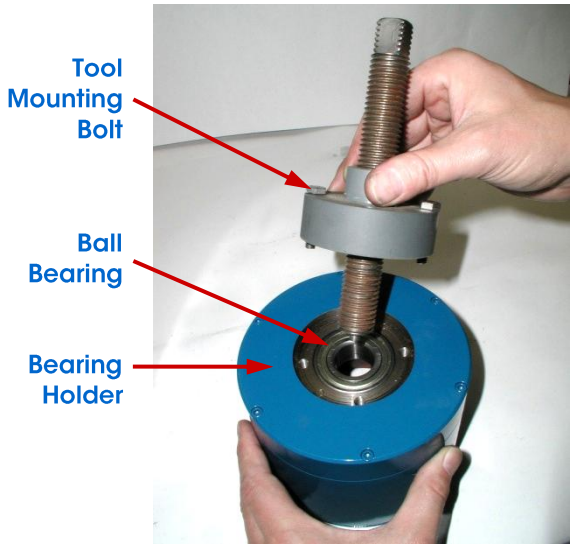
Installation of Outer Magnet:

17 **a.** Bolt the **outer magnet tool** (P/N S314017, available from Liquiflo) onto the bearing holder (30) of the outer magnet (10) using at least two 1/4-20 UNC x 1.5 inch long bolts.



Outer Magnet Tool

NOTE: The ball bearing (27) inside the bearing holder is greased for life and does not require maintenance. Replace ball bearing if required.



17

Caution!
The magnetic couplings supplied with these units are extremely powerful. ***Do not place hands or fingers between the outer magnet and the containment can.***

b. Place the outer magnet (10) into position over the containment can (12); then turn the threaded rod counterclockwise to move the outer magnet downwards.

NOTE: As the outer magnet is lowered, the inner magnet inside the containment can will start to pull the outer magnet downwards.

---

c. When the outer magnet has bottomed out, unbolt the outer magnet tool and remove.

---

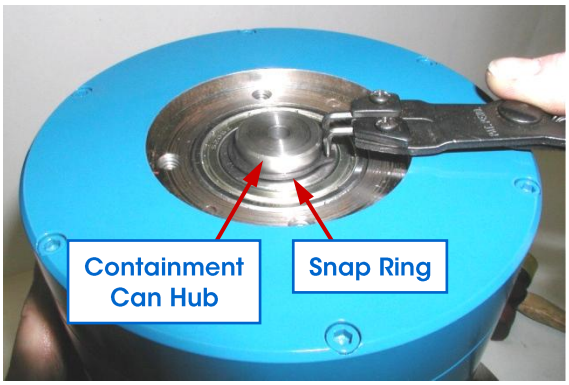
d. Carefully tap the outer magnet into position using a rubber mallet.

NOTE: The hub of the containment can must protrude above the ball bearing surface by approximately 1/4" to allow the external snap ring to be installed (see photo in next step).

---

e. Install the external snap ring (28).

NOTE: The tool shown below is recommended for installing the snap ring.



---

17 **f.** Install the hub (33) to the bearing holder (30) using four screws (15).

NOTE: See **Appendix 1** for the torque specifications of the fasteners.

---

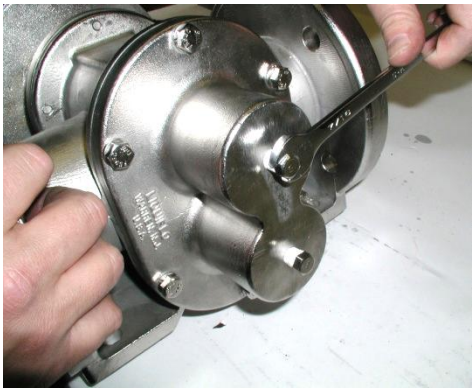
18 Place the pump in an upright position, as shown.

> ***Caution!***
> *The H12/312 and 314 pumps weigh 70 lbs (32 kg) and 85 lbs (39 kg), respectively.*

Installation of Bearing Flush Plugs:

19 Install two 1/8" NPT plugs (9) into the rear housing (2).

NOTE: Prior to installation, apply Teflon tape or pipe lubricant to the threads of the plugs, to prevent leakage and galling.



END OF ASSEMBLY PROCEDURE

Appendix 1: Fastener Torque Specifications

Maximum Torque Specifications for 18-8 Stainless Steel Bolts

Function	Bolt Size	Bolt Type	Quantity (per Pump)	Max Torque Specifications	
				(in-lb)	(N-m)
Housing Assembly	5/16-18 UNC x 1	HHCS	12	132	14.9
Containment Can Assembly	5/16-24 UNF x 5/8	FH-SHCS	8	142	16.0
Outer Magnet Hub Assembly	1/4-20 UNC x 1/2	SHCS	4	75.2	8.50

HHCS = Hex Head Cap Screw
FH-SHCS = Flat Head, Socket Head Cap Screw
SHCS = Socket Head Cap Screw

Appendix 2: Maintenance Tool List

The following tools (or equivalents) are required when performing maintenance on the pumps:

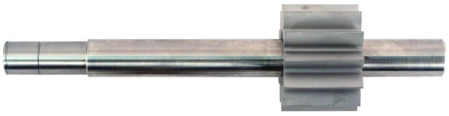
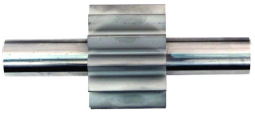
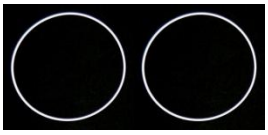
Tool #	Tool	Function	Photo
1	**Outer Magnet Tool** (Liquiflo P/N S314017)	For removal or installation of outer magnet assembly.	
2	**External Snap Ring Tool**	For removal or installation of external snap ring.	
3	**Wrench, 5/8"** *	For turning threaded rod of Outer Magnet Tool.	
4	**Wrench, 1/2"**	For pump housing bolts.	
5	**Wrench, 7/16"**	For 1/8" NPT plugs.	
6	**Allen Wrench, 3/16" Hex**	For hub screws, jacking screws and containment can screws.	
7	**Pointed & Hooked Tool**	Pointed: For removal of retaining rings from drive and idler shafts. Hooked: For removal of bearings from front and rear housings.	
8	**Rubber Mallet** * *	For installation of outer magnet assembly and gear retaining rings.	

* Adjustable wrench can be used as alternative.

* * Required for gear-shaft assembly (see **Appendix 5**).

Appendix 3: Repair Kits

The following components are included in a standard Liquiflo Mag-Drive Pump Repair Kit:

Item #	Repair Kit Component	Quantity	Photo
1	**Drive Gear-Shaft Assembly**	1 (Includes Gear, Drive Shaft, Key & 2 Retaining Rings)	
2	**Idler Gear-Shaft Assembly**	1 (Includes Gear, Idler Shaft, Key & 2 Retaining Rings)	
3	**Wear Plates (Relieved Type)**	4	
4	**Bearings (Sleeve Type)**	4	
5	**Pins, Bearing Lock**	4	
6	**Pins, Housing Alignment**	4	
7	**O-rings, Housing (2-047)**	2	
8	**O-ring, Containment Can (2-049)**	1	
9	**Key, Inner Magnet**	1	
10	**Retaining Ring, Inner Magnet**	1	

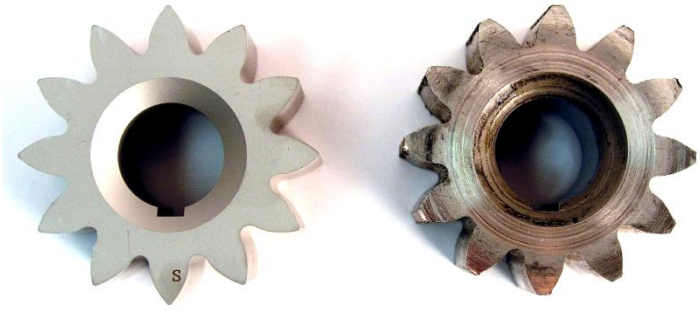
NOTE: To order a Repair Kit for an existing Mag-drive pump, simply place a "**K**" in front of the Pump's Model Code to designate the **Kit Model Code**. Example: **KH12FS6PEE112006KS**. Using this number for ordering will ensure that the kit component materials will match those used in the pump.

Appendix 4: Wear Allowances

When a pump requires maintenance, a convenient way to restore the pump to like-new condition is to use a repair kit. The repair kit contains all *internal wear parts* as well as O-rings, retaining rings, bearing lock pins, housing alignment pins and keys.

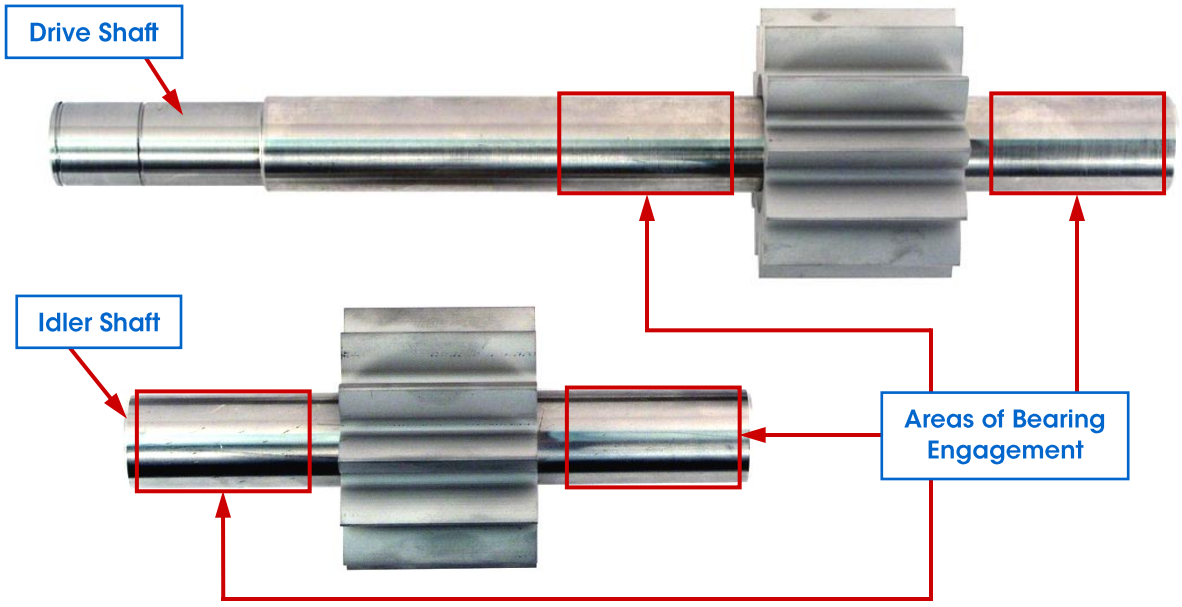
In some cases, only certain parts may need to be replaced. The primary wear parts of the pump are the gears, shafts, wear plates and bearings. The center housing (secondary wear part) may also incur physical wear by contact with the gears caused by excessively worn bearings. (Note: the center housing is not included in a standard repair kit.) These wear parts can be reused if they are in acceptable condition. O-rings and retaining rings should not be reused. The following parts should be inspected and evaluated for reuse based on the specifications given in the **Wear Allowances Chart** (see page 33):

Gears: Spur gears should have a uniform tooth profile on both the leading and trailing edges. If the outer diameter of the gear is worn, pumping performance will degrade. Gears with minor wear should be evaluated for reuse by measuring the outer diameter and comparing it to the minimum diameter specification given in the Wear Allowances Chart. Gears with obvious major wear, such as flattened teeth or other significant wear on the profile, should be replaced (see photo at right).



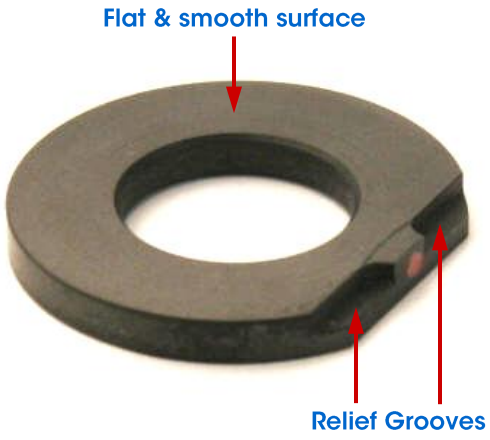
New Gear | Extremely Worn Gear

Shafts: The area of the shaft that is engaged in the bearings will wear over time depending on the service conditions and the materials of construction (see photo below). Hard-coated shafts are available to minimize or eliminate wear of the shaft surfaces. Worn shafts may allow the gears to contact the center housing and accelerate both gear and center housing wear. The shaft journal area should be round and have a minimum diameter as specified in the Wear Allowances Chart.

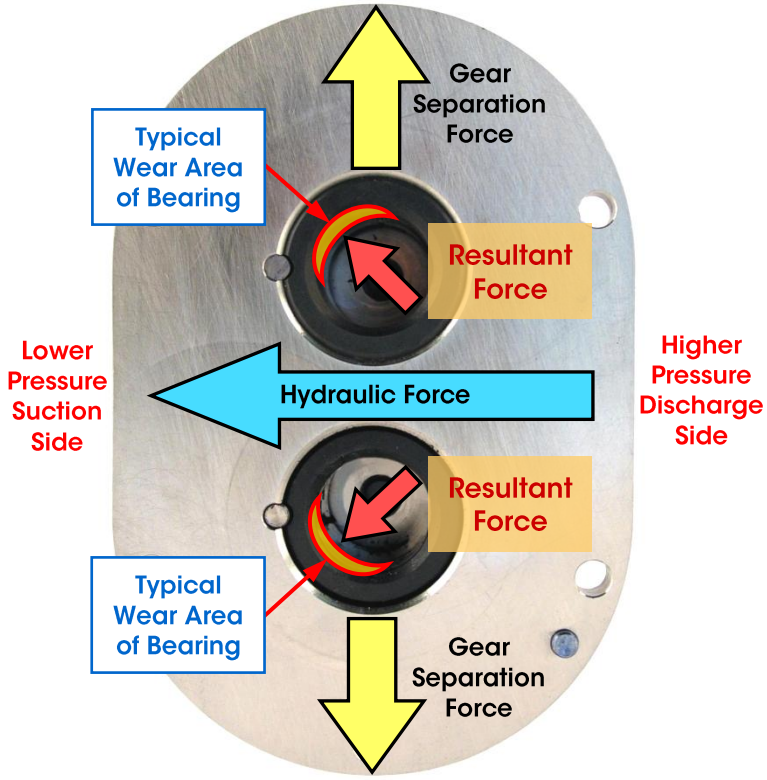


Appendix 4: Wear Allowances (Continued)

Wear Plates: This is a sacrificial part of the pump designed to protect the front and rear housings from wear by continual contact with the sides of the gears. Erosion of the wear plates increase clearances causing slip to increase. This results in a reduction in pump performance. Wear plates should have smooth surfaces and meet the minimum thickness requirements given in the Wear Allowances Chart. (Note: Standard Liquiflo wear plates are manufactured with cut-outs or relief grooves to minimize hydraulically-induced gear separation forces. These *relieved wear plates* increase pump life by reducing loads on bearings and shafts. A typical relieved wear plate is shown at right.)



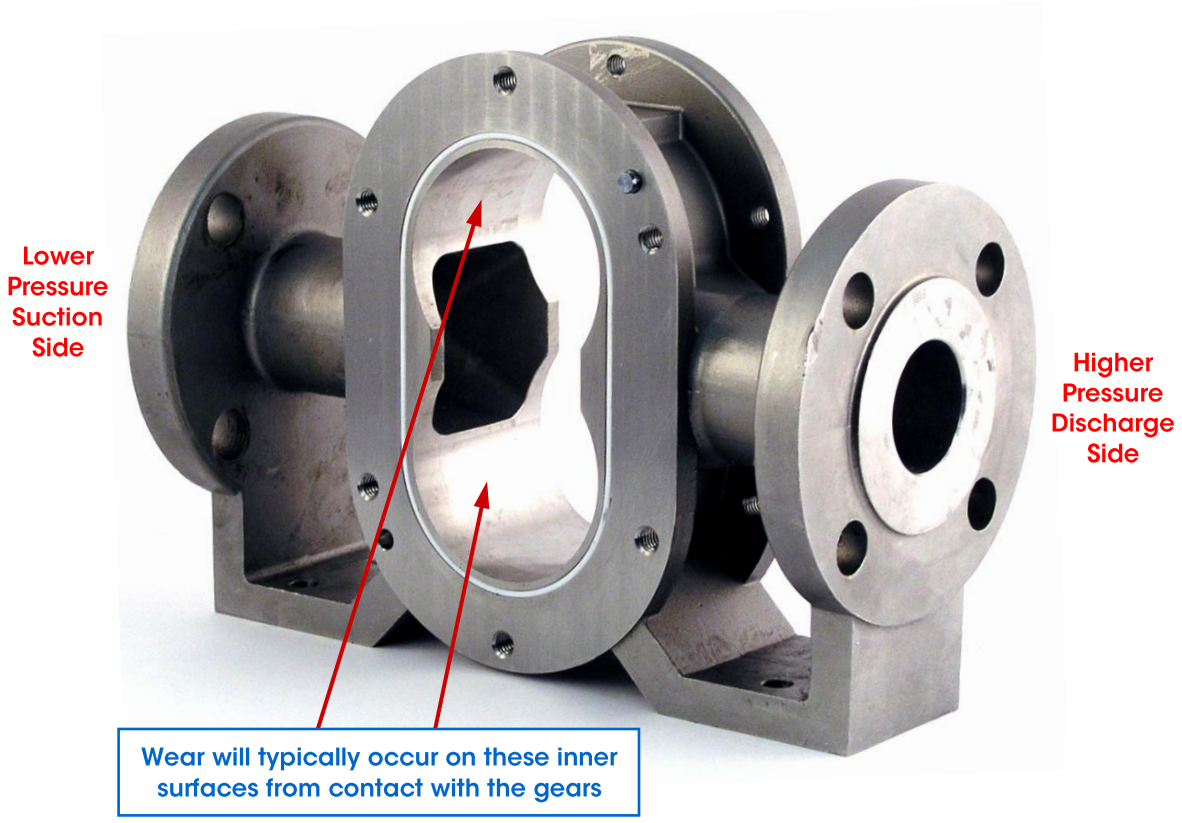
Bearings: The H-Series pumps use sleeve-type bearings that are also known as *journal bearings.* These bearings are designed to support the shafts and precisely position the gears inside the housing. Worn bearings will eventually allow the rotating gears to contact the center housing, causing wear and eventual failure of both of these components. (The typical wear mechanism of the bearings is described below.) If any wear of the bearings is observed, they should be replaced. The Wear Allowances Chart gives the maximum inner diameter that is acceptable for worn bearings.



Typical Wear Mechanism of Bearings

Appendix 4: Wear Allowances (Continued)

Center Housing: The typical failure mode for the center housing is from contact with the rotating gears, caused by extreme wear of the bearings and shafts. Evidence of contact or slight wear on the inside surfaces can be expected. However, if deep grooves or excessive wear is observed, the center housing should be replaced. (See photo below for the typical wear areas of the center housing.) Reusing an excessively worn center housing in a rebuilt pump will cause the pump performance to be lower than expected because of increased slip.



Wear Allowances Chart (Units: inches)

Pump Series	Pump Model	Gears		Shafts		Wear Plates		Bearings	
		Nom. O.D.	Min O.D.	Nom. O.D.	Min O.D.	Nom. Thick.	Min Thick.	Nom. I.D.	Max I.D.
H-Series	H12R	2.790	2.781	1.124	1.121	0.500	0.496	1.127	1.130
	H12F	2.790	2.781	1.124	1.121	0.250	0.246	1.127	1.130
3-Series	312R	2.790	2.781	0.999	0.996	0.500	0.496	1.002	1.005
	312F	2.790	2.781	0.999	0.996	0.250	0.246	1.002	1.005
	314F	2.790	2.781	0.999	0.996	0.250	0.246	1.002	1.005

O.D. = Outer Diameter **I.D.** = Inner Diameter

NOTE: All diameter values listed in the above table are based on standard (untrimmed) parts. Parts requiring viscosity or temperature trims will have dimensions based on the application. Consult factory.

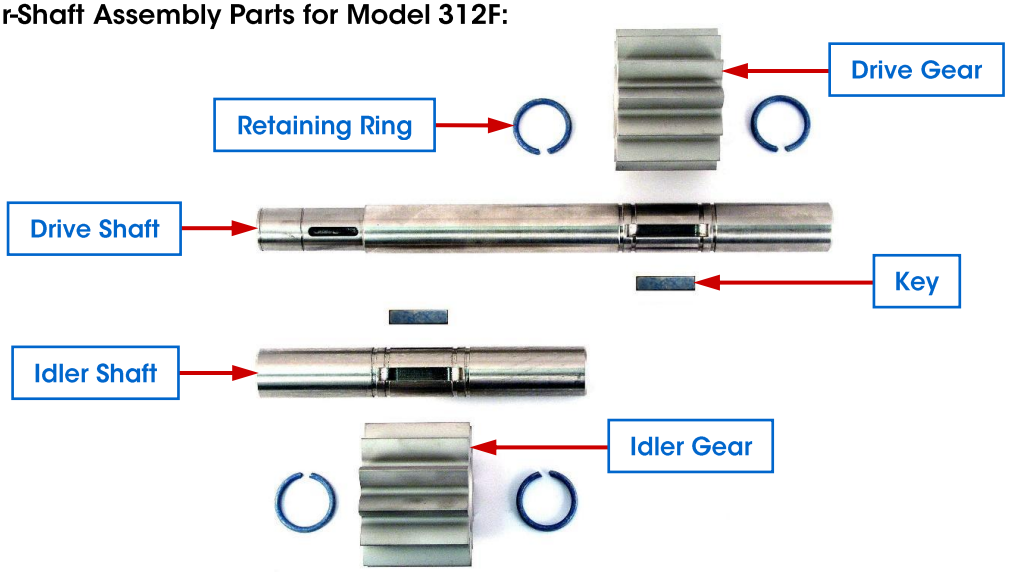
Appendix 5: Gear-Shaft Assembly

Parts List for Gear-Shaft Assemblies

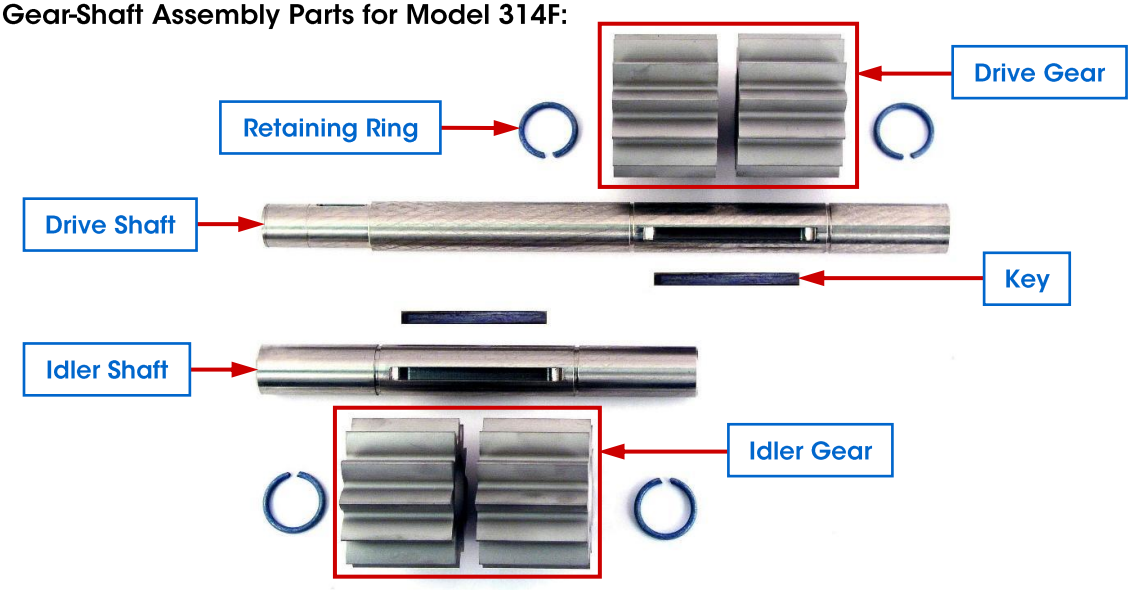
Drive Gear-Shaft Parts			Idler Gear-Shaft Parts		
Part	Quantity		Part	Quantity	
	Models H12 & 312	Model 314F		Models H12 & 312	Model 314F
Drive Gear	1	2	Idler Gear	1	2
Drive Shaft	1	1	Idler Shaft	1	1
Key	1	1 *	Key	1	1 *
Retaining Ring	2	2	Retaining Ring	2	2

* Former design used two keys per shaft.

Gear-Shaft Assembly Parts for Model 312F:



Gear-Shaft Assembly Parts for Model 314F:



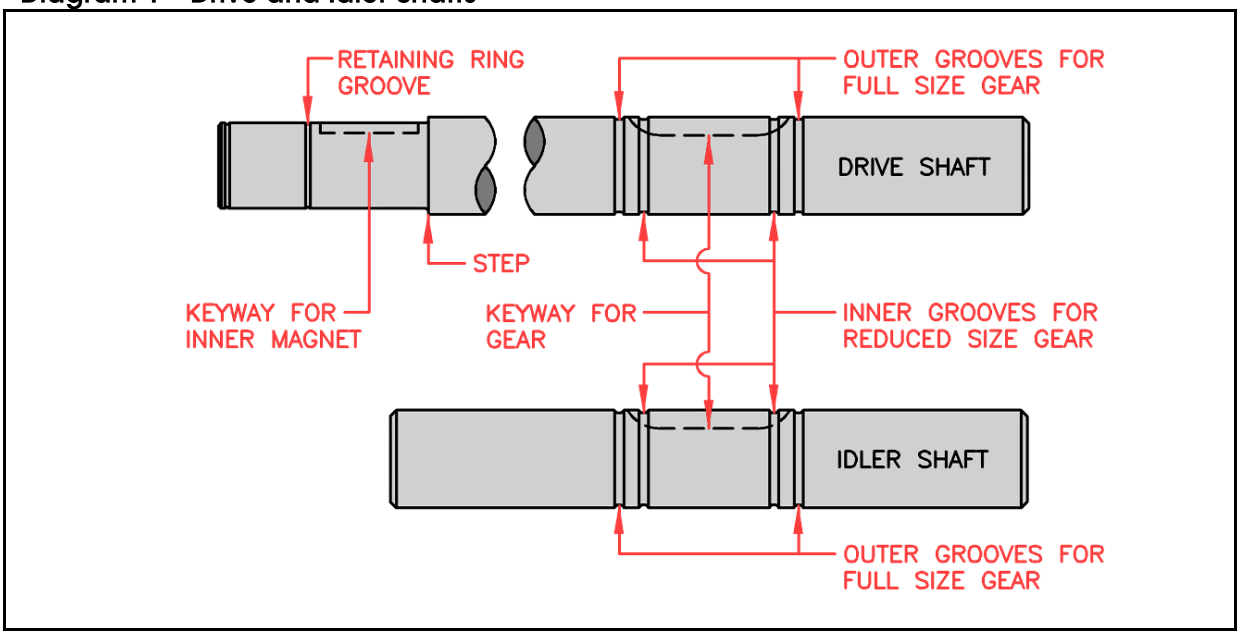
NOTE: The Model 314F gears are comprised of two Model 312F gears, as shown above.

Appendix 5: Gear-Shaft Assembly (Continued)

Description of Parts:

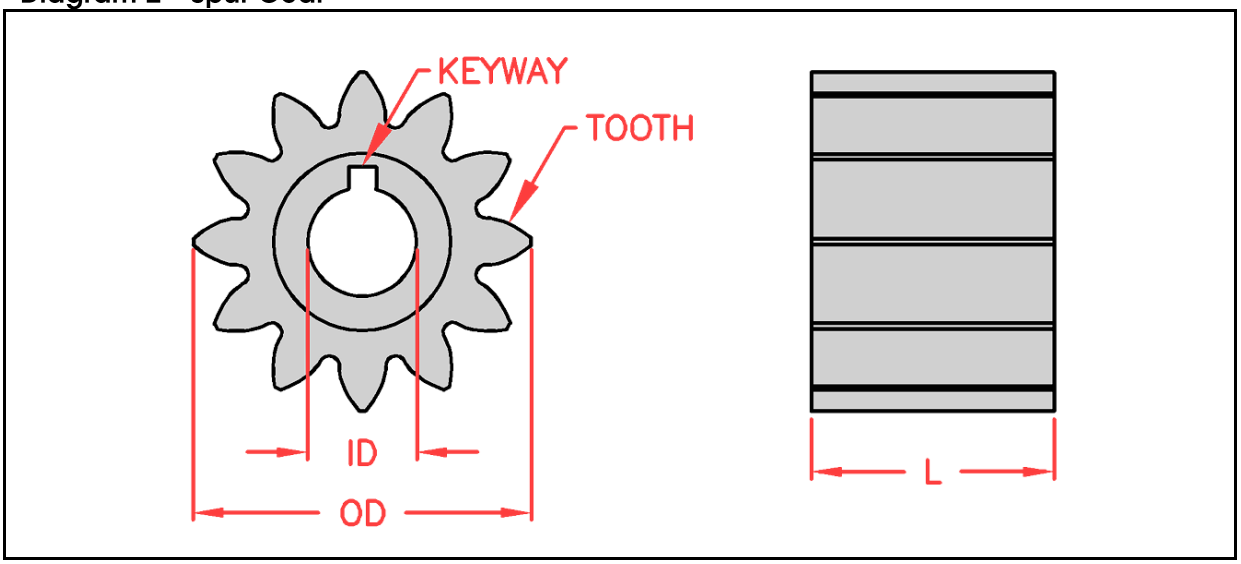
Shafts: The pump contains two kinds of shafts: the *drive shaft* and the *idler shaft*. Both shafts have retaining ring grooves and a keyway for positioning the gears. The drive shaft also has a step, keyway and groove on one end for positioning the inner magnet. The shafts for Models H12 and 312 have two sets of retaining ring grooves to position either full (F) or reduced (R) size gears (see **Diagram 1**). The shafts for Model 314F have one set of grooves to position two adjacent Model 312F gears (see page 34). The chart at the top of page 36 can be used to identify the shafts.

Diagram 1 – Drive and Idler Shafts



Gears: The H-Series and 3-Series pumps use spur style gears as shown in **Diagram 2**. To identify the gears, use the chart at the top of page 36.

Diagram 2 – Spur Gear



Appendix 5: Gear-Shaft Assembly (Continued)

Gear & Shaft Identification Chart (Units: inches)

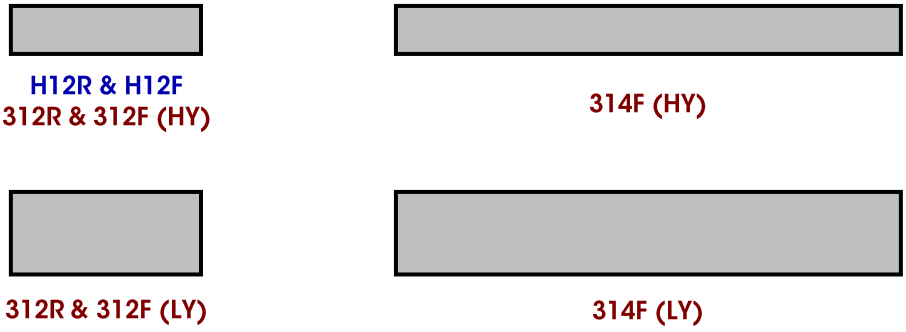
Part	Part Dimension	Pump Models				
		H12R	H12F	312R	312F	314F
Gear (Drive or Idler)	Outer Diameter (OD)	2.79	2.79	2.79	2.79	2.79
	Inner Diameter (ID)	1-1/8	1-1/8	1	1	1
	Length (L)	1.50	2.00	1.50	2.00	4.00*
	# of Teeth	12	12	12	12	12
Drive Shaft	Diameter	1-1/8		1		1
	Length	11.45		11.45		13.44
	# of Gear Ret. Ring Grooves	4		4		2
Idler Shaft	Diameter	1-1/8		1		1
	Length	6.50		6.50		8.50
	# of Gear Ret. Ring Grooves	4		4		2

* Two 312F gears.

Keys: Two types of gear keys are used in the pumps: High-yield (HY) and low-yield (LY). HY and LY keys are used for the Model 312 and 314 pumps. H-series pumps use only HY keys. In the 3-Series pumps, HY keys are used for all gear materials except Teflon; LY keys are used only for Teflon gears. (Note: HY keys have a lower height than LY keys.) To identify the keys, use the following chart:

Key Identification Chart

Note: Key profiles are shown in actual size.



H12R & H12F
312R & 312F (HY)

314F (HY)

312R & 312F (LY)

314F (LY)

Retaining Rings: The retaining rings are used to position the gears on the shafts. They should always be replaced when repairing the pump. (The retaining rings for the pumps are shown at right in actual size.)

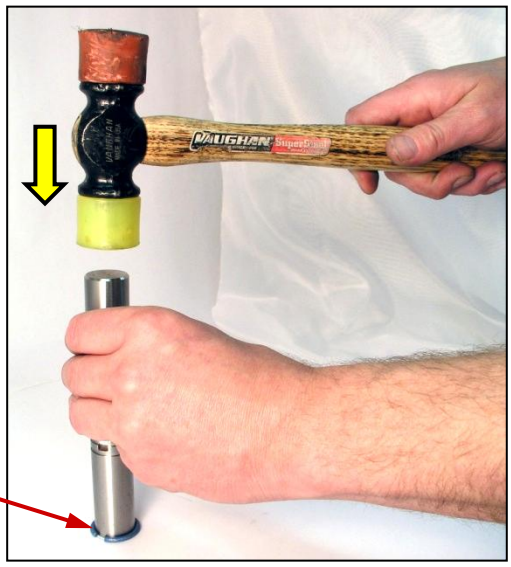
Appendix 5: Gear-Shaft Assembly (Continued)

Gear-Shaft Assembly Procedure:

> ***Caution!***
> *Be careful not to damage the shafts.*

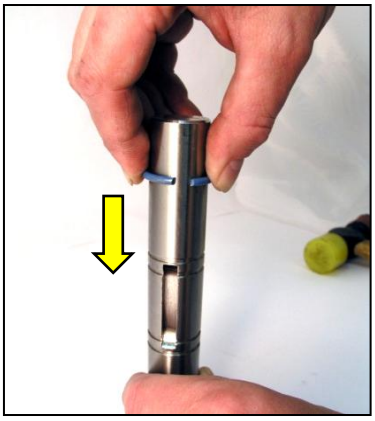
1 Place the first retaining ring (29) on a firm but soft surface and then place the shaft (1 or 20) over the retaining ring, as shown.

2 Strike the top end of the shaft with a rubber mallet to force the retaining ring onto the bottom end of the shaft.

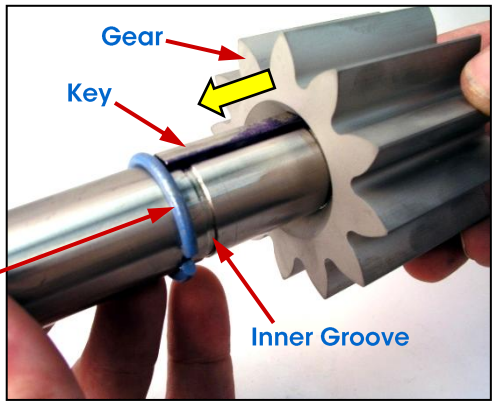


3 Push the retaining ring into the outer groove if a full (F) size gear will be installed or the inner groove if a reduced (R) size gear will be installed.

NOTE: The installation of a Model H12F or 312F gear will be shown.

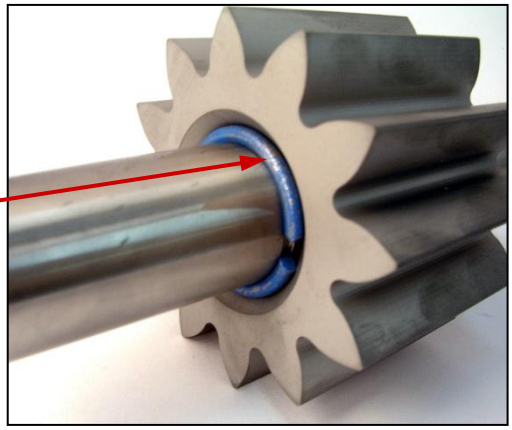


4 Install the key (24 or 23) on the shaft (1 or 20); then install the gear (6 or 22) so that it engages the key and contacts the retaining ring (29).



Appendix 5: Gear-Shaft Assembly (Continued)

5 While holding the gear in place, force the second retaining ring (29) onto the vacant end of the shaft by striking the opposite end of the shaft with a rubber mallet.



6 Slide the retaining ring into the vacant outer groove if a full (F) size gear was installed or the vacant inner groove if a reduced (R) size gear was installed. (This will lock the gear on the shaft.)

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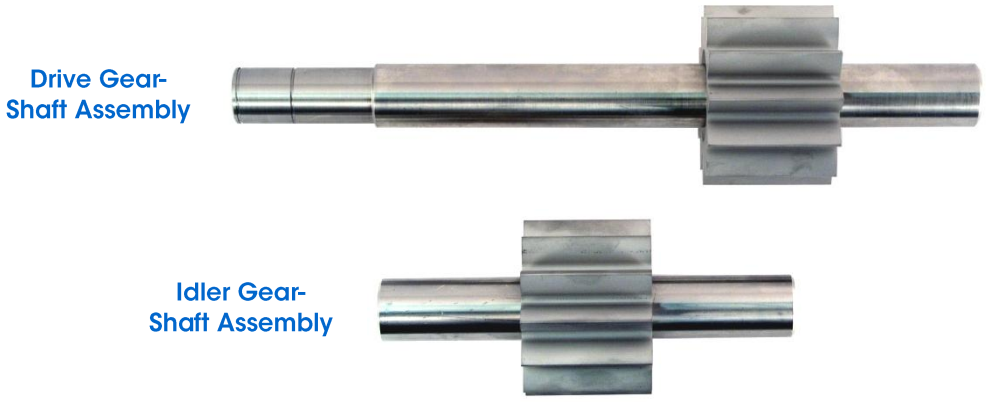
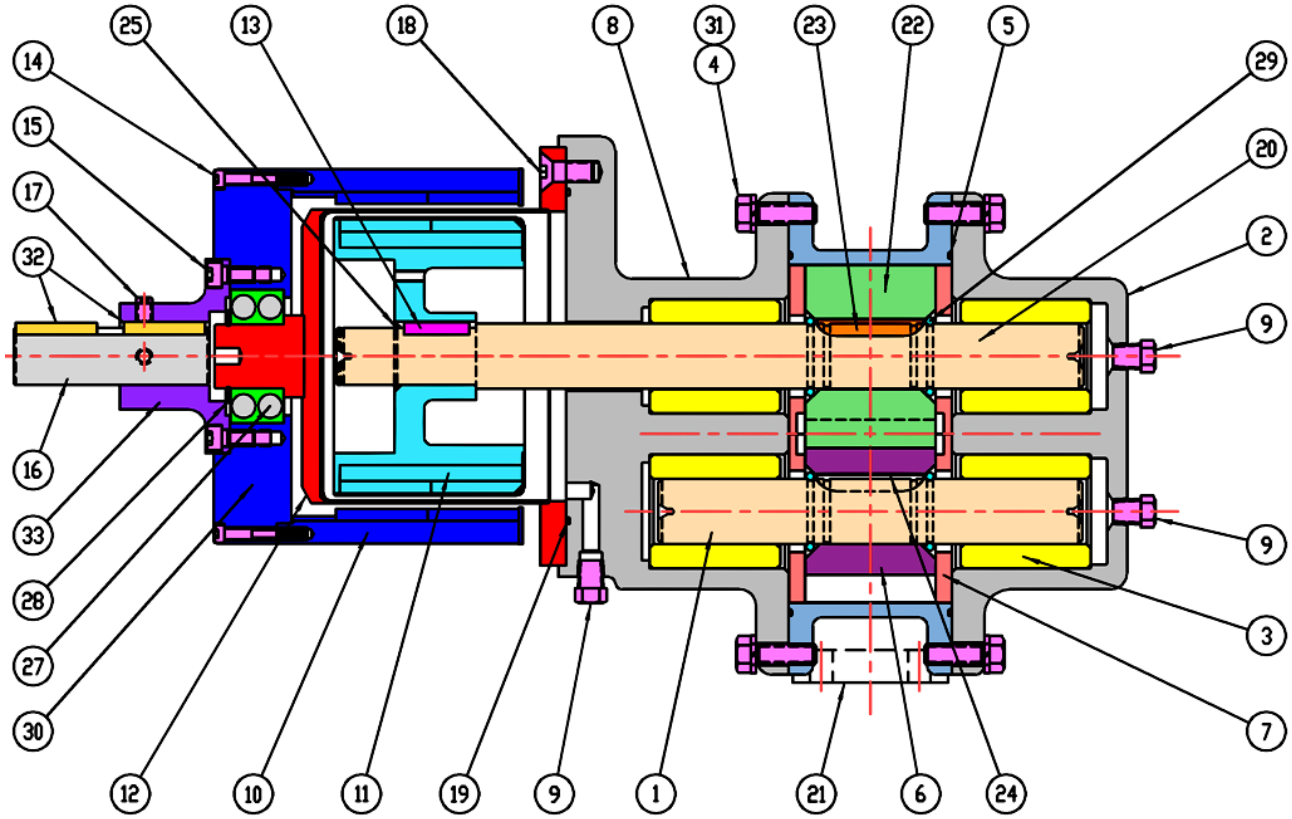
7 Pull the gear by hand along the axis of the shaft to make sure it is securely locked into position.



END OF PROCEDURE

Appendix 6: Reference Drawings

Cross-Sectional Drawing – Mag-Drive Pump, Long-Coupled



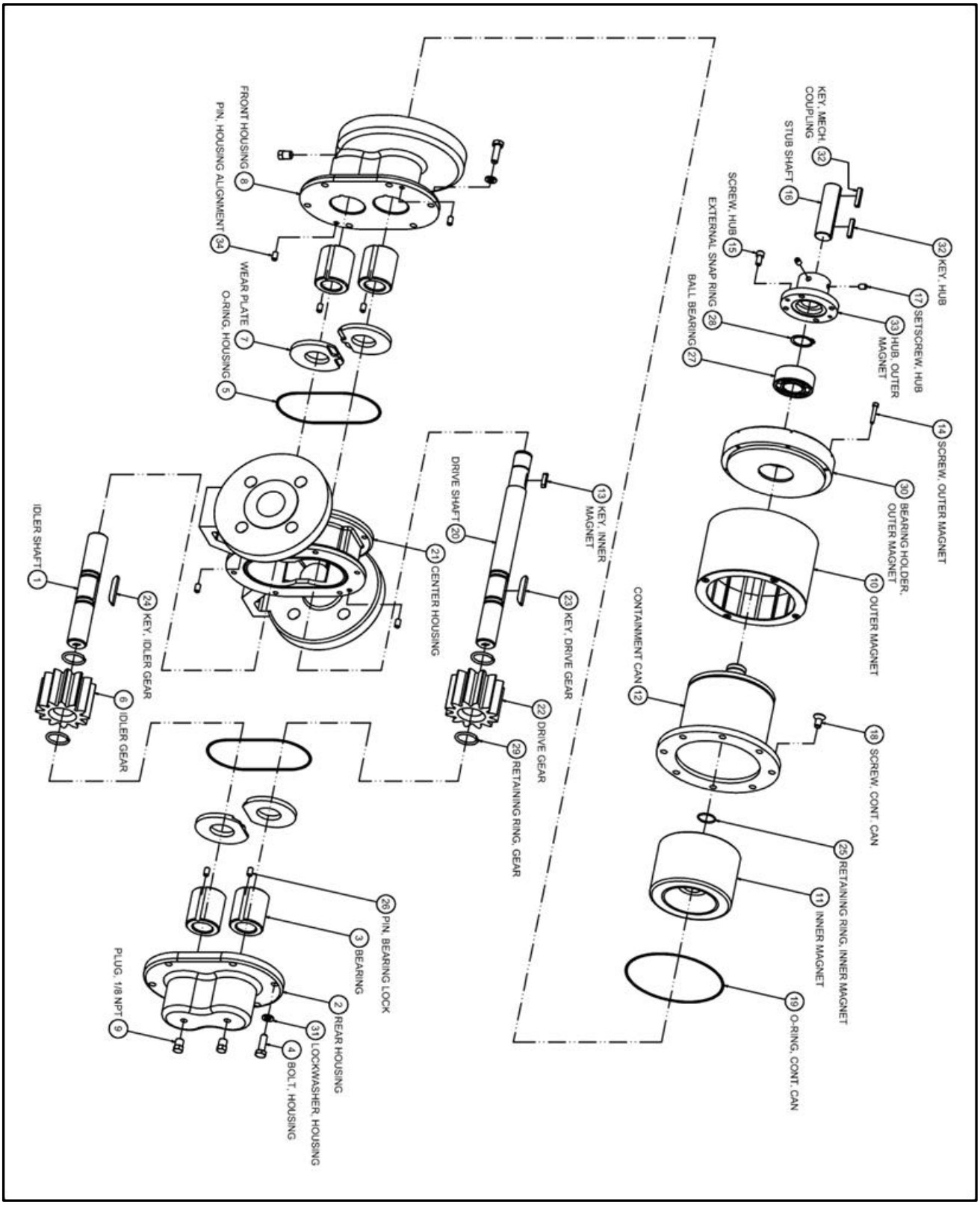
Ref. #	Description	Qty.	Ref. #	Description	Qty.
1	Idler Shaft	1	18	Screw, C. Can (5/16-24 x 5/8)	8
2	Rear Housing	1	19	O-ring, C. Can	1
3	Bearing	4	20	Drive Shaft	1
4	Bolt, Housing (5/16-18 x 1 HHCS)	12	21	Center Housing	1
5	O-ring, Housing	2	22	Drive Gear	1 *
6	Idler Gear	1 *	23	Key, Drive Gear	1
7	Wear Plate	4	24	Key, Idler Gear	1
8	Front Housing	1	25	Retaining Ring, Inner Magnet	1
9	Plug, 1/8 NPT	3	26	Pin, Bearing Lock (Not Shown)	4
10	Outer Magnet (Assembly)	1	27	Ball Bearing	1
11	Inner Magnet (Assembly)	1	28	External Snap Ring	1
12	Containment Can	1	29	Retaining Ring, Gear	4
13	Key, Inner Magnet	1	30	Bearing Holder, Outer Magnet	1
14	Screw, Outer Mag (#8-32 x 1 SHCS)	6	31	Lockwasher, Housing (5/16)	12
15	Screw, Hub (1/4-20 x 1/2 SHCS)	4	32	Key, Hub & Mechanical Coupling	2
16	Stub Shaft	1	33	Hub, Outer Magnet	1
17	Setscrew, Hub (1/4-28 x 3/8 SHSS-CP)	2	34	Pin, Housing Alignment (Not Shown)	4

* Quantity is 2 for Model 314F pump (see page 34).

NOTE: For Liquiflo Part Numbers, refer to H-Series or 3-Series Consolidated Bill of Materials (BOM).

Appendix 6: Reference Drawings (Continued)

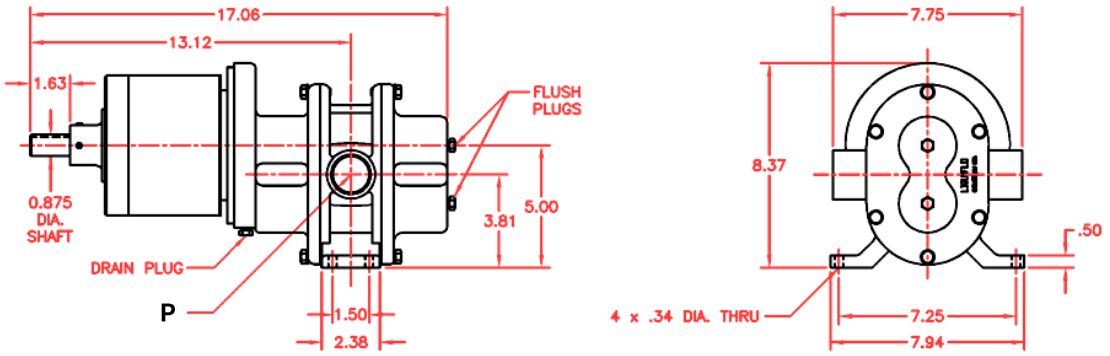
Exploded View Drawing – Mag-Drive Pump, Long-Coupled



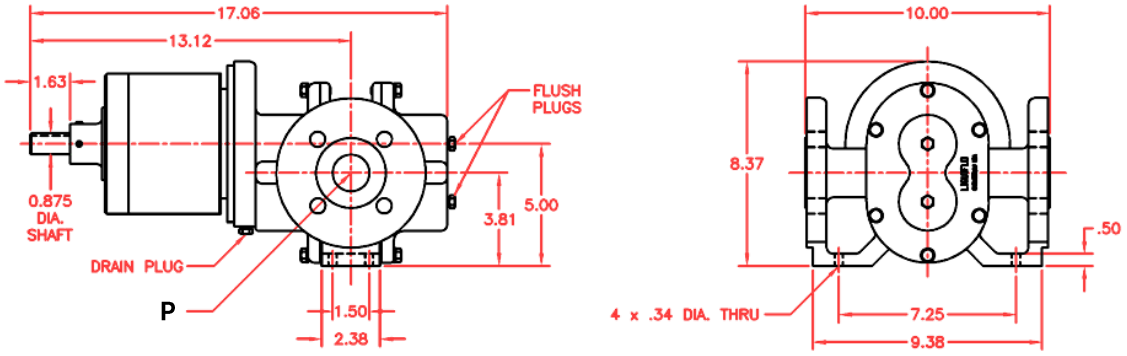
Appendix 6: Reference Drawings (Continued)

Dimensional Drawings – Mag-Drive Pump, Long-Coupled

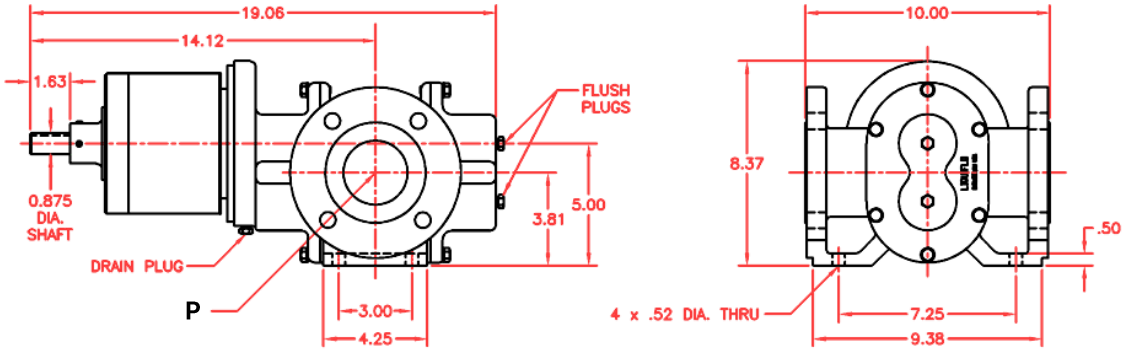
MODELS H12 & 312 – THREADED PORTS



MODELS H12 & 312 – FLANGED PORTS



MODEL 314F – FLANGED PORTS



Units: inches

NOTE: Pump length is measured from end of shaft to end of rear housing. Add 0.31 inches for Flush Plugs.

Dimensional Data – Port Sizes (P)

Pump Models	THREADED	FLANGED	
	NPT or BSPT	ANSI 150# RF	DIN PN16
UNITS:	in	in	mm
H12R & H12F	1-1/4	1-1/2	40
312R & 312F	1-1/4	1-1/2	40
314F	Not Available	2-1/2	65

Appendix 7: Troubleshooting Guide

Troubleshooting Guide – Part 1

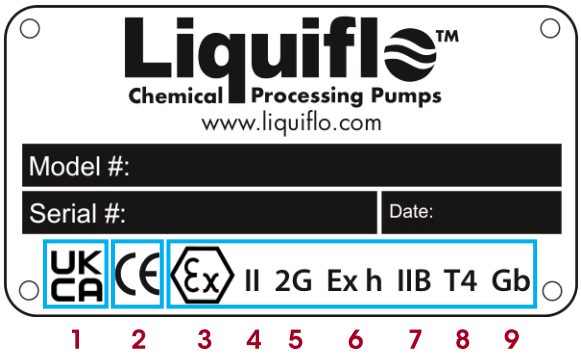
Problem	Possible Cause	Corrective Action
No discharge	Pump not primed	Verify suction pipe is submerged. Increase suction pressure. Open suction valve.
	Wrong direction of rotation	Reverse motor leads or reverse suction and discharge piping.
	Valves closed	Open all suction and discharge valves.
	Bypass valve open	Close bypass valve.
	Air leak in suction line	Tighten connections. Apply sealant to all threads. Verify suction pipe is submerged.
	Clogged strainer	Clean strainer.
	Pump worn or damaged	Rebuild pump.
	Magnetic coupling has decoupled	Stop driver and check temperature and viscosity of fluid. Stronger magnetic coupling may be needed.
Insufficient discharge	Suction pressure too low	Increase suction pressure. Verify suction piping is not too long. Fully open any suction valves.
	Bypass valve open	Close bypass valve.
	Partly clogged strainer	Clean strainer.
	Speed too low	Increase driver speed, if possible. Use larger size pump, if required.
	Pump worn or damaged	Rebuild pump.
Loss of suction after satisfactory operation	Pump not properly primed	Reprime pump.
	Air leaks in suction line	Tighten connections. Apply sealant to all threads. Inspect gaskets, if applicable. Verify suction pipe is submerged.
	Air or vapor pockets in suction line	Rearrange piping as necessary.
	Increase in fluid viscosity	Heat fluid to reduce viscosity. Reduce pump speed.
Excessive power consumption	Fluid viscosity higher than specified	Heat fluid to reduce viscosity. Reduce pump speed. Increase driver horsepower.
	Differential pressure greater than specified	Increase pipe diameter. Decrease pipe run.
	Gear clearances insufficient for fluid viscosity	Purchase gears trimmed for the correct viscosity.
	Plastic gear clearance insufficient for fluid temperature	Purchase plastic gear trimmed for the correct temperature.
	Rotating parts binding or severely worn	Disassemble pump and replace worn parts.

Appendix 7: Troubleshooting Guide (Continued)

Troubleshooting Guide – Part 2

Problem	Possible Cause	Corrective Action
Rapid pump wear	Abrasives in fluid	Install suction strainer. Limit solids concentration. Reduce pump speed or use larger pump running at lower speed.
	Corrosion wear	Use materials of construction that are acceptable for fluid being pumped.
	Extended dry running	Install power sensor to stop pump.
	Discharge pressure too high	Increase pipe diameter. Decrease pipe run.
	Housing stress from piping	Align piping with pump ports. Support piping independently of pump.
	Misalignment	Align pump and motor.
Excessive noise and vibration	Suction and/or discharge piping not anchored or properly supported	Anchor per Hydraulic Institute Standards.
	Base not rigid enough	Tighten hold-down bolts on pump and motor or adjust stilts. Inspect grout and regrout if necessary.
	Worn pump bearings	Replace bearings.
	Worn motor bearings	Replace bearings or motor.
	Pump cavitation	Increase NPSH available.
	Misalignment	Align pump and motor.
Excessive product leakage	Static seal failure caused by chemical incompatibility or thermal breakdown	Use O-rings or gaskets made of material compatible with fluid and temperature of the application.
	Static seal failure caused by improper installation	Install O-rings or gaskets without twisting, bending or pinching. Use star-pattern torque sequence on housing bolts during assembly. Allow Teflon O-rings to cold flow and seat during tightening. Torque bolts to specification.
	Pump port connections not properly sealed	Use Teflon tape or other suitable sealant. Use gaskets compatible with fluid and temperature of the application.
	Crevice corrosion of pump housing material	Only pump fluids that are chemically compatible with the pump housing material. Decrease temperature to reduce corrosion rate to acceptable value. Flush idle pumps that are used to pump corrosive chemicals. Eliminate contaminants in the fluid that can accelerate corrosion wear.

Appendix 8: Tag Certification Markings



The Liquiflo tag provides important information about the pump's use in potentially explosive atmospheres. Markings 3 to 9 comprise the complete ATEX marking. **NOTE: The tag does not provide information about the motor or other devices used with the pump.** It is the responsibility of the user to confirm that all equipment is safe for use in the intended environment.

No.	Marking	Meaning
1	UK CA	This marking confirms that this pump meets the requirements of the UK Regulation **SI 2016/1107** – The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016. **UK Conformity Assessed (UKCA) marking** is a certification mark that indicates conformity with the applicable requirements for products sold within Great Britain. The UKCA marking became part of UK law on EU exit day, January 31, 2020.
2	CE	This marking confirms that this pump is compliant with the European Union's **Machinery Directive 2006/42/EC**. **Conformitè Europëenne (CE) marking** (French for "European Conformity") indicates that a product has been assessed by the manufacturer and certified to meet EU safety, health and environmental protection requirements. The CE marking originated in 1985 and is mandatory for any products marketed in the EU and the European Economic Area (EEA).
3	Ex	This marking confirms that this pump meets the requirements of **ATEX 114 "equipment" Directive 2014/34/EU** – Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres (published on March 29, 2014 by the European Parliament). **ATEX** is a codeword which comes from the French description – "Appareils destinés à être utilisés en **AT**mosphères **EX**plosives." The English translation is: "Devices intended for use in explosive atmospheres."
4	II	**Equipment Group II** indicates that this pump is suitable for surface (non-mining) applications and can be used in areas having explosive gases or liquids.
5	2G	**Equipment Category 2 – Gases/Vapors (G)**: This indicates that the pump is suitable for use in Zones 1 & 2: **Zone 1 (gases):** An area in which an explosive mixture is likely to occur in normal operation **Zone 2 (gases):** An area in which an explosive mixture is not likely to occur in normal operation and if it occurs it will only exist for a short time
6	Ex h	This marking indicates **Explosion Protection** of the pump as defined in standard **EN ISO 80079-37**. Protection type is Constructional Design Safety (**c**).
7	IIB	This marking indicates that the pump is suitable for use in atmospheres containing **Ignitable Gases: Group IIB** (e.g., ethylene, ethyl ether or gases of similar hazard).
8	T4	This marking indicates the **Temperature Class** (Maximum Allowable Surface Temperature of the pump) for the Ignitable Gases Group above (**IIB**): **T4** = 135°C (275°F) max
9	Gb	This marking indicates the **Equipment Protection Level** of the pump as defined in standard **EN ISO 80079-36**. **Gb** = High protection level for Zone 1 gases and vapors; the equipment remains safe in normal operation and also when single faults occur.

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